Country Report – The Netherlands

Stakeholder and Driver Analysis on Energy Efficiency in Agriculture

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Summary

The aim of this report is to present the drivers, stakeholders and barriers of the process of improvement of energy efficiency in Dutch agriculture. Based on the DESTEP-method the most important external factors for energy-efficiency in Dutch agriculture are analysed.

The demographic factors are the dual development in Dutch Agriculture. The bigger farms get bigger and the smaller farms become smaller. Also due to the dual development, succession of farms is a problem. Especially small farms do not provide substantial income to successors, therefore many of these farms will disappear in the near future. The working population in the Dutch agricultural sector is declining. The estimates predict a 20% decline in employability.
The bigger farms that are still growing are more likely to take (energy-) efficiency measures. The growth is a reason to achieve higher cost efficiency (better cost price). It is expected that high costs for seasonal work and the decrease in supply of professional skilled labour stimulates mechanisation and scale increase. Replacing workers by introducing more mechanisation will probably lead to an increase in energy use.

The economic factors are the increase of energy prices, agricultural commodity prices, land prices and wages. Increase in agricultural commodity prices will mean more revenues for the agricultural businesses. This will possibly improve the investment possibilities for the company. This can lead to investments in energy-efficient storage systems or machinery, but also investment in additional land. The investment in additional land will keep the prices of agricultural land at the current high level or even higher. An energy price increase will translate directly in higher cost prices, especially for energy dependant agricultural sectors e.g. greenhouse horticulture. The higher energy prices are expected to also trigger energy-efficiency in sectors with a low energy consumption e.g. arable farming.

The social factors are the growing gap between citizens and agriculture, the social resistance to industrialized agriculture and the high level of education and research institutes. The social developments in Dutch society on industrialised agriculture could lead to an increase in energy use in animal husbandry. The industrialised agriculture is designed to be as efficient as possible. It is expected that integration of new societal demands in the product or production process will have an influence on energy efficiency. Further the consumption of sustainable food offers an incentive to implement energy-efficient techniques but there is not a strong market demand.

The technological factors are bio-based economy, precision farming, genomics and system innovations. The bio-based economy is not expected to change the cultivated crops very much. The interest in plant parts that are not used are expected to have more impact. Especially the additional harvest steps e.g. for sugar beet leafs could lead to an increase in

energy use. A positive side-effect is the additional income potential (money) and the allocation of energy use to the by-product.

The outlook on precision farming show potential of reducing inputs with similar or even higher yields.

Genomics could also lead to higher yields or reduction of inputs. In both cases the energy user per kilogram product is lowered.

The soilless cultivation of outdoor crops is caused by the stringent environmental legislation in The Netherlands. The soilless cultivation of outdoor crops is should result in lowering inputs especially of fertilizer and pesticides. Another system innovation is no-tillage cultivation. The experience of no-tillage trials show potential for saving energy.

The ecological factors are concern of soil fertility, salinization and water management and climate change. A number of bottlenecks of soil fertility became more and more visible to farmers, especially on sandy soils with a high crop rotation. The problems in practice were less plant growth, an increase in fertilizer and pesticides use. The attention to soil fertility is more likely to increase energy use. The additional use or extra use of compost could result in higher energy use. Also the cultivation of crops for green manuring could result in additional energy use.

In the future more extreme weather is expected, more dry periods in spring and summer and more wet years. Also more extreme showers are expected. The extreme weather could lead to increase in energy use. In dry conditions additional energy is needed to irrigate crops and in wet conditions machines and tractors will use more fuel.

The policy factors are the CAP-reforms, the derogation in the Nitrate Directive, national taxes and subsidies. The CAP reforms influence the financial yield per hectare. The financial yield per hectare will be lower, which leads to lower income. The cost price remains the same. To compensate this effect, a lowering of the cost price could further simulate the growth process of bigger farms (see Demographic developments). The CAP reforms could also lead to additional demand on sustainability. This could mean that energy-efficiency will become a condition in de CAP. The end of the derogation exemption to the Nitrate Directive is likely to have a great effect on energy use in agriculture. The organic fertilizer is likely to be processed into products that substitute inorganic fertilizer or become financially more interesting to use for arable farming. The substitution of inorganic fertilizers will lead to a lower energy use. The use of more organic fertilizer in arable farming will increase transport of organic fertilizer between regions in The Netherlands. This will lead to a significant increase in energy use.

Based on the macro factors the most important stakeholders are analysed. Based on the expert judgement of the stakeholders a qualification per stakeholder is made on its importance in energy-efficiency in Dutch agriculture. The stakeholders that should be managed closely have great influence and great interest in energy-efficiency. These stakeholders are crucial for the success of energy-efficiency in the Dutch agriculture. The stakeholders that should be kept satisfied have great influence, but little interest in energy-efficiency. The stakeholders that should be kept informed are interested, but have little influence in energy-efficiency. The stakeholders that should be monitored have little interest and influence on energy-efficiency.

Action	Stakeholder
Managed closely	Farmers
	Suppliers (durable goods)
	National government
	Retail
	Food processing
Keep satisfied	Suppliers (nondurable goods)
	Intermediaries
	Research and education
Keep informed	Farmers' organisations
Monitor (minimal effort)	Trade organisations (commodities)
	NGO's

1 Introduction

1.1 AGREE

This report is a result of an EU-project "Energy Efficiency in Agriculture" (AGREE) supported by the 7th Framework Program. AGREE has the objective of showing the potential of short term energy efficiency gains and the promise of the long term potential. Until now energy efficiency in agriculture has received little attention, except for energy use in greenhouses. Nevertheless, it is considerable, especially when indirect energy use is taken into account (State of art on Energy Efficiency in Agriculture, AGREE 2.1). In AGREE Environmental effects of savings on direct and indirect energy use in agriculture are integrally considered, as energy use efficiency also implies reduction of greenhouse gas emissions.

