# Documentation

## LCA data generation for the Duni carbon calculator

### - Updating with Evolin material and 2010 production data

for
Duni AB

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

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# 1 Introduction

The present report describes the carbon footprint results of work agreed between Duni and PE INTERNATIONAL.

The analyses are performed on LCA models originally developed by IVL. In a previous project (PE 2011), this model was adjusted to fit the carbon footprint reporting.

In the current project, the model is expanded and adjusted with the following

- Adding the Evolin table cover product including changing the material composition and the EoL treatment.
- Changing the production electricity for the German production site to hydropower.
- Adding an additional production site in the life cycle, Skåpafors TLM1.
- Updating production data to the year 2010 for the existing production sites; Skåpafors Tissue Paper, Skåpafors Dals-Langed and Bramsche.

The results of the assessment with the adjusted model is read out and provided as:

- Data in Microsoft Excel to be used by Duni for carbon footprint reporting.
- Graphical representation of the main impacts in the current report.

## 2 Goal and scope

The modelling is building on top of LCA models and databases used in two previous projects by IVL (IVL 2010; IVL 2011).

A detailed discussion of the goal and scope of the present project is not carried out; for this, please refer to the original reports, whereof the first one is critically reviewed.

A few parameters have to be mentioned:

- This report has not been critically reviewed by a panel of interested parties, which is standard according to ISO 2006 when comparative assertion are made to the public regarding the relative environmental performance of the different product systems.
- Only the global warming category of the results is included in the present project. The previous reports contain several others. The results are calculated according to the International EPD system (SEMCO 2008) which excludes uptake and emission of biogenic CO2.

# 3 Work done prior to present project

## 3.1 LCA models from IVL reworked

Two GaBi databases were received from Duni containing the models developed by IVL; one database containing table cover models and one database containing napkin models. A total of four product models were imported into one database, these being:

- Dunicel Napkin
- Dunilin Napkin
- Duni Tissue Napkin
- Dunicel Table Cover

Somme issues to be updated were identified in the models.

The cardboard and plastic film packaging materials were not included in the distribution stage in the model developed by IVL. This was corrected in the rework of the model.

Other issues that were noted but not corrected were:

- The process crediting the recycling of cardboard lacked an input of wood chips and other materials.
- Input of chemicals to the primary production process were missing

The LCA models developed by IVL had a structure similar to the Dunicel model seen in Figure 1, i.e. all life cycle stages and processes were shown together in a single plan.

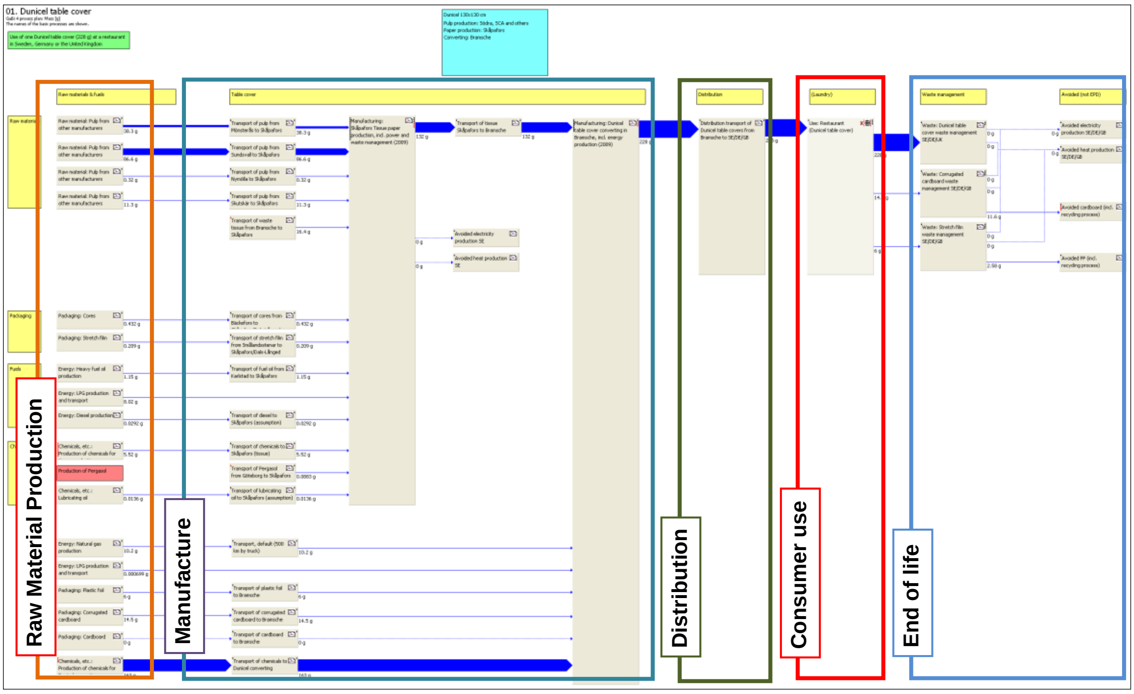


**Figure 1: IVL overall model, exemplified by Dunicel Table Cover model (the breakdown into life cycle stages is shown by the coloured boxes)**

The carbon footprint is recorded in four life cycle stages; Production, Distribution, Use, and End-of-Life (EoL). To match this reporting the model was transformed into four steps with the result seen in Figure 2. The plans and processes from Figure 1 were hence transferred into the appropriate life cycle stage.

