Reportage

Chain analysis Tomatoes on the vine Van Adrichem at location: Sublimato

As this document is translated from Dutch to English it could contain some Dutch data

Colophon Reportage

Research data

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CONTENT

SUMMARY

This reportage gives a calculation of the environmental impact due to the production of 1 kg Sublimato tomatoes on the vine at Van Adrichem Kwekerijen in Westdorpe. This Nursery is linked to the nearby fertilizer factory Yara. Via this method the needed CO_2 is directly delivered to Van Adrichem. At conventional tomatoes on the vine nurseries the CO_2 and warmth is raised with help of cogeneration installations.

The LCA calculation in this reportage gives understanding of the environmental effect due to the production of 1 kg tomatoes on the vine. This environmental effect is related to the different process phases during the production process:

- Production materials.
- Transport.
- Production phase tomatoes on the vine;

Also there has been done a calculation which tells what the avoided environmental impact are if this location would have used a conventional cogeneration installation.

The most important emission source during the production of Sublimato tomatoes on the vine are (percentage specified by CO_2 emission);

- Production fertilizers 32%
- Production CO_2 and warmth 29%
- Production electricity 37%

The emission of these sources contains 98% of the total.

Environmental impact

In the table and graph below there is an overview shown of the environmental impact due to the production of 1 kg Sublimato tomatoes on the vine.

Process phase	CO_2 emissions		Shadow costs		Energy	
	kg CO_2	%	euro	%	MJ	%
Production materials	0,065	37%	0,0092	55,33%	1,27	40%
Transport	0,0011	0,6%	0,00011	0,680%	0,016	0,5%
Production tomatoes on the vine	0,11	62%	0,01	44%	1,92	60%
Total	**0,17**	**100%**	**0,02**	**100%**	**3,20**	**100%**

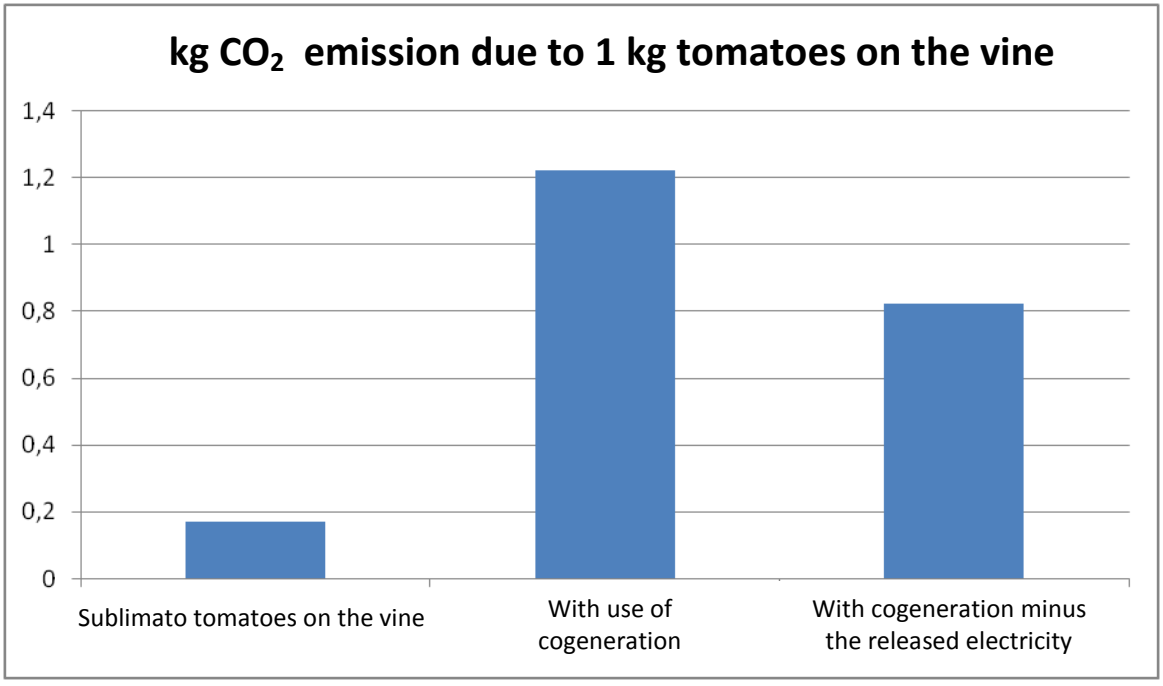
Avoided environmental impact

The following table provides an indication of the avoided environmental impact (CO2, shadow costs and energy) as a result of the Van Adrichem of coupling to the fertilizer plant Yara in comparison to the use of a conventional combined heat and power installation. This information is based on the expected natural gas consumption if a conventional cogeneration installation would have been applied.

