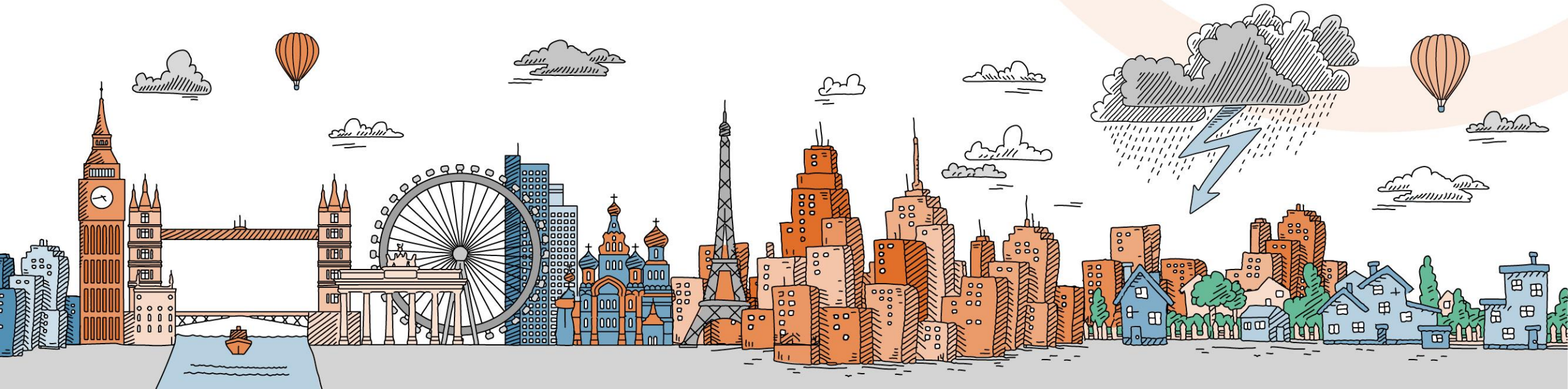


Towards a Biomass Sustainability Framework:

Mapping Biomass Sustainability, Trends & Trade-offs

Dr. Andrew Welfle



Bioenergy under the Microscope

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?

2020

f t in m e b



Biomass and bioenergy

The dirty little secret behind 'clean energy' wood pellets

Burning wood for power is 'misguided' say climate experts

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

Dirtier than coal?

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



'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 Teimane/Arisev.

