

Natural Power

Essent and the bio-based economy

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Foreword

The story that lies before you is about ‘Natuurlijk Vermogen’ (i.e. Natural Power) and Essent’s vision for the bio-based economy, an economy which runs on green raw materials. We have already switched to the use of biomass in our core business: energy generation. But we are convinced that the use of biomass can be improved.

This demands a different way of working, and innovation and cooperation in sustainability. So Essent is readying itself, because spearheading the development of sustainable energy is in our DNA!

In the Netherlands, Essent has been a market leader for twenty years. Production and supply of green power started in 1995 and of green gas in 2005. But our influence is now reaching beyond our country’s borders. In Europe, we are a front-runner in the use of biomass. Worldwide, we are the largest trader in wood pellets. Furthermore, Essent is the first player with a certification method for sustainable biomass, and as a part of RWE we have our own wood pellet plant in Georgia, USA. I am extremely proud of these accomplishments, but I also know we still have a long way to go.

Essent is convinced that the optimized use of biomass can play a central role in a sustainable and economically strong Netherlands. To achieve this vision, major challenges lie before us! An important step has already been taken, i.e. no longer using biomass that can serve as food (first generation biomass) in energy generation. But the list of sustainability issues is long. With current technology, the generation of sustainable energy is not yet cost-effective. So it is subsidized by the government, but that costs society money. We believe that it can be different in the long run. Biomass production and application must become more sustainable and more economical. And that is what Essent stands for.

How can we accomplish this? By making use of every single part of biomass. I’ll give you an example. In the summer, the grass on the sides of the highways is mowed. These cuttings can be used to generate power in one of our power stations. However, only some of it can actually be converted into energy. Roadside grass also consists of components that offer little in the way of energy, but which could serve as raw materials, like proteins and fats, in other industries. This potential can only be realized if we first separate the biomass (biorefining). And if we use the components in order from high to low added value (cascading), then we optimize our use of that biomass. Putting remaining components to good use is a precondition. For us, those principles are elementary for the bio-based economy. Resulting in the sustainable aspect that biomass as a renewable energy source will be used to its

fullest and fossil sources will be saved. And the economic aspect that costs for biomass production and application will be carried by several sectors.

It goes without saying that cooperation is the key to realizing the bio-based economy. Mutual cooperation between sectors is vital. But so is cooperation between government, science and industry. I invite you to read our story, and to work with us in making our economy run on green raw materials. Our natural power is infinite; together, let’s use it to its fullest!



Peter Terium, CEO Essent

“The bio-based economy. The foundations and breeding grounds of a sustainable economy and a renewable energy supply”

Green raw materials are the **engine of our economy**

The Netherlands is working towards a bio-based economy, an economy where biomass is used for the production of chemicals, materials, products, biofuels and energy. Initiatives to make efficient use of biomass are already brewing across the country: more digesters to produce green gas are being built, torrefaction factories are in the pipeline, and algae ingredients are being applied in chemicals and fuels. A green transition is vital if our dependence on increasingly scarce fossil fuels, and our impact on the environment, is to be reduced.



A bio-based economy runs on green raw materials, and we're not there yet. Our feet are still solidly planted in the fossil age. Fossil fuels control the energy supply, the transport sector and a large part of the chemical industry. But oil, natural gas and coal are by no means endless resources, and their use contributes to the build-up of greenhouse gasses in the atmosphere. The time is coming for alternatives to take their place. When oil prices skyrocketed in 2008, the industry realized that this transition is unavoidable. Moreover, the bio-based economy is the way to preserve the economy. Companies and governments are currently taking their positions and are on the lookout for opportunities. Essent is also considering its future, and wants to play a major role in the development of a bio-based economy. And Essent is ready to fulfill this role.

Biomass speaks for itself

By biomass we mean all products from living organisms which can be used as raw materials or fuels. Residues and waste for instance, or crops grown especially for biofuel or bioenergy (like

wood and grasses), or innovatively produced algae. Biomass is an ideal alternative to fossil fuels, because under the right production and operating conditions biomass will not release greenhouse gasses into the atmosphere. Thanks to its short cycle, CO₂ emissions are immediately recaptured by the existing, growing biomass - making the use of biomass climate neutral. The sheer volumes of materials leftover from industry, forestry and agriculture worldwide indicate an enormous potential for biomass. And high-quality technologies will enable the Netherlands to better exploit these immense biomass streams.

A bio-based economy in the pipeline

The foundations of the bio-based economy already exist. Biomass has been in use since the dawn of time. Take applications for food, but also for paper and textiles. In the search for new and better applications of biomass, the Netherlands has long played a pioneering role. Our country has a highly developed agricultural sector with world-renowned (agricultural)

The foundations for the bio-based economy already exist. Biomass has been in use since the dawn of time.