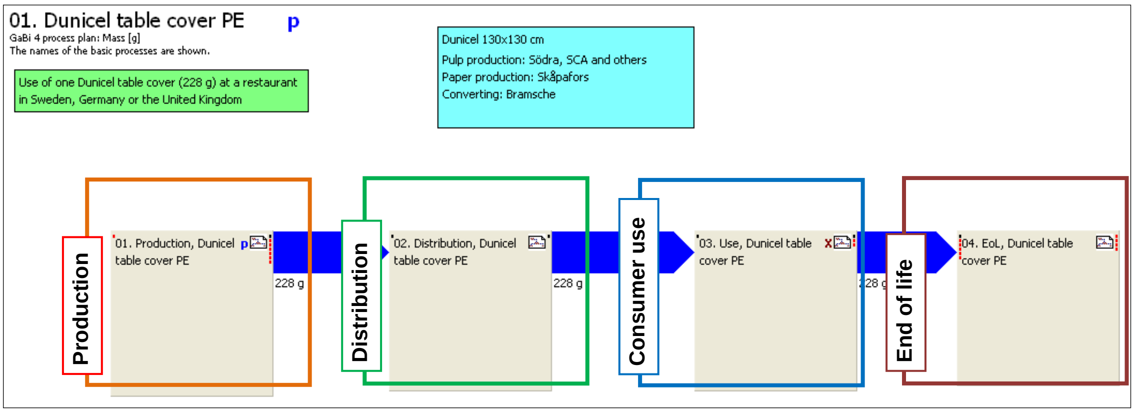


**Figure 2:** **IVL model reworked by PE (GABI 2006)**

## 3.2 Scenario analyses

Two scenario analyses were performed on the four products; one with the power grid mix in the production stage as the variable parameter and one with the waste treatment as the variable parameter.

The scenario analyses are parallel to the ones presented in chapter 4.4 and further in Supplement A.

## 3.3 Results

The two main scenario analyses regarding change in energy scenario and waste treatment were repeated three times; once for each of the markets Germany (DE), Sweden (SE) and UK.

The results were presented in an Excel file with data tables parallel to Table 3, with four products and three markets this equals a total of 12 data tables.

The results were calculated with the methodology CML2001 version November 2009 which includes biogenic CO2 uptake and emission.

# 4 Updated in current report

## 4.1 Adding new product and an additional production site (TLM1)

The extra product, Evolin table cover, is added to the products evaluated by the current project. Consequently, an extra production site is included in the assessments. The relation between products and production sites is depicted in Table 1.

**Table 1: Relation between products and production sites**

| | Skåpafors, Tissue paper, Sweden | Skåpafors, Dals-Langed, Sweden | Skåpafors, TLM 1, Sweden | Bramsche, Germany |
|---|---|---|---|---|
| Dunicel Table Cover | X | | | X |
| Evolin Table Cover | X | | X | X |
| Duni Tissue Napkin | X | | | X |
| Dunicel Napkin | X | | | X |
| Dunilin Napkin | | X | | X |

## 4.2 Production site update to 2010 production data

All production sites included in the previous assessments performed by PE and IVL are updated to production data from 2010. For the Evolint table cover data for 2010 are used already and no update is needed.

The major part of the update is adjusting the value of existing figures to the year 2010 without changing the sources or the substances:

- Input of raw materials
- Consumption of heat, electricity and water
- Input of process chemicals and other auxiliaries
- Direct process emission to air and water
- Generation of waste products

These updates vary only within a few percentages from year to year and will not change the resulting carbon footprint to any large extent.

The exception is the production site in Bramsche, Germany, where the electricity input is changed to electricity from hydropower instead of average German electricity grid mix. This has a significant impact on the carbon footprint from the production site, and hence for the products.

The other life cycle stages; distribution, use and end-of-life; are not updated.

## 4.3 Impact categories

The result is intended for use as a carbon calculator and hence only the global warming potential is included as result. To stay as closely in line with the critically review reports from IVL the same evaluation method is used (SEMCo 2008) which excludes biogenic CO2 both as input and output.

## 4.4 Scenario analyses

The scenario analyses indicated in chapter 3.2 are updated in this report. The scenarios analysed are outlined in Table 2 and described more in detail in Supplement A. The results are delivered graphically in Supplement A and in table format in a separate Excel sheet.

**Table 2: Scenario names for scenario analyses graphs**

| Scenario analyses | Scenarios |
|---|---|
| Reference | Reference energy and waste treatment |
| Energy scenario | Swedish electricity<br>German average electricity<br>EU electricity |
| Waste treatment scenario | Recycling<br>Incineration with energy recovery<br>Incineration with no energy recovery<br>Landfill<br>Compost |

# 5 Results and discussion

The results are repeated three times; once for each of the markets Germany (DE), Sweden (SE) and UK (UK). The results are presented graphically in this report and delivered in a separate Excel file with a table format as Table 3.

All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

**Table 3: Example results table for five napkins for the German market.**

| Germany | Production | Distribution | Use | EOL | Total |
|---|---|---|---|---|---|
| Duni tissue napkin | 7.3 | 0.3 | 0.0 | -3.7 | 3.9 |
| Dunilin napkin | 21.9 | 0.6 | 0.0 | -3.0 | 19.5 |
| Dunicel napkin | 23.9 | 0.8 | 0.0 | -2.2 | 22.5 |
| Cotton napkin | 16.3 | 0.1 | 30.7 | -0.7 | 46.4 |
| Linen napkin | 8.4 | 0.1 | 33.8 | -0.8 | 41.6 |

The graphical presentation is in the following chapter presented per market. The results in Table 3 above are equivalent to Figure 3.