1.2 Objective and Method

The aim of this report is to present the drivers, stakeholders and barriers of the process of improvement of energy efficiency in Dutch agriculture.
A general characterization of Dutch agriculture in the context of energy consumption in agricultural production is followed by an analysis of macro factors linked to the current energy use and in the future. The DESTEP method has been used to a systematic analysis of categories of external drivers. DESTEP stands for: demographic, economic, social, technological, ecological and political. Based on an expert discussion estimation was given about the term (long term or short term) an effect of this driver on energy efficiency can be noticed.
Finally Dutch stakeholders are identified and an indication is given about their influence or power and their interest to change the energy efficiency at farm level.

1.3 Agriculture in the Netherlands

The Netherlands in general

To get a better view of agriculture in The Netherland some general statistics are given to put the agricultural sector in perspective. About 2 million hectares is agricultural land (www.cbs.nl).

Table 1.: Key social and economic statistics for The Netherlands

Subject	Quantity	Source, date
Surface area	41,510 km^2, land 33,718 km^2	CBS, 2010
Population (at May 2012)	16,7 million	CBS, 2012
Work population (2010)	7,3 million	CBS, 2010
Life-expectancy at birth	80.6 man	CBS, 2011
	82.7 woman	CBS, 2011
Gross National Product (2011)	601,900 million Euro	CBS, 2011
Per capita income (2010)	24,900 Euro	CBS, 2010
Inflation (2011)	2.3 %	CBS, 2012
Unemployment (2011)	6.2 %	CBS, 2012

The agricluster in The Netherlands

In The Netherlands the total agricultural sector or Agricluster is made up out of primary agriculture (19,5%), the food- and beverage industry (31%), trade and logistics (46%) and other agriculture related business (4%) (Ministry of Agriculture Nature and Food Quality, 2005).

Table 2.: Key figures Dutch Agriculture

Key figures Dutch Agriculture	Added value (factor costs, in billion euro)	
	2001	2010
Agricluster (a+b+c)	40.6	52.5
Share in national total economy	10.2%	10%
a) Landscaping, agricultural services, forestry	3.8	4.3
Share in national total economy	0.9%	0.8%
b) Foreign agricultural commodities	15.3	22.4
Share in national total economy	3.8%	4.3%
- Processing	6.6	9.0
- Supply	4.0	5.2
- Distribution	4.7	8.2
c) Domestic agricultural commodities	21.5	25.8
Share in national total economy	5.4%	4.9%
- Primary production	7.6	7.0
- Processing	3.2	4.5
- Supply	8.1	10.7
- Distribution	2.6	3.3

Source: Berkhout et al., 2012

The key figures show the share of the total agricluster and each subgroup in the total Dutch economy.

The Netherlands is one of the three largest exporters of agricultural products worldwide. The Netherlands exported agricultural products worth 65 billion euro in 2008, which account for 17.5% of the total Dutch exports that year. More than 80% of Dutch exports go to the EU. Germany remained the most important trading partner for the Netherlands in 2008. Germany accounts for more than 25% of the total agricultural export of The Netherlands (Ministry of Agriculture, Nature and Food Quality, 2010).

The primary agriculture in The Netherlands

The primary production in agriculture in The Netherlands is divided into six main types of production. The following table gives an idea of the size and structure of the primary agricultural production in The Netherlands.

Table 3.: Number of agricultural holdings, land utilization and average energy consumption per type of holding

	2010		2006
	Number of holdings	Land utilization (ha)	Average energy consumption per holding (GJ)
Arable farming	11,962	460,568	270
Horticulture	10,198	92,092	10,313
(incl. greenhouses)	(5,780)	(10,310)	
Perennial crops	1,825	21,340	1,173
Livestock, grazing	38,024	1,077,319	208
Livestock, intensive farming	6,479	75,961	779
Combined	3,836	145,041	434

Source: LEI 2011, CBS statline

In table 3 the total energy consumption of the agriculture is given. Greenhouse horticulture is mentioned specific for the big share in energy consumption. The energy consumption is divided in to subgroups; first natural gas, heat, other, secondly electricity and as third tractor fuel.

Table 4.: Total energy consumption Dutch agriculture (in PJ)

	1995	2000	2005	2008
Greenhouse horticulture	140	137	128	114
- Natural gas, heat, other	137	133	123	131
- Electricity	3	4	5	-17
- Tractor fuel	0	0	0	0
Agriculture, without greenhouse horticulture	32	30	25	25
- Natural gas, heat, other	14	11	8	8
- Electricity	7	8	7	7
- Tractor fuel	11	11	10	10
Agriculture (total)	172	167	153	139
- Natural gas, heat, other	151	144	131	139
- Electricity	10	12	12	-10
- Tractor fuel	11	11	10	10

Source: LEI, 2011

Due to the adoption of CHP-installations (Combined Heat Power) the greenhouse horticulture is since 2008 a net producer of electricity.

2 DESTEP analysis of macro factors

The DESTEP method is a useful tool for a systematic analysis of external factors. It gives a broad analysis of macro factors that may impinge upon an organization's business and operations. DESTEP stands for: demographic, economic, social, technological, ecological and political.
In the table, for each DESTEP factor examples are given of external topics (drivers) that can influence the priorities for policies about energy efficiency in agriculture.

External factor	Factor related to energy efficiency
Demographic	• Demographic development of farms and agricultural sectors
Economic	• Energy market (price, supply)
Social	• Level of education and research • Societal demands
Technological	• Technological developments
Ecological	• Climate change concern • Sustainability demands in supply chain
Policy	• Taxes • Legislation (CAP) • Funds

2.1 Demographic

General demographic trends

The world population will increase with about 1% per year and will be around 9 billion people in 2015. This growth mainly manifests itself outside the EU, particularly in Asia (Silvis et al., 2009). This development can indirectly play an important role for the international oriented Dutch agriculture. The effects for example on the food prices and energy consumption can be significant.