Storing green gas in empty natural gas fields

Groningen 2020 - Dutch production of green gas has once again climbed to record highs this year. The thousands of digesters across our country have produced so much green gas that it has been decided to temporarily store the surplus in empty natural gas fields.

universities next to a strong agro-industry of food companies, feed manufacturers, sugar factories and starch manufacturers. Considerable volumes of organic waste are locally available, such as fertilizer, grass clippings, wood trimmings and waste, and residue streams from agriculture and industrial processes.

The bio-based economy in the near future

Someone who flies over the Port of Rotterdam (in a plane fueled by biokerosine!) in a few decades will see entirely new activity. The second Maasvlakte will hopefully be filled with biorefineries and technology companies, and the third Maasvlakte will be set aside for new development. Container ships will arrive by sea, filled with (pretreated) wood-based biomass, algae or residues from agriculture and industry. Where once these ships were carrying oil or oil-based products, they will now be delivering biomass and biomass derivatives.

Dozens of white dots below, the tanks in the Botlek, will be full of bio-ethanol and biofuels.

Some tanks will have been converted to digesters: the green covering over the tanks bulging with the biogas that is being released. The residue stream, the digestate, will be used again as raw material for other products.

In our vision, the Port of Rotterdam will transition into a major bioport within a few generations. Large-scale biorefineries will turn biomass streams into products like biomethanol, biodiesel, bio-ethylene and bio-olefines - raw materials for scores of products.

Considerable volumes of available organic waste are locally available

From this height, the vast port area will look like a raw materials roundabout, biomass effortlessly coursing through it. Processed streams will leave the roundabout and head towards users. Cargo trains - running on renewable power - will ride to and from Germany.



In our vision, the **Port of Rotterdam** will transition into a **major bioport** within a few generations.

Queen Amalia opens Bio-Maasvlakte III

Rotterdam 2050 - Queen Amalia has officially launched the third Maasvlakte. She baptized the site 'Bio-Maasvlakte III' after the biomass streams that will play the leading role there. The second Maasvlakte is bursting at its seams. The appeal of the Port of Rotterdam's position as a bio-mainport of Europe has filled Maasvlakte II with biorefineries and biostorage stations. Shiploads full of biomass arrive daily. The success of the bio-based economy has called for a third Maasvlakte.



International pipelines will take bio-ethylene and green gas to other parts of Europe. From the air, it will be clear that the Port of Rotterdam has turned itself into a so-called biomass hub, the junction of a bio-based economy.

The development of the bio-based economy will be an important source of growth and innovation for the Dutch economy. The agricultural sector will be less dependent on subsidies because agricultural products have gained value; they will be used in their entirety, even the residues that are not suited for food and animal feed. Digesters which turn manure into biogas will contribute to solving the Dutch manure and mineral problems and will green our energy supply. Special crops will be cultivated for multiple uses in the manufacture of food and bio-based products as well as for the generation of energy. Thanks in part to biomass, the entire Dutch economy and industry will be increasingly powered by renewable energy.

More and more chemical building blocks will come from bio-based raw materials rather than

from oil. Biological elements will also be used in bioplastics, lightweight components for cars and self-repairing materials for the construction sector. Architects and (industrial) designers will use biomaterials in buildings, clothes and

Waste companies will no longer exist, becoming suppliers of raw materials instead.

