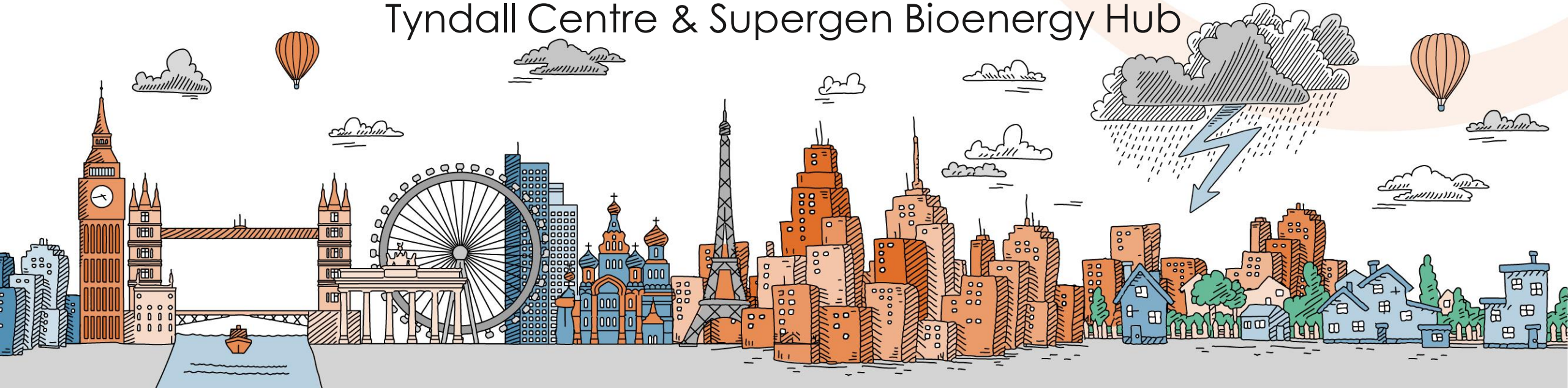


# Bioenergy Sustainability:

## Introducing the Bioeconomy Sustainability Indicator Model (BSIM)

**Dr. Andrew Welfle**

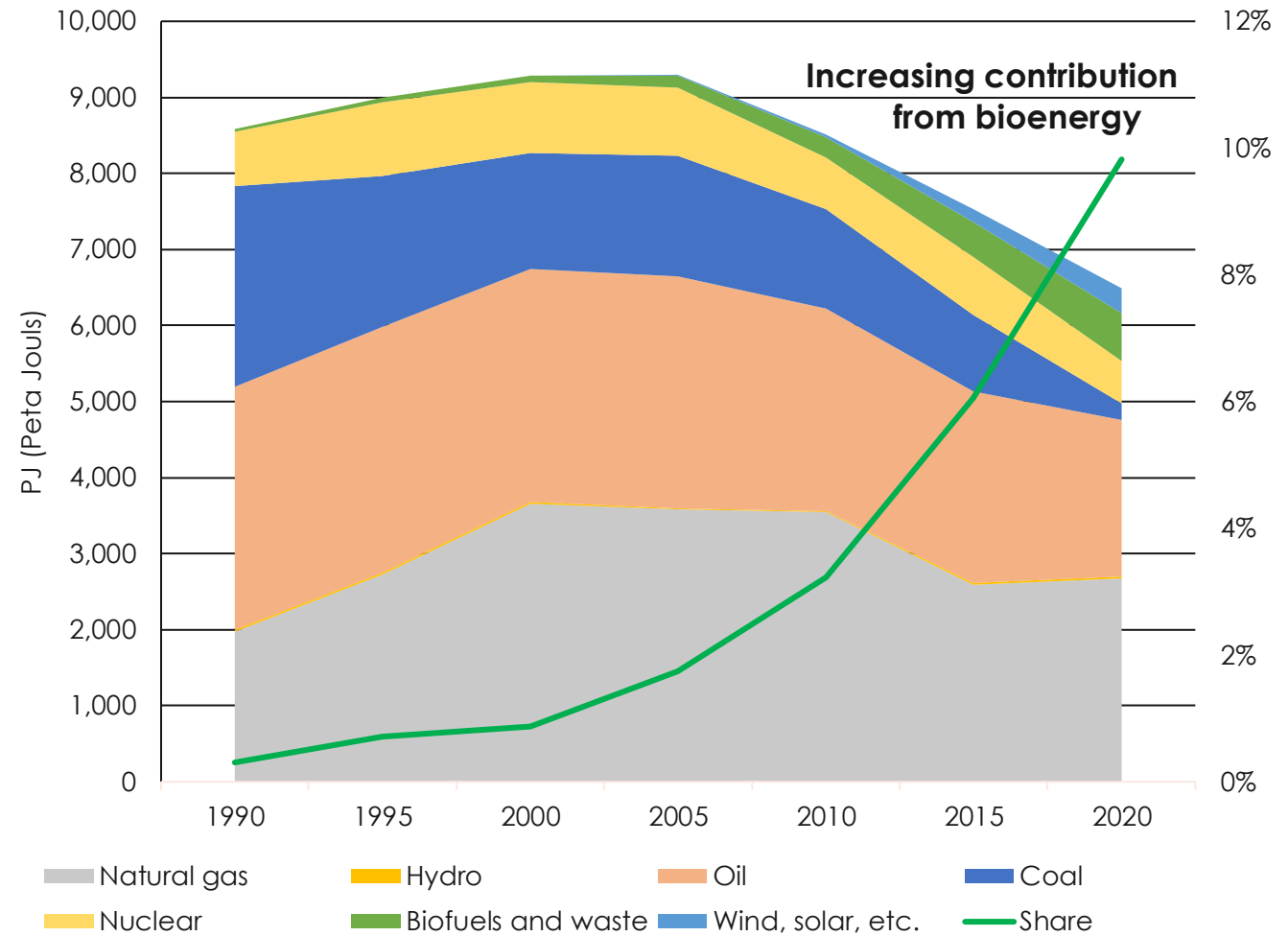
Tyndall Centre & Supergen Bioenergy Hub



# Role of Bioenergy in UK

- Bioenergy is the largest renewable energy technology in the UK, contributing\*:
  - >31% Renewable Electricity
  - >83% Renewable Heat
  - 5% Total Transport Energy
- The Government has strong ambitions to increase bioenergy as part of its industrial strategy and climate change commitments