Agricultural demographic trends in The Netherlands

In primary agriculture and horticulture, which still accounts for about two third of the land use in the Netherlands a dual development is going on. Production is increasing in volume, but more slowly than in the past for policy reasons (environment, quotas). The number of farms is declining quite rapidly, so increase in scale is an important trend. At the same time, there are still many small farms, including part-timers, and farms which all kind of alternative strategies. There is therefore a dual development with the most production and income development among the big farms (Silvis et al., 2009).
The number of agricultural companies is lower each year. Between 2000 and 2010 the number of companies declined with about 25.000 companies (25,7%). Per subdivision a significant difference in development can be seen; greenhouse horticulture (including mushroom farms) 48,1%, field horticulture 29%, arable farming 19,2%, dairy farms 24,8%, other grazing animals 5,6%, intensive cattle farming 34,4% and combined farms 50,5% (Berkhout et al., 2012).

Of the farms about 58% is managed by an owner, who is 50 or older. In arable farming this is even 65% (LEI, 2011). Of the total number of agricultural companies 42% does not have a successor (LEI, 2011).
The succession of agricultural businesses is a problem. Based on the period from 1990 till 2007 a decline of 34% in the number of farms (19,000 farms) is predicted for the future. Especially small farms do not provide substantial income to successors, therefore many of these farms will disappear in the near future (Stokkers et al., 2010).
The number of people employed in the agricluster is lower each year. A 10% of the total working population is working in the agricluster. The estimates predict a 20% decline in employability. Many older workers in the agricultural sector will not be replaces by younger people (Silvis et al., 2009). Also the share of own (family) labour is decreasing in the total labour costs per agricultural company (Berkhout et al., 2012).

Conclusion on Demographic developments in The Netherlands

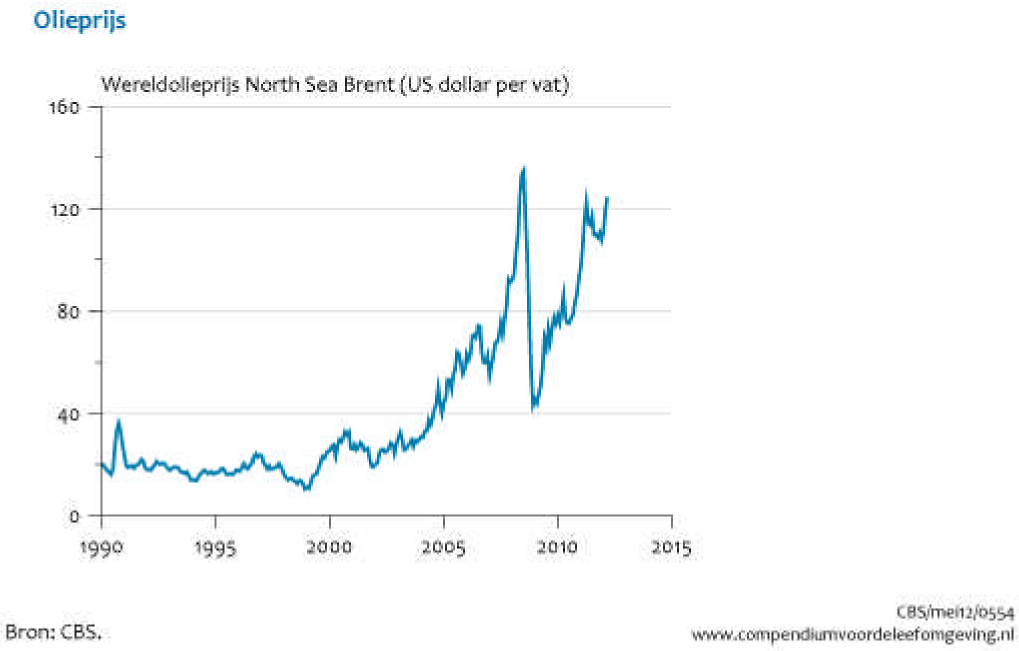
The bigger farms that are still growing are more likely to take (energy-)efficiency measures. The growth is a reason to achieve higher cost efficiency (better cost price). It is expected that high costs for seasonal work and the decrease in supply of professional skilled labour stimulates mechanisation and scale increase. Replacing workers by introducing more mechanisation will probably lead to an increase in energy use.
Based on a certain pay-back period it is expected that older farmers are less likely to invest heavily in energy-saving techniques. The problems with succession of farms could slow down energy saving techniques. The older farmers without successors continue farming but will probably not invest more than necessary in their business.

2.2 Economic

The influence of the global economy on the Dutch agricultural sector is significant. The sector is in large extent focused on international trade. The agricultural sector generates an extensive positive export balance of over €23 billion (in 2007). The proportion of agricultural products and food in the total Dutch exports of goods and services is also fairly high with 17%. A large proportion (around 70%) of the activities of the agricluster is related to foreign sales, so there is heavy dependence on international trade. Around 80% of Dutch agricultural exports go to other EU countries while more than 60% of the imports come from there. This underlines the importance of internal EU market integration with the single currency (euro) and similar policy conditions (Silvis et al., 2009).

Energy prices

An increase in energy prices is foreseen, based on the increase in oil prices seen from 2003 till 2011. Most significant reasons for the high oil prices are a strong demand from upcoming economies like China and India, shortage in production capacity (in refining), political uncertainties mainly in important producing countries and a lack of options to adjust the demand of oil on short terms (CBS-NMP, 2012).



The figure above states the oil price (Brent crude) in US dollar per barrel per year. The gas price follows the crude oil price, but fluctuates less the crude oil. The electricity prices depend on the prices of a number of fossil fuels used to generate electricity.