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

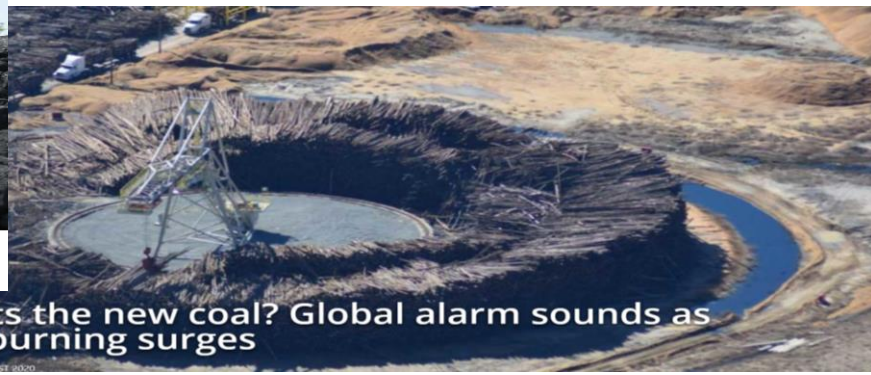
f t in m



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



RSPB friends of the earth see things differently GREENPEACE



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

By JUSTIN CATANZARINI 31 APRIL 2020

Sustainability in Policy

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

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

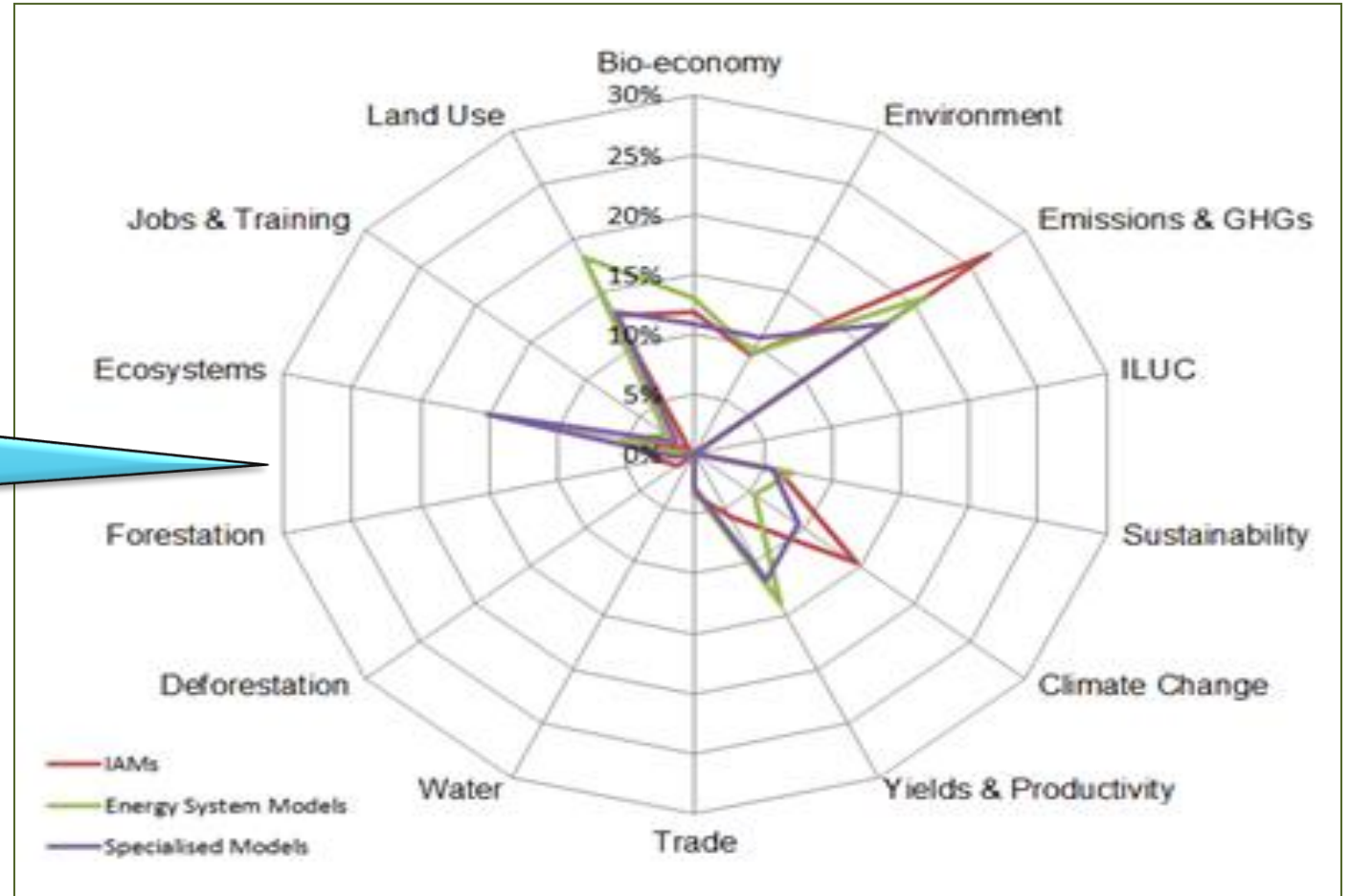
Coverage of Sustainability Issues Differs across Schemes:

		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			
Air Quality	Efficient water use			
	Air pollution			
	No burning for land clearing/waste disposal			
	No burning residues, waste, by products.			
	Economic development			
	Economic benefits to community			
	Economic performance			
Social Aspects	Energy efficiency			
	Energy balance			
	Social impact assessment			
	Social benefits to community			
Labour Conditions	Human rights			
	Land right issues			
	Working conditions			
	Contracts			
	Health and safety			
	Freedom of association, bargaining			
	Discrimination			
	Wages			
	Working hours			
	Child Labour			
Forced labour				
Training, capacity building				

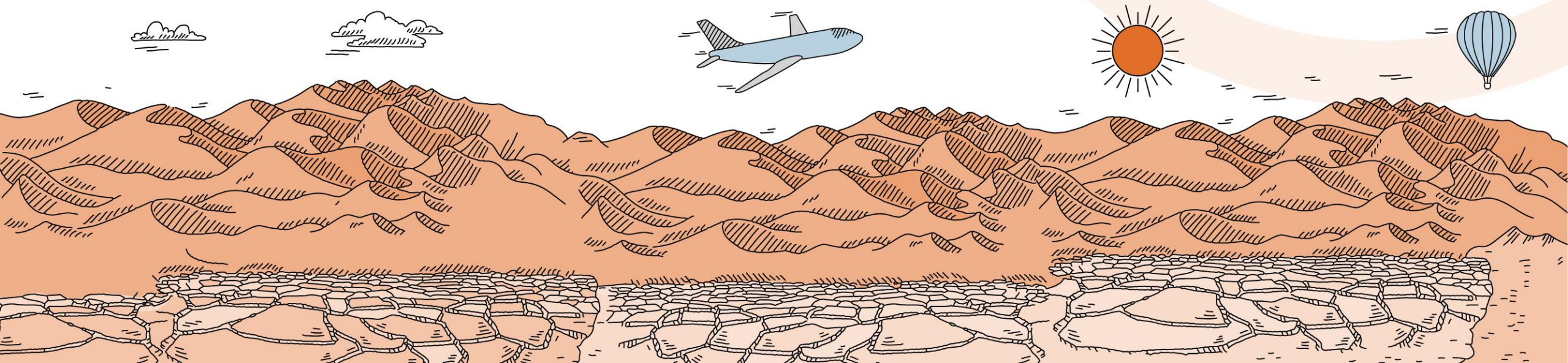
Sustainability in Policy Development

Increasing Use of Models within Bioenergy Research

Coverage of Sustainability Issues within Leading Models used by Policy Makers:



Introducing Supergen's Bioeconomy Sustainability Indicator Model (BSIM)