This shows that the overall environmental impact of the production of the Sublimato tomatoes on the vine (CO2) only contains 14% compared with the production of the use of a cogeneration. If the sold electricity produced by a cogeneration is deducted, the total emission is 20% compared to a conventional cogeneration installation.

		Sublimato tomatoes on the vine			**Without use of cogeneration installation (without avoided emission by released electricity)**			**With use of cogeneration installation (with avoided emission by released electricity)**		
		Kg CO_2	Shadow-costs (euro)	Energy (MJ)	Kg CO_2	Shadow-costs (euro)	Energy (MJ)	Kg CO_2	Shadow-costs (euro)	energy (MJ)
Total		**0,17**	**0,02**	**3,20**	**1,22**	**0,09**	**22,6**	**0,823**	**0,0645**	**15,3**
difference relative to: *cogeneration or **Sublimato	Percentage (%)	14%*	18%	14%	703% **	541%	706%	474% **	388%	478%
	Absolute per kg tomatoes on the vine	-1,05	-0,07	-19,40	1,05	0,07	19,40	0,65	0,05	12,10
	Absolute per year	-1,40E+07	-9,82E+05	-2,60E+08	7,00E+05	4,91E+04	1,30E+07	4,34E+05	3,20E+04	8,10E+06

In the diagram below there is a representation of the emission (kg CO2) as a result of the production of 1 kg of tomatoes (Sublimato, with cogeneration and with cogeneration minus electricity released).



CONCLUSION AND RECOMMENDATIONS

The production of Sublimato tomatoes on the vine has a much lower environmental impact than the production of tomatoes by the conventional method (14% CO2). Also, if taking into account that a large portion of the electricity that is generated by the conventional method will be released to the grid (which yields a positive environmental effect) is the environmental impact of the Sublimato tomatoes on the vine much lower (20% CO2).

The environmental impact of the production of Sublimato tomatoes on the vine is almost entirely attributable to three factors:

- Production van fertilizers;
- Use of CO_2 and warmth;
- Use of electricity.

If Van Adrichem wants to gain more sustainability it is recommended to focus on these three components. The following actions will be effective:

- Targeted research into the use of fertilizers and identify which possible alternative fertilizers will cause a lower environmental impact;
- The environmental impact through the use of CO2 and warmth will go down if the supplier ensures that the transport of CO2 and warmth either takes less energy, or that this transport is powered by sustainably generated electricity. The supplier WarmCO2 has indicated that it is expected that the transport of CO2 and warmth in the coming years will become ever more efficient and thus will require less energy. This increases the advantage for Van Adrichem with this construction even more;
- If Van Adrichem will choose sustainably generated electricity the overall environmental impact of the production of the Sublimato tomatoes will go down significantly.

1. INTRODUTION

1.1. General

In 2014 Van Adrichem Kwekerijen has opened a new location in Westdorpe, Zeeland. This location is linked to the nearby fertilizer factory Yara so the heat and CO_2 released during the production of fertilizer is used for the production of the tomatoes on the vine from Van Adrichem Kwekerijen. Before Yara sold CO_2 and warmth to third parties these products were seen as by-products in the production of fertilizers.

This chain analysis has been prepared to gain understanding of the environmental impact of producing coarse tomatoes on the vine at this new location, 'Sublimato'.

The client wants to know the difference in environmental impact is as a result of this new way of producing compared to the conventional method.

1.2. Task formulation

The task is to establish an LCA in accordance with the current guidelines of producing tomatoes on the vine at the location of the client in Westdorpe. The outcome of this makes clear what the purpose of the link with the Yara fertilizer factory yields for the environment, both absolutely and relatively compared to the overall environmental impact of the production of 1 kg tomatoes on the vine.

1.3. Purpose of the research

This study provides insight into the environmental emission due to the production of coarse tomatoes on the vine.

This should be demonstrate that the environmental emissions due to the production of tomatoes on the vine at the new location in Westdorpe turns out to be more favourable or less favourable compared to the conventional way of producing tomatoes on the vine.