Energy is about one third of the production costs in greenhouses (Vermeulen, 2010). Therefore rising energy prices reduce margins and are very likely to render unprofitable the crops. These are unprofitable crops whose price cannot be raised accordingly due to strong competition from abroad. The LEI-Wageningen UR studied some potential scenarios on energy prices. The reference scenario assumes an oil price of around 100 dollars a barrel. But what happens when oil prices reach 150 dollars? In the assumption that the prices of other energy carriers, including gas, will become equally expensive, production in greenhouse horticulture will decline compared with the growth in the reference scenario. Cucumbers are the most susceptible here, but the production of other vegetables (tomatoes and peppers) and cut flowers will also decline. In the case of higher oil and gas prices, the prices of greenhouse horticulture products will rise. This will compensate the higher costs to some extent. The high energy prices not only result in cost disadvantages, but also revenue advantages for agriculture and horticulture as energy supplier. High oil prices are mainly disadvantageous for the income of greenhouse horticulture and to a lesser extent for livestock farming. This accelerates the closure of farms and increases in scale. But higher oil prices also encourage the introduction of 1st and 2nd generation biofuels and other alternative energy sources which can be supplied by the agricultural sector. Furthermore, high energy prices promote developments towards energy savings in the agricultural and logistics sectors (Silvis et al., 2009).

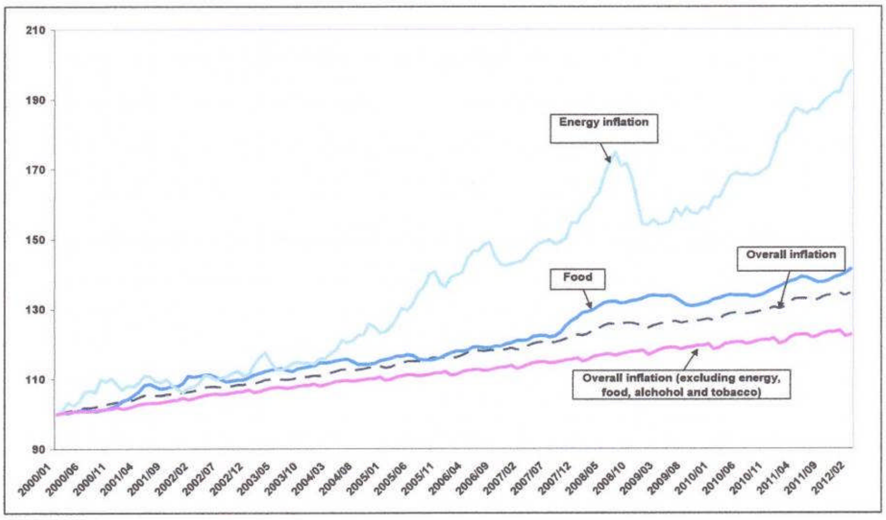
Specific for agriculture is that energy saving options can be found in greenhouses, storage and cold stores of arable and vegetable farms and in animal stables (Leenstra et al., 2009).

Agricultural (commodity) prices

Besides the energy price increase, an increase in agricultural prices is expected. The surge in agricultural commodity prices resulted from a combination of structural and temporary factors. Structural factors such as global population growth, rising incomes in emerging economies and the development of new market outlets have contributed to a gradual rise in world demand (EC Agriculture). One of the new market outlets is biofuels. For example the real price of oilseeds shows an increase of 8% in contrast to the long-term trend projected in the reference scenario (Banse, unspecified year).

Annex: Graphs on EU agricultural market and consumer price developments

Graph A1: Overall and food consumer price against energy consumer price in the EU (January 2000 until February 2012, Jan2000=100)



Source: Eurostat

An increase in agricultural prices could mean an improved farm income and net result.

Wages and land prices

The agricultural sector in the Netherlands operates in a prosperous and densely-populated country. This means that the wage levels (and cost of land) are fairly high (Silvis et al., 2009). A strong surge in land prices is seen, with an increase of 57% from 2005 till 2010 (DLG, 2011). The long-term, from 1952 till 2007, increase in land prices is about 5% per year, without inflation correction (Van der Voort, 2009). The strategy of the medium and big agricultural companies is increase in production volume. Especially in arable farming this translates into a land buying strategy, which leads to an increase in land prices (Luijt et al., 2012).

Conclusion on Economic developments in The Netherlands

Increase in agricultural commodity prices will mean more revenues for the agricultural businesses. This will possibly improve the investment possibilities for the company. This can lead to investments in energy-efficient storage systems or machinery, but also investment in additional land. The investment in additional land will keep the prices of agricultural land at the current high level or even higher. A strong focus on land could mean fewer possibilities to invest in energy-efficient storage of machinery.
Energy price increase will translate directly in higher cost prices, especially for energy dependant agricultural sectors e.g. greenhouse horticulture. The higher energy prices will also trigger energy-efficiency in sectors with a low energy consumption e.g. arable farming.

However, the greenhouse cultivation companies fitted with CHP will also gain from higher energy prices, therefore there is always some uncertainty in the kind of projections of the LEI-Wageningen UR study mentioned above. It is a fact that Dutch greenhouse horticulture has survived past rises in energy prices through a combination of energy saving measures and increased productivity. The combined effect has been a halving of the energy required per unit product over the past 30 years.

2.3 Social

General

The average Dutch citizen has, due to increasing urbanisation, less contact and knowledge of the agricultural sector. Probably due to the lower knowledge level of agriculture, the social resistance to e.g. industrialised agricultural sectors is grown, especially in animal husbandry. Some innovations in the agricultural sector are met with social opposition, for example the establishment of larger farms with intensive farming. Obstructing these innovations may negatively affect the competitive strength of the agricultural sector in the Netherlands and the EU (Silvis et al., 2009).
For consumers other aspects than price of the products become more important. In relatively rich countries the aspects of quality, image, ease of preparation, health and sustainability aspects becoming more important as price of the product to consumers (Silvis et al., 2009). The consumption of sustainable food has risen with 30.5% in 2011. Sustainable food distinguishes as animal friendly, biological, environmental friendly and/or ethical (ELI, 2012). At the moment there is not a strong consumer demand on energy efficiency.

Research and education

The Dutch agricultural sector has access to internationally renowned research institutes on the field of agriculture and bio-based economy. There is significant knowledge on the entire agricultural sector, the integration of knowledge and the use of (process) technology (Minnesma et al., 2003).
The agricultural community is relatively high educated, efficient and innovative (Minnesma et al., 2003).