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

The screenshot shows a web browser window displaying the BSIM model interface. The page has a white background with green and grey text. At the top, it says 'Welcome to the Bioeconomy Sustainability Indicator Model (BSIM) Supergen Bioenergy'. Below this, there is a paragraph explaining the model's purpose: 'The BSIM has been designed to map the sustainability of bioenergy systems through assessment of over 100 sustainability issues. The model has flexibility allowing the analysis of biomass resources, value chains, technologies, and full bioenergy systems. The BSIM can be used to:'. A bulleted list follows: 'benefits.', 'Map the linkages and potential benefits of bioenergy for the UN Sustainable Development Goals.', and 'Generate outputs that can be used to map the linkages between sustainability indicators. Enabling identification of'. Below the list, there is a 'Model Information' section with a table: 'Development Version: 21.0', 'Last Updated: 24/03/2022', 'BSIM Guidance Manual: Link', and 'Developer Contact Details: andrew.welfle@manchester.ac.uk'. To the right of the table is a 'Reset Model' button. At the bottom, there are logos for 'MANCHESTER The University of Manchester', 'Tyndall Centre for Climate Change Research', 'Aston University BIRMINGHAM UK', and 'EBRI Energy & Bioproducts Research Institute'.

BSIM Guidance Manual:

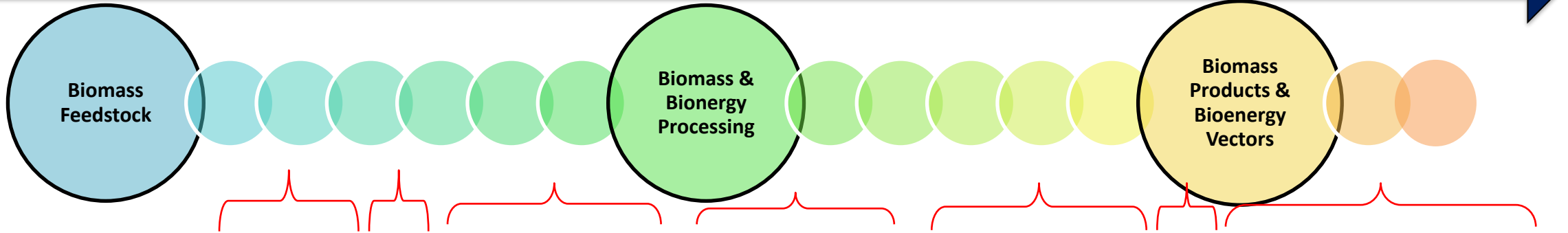
The image shows the front cover of the 'BSIM Guidance Manual'. The cover is white with green and grey text. At the top, it features the 'Supergen Bioenergy' logo. Below the logo, it says 'Supergen Bioenergy Hub'. The main title is 'Bioeconomy Sustainability Indicator Model (BSIM) Guidance Manual'. Below the title, it lists the authors: 'Authors Andrew Welfle, Mirjam Röder'. At the bottom, there are several logos: 'MANCHESTER The University of Manchester', 'Aston University BIRMINGHAM UK', 'EBRI Energy & Bioproducts Research Institute', 'UKRI', 'Biotechnology and Biological Sciences Research Council', and 'Engineering and Physical Sciences Research Council'.

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

BSIM Architecture

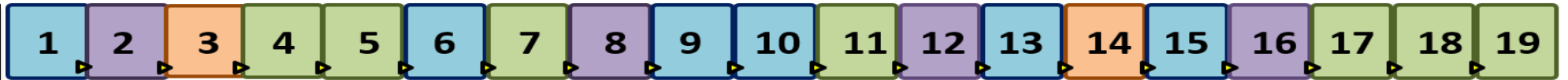
1

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

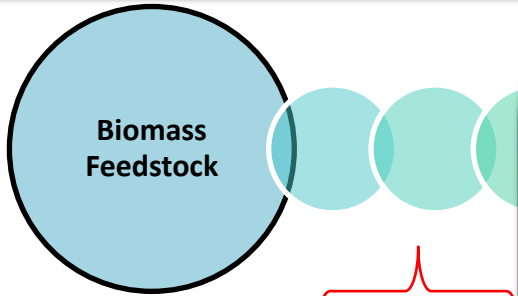
Engaged with stakeholders to develop a framework for assessing sustainability:

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

BSIM Architecture

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

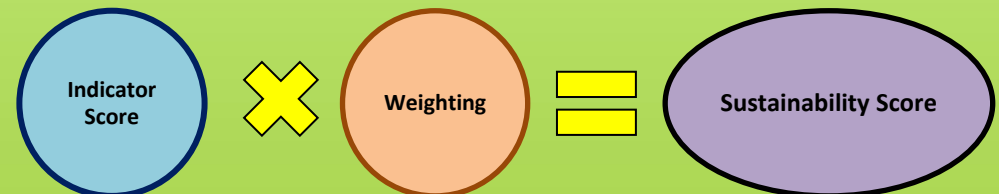


What are the implications of emissions linked to Conversion of Feedstocks to Energy?