The research also provides insight into the environmental emission focal points in the supply chain and provides insight to make further improvement.

1.4. Principles

The LCA has been prepared in accordance with the following guidelines:

- ISO 14040;
- ISO 14044;
- Product Category Rules (PCR) 012-vegetables (17-7-2013).

Unlike the requirements of the PCR-012 packaging materials are not included in the LCA. The infrastructure (greenhouse, etc.) is also not included in the calculation, this is consistent with the PCR-012.

For the making of this LCA the following sources were used:

Provided by Client:

- Document name: Overview purchased materials

General sources

- EcoInvent Database V.3.0
- National Milieu database version 1.5

1.5. Unit of production

The examined product unit: 1 kg type coarse Sublimato tomatoes on the vine.

It is about the 'cradle-to-gate' emission from the production phase, transport phase and production phase of the tomatoes on the vine.

1.6. Project delimitation

For the LCA calculation the principle one calendar year (2013) is used. Because the location of Van Adrichem Kwekerijen in Westdorpe has only been operational since January 2014 there is chosen to determine the materials used, the quantities used at the location of Van Adrichem in De Lier (2013). The surface of De Lier (4.9 Ha) differs from Westdorpe (8,9 ha). Therefore, those values that are based on the production of De Lier are converted directly proportional to the surface of Westdorpe.

Both production sites do not cultivate other products.

The values of the energy and water consumption are based on the used quantities of the location Westdorpe for the first half of 2013 and doubled.

System boundary

With the exception of the packaging materials and processes, the system boundary is followed as prescribed in the PCR 012-vegetables.

The following processes are included in the analysis:

Production phase

The production process of the following materials is included in the calculation:

- Fertilizers;
- Chemical crop protection;
- Plants;
- CO_2 and warmth;
- Other supplies (Foil, rock wool, tomato hooks);

Transport

For all materials which are included within the production phase also the return transport from the supplier to Van Adrichem is included.

For all transport distances applies:

- It is about the journey from the producer to the location in Westdorpe;
- With changing suppliers fixed values from the National Environmental Database are maintained;

Production phase

Within the production phase, the following processes are included:

- Electricity consumption production location;
- Energy consumption by intern (transport) processes;
- Water intake;
- Emissions due to the use of fertilizers, pesticides etc.;
- Waste processing.

This environmental emissions arising as a result of the above-mentioned processes are related to the amount sold tomatoes on the vine (kg).

1.7. Structure of reporting

This report is structured as follows:

- Unit 2: the examined product and process phase;
- Unit 3: the values used for each process phase;
- Unit 4: results.

