

KISS waste tool Manual and Tutorial

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Introduction

The Danish Municipalities have an obligation assure increasing recycling of resources from Danish households significantly under the framework of the European Waste framework directive and the Danish resource strategy. The Innovation Fund have funded the TOPWASTE project where the objective is to contribute to improved use of waste for energy or material recycling integrating economic and environmental considerations including resource scarcity. Aligned with the framework of the Danish resource strategy and as a part of this project the excel tool presented here has been developed.

Karbon Implications of Source Segregation of Waste (KISS waste) is an excel tool with the objective to support municipalities and other with the opportunity to evaluate/assess relevant future scenarios on carbon foot print and resource recovery goals and potentials.

It has been the objective to develop a tool that includes all relevant scenarios and relevant source segregation scenarios. The model includes 3 predefined scenarios

1. Danish Baseline (average Danish Scenario)
2. Mono stream collection at kerbside (collection separated waste from the households)
3. Comingled collection at kerbside (collection of comingled separated waste from the households)

The model includes a predefined waste composition based on Danish waste statistics (ISAG 2009).

On top of the predefined scenarios the model includes options for modelling other waste compositions, and other collection systems (user defined).

Structure

The excel model consist of a number of sheets with different functionalities.

Start sheet

First sheet is the named start. The Start sheet includes all options for selection when modelling the predefined scenarios.

Foreground system definitions:

1. Waste composition divided between multifamily and single family residences
2. Collection structure
3. Choices between different treatment types and techniques

Background system definitions:

1. Energy marginal used in the modelling (predefined or user defined)

Printing report sheet

The sheet for printing report includes all the framework conditions for the model setup. It has been setup for printing directly to A4. In the result sheet and compare systems sheet there are however other interesting graphical results not easily converted to A4. The graphs from those sheets and other sheets can be copied to work using normal copy paste functionalities.

User defined waste composition sheet

If the user wishes to model their own waste composition this sheets contains the functionality to do so based on the knowledge of collected waste fractions.

User defined collection system sheet

If the user wishes to model a collection system different from the predefined collection systems it is possible to setup a user defined collection system.

About sheet

This sheet contains the general information about the model an a list of references used for the data.

Result Sheet

The result sheet contain of relevant presentation of the results for the modeled scenario.

1. There is a graphical presentation of breakdowns on contributions from materials, energy and transport for the different waste flows in the model system
2. There is a graphical presentation of the breakdowns on contributions from materials energy and transport from the different waste fractions
3. There are 2 graphical presentations of the losses of resources for the collected waste flows. One based on wet weight and one based on dry weight
4. There is a graphical presentation of breakdown of the expenses for the sorting and handling of the waste
5. There is a graphical presentation of the overall resource recovery rate as defined by the Danish resource strategy

The graphical presentation can be copied using copy paste functionalities in Excel.

Comparison of 2 systems sheet

The graphical presentation of breakdowns on contribution from the different waste flows are shown here. If the results from 2 different modelled scenarios can be compared in this graphical presentation.

Comparison of 3 systems sheet

The graphical presentation of breakdowns on contribution from the different waste flows are shown here. If the results from 3 different modelled scenarios can be compared in this graphical presentation.

Process database sheet

The data for the different processes used for the modelling are documented her. If the user changes values in this sheet it will directly influence the modelling

Clipboard		Font		Alignment		Number		Styles		
AM167										
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A	B	C	AB	AC	AD	AE	AF	AG	AH	AI
1	Database - all processes		Collection of foil plastic (from kerbside)		Collection of glass waste (from kerbside)		Collection of glass waste (from kerbside)		Collection of glass waste (from kerbside)	
2			Foil plastic waste (to transfer station) (outflow amounts and		Mixed glass waste (kerbside) (inflow amounts and process data)		Recyclable glass waste (to glass sorting plant) (outflow amounts and		Mixed glass waste (at cube and recycling centre) (inflow amounts and process data)	
3	Process description		Foil plastic waste (to transfer station) (outflow amounts and		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??	
4	References		Foil plastic waste (to transfer station) (outflow amounts and		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??	
5	Data status		Foil plastic waste (to transfer station) (outflow amounts and		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??		Collection of glass waste from cube to glass sorting plant. Transport by waste collection truck. Is the glass waste transported directly from cube to sorting and glass production site??	
6	Material 25		t/t inflow waste		0		0		0	
99										
100										
101	Transport									
102	Description of transport		Transport from kerbside to transfer station		Transport from kerbside to transfer station		Transport from cube to transfer station		Transport from cube to transfer station	
103			Transport from kerbside to transfer station		Transport from kerbside to transfer station		Transport from cube to transfer station		Transport from cube to transfer station	
104	Transport by passenger car, distance:		km		0		0		0	
105	Transport by waste collection truck, distance:		km		7.55		7.55		7.55	
106	Transport by long distance truck, distance:		km		0		0		0	
107	Transport by freight ship, distance:		km		0		0		0	
108										
Start Printing Report User defined waste comp User defined collection system About Results Compare 2 sys Compare 3 sys Process Database										