Potential Sustainability Benefits



Sustainability Performance Index:

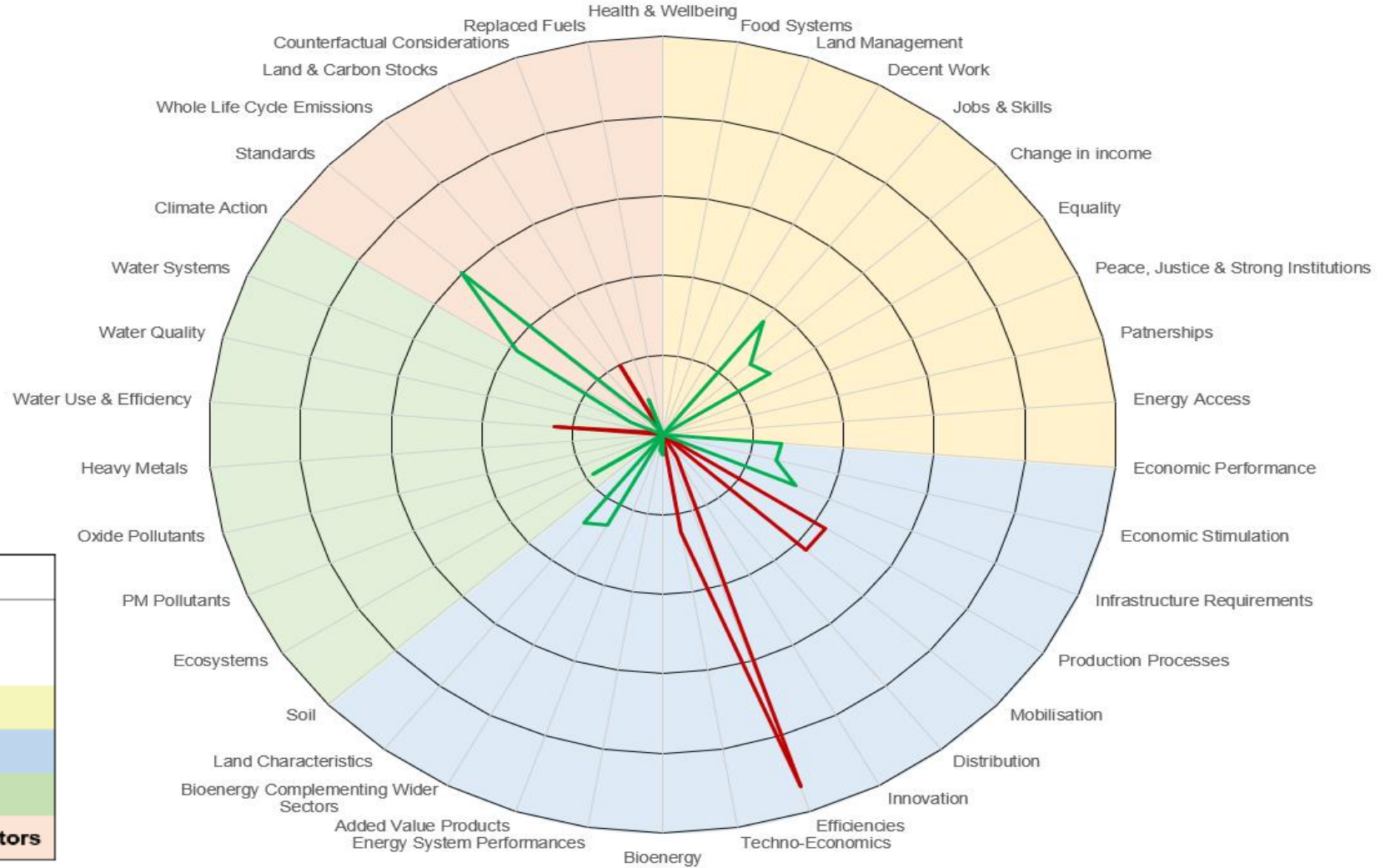


❖ 126 x Sustainability Issues

Outputs Generated by the BSIM

Outputs – Sustainability Maps

a) UK MSW Biomass Resources



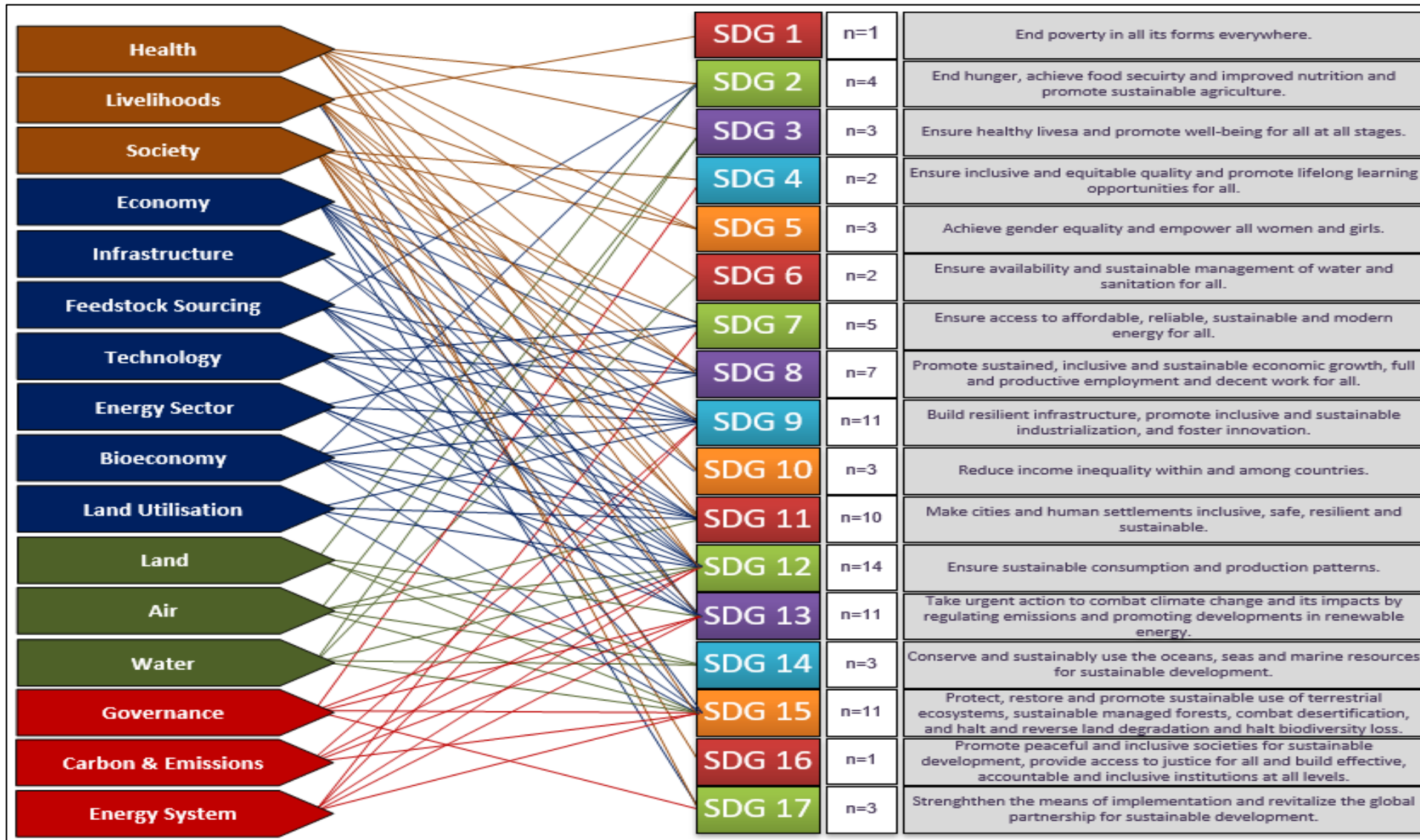
Key	
	Sustainability Benefit
	Sustainability Risk
People Sustainability Indicators	
Development Sustainability Indicators	
Natural System Sustainability Indicators	
Climate Change & Emissions Sustainability Indicators	

