



# Renewable ethanol: driving jobs, growth and innovation throughout Europe

STATE OF THE INDUSTRY REPORT  
2014

  
made in  
eUROPE  
renewable ethanol



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# Foreword

As an industry, we have a track record of which we can be very proud, and we are convinced that renewable ethanol has an increasingly important role to play in meeting some of the fundamental challenges facing Europe. This is not, however, a story that we have told often or well enough, and is the reason behind why to produce this first ever State of the Industry Report.

This Industry Report represents a first step towards building a much better and broader understanding of the renewable ethanol industry in Europe. It is intended to describe the nature of the sector, how it has developed, its positive impacts, as well as explaining why it is so vital to Europe's future.

Having only begun in earnest in 2003 – long after our biggest competitor markets in US and Brazil – we have already made a significant contribution to creating jobs, particularly high skilled and rural, and supporting growth and European innovation. We have also made a significant contribution to the fight against climate change through the replacement of fossil fuels with renewable energy produced with non-food feedstock sourced 93% from Europe.

But renewable ethanol is about much more than just renewable energy. The sector is also a major producer of high-quality protein feed for animals, which is helping to meet Europe's food needs, and replacing imports of GM and antibiotic containing animal feed. Renewable ethanol is also a very important ingredient for beverages and a wide range of industrial sectors and consumer products. Some of our bio-refineries also feed energy back into national electricity grids, and much of the limited CO<sub>2</sub> we generate is used for industrial purposes.

Although the sector has matured quickly, it is still in its infancy. We are nowhere near to realising its potential. It can and should play an even more important role in reversing rising GHG emissions in the European transport sector, bringing additional income and development to Europe's rural communities, turning European technology and innovation into more green jobs, and reducing Europe's energy dependence. Our bio-refineries and the renewable ethanol they produce are essential components of the emerging bio-based economy.

Realising the potential of renewable ethanol will require a more supportive European Union policy framework; one that creates a level playing field and better nurtures the industry. But this will only happen if we, the industry, and the broader stakeholder community that has an interest in our success, work together to transform the awareness and understanding of renewable ethanol in Europe.

I hope that this report makes a significant contribution to the realisation of this objective.

Sincerely,



**Rob Vierhout,**  
Secretary General

# Executive Summary

The European renewable ethanol sector is a dynamic young industry bursting with innovation. New technologies and processes are constantly being developed that have the potential to help maximize the use of Europe's natural resources, and deliver cleaner fuel. But it's not just about fuel! Ethanol is also commonly used in the drinks, spirits, and chemicals industries, and the sector is a major producer of high protein animal feed.

Although EU ethanol production and consumption has been continuously growing since 2003, Europe remains a relatively modest player globally. At 8.8 billion litres installed production capacity and a market value close to €8 billion, the EU is the world's third largest producer of ethanol, after the US and Brazil. Today's EU ethanol industry delivers greater climate savings and net benefits to society than anyone could have expected.

Ethanol is the most cost-effective and readily available means of substantially decarbonising Europe's transport sector, which currently accounts for over a quarter of the EU's total GHG emissions and is rising. When it comes to GHG savings, ethanol is both clean and renewable and is esti-

mated to reduce transport sector GHG emissions by up to 90% compared to fossil fuels. With the right policies in place, substantial further cuts in GHG emission can be achieved.

Ethanol has increased in importance given Europe is now focusing more intently on the carbon abatement costs of renewables as a whole. When ethanol is combusted in your car's engine, it is not combusted separately from the petrol with which it is blended. There is an emerging scientific consensus that when more ethanol is blended into petrol, the petrol burns more efficiently than pure petrol. This is a very significant added benefit, which means that ethanol abates carbon not once, but twice over – in its production and in its combustion. The combustion benefit is a carbon offset that currently is not credited to ethanol at all. When ethanol is duly credited, then the carbon abatement cost of ethanol plummets to, or below, zero, making ethanol today's strongest, safest, and most attractive option to decarbonize the EU's transport sector.

With unemployment – particularly youth and rural unemployment – remaining a key concern in Europe, the renewable ethanol industry serves

as a vital ingredient in Europe's quest to boost growth and create high-skilled and 'green' jobs. Since the EU introduced its biofuels policy, the European renewable ethanol industry has created and sustained 70,000 direct and indirect jobs – in engineering, construction, operations and transport, etc. – even during the economic crisis, with the potential to create 1 million new jobs in Europe.

Our companies have made investments in Europe over the past eight years totalling €8 billion. If the right policy conditions facilitate further investment, then European ethanol production could be the catalyst for transforming rural areas. Cellulosic ethanol production will, for example, make the collection of agricultural residues more economical, which will diversify farmers' income and generate additional European revenues of up to €15 billion annually.

Contrary to some pre-conceived notions, no EU ethanol producer has ever been involved in land grabbing, whether in Europe or beyond. Ethanol production makes excellent use of available space, especially when one considers that the crops and refining process are also used to produce high protein content animal feed.



Figures from the UN's Food and Agriculture Organization (FAO) show that the use of animal feed co-products from EU biofuel production (including EU biodiesel) reduces global land use by about 3 million hectares. This is because yields of biofuel crops grown in the EU are substantially higher than those of soybean in South America.

The FAO also suggests that an average of 0.5 million hectares of arable land – land that could and should be used to grow crops to produce animal feed and fuel – is taken out of production in Europe every year. Whilst ILUC risk remains, this underscores the importance of ensuring that mandatory sustainability criteria are strengthened to increase the social, environmental and climate benefits from biofuels used in Europe.

Concerns over indirect land use change (ILUC) often associated with the EU ethanol industry are fundamentally wrong. The EU ethanol industry has a very positive record, and we welcome recent indications detected over the past year to focus less on ILUC as an abstract global theory (with projected impacts a decade out), and more on how ILUC can be minimized immediately through incentivising better

practices and clear action at the local level.

Europe can produce vast amounts of ethanol with little or no ILUC through the use of low-carbon stock abandoned land, increasing agricultural yields, planting of perennial energy grasses that sequester huge amounts of carbon while yielding feedstock for cellulosic ethanol, and using waste and residues for both conventional and advanced ethanol.

Renewable ethanol has had a tiny impact on global food commodity prices to date and is not expected to have any larger impact going forward. All the serious evidence confirms that commodity costs constitute a relatively small percentage of the eventual price of food. It is the processing, packaging, transport and associated retail services that really add up. These stages along the food supply chain all require energy, so it is not surprising that energy prices play a major role in the eventual cost of food. In fact, ethanol actually boosts food security by helping to increase yields in the poorest parts of the EU, and by producing millions of tons annually of GMO free, antibiotic free animal feeds that would otherwise be imported.

As concerns over energy security and overreliance on energy imports from politically unstable regions increase, there is massive untapped potential for renewable ethanol to help Europe diversify its supply and increase energy security. Ethanol is currently the most taxed fuel in the EU's entire energy mix, and a fairer taxation system based on pragmatic considerations, such as energy content and CO<sub>2</sub> performance, would help to support the growth of the sector and alleviate some of the EU's energy concerns.

To realise the enormous potential of renewable ethanol, the EU must work towards creating a favourable climate that will utilize the full potential of European renewable ethanol production. From a policy-making perspective, what is needed is the creation of a long-term, stable policy framework, that is capable of restoring investor confidence in the EU biofuels market; binding EU 2030 targets for renewable energy use in transport and decarbonisation targets under the Fuel Quality Directive (FQD), and; a fair and balanced EU trade policy that recognizes and respects the fact that the domestic ethanol industry requires time to mature, and that counters unfair trade practices such as dumping.



# A European success story: renewable ethanol

*European renewable ethanol production is a dynamic young industry bursting with innovation. New technologies are being developed that have the potential to help maximize the use of Europe's natural resources, and deliver cleaner fuel. Renewable ethanol can also be found in numerous consumer goods, and the sector is helping to bring highly skilled jobs to rural regions.*

## A global comparison

Although EU ethanol production and consumption has been continually growing since 2003, Europe remains a relatively modest player globally. At 6.7 billion litres and a market value close to €8 billion the EU is the world's third largest producer of ethanol. The US produces and consumes around 50 billion litres annually, followed by Brazil with around 23 billion.<sup>1</sup>

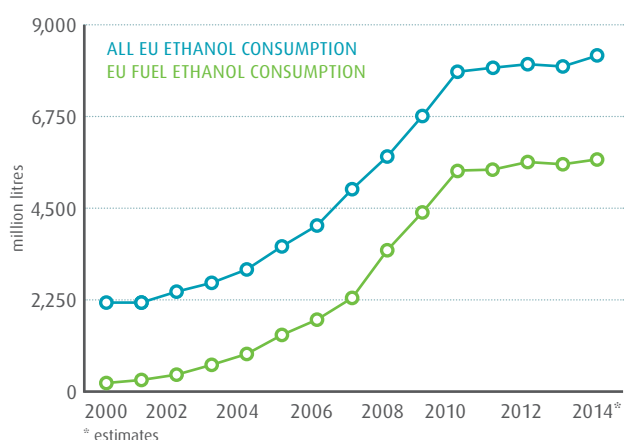
## Bringing benefits to Europe

Despite its size, the impact of renewable ethanol production has been significant. Ethanol is both clean and renewable and reduces transport sector greenhouse gas (GHG) emissions by up to 90% compared to fossil fuel.<sup>2</sup> Ethanol plants turn also a wide range of feedstock into bio-based products making it a true bio-refinery.