## 5.1 German market

Figure 3 and Figure 4 below show the carbon footprint for the napkin and table cover products respectively for the German market in the reference scenario. The cotton and linen napkins and the cotton table cover are also included from the previous projects (IVL 2010, IVL 2011). All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

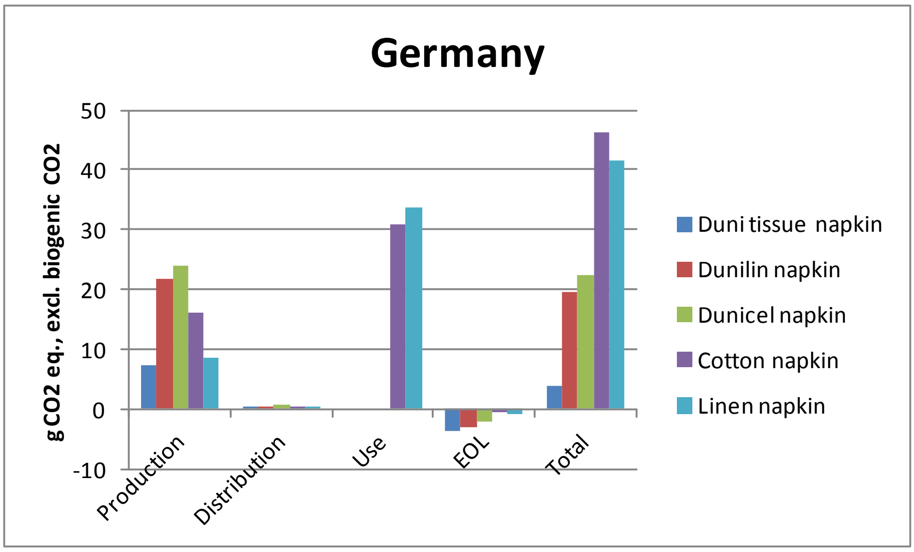


**Figure 3: German market; napkin products in reference scenario**

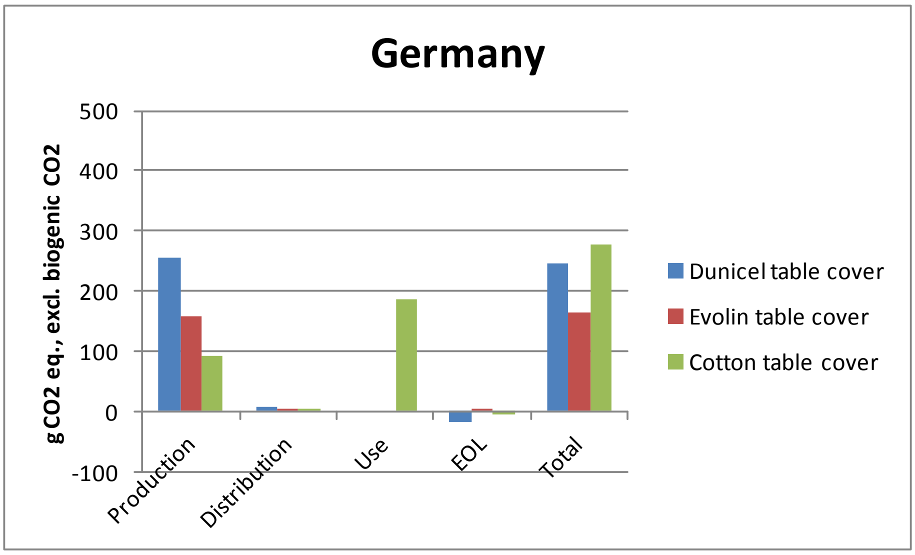


**Figure 4: German market; table cover products in reference scenario**

From Figure 3 and Figure 4 it is evident that the materials Duni tissue and linen represent the lowest carbon footprint from production, however, only available as napkin material. The impacts are followed by cotton at a mid-level and Dunilin and Dunicel as the highest. The Evolin table cover product is in-between cotton and Dunicel.

The distribution is insignificant for all products.

For the single-use products (all products except cotton and linen) the use stage is not connected with a carbon footprint, but the cotton and linen have a significant footprint related to laundry activities and the related transport to and from this.

The End-of-Life (EoL) of the products has a slightly negative footprint from crediting of heat and power due to incineration with energy recovery.

For the napkins the highest total carbon footprint comes from cotton and linen, mainly due to the use stage. The Dunilin and Dunicel napkins have a similar footprint and the Duni tissue napkin by far the lowest.

For the table covers cotton still has the largest footprint but the difference is far less significant as the cotton table cover is used on average 1.5 times before washing. The footprint from the Dunicel table cover is therefore only slightly lower. The Evolin table cover has the lowest footprint.

## 5.2 Swedish market

Figure 5 and Figure 6 below show the carbon footprint for the napkin and table cover products respectively for the Swedish market in the reference scenario. The cotton and linen napkins and the cotton table cover are also included from the previous projects (IVL 2010, IVL 2011). All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