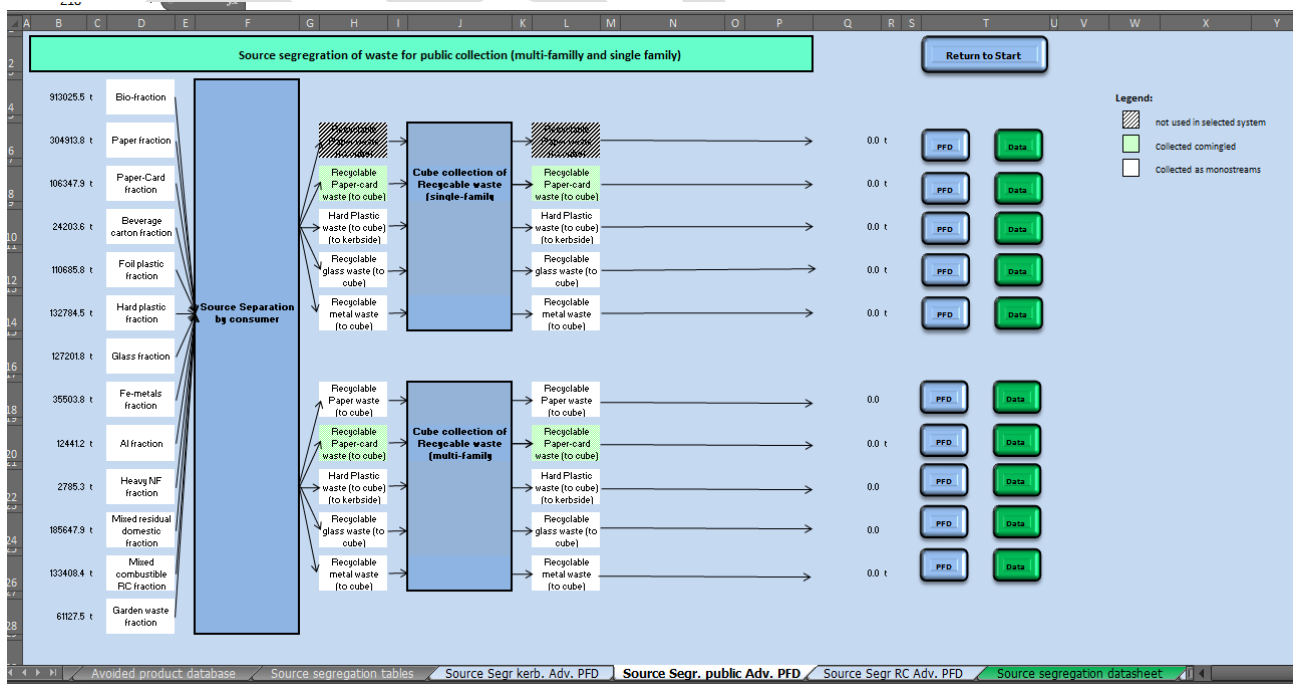
Avoided product database sheet

The data for the avoided materials used in the modelling is listed and documented here.

Database for avoided products			Replaced Fe-metals production	Replaced Aluminium production	Replaced NF heavy metal production	Replaced production of N fertiliser	Replaced production of P fertiliser
<p>Go to Data for selected Collection System</p> <p>Process description</p>			Replaced amounts and data for production of pig iron	Replaced amounts and data for production of primary aluminium	Replaced amounts and production of Primary copper	Replaced production of mineral N fertiliser	Replaced production of mineral P fertiliser
<p>The recovered Fe-metals replaces iron on the market</p>			Aluminium replaces aluminium at the Global market	The recovered NF heavy metals are mainly Copper. The replacement of production and extraction of copper ore is included			
114	CH4 (biogenic)	t CH4/t inflow waste					
115	CH4 (fossil)	t CH4/t inflow waste					
116	N2O	t N2O/t inflow waste					
Energy outputs (i.e. energy production) - Insert negative values							
119	Electricity (continuous / non-flexible production)	MJ/tonnes inflow waste					
120	Electricity (flexible production)	MJ/tonnes inflow waste					
121	Thermal (e.g. production of heat)	MJ/tonnes inflow waste					
THE ENERGY OUTPUTS WILL BE CALCULATED UNDER "AVOIDED"							
123	World Marginal Electricity	MJ/tonnes inflow waste	35000	184000		101000	25.200
124	World Marginal Heat	MJ/tonnes inflow waste					
Output: Waste products with no further treatment							
127	Inert waste to deposit	tonnes/t inflow waste					
128	Salt slag	tonnes/t inflow waste					
129	Filter dust	tonnes/t inflow waste					
130		tonnes/t inflow waste					
131		tonnes/t inflow waste					

PFD sheets (light blue)

For all systems and different flow in the modeled scenarios the flow diagrams are shown in the sheets



Data sheets (green)

For all the systems and different flows in the modeled scenarios the calculations related to the modelling of masses and emissions are shown here.