\* [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)



IEA Bioenergy (2021), IEA (2022), BEIS (2022)



# The World is Watching!

Indonesia's biofuel bid threatens more deforestation for oil palm plantations

MAGAZINE

THE FRIDAY COVER

## The 'Green Energy' That Might Be Ruining the Planet

The biomass industry is warming up the South's economy, but many experts worry it's doing the same to the climate. Will the Biden Administration embrace it, or cut it loose?

### Burning wood for power is 'misguided' say climate experts

Using biomass instead of fossil fuels may not be the answer to averting global warming

### Greenpeace slams certification schemes, inciting criticism: 'The NGO is using palm oil as cannon-fodder to sway EU lawmakers'

By Flora Southey

12-Mar-2021 - Last updated on 12-Mar-2021 at 15:40 GMT



Greenpeace has critiqued a range of sectors, but Palm Oil Monitor interprets the report as an attack on palm oil. GettyImages/Khlongwangchao

2020



Biomass and bioenergy

## The dirty little secret behind 'clean energy' wood pellets

### Dirtier than coal?

Why Government plans to subsidise burning trees are bad news for the planet



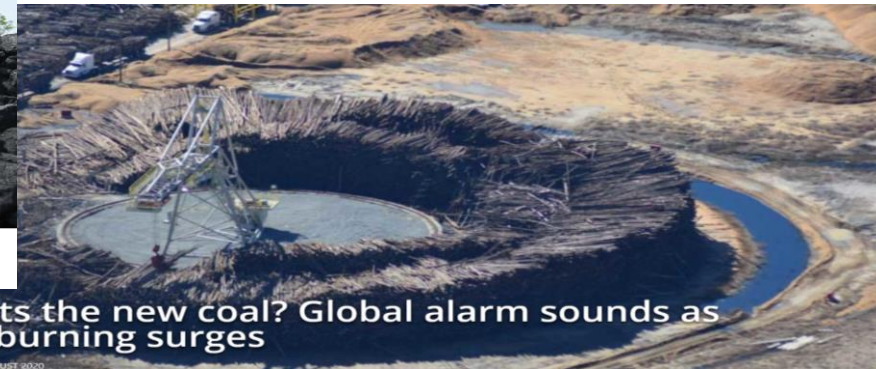
GREENPEACE



This is Europe

### 'Carbon-neutrality is a fairy tale': how the race for renewables is burning Europe's forests

▲ A drone image of forest in the Haanga nature reserve where a section has been 'clear-cut'; November 2020. Photograph: Lis Treimans/Arripiev



### Are forests the new coal? Global alarm sounds as biomass burning surges

by JUSTIN CATANGORA 31 AUGUST 2020

# What is Bioenergy Sustainability?

## How is it Measured, Assessed, & Certified?



# Sustainability in Policy

<b>International</b>	<ul style="list-style-type: none"> <li>➤ UN Sustainable Development Goals</li> <li>➤ Climate Change Targets</li> </ul>
<b>EU Policy</b>	<ul style="list-style-type: none"> <li>➤ Renewable Energy Directive (RED)</li> <li>➤ Fuel Quality Directive (FQD)</li> </ul>
<b>National Policy</b>	<ul style="list-style-type: none"> <li>➤ Renewable Transport Fuel Obligation (RTFO)</li> <li>➤ Renewable Obligation (RO)</li> <li>➤ Feed-In Tariffs (FIT)</li> <li>➤ Renewable Heat Incentive (RHI)</li> </ul>
<b>Industry &amp; Sectoral Regulations</b>	<ul style="list-style-type: none"> <li>➤ Waste</li> <li>➤ Agriculture</li> <li>➤ Forestry &amp; Timber</li> <li>➤ Chemical</li> <li>➤ Industry</li> <li>➤ Construction</li> <li>➤ Energy</li> <li>➤ Transport</li> </ul>

## Sustainability Criteria:

### Land Criteria:

- Focussing on the land from which the biomass is sourced.
- Biofuels may not be made from raw material obtained from land with high biodiversity value or land with high carbon stock such as peatland.

### GHG Emission Criteria:

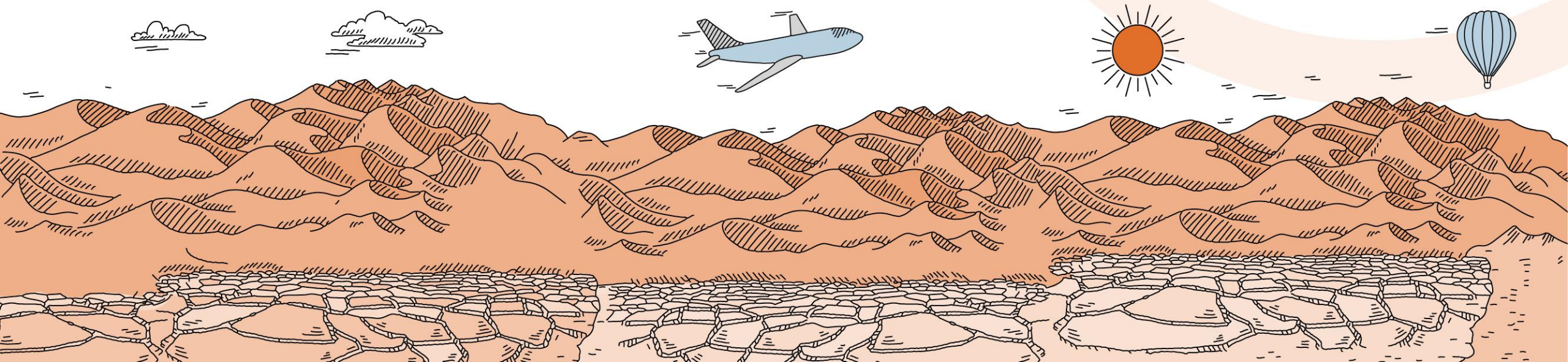
- Focussing on whole life cycle emissions of bioenergy.
- Bioenergy system should achieve a specified GHG emission saving compared to a comparator.