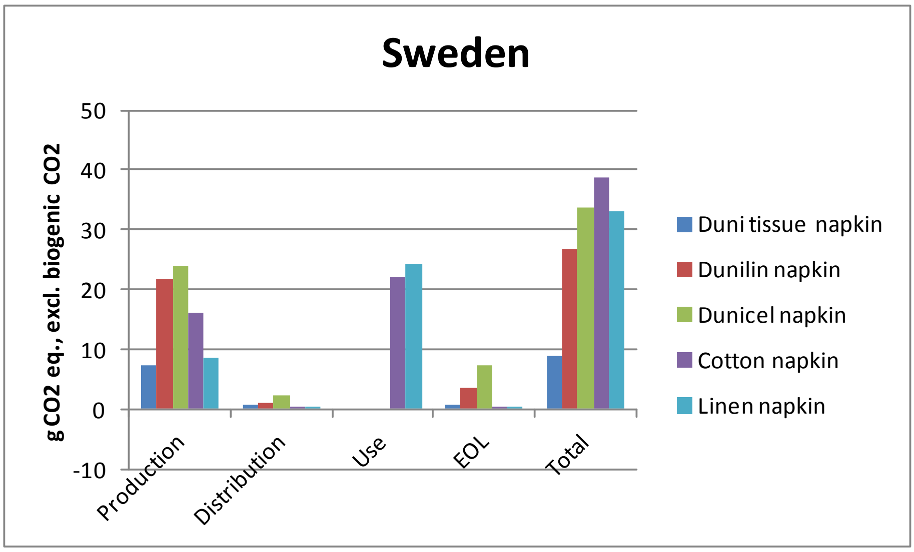


**Figure 5:** **Swedish market; napkin products in reference scenario**

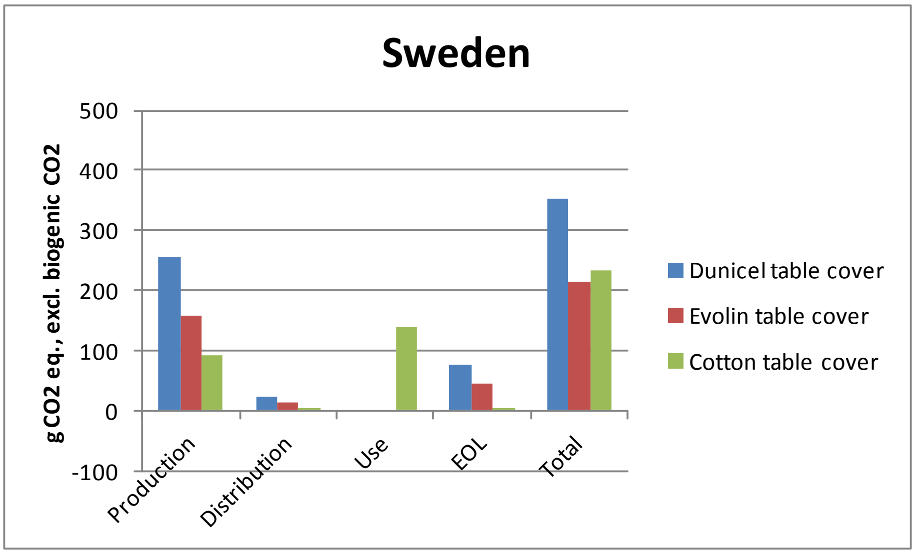


**Figure 6:** **Swedish market; table cover products in reference scenario**

The results from the Swedish market are similar to the German market. The production footprint does not differ as the production remains the same.

The use stages of the cotton and linen products are connected to a lower footprint as the electricity use for the laundry facilities are attached to an electricity grid mix containing a larger share of hydropower and nuclear energy which has a low carbon footprint.

The EoL of the products have no footprint credit due to the nuclear and hydropower that is credited. The footprint from the EoL hence becomes positive.

The lower use stage footprint from the reusable napkins leads to that the footprint is only slightly higher than the Dunilin and Dunicel napkins which are almost identical. The Duni tissue is still with to the lowest carbon footprint.

Similarly, the cotton table cover now has a lower carbon footprint than the Dunicel table cover, and is almost identical to that of the Evolin table cover.

## 5.3 UK market

Figure 7 and Figure 8 below show the carbon footprint for the napkin and table cover products respectively for the UK market in the reference scenario. The cotton and linen napkins and the cotton table cover are also included from the previous projects (IVL 2010, IVL 2011). All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

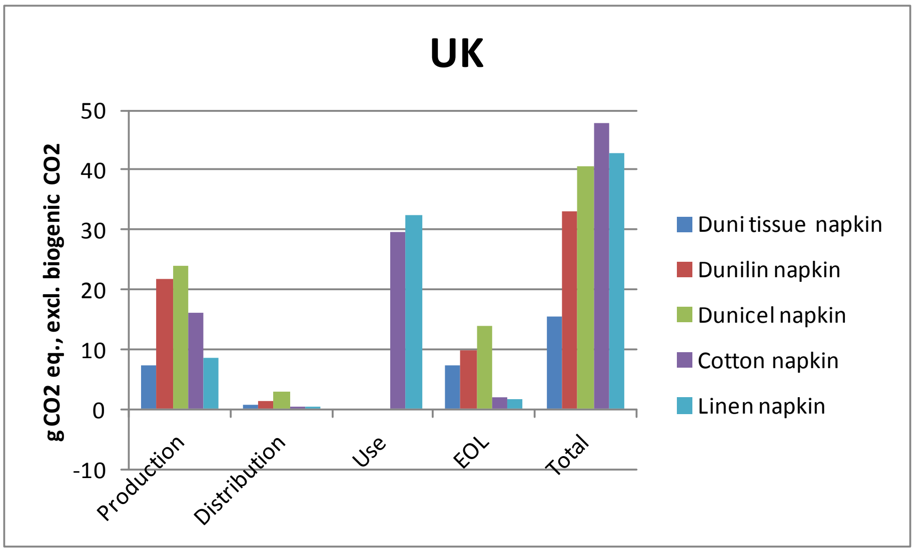


**Figure 7: UK market; napkin products in reference scenario**

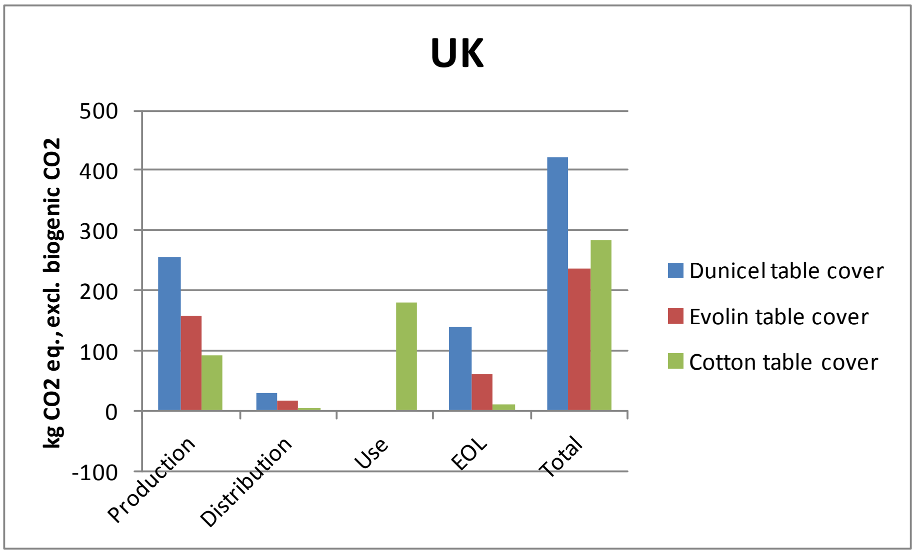


**Figure 8: UK market; table cover products in reference scenario**

The carbon footprint is identical to that of the German and Swedish market as the production locations do not change. The distribution also remains negligible.