Outputs – Sustainability Dashboard

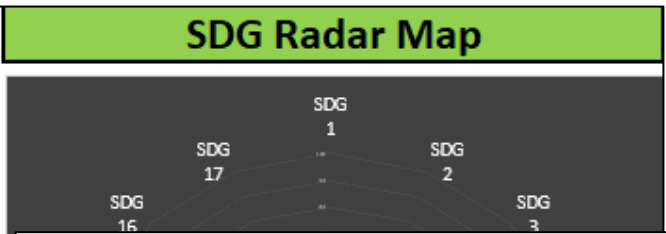
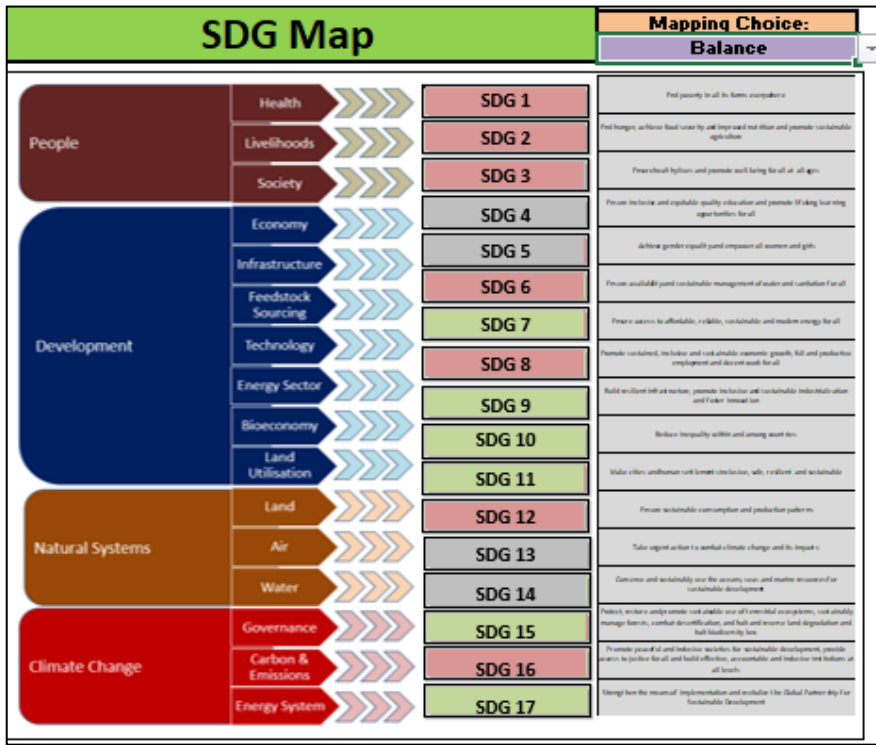
Sustainability Categories Index Scores		Sustainability Theme Index Scores		Sustainability Indicator Index Scores			
People	0.9	Health	-	Health & Wellbeing	-		
				Food Systems	-		
				Land Management	-		
		Livelihoods	0.7	Decent Work	-		
				Jobs & Skills	2.4		
				Change in income	1.9		
		Society	0.4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