# Sustainability in Voluntary Schemes

## Coverage of Sustainability Issues Differs across Schemes:

		Agriculture Focused Schemes		
		Global GAP	SAN	IFOAM
Carbon Conservation	Preservation of above/below ground carbon			
	Land use change			
	GHG emissions			
Biodiversity & Natural Capital	Biodiversity			
	Natural habitats, ecosystems			
	High conservation value areas			
	Native, endangered and invasive species			
	GMO			
Soil Conservation	Soil management, soil protection			
	Residues, wastes, by-products			
	Use of agrochemicals			
	Waste management			
Sustainable Water Use	Water rights			
	water quality			
	Water management, conservation			
	Efficient water use			
Air Quality	Air pollution			
	No burning for land clearing/waste disposal			
	No burning residues, waste, by products.			
	Economic development			
	Economic benefits to community			
	Economic performance			
	Energy efficiency			
Social Aspects	Energy balance			
	Social impact assessment			
	Social benefits to community			
	Human rights			
Labour Conditions	Land right issues			
	Working conditions			
	Contracts			
	Health and safety			
	Freedom of association, bargaining			
	Discrimination			
	Wages			
	Working hours			
	Child Labour			
	Forced labour			
	Training, capacity building			

# Introducing the Bioeconomy Sustainability Indicator Model



# Supergen's BSIM

## Developers:

- ❖ UK Supergen Bioenergy Hub researchers at the University of Manchester and Aston University.
- ❖ Developed following consultation with academia, government, NGO and industry.

## Our Aims:

- ❖ Develop a research tool that enables assessment and comparison of the sustainability of bioenergy systems, feedstocks, technologies or supply chains.

## Our Objectives:

- ❖ Analyse the sustainability credentials of the Supergen Bioenergy Hub projects.

## Who is this Relevant for?

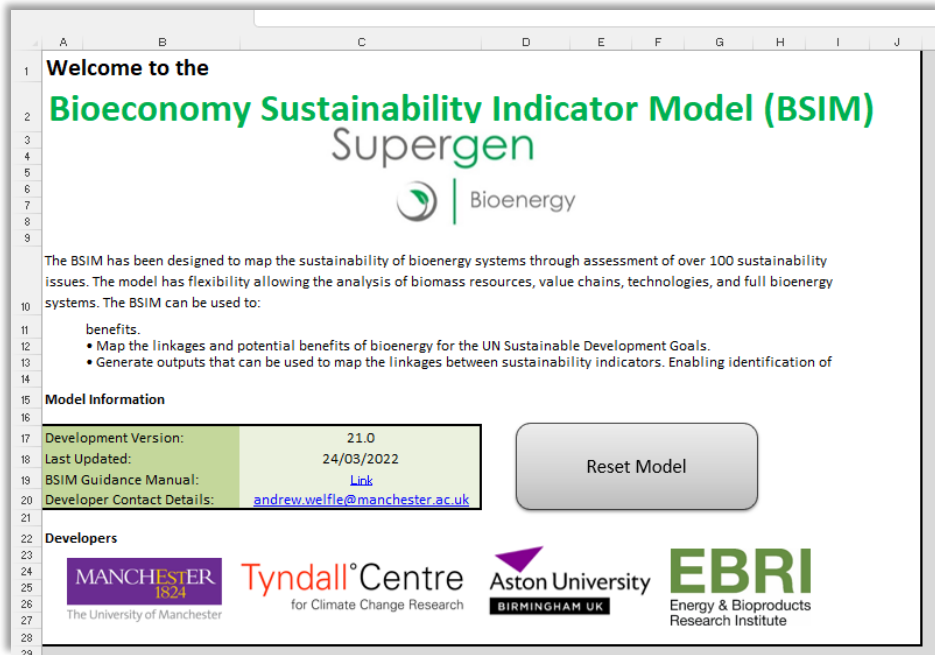
- ❖ Flexibility in the tool will also allow analysis of any bioenergy systems, feedstocks, technologies or supply chains.