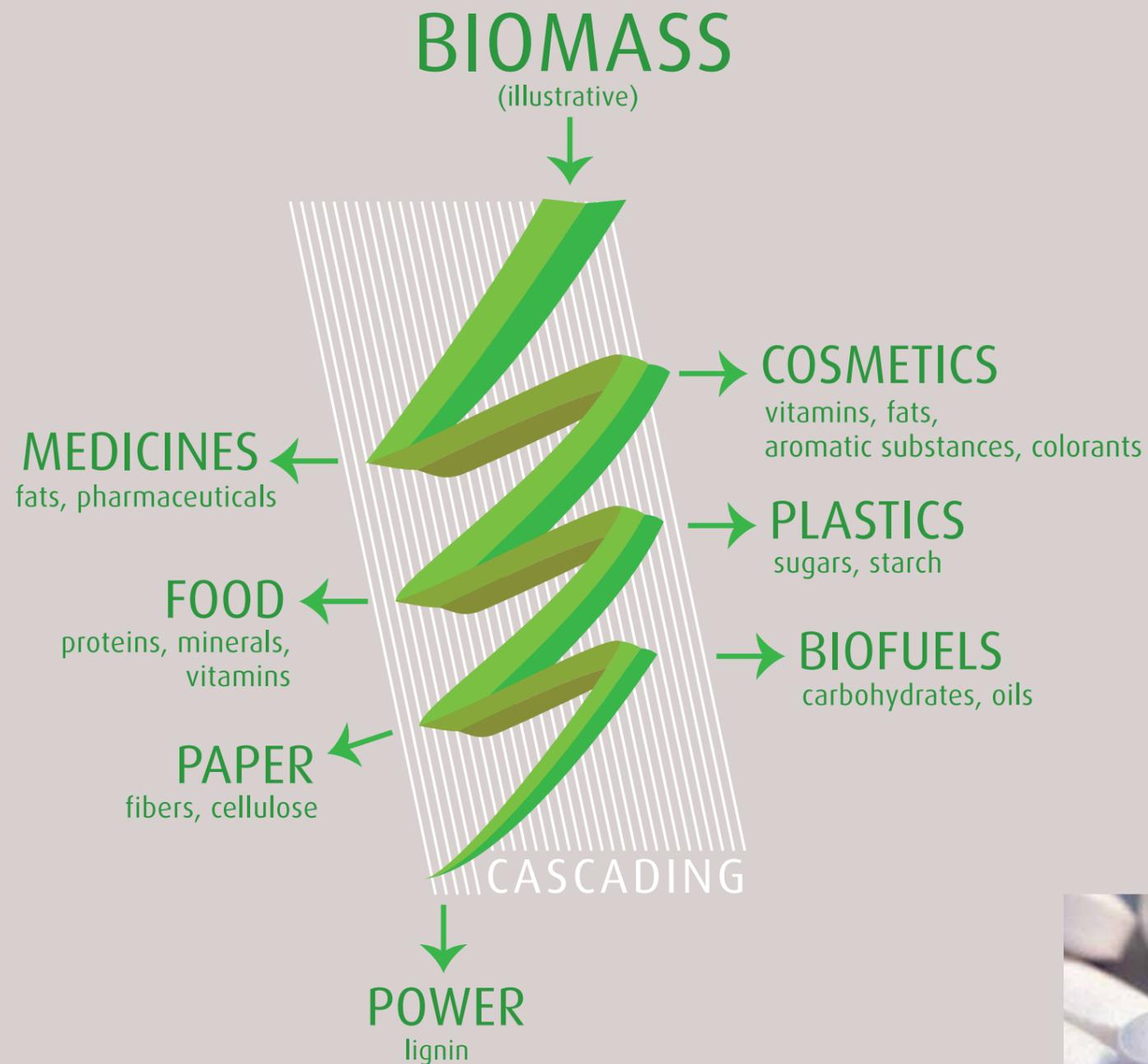
products. The food industry, paper mills and animal feed companies will also prosper in the bio-based economy. Then, all will have come full circle in the Port of Rotterdam. Waste companies will no longer exist, becoming suppliers of raw materials instead.



Using biomass to its fullest means **thinking in terms of value**

Many biomass initiatives currently concentrate on green power, green gas and biofuels. But biomass can mean a lot more. Food, feed and paper are non-energy applications that have already been found, but biomass can also contribute to medicines, construction materials and bioplastics. The challenge is to use biomass to its fullest.





Biomass is full of high-quality components like sugar, starch, oils and fats. Biomass contains proteins, amino acids and fibers, as well as organic compounds and salts, all of which can be processed into valuable products. What is leftover can be used as a source of renewable energy.

between applications, but a choice *for many at the same time*. Cascading is based on multiple use, on co-production. Biomass can be utilized at several layers of the cascade, so the application of biomass as a raw material or fuel does not come at the cost of the food chain.

Is cascading important?

The trick is to optimize the use of biomass in such a way that as little is lost as possible. Cascading, i.e. extracting the valuable components and utilizing the remainder efficiently, makes this feasible. The highest level of the cascade is the application with the highest added value, such as the manufacture of medicines in the pharmaceutical industry. Below this are applications in food and nutrition, chemicals, paper and textiles, and transport fuels. And finally, application as an energy source.

In the use of biomass it is not a matter of choice between food and fuel. Or between medicine and bulk chemicals.

Multiple uses of biomass

In the use of biomass it is not a matter of choice between food and fuel. Or between medicine and bulk chemicals. It is not a choice

Take grass that is cut along the roadside. With the right treatment, proteins from the grass go to the feed industry as an alternative to soy. Whilst the fats can be used as raw materials for cosmetic products or in the pharmaceutical industry. The fiber goes to the textile factory or to the paper mill to become books. Organic acids and sugars go into fine chemicals or bulk



“The development of the bio-based economy demands **unconventional solutions**, which **cross the borders between sectors**.”

