

# Mass and energy balance model

BSEAA PROJECT  
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## Agenda

Introduction to the Aston Mass-Energy Balance Model

Guided walk-through of the model and a challenge!

Discussion of results generated and model feedback

Closing remarks



# Bioenergy for sustainable local energy services and Energy Access in Africa (BSEAA)

Two year research programme

**Identify and support development of innovative, commercial bioenergy pathways and technologies in Sub-Saharan Africa**

Part of the Transforming Energy Access (TEA) Programme

<https://tea.carbontrust.com/structure/bio-energy/>



Foreign, Commonwealth  
& Development Office



Transforming  
Energy  
Access

## The Aston Team

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## Model objective

Modelling of mass-energy balance of different sectors (10kWe to 5MWe)

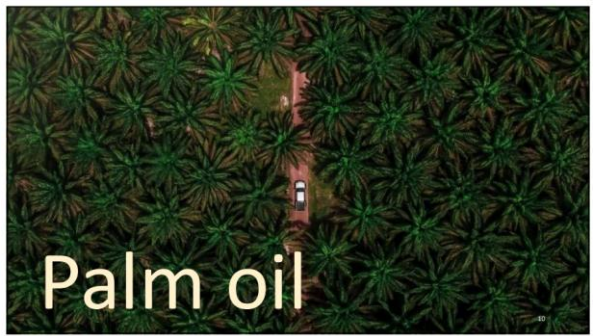
Assessing energy supply from different biomass feedstocks

Consider technology for each demand sector

Compare energy supply and demand to availability of biomass resource

Developing a user friendly tool in Excel format that can be used by developers and industry to assess MEB for different bioenergy demand sectors

# The demand sectors





Sisal

Aston University  
BIRMINGHAM UK

**EBRI**  
Energy & Bioproducts  
Research Institute

# Model design

A diagram on a green background showing a white line that starts from the bottom right and branches out to the left. The branches lead to icons for a microscope, a wrench and screwdriver, a pound sterling symbol (£), a recycling symbol, and a house with a sun on its roof.

All models are wrong,  
but some are useful.

George E. P. Box

A background image of a chalkboard filled with various mathematical formulas and equations written in green chalk.

The practical question is how wrong do they have to be, before they are no longer be useful?

# Model design – user interface

- Simple to use
- Inbuilt methodology document
- All assumptions clearly stated
- Comprehensive feedstock information

**START HERE!**

1. Choose demand sector and feedstocks from dropdown menus.

General Inputs	
Demand Sector	#N/A
Feedstock 1	#N/A
Feedstock 2	#N/A
Percentage of second feedstock	#N/A
Target capacity as MW	MW
Capacity factor / Plant availability	85% %

The cells that can be amended by the user are highlighted in orange.

2. Choose specific inputs for each demand sector. Clear the values that are not required by clicking on "Clear Values" button

Specific Demand Sector Inputs	
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A

**Clear values**

CLICK HERE TO RESET MODEL

# Model design – behind the scenes

The image shows a complex spreadsheet interface with multiple tabs and data tables. Key sections include:

- Process Parameters:** Tables for Feedstock 1 and Feedstock 2 with columns for Moisture, Ash, Cellulose, Hemicellulose, Lignin, etc.
- Energy Flows:** Tables showing energy inputs and outputs in MJ/kg and kWh/kg.
- Material Balances:** Tables showing the flow of various components through different process stages.
- Process Flows:** A central area showing the integration of different process units and their interactions.

# The results

A simple snapshot on user interface page

1. Choose demand sector and feedstocks from dropdown menus.

General Inputs	
Demand Sector	Wood
Feedstock 1	Cornstarch husk
Feedstock 2	White stalks & cobs
Percentage of second feedstock	50%
Target capacity as MW	1.00 MW
Capacity factor / Plant availability	85% %

The cells that can be amended by the user are highlighted in orange.

2. Choose specific inputs for each demand sector. Clear the values that are not required by clicking on "Clear Values" button

Specific Demand Sector Inputs	
Process purpose	CHP

**Clear values**

CLICK HERE TO RESET MODEL

3. Results displayed below.

Results		
	Dry basis	Wet basis
Biomass flow	kg/s	0.4
	annual tonnes	5,773
MWh electricity / t biomass		0.8
MWh heat / t biomass		3.3
Feedstock 1 [annual tonnes]		5,585
Feedstock 2 [annual tonnes]		5,585
Steam flow [tonnes per hour]		8
Annual operational hours		7,440

## Model capabilities



## The model can

Based on user's energy requirement,  
calculate the amount of biomass required

Restricts the feedstock selection depending  
on the demand sector

Automatically update the model depending  
on the choices



## The model can't

Provide specific details of the  
technology. Generalised assumptions  
are used.

Provide process design details e.g.  
vessel dimensions

Provide a detailed simulation

## So remember

The efficiency and yields are predetermined

The feedstock properties come from the database.

The properties are not determined by the user

Who the model is aimed at



Your opinion matters:

<https://tinyurl.com/36fcx844>

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