New markets and employment opportunities were created, not only for farmers in some of Europe's most isolated rural regions but also for highly skilled professionals. Ethanol helps chemical manufacturers become greener, reducing their dependence on fossil fuels. Domestic ethanol production helps Europe become less energy dependent.

It may be difficult to spot, but ethanol is part of our daily lives, used in drinks, perfumes and many industrial manufacturing processes. The petrol in your car contains up to 5% ethanol. And petrol cars built since 2000 can run on petrol with 10% ethanol in it, known as E10.

**ETHANOL CONSUMPTION IN THE EU**



**2013 ETHANOL BALANCE (billion litres)**

	Production capacity	Production	Consumption	Imports	Imports % of consumption	Exports
U.S.A.	56	51	50	1.6	3.2%	2.9
Brazil	40.7	23.5	20.9	0.3	1.4%	3.6
EU	8.8	6.7	7.9	1.2	15.2%	0.1

Source: F.O. Licht

1. RFA 2014 Ethanol Industry Outlook; UNICA  
2. EU Directive 2009/28/EC

## Key facts and figures

- 1 Ethanol – also called ethyl alcohol but more commonly referred to as alcohol – is a volatile, flammable, colourless liquid. It is produced from a variety of biomass through a fermentation process.
- 2 Industrial-scale ethanol production plants can currently be found in 20 EU Member States. France and Germany are the largest European producers. France has the most installations, followed by Poland and Germany.
- 3 The most commonly used feedstock are wheat maize and sugar beet. These three commodities represent close to 90% of raw materials used. Other crops include barley, rye and triticale (a hybrid of wheat and rye).
- 4 Most EU capacity is dedicated for energy use, which is estimated to be around 5.5 billion litres. About 17% of the EU's installed renewable ethanol production capacity is used in a variety of other sectors such as cosmetics, pharmaceuticals, chemicals and beverages.

# Helping industry to develop new products

The chances are that you have used or consumed a product containing ethanol in the past week. While most ethanol produced in Europe ends up in the tank of your car, it is also used by many other industrial sectors to produce countless consumer goods.

### IT'S NOT JUST ABOUT FUEL!

Perhaps the best-known industrial user of ethanol – after transport – is the drinks industry. Ethanol is used to make many kinds of spirits, such as vodka, gin and anisette, and can also be found in ready-to-drink mixes. It is also used to make perfumes, deodorants, paints, thermometers and cosmetics.

Ethanol also has medical uses, and can be found in products such as sanitary wipes and antibacterial hand gels. It is widely used as a solvent, and you'll find it in many products around the house, such as the de-icer or anti-freeze you use to clear your car windscreen. Ethanol is also a key ally in the chemical industry's bid to go green.

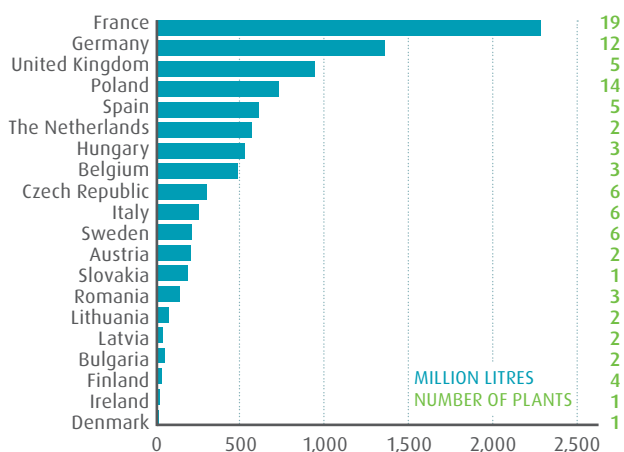
### BREAKING INTO PREMIUM MARKETS

Chemical, pharmaceutical and cosmetic industries use the highest and purest possible form of ethanol, and the same high standards apply for the manufacture of spirits.

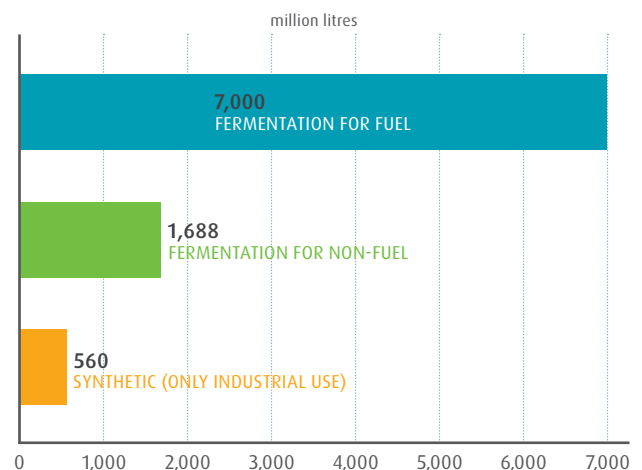
### DENATURED OR UNDENATURED?

Alcohol intended for human consumption – mostly in the form of spirit drinks – needs to be pure; no chemicals can be added. This pure form of alcohol is called undenatured, and always carries a very high excise duty. For non-human consumption ethanol can be blended with certain chemicals and ingredients – this is known as denatured alcohol.

**PRODUCTION CAPACITY OF RENEWABLE ETHANOL  
IN THE EU PER COUNTRY IN 2014**



**INSTALLED ETHANOL PRODUCTION CAPACITY  
IN THE EU IN 2014**



# Renewable ethanol: at the cutting edge of second-generation fuels

*The renewable ethanol sector is a vital ingredient in Europe's quest to boost growth and jobs, and achieve greater resource efficiency. Second-generation production will allow us to produce ethanol from a wider range of feedstock, including cellulosic, agricultural residues and waste streams.*

## Moving towards second generation biofuels

Second generation (or advanced) biofuels, such as cellulosic ethanol, offer renewable fuel that further optimises resource efficiency. Cellulosic ethanol is produced from agricultural residues such as straw, corn stover (the leftover leaves and stalks), dedicated energy crops such as miscanthus and switch grass, and waste. It has the same chemical characteristics as any other type of ethanol and delivers high GHG emission savings.<sup>3</sup>

The production of cellulosic ethanol requires pioneering enzyme and yeast extraction technologies (technologies in which European companies lead), as well as highly skilled people and high-tech facilities. A healthy market for conventional renewable ethanol, combined with a long-term investment plan for advanced biofuels, will help the European bio-economy to realise its full potential. The EU has traditionally excelled in financing initial R&D projects up to the point of pilot and demonstration plants. Dedicated and ambitious investment support for fully integrated commercial scale bio-refineries – as foreseen in the Bio-based Industries Public Private Partnership under Horizon 2020 – is now required to take European ethanol production to the next level.

## Creating highly-skilled jobs

Existing ethanol bio-refineries can easily be turned into more advanced bio-refineries, capable of converting both conventional and cellulosic feedstock and reaping the benefits of both first-generation and second-generation biofuels.

By 2030, some 220 million tonnes of cellulosic material (from agricultural residues, municipal solid waste and forestry residues) could be made available for EU ethanol production, creating up to 300,000 jobs in Europe – mostly in high-tech areas – as a direct result.<sup>4</sup>

Cellulosic ethanol production will make the collection of agricultural residues more economical, which will diversify farmers' income and generate additional European revenues of up to €15 billion annually. Second-generation production technologies have the potential to process new, dedicated energy crops grown on degraded or marginal land that currently lies fallow.

## A constantly innovating sector

The sector is constantly innovating in other ways. New enzymes and yeasts are being developed to further increase ethanol yields. New techniques are introduced to extract oil from maize and wheat and every year the industry becomes more energy efficient. Best practices have been implemented to ensure that production plants are as sustainable as possible and to ensure that the waste level goes to zero or is harmless. Water use is, for example, kept to a minimum and treated before discharge, and several plants are water neutral.



3. EU Directive 2009/28/EC, Annex V.B, page 53

4. Wasted: Europe's Untapped Resource, European Climate Foundation (2014)



## Why EU policy must adapt

The EU must set specific mandates in order to stimulate innovation in capital-intensive advanced ethanol technologies. This target, combined with a longer-term perspective of the EU's climate policy and meaningful financial support for upfront investments, would provide investors and innovators with clarity and a predictable market.

Change is needed. The first commercial cellulosic ethanol facility in Europe opened in Northern Italy in 2013; other pilot and demonstration facilities are currently in operation, but there are no other prospects for commercial scale cellulosic ethanol in Europe at present.

In contrast, several plants are under construction in the USA and Brazil.

This means that while European companies are world leaders in advanced innovative biofuel technologies, investments are increasingly being made outside the EU, where conditions are more favourable.

The EU needs to urgently help ventures move from R&D to the commercial deployment of advanced biofuels to avoid this 'innovation leakage'. Currently the only support mechanism for cellulosic ethanol, contained in the Renewable Energy Directive (RED), is

that all contributions to the renewables target from 'biofuels from wastes, residues, non-food cellulosic material and ligno-cellulosic material shall be considered twice that made by other biofuels'.

There's a problem here: no one can drive on 'virtual' fuel. Double or even quadruple counting means that renewables targets can be met without creating the actual fuel to fill up our vehicles. This leads to a situation where fossil fuels are required to make up for this 'virtual' fuel that has been calculated, but does not actually exist!

