

Spatial Energy Assessment

Replication Toolkit
September 2022

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About this Document

This Toolkit has been created by Scene Connect to guide spatial energy research in the UK. It is designed to support local authorities to conduct their own spatial energy assessments within their respective regions. It has been developed as part of a spatial assessment conducted in 2022 on behalf of Derbyshire County Council and its constituent local authorities. This project has been funded by the Midlands Net Zero Hub.



Scene Connect
Research Lead



Derbyshire County Council
Project Lead



Midlands Net Zero Hub
Project Funder

1. Introduction

This Replication Toolkit has been created for use by UK local authorities wishing to conduct spatial energy assessments in their region. It provides a graphical guide for conducting spatial energy assessments, outlining how different technologies and scales of development can be considered in terms of spatial energy planning.

Spatial energy assessments provide an underlying evidence base for climate and energy planning at both regional and local levels. This includes providing an understanding of spatial opportunities, constraints and resource capacity levels which may underpin Local Plan development.

The replication toolkit has been designed using UK Government guidance on spatial energy planning as well as methodologies utilised for similar studies throughout the UK. Full information on the methodology used can be found in the associated spatial energy assessment of Derbyshire, UK.

1.1 Study Background

In 2022, local energy specialists Scene Connect conducted a study on behalf of Derbyshire County Council and its constituent local authorities, to assess renewable energy opportunities across the county. The study considered the natural, cultural, landscape, and land use constraints on energy development across the region, followed by the available natural and technical resources relevant for the possible development of each technology typology and scale.

The outputs comprised a series of maps which included development recommendations for each technology and scale, to underpin the Council's and constituent authorities' future climate change and energy policies, and local plans.

The technologies considered in the study included:

- Wind turbines
- Ground-mounted Solar Photovoltaics (PV)
- Roof-mounted Solar Photovoltaics (PV)
- Hydroelectric
- Solar Thermal
- Biomass
- Anaerobic digestion
- Energy from Waste
- Heat pumps
- District heat networks
- Low carbon mobility

1.2 How to Use the Toolkit

The Toolkit is designed to guide the user through a step wise process to assessing renewable energy development potential across the UK.

1. Natural and cultural constraints are set out to indicate where renewable energy technology development is likely to be less or more constrained, in line with national, regional, and local development constraints. These constraints are categorised across four designations:

- Natural Heritage
- Land Use
- Landscape
- Cultural Heritage

A full list of constraints is provided in Table 1.1, including references to specific buffer zones which should be applied with regard to each technology or scale of development assessed. Table 1.2 provides a legend which should be referred to when applying the replication toolkit.

2. Using this methodology and Geographical Information System (GIS) analysis, areas of opportunity and constraint may be identified under three categories:

- Less constrained
- Constrained
- Highly constrained

3. An assessment of the relevant natural and technical resources can then be conducted within the less constrained areas, to identify resource availability and apply technical limitations. The data used within this process is set out within the replication toolkit, allowing analysis of potential levels of energy development within the chosen area.

1.3 Legend

This Replication Toolkit includes several icons to indicate buffer zones particular to each technology type that will need to be accounted for alongside the other natural, cultural, and environmental constraints. These buffers have been applied based on UK Government methodology and similar spatial energy studies conducted in the UK. Table 2 details the legend used and buffers applied within this study.

List of Constraints			
Type	International	National	Local
Natural Heritage	Ramsar Sites Biosphere Reserve Global Geoparks	Areas of Outstanding Natural Beauty (AONB) Biodiversity Action Plan Priority Habitats (BAP) Ancient Woodlands Inventory Environmentally Sensitive Areas Heritage Coasts Ministry of Defence Site (MOD) National Nature Reserves Regionally Important Geological Sites (RIGS) Special Areas of Conservation (SAC) Special Protection Areas (SPA) Sites of Special Scientific Interest (SSSI) Marine Protected Sites (MPA)	Local Nature Reserves Local Wildlife Sites
Land Use		Built Environment Landfill Sites Quarries	
Landscape		Community Forest Green Belt National Forest National Park Tranquillity Mapping	

List of Constraints			
Type	International	National	Local
Cultural Heritage	World Heritage Sites	Archaeological Sites	
		Conservation Areas	
		Historic Battlefields	
		Historic Environment Record	
		Listed Buildings	
		Registered Parks & Gardens	
		Scheduled Monuments	