Baseline collection (including separate collection of Bio-waste)		Source separation by consumer in the Baseline collection			
Unit		Generated waste (total inflow amounts)	Waste amounts generated by single family residences	Waste amounts generated by multi family residences	Single fam: % transfer of inflow fraction to outflow
		tonnes inflow	tonnes inflow	tonnes inflow	
13					
14	Waste fraction				
15	Bio-fraction	913025.5	716557.9	196467.6	
16	Paper fraction	304913.8	233207.9	71705.8	
17	Paper-card fraction	106347.9	82650.1	23697.8	
18	Beverage carton fraction	24203.6	19416.1	4787.5	
19	Foil plastic fraction	110685.8	83035.5	27650.3	
20	Hard plastic fraction	132784.5	104221.1	28563.4	
21	Glass fraction	127201.8	97575.2	29626.5	
22	Fe-metals fraction	35503.8	27682.5	7821.2	
23	Al fraction	12441.2	9698.2	2743.0	
24	Heavy metal fraction	2785.3	2173.9	611.4	
25	Mixed residual combustible fraction (kerbside)	185647.9	131842.5	53805.4	
26	Mixed combustible RC fraction	133408.4	102881.0	30527.4	
27	Garden waste fraction	61127.5	47139.9	13987.6	
28	Other mass flows (included in order to keep track of mass balances)				
29	<i>Changed mass 1 (generated, added or lost) (see explanation in adjacent cells)</i>				
30	<i>Changed mass 2 (generated, added or lost) (see explanation in adjacent cells)</i>				
31	<i>Changed mass 3 (generated, added or lost) (see explanation in adjacent cells)</i>				
32	<i>Changed mass 4 (generated, added or lost) (see explanation in adjacent cells)</i>				
33	Ash				
34	Total	2150077.0	1658081.9	491995.1	

Background data sheet

All systems are based on a series of background data

- Composition of the waste fractions
- Emission of fuels and different types of energy production, consumption etc.

Other sheets (chemical composition, hidden sheets, etc.)

There are a series of other sheets used for the modelling and control of data. It is not recommended the user changes anything in those sheets.

Documentation for data used in the model

Description on the background for the different choices of data are found in Ciprian Cimpan (2015)

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References

Ciprian Cimpan (2015) Foreground systems report. System descriptions and LCI data for the KiSS model

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Tutorial for in using KISS waste tool

Here is a small guide/tutorial to try out some of the simple facilities in the tool.

SIMPLE APPROACH

The simple model approach calculates material re-use and carbon footprint from different waste sorting systems based on the waste composition. The composition of the waste is Danish Average (ISAG 2009).

There are 4 parameters to choose/insert as basis of the calculations

- Amount of waste collected in tonnes/year
- Distribution between single family and multi-family housing in percent %
- Choosing sorting system
- Choosing framework for the energy supply (background system), including biomass marginal

Exercise 1 (model the difference between 3 selected predefined Scenarios)

Go to **START** sheet

- Type the amount of waste collected in your case (municipality) (for example 86932 tons/år)
- Choose the distribution between the single family housing and multifamily housing (eks. 43%, 57%)
- Choose sorting system
- Select or deselect kerbside collection of biowaste
- Select treatment for mixed residual
- Choose background system Energy supply framework including biomass energy marginal
- Choose treatment technology for biowaste
- Choose treatment technology for mixed residual treatment

Go to the sheet **RESULTS**. Here you can see the results shown of 4 different graph types.

ADVANCED APPROACH

In the advanced part of the model, there are other parameters that can be adjusted/chosen.

- The system assessed can be modified to be exactly like the system you wish to model and closer to your specific case (municipality)
- The amounts collected per single family or multifamily can be adjusted
- The framework for the energy supply can be adjusted if the pre-chosen version is not covering your case

Exercise 2

Go to the **START** sheet

Amounts and composition of generated household waste

The amount and composition of the generated household waste forms the basis for "the functional unit". All calculations and results are calculated based on this information.

The very first step is to define the ratio between number of single family residences and multi family residences (the residences generating the waste). Information regarding the ratio between number of single family residences and multi family residences is needed for the simple approach as well as for the advanced approach.

Ratio between number of single family residences and multi family residences
Number of single family residences (detached one-house family houses) vs multi-family residences (apartments etc.), calculated in % of total residences.

Total amount of generated household waste
The composition of the generated household waste is defined below. The user can choose between a "simple approach" and a more demanding "advanced approach". It is recommended to use the simple approach by selecting "Default waste composition (based 2009 data)" unless you have the information needed for the advanced approach.