The use stage for the reusable products is still important due to laundry and transport.

The disposal scenario in the UK is dominated by landfilling and the single use products hence have a high carbon footprint due to methane emissions generated in the landfill. For the napkins the difference among the four products with the highest footprint (all except Duni tissue) is not significant.

# 6 Literature


FEFCO, 2009 — European Federation of Corrugated Board Manufacturers: 2009 European Database for Corrugated Board Life Cycle Studies.

GaBi 2006 — GaBi 4: Software and Databases for Life-Cycle-Assessment and Life-Cycle-Engineering, LBP University of Stuttgart and PE International GmbH, Leinfelden-Echterdingen, 2006.

ISO 2006 — Environmental management – Life cycle assessment – Requirements and guidelines (ISO 14044:2006). European Committee for Standardization, Brussels, Belgium.

IVL 2010 — Kristian Jelse & Jenny Westerdahl (2010). Life cycle assessment of single-use and reusable dinner napkins on the professional market. Archivenumber: U2923. IVL Swedish Environmental Research Institute

IVL 2011 — Kristian Jelse & Jenny Westerdahl (2011). Life cycle assessment of Dunicel table cover and alternative products. Archivenumber: U3355. IVL Swedish Environmental Research Institute

PE 2011 — Fabian Hassel and Morten Kokborg. LCA data generation for the Duni carbon calculator. PE International Ag

SEMCo 2008 — General Programme Instructions for environmental product declarations, EPD and supporting annexes. Version 1.0 dated 2008-02-29. Swedish Environmental Management Council (Miljöstyrningsrådet). Available at www.environdec.com.

# Supplement A Scenario analyses

Two scenario analyses are performed in the present report

- Variation in the power grid mix during the production phase
- Variation in the waste treatment

## Supplement A 1 Power grid mix in production

The first scenario analysis is performed on the four products with the power grid mix in the production stage as the variable parameter. The input from the power grid is varied at the four production locations Skåpafors tissue, Skåpafors Dals-Langed, Skåpafors TLM1 all in Sweden, and Bramsche in Germany.

Three variables 'Power_sel_Skap', 'Power_sel_TLM1' and 'Power_sel_Bram' have been created to allow selection between power grid inputs with the values in Table 4.

**Table 4: Values of the Power_sel variables**

| Power_sel value | Power grid input |
|---|---|
| 1 | Sweden (SE) |
| 2 | Germany average (DE) |
| 3 | Europe (EU-27) |
| 4 | German hydropower |

The three parameters are adjusted as plan parameters in the top level of the plan (Figure 2) and transferred into the sublevels. Hence changing the value at a lower level will have no effect as this will be overridden by the top level plan parameter.

A parameter analyses has been performed with the settings in Table 5 below. The column 'Excel name' describes the name of the scenario in the separate Excel file.

**Table 5: Energy scenarios**

| Scenario | Excel name | Power_sel value | | | |
|---|---|---|---|---|---|
| | | Skåpafors tissue | Skåpafors TLM1 | Skåpafors Dals-Langed | Bramsche |
| Reference | Reference | 1 | 1 | 1 | 4 |
| Swedish Energy | Energy.01.Sweden | 1 | 1 | 1 | 1 |
| German Energy | Energy.02.Germany | 2 | 2 | 2 | 2 |
| EU energy | Energy.03.EU27 | 3 | 3 | 3 | 3 |

The scenario analysis is repeated three times; one for each of the markets Germany (DE), Sweden (SE) and UK (UK).

## Supplement A 2 Waste scenario at end of life (EoL)

The scenario analysis with the waste treatment of the table cover and napkins as the variable parameter as seen in Figure 9 with the example of the Dunicel table cover. Only the table cover and the napkins entered into the scenario analyses; the waste treatment of the packaging materials remained unchanged.