Solutions that optimize the use of biomass, as much for its high-quality components as for its low-quality components that can only be converted into energy. Combined, all of these applications will bear the logistic and primary biorefinery costs. Large volumes can be imported. Raw materials with lignocellulosic (woody) material often contain other components like amino acids that can be used in feed as well as in the chemical industry. The minerals are suited for use as fertilizer. The fiber can be used to make paper and transport fuels. The wet residues can be used to make green gas. And the remaining lignin can be converted into power and heat, which can then be used in industrial processes.”

Johan Sanders, Wageningen University and Research Centre

chemicals. At first glance, grass is a simple material. But all of these applications are possible using the same shoots of grass.

Cascading and biorefining demand solid partnership

Cascading needs biorefining. Before biomass can be processed, it must first be divided - 'fractionated' - into its various components. The components are then sent to various factories to be made into products. Any remaining residues are then reused elsewhere in the cascade.

Many players are involved along the way to make this possible. From the suppliers of biomass to the final processors, from the biorefineries to the users. It is an endeavor that requires cooperation. The parties involved must set up the cascade together, and together realize sourcing, transportation, and the separation and distribution of the materials. The energy sector, and particularly a large biomass user like Essent, is a major player in creating the critical mass necessary for building the cascade.

The trick is to **optimize the use of biomass** in such a way that as little is lost as possible. **Cascading** makes this feasible.



Opportunities for the Netherlands

The bio-based economy offers many opportunities for the Netherlands. With Rotterdam as a logistic center, a strong chemical industry and agricultural sector, and outstanding research centers, our country has what it takes to play a leading role. The Netherlands will benefit from a green revolution. It will also serve private enterprise, the knowledge economy and employment, and this in turn will help us reach our climate targets.



“We need an innovation agenda that leads to better and more innovative uses of biomass and residues.”

The Social and Economic Council of the Netherlands (SER),
More chemistry between green and growth, December 17, 2010

“In terms of the biomass raw materials that are needed in a bio-based economy, **attention should be paid to several points:**

- There is still potential to optimize the availability and use of waste and residue streams in the Netherlands.
- The import of biomass will be necessary for the ambitious development of the bio-based economy. Possibilities at the regional level should be well considered. In regions like South America or Africa for instance, possibilities for setting up a supply line for already available, cheap residue streams should first be considered. Then we can work on improving efficiency in agricultural processes, on increasing production volumes and on enabling more expensive biomass streams to find their way to the international market.
- There is also the possibility to plant energy crops on abandoned, degraded farmland and on land which is no longer suited for the production of food.
- All of this is only achievable and acceptable if it happens in a sustainable way. Issues like indirect land use, consequences for the soil itself, and social-economic effects will become increasingly important.
- This development – which should meet sustainable prerequisites – requires an increase in the competitiveness of bio-based applications. International and other markets must be developed, experience must be gained in supply chains, and scale must be increased.”

André Faaij, Copernicus Instituut (University of Utrecht)

The Netherlands is perfectly positioned to become a biomass hub. As a biomass hub, our country will import large quantities of (pretreated) biomass and then add value to that biomass by converting it into a handful of applications to be exported throughout Europe. We already have a predominant standing in oil, a gas roundabout is in the making, and a similar biomass roundabout lies ahead. Our advantageous geographical position and our mainports, like the Port of Rotterdam and the Eemshaven, make the Netherlands extremely suited for receiving biomass produced (and pretreated) elsewhere. Import of biomass for refining and processing purposes, however, still presents logistical challenges. Because biomass is less dense than, say, oil or coal, large volumes of it must be transported. The biomass (residual) streams must be joined and the transport of biomass made as efficient as possible.

Biorefining in the Netherlands

To take a leading role, the Netherlands must look to biorefining. If it does not, the Netherlands

will simply become a throughway in the bio-based economy, and we will only reap the ‘logistic’ fruits of the effort. But biorefining will open doors to the development of the Dutch knowledge economy. As a technological process, biorefining fits with our country. Our businesses and research centers stand out in the development and application of high-quality technologies. The Netherlands is thus an ideal pilot country for green raw materials.

A boost for the knowledge economy

Innovation is more important now than ever. Knowledge determines the competitive position of our country and propels our economy and employment. Focusing on biomass, its logistics and refining will parallel technological developments in many areas. Scores of technologies signal a coming breakthrough. For instance pyrolysis and torrefaction, for treatment of biomass through heating by using little or no oxygen. Pyrolysis gives rise to oily products. Torrefaction breaks down the fibrous structure, making it easier to grind the biomass.