Table 1.1 - List of energy development constraints











Legend	
Icon	Description
	Buffer zones around airport infrastructure, within which the development of the relevant technology should be considered constrained.
	Buffers for individual properties based on technology types and scales in line with planning guidance and to minimise impacts on property owners.
	Designated World Heritage Site buffer zone, as defined by UNESCO.
	Buffers applied to built environment to minimise impacts on settlements.
	Buffer zones applied to existing hydroelectric generation locations where nearby hydroelectric development should be considered constrained.
	Air Quality Management Zones (AQMZ) within which pollution emitting technologies should be considered constrained.
	Proximity to feed stock can be a barrier to development of some technologies, where technologies with limited local supply should be considered constrained.
	Flood risk zones where particular technologies and scales of development should be considered constrained.
	Water source constraints, including ecological status and protection designations, where technologies which utilise water resources should be considered constrained.
	Buffer applied to key infrastructure for safety, amenity, and feasibility reasoning, including roads, railways, waterways, MOD sites, within which the development of the relevant technology should be considered constrained.

Table 1.2 - Replication Toolkit Legend



Wind Energy (< 15m HTT)

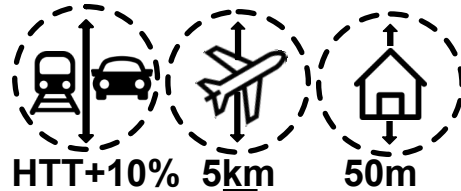
Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

Environmentally Sensitive Areas

Land Use



Built Environment
Landfill Sites
Quarries

Landscape Designations

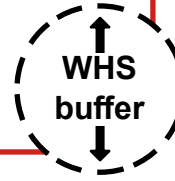
Community Forest
Green Belt

National Forest
National Park
Tranquility Mapping

Cultural Heritage

- Archaeological Sites
- Historic Battlefields
- Listed Buildings
- Scheduled Monument
- World Heritage Sites

Conservation Areas
Historic Environment Record
Registered Parks & Gardens



Highly Constrained

Constrained

Less constrained

Apply natural resource availability

Source:
NOABL Wind
Speed Database

HTT - Height to Tip



Wind Energy (15 - 50m HTT)

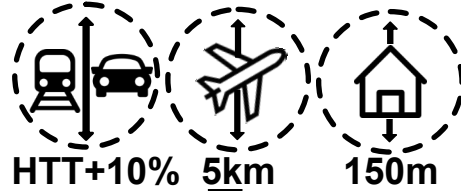
Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

Environmentally Sensitive Areas

Land Use



Built Environment
Landfill Sites
Quarries

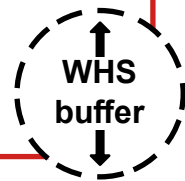
Landscape Designations

- Community Forest
- Green Belt
- National Forest
- National Park

Tranquility Mapping

Cultural Heritage

- Archaeological Sites
- Conservation Areas
- Historic Battlefields
- Historic Environment Record
- Listed Buildings
- Registered Parks and Gardens
- Scheduled Monument
- World Heritage Sites



Highly Constrained

Constrained

Less constrained

Apply natural resource availability

Source:
NOABL Wind
Speed Database

HTT - Height to Tip



Wind Energy (51 - 200m HTT)

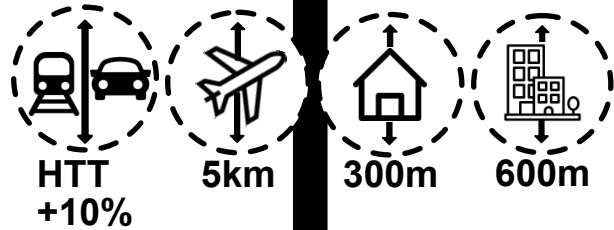
Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Heritage Coasts
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

- Areas of Outstanding Natural Beauty (AONB)
- Biodiversity Action Plan Priority Habitats (BAP)
- Environmentally Sensitive Areas
- Ministry of Defence Sites (MOD)
- National Nature Reserves