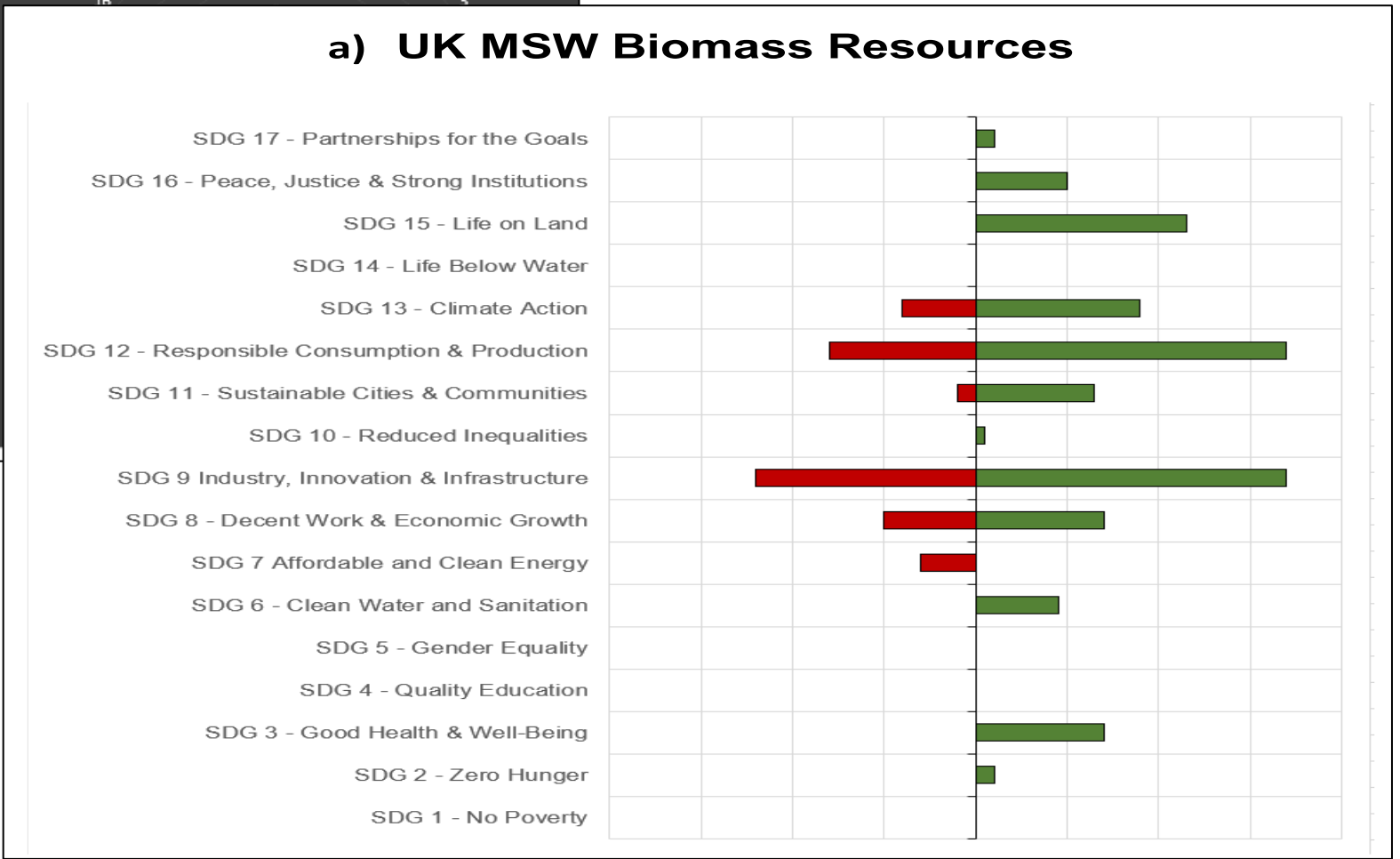
Outputs – SDG Mapping



Outputs – SDG Mapping

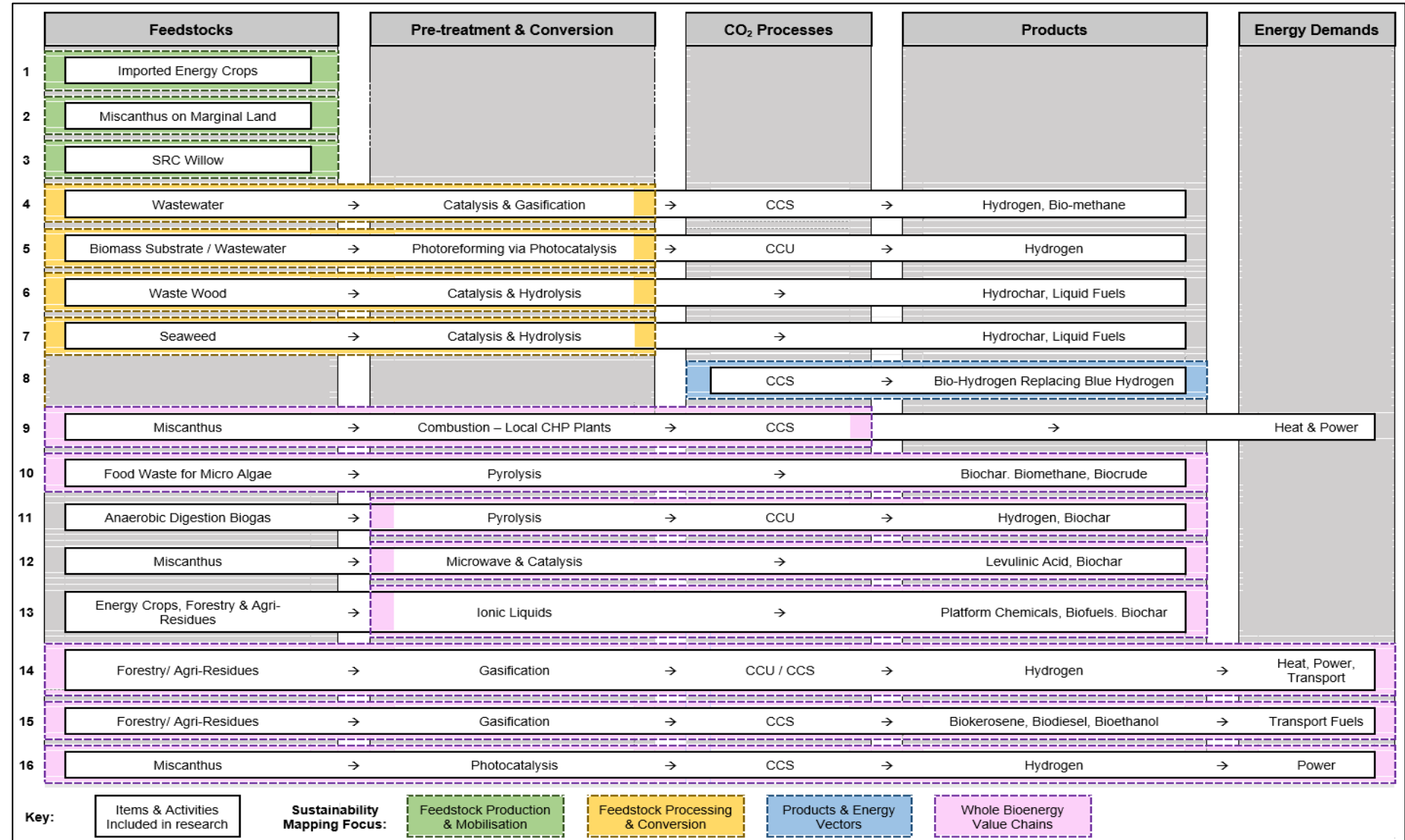


a) UK MSW Biomass Resources



Case Studies – Supergen Projects

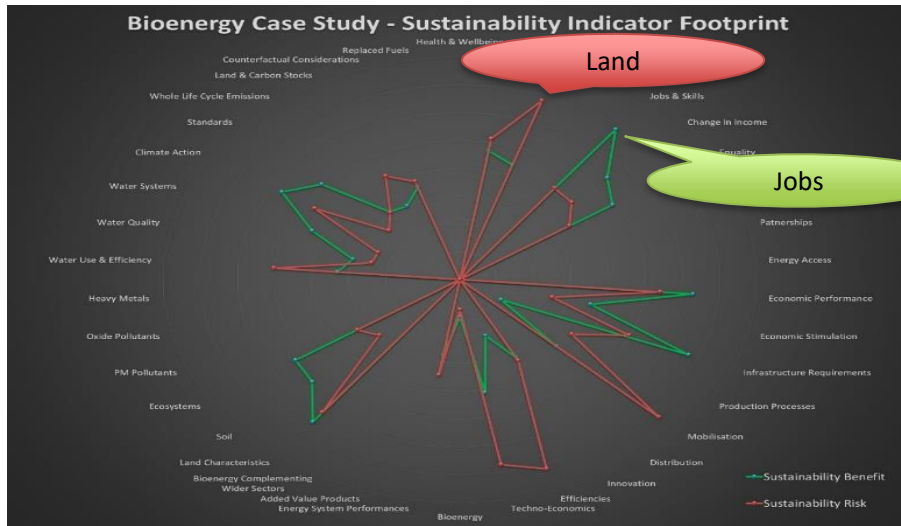
- ❖ 16x Case Studies