“The bio-based economy can advance several Dutch economic strengths.”

Government memo, Closing the chain, October 2007

Biomass is **already contributing** to realizing climate and energy targets. Thirty percent of the generation of renewable energy comes from biomass.

Halfway through the energy transition

Den Haag 2020 - In 2050, the world will be able to run almost entirely on renewable energy. This achievement, which was unthinkable in the last century, is now within reach. The bio-based economy, in particular, has experienced radical growth. Thanks to the efficient utilization of biomass streams, experts expect the world to be completely sustainable within a few decades.



Large-scale biomass gasification and biochemical fractioning methods are also at the brink of massive breakthroughs. All of these techniques have been tested. The next step is to start demonstration projects and then scale up these techniques.

The bio-based economy will boost the Dutch knowledge economy. And because other countries are developing similar initiatives, we should act fast.

Realizing climate and energy targets

In addition to renewable energy sources like wind and solar, the application of biomass is necessary if the 2020 European and Dutch climate objectives are to be met. Biomass can quickly and cost-effectively reduce a large percentage of CO₂ emissions. Biomass is already contributing to realizing climate and energy targets. Thirty percent of the generation of renewable energy comes from biomass. With large-scale co-firing of biomass in the Amer Power Plant, for example, Essent makes a

major contribution to this. We are endeavoring to reach a co-firing percentage of 50 percent (of fuels in Amer plant) by 2015.

The government endorses the importance of the bio-based economy

The importance of the bio-based economy is widely admitted, and the government recognizes its necessity. In the 2007 memo *Closing the chain*, the cabinet at the time proposed that the Netherlands develop into a bio-based economy. The Social and Economic Council of the Netherlands (SER) has also called for concerted efforts to build a biomass-based economy. The SER's advice at the end of 2010, *More chemistry between green and growth*, concluded that many opportunities for economic growth as well as for sustainability lie at our doorstep if the Netherlands invests in the bio-based economy.



Together towards a bio-based economy

The route towards a bio-based economy still faces many obstacles and challenges. Not all of the technologies we need exist, and sustainability cannot always be taken for granted. Essent views sustainability as a necessary prerequisite for a bio-based economy.

The transition to a bio-based economy will not happen overnight. An economy that runs on fossil fuels and raw materials cannot be turned around at the wave of a hand. Biomass is different, it has different properties. And sustainability is not inherent. This transition will take time and requires creativity. In the meantime, fossil fuels and raw materials will continue to play a significant role. What the bio-based economy will look like is not yet certain. Many answers, solutions and technologies are not yet known.

Technological innovation is essential

Knowledge development - in biorefining, for example - is one of the areas which demands cooperation. Biorefining is still in its infancy. It requires new knowledge and new technologies. Brilliant discoveries often occur within universities. Fundamental research is often the key to high-quality applications. Academics, industry and the government then develop the ideas. The Netherlands is rife with knowledge development. Numerous innovative players know where to find each other. In Delft, a test facility is being

built where research institutes and companies can conduct projects to test their ideas for the conversion of biomass. The test facility is an initiative of the BE-Basic consortium, which brings together universities, research institutes and industry to study the large-scale application of clean energy from biomass research.

In Wageningen, the AlgaeParc test facility for large-scale cultivation and refining of microalgae has been realized. In close cooperation with industry and the regional government, a research center is also being established in Wageningen, focusing on the optimized utilization of biomass for nutritional and other applications.

Cooperation between sectors

Technology is not the only challenge. Cascading demands cross-sectoral cooperation. The cascade can only be realized if the players involved join forces, but these are players which traditionally do not work in the same chains. Cascading requires that parties which today barely come into contact must work together. They must look outside their chain of activities



“Technological development is crucial, but the development of a **bio-based economy is above all a transformation of the entire system**. Biorenewable solutions must become part of our economy and production processes.”

Luuk van der Wielen, Delft University of Technology

Milestone in sustainable dairy chain: 1000st Friesian biogas facility

Amersfoort 2020 - Thanks to the successful cooperation between Essent and FrieslandCampina, the thousandth biogas facility is now operational in Friesland. In the fermentation process manure is converted into biogas, which will then be used in small-scale electricity and heat production, upgraded to the quality of natural gas, or used as transport fuel.



and search for partners. And they must be persistent. The road that will lead to a bio-based economy demands long-term and irreversible commitment from all parties, including the government, which must ensure stable regulation and a level playing field in Europe.