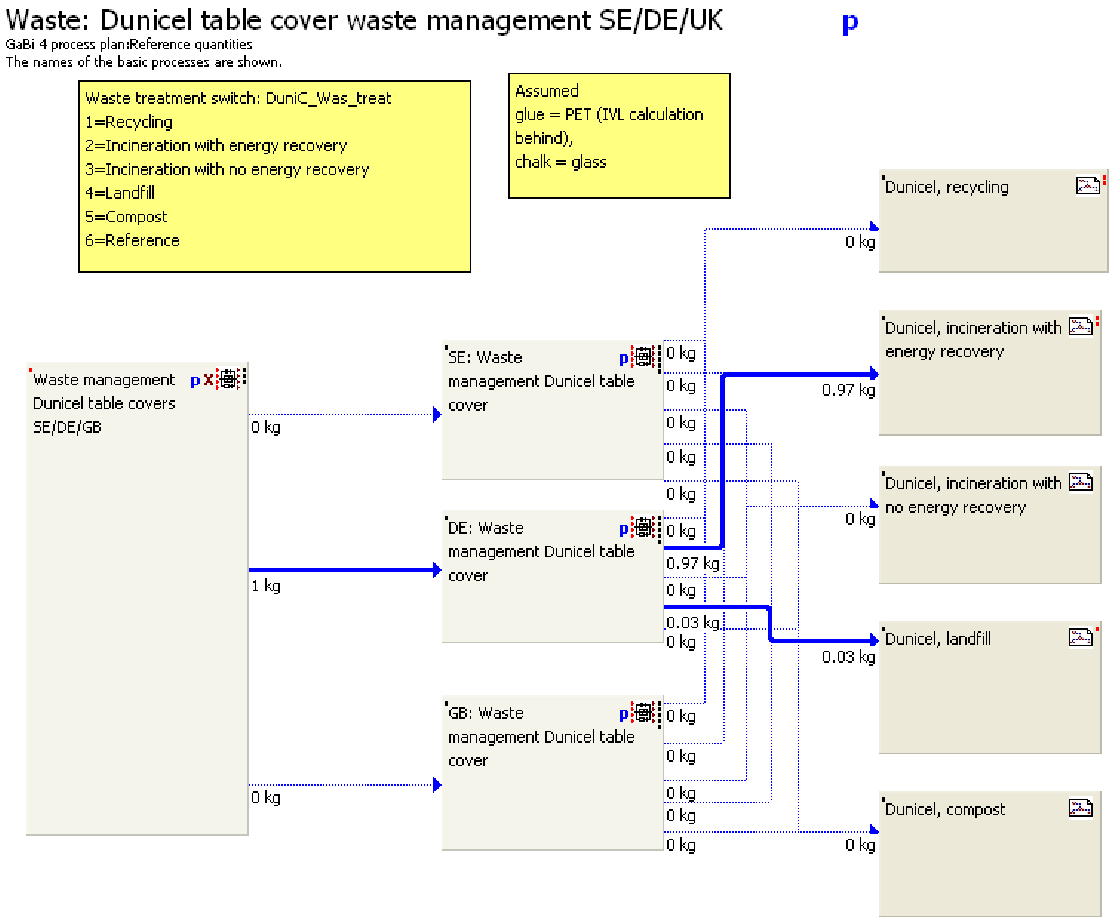


**Figure 9: The end of life (EOL) model using the Dunicel Table Cover as example (GaBi 2006)**

The variable 'DuniC_Was_Treat' was created to adjust the waste treatment scenario at the top level plan (Figure 2). The value settings are shown in Table. The reference scenario represented a combination of scenarios 2 and 4 as seen in Figure 9 equivalent to the waste treatment in the original IVL model (i.e. 93% to incineration with energy recovery and 3% to landfill).

For the calculation of the EoL Scenarios of the napkin and the table cover, only the EoL of the tissue is varied. The EoL treatment of the packaging materials remains the same as in the reference scenario settings.

The column 'Excel name' in Table 6 describes the name of the scenario in the separate Excel file.

**Table 6: Waste treatment scenarios**

| Value | Scenario | Excel name |
|---|---|---|
| 6 | Reference | Reference |
| 1 | Recycling | Waste.01.Recycling |
| 2 | Incineration with energy recovery | Waste.02.Incin.WE |
| 3 | Incineration with no energy recovery | Waste.03.Incin.WOE |
| 4 | Landfill | Waste.04.Landfill |
| 5 | Compost | Waste.05.Compost |

There are some specific comments attached to each of the waste treatment scenarios:

- **Reference Scenario (value = 6):**

The reference scenario is equivalent to the original model developed by IVL and consists of a combination of incineration with energy recovery and landfill reflecting the average current praxis.

- **Recycling Scenario (value = 1):**

The tissue in each of the napkin and table cover products is assumed to be recycled into a paper product modelled based on the testliner production process from FEFCO (FEFCO, 2009) and an avoided product is credited as the kraftliner production process from FEFCO (FEFCO, 2009).

The glue and chalk part of the products are assumed to be waste from the paper recovery process and treated as incineration with energy recovery.

For the EoL of the packaging materials, please see the settings of the reference scenario.

- **Incineration Scenario (value = 2 or 3):**

The products are assumed to be incinerated in their entirety. This is modelled as three separate incineration processes; one for each of the materials tissue, glue and chalk. This is done to simulate the effect of the single materials in an incineration facility, including the quantity of recoverable heat and power.

The two incineration scenarios with and without energy recovery are identical except that the output of heat and power is not credited in the modelling for the scenario without energy recovery.

For the EoL of the packaging materials, please see the settings of the reference scenario.

- **Landfill Scenario (value = 4):**

The products are assumed landfilled in their entity but are modelled as three separate landfill processes; one for each of the materials tissue, glue and chalk. This is done to simulate the effect of the single materials in a landfill, including the quantity of recoverable heat after flaring of landfill gas.

For the EoL of the packaging materials, please see the settings of the reference scenario.

- **Composting Scenario (value = 5):**

The napkin and table cover products cannot be disassembled before entering a composting process. The glue and chalk will not degrade in an actual composting process but the weight of the material will still lead to a consumption of diesel for the machinery for shredding, turning and mixing, and sieving of the compost. Therefore the two materials are included in the compost model. This will lead to a slight overestimation of the emissions related to degradation of organic material but this is assumed to be of negligible importance.

For the EoL of the packaging materials, please see the settings of the reference scenario.

## Supplement A 3 Scenario analyses results

The graphs following present the results from each product with the scenario variations described above both the production energy and the EoL variations. The names are shortened as described in Table 7 below.

**Table 7: Scenario names for scenario analyses graphs**

| Scenario | Excel name | Short name |
|---|---|---|
| Reference | Reference | |
| Swedish electricity | Energy.01.Sweden | E1.SE |
| German average electricity | Energy.02.Germany | E2.DE |
| EU electricity | Energy.03.EU27 | E3.EU27 |
| Recycling | Waste.01.Recycling | W1.Rec |
| Incineration with energy recovery | Waste.02.Incin.WE | W2.I.WE |
| Incineration with no energy recovery | Waste.03.Incin.WOE | W3.I.WOE |
| Landfill | Waste.04.Landfill | W4.LF |
| Compost | Waste.05.Compost | W5.Com |

## German market

Figure 10 below show the five Duni products for the German market with the scenario analyses described in Table 7. All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