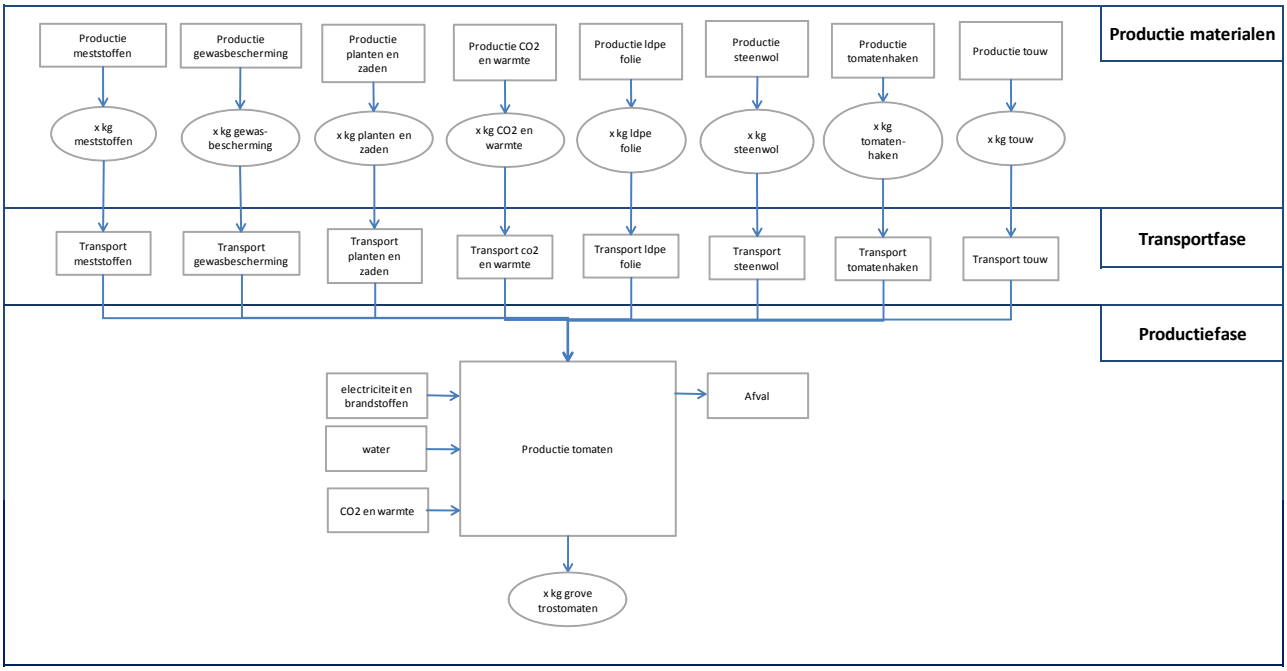
3. PRODUCT- AND PROCESS DESCRIPTION

For this chain analysis the production of Sublimato coarse tomatoes on the vine has been examined. These tomatoes on the vine are produced in the greenhouses of Van Adrichem Kwekerijen and are intended for the international market.

This chapter describes the process. In the next chapter is a detailed description of the output quantities.

3.1. Process-tree

In Figure 2, the process-tree is displayed.



4. LIFE CYCLE INVENTORY (LCI)

Because the nursery of Van Adrichem Westdorpe hasn't been a year operational, there is chosen to use a number of values based on the quantities consumed in the nursery of Van Adrichem in De Lier for the year 2013. For materials and processes of which the use in Westdorpe for 2014 is known, the values of Westdorpe are applied.

With each description there is briefly indicated where the data is based on. In order to keep the overview readable, the quantities are related to 1 tonne of tomatoes. The LCA calculation was prepared for 1 kg of tomatoes.

4.1. Production materials

In this section an overview is given of the various materials that are used in the production of the tomatoes on the vine. These data are related to a reference value from the EcoInvent database, National environmental database or other database. With these reference values is determined the environmental impact of the production of the material involved.

4.1.1. Production fertilizers

Principle: consumption location De Lier 2013
Source: data provided by Van Adrichem

The amount of fertilizer is based on the annual consumption in 2013 at the nursery Van Adrichem in De Lier. These consumption quantities were then related to the surface of Westdorpe. Consumption volumes are converted to weight (where necessary). Finally, an exchange is made to the consumption quantities per tonne of tomatoes.

Subsequently, on the basis of specifications of the supplier the concentration of active substance is determined. This is then coupled to a reference value from the EcoInvent Database.

The outcomes can be found in the table below.

Producten	Verbruik per jaar	Eenheid	Soortelijk gewicht (kg/eenheid)*	Totale verbruik per jaar (kg)	Concentratie werkzame stof (%)*	Hoeveelheid werkzame stof per jaar (kg)	Hoeveelheid werkzame stof per ton tomaten (kg)	Referentie in EcoInvent database
Ammoniumnitraat 18%	3.761	Liter	1,24	4.664	18%	840	0,13	Ammonium nitrate, as N, at regional storehouse/RER U
Bitterzout (vast)	18.000	kg	1	18.000	100%	18.000	2,69	Magnesium sulphate, at plant/RER S
Borax (decahydraat)	94	kg	1	94	100%	94	0,01	Borax, anhydrous, powder, at plant/RER U
IJzerchelaat DTPA 6% (vloeibaar)	1.303	Liter	1,28	1.668	6%	100	0,01	DTPA, diethylenetriaminepentaacetic acid, at plant/RER U
Kaliumchloride (gecompacteerd)	9.000	kg	1	9.000	100%	9.000	1,35	Potassium chloride, as K2O, at regional storehouse/RER S
Kaliumfosfiet	1.065	Liter	1,37	1.459	100%	1.459	0,22	Phosphoric acid, fertiliser grade, 70% in H2O, at plant/GLO U
Kaliumnitraat	27.000	kg	1	27.000	100%	27.000	4,04	Potassium nitrate, as K2O, at regional storehouse/RER S
Kaliumsulfaat	6.891	kg	1	6.891	100%	6.891	1,03	Potassium sulphate, as K2O, at regional storehouse/RER S
Kalksalpeter (vloeibaar)	53.631	Liter	1,05	56.312	100%	56.312	8,42	Calcium nitrate, as N, at regional storehouse/RER U
Kopersulfaat (pentahydraat)	9	kg	1	9,4	100%	9,4	0,001	Sodium metasilicate pentahydrate, 58%, powder, at plant/RER S
pota	141	kg	1	141	100%	141	0,02	Copper carbonate, at plant/RER U
Monokalifosfaat (Haifa)	11.250	kg	1	11.250	100%	11.250	1,68	Monoammonium phosphate, as N, at regional storehouse/RER S
Natriummolybdaat (dihydraat)	28	kg	1	28	100%	28	0,004	Sodium dichromate, at plant/RER U
Salpeterzuur 38%	9.373	Liter	1,24	11.623	38%	4.417	0,66	Nitric acid, 50% in H2O, at plant/RER S
Ureum (vast)	1.500	kg	1	1.500	100%	1.500	0,22	Urea, as N, at regional storehouse/RER S
Zinksulfaat (monohydraat)	25	kg	1	25	100%	25	0,004	Zinc monosulphate, ZnSO4.H2O, at plant/RER S
kaliloog	1.926	Liter	1,5	2.888	50%	1.444	0,22	Potassium hydroxide, at regional storage/RER U
optifos	4.706	Liter	1,5	7.059	100%	7.059	1,06	Organophosphorus-compounds, at regional storehouse/RER U

