



RENEWABLE MATTER

INTERNATIONAL MAGAZINE
ON THE BIOECONOMY
AND THE CIRCULAR ECONOMY

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Towards Renewable Matter

- Christian Patermann: Growth, Sustainability and the Bioeconomy. An Uneasy Triangle?
- Gunter Pauli: Connected Knowledge is All It Takes



The Bioeconomy: A European Gamble. Interview with Fabio Fava

- How Much is Renewable Matter worth?
- Bardi: the Phantom of *Peak Resources*
- Horizon 2020: 79 billion for Research



The Urban Mine: Organic Waste Collection in Big Cities

- Clusters and Innovation in Europe
- Francesco Ferrante: When Innovation is Powered by Regulations
- CO₂: From *Climate Killer* to Resource



New European Commissioners and the Bioeconomy

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contents

	Editorial	4	Towards Renewable Matter
Think Tank	Christian Patermann	6	Growth, Sustainability and the Bioeconomy. An Uneasy Triangle?
	Gunter Pauli	7	It Takes an Integrated and Connected Knowledge
	Gianni Silvestrini	8	Stages of Change
	Edo Ronchi	9	Energies Sustainability and Renewable Materials
	Catia Bastioli	10	Changing the Relationship between the Economy, Territories and People
	Antonio Di Giulio	11	Bioeconomy's Triple Advantage
	Luigi Bistagnino	12	Fighting Waste to Produce New Wealth
Policy	Ugo Bardi	14	The Peak of Resources
	Marco Frey	19	5 Drivers for a Changing Economy
	by the editorial staff	24	Bioeconomy: a European Gamble
	Duccio Bianchi	27	Revision of the Waste Directive and Prospects for a European Circular Economy
	Jukka Kantola	30	The Many Lives of Matter. Here's how to Convert it Back
	Lucia Gardossi	34	Employment, Research and Innovation for Sustainable Growth
	Francesco Ferrante	39	A Ban Spurs the Launch of the Bioeconomy in Italy: the Case of Shopping Bags

Policy

Case Histories

Columns

Marco Gisotti	42	It Takes a Flower
Mario Bonaccorso	46	The European Path to Bioeconomy Runs through Clusters
Emanuele Bompan	54	Urban Mine
Fabrizio Sibilla	60	CO₂: From Climate Killer to Resource
Roberto Coizet	63	Used Oil: 30 Years of Green Economy
Roberto Rizzo	66	Made and ReMade in Italy
Roberto Rizzo	70	The Virtuous Circle of Regeneration
Andrej Kržan	74	PLASTiCE Project: Promoting Sustainable Plastics in Central Europe
Carlo Pessa	77	A New Frontier for Start-Ups
Marco Moro	80	From Recycling to High-End Products
Joanna Dupont Inglis	84	<i>Draught from Berlaymont</i> The New Juncker Commission: High Speed Link or Slow Business as Usual?
Stefano Ciafani	86	<i>Bieconomy and Environment</i> Plastic Mediterranean Sea
Ilaria Nardello	87	<i>The Blue Yonder</i> Portugal Returns to Sea

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Case Histories

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Editorial



This magazine is intended as a virtual roundtable. Our objective is to represent the share of society and of the international economy – which is far more significant than the media would like us to believe – that have proved to be ready for a change we deem unavoidable. It includes tens of millions of people who have changed their lifestyle focussing their renewed attention

on health and the environment, companies that have been able and brave enough to innovate in order to remain competitive, universities and research centres that have promptly geared their activities towards the more pressing needs of innovation and civil society's organizations overseeing politics meant as the ability to take steps to protect common interests.

Towards Renewable Matter

Such virtual roundtable will not rely on a predefined and detailed model, but on a ladder of priorities based on the physical limitations of the planet and areas of analysis accommodating the most innovative visions of economy and society drawing on the concept of *bioeconomy*, *circular economy*, *sharing economy*, *blue economy* and *green economy*. Moreover, faced with the seriousness of change forced by what is simplistically defined as a “crisis”, it is necessary to reason and act on all fronts: from the economy to the environment, from resource management to the solutions to improve social cohesion.

Our challenge is to set up a fresh and more comprehensive network of alliances stemming from widespread interests and genuine needs in order to create more jobs, more security (both environmental and social), more welfare and stability. It is a path still in the making, whose timing and modalities have yet to be defined. For the journey ahead, the 70's can act as our starting point. We have learnt our lesson. Following the oil shocks that undermined energy security that relied on the progressive expansion of fossil fuels, a new concept of renewable energy emerged.

It took nearly forty years for that perspective to turn into reality and become established but now, albeit amongst many contradictions and hesitations, the International Energy Agency's projections leave no doubt: renewable sources will be at the forefront in a shorter span compared to the time elapsed between the energy crisis of 1973 to the present day.

While standing on the first pillar the direction is all the more clear. Today, the march towards renewable energy can only be slowed down, but not reversed. Therefore, time has come to add a second pillar: that of renewable matter.

It is a considerable conceptual leap implying an overturn of the current dominant viewpoint. Up until now, the industrial production generated a one-way material flow, turning part of nature into a mine and another into a dump, passing off

pollution and environmental degradation as unavoidable collateral damage. On the other hand, the renewable matter approach views the environment as a key resource – the major asset for all possible exploitations and whose yield can be smartly utilised – and considers the materials involved in production as a continuous flow, in which single commodities are just the transitory steps matters goes through.

Such conceptual leap requires a change in language. Terms such as “virgin material”, “raw material”, “secondary raw material”, “waste”, “products and by-products” entail a values scales in which matter is progressively degraded (from virgin to raw material, from raw material to secondary raw material and so on and so forth). The concept of renewable matter ousts this old hierarchy by going beyond the idea of recycling as the only phase of reutilization, almost the exception that confirms the rule of a linear process.

Within the “cradle to cradle” vision, transformation becomes crucial, a model that has passed the test of time with flying colours over three billion years of evolution of life on the planet. After use, matter breaks down into parts that get back into the cycle becoming what they were at the beginning or acting as input for other products and for industrial, energy or craft systems. Such perspective would be worth enhancing by creating “Tables of renewability” (inspired by Mendeleev's Periodic Table) classifying the ability of each material to regenerate and to be reutilized according to its structure and the technological and environmental abilities available.

Our magazine, through the ideas and personal experiences introduced in its articles, intends to divulge a radical revolution in conceiving the production cycle. Such a revolution can no longer be held back because in the new millennium the old system has lost its material base. Commodity prices (basic raw materials) are constantly on the rise and dwindling resources cause



uncertainties in the production system. In Europe, unemployment has soared to alarming levels for society. The climatic crisis poses a challenge to common sense, with the scientific community warning against the serious threat of a disaster deriving from the increase in greenhouse gases, rising CO₂ emissions and the inability of the political system to find a global solution. Against this background, new opportunities are emerging requiring a reassessment of the relationship between global and local as well as the relationship with the environment becomes more and more crucial. While to date, only few businesses have influenced the rules of production and growth, from now on environment-committed companies will have the opportunity to show to the production world how efficient systemic thinking can be on a smaller geographical scale. A grassroots approach can be a practical answer to the problems of economically and environmentally out-of-control globalization. Since the above-mentioned overarching change could be applied to any production or social activity, it would be wiser to focus on situations where a change of perspective appears more mature. Although different, there are three fields sharing this new way of thinking. They are deeply interconnected (commodities, biomaterials, waste) and share one common factor: the environment.

Commodities. Raw materials represent the core of the problem. Their flow influences economic trends and income distribution. Current market globalization and the growing importance of financial activities in economic systems make it all the more complex. It is an ever-changing scenario that can be transformed radically by the recent trend of replacing goods with services (i.e. cars and photocopiers are loaned for use rather than owned).

Biomaterials. They are materials coming from the organic realm (produce and waste from organic production chains) and as such they can be regenerated in a relatively short time so they can be considered renewable. Overall, they represent an inexhaustible mine of environmentally low-impact materials that, thanks to technological innovation, can become sources of supply for many industries, thus creating an alternative to conventional raw materials. Biofuels, nowadays used even for aircrafts, or bioplastics, whose range of uses spans from packaging to medical surgical technology, are a case in point.

Waste. As it has become clear over recent years, waste is no longer a price to pay for the production system but it rather represents an

efficiency deficiency that we are trying to fix.

In a period of economic crisis, the fact that waste is just “a misplaced resource” becomes more and more measurable in monetary terms.

It is evident how the huge flow of materials transformed into waste cannot be discarded and must be exploited in some way. But how? There are several possible approaches depending on the level of innovation in the making of a product. If the manufacturer, inevitably generating waste, does not take care of the possible uses of that “waste”, then its exploitation and reutilization becomes difficult. On the other hand, if the maker of a product has devised an efficient reutilizing strategy, the quantity of wasted materials becomes minimal, amounting only to the entropy inherent in any transformation process. Nowadays there are already some materials that go through the “waste” stage with minimal loss of value. Thanks to suitable treatment, they can offer the same performance they had at the beginning of the production cycle. But the majority of materials is partially reutilized or dumped into landfills.

The Environment. The environment is involved in all the flows outlined so far. Raw materials, both organic and inorganic, are taken from the soil. Biomaterial and biofuels derive from crops that inevitably prevent other uses of the same land. Waste has an impact on the environment or causes climate-changing emissions that, in turn, affect soil's quality and yields. In order to harmonize a different industrial strategies, two essential elements are needed. A systemic approach without which there is a risk of becoming inefficient, namely you gain with one hand while losing with the other. And, secondly, the ability to create common interests capable of steering such transformation.

From the Post-War Era we have inherited a thriving society that is now threatened by pollution and a diminishing social cohesion. These problems cannot be solved by erecting defensive walls to stop innovation but by building bridges towards an engaging future. Renewing energies, materials and relations is the way forward. ●



Think Tank

Growth, Sustainability and the Bioeconomy.

An Uneasy Triangle?

by Christian Patermann



Christian Patermann since January 2004 is Programme Director for "Biotechnology, Agriculture & Food" Research at the Research Directorate-General of the European Commission. He is advisor of the State of North-Rhine-Westphalia on the implementation of the knowledge-based BioEconomy.

When decision-makers in politics, economics and in our daily life, when concerned citizens or also consumers discuss about Growth and/or Sustainability their arguments normally follow well defined structures and biases:

some like Growth as the indispensable instrument for well being, jobs, peace. Others regard it as an evil, devil's work; sustainability however is normally everybody's darling, although lately criticized by more and more to be just a buzz word and much too vague.

Upon the arrival of the notion of the knowledge-based or biobased Economy, or just the Bioeconomy, these discussions have become more complex, for some even embarrassing. Some regard the new candidate as a competitor for both, others fear that this intriguing concept is just conceived to smuggle GMO's into our daily life under the pretext of substituting the fossil century. Rarely people look on all of them and ask for their interaction and interlinks. What is true and real in these discussions?

Let us look at the fundamentals of the concept of the Bioeconomy: the renewable biological resources of plants, animals, microorganisms and insects, and the enormous knowledge we have won today on these pillars of life, plus the emerging technological knowledge we own in neighbouring areas by the development of information and communication technologies, nano and cognitive sciences etc.

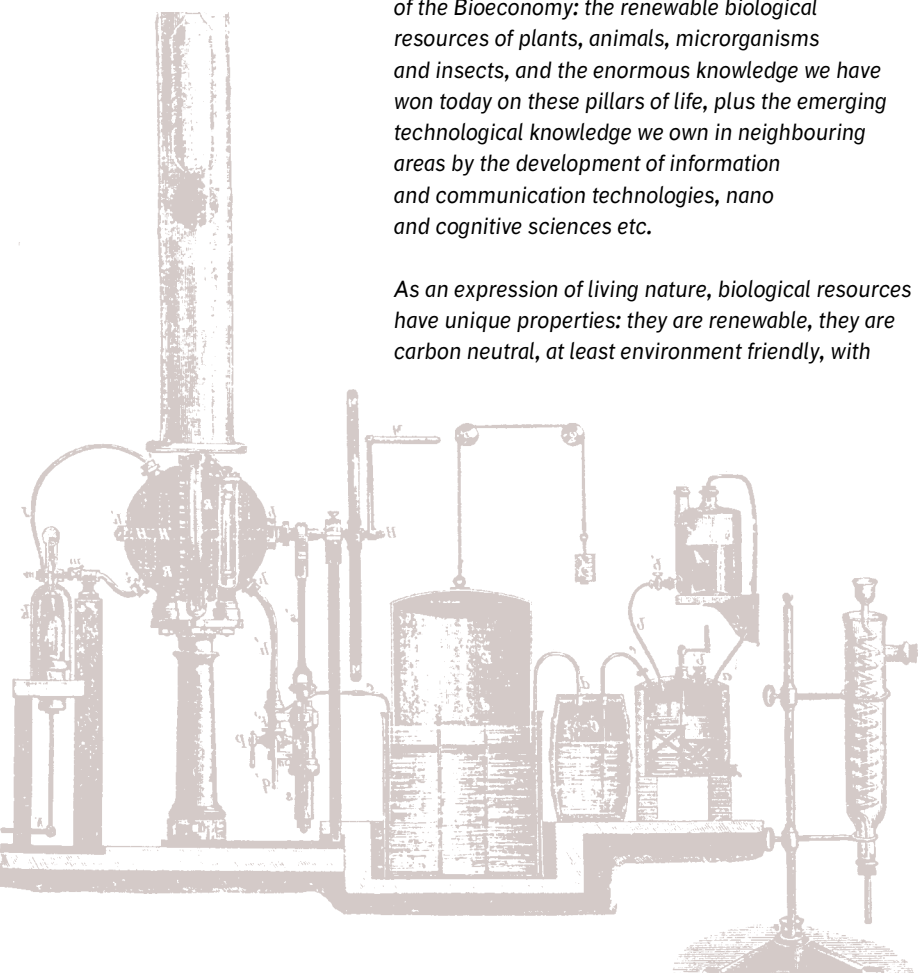
As an expression of living nature, biological resources have unique properties: they are renewable, they are carbon neutral, at least environment friendly, with

an enormous potential to substitute fossil materials. They hold the potential for cascading, multiplied use and can offer new material properties like durability, stability, strength and even non or minimal toxicity. This is by no means new. But what is new is the immense power by a systematic and systemic exploitation of these new sources of knowledge and combining or integrating them in so-called value chains in biobased products and processes. So far with respect to the closeness of the Bioeconomy to the principle of sustainability, which no one can deny.

And what about Growth? The decisive link for understanding the fabric of Growth and the Bioeconomy has already been mentioned: by a smart combination of the unique selling features of biological resources (renewability, carbon neutrality, multiple and sometimes cascading use) with new, added environmentally benign material properties we generate Growth!

Let us take wood as an example. It is far more than a material for furniture or toys. Renewability is its embodiment of growth. If put to cascading use, supported by microorganisms, wood, but also starchy plants, vegetable oils and sugar can generate additional values and hereby Growth. Wood might first be used as building material, then in a chipboard and finally converted to energy in form of pellet. Growth means added value, something we sometimes tend to ignore or forget, but also by making toxic chemicals superfluous, by reducing greenhouses and generally preserving our stocks of finite fossils. This can sometimes only been done with the help of so-called top molecules, e.g. succinic or lactic acids etc. They contain several functional elements that open up a multitude of reaction pathways, and when these complex intermediates in a smart combination can be used again in a variety of downstream or even end products such as polymers, lubricants, surfactants, solvents, cosmetics and fibres. Voilà, pure growth or added value!

Many of such value chains are just being identified by industry in many sectors of the economy all over the world, outside Europe sometimes more intensely and quicker, and here we finally have the justification to speak about a true BioEconomy! There are however many opportunities still untapped and are waiting for a systematic search and research



for future use in household materials, sports, textiles, feed additives or so-called renewable chemicals.

Important economic and logistic obstacles remain as well as how to convince the customer of the new qualities and features.

So to answer the given question at the beginning: Growth, in the widest sense, Sustainability and the Bioeconomy are not an Uneasy Triangle or a Trilemma as defined in Wikipedia! They form an Easy triangle!

The European Commission was the first to recognize and publicise this, qualifying its first European Bioeconomy Strategy with the noteworthy title “Innovating for sustainable Growth – A Bioeconomy for Europe”, two years and half ago.

Let us start to introduce these elements in our discussion on the future of our planet. ●

It Takes an Integrated and Connected Knowledge

by Gunter Pauli



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The onslaught of bad news about the environment, poverty, unemployment, human rights abuses and the inability of policy makers to face up to global crises combined with the business-as-usual approach by corporations leaves many concerned citizens baffled.

The data before us are clear: climate change is advancing, there is no chance to absorb the hundreds of millions of unemployed youth while competitiveness of most of the nations around the world continues to erode. The only solution economists imagine to all the problems and the wrongs is growth, driven by more consumption for which citizens are expected to accumulate more debt.

There is a lot of time and effort spent on the analysis of all available information. While many desperately search for alternative solutions, there is not one capable of reversing the negative trends. There is a blind belief in one solution: growth, and those nations that lack growth should first pass through a period of austerity. Every expert approaches the bulk of information from her or his perspective framed in a clear silo, robbing the world of an integrated and connected knowledge that is required to create a vision indispensable to design fresh and effective pathways forward.

The lack of comprehensive knowledge of how economic and social systems operate leaves no space for the wisdom urgently needed to mobilize the best minds and the committed individuals to evolve from analyses of unfolding dramas to a pragmatic portfolio of initiatives. In my view, too much effort is reserved to analyze the problems, to theorize solutions and fiercely debate these options. Hardly anyone focuses on the demonstration on the ground that it is possible to outcompete the present growth model by performing better – even according to their parameters of success.

Few people have realized that analysis and theory, concept development and case studies cannot make

a dent in the present negative trends unless there is a fundamental shift in the business model. We should evolve from the logic of economies of scale and cost cutting towards a society that uses what it has, responds first to basic needs of all, circulates the newly gained purchasing power in the local communities and generates capital, especially social capital while strengthening the Commons. We have to evolve from consuming something once through an authoritative linear supply chain management, to unending cascading of nutrients, matter and energy, like ecosystems do, and a biobased economy can, backed up with a creative upcycling of minerals. This not only strengthens the local economy, it creates resilience against global shifts and shocks.

The core shift in the business model is to go beyond this relentless cost cutting drive and to embrace a business strategy that aims to generate more value with what is locally available, and rely increasingly on regenerating resources within the limits of its carrying capacity. This fundamental shift forces companies out of the straight jacket to only focus on one product portfolio. The acceptance of this novel – yet easily understood strategy – is a major challenge, since it is fundamentally different from what Mba's have been trained to pursue as the pathway to success. The upside is that this new business model offers opportunities to generate multiple revenues with resources that are within the immediate reach of enterprise, entrepreneur and the communities while it could put nature back on its evolutionary path – not just protect it from the ignorant consumer. The surprise is that when one generates several income streams from available resources then one can extract its business from the hard game of world market prices!

This is not the advent of the end of globalization, it is the beginning of something much better! ●



Think Tank

Stages of Change

by Gianni Silvestrini



While fossil fuels for energy production have been used for the past 250 years, their utilization to generate new materials and a plethora of plastics dates back to no more than a century ago.

However, after a rapid growth, in the next decades the employment of hydrocarbons will probably slow down and fall, mainly due to the constraints brought about by climate change.

In some fields, their central role is already deteriorating. As for electricity generation, in many countries renewable sources are rapidly expanding. Their potential is colossal, and they are to meet humankind's electricity demand in an efficient energy use scenario.