Sustainability is a prerequisite

Sustainability in a bio-based economy will not happen on its own. Biomass is not sustainable by definition. The production of biomass comes with potential downsides like deforestation, exploitation, encroachment into nature reserves, imbalances in mineral content, environmental pollution and competition with the food supply. Only when a bio-based economy does not come at the expense of people, nature or the environment can we speak of a real green revolution. Clear frameworks and certification systems will make it possible to separate bad biomass from good streams. A variety of criteria will determine the line between the two, and factors like greenhouse gas emissions, biodiversity, soil impact, water use and social effects will play a role in the

stipulations. The entire chain must be examined, from pre-harvesting (cultivation and logistics) and post-harvesting (treatment) to conversion into end products. Luckily, cascading offers us a solution. Innovative techniques make it possible to distinguish between food (e.g. corn) and the residue streams (e.g. corn husks) and use of the latter as raw material or fuel. One crop becomes two: food and raw materials.

Sustainability in a bio-based economy will not happen on its own. Biomass is not sustainable by definition.

Essent views sustainability as a necessary prerequisite for a bio-based economy. The government also recognizes the importance of sustainability in a bio-economy. In January 2011, the Commission on Biomass Sustainability



“Even conservative estimates assert that the **potential of global biomass production is huge**: technical availability of biomass will not be an obstacle for the bio-based economy.

Success will depend on sustainability. This means that industry, government and research centers must come together to determine criteria and measurement and certification methods.

The motivation to do this is intrinsic to the process, since sustainability increasingly means:

- a license to operate,
- translation into market value and revenues (like the Dow Jones Sustainability Index),
- added advantages for early movers which co-develop criteria and certification methods,
- social and consumer acceptance.”

Luuk van der Wielen, Delft University of Technology



Issues (the so-called Corbey Commission) released its report *Sustainability and Decisiveness*. The commission proposed that strict conditions for sustainability are needed, considering the risks inherent in the large-scale application of biomass. The government and industry are now working together to give form to these conditions, from which laws and regulations will follow. Essent is involved in this process, striving for an unambiguous, international and sustainable certification system.

International criteria and fair policy frameworks are necessary

International, unambiguous criteria are necessary to safeguard the bio-based economy from new social and environmental problems. Our country is a leader in the development of sustainability criteria. “The Netherlands was one of the first countries to recognize that sustainability in the use of biomass in the energy sector is very important,” the Corbey Commission report states. Since this report, the so-called Cramer criteria have contributed significantly to

the formation of sustainability requirements in European law and regulation.