Conclusion on Social developments in The Netherlands

The social developments in Dutch society on industrialised agriculture could lead to an increase in energy use in animal husbandry. The industrialised agriculture is designed to be as efficient as possible. It is expected that integration of new societal demands in the product or production process will have an influence on energy efficiency. Further the consumption of sustainable food offers an incentive to implement energy-efficient techniques but there is not a strong market demand.

2.4 Technological

General

Research shows that technology played an important role in the increase in production (yield) in agriculture seen from 1950. Strijker (1999) analysed the developments in EU agriculture and concluded that technology is the decisive factor in the increase in yield per hectare in this period.

Specific technological developments

The bio-based economy; the bio-based economy is not expected to lead to big changes in land-use. But the bio-based economy could lead to a change in cultivated crops, crops with a high yield in dry matter or perennial crops (Leenstra et al., 2009).
A number of projects are working on biomass out of by-products. The main focus is in these projects the plant-based substances. The production of protein for animal feed or bio-plastics out of plant-based substances in sugar beet leafs or grass (grassanederland.nl and ACConsult).
The Precision farming (including robotisation); the precision agriculture shall increase production and at the same time reduce inputs, energy and emissions. (Syscope, 2010).
Robotisation is expected to lead to a trend breach worldwide. The application of robotics to solve the labour problem seems to aim at the long term, as can be seen in greenhouse farming. Labour scarcity can speed up robotisation in the short term. The extent to which robotisation is applied in animal sectors will depend on the social acceptance and the extent to which the sectors are able to guarantee the intrinsic value of the animal (Leenstra et al., 2009).
Genomics; This knowledge can be applied to management and nutrition in plants and animals, but traditional selection of improved generations can also be more efficient by using genomics. Using genomics offers the possibility for tailor-made applications: dependent on market demand. This leads to a perspective that responds to social questions such as the quality of the products, removing negative side effects of production or food production under specific conditions such as drought and salinization. Concrete examples are the demand for unsaturated fatty acids in animal products, type o starch in potatoes, resistance to particular diseases and plaques in plants or animals or defining the ripening stage of fruit (Leenstra et al., 2009). Genomics is also applied for selection of cold-resistant varieties of vegetables for greenhouse production in central Europe and heat resistant varieties for the Mediterranean area (for instance, (http://www.spicyweb.eu/)
Micro systems and nanotechnology; Practical applications vary from new processing and production systems to 'delivering systems' that effectively have additives take the right positions in the body (in cells), or in the field of packaging and logistics (preservative, signalling packaging, self-repairing foils) and intelligent sensors for many substances (Leenstra et al., 2009);
ICT-developments; Applying ICT-developments is a precondition for utilising genomics (computing and data storage capacity), robotisation and precision farming (sensors, communication and decision models) and logistic possibilities (in the chain as well as from produces to consumer) (Leenstra et al., 2009).
System Innovations: Soilless cultivation of outdoor crops; The research program soilless cultivation of outdoor crops develops cost effective closed cultivation systems for outdoor horticulture. The cultivation system can comply with European regulations for water quality. The new cultivation system allows growers to produce in a cost effective way with minimal emission from fertilizers and pesticides (http://www.teeltdegronduit.wur.nl).
No tillage cultivation technique; No tillage systems contribute to lower fuel consumption and lower energy consumption and greenhouse gas emissions (Biokennis bericht, 2008).

Conclusion on Technological developments in The Netherlands

The bio-based economy is not expected to change the cultivated crops very much. The interest in plant parts that are not used are expected to have more impact. Especially the additional harvest steps e.g. for sugar beet leafs could lead to an increase in energy use. A positive side-effect is the additional income potential (money) and the allocation of energy use to the by-product.
The outlook on precision farming show potential of reducing inputs with similar or even higher yields.
Genomics could also lead to higher yields or reduction of inputs. In both cases the energy user per kilogram product is lowered.
The soilless cultivation of outdoor crops is caused by the stringent environmental legislation in The Netherlands. The soilless cultivation of outdoor crops is should result in lowering inputs especially of fertilizer and pesticides. Another system innovation is no-tillage cultivation. The experience of no-tillage trials show potential for saving energy. This especially on diesel fuel use for soil cultivation.

2.5 Ecological

Attention for soil fertility and no tillage.

The soil is (one of) the most important production factor for agriculture. The boundaries of agricultural production are determined by soil fertility, climate and management (Schils, 2012). A number of bottlenecks became more and more visible to farmers, especially on sandy soils with a high crop rotation. The problems in practice were less plant growth, an increase in fertilizer and pesticides use. All with little to no effect on plant growth. Research by Hortinova revealed that the organic matter in the soil was very low, less than 1%. Soils without the problems were well above the 1% (vitalebodem.nl).
Related to the soil fertility is the attention for **No tillage cultivation techniques.** No tillage could have a positive effect on soil life, soil structure, better water retention and water infiltration (BioKennis bericht, 2008).

Salinization and water management.

Especially in the southeast delta region of the Netherlands the risk of an increase in salinization is expected, combined with a decline in freshwater from rivers and other sources On average it rains 10% less. In the future more extreme weather is expected, more dry periods in spring and summer and more wet years. Also more extreme showers are expected . The consequence is that water management need to be in order. This especially to have sufficient freshwater available for agriculture in dry periods (Stuyt et al., 2006). Salinization will greatly reduce productivity of grasses, grain, fruit and potato crops. For sugar beets an increase in sugar yield is expected due to reversed osmoses (Blom et al., 2008).

Climate change and water management.