4.1.2. Production chemical crop protection

Principle: consumption location De Lier 2013
Source: data provided by Van Adrichem

For all plant protection products on the basis of supplier data is determined what the active substance is and what the concentration of the active substance relative to the total. For the active substances where no direct reference in the EcoInvent Database is available, the environmental impact is determined by reference to the function (insecticide, fungicide or herbicide).

Producten	Werkzame stof	Verbruik per jaar	Eenheid	Gehalte werkzame stof	Eenheid	Hoeveelheid werkzame stof (kg)	Hoeveelheid werkzame stof per ton tomaten (kg)	Type middel	Referentie in EcoInvent database
altacor	Cloorantraniliprole	3	kg	0,35	kg/kg	1,1	0,00016	insecticide	chlorothalonil, at regional storage/kg/RER
floramite	Bifenazaat	16	liter	240	g/l	3,8	0,00057	insecticide	Insecticides, at regional storehouse/RER S
luna	Fluopyram	26	liter	500	g/l	13	0,0019	fungicide	Fungicides, at regional storehouse/RER S
oberon	Spiromesifen	13	liter	240	g/l	3,1	0,00047	insecticide	Insecticides, at regional storehouse/RER S
ortiva	Azoxystrobin	9	liter	250	g/l	2,3	0,00034	fungicide	Fungicides, at regional storehouse/RER S
scala	Pyrimethanil	9	liter	400	g/l	3,6	0,00054	fungicide	Fungicides, at regional storehouse/RER S
signum	Boscalid (26,7%) en pyraclostrobin (6,7%)	18	kg	334	g/l	6,0	0,00090	fungicide	Fungicides, at regional storehouse/RER S
aaterra	etridiazool	27	liter	700	g/l	19	0,0028	fungicide	Fungicides, at regional storehouse/RER S
fame	flubendiamide	4	kg	240	g/l	0,96	0,00014	insecticide	Insecticides, at regional storehouse/RER S
previcuer energy	fosetyl en propamocarb	27	liter	840	g/l	23	0,0034	fungicide	Fungicides, at regional storehouse/RER S
runner	methoxyfenozide	4	liter	240	g/l	0,96	0,00014	insecticide	Insecticides, at regional storehouse/RER S
rocket	polyoxyethylene glycols en paraffinic hydrocarbons, d-limonene	18	liter	100	%	18	0,0027	herbicide	Propylene glycol, liquid, at plant/RER U
proplant	propamocarb	25	liter	605	g/l	15	0,0023	fungicide	Fungicides, at regional storehouse/RER S

4.1.3. Production seeds and plants

Principle: location Westdorpe 2014
Source: data provided by supplier

For environmental impact related to the production of seeds and plants there is no reliable data available. However, supplier Vreugdenhil has indicated the natural gas consumption for the benefit of the plants supplied for location Westdorpe. This natural gas consumption is taken into account in the calculation in order to determine whether this emission contribute a significant contribution to the total.