Land Use



- Built Environment
- Landfill Sites
- Quarries

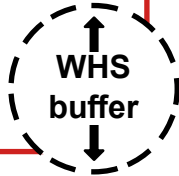
Landscape Designations

- Community Forest
- Green Belt
- National Forest
- National Park

- Tranquility Mapping

Cultural Heritage

- Archaeological Sites
- Conservation Areas
- Historic Battlefields
- Historic Environment Record
- Listed Buildings
- Registered Parks & Gardens
- Scheduled Monument
- World Heritage Sites



Highly Constrained

Constrained

Less constrained

Apply natural resource availability

Source:
NOABL Wind
Speed Database

HTT - Height to Tip



Hydropower

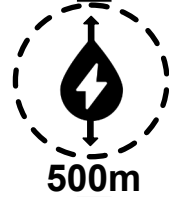
Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Environmentally Sensitive Areas
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)

- Environmentally Sensitive Areas

Land Use



- Built Environment
- Landfill Sites
- Quarries

Landscape Designations

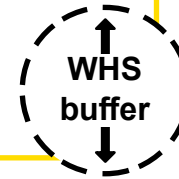
- Community Forest
- Green Belt

- National Forest
- National Park
- Tranquility Mapping

Cultural Heritage

- Archaeological Sites
- Historic Battlefields
- Listed Buildings
- Scheduled Monument

- Conservation Areas
- Historic Environment Record
- Registered Parks & Gardens
- World Heritage Sites



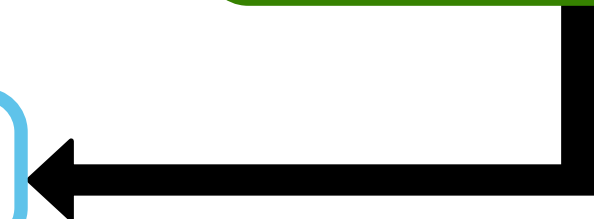
Highly Constrained

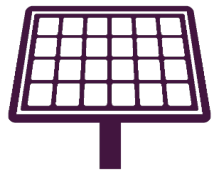
Constrained

Less constrained

Apply natural resource availability

Source:
 Environment Agency
 Ordnance Survey
 Historic England





Ground-mounted Solar PV (> 5 MW)

Spatial Energy Assessment Replication Toolkit

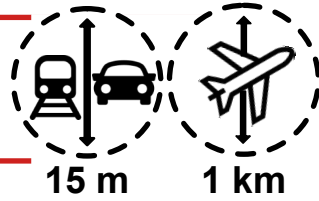
Natural Heritage

Ancient Woodlands
 Local Nature Reserves
 Local Wildlife Sites
 Ramsar Sites
 Regionally Important Geological Sites (RIGS)
 Sites of Special Scientific Interest (SSSI)
 Special Areas of Conservation (SAC)
 Special Protection Areas (SPA)

Environmentally Sensitive Area

Land Use

Built Environment



Landfill Sites
Quarries

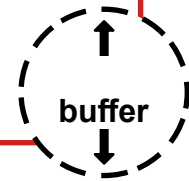
Landscape Designations

Community Forest
 Green Belt
 National Park
 National Forest
 Landscape Sensitivity (High)

Tranquility Mapping
Landscape Sensitivity (Moderate)

Cultural Heritage

Archaeological Sites
 Conservation Areas
 Historic Battlefields
 Historic Environment Record
 Listed Buildings
 Registered Parks & Gardens
 Scheduled Monument
 World Heritage Sites



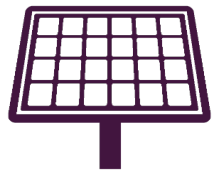
Highly Constrained

Constrained

Less constrained

Apply natural resource availability

Source:
Horizontal Global Insolation



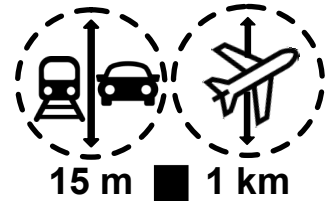
Ground Mounted Solar PV (< 5 MW)

Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Area of Outstanding Natural Beauty (AONB)
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

Land Use



Environmentally Sensitive Area

Landscape Designations

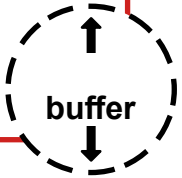
- Community Forest
- Green Belt
- National Park
- Landscape Sensitivity (High)

Built Environment
Landfill Sites
Quarries

National Forest
Tranquility Mapping
Landscape Sensitivity (Moderate)