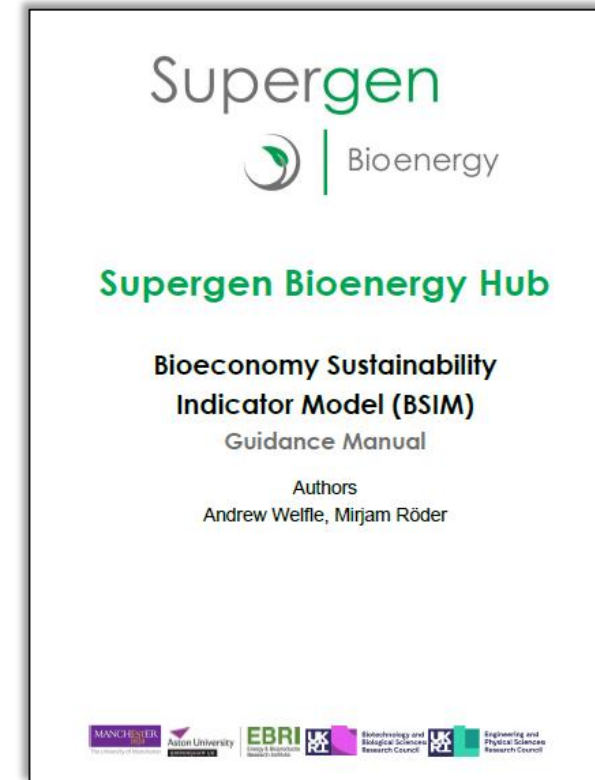
# Further Information

## Access the Model:

Open Access via Supergen  
Website: [bit.ly/SBH-BSIM](https://bit.ly/SBH-BSIM)



## BSIM Guidance Manual:

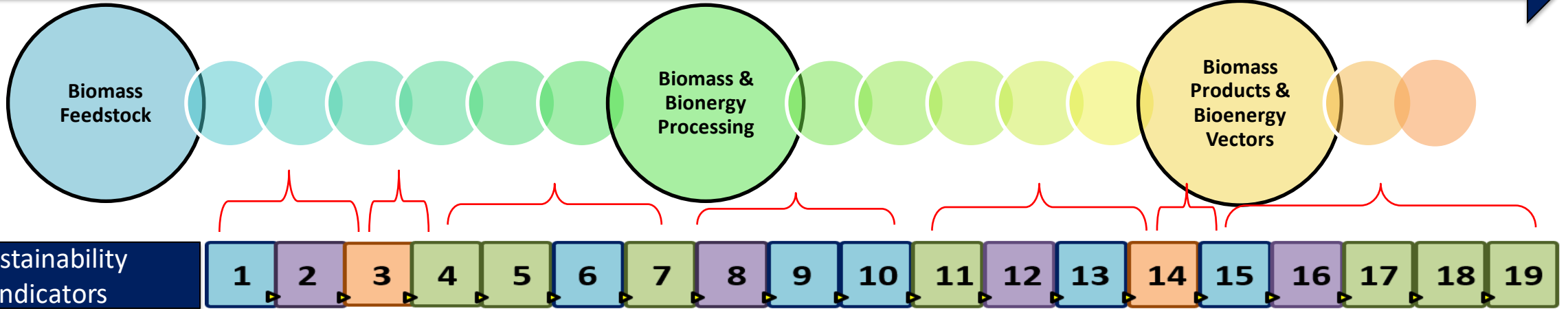


Welfle A, Röder M. (2022) Mapping the Sustainability of Bioenergy to Maximise Benefits, Mitigate Risks and Drive Progress toward the Sustainable Development Goals. Renewable Energy. Vol. 191 493-509. [www.sciencedirect.com/science/article/pii/S0960148122004463](https://www.sciencedirect.com/science/article/pii/S0960148122004463)

# BSIM – How it works

1

Sustainability Impacts & Benefits Linked to Activities & Processes along a Bioenergy Value Chain



2

Sustainability Indicators

3

Sustainability Assessment Framework

## Sustainability Assessment Framework

Categories	Themes	Indicators	Issues
People			
Development			
Natural Systems			
Climate Change	Emissions	Land Use Change	Direct Land Use Change Indirect Land Use Change

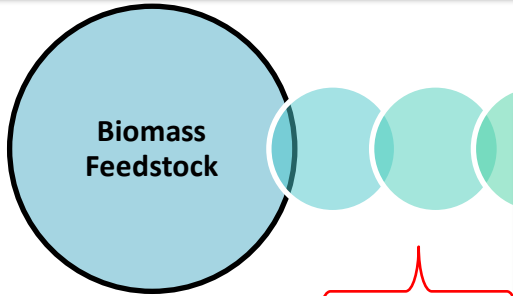
Engaged with stakeholders to develop a framework for assessing sustainability:

- ❖ 4 x Sustainability Categories
- ❖ 16 x Sustainability Themes
- ❖ 38 x Sustainability Indicators
- ❖ 126 x Sustainability Issues

# BSIM – How it works

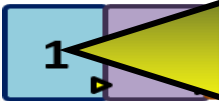
1

Sustainability Impacts



2

Sustainability Indicators



3

Sustainability Assessment

Categories

Themes

People

Development

Natural Systems

Climate Change

Emissions

Land Use

## BSIM Calculation Mechanics

- Indicator Applicability: Yes / No
- Sustainability Indicator Assessments:
  - Scale of potential sustainability risk
  - Scale of potential sustainability benefit
- Indicator Weightings:

### Potential Sustainability Risks

Very High High Medium Low Very Low None

What are the implications of emissions linked to  
**Conversion of Feedstocks to Energy?**

### Potential Sustainability Benefits

Low Very Low Low Medium High Very High

Sustainability Performance Index:

Indicator Score



Weighting



Sustainability Score

❖ 126 x Sustainability Issues



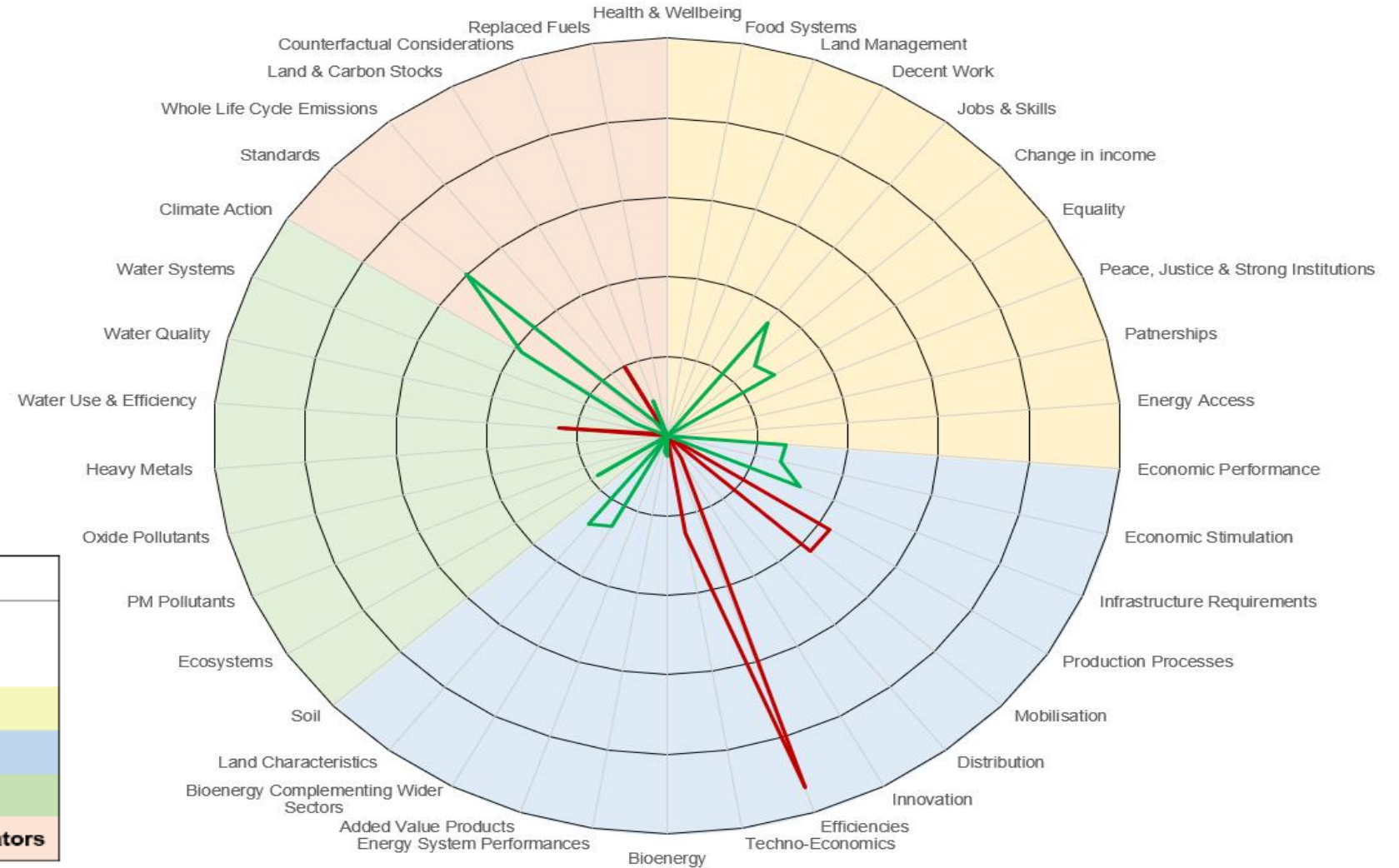
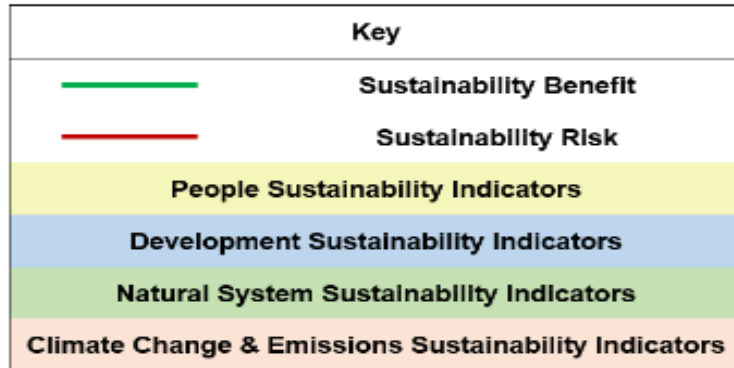
# Sustainability Assessment Framework

Categories	Themes	Indicators
People	Health	Health & Wellbeing
		Food Systems
		Land Management
	Livelihoods	Decent Work
		Jobs & Skills
		Change in income
	Society	Equality
		Peace, Justice & Strong Institutions
		Partnerships
Energy Access		
Development	Economy	Economic Performance
		Economic Stimulation
	Infrastructure	Infrastructure Requirements
	Feedstocks	Production Processes
		Mobilisation
		Distribution
	Technology	Innovation
		Efficiencies
		Techno-Economics
	Energy Sector	Bioenergy
Energy System Performances		
Bioeconomy	Added Value Products	
	Bioenergy Complementing Wider Sectors	
Land Utilisation	Land Characteristics	
Natural Systems	Land	Soil
		Ecosystems
	Air	PM Pollutants
		Oxide Pollutants
		Heavy Metal
	Water	Water Use & Efficiency
		Water Quality
Water Systems		
Climate Change	Governance	Climate Action
		Standards
	Carbon & Emissions	Whole Life Cycle Emissions
		Land & Carbon Stocks
	Energy System	Counterfactual Considerations
Replaced Fuels		