As regards "renewable matter" – the biomaterials that have a market thanks to their characteristics and their environmental added value – the situation is not quite the same. Their current production is still less than 1% compared to that of traditional chemistry. In the long run, their role could change dramatically, albeit not along the same lines as the renewables, due to the need for the biochemical sector to share its soils with food, energy and raw material production. Today, only 0.03% of the planet's total arable land is used for bioplastics, so in real terms this sector's evolution margin is substantial. So, to give you some figures, during the second half of the century, 0.6% of agricultural land could meet a quarter of plastic materials' demand.

Biomaterials can guarantee better environmental performance compared to industrial chemistry's products. Well-managed supply chains help create a closed-cycle production and activate virtuous synergies between the biological and industrial worlds. Moreover, production often entails lower emissions. Ultimately, their utilization enables an increase in the products' added value and their disposal is assisted by biodegradability.

Plastic-induced environmental damage has been estimated around US\$ 75 billion per year by UNEP, one third ascribable to production and 17% to the 10-20 million tons of waste that are dumped in the oceans each year.

These are the characteristics that enable biomaterials to succeed, despite production costs being often higher compared to those of conventional chemistry. Besides, rapid innovation of the processes will lead to significant technological performance advancements and to a reduction in prices, which will result in better competitiveness. In this respect, a crucial element in the comparison with chemical

products is represented by hydrocarbon prices. So, it is interesting to notice, for example, how the dramatic price reduction of methane caused by shale gas on the US market is affecting the production of biopolymers. As a result, some processes such as that of bioethylene and biopropylene have become disadvantageous, so much so that important multinationals have stopped their billion dollars investment in Brazil. In the United States, shale gas success has effectively made ethylene's production decidedly cheaper, starting from low-cost methane.

At the same time, there are other biopolymers that are at an advantage. Some products such as isobutylene and butadiene, derived from the production process of ethylene from oil, are now dwindling. They are intermediate products used for processing important products such as synthetic rubber and nylon. This is why in the United States some biopolymers are becoming economically appealing.

Let us now think about the evolution of biomaterials in the long term, in view of a prospective serious climate agreement.

Consequently, in 10-20 years, a drastic depreciation of fossil fuel reserves might occur, the so called "carbon bubble". So, if following an escalation in the planet's warming, new strict objectives for climate-changing emission reduction should be set up, a high share of fossil reserves belonging to energy multinationals or to the producing countries might not be utilized.

How would this impact on hydrocarbons' prices?

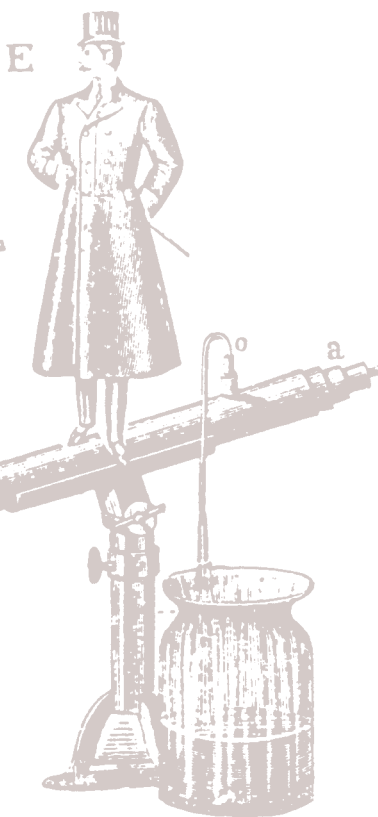
In addition, what kind of repercussions might the limitations of their employment as energy source have as opposed to their use as raw materials?

It is an open question. On the one hand, given the considerable investments made in explorations and drilling, the petrochemical industry's supply price might drop, facilitating new applications substituting metals (such as in the use of composite materials for car bodywork).

On the other, the hydrocarbons' use restriction would take place through the recognition of a high value to CO₂, as much as 100 euro/t, thus favouring the processing of biomaterials with emissions far lower than those of petrolchemistry. ●

Gianni Silvestrini

is Chairman of Gbc Italia, Scientific Director of the Kyoto Club and of QualEnergia magazine, Chairman of Exalto. Since 1978, he is an energy researcher at Cnr and at Politecnico di Milano, where he has also coordinated the Ridef Master's post graduate course.



Energies Sustainability and Renewable Materials

by Edo Ronchi



Edo Ronchi, since 2008 is Chairman of Fondazione per lo Sviluppo Sostenibile. He was XIII legislature's (1996-2000) Environment Minister.

Renewable energies are to be considered neither plentiful nor inexhaustible nor cheap. Indeed, using renewable energy sources requires – for the production of electricity, usable thermal energy and fuels – institutional regulations and activities, professionalism and work, technologies, facilities and investments and land and non-renewable resources for plants.

The exploitation of renewable sources for energy implies using limited, expensive and non-plentiful resources. For these reasons they must be used in moderation, efficiently, always prioritizing energy saving. To mitigate the current serious global climate crisis, the use of renewable energy sources must grow, thus replacing the use of fossil fuels. Such replacement stems not so much from scarcity of fossil fuels: their limited availability affects the oil price, which is expected to rise, but it does not seem to have an effect on gas (because of the augmented availability of shale gas as well) nor on the still plentiful coal. The urgency to replace fossil fuels depends mainly on environmental reasons: the need to reduce CO₂ emissions, the main greenhouse gas. In addition, the environmental imperative to use renewable energy sources should not lead us to neglect the environmental impacts of plants, electricity and heat production from renewable sources and biofuels.

Making no concession to corporate interests or groundless scaremongering and bearing in mind the importance of analysis and balanced evaluation of ecological costs and benefits, we should consider that the ultimate goal – renewable energy production – does not justify the employment of any means, so the available ones must respect the environment: a precious and dwindling resource. Hydroelectric power is precious, but watercourses are important ecosystems as well, requiring adequate water quantity and uninterrupted flow. There is ample room for solar panels and wind farms without affecting quality landscapes and farmed land. Production origin and modes of biofuels need careful monitoring: in order to produce palm oil, most of Indonesia's tropical forests have been destroyed and the expansion of ethanol production from sugar cane in Brazil is shrinking the Amazon Forest.

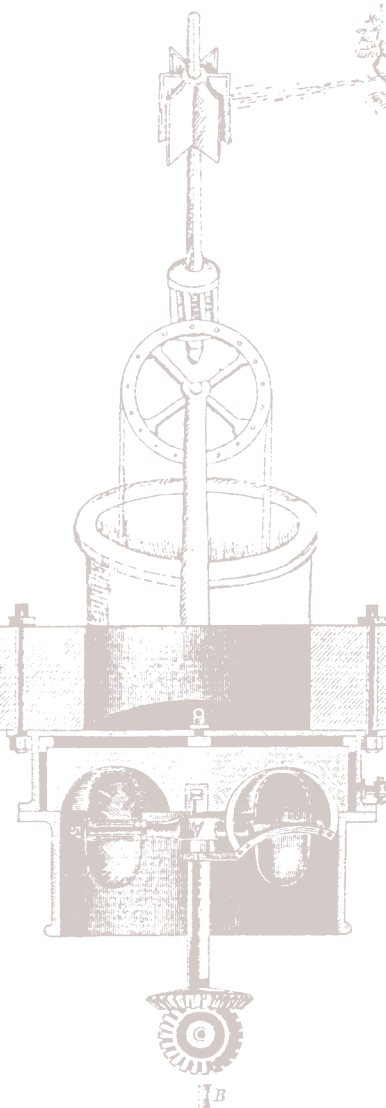
When dealing with the issue of renewable matters, such well-grounded considerations on renewable energy sources must be borne in mind. It is important to highlight their environmental advantages

and their development potential but also their limitations and danger, avoiding emphasizing their usefulness based on unreliable ecological benefits, such as the definition of renewable matter as "inexhaustible resource". Renewable matter is amongst the ecosystem services guaranteed by natural capital and as such it is not at all inexhaustible, but it is confronted with at least two constraints: the first stems from natural capital's limited regeneration ability and resilience.

The second depends on the necessity to maintain other ecosystem services. Let me give you an example with one of the main renewable materials: wood.

It is true that trees do grow and, if cut, they can grow back and/or can be planted again, but not all of them and not everywhere, not in every soil and generally speaking not in a short time. Moreover, woodland and forests not only provide wood but many more – and often more important – ecosystem services: biodiversity, climate, air, hydrogeological structure, landscape, cultural and recreational opportunities. So, the collection and use of such an important matter – wood – demands care and respect of ecological sustainability criteria, despite being renewable. In addition, fertile soil provides an all-important service: agricultural and food production.

Again, it is necessary to monitor the unregulated mechanisms of the global market that can make corn production fill SUVs tanks cheaper, rather than the stomachs of millions of undernourished or starved people. For instance, they can cause a rise in corn prices for food compared to its use for the industrial sector. Since the global market seems so difficult to regulate, how can such a risk be avoided locally? By eliminating or, when it is not possible, minimizing the use of renewable materials made of agricultural and food products for industrial use and by not using cultivated land for agricultural and food production of renewable materials for industrial use. But how can the development of the production and the industrial use of renewable matters be guaranteed? With the good practices and technologies already available, by enhancing and revamping, with adequate cultivation methods and techniques, vast marginal and uncultivated areas – not crucial from an ecological viewpoint – and by recycling a variety of discarded matter and biodegradable wastes that are normally thrown away or disposed of inadequately. ●



Think Tank

Changing the Relationship between the Economy, Territories and People

by Catia Bastioli



Catia Bastioli is CEO of Novamont and European Inventor 2007 for bioplastics. She has transformed her research into an industrial reality, leader today in the development and production of bioplastics and biochemicals from renewable sources, thus putting into effect her idea of Bioeconomy as territorial regeneration through integrated Biorefineries that combine chemistry, agriculture and environment.

The challenge that we are facing – how to get the economy running again – is an industrial revolution which radically changes the relationship with our territory, currently characterized by the Nimby syndrome. For over two centuries we have witnessed a race towards ever bigger plants, while the environment was reduced to a mine or a landfill, pollution was increasing, and the juxtaposition between work and health was becoming more and more evident. Today, we are paying a high price for this; the moment has come to turn a page, not only reducing the pollution from the production process, but also rethinking the production system so that it is integrated with the territory.

This means that we cannot engineer development with anonymous recipes that are replicated in every corner of the planet with few differentiations. Bioeconomy, the economy that integrates biosphere resources and those coming out of human intelligence, is based on the knowledge and respect of each territory and its peculiarities. Only a deep knowledge of the capabilities and the needs of each territory, together with a continuous research on how to use resources in the most efficient way, without creating imbalance, will allow us to implement a development which takes into account the needs of the economy, the environment and those people who inhabit a territory. An example is represented by the use of advanced technologies, not in places with an agricultural or touristic tradition, but in those that have suffered the consequences of de-industrialization and that can now have a new opportunity: an innovative integration between the agricultural and the industrial world. This should not be done with top-down projects that concentrate activities in one single big company, but through a network model where the company is a catalyzer for a number of smaller and widespread initiatives: cooperatives of young farmers who get together to produce raw materials, other businesses that follow other stages of the process, always trying to use the material produced as an operational solution to solve problems, provide services and improve the quality of life.

This material needs to be studied accurately in order to reduce their environmental impact, guaranteeing a benefit for all and a competitive capacity for the collectivity, which identifies itself with the project and is committed to its success. I refer to those innovative products that are starting to be produced in sectors such as lubrication (improving their performances and avoiding the risk of polluting water

and soil, which is typical of non-biodegradable oil derivatives), plasticizers for polymers, obtained from renewable sources and risk-free, that can replace the phthalates (under observation due to their effects on the endocrine system); tyres (that provide minor resistance to rolling, thus reducing consumption), cosmetics, antioxidants and natural herbicides. What is needed is integration between the territory, universities, research centres, and people committed to these issues in order to create a multiplier effect of benefits, first of all the creation of employment. This model would prevent repeating past mistakes (excessive support from public finances to non-competitive and highly polluting productions, which only creates idle revenues; ad hoc interventions without an integrated strategy, which disincentivizes virtuous development, thus contributing to the increase of commercial imports and generating unemployment) and would guarantee a management of territories that favours their potentialities in terms of bioeconomy. This way, it would also be possible to rethink unsustainable approaches such as sectorial and indiscriminate incentives, lacking any systematic logic in sectors with huge volumes of production. These are not only projects for the future. The example of biodegradable and compostable shoppers, which have transformed organic waste into a resource, shows how Italy is capable of elaborating – from a creative, scientific, organizational and political point of view – models that are successful at the level of competitiveness and international consensus. What has been done so far was made possible thanks to a fertile dialogue between researchers, environmentalists, citizens, politicians and industrial organizations. This model was also successful in solving several problems: creation of new employment (according to data from Plastic Consult, this supply chain currently employs more than 1,500 people, there are roughly 150 operators and its turnover amounts to 450 million euros, but could also reach a billion if illegality was eliminated; the complete implementation of the upstream part of the supply chain of bioplastics could generate 6,000 direct new jobs, and the extension of this model to Europe would surely mean new jobs for tens of thousands of workers), as well as reduced environmental impact (in a couple of years Milan has become a world leader in organic collection both for quantity and quality). This is the demonstration that in order to come out of the crisis, it is necessary to devise new strategies which put the interests of citizens at the centre, starting from experiments of systemic projects on the territory. ●



Bioeconomy's Triple Advantage

by Antonio Di Giulio



Antonio Di Giulio is Head of the Strategy Unit in the Bioeconomy Directorate of the Research and Innovation Directorate-General at the European Commission.

The Bioeconomy aims to promote the most efficient and sustainable production and exploitation of biological resources to tackle global interconnected challenges.

The concept of the bioeconomy integrates primary production sectors – like agriculture, forestry and fisheries – and processing industries along the value chains for food, biobased products and bioenergy. This overarching, coherent approach is essential to allow the bioeconomy strategy to address major interconnected societal challenges such as food security, the sustainable management of natural and biological resources; the mitigation of climate change, job creation and promoting competitiveness.

The final objective is to explore and develop triple-win solutions, to overcome the trade-offs among agriculture, nutrition and health, environmental sustainability and economic growth. To achieve this result, the EU Bioeconomy Strategy develops a supportive Research and Innovation policy environment that provides the ground for concrete actions.

Policy coherence is essential for the bioeconomy. Why is policy coordination so crucial in developing the bioeconomy? One of the reasons is the use of biomass, which is subject to trade-offs, not only between food and fuel but also between feed, biochemicals, bioplastics and other biomaterials. This is further exacerbated by the need to increase agricultural productivity while protecting biodiversity, ecosystems and the environment.

We cannot continue to focus on individual sectorial priorities – we have to look at the broader picture

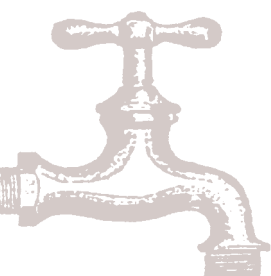
and to create a win-win environment for industries, investors and society.

In this regard, the second pillar of the Strategy aims not only at improving coherence and synergies between the wide range of policy areas related to the bioeconomy at European level, but also at encouraging similar initiatives at regional and national level.

The Strategy also encourages further international cooperation on research and innovation and at policy level it seeks to address in particular food security, climate change and a sustainable biomass supply.

Efficient, advanced and innovative biobased industries would not exist without receptive markets. Through policy interaction and dialogue with stakeholders, market-making measures for biobased products can be established to support the development of the bioeconomy. Indeed, the Bioeconomy Strategy foresees to support the development of biobased markets through a wide range of actions.

- It aims at improving the understanding of available supply and demand of biomass and bio-waste across bioeconomy sectors, thus allowing the review of the existing policies and the development of new ones in support of a long-term biomass strategy for Europe.
- It also provides support to overcoming the “valley of death” between products and their markets for the development of biobased products by providing support to demonstration, pilot and up-scaling activities.
- Furthermore, the strategy supports the development of market instruments to encourage the uptake of biobased products by consumer markets and green procurement. It does this by developing market instruments ranging from standards and labels for biobased products to sustainability and life cycle assessment methods.
- Finally, the Bioeconomy strategy develops approaches to better inform consumers about product properties in order to promote a more sustainable lifestyle, and to involve civil society in a participatory governance of the bioeconomy. ●



Think Tank

Fighting Waste to Produce New Wealth

by Luigi Bistagnino



Luigi Bistagnino is Full Professor at the Department of Architecture and Design, Politecnico di Torino, coordinator of the research group Systemic Design.

Innovating involves approaching problems from a different perspective. In other words, one needs to move from a quantitative to a qualitative analysis, thus feeling an integral part of a living system where everything is constantly evolving, with every element interconnected with the others in an input and output fluid exchange. At the same time, matter is part of this system and of ourselves.

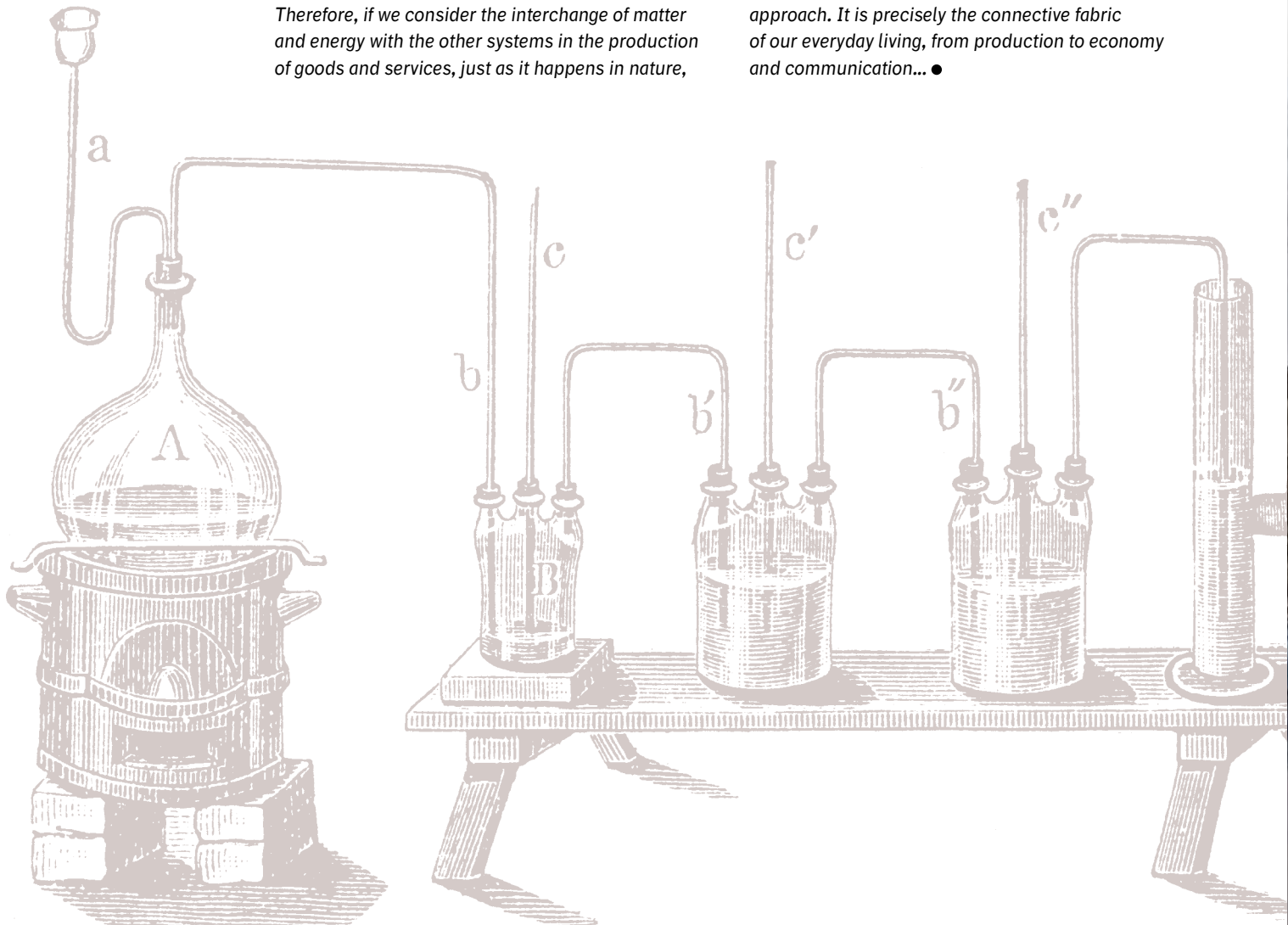
A new way to see, to act and to think in the various fields of knowledge is set out before us. Within the economic sciences, people are considering the fact that 60/80% of all resources currently employed in a production process are incorporated in the end product, while the remaining 20/40% end up, at best, in a landfill or, at worst, as special waste. Society and, above all, the planet can no longer take the extra cost that industries have fraudulently dumped on them upon themselves. Thankfully, a new economic vision is on the horizon, one that sees the dynamic flow of matter, both incoming and outgoing, as an item included in the profit and loss account. Therefore, if we consider the interchange of matter and energy with the other systems in the production of goods and services, just as it happens in nature,

new production activities are generated. Together with the existing ones they form a very solid network and extend the portfolio of job opportunities, of economic flow and zero waste.