Cultural Heritage

- Archaeological Sites
- Conservation Areas
- Historic Battlefields
- Historic Environment Record
- Listed Buildings
- Registered Parks & Gardens
- Scheduled Monument
- World Heritage Sites



Highly Constrained

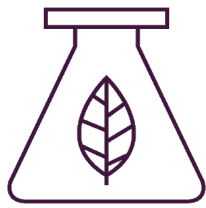
Constrained

Less constrained

Source:
Horizontal Global Insolation

Apply natural resource availability





Biomass

Spatial Energy Assessment Replication Toolkit

- Natural Heritage
- Land Use
- Landscape Designations
- Cultural Heritage

All constraints have been considered within the below input parameter values, including conservation areas, listed buildings, and other permitted development limiting constraints.

Air Quality Management Zones (AQMA) and smoke control zones will limit the ability to install domestic and commercial systems.



Input Parameters

No. Suitable Buildings

- 2.5% - New builds
- 50% - Off-grid Domestic
- 5% - Detached and Semi-detached domestic
- 2.5% - Terraced
- 2.5% - Flats
- 10% - Commercial Properties

System Capacity

- Domestic - 25 kW
- Commercial - 100 kW

Local Feed stock

- Proximity to managed forestry / energy crops
- Grade 3/4 agricultural land types
- Manged woodland (FCS)
- Managed woodland (other)

Source:
Forestry Commission
Natural England

Apply natural resource availability





Anaerobic Digestion

Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands Inventory
- Environmentally Sensitive Area
- Local Nature Reserves
- Local Wildlife Sites
- Ramsar Sites
- Regionally Important Geological Sites (RIGS)
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)

Land Use

- Built Environment
 - Buffers
- 
- 1km

- Landfill Sites
- Quarries

Landscape Designations

- Community Forest
- Green Belt
- Landscape sensitivity (High)

- National Forest
- National Park
- Landscape sensitivity (Moderate)
- Tranquillity Mapping

Cultural Heritage

- Archaeological Sites
 - Conservation Areas
 - Historic Battlefields
 - Historic Environment Record
 - Listed Buildings
 - Registered Parks & Gardens
 - Scheduled Monument
 - World Heritage Sites
- 
- WHS
buffer

Highly Constrained

Constrained

Less constrained

Apply natural resource availability

Source:
Existing feed stock (DEFRA)
Biogas yield (NNFCC)





Energy from Waste

Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Environmentally Sensitive Areas
- Local Nature Reserves
- Local Wildlife Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Ramsar Sites
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

Land Use

- Built Environment
- 

- Quarries
- Registered Common Land

- Proximity to waste sites
- Proximity to High Voltage (HV) electricity network connection

Landscape Designations

- Community Forest
- Green Belt
- National Forest
- National Park

- Tranquillity Mapping

Cultural Heritage

- Archaeological Sites
 - Conservation Areas
 - Historic Battlefields
 - Historic Environment Record
 - Listed Buildings
 - Registered Parks & Gardens
 - Scheduled Monument
 - World Heritage Sites
- 