### DOUBLE COUNTING HAS NOT DELIVERED INNOVATIVE ADVANCED BIOFUELS IN THE EU

Country	DC BIODIESEL		DC ETHANOL	
	Volumes m <sup>3</sup>	% of diesel replacement	Volumes m <sup>3</sup>	% of gasoline replacement
Denmark	12,500	12%	3,000	3%
France	132,000	5%	0	0%
Germany	350,000	13%	0	0%
Hungary	n.a.	n.a.	0	0%
Italy	111,000	7%	0	0%
The Netherlands	100,000	28%	50,000*	18%
Spain	192,000	10%	0	0%
UK	900,000	90%	0	0%

\*methanol



# Ethanol plants: the engine room of the new bio-based economy

*The bio-based economy is about replacing fossil fuel derivatives with renewable, low carbon bio-products and materials. Bio-refineries are the engines of this new economy, and with pioneering technology, ethanol plants can turn a wide range of feedstock into bio-based products including food, feed, fuel and chemicals.*

## **Greening the chemicals sector**

The European ethanol industry will help chemical manufacturers become greener by reducing their dependence on fossil fuels. The sector is heavily reliant on fossil-based raw materials, which are of course rapidly depleting and environmentally damaging. Developing alternatives will help

cut emissions and secure the EU's competitiveness in a post-carbon economy. The end result will be chemical-based processes and products with a significantly reduced carbon footprint.

Change is already underway. The production capacity of bio-based plastics for instance is estimated to have increased by 200% since 2010, with further growth anticipated.<sup>5</sup> Replacing fossil sources with renewable ethanol will not only help reduce dependency on finite resources and cut the CO<sub>2</sub> footprint of end products; it will also support growth and jobs in rural areas where biomass is sourced and often processed.

A modern ethanol plant transforms biomass into a multitude of valuable products. The production process is continuously optimised to improve its efficiency and new applications for the end products are repeatedly found. European ethanol biorefineries are very resource efficient and innovative and a vital building block for the development of Europe's bio-based economy.

<sup>5</sup> *European Bioplastics (2014)*



# Did you know

There are bio-refineries operating in Europe today that are energy self-sufficient and even feed some of the green electricity into the national energy grid.

In 2012 animal feed produced in EU ethanol biorefineries replaced roughly 10% of third country imports, lowering emissions and land use for the animal feed sector.

Through such integrated process some plants achieve emission savings for ethanol of up to 90% compared to fossil fuel alternatives.

Many of the co-products of ethanol production are essential raw materials for Europe's industries that would otherwise have to be imported or separately produced.

CO<sub>2</sub> released in the production process is used in the production of carbonate beverages, greenhouses to stimulate plant growth or is captured underground.

Ethanol biorefineries invest millions every year to improve efficiency and develop new applications for their end products.

Water taken from rivers is returned cleaner than when it was extracted.

# 1 What goes in

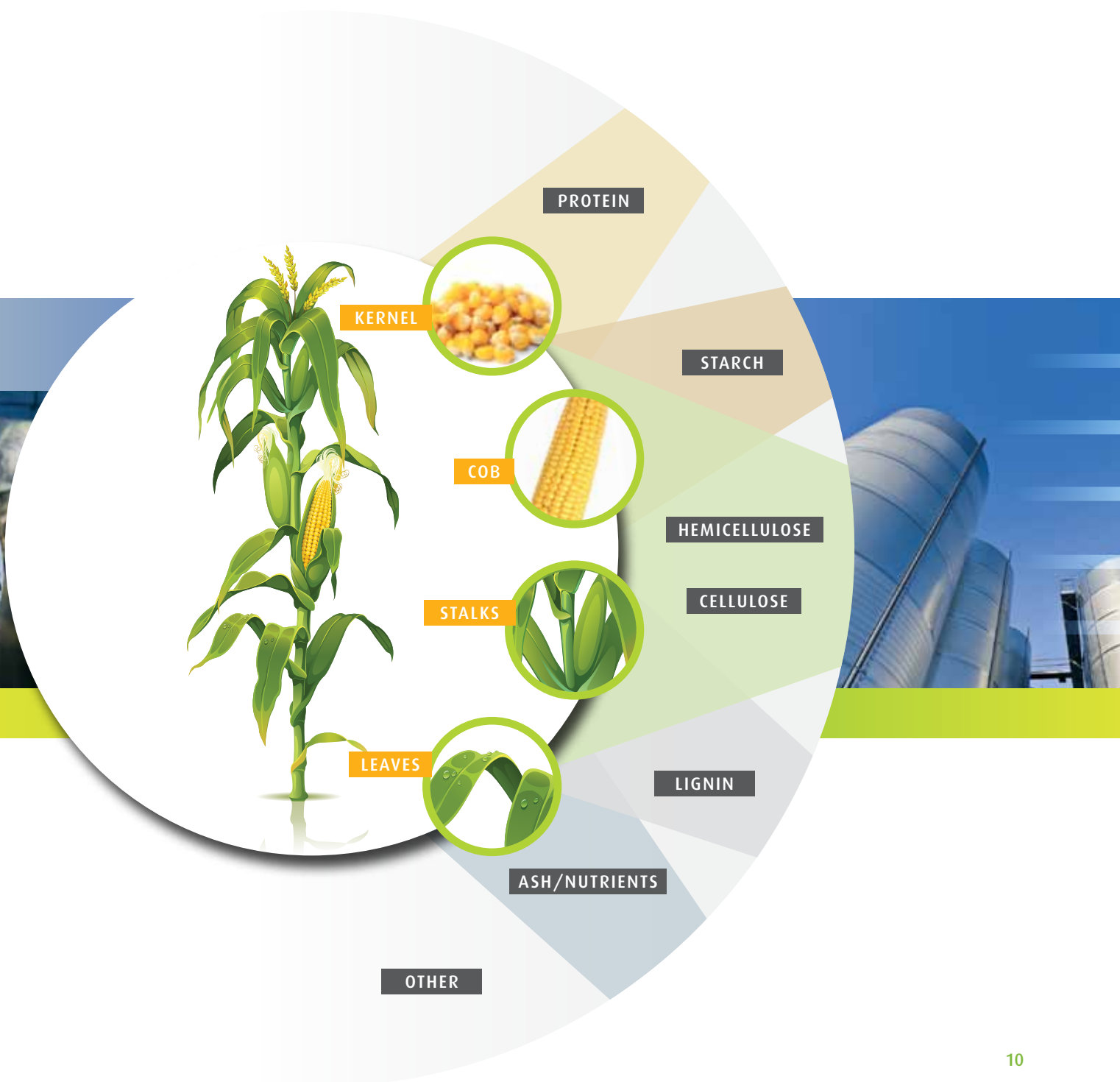
Biorefineries use biomass to produce a wide range of high-value bio-based products.

Traditionally, biomass such as maize, wheat, barley, rye or sugar beet are used. Due to technological advancement, non-edible based raw materials, such as municipal waste, agricultural residues, or recycled wood and energy crops can also be used.



# 2 How it works

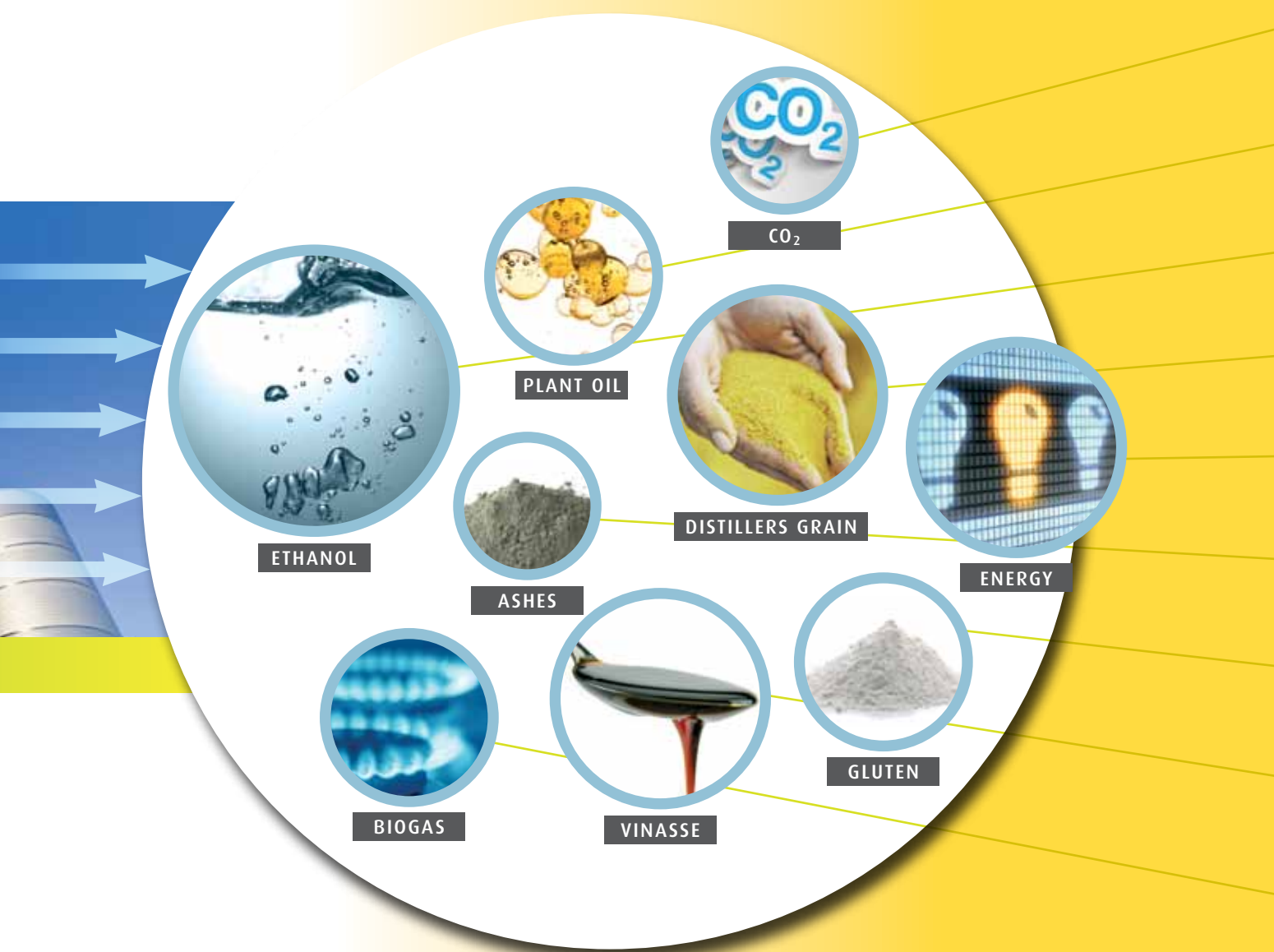
We can divide organic materials into their different components, such as proteins, starches, hemicellulose, cellulose, lignin, and nutrients. Each of them is then used in the most efficient way to produce a range of high-value products.