# Outputs Generated by the BSIM

# Outputs – Sustainability Maps

## a) UK MSW Biomass Resources





# Outputs – Sustainability Dashboard

Sustainability Categories Index Scores		Sustainability Theme Index Scores		Sustainability Indicator Index Scores	
People	0.9	Health	-	Health & Wellbeing	-
		Livelihoods	0.7	Food Systems	-
				Land Management	-
				Decent Work	-
				Jobs & Skills	2.4
				Change in income	1.9
				Equality	1.9
		Society	0.4	Peace, Justice & Strong Institutions	-
				Partnerships	-
				Energy Access	-
Development	2.4	Economy	1.6	Economic Performance	2.0
		Infrastructure	2.5	Economic Stimulation	1.1
				Infrastructure Requirements	2.4
		Feedstocks	-1.6	Production Processes	-2.3
				Mobilisation	-2.0
		Technology	-2.2	Distribution	-
				Innovation	-0.2
				Efficiencies	-5.0
		Energy Sector	0.5	Techno-Economics	-1.0
				Bioenergy	0.3
		Bioeconomy	0.8	Energy System Performances	0.5
				Added Value Products	-
Bioenergy Complementing Wider Sectors	2.1				
Land Utilisation	2.2	Land Characteristics	2.2		
Natural System	0.7	Land	0.8	Soil	-
				Ecosystems	1.3
		Air	-	PM Pollutants	-
				Oxide Pollutants	-
				Heavy Metals	-
		Water	-0.1	Water Use & Efficiency	-1.1
				Water Quality	0.0
				Water Systems	0.5
Climate Change	2.4	Governance	3.5	Climate Action	2.7
				Standards	3.8
		Emissions	0.1	Whole Life Cycle Emissions	0.3
				Land & Carbon Stocks	-0.9
		Energy Systems	-	Counterfactual Considerations	0.9
				Replaced Fuels	-

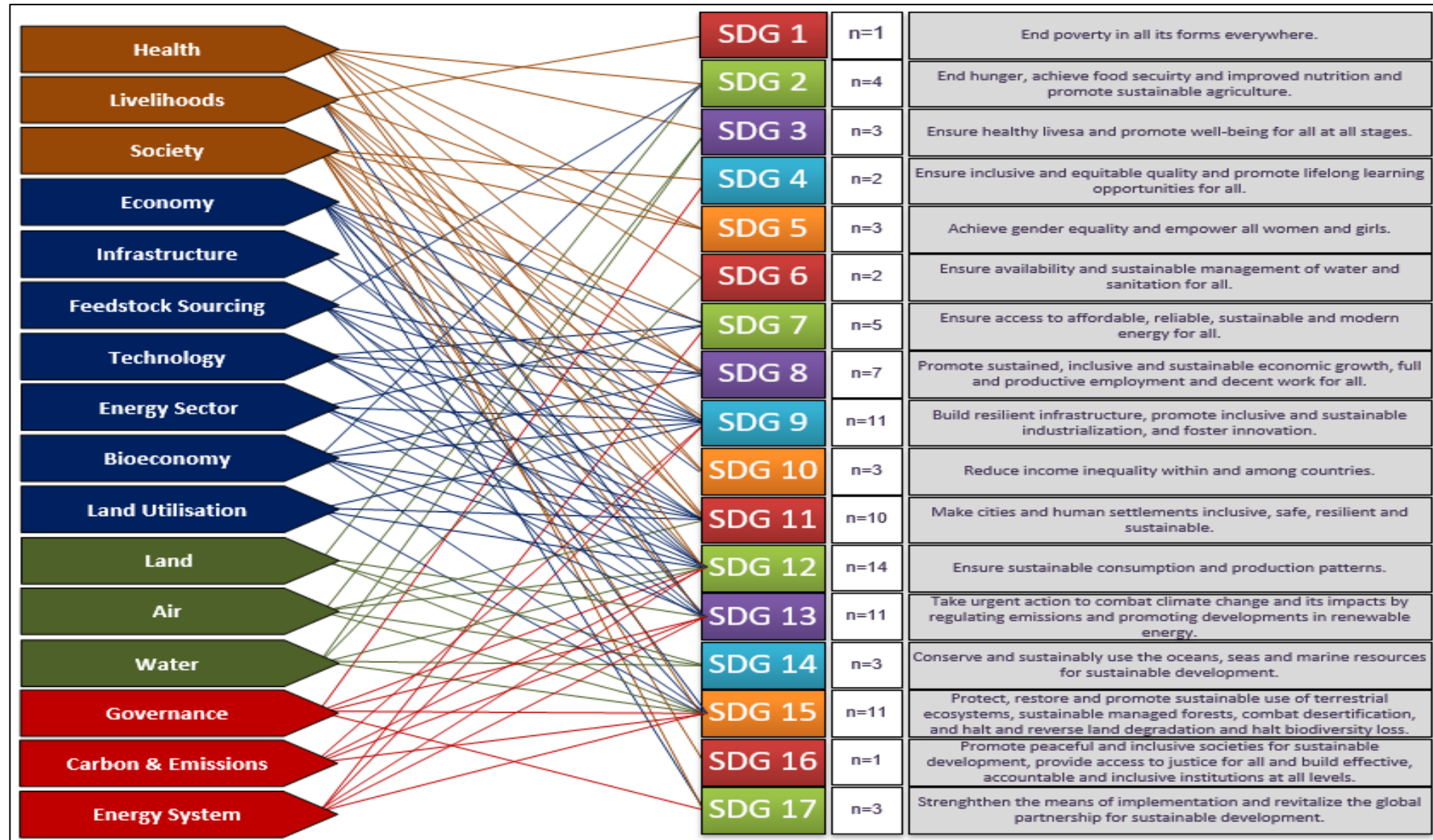
- ❖ Sustainability is not a set end-destination. There are many nuances and trade-offs.
- ❖ Identify areas where benefits can be promoted & maximised.
- ❖ Identify areas to target actions to mitigate risks.
- ❖ Make mature bioenergy decisions by considering risks against the wider benefits that may be gained.