Such tangible dynamic situation occurring when a new network is created causes new thirst for knowledge promoting a close multidisciplinary dialogue. The combination of different viewpoints sheds a new light on fresh cultural panoramas, with the possibility of real, albeit unexpected, solutions.

Since actions depend on the relations occurring amongst the actors, society as a whole will obviously benefit from it: cooperation could be spontaneously accepted instead of the current continual competition. The environment will be the beneficiary of the complexity of such exchanges, acting as the litmus test for the whole system, absorbing its positive effects.

In this complex set of relations, renewable matter can be a first field to give some serious thought to, an unmistakable stepping stone to understand and share the potential of a systemic cultural approach. It is precisely the connective fabric of our everyday living, from production to economy and communication... ●



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il futuro dei pneumatici fuori uso, oggi

Policy

The Peak of Resources

by Ugo Bardi

If you were asked to imagine an antithetical situation to that of circular economy, what would come to your mind? Probably the world of fossil fuels, namely the carbon stock that has been accumulating underground for hundreds of millions of years and that we have squandered in just a few generations: the exploitation of dwindling goods is measured in months while that of carbon stocks goes beyond the domain of human history. Our bet on fossil fuels has meant consolidating the idea of linear development. This process is still happening today: more sophisticated technologies to find new fields, changed climate conditions, shale oil and gas rush have increased the quantity of oil and gas available. However, the advances in this direction are useless from a climate point of view (CO₂ concentration is already too high) and limited from the available resources viewpoint. This limit is called Peak Theory.

Ugo Bardi is a member of the Department of Earth Sciences of the University of Florence. He is a member of the Club of Rome.

There is a ghost hovering around the world. Its name is "The Peak". In a way, it is an obvious concept: if we exploit a non-renewable resource, its production is bound to start from zero at the beginning of its exploitation and go back to zero when such resource is completely exhausted. Between these two extremes, there is bound to be a point of maximum production, this can be called "peak production". It is a general phenomenon affecting not only non-renewable resources but also renewable ones, if we exploit them quicker than they can be replenished.

So, understanding the mechanisms leading to peak production and their characteristics is crucial to comprehending that nebulous

entity – nowadays called "civilization" – that could not exist in its current form without a continuous flow of cheap energy and resources. Resources presently coming mainly from the mineral kingdom. When these flows must be reduced (in post-peak scenarios), what will happen to our civilization?

In order to understand the concept of peak, we must go back in time to when it was first introduced by American geologist





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Marion King Hubbert in 1956. Hubbert was an oil expert and according to his interpretation, Southern US oil production (thus excluding Alaska) would have followed a bell curve, reaching its maximum in 1970 and declining afterwards. This maximum level was the first example of peak for a resource.

Hubbert was challenged, insulted and in some cases worshiped for his forecast that proved surprisingly perfect when in 1971 US

oil production peaked and then started its long decline. Moving on from this, Hubbert calculated that the world's oil production would have peaked around the year 2000, an event later known as *peak oil*, a definition proposed by English geologist Colin Campbell. This forecast proved to be less accurate: in 2014 we have not seen the global peak oil, in fact oil production is still slightly increasing, thanks especially to "non-conventional oil" (shale oil and Canadian oil sands) that Hubbert did not take into

"It is the customary fate of new truths to begin as heresies and to end as superstitions."

— Thomas Henry Huxley

consideration in his forecast because he was unaware of their existence.

Over five decades after Hubbert's first presentation of his ideas, we can affirm that his theory has proved rather inaccurate in determining the peak date of a given resource. At the same time though, it has become a sort of "universal wrench" enabling us to interpret many historical trends of resource production; not only for oil and mineral resources but also for theoretically renewable resources when exploited faster than their regeneration rate.

There is a plethora of examples and so far one of the most famous cases of Hubbert curve is US whale oil production in the 19th century. The kind of whale hunted for this purpose (right whale) was pushed to the brink of extinction; presently its population is still nowhere near the numbers before the hunt started. The economic history of the world presents many such examples: coal mining in the United Kingdom and in other European countries, gold mining in California, mercury mining and the list goes on.

The concept of peak has proved to be fruitful, in particular giving rise to a current of thought that is sometimes called "peakist movement" (a term not always seen as a compliment). Nevertheless, it has also remained "transparent" – or completely invisible – to the eyes of the public, politicians, policy makers and most economists. As Thomas Henry Huxley affirmed, "It is the customary fate of new truths to begin as heresies and to end as superstitions".

It appears though that Hubbert's Theory still belongs to the realm of heresies, or maybe not, since for the majority of people it simply does not exist. In reality, when discussing peak production, we are often faced with a situation where the so-called "abundantists" line up

barrels of oil as if they were toy soldiers ready for battle, while "peakists" sometimes seem to think like those prophets that in the past preached the apocalypse. We are always faced with the quasi-insurmountable obstacle of spreading the concept of peak against the stern objection "but if oil resources are not exhausted, why should there be a peak?" Experience teaches us that it is not possible to proceed in this debate unless we offer a good explanation of the peak concept and its reasons.

First, peaking (of oil or of any other resource) does not mean that the resource is "exhausted" or that there is none left. We are talking about peak production, that is, the moment when it reaches its highest historical level. It does not mean that in the post-peak period such resource is not produced, it only means that its production is lower.

We must also remember that the peak of any resource does not spell apocalypse or disaster. Normally when in a region a resource peaks, it is replaced by another or by the same resource produced in a different region. This is what has happened with oil in the USA. As we said earlier, US oil production peaked in 1971, but oil consumption has increased thanks to rising imports.

Finally, we must also highlight the fact that peaking is not a physical law and it can be reverted. In many instances, reverting the trend of production decline has been possible by increasing investment. The USA provide us with a further example. After the 1971 peak, production kept shrinking until a few years ago, when this trend was reversed thanks to massive investments of the oil industry in shale oil extraction, a resource that was once considered too expensive to be exploited. This is leading the US production towards a second peak that could occur in the next few years.

Figure 1: The Hubbert Curve as it was originally presented in 1956 in relation to the US oil production. Real production followed quite closely the curve (the highest one of the two represented in the diagram) till a few year ago when shale oil production boom changed the situation leading to a new production expansion phase that should peak in the next few years.

Source: M.K. Hubbert, "Nuclear Energy and the Fossil Fuels", Spring Meeting of the Southern District Division of Production American Petroleum Institute, 1956.

Figure 1 | The Hubbert Curve

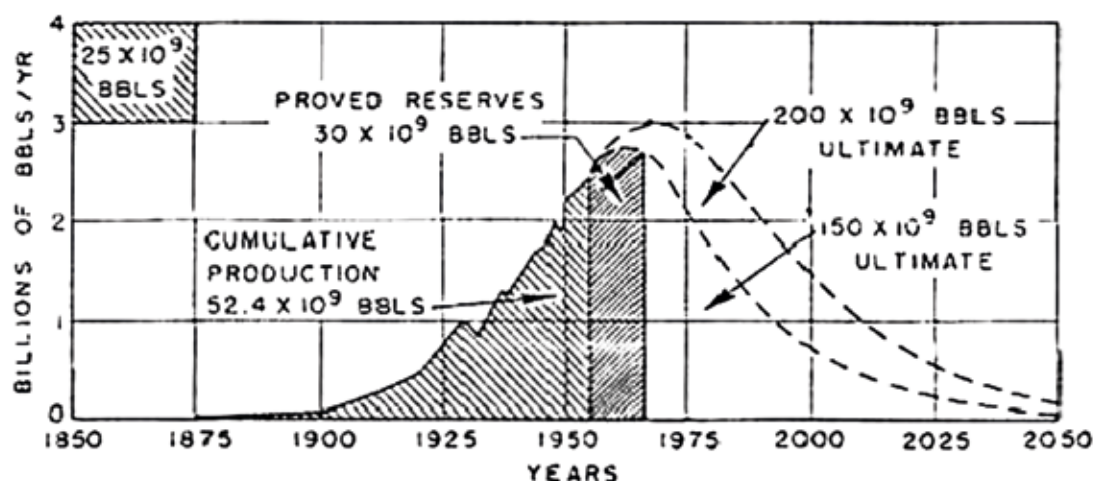
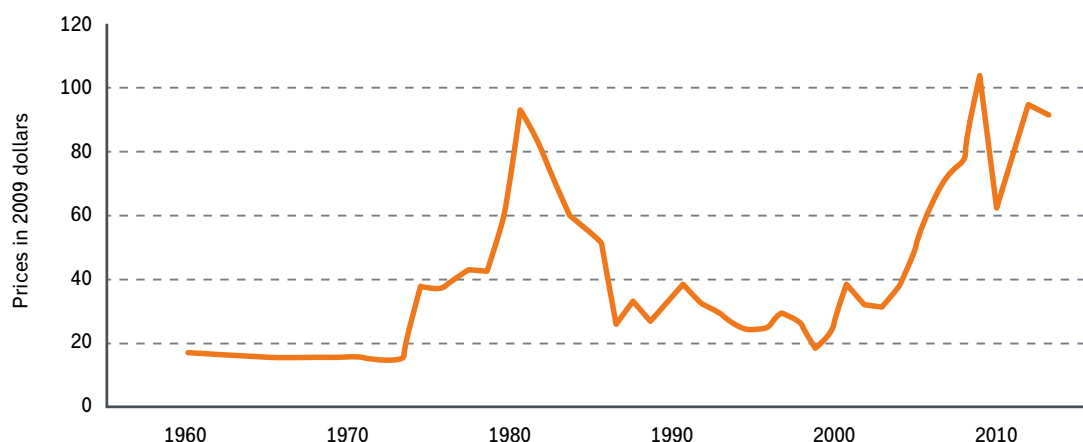


Figure 2 | WTI oil prices

Source: Author's estimate based on data from the Federal Reserve Bank of St. Louis, USA.



So, once we have established what the Hubbert Peak is, we must understand what causes it. Why is it that so often the production of a resource follows such a well-defined curve? We can explain it as the result of the combination of two factors: one has to do with the laws of geology and the other with those of economy.

Geology tells us that mineral resources are not all the same. Every resource is present in fields with different concentrations (or “grades”), deepness and purity. The “easier” resources do not need a lot of work to be extracted and refined but the exploitation of “difficult” resources requires deeper mining and more complex processing in order to extract useful minerals. Just remember that at the very beginning of oil extraction, this resource could be found on the surface or just a few metres underground. Today we talk about kilometres and in very hardly accessible regions or at the bottom of the sea. This entails a higher financial and resource investment.

Now, let us combine geologic resources dispersion and the obvious economic principle of profit maximization. Clearly, there is a tendency to extract and exploit cheaper resources. At the beginning, extraction is relatively cheap; profits are high and are mainly invested in new search and extraction. This causes a rapid increase in production. Over time though, cheap stocks are exhausted so costs increase and profits fall. Consequently, less is invested in R&D of new resources. The rapid initial growth slows down until it stops. Production decreases after reaching its highest level, this is why there is a peak. This logic can be applied to any depletable resource, peaking is not confined to oil only.

It can be demonstrated with a mathematical model (see “A Simple Interpretation of Hubbert’s Model of Resource Exploitation”, <http://www.mdpi.com/1996-1073/2/3/646>) that the Hubbert Curve, symmetric and regular, occurs

if producers keep reinvesting a constant fraction of their profits in searching for and extracting the resource.

This is obviously an approximation, but the fact that many historical cases present a similar curve means that in many instances this is what happens in reality. Naturally, the price mechanism can heavily influence production trends. It goes without saying that producers try to maintain their profits by increasing sale prices in order to compensate for rising extraction costs. In reality, the market can react to the perception of a vital resource shortage, such as oil, by raising prices. This generates an increase in profits and new investments, sometimes massive; as a result it is possible to counter a decline in production for a certain period. But not forever, because high prices tend to reduce demand, at this point the market shrinks and prices fall. A contraction of production follows. It is impossible to elude Hubbert’s Mechanism because, at the end of the day, it is based on a fundamental economic principle: the decreasing return on investment.

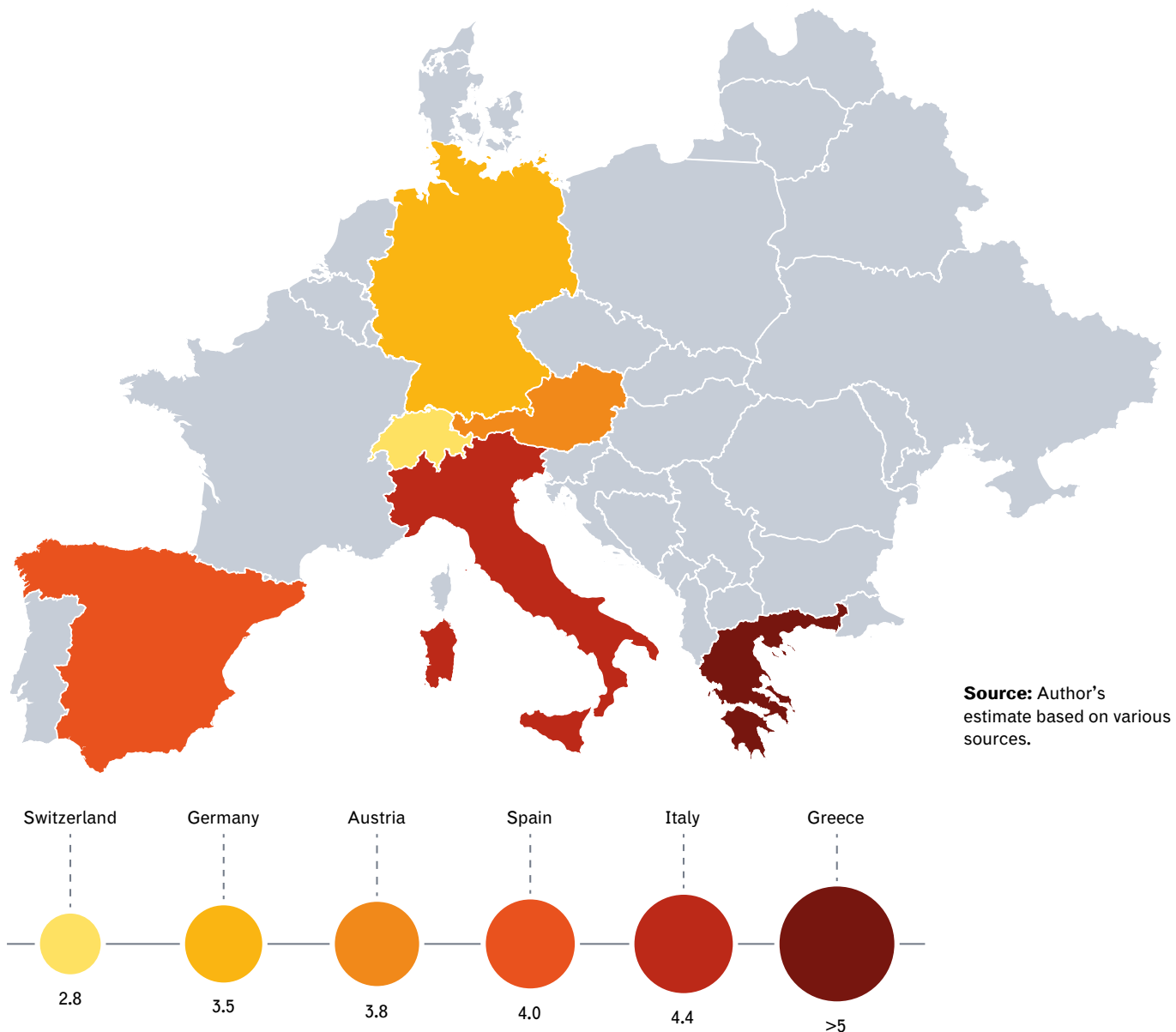
As seen so far, the mechanism that leads to a peak is applicable to all mineral resources: overtime, easy and cheap resources are exhausted, with extraction becoming increasingly expensive. This results in a general increase of costs. So far, we have not seen the beginning of the decline of any crucial mineral resource: the “peak of minerals” is still ahead of us, in the future, but perhaps not that far off. According to a 1972 study, *The Limits to Growth*,¹ the peak should have been reached in the second decade of the 21st century. The mining industry’s effort to maintain current levels of production requires higher and higher investments and it is clear that it cannot increase *ad infinitum*.

High mineral resources prices create problems, particularly serious ones, in countries that depend heavily on imports, namely countries with

Figure 2: As seen in this diagram, oil prices have increased by a factor of 5 in the last few years, starting a trend that appears irreversible unless a serious economic crisis reduces demand substantially as it briefly happened in 2008 at the beginning of the economic downturn. Similar trends can be found in all mineral resources: prices increasing by a factor of 3-5 compared to levels considered “normal” until a few years ago.

1. *The Limits to Growth*, commissioned to MIT by Club di Roma, published in 1972 by Donella H. Meadows, Dennis L. Meadows, Jørgen Randers & William W. Behrens III.

Costs of fossil fuels imports and GDP ratio (2012)



an economy based on transformation, processing imported raw materials and exporting finished products. This type of economy characterizes many European countries, including Italy.

It can be argued that Italy's deep economic crisis over the past few years is due to the heavy costs of its imports, particularly of fossil fuels, in an economy that is not as efficient as other European economies in using them.

What does the future hold? As usual, accurate forecasting is not possible. However, we can predict that the gradual exhaustion of cheap mineral resources will make production more expensive. Technological innovation, often portrayed as a panacea for solving depletion issues, can mobilize new resources but only if the productive system is prepared to pay high ensuing costs. Consequently, we are travelling a road leading to a world where past assumptions are no longer valid. For example, in the majority of cases, extracting a mineral resource was less

expensive than recycling it. However, this could no longer be the case in the future.