# 3 What comes out

For instance, sugars are freed for the fermentation into ethanol and fibers and proteins are used to produce animal feed.

This ensures that nothing of the biomass goes to waste and our resources are used efficiently.



# 4 Bio-based economy

Ethanol is a versatile product that finds its application in many products. Traditionally it is used in the beverage industry, but it can also be used as a motor fuel to power your car. Ethanol has industrial uses and is also an essential building block to produce other bio-based products, such as bio-plastics and bio-chemicals.

The animal feed is very rich in proteins and helps Europe to address its protein deficit and reduces soymeal imports from third countries. It is typically used to feed cattle and other ruminants, pork, poultry and fish.

The leftovers, such as lignin are used to generate electricity in a biomass generator. The energy is used to power the biorefinery, but some of it is also fed back into the national energy grid.

The ashes and vinasses are used as organic fertilisers in the agricultural sector.

CO<sub>2</sub> that is released during the fermentation of starch to ethanol is captured and can be used to produce carbonated soft drinks or in greenhouses to stimulate plant growth.



**GREENHOUSES**



**ELECTRICITY**



**BIO PLASTICS**



**ANIMAL FEED**



**COSMETICS**



**BEVERAGES**



**FUEL**



**FERTILIZERS**



**CARBONATED DRINKS**



**BIO CHEMICALS**



**PHARMACEUTICALS**

# Bringing highly skilled jobs and additional income to revitalise rural Europe

*Unemployment in Europe – and in particular youth and rural unemployment – remains a key concern. Europe’s innovative renewable ethanol industry is creating new markets and employment opportunities, not only for Europe’s farmers but also for highly skilled professionals.*

## **Ethanol: a job creator**

ePURE producing companies have created jobs in engineering, construction, operations and transport, and sustained many more jobs indirectly. Since the EU introduced its biofuels policy, the European renewable ethanol industry has created and sustained 70,000 direct and indirect jobs, even during the recent economic crisis.<sup>6</sup>

Employment in the European ethanol sector could rise significantly under the right policy conditions, with studies suggesting that up to 1 million new jobs could be generated if the potential for advanced ethanol production is fully realised.<sup>7</sup> Jobs will come from constructing bio-refining capacity, making the necessary adjustments to existing bio-refineries, operating these bio-refineries and collecting and delivering advanced feedstock to these plants.

## **Revitalising Europe’s regions**

Our companies have made investments in Europe over the past eight years totalling €8 billion. If the right policy conditions facilitate further investment in advanced bio-fuels, then European ethanol production could be the catalyst for: transforming agricultural and transport infrastructure in rural areas, particularly in Eastern Europe; increasing demand for cellulosic material, which will create new markets for farmers to sell their crops and organic waste; and enabling the development of support services and businesses linked to ethanol biorefineries.

## **Providing additional income and helping to sustain agricultural production**

By creating jobs, boosting household incomes, and generating additional revenues for farmers, European ethanol production can help alleviate rural poverty in some of the most developed and underdeveloped areas of Europe.

This view is backed by the FAO, which states that investment in biofuels can help to improve food security in rural economies by creating jobs and boosting incomes.<sup>8</sup>

ePURE producing members have invested in developing highly skilled professionals in a wide variety of sectors, such as services, research and agriculture.



**FAO, May 2011**

Investment in bioenergy could spark much-needed investment in agricultural and transport infrastructure in rural areas and, by creating jobs and boosting household incomes, could alleviate poverty and food security (and) there is great potential for the co-production of food and fuel using existing methods and technologies.<sup>9</sup>



6. *Contribution of Biofuels to the Global Economy, Cardno Entrix (2012)*

7. *Moving Towards a Next-Generation Ethanol Economy, Bloomberg New Finance (2012)*

8. *Bioenergy and Food Security: The BEFS Analytical Framework, UN Food and Agriculture Organisation (2011)*

9. *Making Integrated Food-Energy Systems work for People and Climate, UN Food and Agriculture Organisation (2011)*



FOR EVERY 100M LITRES OF DOMESTICALLY PRODUCED RENEWABLE ETHANOL,  
APPROXIMATELY 1,500 LONG-TERM JOBS ARE CREATED.

## Ethanol production: boosting growth and jobs in

### France

The French renewable ethanol industry's investments generated €815 million of added-value to the French economy in 2010, and sustained 8,900 jobs. That year, ethanol production and sales resulted in more than €300 million in fiscal revenues to the French government. Furthermore, with a direct added-value of €34 million, the sector contributed significantly to the country's trade balance.<sup>10</sup>

### Germany

A single ethanol plant in Germany alone sustained 2,500 jobs, created €51 million of direct added-value to the economy and generated indirectly an additional €96 million for other industries, such as farming. The project created €92 million tax revenues for the public purse in the past four years.<sup>11</sup>

### Hungary

An ethanol plant in Hungary accounts for €275 million of the country's GDP and 1,250 jobs, a contribution that is expected to increase to €450 million and 1,750 jobs in the course of 2014.<sup>12</sup>



10. *Estimated Socio-Economic Impacts of the Bioethanol Industry in France in 2010*, PricewaterhouseCoopers (2013)

11. *The Economic Importance of Bioethanol Production by the CropEnergies Group in Germany*, WifOR (2013)

12. *Impact Study on Pannonia Ethanol Dunafoldvar and Pannonia Ethanol Mohacs*, HETFA Center for Analyses (2013)

# Managing land in a more efficient way

*Producing ethanol from feed crops is much more efficient than you might think. Enriched protein-rich animal feed is produced at the same time as renewable energy feedstock, thus optimising the use of EU grain and reducing the need for overseas imports.*

## An incentive to optimise land use

Ethanol made in Europe results in additional demand for agricultural crops. A demand that has not resulted in more land being used but was achieved through increased agricultural productivity.

In 2013 the EU ethanol industry used 7.83 million tonnes of grains and 1.5 million tonnes of sugar. 93% of the feedstock used to produce ethanol originated in the EU. According to the EU Cereal Balance 2% of the grain grown in the EU is used to produce fuel ethanol, which means that 98% of European grain production is used for other purposes. Production of renewable ethanol in Europe only uses around 0.7% of agricultural land: less than the unused farmland in Romania alone.

Ethanol production makes excellent use of available space, especially when you consider that crops are also used to produce high protein content animal feed. The protein extracted from cereal is enriched to produce animal feed that replaces imports of soy meal from other parts of the world. In this way European ethanol production contributes indirectly to reducing land use outside Europe.

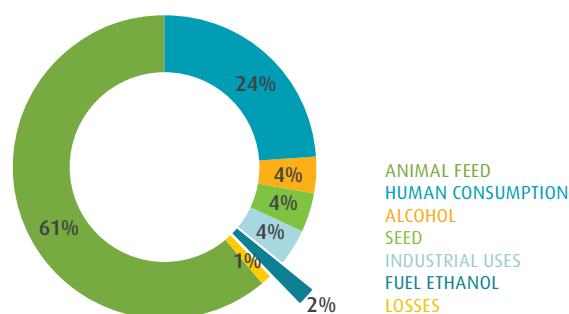
## Realising the untapped potential

In Europe there is ample opportunity to increase yields (by a factor of 2 - 3 in parts of central and Eastern Europe) without using more land.

According to the FAO, an average of 0.5 million hectares of arable land is taken out of production in Europe every year.<sup>13</sup> This abandoned land could and should be used to grow crops to produce animal feed and fuel.

With further advances in agricultural productivity, and by using fallow agricultural land, Europe has massive untapped potential for meeting the demand for renewable energy and animal feed in sustainable ways.

END USE OF EU CEREALS SUPPLY IN 2013/14



Source: EU Cereals Balance, DG AGRI, European Commission



13. Staff Working Document 343, page 94, European Commission (2012)

## Making better use of the land

Europe's renewable ethanol production represents only **0.02%** of global agricultural land use.<sup>14</sup>

In 2013/2014, European production of renewable ethanol co-produced an estimated **3.7 million tonnes** of animal feed co-product – which is enough animal feed to substitute about 1.7 million tonnes of soya bean meal and 1.7 million tonnes of feed wheat.