Leverancier	Producten	Verbruik (stuks)	Gewicht per eenheid (kg)*	Oppervlak bij leverancier nodig (m2)	Aardgas per m2 tijdens groeiperiode (m3)**	Totale hoeveelheid aardgas nodig (m3)	Referentie in NMD database
Plantenkwekerij Vreugdenhil	Endeavour RZ	87.600	0,05	3.504	4,373	15.322	SBK aardgas, brandstof

4.1.4. Production foil

Principle: location Westdorpe 2014
Source: data provided by supplier

The data relating to the quantity of foil used in the location Westdorpe (weight and number of rollers) is provided by the supplier Brinkman.

Producten	Verbruik per jaar (rollen)	Gewicht folie per jaar (kg)*	Gewichtd folie per ton tomaten (kg)	Referentie in EcoInvent Database
Rotaflex Gold LPDE folie	162	4.650	0,70	SBK LDPE-folie

4.1.5. Production Rockwool

Principle: consumption location Westdorpe 2014
Source: data provided by supplier

The amount of Rockwool is determined by converting the quantities consumed to volume. Both the consumption amount in location Westdorpe as the specific gravity of the Rockwool is provided by the supplier Cultilene.

Producten	Verbruik per jaar (stuks)	afmeting per stuk (cm)	volume per stuk (m3)	soortelijk gewicht (kg/m^3)	Totale gewicht per jaar (kg)	Gewicht per ton tomaten (kg)	Referentie in EcoInvent database
Cultilène Optimaxx	29.376	133x19,5x7,5	0,019	45	25.116	3,8	Rock wool, at plant/CH S

4.1.6. Production other supplies

Principle: location Westdorpe
Source: data provided by supplier

The main 'other' supplies for the production of tomatoes on the vine are tomato hooks and rope. The consumption quantities are supplied by the client. The conversion of this to weight is made on the basis of estimation and previous studies. Any inaccuracy on the outcome will be minimal in all probability. Other supplies (gloves, etc.) are not included because the environmental impact is likely to be negligible.

Producten	Materiaal	Verbruik per jaar (stuks)	Gewicht per stuk (kg)	Gewicht per jaar (kg)	Gewicht per ton tomaten	commentaar	Referentie nationale milieu database
QHS System 220 touw wit/geel	Nylon	356.580	0,011	3.922	0,6	gewicht inschatting, afgeleid van eerder onderzoek	SBK kunststofvezels (polyprop)
haken rood	Verzinkt staal	5.500	0,026	145	0,02	gewicht inschatting, afgeleid van eerder onderzoek	SBK Staal verzinkt

4.2. Transport materials to Van Adrichem

Source: data provided by Van Adrichem

For the calculation of the transport distances are the return distances between Van Adrichem Westdorpe and suppliers determined. This is multiplied by the total weight for one year supplied and related to one tonne of tomatoes on the vine.

Van Adrichem involves the materials from the following suppliers.

- Fertilizers: Iperen, Westmaas
- Chemical crop protection: Iperen, Westmaas
- Seeds and plant: Plant nursery Vreugdenhil, De Lier
- Foil: Brinkman, 's-Gravenzande
- Rockwool: Cultilène, Tilburg
- Fuel: Several gas stations
- Tomato hooks, rope: WDP Products, Erp

In particular the weight of the plants is a rough estimate. The other weights have been calculated as set out in the preceding paragraphs.

Section	Descent	Distance (retour)	Total transported weight per year (kg)	transported weight per tonne tomatoes on the vine (kg)	Weight.distance per tonne tomatoes on the vine (ton.km)	Reference in National Milieu database
Fertilizers	Westmaas	240	159611	24	5,7	SBK truck > 16 tonne inclusive retour transport
Chemical crop protection	Westmaas	240	200	0,030	0,007	SBK truck > 16 tonne inclusive retour transport
Seeds and plants	De Lier	300	4425	0,66	0,20	SBK truck > 16 tonne inclusive retour transport
Foil	'S Gravenzande	300	4650	0,70	0,21	SBK truck > 16 tonne inclusive retour transport
Rockwool	Tilburg	250	25116	3,8	0,94	SBK truck > 16 tonne inclusive retour transport
Tomato hooks	Erp	350	145,0	0,022	0,0076	SBK truck > 16 tonne inclusive retour transport
Rope	Erp	350	392	0,59	0,21	SBK truck > 16 tonne inclusive retour transport

4.3. Production tomatoes on the vine

For the calculation of the environmental impacts associated with the production of tomatoes on the vine there is determined how much water and electricity is consumed. Also, the waste that is released during the production is calculated. In addition, there has been done a calculation on the environmental impact due to the coupling with Yara.