In essence, there is no escape from a very simple concept. As described in *Extracted*, Club di Roma latest report,² mineral deposits that we call "resources" are the result of energy provided by geologic processes that needed millions of years to concentrate dispersed materials on the Earth's crust in forms that we are able to exploit. It is a "gift" given to us by the planetary system, but it is a one off.

Eventually we must learn how to manage mineral resources without thinking that they are free. This means learning how to recycle, reuse and use efficiently. It is possible, but it requires time and investments and we must abandon the idea that we only need "to dig deeper" to solve the problem. ●

2. The book is currently only available in German (*Der Geplündete Planet*, Oekom verlag, 2013) and in English (*Extracted*, Chelsea Green, 2014).

5 Drivers for a Changing Economy

by Marco Frey

Marco Frey, Director
of the Institute
of Management at Scuola
Superiore Sant'Anna
in Pisa.

The simple question that we ask ourselves here is if the turning point of “renewable matter” is a real radical change in the industrial notion of resource flow.

This implies analysing what its economic relevance is, assuming that there is a very close connection between economic development and the rational and sustainable use of matter flows.

In order to answer this broad research question, it is necessary to mention some changes occurring in our economies.

We shall try to make a list to shed some light on the joint effect of processes holding together economic, social and value changes.

First and foremost we need to analyse the ever-so-pressing issue of the lack of basic raw



materials and commodities which is one of the drivers of a radical transformation occurring in the economic system. A recent report by McKinsey (2012) shows how, in just a decade, the real price of commodities has soared by 147% compared to the prices at the onset of the new millennium. Europe is particularly affected by such a situation, because it depends largely on foreign supplies of raw materials. **Figure 1** shows such dependence on a series of materials, starting from fossil fuels.

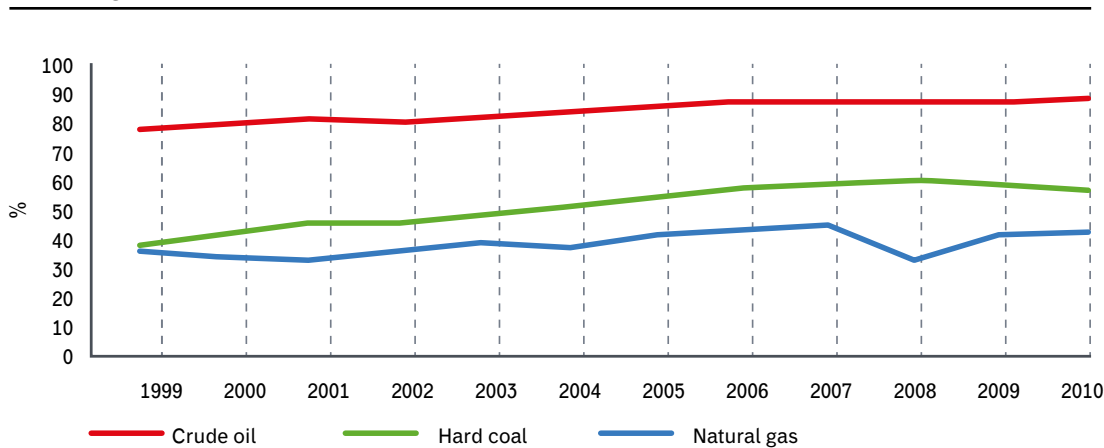
In the last decade, the absolute consumption of raw materials in Italy has fallen around 23%, which accounts for a reduction of 220 million tons of extracted materials from the planet per year.

Then there is a second driver: a growing interest for a more efficient and renewable use of resources. Here, over the last few years, the United Nations – mainly through UNEP in 2011, OECD in 2011 and above all the European Commission in 2014 – have emphasized the need to set up a long-term strategy for an efficient use of resources. The European Commission states that “Europe 2020 strategy is one of green growth that not only will help us create a strong economy in the long term, but it also offers real business opportunities to come out of the current crisis and this time in a sustainable way [...] For this transformation to take place eco-innovative solutions will be key. They affect the way resources flow into the economy [...] Innovation tackling systems as a whole and considering value chains in their entirety” (Potočník, 2013). With regard to this, it is interesting to analyse

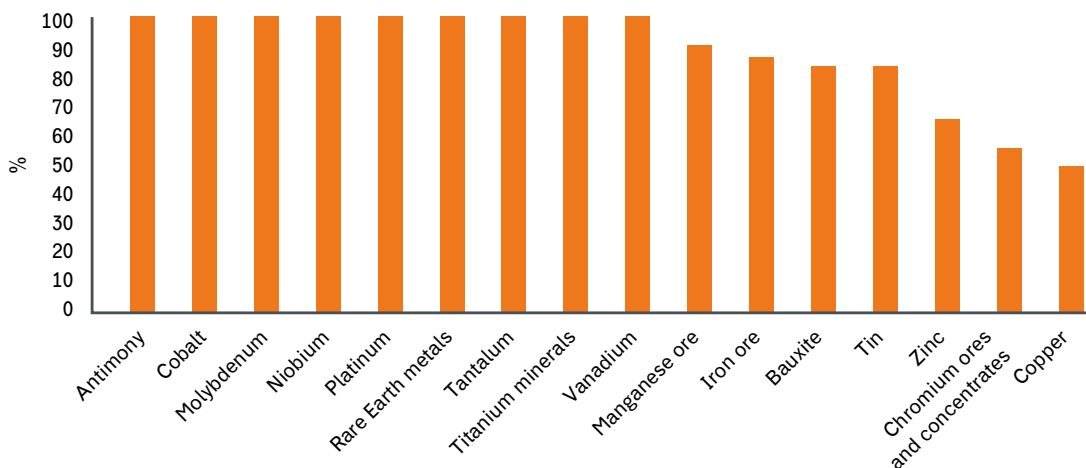
some data concerning Italy and Europe. In the last decade, Italy has been one of the countries in which the absolute consumption of raw materials has fallen more considerably, around 23%, which accounts for a reduction of 220 million tons of extracted materials from the planet per year. This means that, thanks to the simultaneous reduction of GDP, resources productivity has soared by 35%. **Figure 2** shows an analysis of what has happened over the last forty years. Here we see how Italy’s absolute consumption of resources has progressively soared from the 70’s right up to the 90’s, when it started to fall, until it went back to the levels of the early 70’s in 2011 (Bianchi, 2014). The major contributors, rather than the country system with its deliberate strategy, have been the various actors, spurred “to do better with less” by competition and resource scarcity.

Such structural reduction process in the use of materials is taking place in Italy and other countries, such as Germany, Great Britain and Hungary. Generally, in Europe 15, from 2000 to 2009 there was a reduction of 10% in the use of materials, compensated partly (+28% with a net effect of -3%) by the growth characterizing the 12 countries who have lately joined the EU. Overall, the EU went from its peak of 8.3 billion tons of materials in 2007 (almost 17 tons per capita) to 7.3 billion tons in 2009, as a consequence of the crisis and the contraction of investment and infrastructure.

Figure 1 | Import share for the use of specific materials in Europe 27

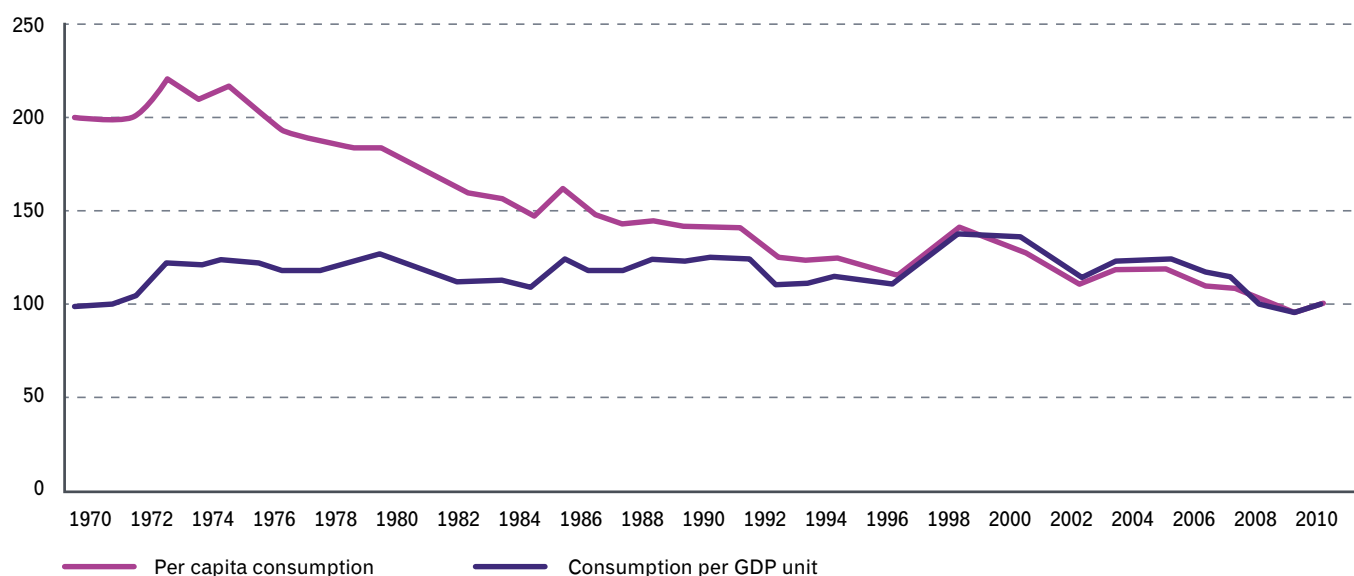


Source: Eurostat Statistics, 2010.



Source: Raw Materials Initiative Annex, EU 2008.

Figure 2 | Consumption levels of resources in Italy (2011 = 100)



As for the per capita consumption of resources in the various countries, **figure 3** shows how the most virtuous countries (The Netherlands, Great Britain, Italy) have a lower per capita consumption among the OECD countries that are now growing both in Europe and worldwide (such as Eastern European countries or Korea) and how, generally speaking, Europe is more efficient compared to other OECD countries.

The remarkable differences and the trends in the use of resources amongst the countries is a hot issue for the future.

Together with efficiency there is a third significant process focussed on matter renewability: market growth of bioeconomy products and above all of ever-increasing flows, originating from the reutilization of waste.

The bioeconomy – intended as the production of renewable biobased resources and their transformation together with that of waste flows into added-value products such as foodstuffs, feeds, bioenergies and bioproducts – has been adopted by the European Union as the strategic development line. The market grows by 7% annually (Csse, 2011) and contains highly innovative initiatives such as the Matrica project green refinery, recently presented at Porto Torres.

As regards (material) waste recycling, the picture is complex and demands a close analysis of the different production chains, which could be carried out within the editorial programme of this magazine with the presentation of significant experiences.

In macroeconomic terms, in order to understand the evolution of this field, the fluctuation of prices and international trade can be taken into consideration. Actually, despite the crisis and augmented availability in the more advanced countries, prices of the main secondary raw materials have almost remained stable in the last decade (**figure 4**).

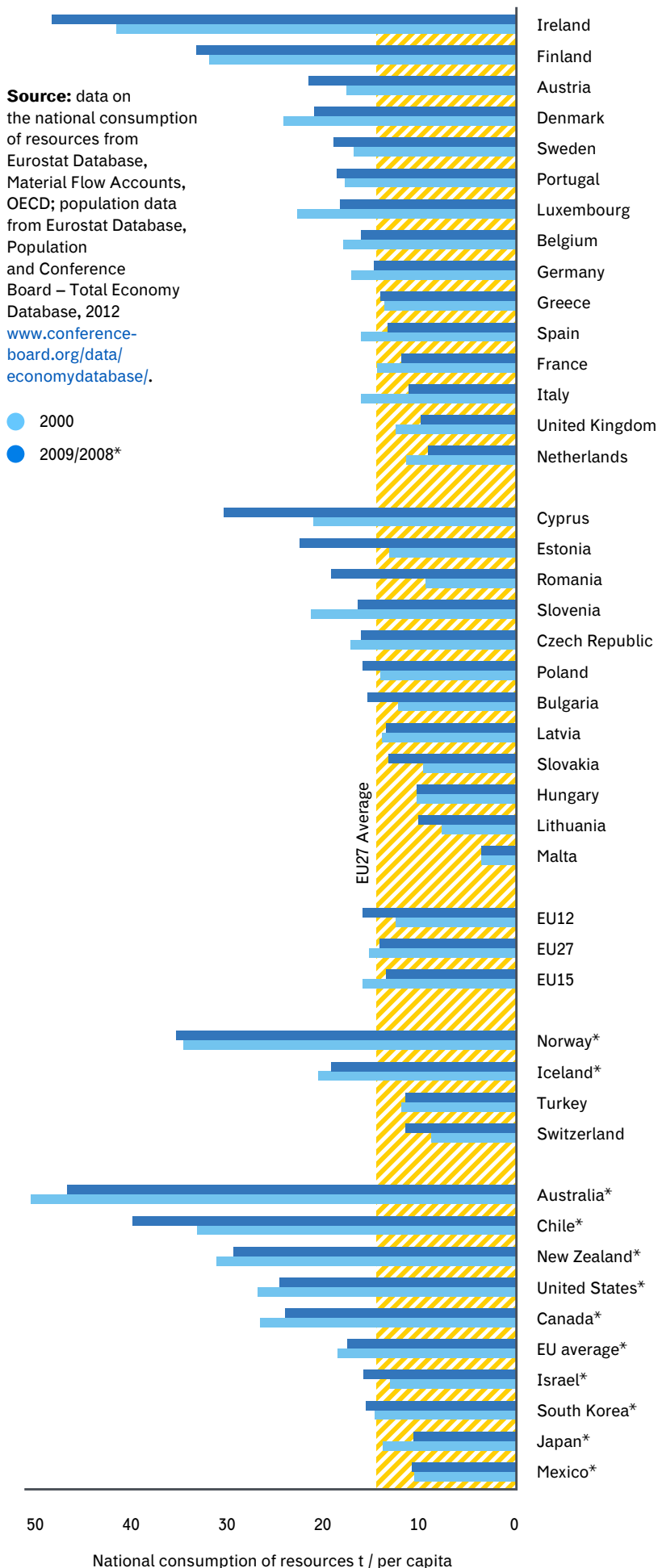
According to the European Environment Agency (2012), in Europe alone, across-the-border waste shipping (mainly special and dangerous) has soared considerably in the last ten years: in 1999, it amounted to around 3 million tons; in 2009, it already reached 11 million. Nations such as France and England, for instance, if they did not export, they could not cope with their high levels of plastic and paper collection, because they are able to reutilize between 50 and 75% within their respective countries. In the near future, it can be expected that countries that today buy secondary raw materials will start sorting waste and reutilize their own discarded materials, thus becoming independent in finding “regenerated” resources. This is precisely why it is imperative that each country develops their own reutilization supply chains, which will in turn feed a “circular” economy able to increase its self-sufficiency in the management of resources.

From this point of view, Italy has a strong industrial tradition in the reutilization of secondary raw materials within the production processes: the textile industry in Prato developed eight hundred years ago on used clothes, Luccchia’s paper mills have been equipped with the adequate technologies to use pulp for decades, Italy’s metallurgical industry has always used (imported) scrap metals etc. Other branches have only just recently appeared, such as those of used oils, worn out tyres, of EEEW, of rare earth elements. Nor should we limit our analysis to urban waste, even though it is supported by a recycling system such as that of mandatory consortia. Special waste accounts for 80% of total generated waste and it incorporates most of recycling added value (in 2009, in Europe, as much as 7 billion euros). Much can still be done in this field: let us take EEEW as an example. In Italy, from 2008 to 2010, the amount of waste collected from each citizen per year went from 2.8 to 4.2 kg, a strong

Source: our estimate on data by Istat and Eurostat (cf. Bianchi 2014).

In the near future, it can be expected that countries that today buy secondary raw materials will start sorting waste and reutilize their own discarded materials, thus becoming independent in finding “regenerated” resources.

Figure 3 | Use of resources per person and per country 2000, 2009



increase, but the country is still lagging behind Scandinavian countries that boast up to 15 kg per person.

Another equally significant change is that of the growing complementarity (and thus replacement) of the product with the service. The economic system has now – and this is the fourth factor to consider – a natural tendency towards a growing dematerialization, linked mainly to the service industry (close to 80% of those in work) in the most advanced countries. In the last few years, such *servitisation* has been accompanied by another significant phenomenon: that of the *sharing economy*.

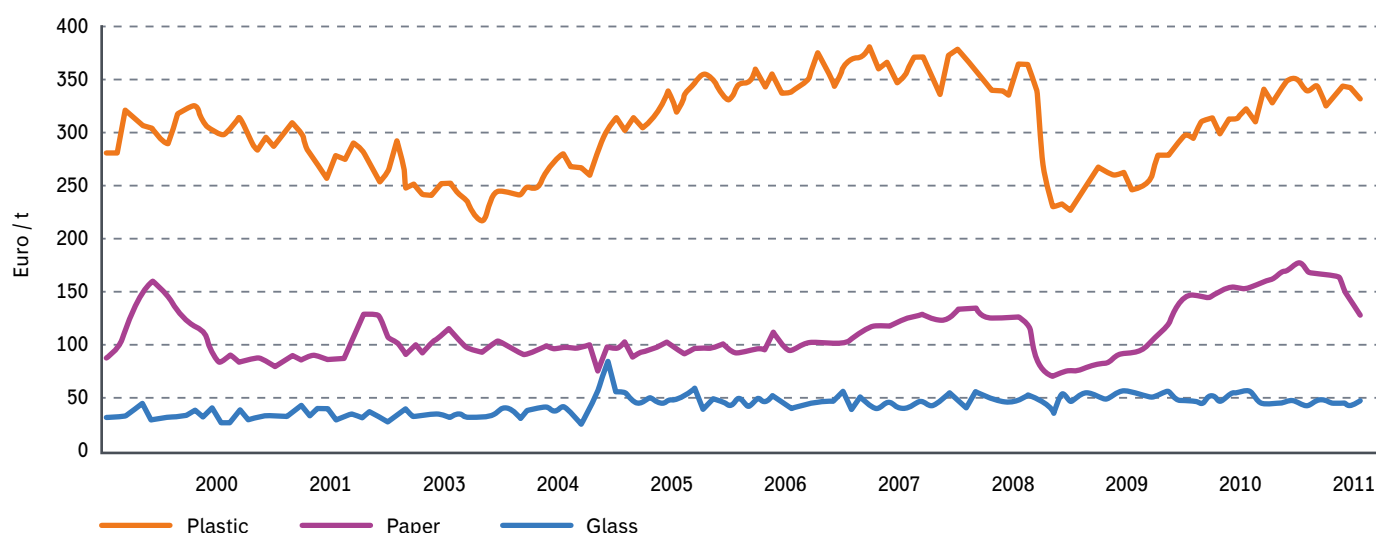
Thanks to the Web, more and more industrial products (cars, photocopiers, and also machineries) or goods (such as houses) are hired rather than bought, with better chances of enhancing the materials used and their utilization. It is worth noting that in such collaborative trade mode, whose market was estimated around 110 billion dollars in 2013, benefits can be distributed amongst the various actors along the service chain, both on the supply and demand side. For example, those who shared a house through Airbnb (the company that had over 2.4 million customers in 2012) earn on average 9,300 dollars a year.