Simple approach

Default waste composition (based on 2009 data)

Advanced approach

User specified waste composition

Insert total amounts of generated domestic household waste (including waste management centres): This will be the basis for the functional unit (combined with the amount of waste generated in the residential area).

Go to Advanced Approach, User specified waste composition - STEP 1

Choose advanced approach (stay in the **START** sheet)

- Choose sorting system
- Choose framework for the energy system (you can change the details on the right)

Then press the go to **user specified waste composition** – STEP 1

- Type the amounts of collected waste flows as shown here and
- Choose the distribution between single family and multi-family housing to (67%, 33%)

STEP 1: Calculation of generated waste composition based on existing collection system

Amounts and composition of generated household waste - Advanced approach

Ratio between number of single family residences and multi family residences

Number of single family residences (detached one-house family houses) vs multi-family residences (apartments etc.), calculated in % of total residences:
 Default value (Average for Denmark, 2009): 60% single family residences / 40% multi-family residences

Single family residential: 73% %
 Multi-family residential: 27% %

Ratio between amounts of kerbside collected mixed domestic residue waste from single family residences and from multi family residences:

Single family residential: 9.92 [kg per week] (from Pedersen and Domela, 2003) 77.1% of the total domestic combustible residue comes from single-family residences
 Multi-family residential: 7.96 [kg per week] (from Pedersen and Domela, 2003) 22.9% of the total domestic combustible residue comes from multi-family residences

Collected waste amounts	Total amounts	Allocated to Domestic waste	Domestic waste
	[tonnes per year]		
Mixed domestic combustible residual waste [Dagrenovation], kerbside collected	1040873	100%	1040873
Bio-waste, collected at kerbside	414380	100%	414380
Recyclable paper, collected at kerbside monostream or comingled ind residues	88951	100%	88951
Recyclable paper, public collection (cubes etc.)	68222	100%	68222
Recyclable paper, collected at recycling centre	17055	100%	17055
Paper-card waste, collected kerbside		100%	0
Paper-card waste, public collection (cubes etc.)		100%	0
Paper-card waste - collected at recycling centre (corrugated cardboard not included)	11731	100%	11731
Beverage cartons, collected at kerbside		100%	0
Foil Plastic, collected kerbside		100%	0
Foil Plastic, public collection		100%	0
Foil plastic, collected at recycling center	54815	100%	54815
Hard Plastic, collected kerbside		100%	0
Hard Plastic, public collection		100%	0
Hard plastic, collected at recycling center	87213	100%	87213
Glass, collected kerbside		100%	0
Glass, public collection (cubes etc.)		100%	0
Glass, public collection (cubes etc.) and at recycling centre	97976	100%	97976
Fe-NF metal waste, collected kerbside	5000	100%	5000
Fe-NF metal waste, public collection (cubes etc.)		100%	0
Fe-NF metal waste - collected at recycling centre	19966	25%	4992
Sorting residues from comingled streams	100	100%	100
Mixed combustible RC waste - collected at recycling centre	395284	50%	197642
Garden waste - collected at recycling centre	611275	10%	61128
TOTAL	2912841		2150077

Return to Start

Specifying collection system

SIMPLE

- a) After specifying your waste composition (STEP 1), it is an option to choose an already specified waste collection system at the **START** sheet

Waste collection system - simple approach and advanced approach (user defined)

Waste collection system
 Select waste collection system:

Chosen Collection system: Baseline collection system

- b) Then choose the details for your system
- a. Energy marginals

<p>106</p> <p>107</p> <p>108</p> <p>109</p> <p>110</p> <p>111</p> <p>112</p> <p>113</p> <p>114</p> <p>115</p> <p>116</p> <p>117</p> <p>118</p> <p>119</p> <p>120</p> <p>121</p> <p>122</p> <p>123</p> <p>124</p> <p>125</p> <p>126</p> <p>127</p> <p>128</p> <p>129</p> <p>130</p> <p>131</p> <p>132</p> <p>133</p> <p>134</p> <p>135</p>	<p>Choosing Energy Marginal for Scenario</p> <p>Select energy scenario: <input type="text" value="Energy scenario 2020-2035"/></p> <p>According to the selected energy scenario, the results are calculated by use of:</p> <table border="0"> <tr> <td>Electricity consumption, continuous (non-flexible)</td> <td>Consuming DK electricity continuously (2020-2035)</td> </tr> <tr> <td>Electricity consumption, flexible</td> <td>Consuming DK electricity in a flexible production, 100% Wind (2020-2035)</td> </tr> <tr> <td>Electricity production, continuous (non-flexible)</td> <td>Producing DK electricity continuously (2020-2035)</td> </tr> <tr> <td>Electricity production, flexible</td> <td>Producing DK electricity flexible, 100% Coal (2020-2035)</td> </tr> <tr> <td>Heat / steam (same for input and output)</td> <td>Boiler, natural gas</td> </tr> <tr> <td>Transport, long distance truck</td> <td>Diesel (fossil)</td> </tr> <tr> <td>Transport, waste collection truck (short distance)</td> <td>Diesel (fossil)</td> </tr> <tr> <td>Transport by passenger car</td> <td>Petrol (fossil)</td> </tr> <tr> <td>Transport by freight ship</td> <td>Heavy fuel oil</td> </tr> <tr> <td>Biomass marginal</td> <td>Residues (thinning), others</td> </tr> </table> <p>Choosing biomass marginal for selected Energy Scenario</p> <p><input type="text" value="Residues (thinning), others"/></p>	Electricity consumption, continuous (non-flexible)	Consuming DK electricity continuously (2020-2035)	Electricity consumption, flexible	Consuming DK electricity in a flexible production, 100% Wind (2020-2035)	Electricity production, continuous (non-flexible)	Producing DK electricity continuously (2020-2035)	Electricity production, flexible	Producing DK electricity flexible, 100% Coal (2020-2035)	Heat / steam (same for input and output)	Boiler, natural gas	Transport, long distance truck	Diesel (fossil)	Transport, waste collection truck (short distance)	Diesel (fossil)	Transport by passenger car	Petrol (fossil)	Transport by freight ship	Heavy fuel oil	Biomass marginal	Residues (thinning), others	<p>IF User Specified Energy Scenario</p> <p>Then select energy marginals:</p> <table border="0"> <tr> <td>Electricity input, continuous (non-flexible)</td> <td><input type="text" value="Consuming DK electricity continuously (2020-2035)"/></td> </tr> <tr> <td>Electricity input, flexible consumption</td> <td><input type="text" value="Consuming DK electricity in a flexible production, 100% Wind (2020-2035)"/></td> </tr> <tr> <td>Electricity output, continuous (non-flexible)</td> <td><input type="text" value="Producing DK electricity continuously (2020-2035)"/></td> </tr> <tr> <td>Electricity output, flexible</td> <td><input type="text" value="Producing DK electricity flexible, 100% Coal (2020-2035)"/></td> </tr> <tr> <td>Heat / steam (same for input and output)</td> <td><input type="text" value="Boiler, natural gas"/></td> </tr> <tr> <td>Transport, long distance truck</td> <td><input type="text" value="Diesel (fossil)"/></td> </tr> <tr> <td>Transport, waste collection truck (short distance)</td> <td><input type="text" value="Diesel (fossil)"/></td> </tr> <tr> <td>Transport by passenger car</td> <td><input type="text" value="Petrol (fossil)"/></td> </tr> <tr> <td>Transport by freight ship</td> <td><input type="text" value="Heavy fuel oil"/></td> </tr> </table>	Electricity input, continuous (non-flexible)	<input type="text" value="Consuming DK electricity continuously (2020-2035)"/>	Electricity input, flexible consumption	<input type="text" value="Consuming DK electricity in a flexible production, 100% Wind (2020-2035)"/>	Electricity output, continuous (non-flexible)	<input type="text" value="Producing DK electricity continuously (2020-2035)"/>	Electricity output, flexible	<input type="text" value="Producing DK electricity flexible, 100% Coal (2020-2035)"/>	Heat / steam (same for input and output)	<input type="text" value="Boiler, natural gas"/>	Transport, long distance truck	<input type="text" value="Diesel (fossil)"/>	Transport, waste collection truck (short distance)	<input type="text" value="Diesel (fossil)"/>	Transport by passenger car	<input type="text" value="Petrol (fossil)"/>	Transport by freight ship	<input type="text" value="Heavy fuel oil"/>
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b. Treatment of biowaste