Some **70%** of protein crops consumed as animal feed in the EU is imported.<sup>15</sup>

FAO figures show that the use of animal feed co-products from EU biofuel production (including EU biodiesel) reduces global land use by about **3 million hectares**. This is because yields of biofuel crops grown in the EU are substantially higher than those of soybean in South America.<sup>16</sup>

In 2013/2014 ethanol produced in Europe co-produced enough animal feed to free up approximately **1.4 million hectares** of agricultural land outside of Europe for other purposes due to the higher yields of EU crops.

EU ethanol production utilises 1.9 million hectares of land but saves **1.4 million hectares** of land in 3<sup>rd</sup> countries due to the co-production of animal feed which displaces the need for crop imports.



14. The current available global agricultural land area is 5 billion hectares. UN Food and Agriculture Organisation (2013)

15. EU Protein Deficit: What Solution for a Long-Standing Problem? European Parliament (2010)

16. Biofuel Co-Products as Livestock Feed: Opportunities and Challenges, UN Food and Agriculture Organisation (2013)

# In harmony – not competition – with Europe’s food supply

*One concern that some people have about biofuels is that diverting crops to produce fuel for cars will make food more scarce and expensive. The reality however is rather different.*

## Making the most of Europe’s crops

The overwhelming majority of agricultural crops that end up as ethanol are not intended for human consumption, but to feed animals. Sugars extracted from the crop – be it wheat, maize or rye – are used to produce ethanol, while protein is extracted and enriched for animal feed. This helps to reduce Europe’s reliance on protein feed imports from the Americas and, on top of this animal feed produced in Europe is GMO-free. In fact, for every tonne of cereals grown, as much animal feed is produced as ethanol.

Some ethanol plants also produce gluten that can be used in food manufacturing, and those plants that use maize as feedstock can also generate maize oil – a valuable animal feed and important ingredient for various industrial processes.

## So what is driving food costs?

Commodity costs constitute a relatively small percentage of the eventual price of food. It is the processing, packaging, transport and associated retail services that really add up. These stages along the food supply chain all require energy, so it is not

surprising that energy prices play a major role in the eventual cost of food.

Together, these factors account for close to 90% of all food costs.<sup>17</sup> As a consequence, even significant changes in agricultural commodity prices have relatively little effect on retail food prices. In 2013 food prices did not fluctuate a great deal, even though cereal prices tumbled by as much as 40%.

All the serious evidence suggests that the emergence of biofuels has not been responsible for food price rises.

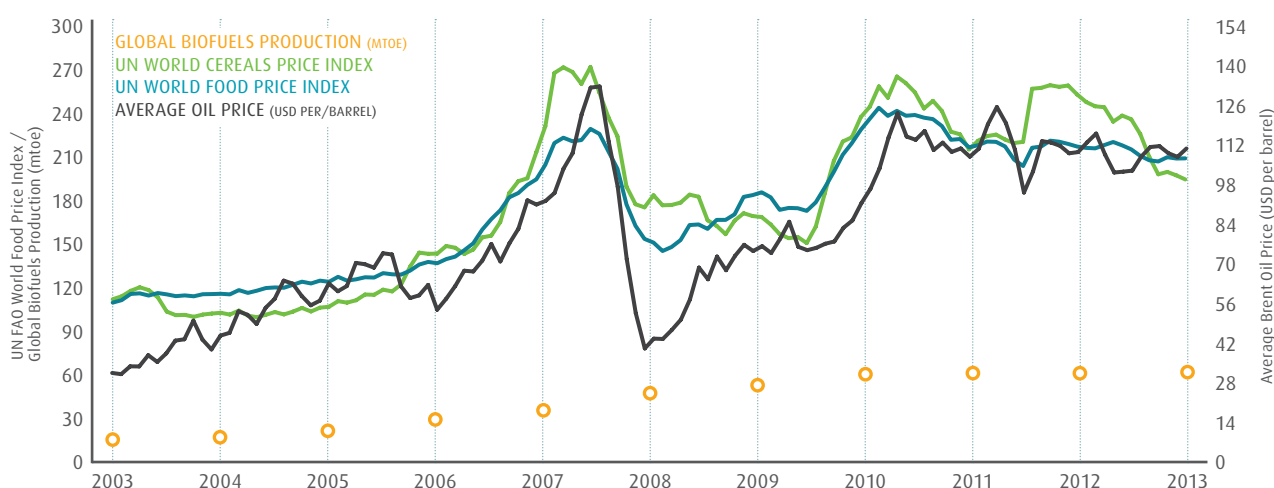
## What Affects Your Food Costs ?

**14%** Commodity Prices      **86%** Everything Else



- FOOD PROCESSING
- PACKAGING
- RETAIL TRADE
- FOOD SERVICES
- ENERGY - TRANSPORTATION
- FINANCE
- OTHER

**WORLD FOOD AND OIL PRICES (2004-2013)**



17. US Department of Agriculture

## The facts about food prices

The World Bank, which in 2008 suggested that biofuels were playing a major role in higher food prices, released an analysis in July 2010<sup>18</sup> which found that "...the effect of biofuels on food prices has not been as large as originally thought..." and that "...the use of commodities by financial investors may have been partly responsible for the 2007-08 spike".

A March 2010 report<sup>19</sup> from the UK's Department for Environment, Food and Rural Affairs found that "available evidence suggests that biofuels had a relatively small contribution to the 2008 spike in agricultural commodity prices".

In 2013, a World Bank report<sup>20</sup> concluded that "most of the (food commodity) price increases are accounted for by crude oil prices (more than 50%), followed by stock-to-use ratios and exchange rate movements, which are estimated at about 15% each" and "our results imply that (biofuels) effect on food prices is not as strong as has been reported in previous studies".

The European Commission published a report in March 2013<sup>21</sup>, which found that grain use for ethanol has had "a minor (1%-2%) price effect on the global cereals market".

## Let's keep things in perspective

EU ethanol production yields enough protein to feed about 2.3 million dairy cows per day, which is **10%** of the current EU dairy herd of 23 million cows.

On a net basis renewable ethanol production in Europe uses only **2%** of the EU grain supply, and only 0.7% of Europe's agricultural land.

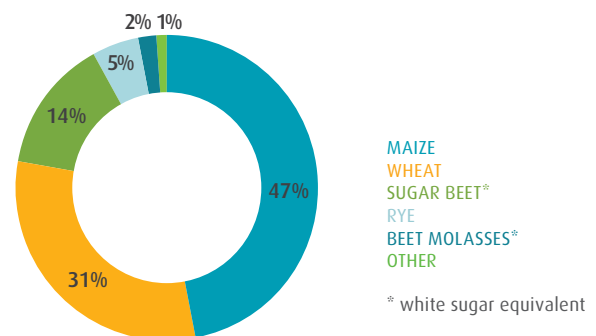
The EU is abandoning agricultural land every year at a rate of **0.5 million ha**.

1.4 billion ha of land – or **28%** of the world's total agricultural area – is used annually to produce food that is either lost or wasted.<sup>22</sup>

## A variety of crops

Ethanol can be made from many different kinds of raw material. Even though most ethanol is still produced from agricultural crops, European production makes use of an ever-increasing variety of feed crops. The biggest share still comes from wheat, but there is also maize, barley, rye, triticale (a hybrid of wheat and rye) and sugar beet. The ability to vary feedstock gives producers flexibility and the possibility to adjust to market circumstances.

ESTIMATED FEEDSTOCK SHARE OF EU ETHANOL PRODUCTION (2013)



18. *Placing the 2006/08 Commodity Price Boom into Perspective*, World Bank (2010)

19. *The 2007/08 Agricultural Price Spikes: Causes and Policy Implications, Annex 5*, Department for Environment, Food & Rural Affairs (2010)

20. *Long-Term Drivers of Food Prices*, World Bank (2013)

21. *Renewable Energy Progress Report, page 12*, European Commission (2013)

22. *Food Wastage Footprint: Impacts on Natural Resources*, UN Food and Agriculture Organization (2013)

# Ethanol: answering the need to decarbonise Europe's transport sector

*Ethanol – the only renewable fuel that can be mixed with petrol and used in petrol engines – is the most cost-effective and readily available means of substantially decarbonising Europe's transport sector.<sup>23</sup> With the right regulations in place, substantial cuts in greenhouse gas (GHG) emissions will be achieved.*

## **A sustainable alternative ...**

Renewable ethanol provides a solution to one of Europe's most pressing environmental issues. Transport sector emissions have increased steadily by 36% since 1990, and in 2013 accounted for 26% of total EU GHG emissions.<sup>24</sup> Ethanol, which is both clean and renewable, reduces GHG emissions in some cases by up to 90% compared to fossil fuel alternatives.<sup>25</sup> In 2013 the European industry achieved on average emission savings of 60% equal to taking 2.7 million cars off the road. Furthermore, ethanol is produced in a sustainable manner, and complies with some of the most stringent sustainability criteria in the world at every stage of the production process.

## **... but current EU rules must be adapted**

ePURE firmly believes that there are gaps in existing EU regulations. The Fuel Quality Directive (FQD), which requires fuel suppliers to reduce the greenhouse gas intensity of energy supplied for road transport, has put in place a sophisticated methodology for calculating biofuels savings. However, a similar methodology does not exist for fossil fuels. Given that sustainable biofuels replace marginal oil that

would otherwise come from carbon intensive sources such as oil sands, an accurate means of calculating the carbon intensity of the EU fossil fuel mix is vital if the FQD is to be properly implemented.