Highly Constrained

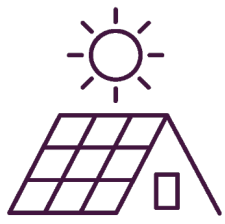
Constrained

Less constrained

Source:
Local Authority Landfill Sites
Ordnance Survey

Apply natural resource availability





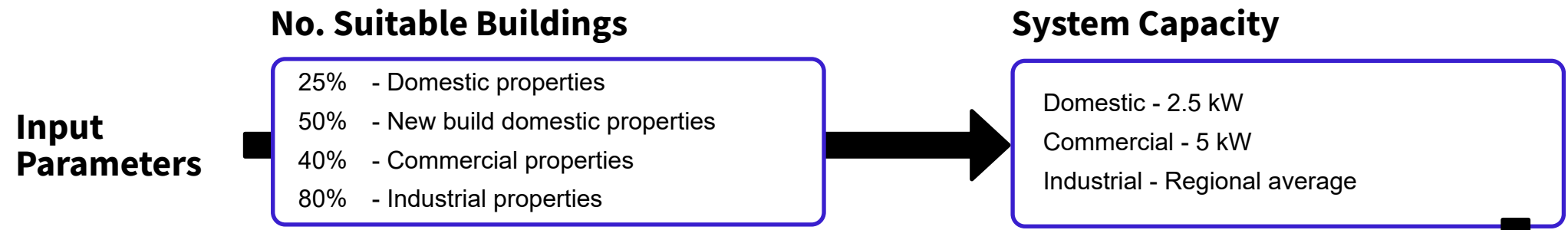
Rooftop Solar PV

Spatial Energy Assessment Replication Toolkit

- Natural Heritage
- Land Use
- Landscape Designations
- Cultural Heritage

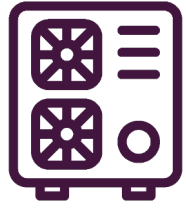
All constraints have been considered within the below input parameter values, including conservation areas, listed buildings, and other permitted development limiting constraints.

Constrained



Source:
Global Horizontal Insolation (GHI)
ONS Data, English Housing Survey (EHS)
Residential Support Scheme (RSS)

Apply natural resource availability



Heat Pumps

- Natural Heritage
- Land Use
- Landscape Designations
- Cultural Heritage

All constraints have been considered within the below input parameter values, including conservation areas, listed buildings, and other permitted development limiting constraints.

Flooding Zones are a potential constraint to deeper geothermal systems and any high-risk zones are not considered on this basis.

Water source constraints, including ecological status and protection designations may mean water-source heat options are unlikely to be considered acceptable.



Constrained

No. Suitable Buildings

- 100% - New builds
- 100% - Off-grid Domestic
- 75% - Detached and Semi-detached domestic
- 50% - Terraced
- 25% - Flats
- 50% - Commercial Properties

Input Parameters

System Capacity

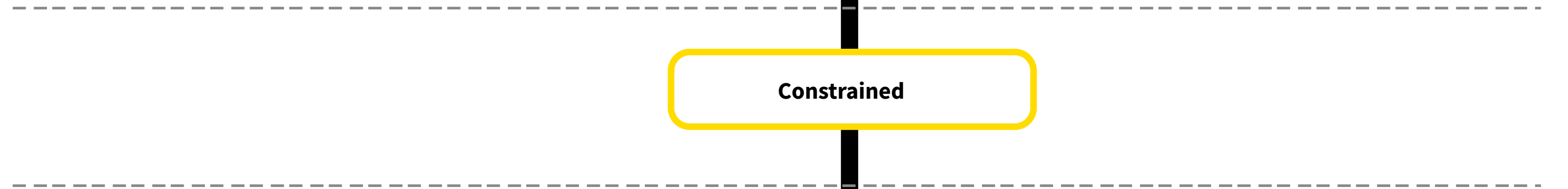
- Domestic - 5 kW
- Commercial - 100 kW

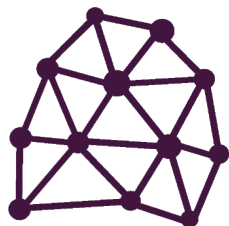
System Performance

Weighted Coefficient of Performance - 2.5

Source:
 Communities & Local Government (CLG) Statistics
 ONS Data, English Housing Survey (EHS)
 Residential Support Scheme (RSS)

Apply natural resource availability





District Heat Network

Spatial Energy Assessment Replication Toolkit

Natural Heritage

- Ancient Woodlands
- Area of Outstanding Natural Beauty (AONB)
- Environmentally Sensitive Areas
- Local Nature Reserves
- Local Wildlife Sites
- Regionally Important Geological Sites (RIGS)
- Sites of Special Scientific Interest (SSSI)
- Ramsar Sites
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

Land Use



- Built Environment
- Landfill Sites
- Quarries
- Registered Common Land

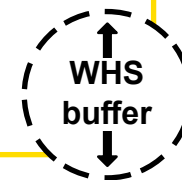
Landscape Designations

- Community Forest
- Green Belt
- National Forest
- National Park
- Tranquillity Mapping

Cultural Heritage

- Archaeological Sites
- Scheduled Monument

- Conservation Areas
- Historic Battlefields
- Historic Environment Record
- Listed Buildings
- Registered Parks & Gardens
- World Heritage Sites



Highly Constrained

Constrained

Less constrained

Source:
 UK Heat Map
 British Geological Survey
 Coal Authority

Apply natural resource availability





Low Carbon Mobility

Spatial Energy Assessment Replication Toolkit