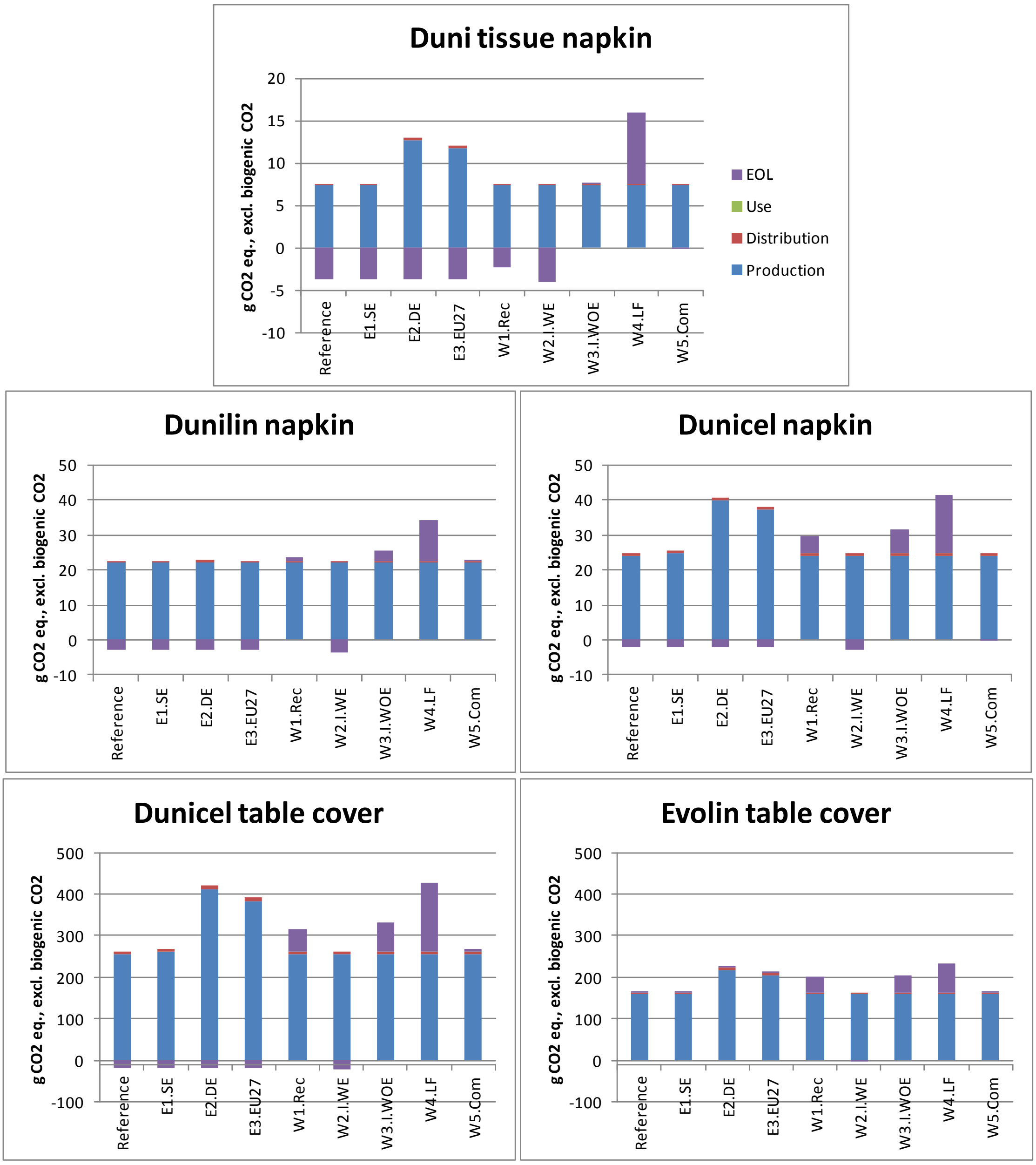


**Figure 10: German market, scenario analyses, results per product use**

## Swedish market

Figure 11 below show the five Duni products for the German market with the scenario analyses described in Table 7. All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