## **Why we want to see more ambition**

Since the introduction of the Renewable Energy Directive (RED) and FQD targets, the use of biofuels in Europe has grown to 5% of total transport energy, and is projected to reach 8% by 2020. These binding targets have provided guidance and predictability, which in turn has encouraged investment in the sector and allowed renewable energy use in transport to blossom.

It is now absolutely imperative that the EU sets ambitious targets for 2030 in order to ensure consistency and continuity, and to capitalise on the full benefits of sustainable biofuels. A sub-target combined with GHG emissions requirements, as is currently the case, is the right way forward to ensure future growth in the EU biofuels market.

What is called for is the creation of a long-term, stable policy framework, in part, to restore investor confidence in the EU biofuels market, which was badly shaken by the Commission's Indirect Land Use Change (ILUC) proposal in 2012. Renewed, ambitious, and binding 2030 targets for renewable energy use in transport and decarbonisation targets under the FQD are clearly the way forward.



23. *The Role of Biofuels Beyond 2020*, Element Energy (2013)

24. DG CLIMA, European Commission (2013)

25. EU Directive 2009/28/EC

## Achieving the highest sustainability standards

In 2009, the EU set ambitious objectives of achieving 10% renewable energy in the EU transport sector and a 6% reduction in the GHG intensity of fuels used in road transport by 2020. In order to qualify for both of these targets, biofuels consumed in the EU must comply – and demonstrate compliance – with strict sustainability criteria.

## In particular:

**Emission savings:** biofuels must provide at least 35% GHG emissions savings compared to fossil fuels, a threshold set to rise to 50% as of 2017, and to 60% as of 2018 for new installations.<sup>26</sup>

**Land use:** raw materials must not be grown on land with high-carbon stocks (e.g. forests), of high biodiversity value (e.g. highly bio-diverse grasslands), or wetlands.

Biofuels produced within the EU must meet cross compliance environmental rules, part of the Common Agricultural Policy (CAP).

The European Commission is obligated to report on food availability, compliance with land-use rights and with international labour conventions.

To demonstrate compliance with the EU sustainability criteria, biofuels must comply with national verification systems or with one of the 15 voluntary schemes that have been approved by the European Commission. Compliance is controlled by Member States.



26. EU Directive 2009/28/EC

# How Europeans benefit from ethanol at the pump

*Petrol sold in the EU typically contains up to 5% ethanol by volume. This is referred to as E5, and is widely available as the default petrol of choice. Since 2000 all new petrol cars can also run on a mixture of petrol and up to 10% ethanol, known as E10.*

## From 5 to 10...

You cannot see it at the pump but every litre of petrol contains in it up to 5% ethanol. Labelling is required once the ethanol percentage goes up to 10%. This so-called E10 is available in France, Finland and Germany, while other European countries are considering its introduction. E10 means more GHG emissions savings, more energy independence, but not more fuel consumption.<sup>27</sup>

E10 is already widely available in the US, Australia and New Zealand, while Brazil offers regular petrol containing between 18 and 25% ethanol. In Thailand, blends of E20 have been introduced, while the USA recently started commercialising E15. If we are to build on the progress to date then it is essential that consumers understand the benefits of ethanol and are not deterred by unfounded concerns about car-fuel compatibility and poor performance. Communicating clear and honest

information to consumers is therefore essential if we are to realise the potential of ethanol at the pump.

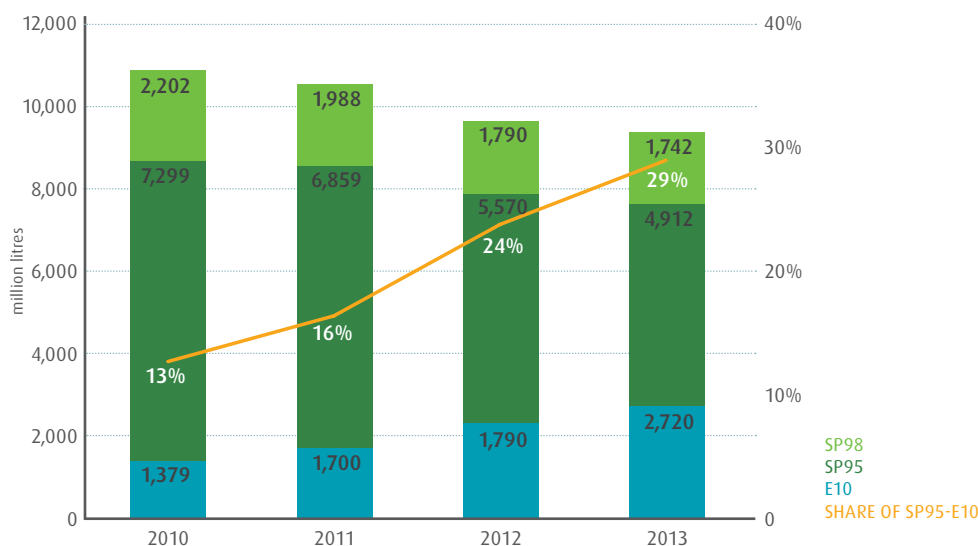
## .... And even beyond

Europe must also be ambitious. The current blending limit of 10% in regular petrol prevents RED and FQD targets from being achieved. Going beyond E10 is the obvious way forward. Research has demonstrated that E20 could lead to lower fuel consumption and reduced CO<sub>2</sub> emissions.<sup>28</sup> By establishing an E20 fuel standard, Europe would be lowering car emissions even further and at the same time increase our energy security.

## Higher blends

Ethanol can also be used in higher concentrations. A mixture of between 65 and 85% ethanol, called E85, is widely available in Sweden, France, Germany, and more sporadically in Hungary, Austria, the Netherlands and Spain. E85 requires dedicated 'flex fuel vehicles' (FFVs), which are able to run on E85, petrol, or any mixture of the two, without the need for separate fuel tanks. In 2003, Brazil was the first to introduce FFVs, and today they account for more than 90% of new car sales in that country.<sup>29</sup>

SHARE OF E10 IN THE FRENCH PETROL MARKET



Source: Comité Professionnel du Pétrole

27. VTT Technical Research Centre of Finland (2011)

28. Meta-analysis of E20/25 trial reports and associated data, Vienna University of Technology, Institute for Powertrains & Automotive Technology (2014)

29. Brazilian National Association of Automobile Manufacturers (ANFAVEA)



## How to successfully roll out E10: the French experience

Distributors were able to time the introduction of E10 at the pumps themselves, while effective coordinated communication helped to educate and reassure consumers. These key measures enabled the successful roll out of E10 in France.

The French government authorised the distribution of unleaded E10 petrol in April 2009. At the same time, a list of E10-compatible cars was established, based on information supplied by car manufacturers, and made available on the Internet. Furthermore, distributors were able to decide if and when they would introduce E10 at the pump, enabling them to manage the process at their own pace.

A survey carried out in 2010 found that what motorists needed were assurances that their car would not be damaged, and that an alternative fuel would be available if their car was not compatible. In collaboration with industry, communication materials were sent to distributors ahead of E10 launches, and leaflets for cashiers were made available, along with pump labels and flyers.



Since its introduction in France, the market uptake for E10 has constantly increased, and in 2013 represented **29%** of the total petrol market in France. In 2013, E10 was sold at **40%** of all services stations, while **88%** of vehicles in France were E10 compatible.<sup>30</sup>



30. French National Association of Ethanol Producers (SNPAA)

# Why fair and balanced trade policies should be a EU priority

*Investment in new innovation will only be made if the right policy framework is in place. This is vital to ensuring that new technologies are adopted and more jobs created, and is the reason why the EU should implement a fair and balanced trade policy.*

## An unbalanced global market

Every country that develops an ethanol market needs decades to establish the supply chains and infrastructure necessary to support a competitive industry. This means that during the development phase, the domestic sector must be shielded from global competition.

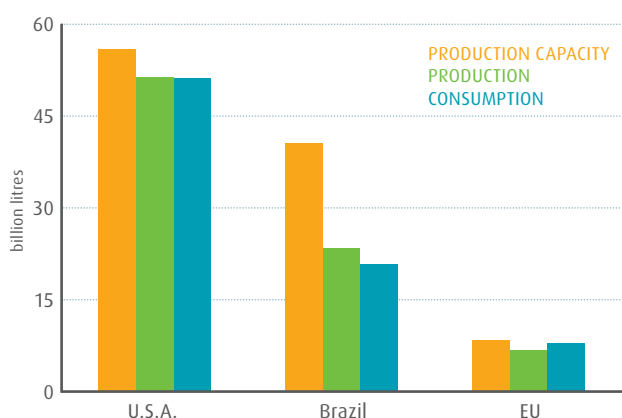
Both the US and Brazil have a long history of government support for their domestic industries. Both the American and Brazilian sectors have been operational since the 1970s. And although the USA has been the world's largest producer of ethanol since 2005, it protected its domestic market from Brazilian competition until 2011.

The EU domestic ethanol fuel industry by contrast dates back to only 2003, and is a relatively open market for third countries. Through a range of bilateral free trade agreements and autonomous trade preferences, over 76% of all ethanol exports to the EU in 2013 were not subject to any import duty. Of the top ten countries exporting ethanol to Europe, only four had to pay import duties. Besides Russia and South Africa, these include Europe's two largest competitors, Brazil and the US – with both ethanol industries 4.8 and 6.3 times larger than the EU respectively.