And last but not least there is another side to this change linked to the enhancement of the environment (and the ecosystem services) as a key resource for economic development and business activities, in particular in those sectors where the quality of landscape has improved (tourism) or that use natural raw materials. In this respect, water, biomasses, fishing and land uses are some of the key ecosystem resources that make up the basis of the bioeconomy. The effects on the agricultural and food system are tremendous, since companies such as Barilla modify radically their durum wheat supply system (providing incentives for farmers to use crop rotation) because this improves the quality and quantity of production. In this field too, as in the previous one, the changes underway can benefit those on the supply (for instance Barilla) as well as on the demand side (farmers).

Overall, such changing events foreshadow radical innovations in the economic system and a new balance in the use of resources bound to change the components and the nature of products-services, trading modes and reference prices. Going back to the initial question on how this change is already happening and how significant it is from an economic point of view, all five change processes described above and summed up in **figure 5** are becoming increasingly relevant, both in the policy makers' analyses and in the strategic choices of economic actors.

After all, these processes are interconnected and require – in order to fully express their innovative potential – a strategic vision of the evolution of

Figure 4 | Prices evolution of secondary raw materials in the EU 2000–2011



the economic system where the action of policy makers must be accompanied by investments in the private sector and by a transformation of lifestyles and consumption habits (a crucial issue only barely touched upon in this paper).

For example, the last process described in the analysis, that integrating the environment with biodiversity and the ecosystem services, is represented in **figure 5** as having a clear position in a global economic cycle linking these variables to the sharing economy and to the material flow. It is an apparently simple logical connection, but it implies going beyond a set of knowledge and policy limitations necessary to face, in an integrated way, the main economic trends characterizing the next decades.

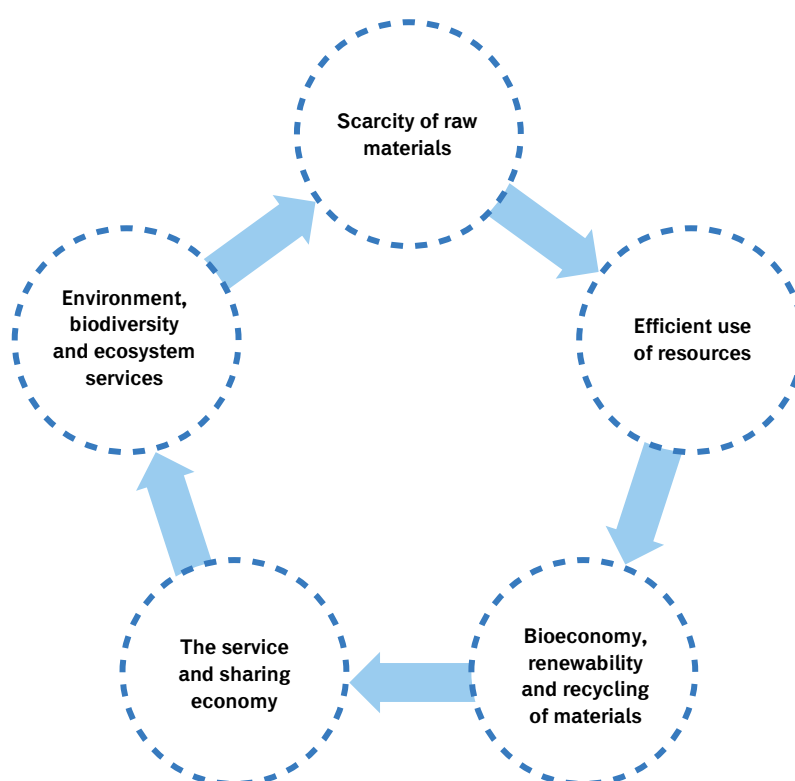
Such representation requires an integrating and complex effort of monetizable factors with non-monetizable ones, of economic parameters with social processes, of network and multi-instrumental modalities of governance. For these reasons, in the next decades, the economy will have to operate an analysis shift. This magazine will try to offer a contribution towards this change. In the next issues the underlying arguments of these ongoing change processes will be further illustrated, in order to equip readers with better ability to interpret the economy of renewable matter. ●

Source: Etc / Scp based on foreign trade statistics of Eurostat.

Note figure 4: Prices are calculated as weighed averages of a number

of sub-fractions of waste glass, paper and plastic for export within and outside the EU.

Figure 5 | The change processes ascribable to renewable matter



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Bioeconomy: a European Gamble

Interview with Fabio Fava



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by the editorial staff

The Bioeconomy. In Europe this sector is currently worth € 2 trillion with 22 million jobs and yet this word is still relegated to technical language, as if it were an academic oddity, a marginal production.

What's more, its very definition is still misunderstood. A cultural delay that could be very costly especially for Italy, a country boasting cutting-edge examples in this field. How can such barriers be overcome? We asked this question to Fabio Fava, professor of Industrial and Environmental Biotechnology at the Alma Mater University in Bologna and Italian representative for the bioeconomy for the European Commission's Horizon 2020 Programme Committees.

"Actually, the OECD and Europe have two slightly different interpretations of the term bioeconomy" replies Fava. "To me the best bet is the European one since Europe is the bigger investor in research and innovation and has a wider picture of the field. It regards bioeconomy as a set of strategies to enhance the biological resources necessary for the production of raw materials from which food, chemical compounds and fuels can be extracted. In short, not just a mere market segment, but a way of reorganizing the general production system, taking into consideration environmental issues and resource limitations."

Sometimes it happens that extremely advanced approaches are impressive on paper but a little far-fetched in practice. Is bioeconomy a good theory or a functioning reality?

"I'll reply with an example. Seven or eight years ago biorefineries did not exist. In Europe there are 37 of them and their number might rise considerably, with Italy leading the way in the field. And biorefineries are just one of the pillars of the bioeconomy, a new and fast-growing sector, where research and innovation are making good progress."

It took quite a number of years for this process to take off.

"I believe that the most significant commitment includes the Seventh Framework Programme right up to Horizon 2020. It is important to notice that lately the bar has been raised with the introduction of the package of the sea issues: the whole of the marine chapter, from the protection of coastal areas to the production of biological resources is now part of the bioeconomy. We are talking about microorganisms, algae, enzymes, but also transport and maritime tourism that is worth US\$ 40 billion a year in Italy alone."

Might such a vast interpretation of the bioeconomy not be too disorientating?

"Quite the opposite, I find it unifying. It is about bringing together issues and problems that, if taken separately, can have a limited value but when integrated into one comprehensive strategy represent a top-ranking whole that might restructure the economy, propelling it into the future."

Sustainability can be defined as the ability to last into the future, respecting renewable resources' regeneration time. But for this very reason, is it not difficult to accommodate all the various requirements? Is it possible to keep production competitiveness while diminishing the production impact on the various ecosystems involved?

"It's certainly complex. But the impact of another kind of production would not be any lighter. Quite the opposite is true: with the bioeconomy approach, problems come to the surface and it is possible to find ameliorative solutions. The European Union is investing heavily in research and innovation not only to strengthen single sectors, but to integrate them in quality supply chains in various locations."

Fabio Fava is Full Professor of Industrial & Environmental Biotechnology at the School of Engineering & Architecture of the Alma Mater Studiorum-University of Bologna.

Give us some examples.

“Let’s take the food industry. In Italy, the yearly turnover is € 132 billion, with a slight loss incurred at the beginning of this crisis but now it is picking up again. In Europe, it is worth a trillion euros, i.e. half of the whole of the bioeconomy and represents the first manufacturing sector (in Italy it ranks second after the mechanical industry). Is that a good result?”

It would seem so.

“And I think that it could be even better, because the by-products, the discarded material, often become refuse: a colossal waste. 30% of processed material is not turned into food and is only partially used, with a lot of it ending up in landfills. In Italy, there are about 12 million tons of waste from the agro-industrial sector that companies do not know how to utilize. In fact, whether they become animal feeds or waste in landfills, they have to pay for their removal.”

Could biogas be generated instead?

“Biogas is a fashionable option and it is a possibility. But it is far more interesting if we consider turning them into chemical compounds and biobased materials and then with the residue producing biogas, which is worth much less on the market. We have to consider integrating this circuit to biorefineries, the industrial locations where cascade goods are produced, just as it is done in the oil refining process. Here all resources are used, including waste from other processes, to make high-quality chemical compounds and raw materials. Then, only at the end of the process, the residue is used for the production of biogas.”

Such mechanism could expand with considerable advantages for the environment. But the quantity of available materials to feed the virtuous circle could be a limitation. And the quality of such waste as well, since a good level of homogeneity makes the organization of the production cycle easier.

“This is why first and foremost there is a need for assessing and organizing the combination of waste material available. I have already touched upon the agro-industrial field. Forests are another case in point. In Italy, forested areas are growing and currently cover 10,5 million hectares, about a third of the country. Therefore, in theory, there is an abundance of wood, but such potential is only barely utilized. As a result, we rely on imports to support the national timber industry instead of using the raw material we have at home. Just to give you some figures, forests provide a turnover of half a billion euros and 200,000 jobs, as opposed to a system of timber processing that at national level is worth € 28 billion and 410,000 jobs.”

Clearly there is a problem between the relation of the value – low – attached to

forest preservation and the cost – higher – of the workforce. If we are not able to include the benefits from land reclamation, hydrogeological instability protection and tourism in the value of forests, the figures do not add up.

“To those benefits, sometimes difficult to quantify, I would add the biological resources obtainable from woodland that can feed the bioeconomy. Indeed, in Italy we have patents – second generation biofuels – allowing us to start not from starches but from cellulose. It is always a problem of synergies; in other words, understanding the possibilities of integration amongst the various supply chains.”

If we managed to exploit the agro-industrial waste, of the woodland and the urban waste cycle to their full potential, would we have enough raw materials to feed an advanced network of biorefineries?

“It is difficult to work that one out. I reckon there is a potential mass of over 30 million tons of organic matter each year. It is a considerable amount but the objectives are just as great and a total reutilization is improbable. It is also true that while some by-products such as those from the agro-industrial sector guarantee a constant and homogenous flow ready to feed a biorefinery, with other wastes, such as urban ones, the quality is more uncertain and heterogeneous. All this suggests we should integrate the system with a share of dedicated materials.”

A sensitive subject: non-food crops.

A question attracting increasing opposition.

“If we do not wish to get entangled in an ideological debate, we must evaluate cases on an ad hoc basis: it is difficult to compare problems in poor areas in Africa or in South America with those of a rich European region. Let us take into consideration Italy. In Italy, the cultivated area keeps shrinking and in the last few years alone it has lost, taking into account abandoned and non-cultivated land, one and half million hectares. We are talking about a huge area that is no longer used for food production. In all fairness, I do not think it is a problem if these abandoned areas are utilized to generate income from biomasses destined to biorefineries. In these cases there is no conflict between land uses, it only offers a chance to create low environmental impact jobs instead of unemployment.”

Environmental impact is also questioned: if these products come from afar or if they require a lot of energy, the outcome can be debatable.

“There is no doubt about it. Nevertheless, Europe has provided clear guidelines on these matters to evaluate for example greenhouse effect impacts. Advanced biorefineries utilize raw materials produced locally and respecting the environment: the integration concept does not work if a crop is

The European Bioeconomy sector is currently worth € 2 trillion with 22 million jobs.

With the bioeconomy approach, problems come to the surface and it is possible to find ameliorative solutions.

cultivated in Sicily and then the product is sent to France.”

But if bioeconomy development scenarios are so full of money-generating opportunities and jobs creation, why is it so difficult to turn them into reality? What is stopping their development?

“The delay is due to two main factors. First: governments’ lack of information (and training) on bioeconomy and on its real potential, especially in Eastern and Southern EU countries. Second: little accurate technical information on the potential and opportunities offered by each productive pillars, from agro food to biorefineries, and inadequate relationships with the environment – even in Western and Northern European countries.”

Does the difficulty in accepting production plants by affected people have anything to do with it?

“Yes, absolutely. And on this matter we go back to communication problems, in this case ‘wrong communication’: people go as far as talking about ‘biological bombs’ while these plants use totally safe technology. The problem is that many people do not even know what a biorefinery is and are completely unprepared when faced with groundless fears. Partly, it is also our fault. As academics, we mainly focus on publishing our research in prestigious magazines that are obviously read by experts. We need to knock down this barrier and offer all-round and open communication.”

So, in your opinion, there are pieces of good news to communicate that are not being communicated.

“They are not well communicated, perhaps only when an important plant opens, such as the Porto Torres Biorefinery in Sardinia with its dedicated thistle crops. Moreover, visiting that area, I have discovered an extraordinary landscape: fields covered in thistle’s purple flowers, a grandiose view. So, what is needed is a more detailed portrayal, a flow of information enabling people to understand the advances being made and future prospects.”

Beyond Italy and Europe, could you tell us something about the global panorama? Which are the strongest competitors?

“America, as a continent, is a big producer and enjoys a long tradition in the field. Brazil is a case in point; it started producing bioethanol a long time ago. China has enormous potential – it is rich in raw materials and land bought in Africa – but it is pursuing traditional markets. Europe only started 10 years ago but with a very innovative approach based on multi-product biorefineries able to produce chemical compounds, materials and fuels. This choice offers greater economic and environmental sustainability compared to traditional single-product biorefineries. Thanks to

the stimulus that in 2007 started off the Seventh Framework Programme in particular. We do not aim only at producing biofuel. We obtain it in our integrated cascade biorefineries at the end of a process where other high added-value products are created.”

How much has the EU invested?

“A lot. We started with € 200 million invested within The Seventh Framework Programme and member states (mainly north western ones) have given just as much. Moreover, recently a € 3.78 billion package has been created to specifically support research and innovation in the biobased industry for the 2014-2020 period. Over 100 partners, both in the public and private sector, support this package known as biobased industry Public Private Partnership. More than two thirds of these funds, that is € 2.7 billion, come from the industrial sector. So, this sector has done its share. It is interesting that companies have managed to find an agreement to take part in such an ambitious biorefinery programme.”

What’s the outlook for the future?

“By 2020, the biorefinery product market is expected to be worth more than € 500 billion globally, with Europe controlling 40% of it. The research and innovation ability in all sectors involved will be a crucial factor. I am thinking about those that do not spring to mind immediately. For example, the evolution of agricultural machinery: it will have to be conceived and designed to meet new needs in order to lower raw materials costs and to harvest agricultural residues exploited by biorefineries.

Another opportunity for Italy: we are well-placed in the production of agricultural machinery.

“And we must carry on improving our technology: we are heading towards agricultural machinery controlled by Gps. Once again, synergy will be key. In this game, we have excellent trump cards to play, we just have to do it.”●

By 2020, the biorefinery product market is expected to be worth more than € 500 billion globally, with Europe controlling 40% of it.



Revision of the Waste Directive and Prospects for a European **Circular Economy**

by Duccio Bianchi

Duccio Bianchi has founded and directed the Research Institute Ambiente Italia. Since 1984, he is researcher and consultant in the field of environmental policies and, in particular, the management of waste.

The European circular economy is shaping up, at least in terms of objectives. The proposal for a new waste directive sets ambitious targets for recycling, while at the same time reducing space for other forms of waste disposal: landfills and energy recovery.

In particular, the target of +70% by 2030 for recycling of urban waste indicates the resource base on which to implement the circular economy of the EU. The big jump requested in the integration between waste management and industrial, distribution

and consumption policies represents a challenge in many respects. However, the benefits that would derive from this would be extremely important: up to 870,000 new jobs and a reduction of CO₂ emissions between 300 and 400 million tons.

The proposal for a waste directive presented at the commission on 2nd July 2014,¹ in the framework of a packet of measures aimed at promoting circular economy, is the first important regulatory step of the strategy for resource

1. Com(2014) 397 Directive proposal to the European Parliament and Council which modifies the directives 2008/98/EC on waste, 94/62/EC on packaging and its waste, 1999/31/EC on landfills, 2000/53/EC on old vehicles, 2006/66/EC on batteries and accumulators and their waste, 2012/19/UE on electric and electronic waste.

efficiency, already contained in the Europe 2020 agenda for an intelligent, sustainable and inclusive growth.

This proposal is the result of a wide consultation with stakeholders and it also complies with the legal obligation of re-examining the objectives (recovery and recycling) contained in directives on waste, landfills and packaging.

Although formally in continuity with the European regulatory tradition on waste and with the “communitarian hierarchy”, the proposal also presents various innovative aspects.

This change is visible in the set of objectives.

The system of the proposed objectives shifts the focus on the re-use and recycle of matter (although prevention is still present, but with no mention of the instruments to achieve it), while energy recovery becomes a secondary variable and even disappears from the set of objectives. The proposal sets – although moving them, for the whole of the Union, to 2020, 2025

and 2030 – a simple but dramatic series of targets:

- 50% recycling by 2020 and 70% urban waste recycling by 2030; a net recycling of matter of 70% by 2030 means the achievement, in all member states, of a target which today is achieved only by a few regions and that represents more than double the current level in 17 out of the 28 member states;
- the reduction of waste to be sent to landfills below 25%, with the ban on recyclable or biodegradable material, by 2025 and a potential disappearance of landfills by 2030; this target is very close to achievement at the European level (the EU as a whole uses landfills for 27% of its waste) and it is already implemented by seven states (six of which are already below 3%) in the centre-north, although in other seven states landfills are used for 70% of waste disposal;
- a revision of the objectives of the packaging

directive, from which the references to energy recovery disappear, and in which new targets for recycling are set, to be achieved by 2020 (60% recycling of material), 2025 (70% recycling) and 2030 (80% recycling), detailing the objectives for each material. Between 2025 and 2030 they should reach 60% for recycling of plastic packaging, 80% for wood, 90% for metal, glass, paper and cardboard.

The “hierarchy” is not under discussion, but in practice energy recovery becomes only one of the possible treatments of residual waste. On the other hand, the higher presence of renewables in the conventional energy system (which annuls or reduces the environmental preference for energy recovery from waste) and the transformation of landfills from biological reactors into deposits of mineralized waste (which annuls or drastically reduces the emissions from landfills) pose real questions on the coherence and validity of the end of the hierarchy itself, at least in some respects.

This is the direction. It shifts the focus of waste management to recovery and recycling. It therefore poses a problem of technological feasibility and economic sustainability of recycling such huge quantities of waste. By putting the revision of waste regulation in the framework of policies of “circular economy” the need for an integration between waste management and industrial processes of production, distribution and consumption is strengthened. The aim of waste management policies is to reintroduce used products in the consumption circuit (re-use) or production circuit (recycle). This is in line with the idea of circular economy, in which somebody’s waste becomes somebody else’s resources, unlike the linear economy, where once consumption



is over, the cycle of that product is entirely finished, forcing the economic chain to endlessly continue with the same scheme: extraction, production, consumption, disposal.

The waste directive, with its system of objectives and the strengthening of schemes of responsibility extended to producers (the most efficient instrument in stimulating recycling created by the European Union) thus becomes instrumental in implementing and improving a green economy. This is primarily done through the creation of new chains of recovery of industrial material. The proposal of the directive does not create new materials or new schemes of extended responsibility, but reaching the target will require, at least, a strong development of the supply chains of furnishing products and textile waste (on this, in France, two new schemes of extended responsibility have been implemented, through Eco-Mobilier and Eco-Tlc), in addition to the recovery of organic waste and the packaging and graphic paper.