# Outputs – SDG Mapping

## The 17 United Nations Sustainable Development Goals:

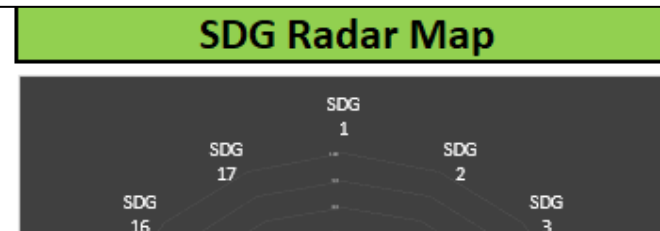
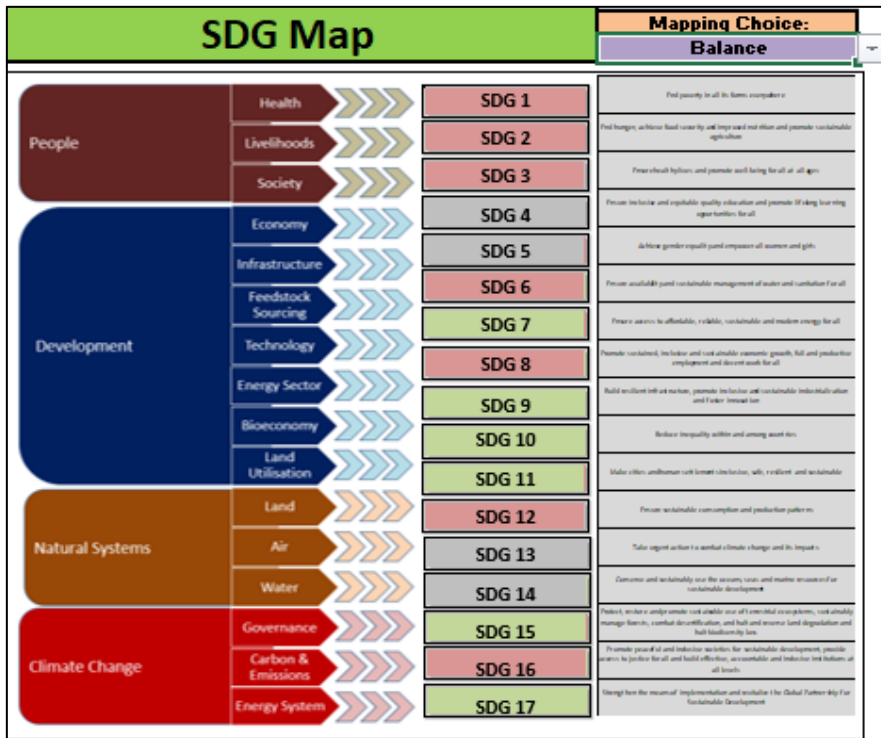