## The problem Europe faces

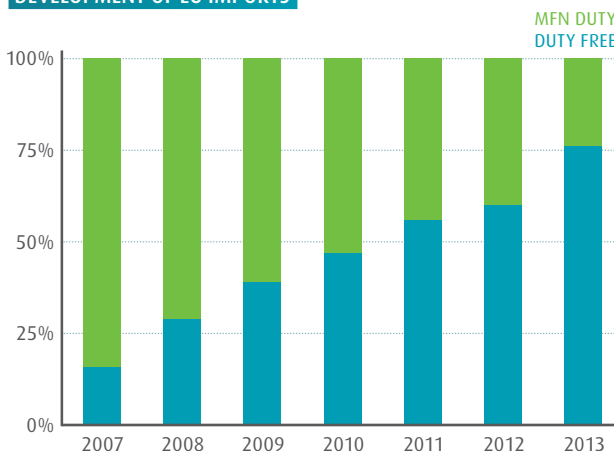
Just like any other trading bloc, the EU needs to maintain tariffs to allow its domestic industry to mature and establish a level playing field with its main competitors. However, due to a combination of dumping practices and government subsidies, US ethanol exports to the EU in 2011 topped over 1 billion litres, representing about 20% of EU consumption. The resulting drop in prices has had severe implications for the domestic industry

**ETHANOL BALANCE 2013**



Source: ePURE, F.O. Licht, USDA GAIN

**DEVELOPMENT OF EU IMPORTS**



Source: Eurostat



with many producers experiencing a sharp decline in revenue and several ethanol plants forced to shut down as a result.

Although anti-dumping measures were imposed in February 2013, EU producers are still struggling to recover from the damage caused. This nascent recovery has been seriously undermined by the continuation of questionable trading practices, with large volumes of USA ethanol still entering the EU by circumventing anti-dumping measures.

**Need for a sound customs classification system**

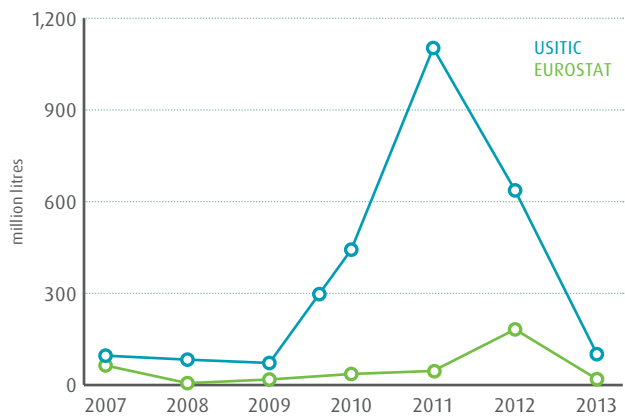
For EU trade policy to be effective, customs loopholes, through which ethanol enters the EU at a much lower duty rate, must be properly addressed. It is relatively straightforward for customs authorities to determine the correct amount of import duties for ethanol. However, when ethanol is mixed with other components, such as gasoline, it becomes more difficult for authorities to classify the product. What this means for the industry is illustrated by the following two examples.

In 2011, only 5% of all ethanol exported from the US to the EU was classified as ethanol in the EU. The remaining 95%, about 950 million litres, entered the EU through improper classification, meaning that on US ethanol imports alone, customs duties worth roughly €180 million were not correctly collected by Member States.

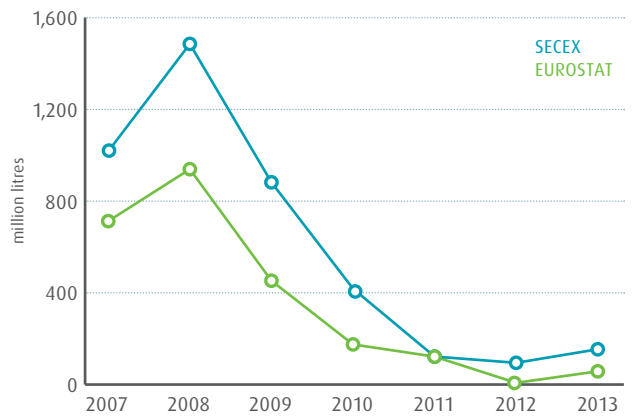
A similar picture presents itself when comparing Brazilian export data with imports registered in the EU. The gap is slightly less severe, with an average gap between recorded exports and recorded imports of 58% since 2007.

ePURE believes that policy makers must take these factors into account when developing future trade policy, and recognise that the domestic ethanol industry requires stable and predictable market conditions in order to mature. Exposing the industry to further global pressures, and doing nothing to counter unfair trade practices, would be a fatal blow to EU ethanol producers.

**U.S.A. EXPORTS TO THE EU**



**BRAZILIAN EXPORTS TO THE EU**



# Reducing Europe's energy dependence by investing in ethanol

*While other regions in the world have taken appropriate steps to reduce energy imports, Europe's dependence has increased.<sup>31</sup> Renewable ethanol, produced in Europe, can help diversify energy sources and contribute to energy security.*

## **An over-reliance on imports**

Over-reliance on energy imports hampers EU competitiveness by leaving businesses at the mercy of price increases and supply shortages beyond their – or their governments' – control. The recent crisis in Ukraine has brought home the fact that Europe is over-reliant on foreign oil in 2013, the EU imported over 30% of its crude oil imports from Russia.<sup>32</sup>

In 2013, the EU's oil import bill topped €293 billion, almost the size of the entire debt of Greece, and contributed to a significant deficit in the EU energy trade balance of around 2% of GDP.<sup>33</sup> The transport sector is especially vulnerable, with 94% of its energy coming from oil, of which 84% is imported from politically unstable regions.<sup>34</sup>

Investing in renewable ethanol produced in the EU can help Europe wean itself off foreign energy imports and increase energy security. A major obstacle to realising this objective is that renewable ethanol and other alternatives are simply not competing on a level playing field with fossil fuel.

## **The case for fairer taxation**

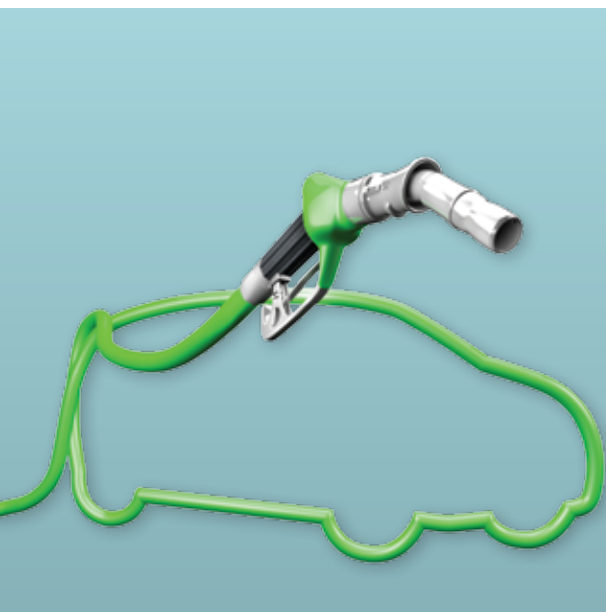
Based on volume, ethanol is the most taxed fuel in the entire EU energy mix. What is needed is fairer fuel taxation, which means taxing fuels based on their energy content and CO<sub>2</sub> performance, as advocated in the European Commission's proposal on the revision of the Energy Taxation Directive.<sup>35</sup>

A fairer and less costly fuel tax regime would allow the market to price the most efficient fuels. It would open the EU market to sales of small, highly efficient petrol engines and new fuels such as E20 or E85 for passenger cars. ED95, a blend of 95% ethanol and 5% ignition improver used in modified heavy-duty diesel engines, would become an attractive and viable option that could help further decarbonise the transport sector.

## **Achieving the right balance**

A shift towards petrol engines is needed, which would also help to tackle the increasing imbalance between petrol and diesel. Today, Europe has a surplus of petrol, which it needs to export to markets such as the US or Africa. However, changes in US energy policy (including measures such as ambitious ethanol incorporation rates to encourage domestically produced energy), mean that opportunities for petrol exports are shrinking, leaving Europe with a surplus of petrol.

With Europe's dependence on imported diesel increasing – in particular from Russia – a fairer tax regime would enable Europe to address its fuel balance, and to properly take into account issues such as pollution, energy security and long term cost.