The climate change effects in the Netherlands are characterized by three aspects, increase in average temperature, increase in the amount of rainfall and an increase in extreme weather situations. The overall impact of climate change for The Netherlands is expected to be low. The increase in temperature could lead to an increase of production, but also in an increase of plagues and diseases. A high impact for agriculture can be expected from the extreme weather conditions (Blom et al., 2008). The wet conditions will predominantly be a problem for clay soils in The Netherlands. This will lead to problems with nitrate leaching and fungus and bacteria diseases which can spread and grow more easily in wet conditions. Dry conditions will affect sandy soils more. This will lead to yield loss in potatoes, grain and maize crops. Also drought can lead with problems in the uptake of nitrogen by the crops (Blom et al., 2009). Climate change will potentially also lead to more diseases and plagues. Due to the mild winters more diseases and plagues will survive. The increase in temperature will also lead to new (for The Netherlands) diseases and plagues (Blom et al., 2009).

Conclusion on ecological developments in The Netherlands

The attention to soil fertility is more likely to increase energy use. The additional use or extra use of compost could result in higher energy use. Also the cultivation of crops for green manuring could result in additional energy use.
The extreme weather could lead to increase in energy use. In dry conditions additional energy is needed to irrigate crops and in wet conditions machines and tractors will use more fuel.

2.6 Policy

International policies

The driving forces which largely determine the prospects of the agricultural sector are mainly international and European developments related to the demand for and supply of products. In this context, government policy can greatly influence the development of the sector on a number of points (Silvis et al., 2009).
The WTO and the EU are very influential with respect to policy for the agricultural sector, and particularly for the highly internationally-oriented Dutch agricultural sector. Agreements in a WTO context about further liberalisation of trade, including expansion of market access and reduction of export support, directly affect the markets and partly determine the future Common Agricultural Policy (CAP). This stipulates for the coming years the end of milk quotas, changes in farm supplements (simplification and conditions; discounts) and rural policy (supplementary resources). In addition, the scope of the EU has become broader, so that the EU is also very influential in determining many of the production conditions of the agricultural sector, related among other things to the environment, energy, nature, animal welfare and health, food quality, etc. National policy thus tends to be an elaboration of EU policy. This applies for example, through Natura 2000, to nature policy and management. Compared with the past, spatial planning policy with agricultural development areas and Greenports determines much more where intensive livestock farming and greenhouse horticultural holdings may be established (Silvis et al., 2009).
The derogation to the Nitrate Directive; The derogation (exemption) granted by the European Commission to the Netherlands with regard to the Nitrate Directive. As a result, the Netherlands can apply 250 kg of animal manure per hectare of grassland instead of 170 kg. If the derogation is no longer granted, this will increase further. As a result, manure disposal costs will rise, meaning that the cattle population will decline. This will particularly affect the

number of dairy cows (around -5%), fattening pigs (-5%) and breeding sows (-2%) (Silvis et al., 2009).

National policies

In 2007 the coalition agreement of the Dutch Government stated the following; strive for a 2% reduction in energy consumption per year, stimulation of alternatives commodities for fossil and translated to a 20% alternative energy share and a 30% reduction of greenhouse gases. In 2007 the Ministry of Agriculture policy was to focus on efficient use of biomass, sustainable production of biomass, stimulate use of renewable energy, market development by e.g. purchasing policy of Ministry of Agriculture (LNV, 2007).
The Dutch farmers' organisations and product boards and the Ministry of Agriculture signed a covenant on energy-efficiency, renewable energy and reduction of greenhouse gases in June 2008, called 'Schoon en zuinig'. The covenant is translated in work programmes per agricultural subsector.
The fiscal re-taxation of agricultural diesel fuel, from low excise duty to high excise duty. Based on the spring agreement of 2012 of the Dutch government, the fiscal taxation of agricultural diesel fuel to a lower excise duty will end at January 1, 2013 (Volkskrant, 2012);

Conclusions on Policy developments in The Netherlands

The international policies on WTO agreements are expected to have no effect on energy use. The CAP reforms influence the financial yield per hectare. The financial yield per hectare will be lower, which leads to lower income. The cost price remains the same. To compensate this effect, a lowering of the cost price could further simulate the growth process of bigger farms (see Demographic developments). The CAP reforms could also lead to additional demand on sustainability. This could mean that energy-efficiency will become a condition in de CAP.
The EU policy on sustainability and biofuels will potentially initiate a increase in sustainability and biofuel use.
The end of the derogation exemption to the Nitrate Directive is likely to have a great effect on energy use in agriculture. The organic fertilizer is likely to be processed into products that substitute inorganic fertilizer or become financially more interesting to use for arable farming. The substitution of inorganic fertilizers will lead to a lower energy use. The use of more organic fertilizer in arable farming will increase transport of organic fertilizer between regions in The Netherlands. This will lead to a significant increase in energy use.

2.7 Driver analysis

Based on the DESTEP analysis the importance per drivers is determined. The importance is scored based on the term in which the effect could be noticed.

Driver	Importance	
	Short-term (<3 years)	Long-term (>5 years)
• Dual development in agriculture (bigger becomes bigger, smaller become smaller)		X
• Problems in succession of farms		X
• Decline in working population		X
• Energy price increase	X	
• Agricultural commodity prices increase	X	
• Land price increase		X
• Increase in wages		X
• Internationally renowned research institutes present		X
• High level of education in agricultural sector and efficient and innovative entrepreneurs		X
• Social resistance to industrialised agriculture		X
• Growing gap between citizens and agriculture		X
• Bio-based economy (use of by-products)		X
• Precision farming and robotisation	X	
• Genomics		X
• System Innovation		X
• Concern on Soil fertility	X	
• Salinization and water management		X
• Climate change		X
• Legislation (CAP)	X	
• Derogation in Nitrate Directive	X	
• Taxes (e.g. diesel fuel)	X	
• Subsidies to stimulate bio-energy or save fossil fuel consumption	X	

Clarification per driver

Demographic
All three demographic drivers are expected to have a noticeable effect on the long term. These are all processes that will take a number of years.

Economic
Energy prices and agricultural commodity prices are likely to show effect on the short term. It is seen that after good years earning are invested immediately into e.g. mechanisation or storage. The land price and wages increase change gradually.