<p>136</p> <p>137</p> <p>138</p> <p>139</p> <p>140</p> <p>141</p> <p>142</p> <p>143</p> <p>144</p> <p>145</p> <p>146</p> <p>147</p> <p>148</p> <p>149</p> <p>150</p> <p>151</p> <p>152</p> <p>153</p> <p>154</p> <p>155</p> <p>156</p> <p>157</p> <p>158</p> <p>159</p> <p>160</p> <p>161</p> <p>162</p> <p>163</p> <p>164</p> <p>165</p> <p>166</p> <p>167</p> <p>168</p> <p>169</p> <p>170</p> <p>171</p> <p>172</p> <p>173</p>	<p>If biowaste is collected separately, then choose bio-waste management</p> <p>The results are now calculated by use of the following options:</p> <table border="0"> <tr> <td>Pre-treatment:</td> <td>Bio-waste pre-treatment: Pulping</td> </tr> <tr> <td>Biogas production:</td> <td>Monodigestion</td> </tr> <tr> <td>Biogas upgrading:</td> <td>No upgrading</td> </tr> <tr> <td>Upgraded biogas is used for:</td> <td>Natural gas grid (for heat & power production)</td> </tr> </table> <p>Select bio-waste management:</p> <table border="0"> <tr> <td>Pre-treatment:</td> <td><input type="text" value="Bio-waste pre-treatment: Pulping"/></td> </tr> <tr> <td>Biogas production:</td> <td><input type="text" value="Monodigestion"/></td> </tr> <tr> <td>Biogas upgrading:</td> <td><input type="text" value="No upgrading"/></td> </tr> <tr> <td>If biogas upgrading is selected, it is used for:</td> <td><input type="text" value="Natural gas grid (for heat & power production)"/></td> </tr> </table>	Pre-treatment:	Bio-waste pre-treatment: Pulping	Biogas production:	Monodigestion	Biogas upgrading:	No upgrading	Upgraded biogas is used for:	Natural gas grid (for heat & power production)	Pre-treatment:	<input type="text" value="Bio-waste pre-treatment: Pulping"/>	Biogas production:	<input type="text" value="Monodigestion"/>	Biogas upgrading:	<input type="text" value="No upgrading"/>	If biogas upgrading is selected, it is used for:	<input type="text" value="Natural gas grid (for heat & power production)"/>				
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Biogas upgrading:	<input type="text" value="No upgrading"/>																				
If biogas upgrading is selected, it is used for:	<input type="text" value="Natural gas grid (for heat & power production)"/>																				
<p>151</p> <p>152</p> <p>153</p> <p>154</p> <p>155</p> <p>156</p> <p>157</p> <p>158</p> <p>159</p> <p>160</p> <p>161</p> <p>162</p> <p>163</p> <p>164</p> <p>165</p> <p>166</p> <p>167</p> <p>168</p> <p>169</p> <p>170</p> <p>171</p> <p>172</p> <p>173</p>	<p>If mixed residual is send to cental sorting and enzymatic treatment</p> <p>The results are now calculated by use of the following options:</p> <table border="0"> <tr> <td>Biogas upgrading:</td> <td>No upgrading</td> </tr> <tr> <td>Upgraded biogas is used for:</td> <td>Natural gas grid (for heat & power production)</td> </tr> </table> <p>Select treatment of bioslurry:</p> <table border="0"> <tr> <td>Biogas upgrading:</td> <td><input type="text" value="No upgrading"/></td> </tr> <tr> <td>If biogas upgrading is selected, it is used for:</td> <td><input type="text" value="Natural gas grid (for heat & power production)"/></td> </tr> </table>	Biogas upgrading:	No upgrading	Upgraded biogas is used for:	Natural gas grid (for heat & power production)	Biogas upgrading:	<input type="text" value="No upgrading"/>	If biogas upgrading is selected, it is used for:	<input type="text" value="Natural gas grid (for heat & power production)"/>												
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Digestion residues are used for:	<input type="text" value="Soil improvement"/>																				

ADVANCED APPROACH

- c) It is also an option to specify your own system the next **Advanced Approach** option is to specify your own collection system

100 **Advanced approach**
 103 **Waste collection system - Specify your own collection system** You have chosen to specify your own collection system [Go to Advanced approach specifications - STEP 2](#)

Specify Type of collection

- a. Specifying you own collection system requires data on
 - i. Collection types (kerbside (mono/comingled), cube, recycling center), efficiencies (% of available fraction) and purities

39 **Select type of waste collection systems for specific streams - advanced approach**

Monostream waste flows collected at kerbside:		
Select separated streams collected:	Single-family residence	Multi-family residences
Biowaste	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Paper	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Cardboard	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Beverage Cartons	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Foil Plastics	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Hard Plastics	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Glass	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Metals	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Garden waste	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected

Monostream waste flows collected publicly (cubes etc):		
Select separated streams collected:	Single-family residence	Multi-family residences
Paper	<input type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Cardboard	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Hard Plastics	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Glass	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Metals	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected

Monostreams waste flows collected at recycling center:		
Select separated streams collected:	Single-family residence	Multi-family residences
Paper	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Cardboard	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Foil Plastic	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Hard Plastics	<input checked="" type="checkbox"/> Collected	<input type="checkbox"/> Collected
Glass	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Metals	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Garden waste	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected

Other comingled stream waste flows collected kerbside:		
Select waste flow collected:	Single-family residence	Multi-family residences
Paper	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Cardboard	<input checked="" type="checkbox"/> Collected	<input checked="" type="checkbox"/> Collected
Beverage Cartons	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Foil Plastics	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Hard Plastics	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Glass	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Metals	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected

Comingled stream waste flows collected publicly (cubes etc):		
Select waste flow collected:	Single-family residence	Multi-family residences
Paper	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Cardboard	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Hard Plastics	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Glass	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected
Metals	<input type="checkbox"/> Collected	<input type="checkbox"/> Collected