31. *Clean Power for Transport*, DG MOVE, European Commission (2013)

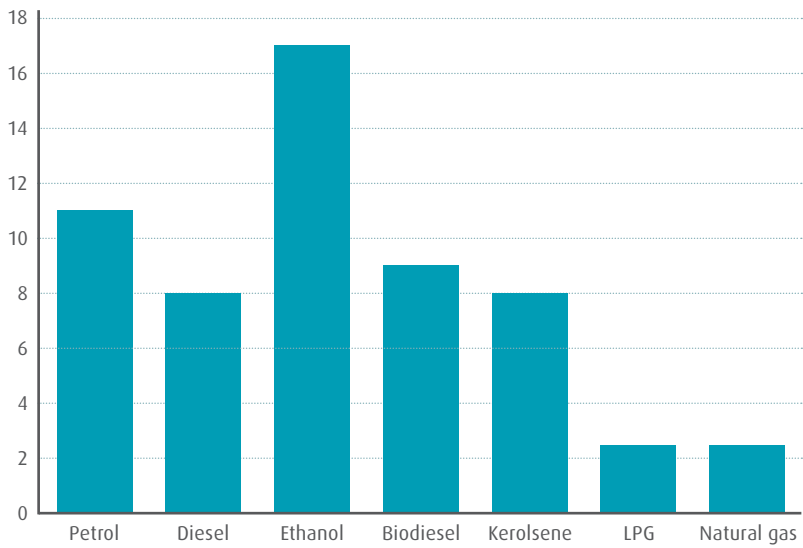
32. *EU Crude Oil Imports*, DG ENERGY, European Commission (2014)

33. *EU Crude Oil Imports*, DG ENERGY, European Commission (2014)

34. *Clean Power for Transport*, DG MOVE, European Commission (2013)

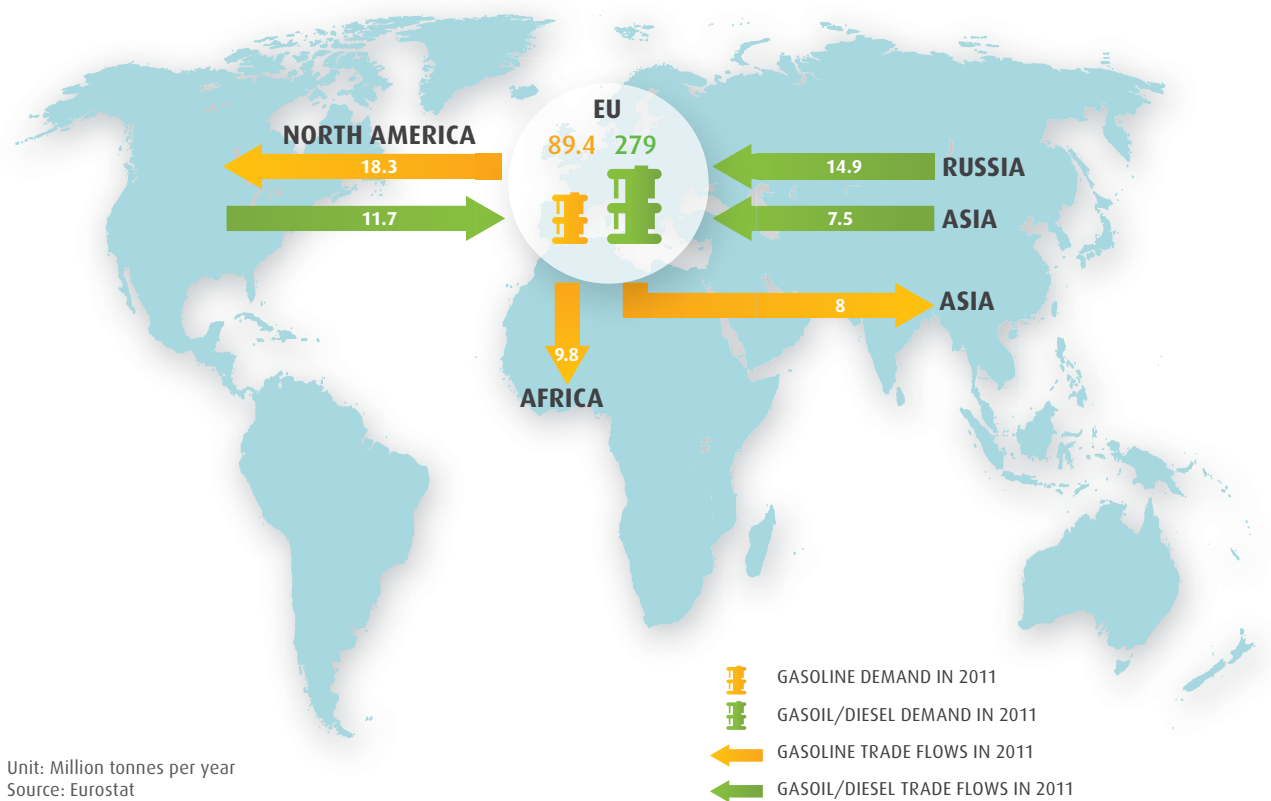
35. COM(2011) 169, European Commission (2011); SEC(2011) 409, page 39, European Commission (2011)

**EFFECTIVE MINIMUM RATE PER ENERGY CONTENT (e/G): MOTOR FUELS**



Source: DG TAXUD, European Commission

**EUROPE'S PETROL-DIESEL IMBALANCE**



## Organisation

ePURE's 22 member companies are based throughout 16 member states and account for 90% of the installed renewable ethanol production capacity in Europe. The ethanol produced by our members is used for a wide variety of industrial uses.

An additional 34 companies are associate members of ePURE. These companies come from various sectors. They do not produce ethanol, but have a strong interest in the promotion of ethanol production.

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## Organisation Structure

### General Assembly

Once a year all the members are represented in the General Assembly. The General Assembly confirms the annual budget and accounts, the President and vice-President of the Association and is authorised to amend the bylaws.

### Board of Directors

The ePURE Board of Directors consists of executives of European ethanol producing companies. A producer member has automatically a seat on the Board. The Board meets at least four times a year. The Board of Directors determines new strategies, policies, positions, actions and representations of the Association.

### Working Groups

ePURE has three permanent Working Groups on EU Regulatory Affairs, on Trade and on Communication. These Working Groups provide support to the Board. Furthermore ePURE has a Platform that discusses items relevant for the industrial and potable markets. For more technical topics special Task Forces are created.

### Secretariat

ePURE has a permanent Secretariat in Brussels which supports the Board of Directors, the Working Groups, Task Forces and Platform.

# Glossary

## **Bio-based economy**

In a bio-based economy food, feed, goods and energy are produced from biomass instead of fossil fuel.

## **Bio-based Industries Public Private Partnership (PPP)**

An initiative between the European Commission and a consortium of bio-based industries to support industrial research and innovation, bring together the resources needed to address the challenges involved in commercialising new technologies.

## **Cellulosic ethanol**

Cellulose is the fibrous substance that is contained in leaves, stems, and stalks of plants and trees. It is the most abundant organic compound on earth and can be used to produce ethanol, known as cellulosic ethanol.

## **Double cropping**

Or multiple cropping is the practice of growing two or more crops in the same space during a single growing season.

## **Enzymatic hydrolysis**

Hydrolysis usually means the cleavage of chemical bonds by the addition of water. Where a carbohydrate is broken into its component sugar molecules by hydrolysis (e.g. sucrose being broken down into glucose and fructose), this is termed *saccharification*. In ethanol production from cellulosic feedstock, hydrolysis reactions are carried out using enzymes to break down the cellulose and hemicellulose in the biomass.

## **Ethanol**

A liquid produced from the fermentation of sugars in carbohydrates, derived from biomass or organic wastes. Most of the ethanol is produced from agricultural crops like cereals (maize, wheat, barley) and sugar (juice) from cane and beet.

## **E5/E10/E20/E25/E85/E100**

Stands for different percentage levels of ethanol blended into gasoline.

## **ED95**

A motor fuel blend of 95% ethanol and 5% ignition improver used in modified heavy-duty diesel engines.

## **Flex-fuel vehicles (FFVs)**

Flex-fuel vehicles, also known as FFVs or flex cars, are vehicles that can run on a blend of high percentage of ethanol and gasoline. In Europe and the US, the percentage of ethanol is never more than 85%. In Brazil, Flex-fuel cars can use any blend of gasoline/ethanol up to 100% ethanol. Every flex car can also run on gasoline only.

## **Fuel Quality Directive (FQD) – Directive 2003/30 – OJ L 140/88 of 5 June 2009**

The FQD is the European law that sets environmental standards for petrol and diesel quality. The FQD sets a ceiling on the maximum volume of ethanol that is allowed in petrol and also contains sustainability rules on the use of biofuels identical to the rules written into the RED.

## **Greenhouse gas emissions (GHG)**

GHG is a gas in the atmosphere that greatly affects the temperature of the Earth. Without these gasses temperature would be much lower, too much of it causes too high temperature. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide and ozone.

## **Horizon 2020**

Horizon 2020 is the biggest EU Research and Innovation programme with nearly €80 billion of funding available for the period 2014 to 2020 – in addition to the private investment that this money will attract.

## **Indirect Land Use Change (ILUC)**

ILUC refers to concerns that the increased demand for land for biofuel crop cultivation turns land not previously used for food and feed crops (such as forest) into agricultural land possibly resulting in more GHG emissions released into the atmosphere.

## **Oil sands**

Oil is loose sand or partially consolidated sandstone containing naturally occurring mixtures of sand, clay and water, saturated with a dense and extremely viscous form of petroleum technically referred to as bitumen (or colloquially tar due to its similar appearance, odour and colour). Separating the oil from the sand requires large volumes of water and energy. Hence the GHG emission of crude from oil sands is considered on average 50% higher than conventional crudes.

## **Renewable Energy Directive (RED) Directive 2003/28 – OJ L 140/16 of 5 June 2009**

European law that sets goals for the use of renewable energy in a) electricity production (for heating and cooling) and b) road transport. The latter goal is mandatory (10% by energy by 2020). The RED contains a detailed set of sustainability standards to be complied with. These rules are considered the most advanced in the world.

## **Second-generation biofuels**

Although definitions vary, second-generation biofuels are usually considered to be biofuels produced from non-edible feedstock.





**ePURE**

25, rue Archimède,  
B-1000 Brussels  
+32 2 657 66 79  
[www.epure.org](http://www.epure.org)  
[info@epure.org](mailto:info@epure.org)  
[@ePURE\\_ethanol](https://twitter.com/ePURE_ethanol)

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