4.3.1. Consumption water and electricity

Principle: nursery De Lier 2013
Source: data provided by Van Adrichem

Consumption quantities of water are supplied by Van Adrichem and converted to the amount per tonne tomatoes on the vine.

Products	Type	Consumption per year (kWh)*	Consumption per tonne tomatoes on the vine (kWh)	Reference in Database	Database
Electricity consumption	grey	600.000	90	SBK electricity, average	National Milieu Database
Water	----	1.500	0	SBK 282 water, average	National Milieu Database

4.3.2. Waste during production

Principle: nursery De Lier 2013
Source: data provided by Van Adrichem

The quantities of waste and the way of processing are indicated by Van Adrichem. For the transport distances there is calculated with average values from the National Environment Database, and in the case of the composting, the investigation LAP2. In This study also the environmental impact of the composting of green waste is applied.

Waste processor	Products	discharged quantity per year (kg)	discharged quantity per tonne tomatoes on the vine (kg)	Way of processing	Distance	Reference in database	Database
Still deciding	Rockwool mats	25.116	3,8	Recycling	150*	SBK 035-3 recycling Rockwool (isolation)	NMD
Val / Van Vliet	Tomato leave clean	67.000	10	Composting	35**	Composting green waste	Research LAP2
Val / Van Vliet	Tomato waste shredded	297.000	44	Composting	35**	Composting green waste	Research LAP2
Val / Van Vliet	Green Waste	13.000	1,9	Composting	35**	Composting green waste	Research LAP2
Local processor	Rope hooks	1.979	0,30	Recycling	200*	SBK Recycling steel (galvanized) (200km)	NMD
Innovarek	Walking foil	4.650	0,7	Recycling	150*	SBK 029-3 recycling polyo-lefinen (pe,pp) (pipelines, foils)	NMD

4.3.3 Production CO_2 and warmth

Principle: estimation consumption Westdorpe 2014
Source: Van Adrichem / WarmCO_2

Nursery Van Adrichem buys CO_2 and warmth at supplier WarmCO_2 who takes care of the connection with Yara fertilizer plant. CO_2 and warmth released during the production of fertilizer are applies as waste. There are no earnings from the sale of these products. The costs Van Adrichem paid for 100% attributed to the construction, maintenance and energy for the supply of CO_2 and warmth. As a result, the environmental impact of these products is only related to the transport between Yara and Van Adrichem. As infrastructure is not part of this, only the energy (electricity) for the purpose of transport is taken into account.
The data for this are provided by supplier WarmCO_2 based on calculations from 2012. It is expected that the energy consumption in the future will reduce.

Products	Consumption per year	Unit	Electricity consumption transport per unit (kWh)*	Consumption per tonne tomatoes on the vine (kWh)	Reference in NMD Database
Warmth	31,5 * 10^6	kWh	0,06	283	SBK electricity, average
CO_2	3.600	Ton	0,08	43	SBK electricity, average

4.4. Avoided natural gas

Principe: location De Lier 2013
Source: Van Adrichem

To determine what the link with Yara contributes to environmental impact there is also determined what the impact would have been if a cogeneration installation would have been used.

The total amount of natural gas burned in cogeneration installations if the nursery Van Adrichem would not use CO_2 and warmth from the fertilizer producer Yara, is stated by Van Adrichem as 34 m^3 per year per m^2. This amount is converted to the total area of Westdorpe and related to the production of one ton of tomatoes on the vine.

Since in a cogeneration installation electricity is released which in large part will be delivered to the grid there is calculated what avoided environmental effects would have been if such release of the electricity is subtracted by the consumption of natural gas. Previous research shows that about 34% of the energy of the natural gas may be allocated to the electricity that is fed back to the grid. For completeness, this assumption has been included in the calculation.

Natural gas consumption per m2 per year	Total area (m2)	Total natural gas consumption per year (m3)	Total natural gas consumption per tonne tomatoes on the vine (m3)	Energy percentage sold electricity to grid	Reference in NMD
34	90.000	3.060.000	457	34%	SBK natural gas, fuel

5. RESULTS

The tables below show the results of three considered effects: energy consumption, the shadow costs and CO_2 emission. The results are based on calculations using Simapro 7 software based on above LCI data.