Social

All social drivers are expected to have an effect on the long term. Research and education will both take a number of years to see effect of efforts made. The social resistance to industrialized agriculture and the growing gap between citizens and agriculture will change gradually the course of agricultural practice.

Technological

Only precision farming is expected to have an effect on the short term. The first innovators are working and experimenting with GPS-technology in practice. Several measures and techniques are ready to adopt at a larger scale. The bio-based economy (use of by-products), genomics and system innovations are technological developments that take a number of years to show an effect on energy use.

Ecological

Climate change and salinization and water management are developments that are effects visible in the long term. The attention to soil fertility is characterized by cultivation measures that can be apply the next cropping season. Therefore the attention to soil fertility is likely to have an effect on the short term.

Policy

All the developments in policy are expected to have an effect on the short term. A number of policies on taxes and subsidies will have effect on the short term, because the date in which the legislation takes effect is 2012 or 2013. In 2013 the derogation on the Nitrate Directive will end and the CAP due to be reformed.

3 Stakeholder analysis

The stakeholders' analysis is divided into two steps. The first step is the identification of stakeholders. The second step is the prioritization of stakeholders.

3.1 Identification of key stakeholders

The following key stakeholders are identified.

- Farmers
  Farmers are directly responsible for the activities on their farms. These tasks result in a certain energy use in their business. Farmers have therefore a strong influence on the energy-efficiency. They also have much interest in energy-efficiency, especially in potential financial gains.
- Farmers' organizations
  There are different farmers' organisations, which represent (mostly per agricultural sector) their members (the farmers). Because they represent the farmers, they have a great interest in energy-efficiency. The farmers determine the agenda of the farmers' organisations. Farmers' organisations inform and advice their members, but finally have little influence on energy saving behaviour and actions taken by the farmers on their farms.
- Agricultural input suppliers (nondurable goods)
  These suppliers often have sales representatives that have a strong relationships with their clients/farmers. Therefore their influence is big. Their interest is to sell agricultural inputs, such as fertilizers, crop protection, fodder, (fossil) energy. The use of fewer inputs would stimulate energy-efficiency. The interest of the suppliers goes not parallel with energy-efficiency and therefore they are classified as low interest stakeholder.
- Agricultural input suppliers (durable goods)
  The suppliers of mechanisation, greenhouses, animal husbandry systems and storage systems provide capital goods and systems that cause a considerable energy use. The use of energy can be a selling point. These suppliers have therefore great influence on farmers (and energy-efficiency). They also benefit from selling energy efficient machinery or storage systems. Therefore they have also a great interest in energy-efficiency.
- Food processing industry
  Food processors are interested in saving energy costs in their own production process. But related to marketing strategies they are more and more interested in the energy use of their suppliers of raw material. A number of projects to work on sustainability of primary production are unfolded the past few years. They have a significant interest in energy-efficiency and as buyer (or co-operatives) also significant influence on farmers.
- Trade organizations (commodities)
  The commodity market is a world market. Price and a certain quality standard are important for them. It is expected that they have no or little interest and influence on energy efficiency at farm level.
- Retail organizations
  The customers' demands are translated within the supply chain by the supermarkets. Just like some food processors energy-efficiency can be part of a marketing strategy, transparency policy or social venture entrepreneurship. They have a significant interest in energy-efficiency and as buyer also significant influence on the measures and practices of farmers.

- Intermediaries (banks, accountants, advisors, etc.)
  The intermediaries have often steady relationships with farmers. It's known that banks and accountants have considerable influence in strategic decisions. They therefore have great influence on farmers. As organisations they have little or no (direct) interest in energy-efficiency at farm level.
- National government
  The choices made by the national government determine e.g. the subsidies, taxes and legislation. The influence on farmers is significant. The national government has interest in energy-efficiency, due to national and international agreements they have committed to.
- Education, research organisations
  The educational institutes educate the farmers and employees of the future. The focus of the educational institutes stimulates the potential available skills in the agricultural sector in the future. Research results are translated into practice by farmers. Therefore the influence of research and education is expected to be significant. The structuring and financing of research and education determines predominantly the research and education themes. Therefore the interest is not specific on energy-efficiency except when it is prioritised by financers.
- Non-Governmental Organisations (nature conservation and animal welfare organisations)
  Nature conservation and animal welfare organisations are mainly the channel for critical citizens to express their concerns on developments within the agricultural sector. At the moment the use of energy in agriculture is not a major issue related to for example animal welfare or the use of pesticides. Concerning energy efficiency the NGO's have no significant interest or influence on farmers at the moment.

3.2 Prioritization of stakeholders

The following diagram is used to prioritise the stakeholders. This is done based on a brainstorm sessions with experts. Of course there are many nuances and individual stakeholders will have deviated positions than the general category they belong to.