According to studies carried out by the Commission, the measures included in this review of the legislation will lead to the creation of over 180,000 jobs under the EU aegis by 2030, in addition to further 400,000 which, according to estimates, will result from the implementation of waste legislation currently in place.² Both separate waste collection and the preparation for recycling (including composting) are labour-intensive sectors, compared to mixed waste collection, incinerators and landfills. Based on a similar set of measures, Beasley & Georgeson (2014) have estimated an impact of between 630,000 and 870,000 new workers (direct and indirect, of which about 300,000 in the re-use preparation sector and marketing of furniture and textiles) and a reduction of CO₂ emissions of 300 to 400 million tons, specifically due to recycling.³

If on the one hand the feasibility of an adequate collection and recycling system to achieve the objectives is not under question – in many European regions, from Germany to the Italian north-east, these targets are already met or even surpassed – the objectives appear more challenging with regards to a homogenous implementation in all the states of the Union, as well as the capacity of effective industrial recycling.

For materials such as metals, glass and wood the achievement of the targets, albeit ambitious, only requires an improvement in the capacity of interception and selection. Currently the recycling rate⁴ of metal packaging in the EU area amounts to 72.5% (with seven countries already meeting the objective set by the directive for 2025) and there is a demand for metal waste which is far superior to the quantity of actual packaging.

Also for glass, the gap between the current level of recycling (72.8%) of packaging and the objectives seems easy to close, despite the

increase in the recovery of other fractions of glass – for example from computer monitors – as the glass and ceramic industries have wide margins of increment in recycling rates. The increasing demand for wood packaging, whose recycling rate currently stands at 37.9% (although these are not entirely reliable data, as states do not uniformly distinguish between re-use and recycle) appears more disrupting. A growth in the recycling rate, however, appears compatible with the capacity of organization of collection and with the demand from both the wood and composting industries, the main areas of recycling. However, it will conflict with the demand for energy uses, which is also financially supported and stimulated as for any other renewable resources.

The two really critical areas for the achievement of the objectives, but where there is also great innovation, are paper and plastic.

As for paper, a simultaneous increase in the rate of collection of packaging and graphic paper would require a significant increase in the recycling rate of the European industry (roughly over 60 million tons). For many states, this would be totally unsustainable, however it would be sustainable at European level with the increase in the recycling rate in part of the continental industry (Spain uses 80% more than what it produces, France 62% and Italy 55%), and above all of the Scandinavian one (which today produces 25% of European paper, but recycles less than 10%), combined with exports or the use of the product for second generation biofuels.

As for plastic, the challenge is even harder, as today the European average recycling rate amounts to a mere 35%, alongside a quota of “exports for recycling” which is over 25% of what is recycled inside the Union. The required added capacity for recycling would amount to 3.7 million tons, double the growth of recycled quantities in the last ten years. A further increment in the capacity of plastic recycling will require an intervention upstream in the supply chain, with reusable plastic packaging that could be more easily recycled, as well as an improvement in the capacity of selecting homogenous or compatible polymers, and innovation in other sectors where plastic is used, even outside the industry of plastic material, in particular that of heterogeneous plastic and residues of selection. The supply chains of plastic lumber, wood-plastic composites, products for building industry, are all supply chains that could potentially be expanded and that are environmentally convenient compared to any other energy alternative. In this sector a change of scenario could also come from other innovations, such as the use of compostable plastic for that packaging that is in close contact with fresh food. ●

2. Estimates in Swd(2014) 207, Commission Staff Working Documents: Impact Assessment.

3. Beasley G., Georgeson R., *Advancing Resource Efficiency in Europe*, Feb, 2014.

4. All these numbers are based on data provided by Eurostat, for 2012, in the table *Packaging waste*.



The Many Lives of Matter.

Here's how to Convert it Back

by Jukka Kantola

We are living in interesting times. It is said that the 19th century was powered by coal, the 20th century by oil and hopefully the 21st century will be powered by the bioeconomy. So are we going back to our roots? Today chemical companies like DSM are already looking ahead to the bioeconomy, and they are not the only ones.

Jukka Kantola has established NISCluster Ltd, a new bio-consulting company focusing on the versatile valorisation of woody biomass for novel applications.

Traditional forest industry products (like pulp and paper) are a vital part of the bioeconomy. Here we take a closer look at other emerging products. Forest resources are becoming an interesting alternative for the bioeconomy as the acceptance of food chain biomass reduces. The transition from first generation to second generation is well under way and we have already seen the first commercial investments in 2G (Second generation) biofuels: Beta Renewables came on stream in Crescentino, Italy, last year and the next wave of investments is already in the pipeline in the USA. All of these are still based on 2G agriculture biomass, but woody biomass is also becoming an option.

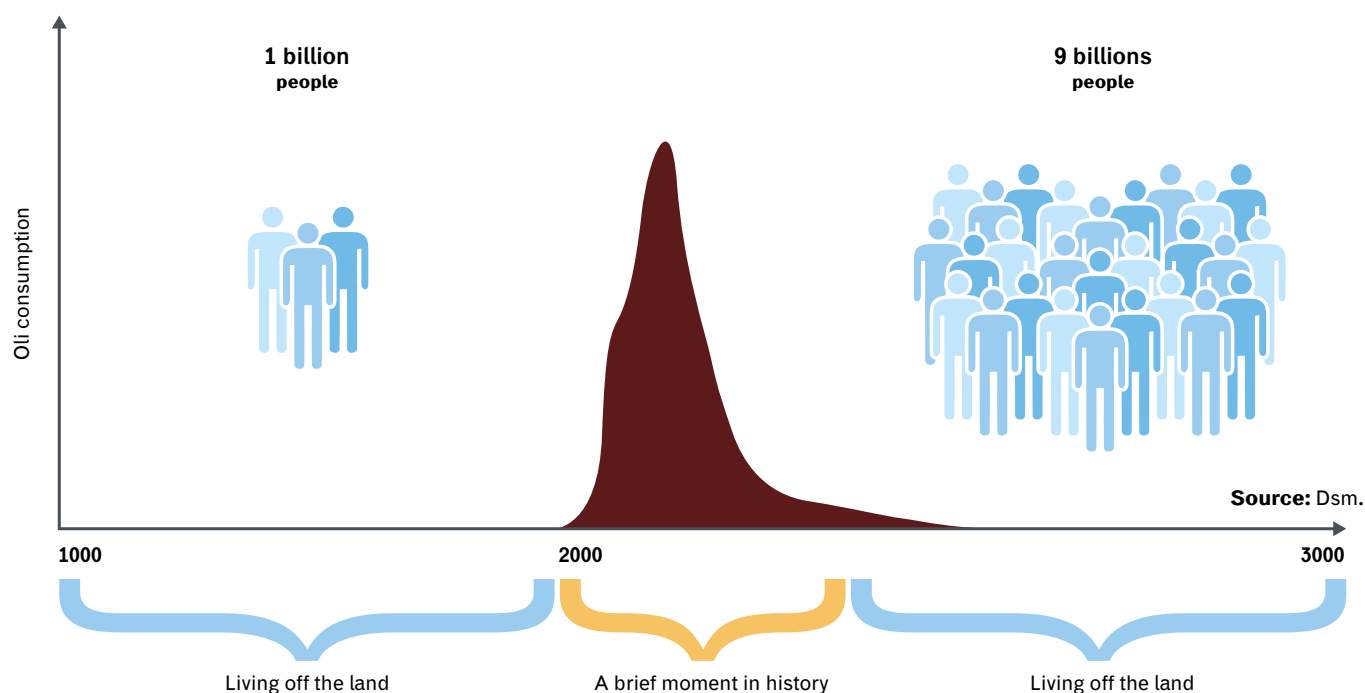
And the bioeconomy is not only bioenergy – although all too often we see it as the main use for biomass. Nowadays shale gas

is distracting interest from bioenergy. The USA is already heavily deploying shale gas resources and the EU is gradually acknowledging it as an alternative for energy generation with European Commissioner for Energy Günther Oettinger referencing it as he presented the new EU energy and climate targets. This could create an opportunity to drive biomass for more valuable conversions too, including chemicals and materials.

Woody biomass is an alternative source for various applications and commodities as depicted in the [figure 1](#). At the moment the EU regulatory framework is directing biomass for energy use and forgetting opportunities in the other biosectors – such as chemicals, materials and the mechanical forest industry.

The European Commission has recently issued a new proposal for energy and climate targets. The key difference compared with the current approach is that there will be fewer binding targets. Indeed it seems that the only binding target is a 40% reduction in Greenhouse Gases (GHG). The former renewable energy source

The end of an era



target of 20 % has now been superseded by an EU-wide target of 27% with no specific obligations for member states. This could result in a slowing of investments in bioenergy unless member states take the initiative in imposing adjusting measures.

Chemicals, like materials, are currently dominated by derivatives of petrochemicals. The petrochemical industry has been well developed for decades. Petrochemical companies represent some of the largest organisations in the world and

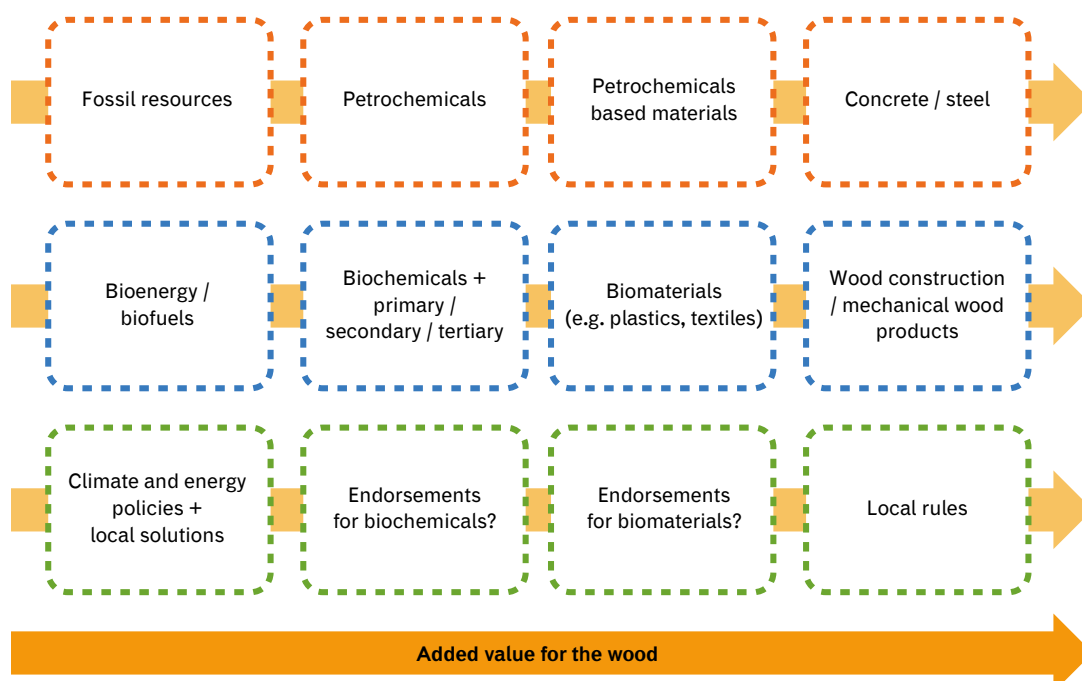
their refineries are massive. There is enormous economy of scale in terms of company and refinery size favouring the existing model and biorefinery simply does not have the scale to compete in either the bulk chemicals or niche chemicals market. It would require significant resources to create new products and new demand.

In materials, paper-based products already dominate in the printing, sanitary and partially in the packaging industries. These are all good examples of the bioeconomy.

The Oil age will end long before we run out of oil. And while running out, it will become much more expensive.

Figure 1 | **Woody biomass is an option**

Source: NISCluster.



Similar opportunity exists in industries like plastics and textiles. World plastic consumption is less than 300 Mton and today only a few percent is based on biomaterials.

The picture for textiles is a bit better – with some 5% based on biomass-based viscose.

As populations grow so consumption in these sectors will increase and this presents significant opportunities for woody biomass.

Woody biomass can be converted into materials in a variety of ways: through further conversions of fibre or via a chemical route. Fibre conversions are the basis for products like dissolving pulp, microcellulose and nanocellulose products.

It can be done via mechanical, chemical or biological treatments. This means that conversion products will have functional

properties and be able to bring added-value compared with petro-based products.

Another way to tap into biomaterials is to decompose the fibre structure.

This is mainly done via sugar conversion but will mean lower yields and less competitiveness against non-renewable sources unless all components of woody biomass, including lignin, can be holistically deployed and utilized.

Sawmills, plywood and mechanical wood products are a vital part of the bioeconomy.

It has been said that mechanical wood processing is the backbone of the bioeconomy, and saw mills in Europe are using almost

From the misallocation of biomass to the renewable energy and materials directive (Remd).

The revolutionary proposals of nova-institut

“Which agricultural feedstocks are best for industrial uses?” This is the title of the paper published on July 2013 by the German nova-Institut led by Michael Carus, who is one of the authors, together with Lara Dammer. In less than ten pages the two authors analyze one of the most controversial issues of the bioeconomy, also underlined by the decision of EU Energy Council to limit the share of food-based biofuel used in cars and trucks to 7% of the total consumption. The paper “is based on scientific evidence and aims to provide a more realistic and appropriate view of the use of food-crops in biobased industries, taking a step back from the often very emotional discussion”.

According to Carus and Dammer “all kinds of biomass should be accepted for industrial uses; the choice should be dependent on how sustainably and efficiently these biomass resources can be produced. Of course, with a growing world population, the first priority of biomass allocation is food security. The public debate mostly focuses on the obvious direct competition for food crops between different uses: food, feed, industrial materials and energy”. However, the authors argue that “the crucial issue is land availability, since the cultivation of non-food crops on arable land would reduce the potential availability of food just as much or even more”.

Carus and Dammer suggest “a differentiated approach to finding the most suitable biomass for industrial uses”. In particular, they suggest to consider some aspects, such as the availability of arable land, the resource

and land efficiency, the flexibility of crop allocation in times of crisis. According to the authors, “this means that research into first generation processes should be continued and receive fresh support from European research agendas and that the quota system for producing sugar in the European Union should be revised in order to enable increased production of these feedstocks for industrial uses”.

In conclusion the two scientists of the nova-Institut ask for “a level playing field between industrial material uses of biomass and biofuels/bioenergy in order to reduce market distortions in the allocation of biomass for uses other than food and feed”.

Last May Carus and Dammer, together with Roland Essel (nova-Institut) and Andreas Hermann (from Öko-Institut, a leading European research and consultancy institute working for a sustainable future, based in Germany) published another paper focused on the misallocation of biomass in Europe: “Proposals for a Reform of the Renewable Energy Directive (Red) to a Renewable Energy and Materials Directive (Remd)”.

This paper is a comprehensive analysis of hurdles carried out by the four authors and shows – from their point of view – that the Red (Renewable Energy Directive), which will in future be associated with the Fqd – Fuel Quality Directive 9870 – in the transport sector, is one of the main causes of the longstanding and systematic discrimination between material and energy uses. “The Red – they write – hinders the development of material use and therefore that of the whole biobased economy. Unfavorable framework conditions combined with high biomass prices and uncertain biomass supplies deter investors from putting money into biobased chemistry

200 M m³ round wood for processing – accounting for almost half of the continent's total wood consumption.

The use of concrete in construction contributes some 5% of total global GHG-emissions. Wood construction is a viable way to reduce the greenhouse effect and, with side-streams from mechanical wood processing always 40-50% of the wood intake, would provide a natural source of raw materials for novel biorefining concepts.

Nova Institute has introduced a proposal to facilitate value creation for the biomass sector called "Proposals for a Reform of the Renewable Energy Directive (Red) to a Renewable Energy and

Materials Directive (Remd)" (see box). All the ideas outlined above are well in line with it. If the EU is to incentivise the bioeconomy it should not confine itself to bioenergy alone, but also consider the potential of biomaterials.

In summary, a great deal is already underway in the bioeconomy. The forest industry has deep insights into forest management and supply chains and is well positioned to seize the opportunity and play a vital role in the bioeconomy of the future. ●

and plastics – even though these would produce higher value and greater resource efficiency". "Misallocation of biomass" is the right phrase according to Carus and colleagues, since this is blocking "higher value material uses like chemicals and plastics from coming to fruition. Therefore, Red-linked developments on the ground will have a considerable impact on the availability of biomass for the materials industry".

As far as nova-Institut's concerned, Europe needs a new political framework for the most efficient and sustainable utilization of biomass. Five years ago this was a worldwide problem – today it is mainly a problem for Europe. In America and Asia the political framework for biobased chemicals and plastics is much more favorable than in Europe. Accordingly, most of the new investments are going to USA, Canada, Brazil, Thailand, Malaysia and China.

"The reform proposal – the authors write – calls for an opening of the support system to also make biobased chemicals and materials accountable for the renewables quota of each Member State. The basic idea is to transform the Red into a Remd, Renewable Energy and Materials Directive". The paper does not intend to establish a new quota for the chemical industry. Instead, it proposes that the material use of a biobased building block such as bioethanol or biomethane should be accounted for in the renewables quota the same way as it counts for the energy use of the same building block, e.g. fuel. Other building blocks, such as succinic acid, lactic acid, etc. could be accounted for based on a conversion into bioethanol equivalents according to their calorific value. Reduction of greenhouse gas emissions could also be the basis for such a conversion.

Finally, last October Carus, Dammer and Essel published on the same issues a new policy paper, whose title is "Options for Designing a New Political Framework of the European Bio-based Economy. nova-Institute's contribution to the current debate". "The bioenergy and biofuels sector – according to the nova-Institut – finds itself in troubled waters; many member states of the EU are not on track to meet the targets set out in the 'Renewable Energy Directive (Red)' and investments are stagnating. Political and public debates focus more on the effects on global food prices, pressure on ecosystems, and direct as well as indirect land-use change, rather than previous growth and future opportunities and investments. This is partly due to the fact that the whole sector (with some exceptions in the wood heating market) is strongly dependent on incentives. If those are reduced, many companies might face bankruptcy and new investments will stop – as can already be witnessed in many member states.

The material use of biomass presents an alternative to energy use. It can create much more added value per tonnes of biomass, innovation, employment and investment and – if done right – can contribute to the economically and ecologically viable future of the European Union. The current framework, however, focuses only on the energy sector in terms of market instruments; biobased materials and chemicals are only considered in research policies without any widespread application of novel biobased materials so far".

You can download the three papers here: <http://bio-based.eu/policy/#top>

Employment, Research and Innovation

for Sustainable Growth

by Lucia Gardossi

A 79 Billion Euro Policy Package for Horizon 2020

Europe: innovation for sustainable and inclusive growth

Lucia Gardossi heads the laboratory Biocatalysis of the University of Trieste. She is Vice President of the advisory group to the European Commission's Horizon 2020, which deals with the bioeconomy.

1. <http://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52010DC2020&from=IT>

In times of financial straits, substantial demographic changes and increasing global competition, innovation is Europe's best tool to successfully deal with such issues.¹ This is why innovation was given centre stage in the strategy "Europe 2020" to promote job creation, productivity and social cohesion throughout Europe.

The EU outlined strategies to generate smart (through the development of innovation and knowledge), sustainable (adopting sustainable economic practices offering a more efficient and competitive approach to resource management), and inclusive (aiming at creating jobs and social and territorial cohesion) growth. This ambitious development vision is put in place through a series of targets to be reached by 2020, that is: increasing 20-64 year olds employment rate to 75%, investing 3% of EU's GDP in R&D; reduction of carbon emissions by 20% (and by 30% if the conditions are right); increasing energy from renewable sources by 20% and energy efficiency by just as much; reducing the rates of early school leaving below 10% and increasing third level education to 40%; reducing to 20 million the number of people at risk of poverty. It goes without saying that the achievement of such ambitious targets is strictly connected to consistent policies to fund technological research and innovation.