The reason that has been chosen for these three effects, it is as follows:

- Shadow Costs; shadow costs provide insight into the environmental impact of the production of tomatoes on the vine based on a weighting of 11 different environmental impacts;
- CO2 emission; this is the current discourse regarding environmental impact in organizations;
- Energy (MJ); the link with fertilizer plant Yara aims to reduce energy use and environmental impact, the column 'Energy' provides insight into achieving the former.

The table below shows the results of the LCA. The process stages are explained later in this chapter.

Process phase	**CO_2 emission**		**Shadow costs**		**Energy**	
	kg CO_2	%	euro	%	MJ	%
Production materials	0,065	37%	0,0092	55%	1,27	40%
Transport	0,0011	0,6%	0,00011	0,68%	0,016	0,5%
Production tomatoes on the vine	0,11	62%	0,01	44%	1,92	60%
Total	**0,17**	**100%**	**0,02**	**100%**	**3,20**	**100%**

The table below displays (absolute and relative) what the avoided environmental impacts are by the link with Yara fertilizer plant. This shows that the link with Yara got CO_2 emissions and energy costs and shade lower than with the use of a cogeneration installation.

		Current concept with Yara			**Using cogeneration installation (without emission avoided by electricity delivered)**			**Using cogeneration installation (with emission avoided by electricity delivered)**		
		CO_2	Shadow-costs	Energy	CO_2	Shadow-costs	Energy	CO_2	Shadow-costs	Energy
Total		**0,17**	**0,02**	**3,20**	**1,22**	**0,09**	**22,6**	**0,823**	**0,0645**	**15,3**
Difference relative to * WKK ** Subli-mato	Percentage (%)	14%*	18%	14%	703% **	541%	706%	474% **	388%	478%
	Absolute per kg tomatoes on the vine	-1,05	-0,07	-19,40	1,05	0,07	19,40	0,65	0,05	12,10
	Absolute per year	-1,40E+07	-9,82E+05	-2,60E+08	7,00E+05	4,91E+04	1,30E+07	4,34E+05	3,20E+04	8,10E+06

5.1. Production materials

Within the phase "production materials" the biggest issue is caused by the production of fertilizers.

Section	**CO_2 emission**		**Shadow costs**		**Energy**	
	kg CO_2	%	euro	%	MJ	%
Fertilizers	0,056	32%	0,0085	51%	1,0	31%
Crop protection	0,0002	0,1%	4,38E-05	0,26%	0,003	0,1%
Plants and seeds	0,0018	1%	1,83E-05	0,11%	0,087	2,7%
LDPE foil	0,0018	1%	0,00015	1%	0,064	2,0%
Rockwool	0,0036	2%	0,00036	2%	0,062	1,9%
Tomato hooks and rope	0,0015	1%	0,00012	1%	0,052	1,6%
Total	**0,065**	**37%**	**0,0092**	**55%**	**1,27**	**40%**

5.2. Transport

The transport phase makes a very small contribution to the total (0.64% of the total CO_2 emission).

Section	CO_2 emission		Shadow costs		Energy	
	kg CO_2	%	euro	%	MJ	%
Transport total	**0,0011**	**0,64%**	**0,00011**	**0,68%**	**0,02**	**0,50%**

5.3. Production tomatoes on the vine

Within the phase 'production tomatoes on the vine' the biggest issue is caused by the production of electricity and the CO^2 and warmth (37% and 29% of the total).

Section	CO_2 emission		Shadow costs		Energy	
	kg CO_2	%	euro	%	MJ	%
Remaining fuels	2,67E-05	0,015%	3,47E-06	0,02%	0,0022	0,069%
CO_2 and warmth	0,0509	29%	0,00343	21%	0,86	26,788%
Water consumption	5,39E-05	0,031%	4,95E-06	0,03%	0,0012	0,038%
Waste	-0,0071	-4,1%	-0,00044	-2,62%	-0,024	-0,763%
Electricity	0,064	37%	0,0043	25,93%	1,08	33,759%
Total	**0,108**	**62%**	**0,0073**	**44%**	**1,92**	**60%**

6. SOURCES

- Data provided by Van Adrichem
- Data provided by suppliers
- SBK National Milieu Database
- EcoInvent Database V3.0
- SKAO CO_2 prestatieladder 2.1