- ❖ Broad range of feedstocks, technologies, vectors and energy demands.
- ❖ Working with 23 SBH partners.
- ❖ UK bioenergy sustainability trends.



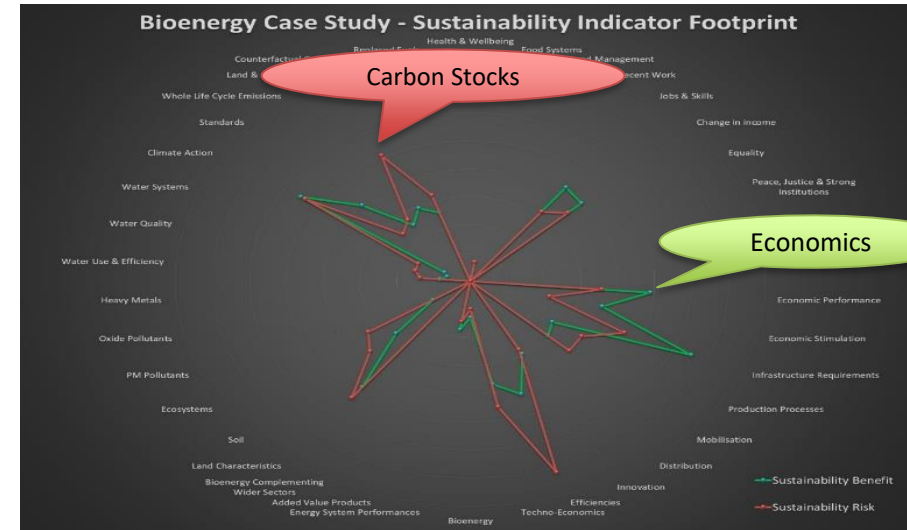
Biomass-Bioenergy Sustainability Trends

Findings from Assessed Case Studies:

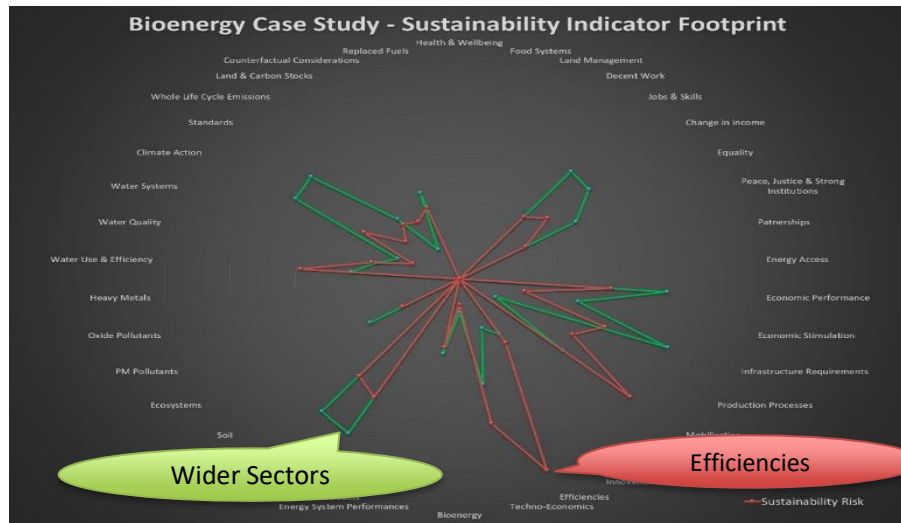
Energy Crops



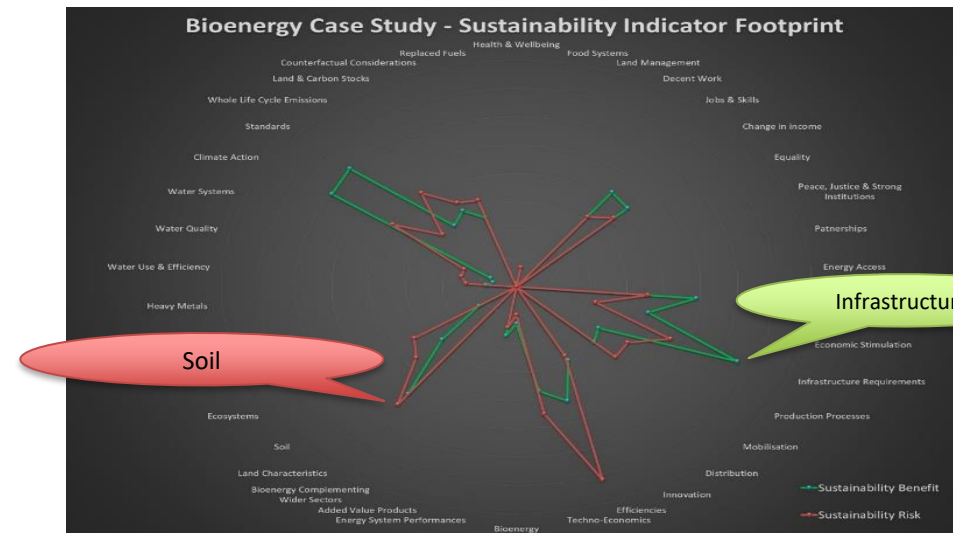
Forestry Residues



Municipal Solid Wastes



Agri-Residues



Consistent Sustainability Trends

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

Sustainability Thoughts

- ❖ ‘Sustainability’ is a term used to describe broad ranging themes. Bioenergy’ is itself also an extremely broad term. ‘Sustainable bioenergy’ is far from a homogenous concept – a problem when developing policy to regulate?
- ❖ Sustainable bioenergy is a series of trade-offs rather than a ‘green’ destination.
- ❖ Current legislation focuses and sets benchmarks for emissions performance, carbon and biodiversity. Although sustainability goes far beyond these.
- ❖ There are also no current mechanisms to ensure that potential benefits are achieved or maximised?
- ❖ Would an approach of awarding ‘credit’ across a broader range of sustainability indicators in addition to requiring minimum benchmark performances be a better way of assessing and regulating sustainability?



Thank you

Do you have any questions?

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 @andrew_welfle

 Andrew Welfle



Biomass and Bioenergy
Volume 177, October 2023, 106919



Sustainability of bioenergy – Mapping the risks & benefits to inform future bioenergy systems

Andrew James Welfle ^{a b}  , Alberto Almena ^{a c}  








Biomass and Bioenergy
Volume 136, May 2020, 105542



Research paper

A review of the role of bioenergy modelling in renewable energy research & policy development

Andrew Welfle ^{a b}  , Patricia Thornley ^{c d}  , Mirjam Röder ^{c d}  



Renewable Energy
Volume 191, May 2022, Pages 493-509



Mapping the sustainability of bioenergy to maximise benefits, mitigate risks and drive progress toward the Sustainable Development Goals

Andrew Welfle ^a  , Mirjam Röder ^b  