2. <http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>

3. <http://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52010DC0546&from=IT>

The funding programme integrated in "Horizon 2020" provides the adequate financial support for implementing such policies and is divided into three pillars or priorities: "Excellent Science", "Industrial Leadership" and "Societal Challenges".² The new programme will be active from 1st January 2014 until 31st December 2020 with a 79 billion euro budget.

First Pillar. "Excellent Science" (24.4 billion euro) promotes frontier research, future and emerging technologies. Such activities must aim at developing long-term expertise,

strongly focusing on next-generation science, infrastructures and researchers. Research activities to be carried out must be chosen according to scientific needs and opportunities without pre-arranged researching priorities (following a bottom up approach). This is why research is funded according to the excellent science principle.

Second Pillar. Horizon 2020 (17 billion euro) must promote the strengthening of Europe's industrial leadership through a complete range of tools supporting the whole research-innovation cycle according to themes and priorities established by companies. Technological innovation will benefit from key enabling technologies picked out as crucial tool to promote industrial development: information and communication technology, nanotechnology, advanced materials, biotechnology, advanced manufacturing and transformation and space.

Third Pillar. "Societal Challenges" (about 30 billion euro) aims at implementing research, technological development, demonstration and innovation promoting the achievement of priority targets such as wellbeing, nutrition, energy, the environment, transport, resource use and social changes.

As highlighted by the EU, the main problem of the Union and its member states is probably to have a much more strategic approach to innovation.³ It is necessary to find an approach where innovation is key for all these policies and to adopt a medium and long-term approach. Every aspect of adopted policies (tools, actions and funds) must be devised bearing in mind its contribution to innovation. National/regional and European policies must be aligned and reinforce each other. And last but not least, highest authorities must define a strategic agenda and regularly follow up the progress made in order to intervene in case of delays.



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What kind of Innovation for Europe's Bioeconomy and Bioindustry?

Europe has a unique intellectual and industrial resource potential as well as a cultural environment suitable for the development of new production and economic models able to combine efficiency and sustainability. To this end, Horizon 2020 outlines a path for the development of Europe's **bioeconomy** that must really reflect people's needs while respecting and enhancing territorial and environmental specificities. Regions with a strong rural inclination, as well as coastal areas, can find in the development of their own bioeconomy model a tool to contrast depopulation and unemployment. Little Europe, compared to other continents, has an extensive coastline. Taking into account islands as well, the total coastline amounts to a staggering 100,000 km, equating to two and a half times the circumference of Earth. About 200 million Europeans live near coastal areas and in many cases their livelihood is based on marine ecosystem resources.

While respecting the landscape, "**integrated biorefinery**" is an industrial system based on technologies capable of developing renewable and sustainable biobased products as well as hybrid products and biofuels.⁴ This complex integrated system is based on a cascade approach in line with the principles of the **circular economy**⁵ where all the components of biomass are exploited and transformed so that high added-value products can contribute to the economic sustainability of the whole production cycle. At the end of the cycle, residual products can go back to the soil as nutrients for agricultural activities to prevent soil depletion. It is obvious that **raw materials supply** plays a crucial role in such a strategy and must be in line with *in situ* resources without compromising the social and ecological balance.

Extending the range of biomass typologies to use in **second and third-generation biorefineries**, including those coming from silviculture, organic waste and industrial by-products, will make possible avoiding conflicts between food and fuel crops while supporting economic development

4. Council Decision of 3 December 2013 establishing the specific programme implementing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020) and repealing Decisions 2006/971/EC, 2006/972/EC, 2006/973/EC, 2006/974/EC and 2006/975/EC (2013/743/EU).

5. http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf

that respects both rural and coastal areas in the EU. So, technological innovation must focus on biomass that does not compete with food production and it must examine the sustainability of connected systems of soil exploitation. In particular, scientific research is expected to increase the value of an expanding range of renewable resources, organic waste and by-products thanks to new and efficient processes from a resource point of view, including the transformation of **urban organic waste** and their use in agriculture.

This will also help to overcome ethical conflicts created by the introduction of first generation biofuels by countries (China, USA, Brazil) that have promoted technologies exploiting agricultural produce that can be used for food production.

Biotechnologies, identified as crucial enabling technologies, can foster innovation and increase resource use efficiency to produce “more with less”. The aim is twofold: on the one hand to allow European companies (in the chemical, health, mining, energy, cellulose and paper, wood and fibre material, textile, starch and food product business) to devise new products and methods able to satisfy both industrial and social needs, preferably using competitive environmentally-friendly production methods; and on the other hand to exploit the potential of biotechnologies in identifying, monitoring, preventing and eliminating pollution.

Estimates conclude that a shift to biological raw materials and biological processing methods could **save up to 2.5 billion tons of CO₂ equivalent per year by 2030**, increasing markets for biobased raw materials and new consumer products. The Horizon 2020 Programme details the strategies to adopt in order to take advantage of this potential that must be based on the development of relevant (bio)technology know-how and focused mainly on three essential elements: a) substitution of current transformation processes based on fossil fuels with processes based on biotechnologies efficient both at resource and energy level; b) creation of reliable, sustainable and adequate biomass, by-products and waste flow supply chains and a vast network of biorefineries across Europe; c) stimulating the development of markets for biobased products and processes, taking into account related risks and advantages.

Since biotechnology innovation is expected to open up new markets, it is crucial to have **European and international standards and certification** to determine biological content, features and biodegradability of products. It is necessary to further develop products’ lifecycle analysis methods and strategies in order to keep them in line with scientific and industrial progress.

Horizon 2020 focus on aquatic biological resources deserves special attention. Over 90% of **marine biodiversity** is yet to be explored and offers a huge potential for the discovery of new species and applications in the field of marine biotechnology that should generate a 10% annual growth in this sector.

One of the main characteristics of aquatic biological resources is that they are renewable and their sustainable exploitation is based on deep knowledge and high qualitative productivity of aquatic ecosystems. The global objective is to manage aquatic biological resources in order to maximise by-products, economic and social advantages offered by oceans, seas and Europe’s internal waters. To this end, Horizon 2020 intends to support further exploration and exploitation of the vast opportunities offered by marine biodiversity and aquatic biomass to create new, innovative and sustainable processes, products and services on markets with potential application in industries such the chemical and materials sectors, fishing and aquaculture, pharmaceutical, cosmetics and energy companies.

Local Needs Drive European Innovation

The geography of innovation is still very heterogeneous; some regions are very competitive on the global technological front while others are trying to catch up with them by adopting and adapting innovative solutions to their specific situation (technological gap). Public support must adapt its strategies and its interventions in order to take into account such diversity. In order to achieve Europe 2020 intelligent growth target, the full innovative potential of EU regions must be mobilized. Innovation is crucial for all regions: for advanced regions in order to maintain their advantage and for the ones lagging behind to catch up. R&D and innovation results vary enormously within the EU as shown by the regional innovation performance index.⁶

There are also considerable differences in achieving the target of investing 3% of GDP in R&D. Within the EU, only 27 regions, approximately one out of ten, has achieved this target. Compared with previous European programmes for research funding, Horizon 2020 is part of a concerted strategy including several funding sources of the European Commission (i.e.: for agriculture, regional and industrial development). Its top priority is to align EC, national and regional policies. This is why for the first time, EC priorities also involve members states, their regions and micro-geographic areas which share priorities and specificity. It is then crucial to establish how well prepared the infrastructures devoted to scientific research and training are to take on board these strategic changes.

6. <http://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52010DC0553&from=IT>

In order to promote policy alignment within the EU, a **Smart Specialization Strategy** has been developed with the aim of preventing intervention fragmentation and applying the efforts in innovation promotion at peripheral and regional level.⁷ Regional policies are a key tool in transforming EU innovation priorities into effective practical actions. Such actions include the creation of favourable conditions for innovation, education and research in order to promote strong investment in R&D and know-how, as well as initiatives supporting higher added-values activities.

Regions have a central role to play because they are the main state partner for universities, other education and research institutes and SMEs, key actors within the innovation process and thus crucial elements of the Europe 2020 strategy.

The new planning cycle of **Cohesion Policy 2014–2020** (regional structural funds of at least 100 billion euros) establishes that all regions of member states must draw up a document outlining, starting from their available resources and abilities, their smart specialisation strategy identifying competitive advantages and technological specializations more in line with their innovation potential specifying private and public investment needed to support their strategy, particularly in the field of research, technological development and innovation.

Thus, the EU intends to discourage the trend of allocating public funds evenly to different productive sectors without taking into due consideration their strategic position and their development prospects in the global panorama. It also intends to develop innovation strategies of companies and regional productive sectors devoted to international value chains. National and regional governments should develop smart specialisation strategies to maximise the impact of regional policies combined with EU policies. Smart specialisation strategies can stimulate private investment and become a key element for the development of a multilevel governance of integrated innovation policies.

Overcoming Fragmentation through Innovation Transversality

More and more frequently, innovation is seen as an open system where several actors interact and collaborate. Boundaries amongst scientific sectors, but also amongst traditional industries, are becoming more and more blurred and consequently transversality has an increasingly important role in creating high quality research and in accelerating the innovation process for emerging markets' needs. This is particularly true for bioeconomy, a meta-sector including a vast range of know-how and several productive sectors.

For example, **clusters** – geographic concentration of businesses, oftentimes SMEs that interact with each other and with their customers and suppliers and share a pool of specialists – offer a favourable context for promoting competitiveness and orientating innovation towards the bioeconomy sectors (see also the article published in this issue of *Renewable Matter* “The European Path to Bioeconomy Passes through Clusters”).

According to Horizon 2020, it is crucial to promote both inter-sector cross-fertilization and mobility between the business world and academic research. This helps avoid know-how fragmentation, **promote technology transfer and cross the so-called “death valley”**, that is the gap between research and industrial innovation. Although European researchers are extremely prolific in terms of scientific publications, very often these results are not turned into innovations with an impact on the life of the people that fund them through taxation. For example, the analysis of half of the results (7,888) of the projects funded by the EC during the previous framework programme for research (FP7) shows that 16,709 pieces of research were published but there were only 629 intellectual property rights applications.⁸

For this reason, the latest funding policies call for increasing focusing of resources on great interdisciplinary projects involving entire “systems” and “sectors” of knowledge and innovation. So, local scientific knowledge and excellence must be used to create synergies. In such a context, the role of regions is once again crucial. Their mission is to draw up policies locally relevant and able to integrate scientific resources and technological innovation at last.

With transversality in mind, even intervention aiming to promote industrial growth and innovation must not encourage a single production sector but rather strengthen the competitiveness of an entire value chain carried out through the **integration of sectors with different levels of innovation**. This will also benefit traditional low-tech sectors that are nonetheless strongly integrated into the surrounding area and become involved downstream in the meta-sector as suppliers of biomass and by-products to be enhanced. This is the only way in which creating new innovation and value chains in bioeconomy will lead to broad-spectrum solutions able to promote local sustainable and coherent development.

Public and Private Contribution to Innovation

In this historic moment, through Horizon 2020, the EU clearly sets out a strategy that promotes

7. <http://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52010DC0553&from=IT>

8. http://era.gv.at/object/document/764/attach/6th_fp7_monitoring_report.pdf

9. http://ec.europa.eu/prelex/detail_dossier_real.cfm?CL=it&DosId=199719, Communication of the Committee to the European Parliament, to the European Council, to the European Economic and Social Committee and to the Committee of the Regions. Europe 2020 Beacon Initiative. Innovation Union. SEC(2010) 1161.

10. <http://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52010DC0546&from=IT>

11. http://europa.eu/rapid/press-release_IP-14-42_it.htm

innovation by focusing resources on activities able to have a social impact and to act as a driving force for industrial innovation and economic development.

The reasons, besides the already mentioned economic crisis, are explained in the “Innovation Union”⁹ document offering a clear analysis of the European system’s limitations. Private sector R&D activities are increasingly transferred to emerging countries and many qualified researchers move to countries where they enjoy better terms and conditions. The EU invests in research and innovation 0.8% of GDP less than the US and 1.5% less than Japan’s. The number of innovative SMEs managing to become big companies is still too small.

According to recent estimates, the target of investing 3% of the EU’s GDP in R&D by 2020 could create 3.7 million jobs while increasing its annual GDP by 800 billion euros by 2025.

The same document highlights how urgent it is to remove obstacles that still hindrance entrepreneurs from bringing their “ideas to the market”: access to funds must be facilitated, especially for SMEs while cutting the costs of intellectual property rights.

Consequently, public support to innovation must be adapted to these changes, integrating the commitment in favour of research and technology by promoting open collaboration amongst all concerned parties.

This support is justified since market forces are not always able to guarantee adequate long-term funding for investments. For example, private investments in biorefineries are still considered high risk since the concept of biorefinery is not fully established in the chemical and energy fields. Pilot infrastructures and plants, necessary to demonstrate the feasibility of innovative processes, require huge investments. Moreover, the time necessary for a product to reach the market is on average quite long, thus causing unacceptable financial exposure for SMEs. Hence, it is crucial to reduce financial risk through **public co-funding** of plants and infrastructures accessible to various actors and companies engaged in the innovative process.

In Europe, in order to promote sustainable growth, it is necessary to optimize public and private contribution since responsible research

and innovation imply that the best solutions are achieved by the interaction of partners with different perspectives but with common interests. To this end, Horizon 2020 envisages the creation of public-public and public-private partnerships based on contracts between public and private investors but also institutionalized public-private partnerships such as joint technology initiatives.

In **joint technology initiatives**, public and private funds are used synergistically to overcome barriers stopping the transfer of results to the market. The **Bio-based Industries Consortium** is a good case in point. It groups together over 60 European members (public research institutions, businesses and SMEs) involved in biotechnology, agriculture, chemistry, forestry and food production. They all share an interest in developing and demonstrating the applicability of biobased technologies and transforming them into useful products for European citizens. This joint technology initiative funds R&D projects for a total of 3.8 billion euros, of which approximately one billion comes from the EU and the rest from consortium members. It is interesting to highlight that non-consortium parties can have access to funding.¹⁰

The EU is confident that all these policies and measures for funding research and innovation will lead the European industry towards a “New Renaissance”.¹¹●

A Ban Spurs the Launch of the Bioeconomy in Italy: the Case of Shopping Bags

by Francesco Ferrante

On 13th September 2014 the beginning of an investigation conducted by Turin's Public Prosecution captured the headlines. The enquiry was about plastic bags that were supposed to be biodegradable but are not. Perhaps this will put an end to an occurrence which started well over 93 months ago – it seems impossible to find a solution to the Italian proverbial slowness – when, with a very concise amendment of the 2007 Financial Act, the so called “shopping bag revolution” was set in motion.

Since 2009 **Francesco Ferrante** has been Vice President of the Kyoto Club. He is among the founders of Symbola and one of the promoters of the Coordination FREE. From 2006 to 2013 he was Senator the Democratic Party, member of the Environmental Commission.

For once, the revolution involving landfills and waste management saw Italy as the leader in Europe. Funny, since Italy is known for having the highest number of law infringements, some of them very costly such as those of waste in landfills. A few concise lines were more effective than many words and bills. Such amendment certainly opposed the widespread trend by any

Italian government following one upon the other, regardless of their political leanings, to try to avoid making choices on environmental policies while leading the country. Such amendment has created a set of environmental regulations, a change in the lifestyle of many citizens, while supporting environmentally-friendly technological innovation able to create new jobs and backing the industrial reconversion of the all-important chemical sector.

In the last few years, only the so-called “ecobonus” (building subsidy) for property renovation – whose stabilization is still postponed as we speak – has played an equally stimulating function in an economic sector already in dire straits. The chemical and building industries have been two essential contributors to the development of Italy, both for the wealth and the number of jobs created.

Today, though, with some analogies confirming that the green economy is not just a sector but a new way to conduct the economy, they both have to reconvert if they want to survive into the future: the chemical sector has to change its resource base with which it feeds its production cycles – going from fossil fuels sources to biological renewable ones – and the building industry must concentrate on renovations, restorations and urban regeneration rather than expanding built-up areas with new buildings. But – however simple – policies are needed, such as the ban to produce a widespread item or tax concessions. Otherwise, positive innovations offered by research and its technological applications may struggle and the history of renewable sources – which are more and more competitive but ostracized by all ministers of economic development – is a bad example of how “insensible politics” misses opportunities: today half of the electric power generated in Italy comes from renewable sources and half a million citizens has a photovoltaic system installed on their roof. The continual government stop-and-go policies have put a strain on businesses and have not been able to create a sector with guaranteed and long-term employment.

But the case of plastic bags is a positive one: when in December 2006 the regulation providing for a ban of the sale of non-biodegradable plastic bags was introduced, environmentalists as well as the most innovative host of the Italian chemical industry rejoiced. Many opponents started to



lobby against it, well aware that in Italy “a delay is easily obtained”. Indeed, with the next Berlusconi government the coming into force of the ban was postponed from 2010 to 2011. The united efforts of the citizens’ movements organized in associations (Legambiente had led the way in the plastic bag battle since the late 80’s), the rise of the most innovative industrial entities (gathered in the association Assobioplastiche) on the one hand and the awareness of the “plastic” lobby groups that they were a small minority on the other, accomplished a miracle: from 1st January 2011 non-biodegradable plastic bags are no longer marketable in Italy.

The reform/revolution came at the right time as it was immediately confirmed by how it was welcomed by the citizens: in the first two large-scale retailers that anticipated the coming into force of the ban there was an immediate result with a fall of 50% of disposable plastic bags. Moreover, all the surveys indicated citizens were in favour of the ban: which is rather strange since any ban is normally frowned upon. Apparently, a more ecologically sustainable alternative and the “visible” evidence of the environmental impact of plastic bags gained the upper hand over old habits. The plastic of those bags is that of the “artificial island” in the Pacific, is the source of widespread pollution, even in those

places which we would expect to be pristine, it is the ubiquitous enemy of our seas that kills turtles and sea mammals. In short, it was a situation where the environmentalist’s “enemy” was indeed indefensible, without even resorting to the argument – as sound as it may be – of the contribution to the climate change and greenhouse effect that plastic bag production entails.

Nevertheless, Federchimica and Plastic Europe, after an initial opposition, made the best of a bad bargain; some of them know where the best future of the chemical industry lies but lobbyists and swindlers did not give in and tried to play their trump card with Europe and their regulations on the “free movement of goods” guaranteed by European treaties, against the Italian set of rules, regarded as the most advanced all over the world. In October 2012, in Denver (USA) lawmakers, Ngo’s and other industries showed an interest in our initiative. It is no coincidence that since then many American states have followed suit, from California to Hawaii. The European Parliament itself rejected that distorted interpretation of the treaties. A few weeks before its renewal, it passed the new bill for a new directive on packaging, envisaging the possibility for every member state to resort to bans as well as tax regulations to achieve the 50% reduction target of the use of disposable plastic bags within three years.

The biorefinery of Porto Torres, in Sardinia. The world largest and most innovative integrated pole of green chemistry.