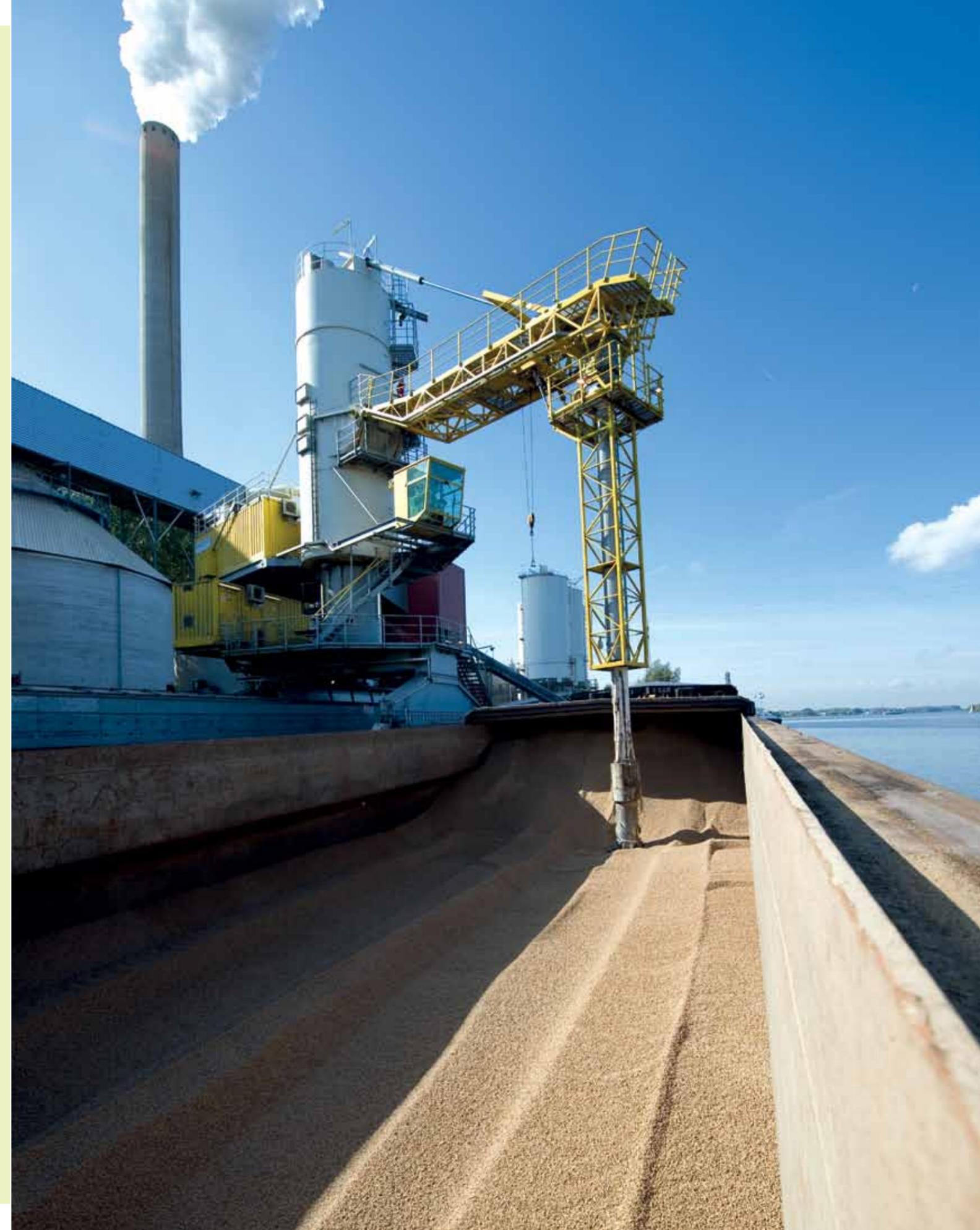
By applying the right policy frameworks and instruments, the government can facilitate the transition to a bio-based economy, thereby taking away barriers to implementation and supporting a level playing field. This concerns, among other things, financial support, guarantee schemes and accommodating policies – like permit procedures for experimental biorefinery facilities – to support investments in technological innovation. Differences in legislation, regulation and incentives will only lead to unfair competition. As a pioneer in the bio-based economy, and because of its importance for the Dutch economy, Essent urges the Dutch authorities to be an advocate within European politics in order to realize a level European playing field for parties active in the bio-based economy.

“Sustainability should not be addressed in the way it is being addressed today: one issue a year and time and time again in reaction to public opinion. We must understand all of the issues (particularly the impact on the fertility of soil) and come up with robust solutions.”

Johan Sanders, Wageningen University and Research Centre

A sound partner in Essent

On its own, as well as in cooperation with industrial partners, research centers and social organizations, Essent is working to realize the bio-based economy. As the largest renewable energy producer in the Netherlands and as a pioneer in biomass application, Essent is a sound partner in this endeavor. Essent has long been urging the necessity of knowledge development, transparency and certification; it imports large quantities of biomass and is a major force behind the realization of Dutch energy and climate goals.



“To speed up the **transition to a bio-based economy**, existing industrial infrastructure, in cooperation with stakeholders which are already active in biomass supply and utilization, should be used as much as possible. At the same time, new high-efficiency refinery concepts can be developed for implementation in the long term.”

René van Ree, Wageningen University and Research Centre

Essent is a pioneer in biomass. We have used biomass for more than twenty years, and we have become the largest producer of green electricity. In recent years, the Amer Power Plant in Geertruidenberg has largely run on biomass, and it has burned wood pellets since the start of this century. The facility also has a wood gasifier which burns on wood of the so-called B category (scrap and waste wood from construction and the wood processing industry). More than four million tons of biomass have already been used to produce green electricity.

By co-firing more than 33 percent biomass (calculated in mass), Essent is an international leader. And major steps are currently being taken to raise that percentage to at least 50 (calculated in mass).

Essent is involved in scores of bioprojects

The scale-up of co-firing in the Amer Power Plant is just one of the many bio-economy projects that Essent has underway. We are also involved in the development of torrefaction.

Torrefaction (a thermal process with relatively low temperatures) changes the biomass properties to obtain a better fuel quality. This is how torrefied biomass, otherwise known as biocoal, is produced.

Essent is a pioneer in biomass. We have used biomass for more than twenty years.

This biocoal has a higher energy content, but also lower volume - which reduces transport costs. Biocoal can also be stored outside, and can be introduced into the burners using regular transport methods and mills. Essent is going to co-fire substantial amounts of biocoal in its plants. For this, the company has signed contracts with Topell Energy B.V. and Stramproy Green Coal B.V., which are building modern factories in the Netherlands to produce biocoal.