Choose treatment of mixed residual waste flows collected at kerbside:
 Select **ONLY** one treatment type

Mixed residual for	<input type="checkbox"/> Incineration
	<input type="checkbox"/> Central sorting and enzymatic treatment
	<input checked="" type="checkbox"/> Central sorting and mechanical treatment

Start User defined waste comp User defined collection system About Results Compare 2 sys Compare 3 sys Process Database Avoided product database

- d) Secondly you have to specify collection efficiency :

Type selected source separation efficiencies for modelled waste collection system

Source separation efficiencies are given as: % of available potential for system specific collection procedure of the specific waste type

Source separation efficiencies for monostreams collected waste:

	Source separation efficiencies for biowaste, collected kerbside	Source separation efficiencies for paper waste, kerbside collected	Source separation efficiencies for papercard waste, kerbside collected	Source separation efficiencies for beverage carton waste, kerbside collected	Source separation efficiencies for foil plastic waste, kerbside collected	Source separation efficiencies for hard plastic waste, kerbside collected	Source separation efficiencies for Glass waste, kerbside collected	Source separation efficiencies for Fe- & Non-ferrous metal waste, kerbside collected	Source separation efficiencies for garden waste, kerbside collected
Single-family residences, kerbside:	60.0%	99.0%	60.0%	1.0%	60.0%	60.0%	90.0%	60.0%	
Multi-family residences, kerbside:	50.0%	50.0%	50.0%	2.0%	50.0%	50.0%	80.0%	50.0%	

Source separation efficiencies for public collected waste (cubes etc):

	Source separation efficiencies for paper waste, public collected	Source separation efficiencies for papercard waste, public collected	Source separation efficiencies for hard plastic waste, public collected	Source separation efficiencies for Glass waste, public collected	Source separation efficiencies for Fe- & Non-ferrous metal waste, public collected	Source separation efficiencies for garden waste, public collected
Single-family residences,public:	60.0%	60.0%	60.0%	90.0%	60.0%	1.0%
Multi-family residences,public:	50.0%	50.0%	50.0%	80.0%	50.0%	2.0%

Source separation efficiencies for waste at recycling center:

	Source separation efficiencies for paper waste, collected at RC	Source separation efficiencies for papercard waste, collected at RC	Source separation efficiencies for foil plastic waste, collected at RC	Source separation efficiencies for hard plastic waste, collected at RC	Source separation efficiencies for Glass waste, collected at RC	Source separation efficiencies for Fe- & Non-ferrous metal waste, collected at RC	Source separation efficiencies for garden waste, collected at RC
Single-family residences, RC:	60.0%	60.0%	60.0%	60.0%	90.0%	60.0%	1.0%
Multi-family residences, RC:	10.0%	5.0%	50.0%	50.0%	5.0%	67.0%	2.0%

Source separation efficiencies for comingled kerbside collected waste:

	Source separation efficiencies for comingled paper waste, kerbside collected	Source separation efficiencies for comingled papercard waste, kerbside collected	Source separation efficiencies for comingled beverage carton waste, kerbside collected	Source separation efficiencies for comingled foil plastic waste, kerbside collected	Source separation efficiencies for comingled hard plastic waste, kerbside collected	Source separation efficiencies for comingled Glass waste, kerbside collected	Source separation efficiencies for comingled Fe- & Non-ferrous metal waste, kerbside collected
Single-family residences, kerbside:	60.0%	60.0%	1.0%	60.0%	60.0%	90.0%	60.0%
Multi-family residences, kerbside:	50.0%	50.0%	2.0%	50.0%	50.0%	80.0%	50.0%

Source separation efficiencies for comingled public collected waste (cubes etc):

	Source separation efficiencies for paper waste, comingled public collected	Source separation efficiencies for papercard waste, comingled public collected	Source separation efficiencies for hard plastic waste, comingled public collected	Source separation efficiencies for Glass waste, comingled public collected	Source separation efficiencies for Fe- & Non-ferrous metal waste, comingled public collected	Source separation efficiencies for garden waste, comingled public collected
Single-family residences,public:	60.0%	60.0%	2.0%	90.0%	60.0%	1.0%
Multi-family residences,public:	50.0%	50.0%	50.0%	80.0%	50.0%	2.0%

And finally purity of collected fractions:

Composition of collected waste

	Bio-waste, collected at kerbside	Recyclable paper, collected at kerbside	Recyclable paper, public collection (cubes etc.)	Recyclable paper, collected at recycling centre	Paper-card waste, collected kerbside	Paper-card waste, public collection (cubes etc.)	Paper-card waste = collected at recycling centre	Beverage Cartons, collected kerbside	Foil Plastic, collected kerbside	Foil Plastic, public collection	Foil plastic, collected at recycling center	Hard Plg collected k
	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Single-family												
Bio-fraction	93.0%											
Paper fraction		98.0%	98.0%	98.0%								
Paper-card fraction	2.0%				98.0%	98.0%	98.0%					
Beverage carton fraction								95.0%				
Foil plastic fraction									95.0%	95.0%	95.0%	
Hard plastic fraction	1.0%											9
Glass fraction	0.3%											
Fe-metals fraction	0.2%											
Al fraction												
Heavy metal fraction												
Mixed combustible residual domestic fraction (kerbside)	3.5%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	5.0%	5.0%	5.0%	5.0%	
Mixed combustible RC fraction												
Garden waste fraction												
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0
Multi-family												
Bio-fraction	88.0%											
Paper fraction		98.0%	98.0%	98.0%								
Paper-card fraction	2.0%				98.0%	98.0%	98.0%					
Beverage carton fraction								95.0%				
Foil plastic fraction	0.5%								95.0%	95.0%	95.0%	
Hard plastic fraction	1.0%											9
Glass fraction	0.5%											
Fe-metals fraction	0.2%											
Al fraction												
Heavy metal fraction												
Mixed combustible residual domestic fraction (kerbside)	7.8%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	5.0%	5.0%	5.0%	5.0%	
Mixed combustible RC fraction												
Garden waste fraction												
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0



RESULTS

- a) On the sheet **RESULTS** you can find a graphical presentation of the results.
- b) When all choices have been made, you can go to the sheet **START** and save the results by pressing the button **SAVE results for REFERENCE Scenario**. Then change a parameter like “collection system” and save the results by pressing **SAVE Results for Alternative 1**. Then you can compare the 2 systems when looking at the graphical presentation of the results in the sheet **COMPARE 2 SYS**.

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Comparison

In order to compare the results of various scenarios, the results have to be saved.

Step 1: Define the reference scenario
Define the amounts and composition of generated household waste above.
Select Baseline collection system and settings for this.
Save the results for the reference scenario by clicking the button below. The existing Ref

Save the results for the REFERENCE scenario

Step 2: Define the first alternative scenario
Define the first alternative scenario for the comparison. This can be either a different sort
Select settings for the scenario. Do NOT change the amounts and composition of the gen
Save the Alternative scenario no 1 by clicking the button below. The existing Alternative s

Save results for the Alternative scenario no 1

Exercise 3

The design of the different systems can be seen in the PROCES FLOW DIAGRAMS (PFD). The details of the calculations are found in the DATA sheets.

- As an example try and choose GO TO selected waste collection system via START sheet

The screenshot shows a software interface with a data table on the left and a sidebar on the right. The data table has columns L, M, N, O, P, Q, R, S, T, U. The table contains the following data:

0.8%	3.4%
0.6%	2.3%
0.2%	5.4%
0.0%	1.6%
0.7%	0.5%
0.2%	0.1%
0.9%	9.3%
0.9%	5.2%
0.0%	23.9%
100%	100%

Below the table is a dropdown menu with the text "(no separate collection of biowaste)".

The sidebar on the right contains several sections:

- User Guide - conta**: Lists various waste fractions: Foil plastic fraction, Hard plastic fraction, Glass fraction, Fe-metals fraction, Aluminium fraction, Heavy metal fraction (non-ferro), Mixed residual domestic fraction, Mixed combustible RC fraction, Garden waste fraction.
- User Guide: Sourc**: Contains a button labeled "Go to Flow Chart for selected Collection Sys" with a red arrow pointing to it.
- User Guide: Energ**: Contains text about "Average DK electricity producti" and "Electricity input = electricity co".

At the bottom left, there is a section titled "Energy Scenario marginals:" with three dropdown menus, each set to "Average DK electricity production (2013-2020)".

Green buttons leads to **Data sheet, calculations for the specific waste flow**

Blue buttons leads to a **PFD** for the specific waste flow.

The screenshot shows a software interface with a waste flow diagram on the left and a table of waste types on the right. The diagram includes boxes for 'Cubicle collection of Recyclable paper waste', 'Kerbside collection of Paper', and 'Recycling Centres', all pointing to a central 'Transfer station (sorting, quality check, baling)'. From the transfer station, arrows point to various waste types, each with a corresponding 'PFD' (blue) and 'Data' (green) button. A 'Return to Start' button is located at the top right. Red arrows from external text point to the 'PFD' and 'Data' buttons for 'Recyclable Paper waste'.

Waste Type	Quantity (t)	PFD Button	Data Button
Recyclable Paper waste	172863.6	Blue	Green
Paper-Card waste	11731.0	Blue	Green
Sorting residues (from transfer station)	1364.4	Blue	Green
Fe-S.Non-Ferrous metals waste	49915	Blue	Green
Mixed combustible waste (FC)	197642.0	Blue	Green

Try to press some of the buttons yourself 😊

DRAFT