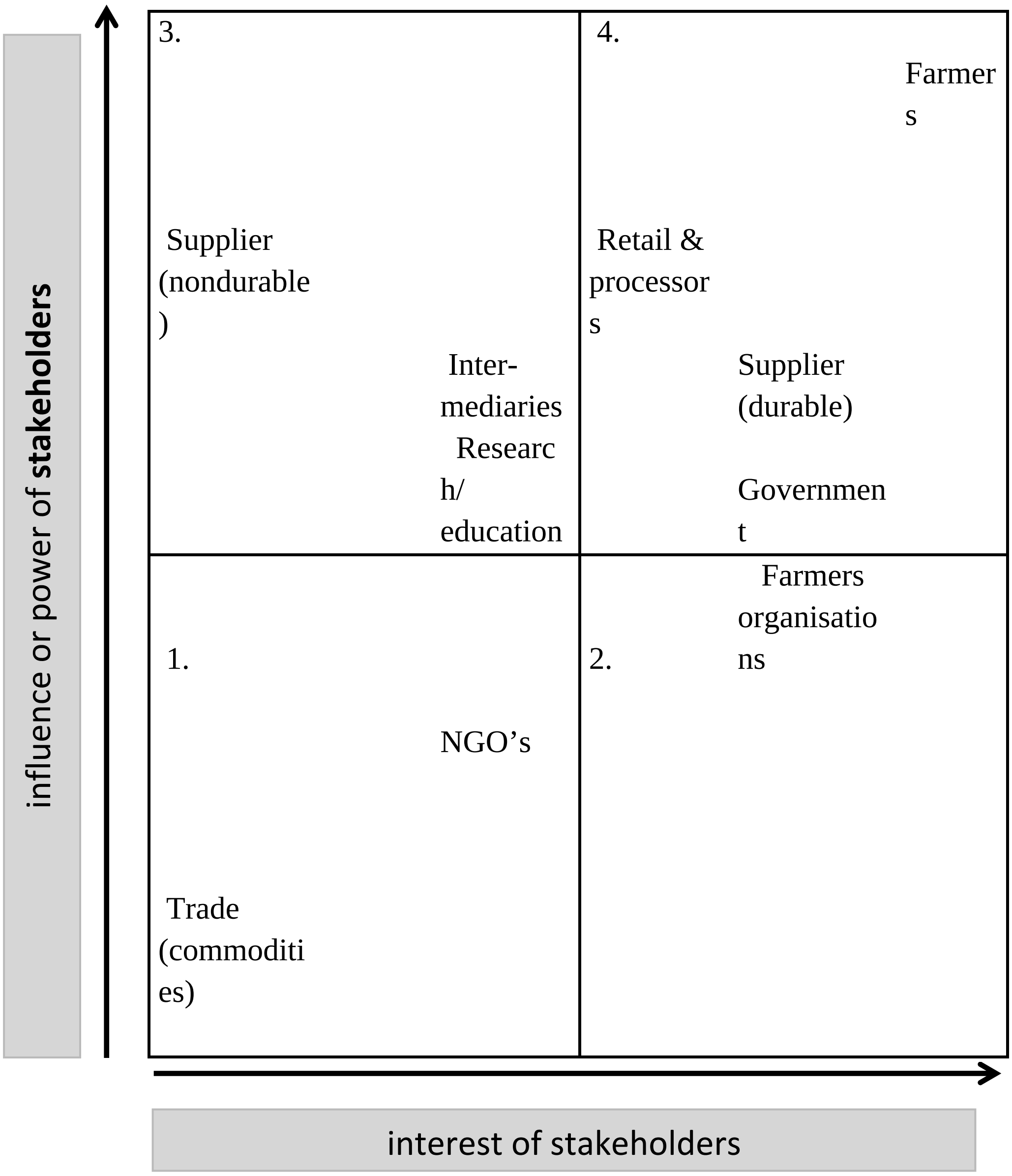


Figure 1.: Influence/Interest grid for stakeholder prioritization

The four quadrants are given in the diagram of figure 1. In terms of stakeholder management different actions are needed per quadrant for an effective and successful involvement of stakeholders in improvement of energy efficiency in agriculture. Suggested actions per quadrant of the diagram are:

1. Monitor (minimum effort) the developments in the position of the stakeholder

2. Keep the stakeholder informed
3. Keep the stakeholder satisfied, so their powerful position will not be a bottleneck.
4. Manage closely and stimulate collaboration

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Annex

List of Dutch stakeholders

Farmers' organizations
- LTO Nederland
- LTO Noord
- NOP
- ZLTO
- LLTB
- LTO Glaskracht
- Productschap Tuinbouw
- NJAK
- NVA / NVM / NVV / NVP / NAO

Agricultural input suppliers (non-durable goods)
- Agrifirm (Cehave)
- CZAV
- ForFarmers
- CAV Agrotheek
- Horticoop
- Profyto
- Ten Brinke
- AVAG platform toeleveranciers glastuinbouw

Agricultural input suppliers (durable goods)
- Agricultural mechanisation (branche organisatie COM)
- Greenhouse construction (Ammerlaan, Amelsvoort, Baptist, Zwirs-Knijnenburg, etc.)
- Livestock housing construction (Lely, Altez-Noord, Genugten, Stalbouw.nl, etc.)
- Livestock housing technique (Greutink, Lely, Insentec, Alfa Laval, Spinder, AHC CAWI, etc.)
- Climate control livestock housing (Fancom, Hotraco, Stienen, etc.)
- Storage technique (e.g. cold stores) (Polem (silo's), Tolsma, Omnivent, Cofely, Roma NL, Tolsma, etc.)

Food processing industry
- Dairy (FrieslandCampina, Arla, Cono kaas, Doc Kaas, etc.)
- Vegetables and potatoes (Unilever, Oerlemans, Laarakkers, HAK, Aviko, McCain, FarmFrites, Veco, Ardo, Baltussen, Kramer (GKZ), etc.)
- Sugar (Cosun/Suikeruni)

- Meat (Vion, Unilever, Ad van Geloven, Storteboom, etc.)
- Eggs (eierpakstations)

Trade organisations

- Tracomex
- Archer Daniels Midland
- Cargill
- Bunge
- Dreyfus
- Glencore
- Vegetable veiling (Greenery/Bakker Barendrecht, Veiling ZON)
- Non-food veiling (Flora Holland, Plantion)
- Fresteem, Nederlands grootste vereniging van telers
- TNI terra natura international

Retail organisations

- Ahold/Albert Heijn
- Jumbo Supermarkten
- Sligro
- Detailresult
- Coop Nederland
- Poiez
- Sperwer Holding

Intermediairies

- Banks (Rabobank, ABN AMRO Bank, ING Bank)
- Advice (DLV, Hortinova, Arvalis,
- Accountants (Accoun-AVM, Countus, Flynth, Alfa accountants, etc.)

National government

- Ministerie van Economie, Landbouw en Innovatie
- Ministerie van Infrastructuur en Milieu
- Agentschap NL
- RIVM
- Provincies

Non-governmental organisations

- Stichting Wakker Dier
- Milieudefensie
- Dierenbescherming
- Natuur en Milieu
- WNF

- Greenpeace
- Platform duurzame glastuinbouw