Breaking ground: Essent greens more than 50% of its coal-fired power plant

Geertruidenberg 2015 - Essent's Amer Power Plant is now co-firing more than 50 percent of biomass. This places Essent solidly at the forefront of worldwide developments. A new accomplishment after also having been the first to be co-firing 33 percent.



“By coping with organic residue streams of various compositions - in its infrastructure, separation and processing - Essent can add considerable value to the bio-based economy.”

André Faaij, Copernicus Institute (University of Utrecht)

“Essent: the driving force behind the bio-based economy”

Den Bosch, 2020 – The bio-based economy is nearly a fact. The Netherlands is known worldwide as a biomass hub. Millions of tons come into the country through the harbors, everything certified as sustainable, a certification which also proactively analyzes and monitors indirect effects on the environment and society. The biomass is then processed at one of the many biorefineries in the Netherlands. In the past decade, Essent has been an important driving force behind scores of bio-initiatives. For decades, Essent has generated renewable energy at several locations, where the residual heat is also being applied. This is happening at large-scale facilities like the Amer Power Plant, but also at dozens of (petro)chemical groups, paper mills and metal companies. Some of our power stations run on lignin, a residue from biorefining. Other stations use syngas, which comes from the gasification of various types of (residual) biomass and from combustible waste. Bio-oil and gas are also used for power generation, but only after the usable components are extracted for various other industrial products.

Peter Terium looks back at Essent in the BBE in the second decade of the 21st century



Another development in the bio-based economy is the production of biogas (green gas). Essent is producing and using biogas from manure and other materials in several locations. One of these projects is being realized in Zeewolde, where thousands of homes and office buildings will be heated by so-called ‘Poldergas’ from a biodigester. Cogeneration turns biogas into renewable power and heat. The latter is used for the (heat) distribution network of the Polderwijk residential area. As a market leader in green gas, Essent is always on the lookout for new possibilities in this market.

Experience with sustainability issues

Essent has extensive experience with sustainability issues. In 2001, Essent established the Green Gold Label certification system, which guarantees that the biomass has been sustainably produced. The external and independent certifier Control Union conducts the screenings and issues the certificates. The method examines the origin of the biomass and assesses the entire

chain, from the origin to its final use. More than 85 percent of biomass used by Essent is certified. Essent is currently considering how indirect effects, like indirect land-use change, can be determined, and how such effects can be considered in the labeling process, as well as how to make the label independent so that it can be used more widely, not only in the energy sector but in other sectors as well.

As a market leader in green gas, Essent is always on the lookout for new possibilities in this market.

Innovative partnerships

Essent underlines the importance of innovative partnerships in the biomass chain. Cooperation is nothing new to our organization. Scores of



Essent has extensive experience with sustainability issues. In 2001, Essent established the **Green Gold Label** certification system.

joint initiatives are underway. Essent has joined forces with FrieslandCampina to support the production and supply of green energy via dairy farms. FrieslandCampina dairy farmers are supported by Essent in the setting up of local initiatives. FrieslandCampina buys so-called green certificates from its own dairy farmers through Essent. Several dozen farmers have already expressed interest in the production and supply of energy (from biomass and other sources). This successful partnership makes us keen to build more partnerships so that the bio-based economy may succeed.

Afterword

We hope that this brochure draws a clear picture of our vision for the bio-based economy. We would be pleased to meet with you to discuss how to join forces.

Cooperation is nothing new to our organization. Scores of joint initiatives are underway.



Colophon

This brochure was realized with the kind cooperation of:

André Faaij

André P.C. Faaij is a professor of Energy System Analysis at the Copernicus Institute for Sustainable Development at the University of Utrecht (Department of Natural Sciences). He has a background in chemistry and the environmental sciences. For his doctorate, he conducted research in biomass and waste energy production.

René van Ree

René van Ree is the Biorefinery and Bioenergy Program Manager at the DLO Institute for 'Food Bio-based Research' at Wageningen University and Research Centre. He is also the coordinator of the IEA Bioenergy Task 42 in biorefinery and the co-chair of the European Biofuels Technology Platform.

Johan Sanders

Johan P.M. Sanders is a professor of Valorization of plant production chains at the Wageningen University and Research Centre, focused on the development of bulk chemicals and other valuable products from large and small-scale biorefinery processes. He has held various research positions at AVEBE and Gist-brocades.

Luuk van der Wielen

Luuk A.M. van der Wielen is a professor of BioSeparation Technology at Delft University of Technology (Department of Applied Natural Sciences). He is also the director of BE-Basic, a visiting professor at the Technical University of Malaysia, and he holds a variety of international, industrial and governmental consulting positions.

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