# Outputs – SDG Mapping





# Outputs – SDG Mapping



## a) UK MSW Biomass Resources

SDG 17 - Partnerships for the Goals

SDG 16 - Peace, Justice & Strong Institutions

SDG 15 - Life on Land

SDG 14 - Life Below Water

SDG 13 - Climate Action

SDG 12 - Responsible Consumption & Production

SDG 11 - Sustainable Cities & Communities

SDG 10 - Reduced Inequalities

SDG 9 Industry, Innovation & Infrastructure

SDG 8 - Decent Work & Economic Growth

SDG 7 Affordable and Clean Energy

SDG 6 - Clean Water and Sanitation

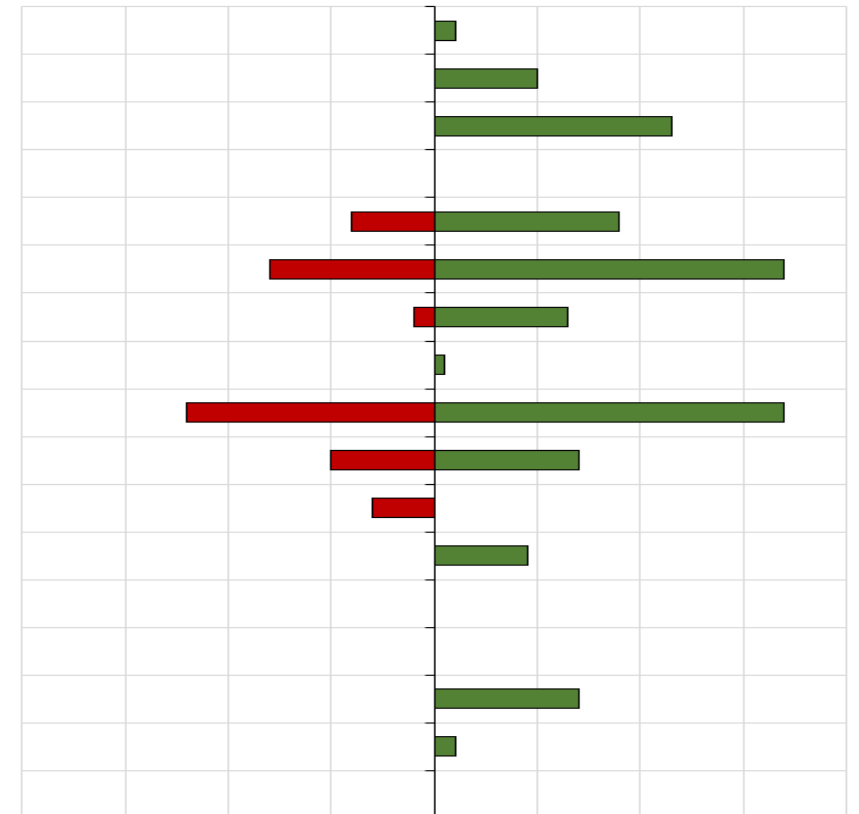
SDG 5 - Gender Equality

SDG 4 - Quality Education

SDG 3 - Good Health & Well-Being

SDG 2 - Zero Hunger

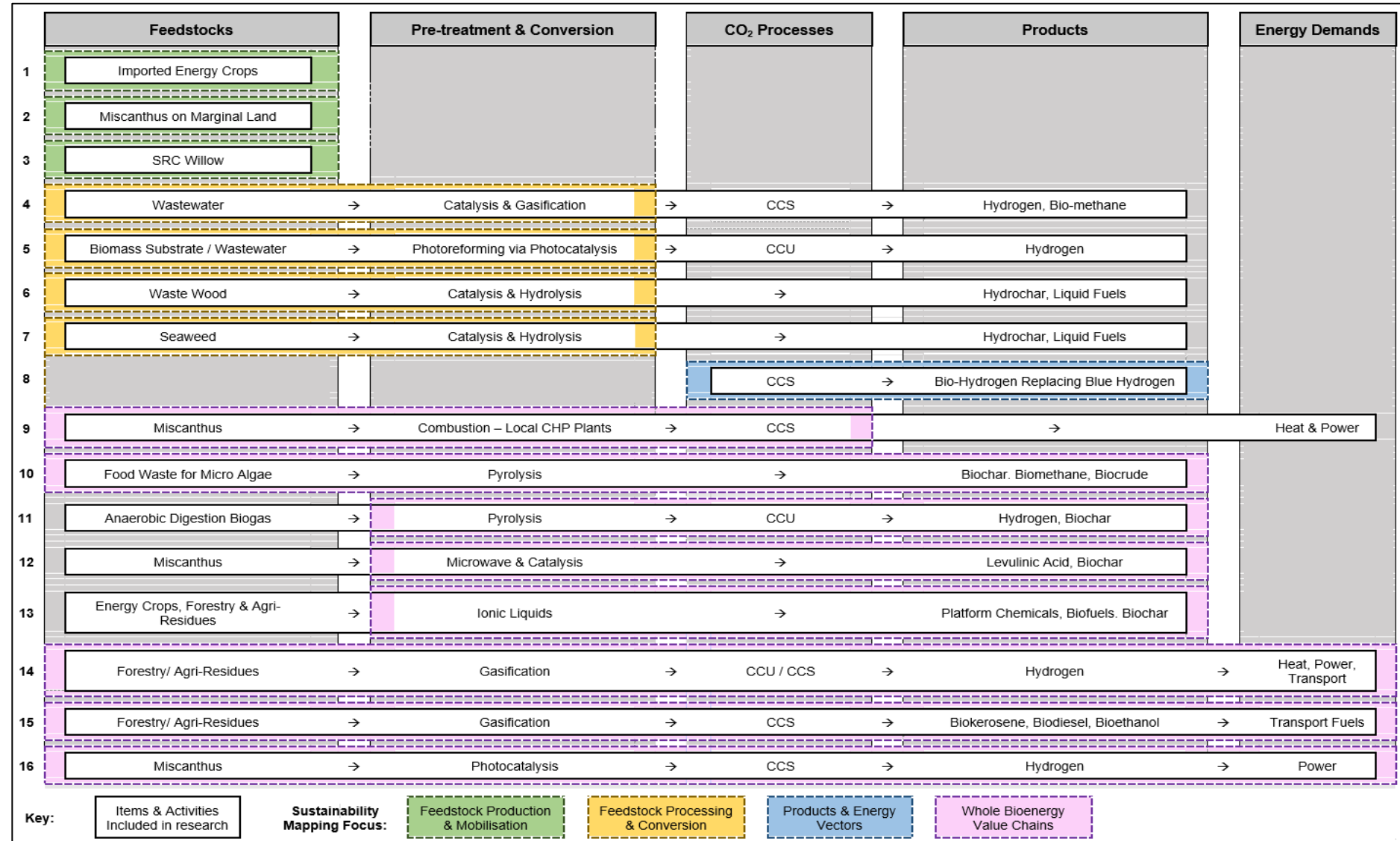
SDG 1 - No Poverty



# Applying the BSIM to Help Bioenergy Decision Makers

# Mapping the Sustainability of UK Projects

- ❖ 16x Case Studies
- ❖ Range of feedstocks, technologies, vectors & energy demands.
- ❖ Worked with 23 University & Industry partners.
- ❖ Focus on identifying sustainability trends.



# Maximise Benefits & Minimise Risks

## Consistent Sustainability **Benefits** across Case Studies:

### **People:**

Jobs & Skills / Changes in Income / Partnerships  
/ Energy Access

### **Development:**

Economy / Energy Sector / Bioeconomy / Land  
Utilisation

### **Natural Systems:**

Soil / Heavy Metals / Water Systems

### ***Climate Change & Emissions***

Climate Action / Emissions / Replaced Fuels

## Consistent Sustainability **Risks** across Case Studies:

### **People:**

Land Management

### **Development:**

Infrastructure / Feedstock Mobilisation / Techno-  
economics / Efficiencies

### **Natural Systems:**

Air Pollutants/ Water Use & Efficiency

### **Climate Change & Emissions:**

Emissions / Carbon Stocks



# Conclusions

- ❖ Bioenergy targeted for key role in achieving climate change targets – more biomass will be required to balance future demands.
- ❖ Bioenergy only provides a viable alternative energy option if it is sustainable.
- ❖ There is an existing framework of mandatory sustainability requirements, supported by multiple voluntary sustainability schemes.
- ❖ BSIM allows you to map the full sustainability of bioeconomy projects:
  - Identify leading sustainability risks, potentially mitigated through targeted actions.
  - Identify leading sustainability benefits, maximised and used to promote schemes.

# Any Questions?

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