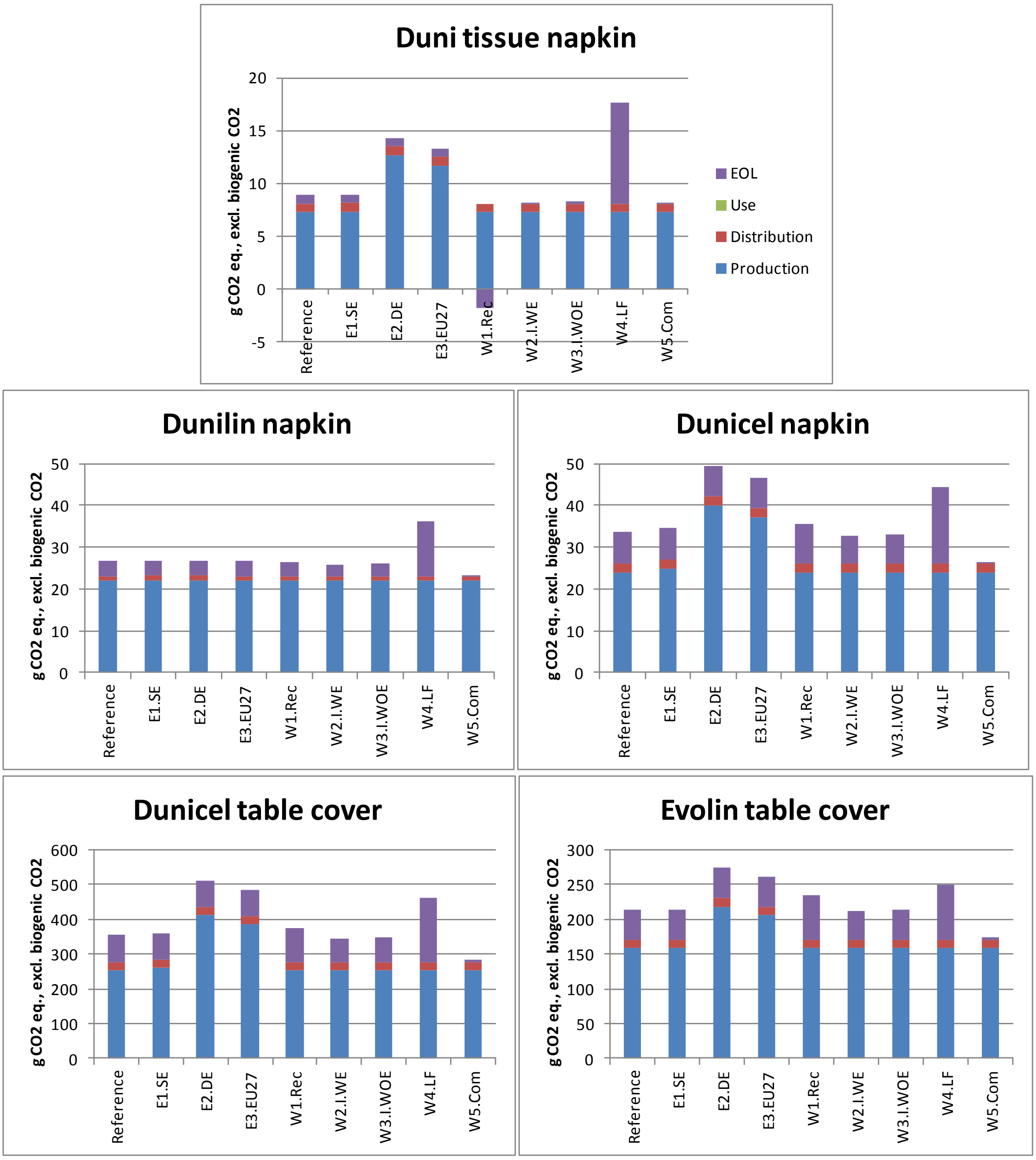


**Figure 11:** **Swedish market, scenario analyses, results per product use**

## UK market

Figure 12 below show the five Duni products for the German market with the scenario analyses described in Table 7. All results are in g CO2 equivalents per product use (napkin and table cover) excluding uptake and emission of biogenic CO2.

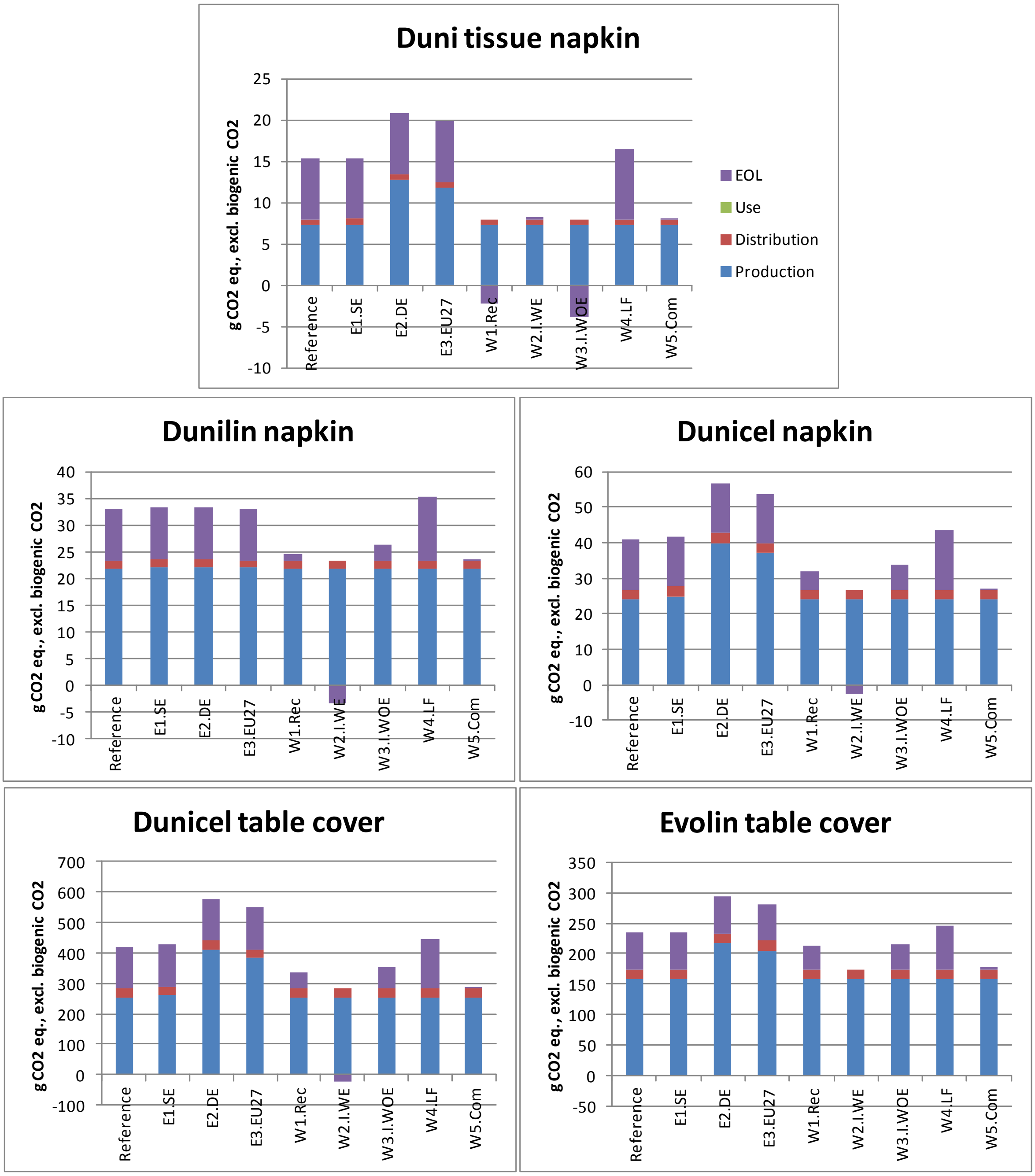


**Figure 12:** **UK market, scenario analyses, results per product use**