In addition, that bill enshrines the fundamental value of an efficient sorting of the organic fraction of waste, of compostable plastic bags, in line with the Italian regulations. Moreover, it is not coincidental that Italy has already achieved what for other European Countries is still an objective: the 180,000 tons of shopping bags put on the Italian market in 2010 – before the ban – have become 90,000 tons in 2013.

This story denies the trite cliché according to which Italians would be resistant to behaving “ecologically”. “We are not Swiss!” (or English, German, etc.). How many times have we heard this phrase (or used it ourselves)? However, with plastic bags, we have demonstrated how many significant aspects of our lifestyle can be changed in a short time, using more and more often the same bag. And when the institutions manage to carry out what they are supposed to do and set up an efficient system, the evidence shows that “it can be done” (as demonstrated by the “Milan Case”, the European metropolis with the highest record of source collection, which is the subject of another article in this issue of *Renewable Matter*). As demonstrated by more emblematic cases in the North-East and in Campania (think of Salerno), which are systematically analysed by those in other countries who would like to introduce efficient and modern systems of source collection.

However, Italy is indeed the land of pettifoggery, where every law has a loophole. Once the “revolution” was completed, in 2011 retailers started using fake biodegradable plastic bags that have polluted the environment and the market, cheating consumers. New regulations had to be introduced to specify that the only bags allowed on the market were those biodegradable and compostable according to the EU regulation (UNI EN 11432). But the muddled regulatory procedure and the slyness of some operators made it possible that today almost half of the shopping bags are illegal.

On 21 August, the DL91 came into force finally providing for severe sanctions (up to 100,000 euro) for those still marketing illegal bags, hence the legal proceedings by the Public Prosecution Office in Turin mentioned at the beginning of this article.

At last, we can safely say that the industrial reconversion of the Italian chemical industry is fully supported through the first shift from fossil to renewable vegetable raw materials.

A change underway that repeats the glories of the Italian chemical industry. In the 60's, the Italian economic boom relied on the car industry – the legendary 500 – and the chemical sector, whose symbol product was Moplen by Nobel Prize winner Giulio Natta.

Today a new revival of the economy enabling the country to move realistically away from the crisis can only rely on the green economy, that

of renewable sources, energy efficiency, of a new and sustainable mobility, or urban regeneration with zero soil use, of quality and multifunctional agriculture. A new economy where the role played by the “green chemistry” becomes essential in order to pave the way for the future. Think of the plant in Crescentino by MossiGhisolfi Group, the first of a series already producing second generation biofuels, called upon to offer an industrial and clean future to other regions; Sulcis in Sardinia, which experienced a decline because their economy was linked to resources such as coal or where their installations did not have close connections with their surrounding area, such as the Alcoa factory in Porto Vesme. Green chemistry can make industrial reconversions possible – think of the positive experience in Porto Torres (Sardinia) where Novamont together with ENI has become a joint venture, Matrica. Without it, it would be impossible to maintain jobs in many industrial sites that have now become obsolete and uneconomic, starting from the many refineries bound to close down and a shrinking market (consumption decreases not only because of the crisis) as well as their environmental impact.

Indeed, it was the European Commission that on 3rd February 2012 adopted a strategy to direct the economy of the Union countries towards a wider and more sustainable use of renewable resources. The avowed objective was to create a more innovative society and a low-carbon economy with reduced emissions. This could be achieved through the sustainable use of renewable resources coming from agriculture for industrial purposes, while protecting biodiversity and the environment.

For once, Italy is now leading the way of a wider and more sustainable use of renewable resources, as clearly indicated by the European Commission. Italy is helped by gifted and dedicated researchers that have seen this as the only way forward for twenty five years now, by some brave and far-sighted entrepreneurs who, against all odds, obstacles (think of the Nimby committees and the many politicians that oppose the green chemistry in Sardinia), are betting on environmentally-friendly innovation to make plants that will be able to be taken as a model the world over. Italy is also helped by a simple ban – so stubbornly wanted by an environmental association – that outlaws a very popular product. A small example of good politics worth reproducing on a large scale. ●

The green economy is not an industry but a different kind of economy.

Italy has already achieved what for other European Countries is still an objective: the 180,000 tons of shopping bags put on the Italian market in 2010 – before the ban – have become 90,000 tons in 2013.



It Takes a Flower

by Marco Gisotti

Marco Gisotti is a journalist and adviser. He heads Green Factor, an environmental communication and studies agency.

After China, Europe is the main consumer of natural rubber in the world.

Who has never seen that beautiful plant called dandelion, also known in scientific terms as *Taraxacum*? It is much appreciated in phytotherapy and some people also use it as a salad dressing, but it could even be the next frontier in the tyre industry.

In Hannover, Germany, the natural rubber used for treads has been replaced by a new product, an extract of dandelion (to be precise of the Russian dandelion, ***Taraxacum kok-saghyz***), then renamed “taraxagum”. The new tyres that Continental is planning to launch on the market in the next five-ten years, have been developed by the Fraunhofer Institute of Molecular Biology and Applied Ecology together with the centre for agricultural research Julius Kühn-Institut and the Aeskulap GmbH, a company specialized in medical and technical research.

In order to grow this plant, which is already growing spontaneously in many parts of the countryside, many inactive fields in European temperate regions will be used.

But why should we produce rubber from such an unconventional source, instead of continuing to extract it from the ***Hevea brasiliensis***, as it has been done for two centuries?

The latex which is extracted from the cortex of this majestic plant, also known as rubber tree, is very precious, at least since 1839, when Charles Goodyear developed a special treatment, vulcanization, which was able to give special elasticity to its derivatives and which has proved essential in the tyre industry.

Since then, people have tried in all possible ways to plant the **Hevea** outside of Brazil, but with little success. Currently this plant is only grown in Southeast Asia, in some tropical African countries, and obviously, in some parts of Latin America.

This is not enough to satisfy the global demand for natural rubber, especially as some *Hevea* plantations are being replaced with oil palms, more profitable for local economies, and also because a parasitic bacteria is attacking the roots of *Hevea brasiliensis*, causing its death.

Despite the economic crisis, the car industry, both at a global and European level, continues to register an upside trend, pulling with it the tyre industry.

According to the latest “European Tyre & Rubber Industry Statistics” by ETRMA, the

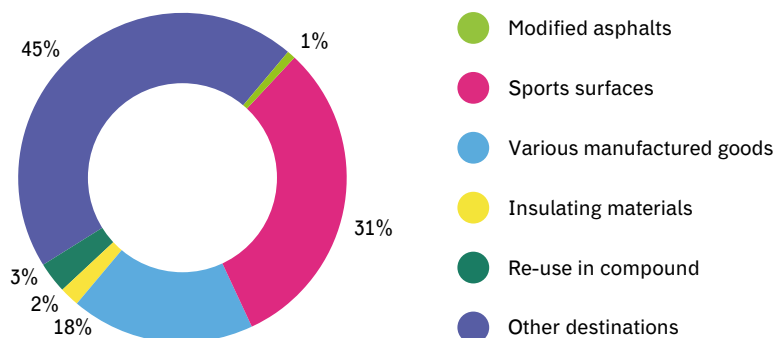
European association of tyre and rubber products producers, from now to 2025 the market is supposed to grow, despite 2012 being a particularly hard year.

So, although in crisis, in 2012 Europe alone has consumed 1,100 kt of natural rubber, coming mainly from Indonesia, and about 2,400 kt of synthetic rubber (after China, Europe is the main consumer of natural rubber in the world). Out of these amounts of rubber, the tyre industry has absorbed 74% of natural rubber (800 kt) and 48% of synthetic rubber (1.100 kt).

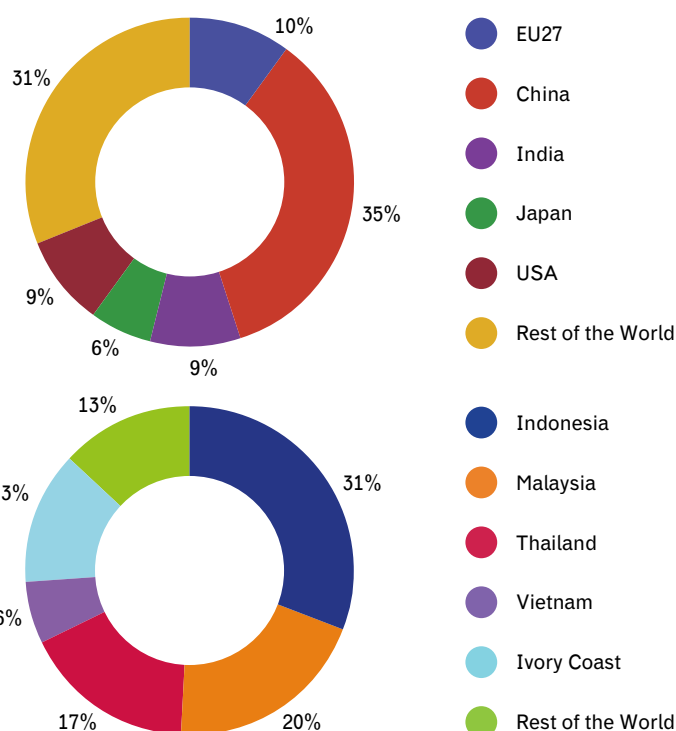
In terms of market trends in the tyre and rubber products industry in our continent, the historical series show a serious decline in sales in 2008 (-8% of 2007 productions) with an even more dramatic drop in 2009 (-21.3%), an equally rapid growth in 2010 (+22.7%) with a positive trend in 2011 (+3%) and another drop in 2012 (-8%). In 2013 a very slow recovery was registered in all sectors, apart from the car industry (-1%), although not an exciting one. "2013 was definitely not a boom year for the tyre market" explains Fazilet Cinaralp, secretary general of ETRMA, "however, sales data show a strengthening of the market and a return to growth after such a negative 2012. Our hope is that this trend is confirmed in 2014, for which we are expecting a 2-3% growth".

In other words, the tyre industry, with its ups and downs, is not coming to a halt, it needs raw material and is looking for substitutes for *Hevea brasiliensis* latex. A potential substitute could be a perennial shrub from Mexico, the Guayule (*Parthenium argentatum*), already known for its widespread use in the USA during the Second World War. Italy too had expressed an interest in it in 1938, when the Ministry of Industry wanted Pirelli and Iri to found the Italian agricultural autarchic rubber society (Saiga, Società agricola italiana

Distribution of usage of recycled rubber from Out of use tyres in products and applications in 2013

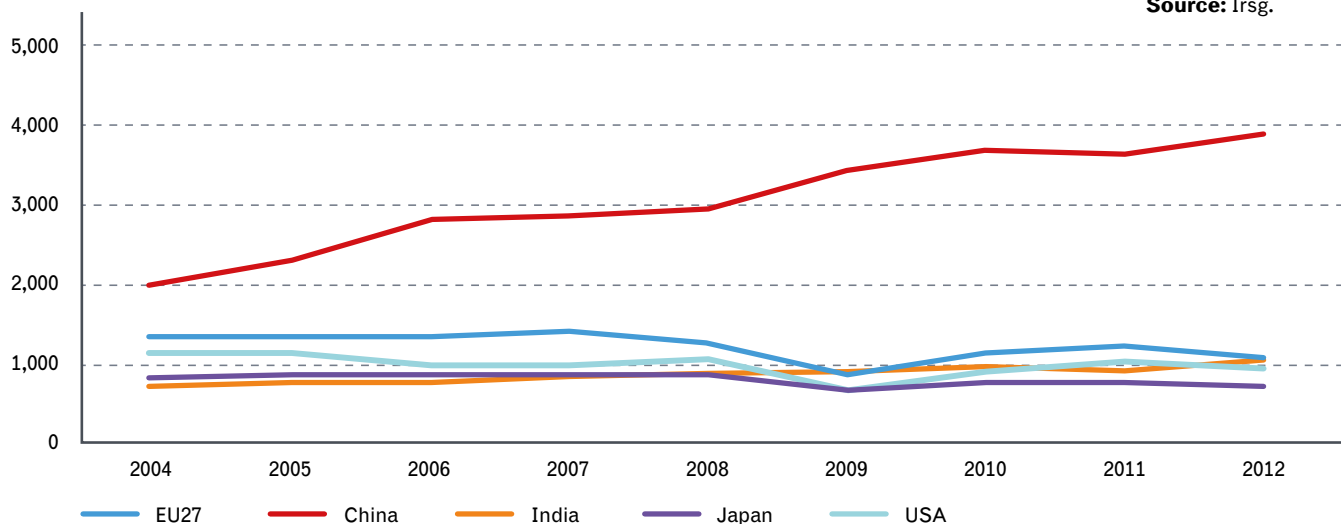


Natural rubber: share of consumption by country (above) and European imports' origins (below) in 2012

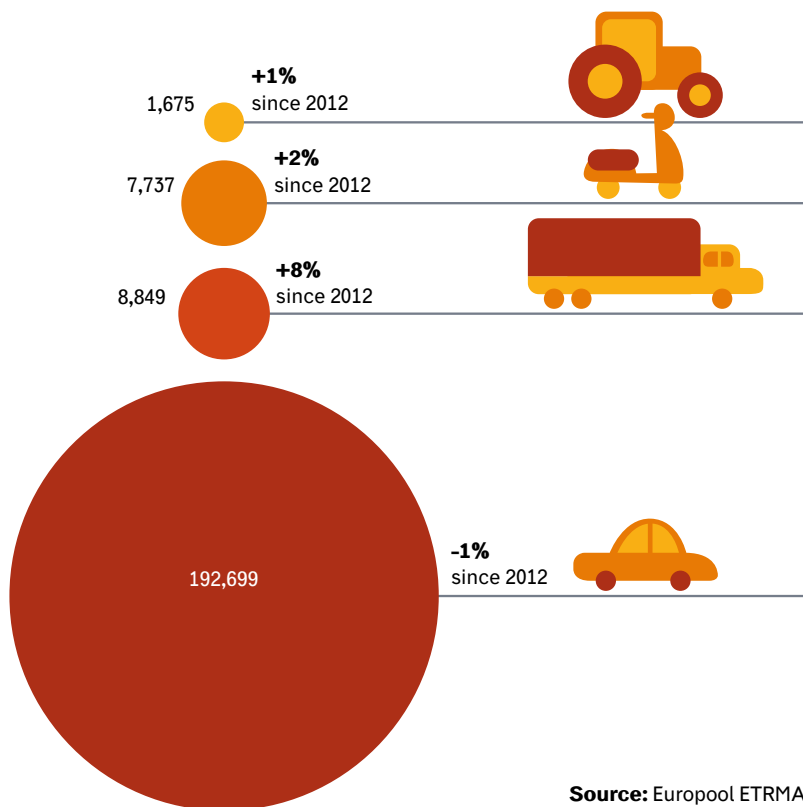


Consumption of natural rubber in the main markets (thousands of tons)

Source: Irsig.



Tyre sales (in thousands) in Europe (2012-2013)



Source: Europool ETRMA.

gomma autarchica): in 1940, 25 million Guayule plants were shipped from California to Cerignola, Puglia, in the hope that every hectare of cultivated soil could generate at least a ton of rubber.

With the end of war, the project was suspended and the Tavoliere countryside was brought back to its cereal growing vocation.

This was a pity, because Guayule is a plant with a very low environmental impact, it needs very little water and does not require pesticides. In addition, its latex is hypoallergenic, making it good also for the medical industry.

However, in recent times Versalis, the company of the ENI group specialized in biomaterials, together with Yulex Corporation, turned again to *Parthenium argentatum* and started its exploitation.

There are also those who are not thinking of replacing *Hevea brasiliensis*, but only improving it genetically: for a few years, Bridgestone has launched a project of Dna decoding for the rubber tree, from which it is hoping to obtain high quality and 100% sustainable tyres in the next decades – the objective is 2050.

Will this be the right path? Meanwhile, other plants are proposed for the “biotyre” market.

The second life of tyres

A conversation with Giovanni Corbetta, General Manager of Ecopneus

They are called “ELTs”, “end-of-life tyres”: they are the tyres of our cars (but also trucks, tractors, motorcycles etc.). Up until a few years ago, it was not uncommon to see piles of them stacked in junkyards and, unfortunately, even abandoned at the side of roads or in improvised illegal dumpsites. Today, 3 years on from the introduction of ELTs recycling and collection system, the situation has dramatically changed.

“We are very young” underlines Giovanni Corbetta, General Manager of Ecopneus, the main Italian limited liability consortium in charge of finding, collecting, treating and sending to a final destination used tyres. “We were born ‘because of the law’ in 2011, although in some way we were already active at least since 2006. And in a few years we have reached important objectives. Only in 2013 we have recovered over 247,000 tons of used tyres from over 33,000 tyre repairers all around Italy.”

According to the “Sustainability Report 2013” by Ecopneus, all these recovered tyres amount to 347 million tons of CO₂, which could be avoided thanks to the use of recycled rubber instead of new rubber, 3,2 billion of kWh of saved energy; 1,3 million cubic metres of water which was saved in the productive cycles

of new rubber, steel and other tyre components.

“Of these 247,000 tons, 152 are destined to energy recovery in cement factories and 62 to the recycling market in the form of granule and rubber dust, although the percentage of recovered material is growing and this is our own very objective. Compared to other European countries, unfortunately in Italy we still have too many barriers, both cultural and bureaucratic, which need to be overcome to comply with recommendations on recovered material. There still exist grey areas that leave ample margins of ambiguity on what can be considered waste and what is recyclable material.

With products obtained from ELTs it is possible to lay road surfaces, build artificial football fields and sports floors. In the future we see the possibility of increasing the use of recycled rubber, thus reducing consumption of new rubber and oil. The research on devulcanization of rubber is also providing very encouraging results.”

Oranges, for example. In Japan, thanks to nanotechnologies, Yokohama is developing a mixture based on oil from orange peel. The “recipe” is called BluEarth.

Another recipe made from “residues” of food products comes from Goodyear Tyre & Rubber Company which has developed a system based on rice husk. Also called chaff, husk is a sub product of the processing of crude rice, often sent to incinerators for energy recovery with a problem of ashes recovery. These ashes, however, can now be used to produce an eco-friendly silica that is useful in tyre production: “Silica – explains Goodyear – is mixed with the rubber from the tyre tread to reinforce it and reduce resistance to rolling, contributing to less use of fuel.

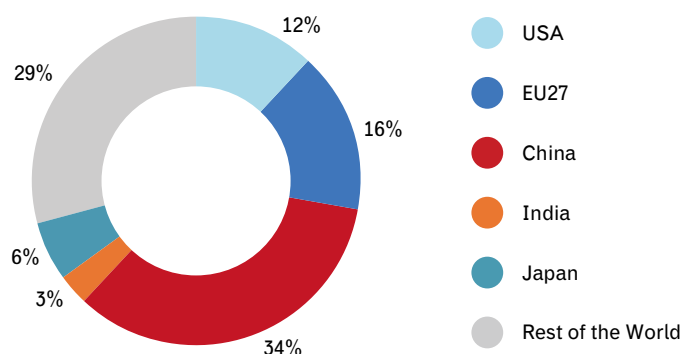
It can also have a positive impact on the adherence of the tyre on a wet surface”.

Since last year, Pirelli too is experimenting a less environmentally impacting procedure in Brazil, in order to extract silica from the residues of rice production. Among Italian cases, the work of Novamont deserves a special mention, a company already known for its Mater-bi, obtained from corn starch, which in the tyre industry can successfully replace lampblack or silica.

This new tyre, made by Goodyear, will be lighter, will consume less tread, will be less noisy, will be responsible for fewer emissions of carbon dioxide and will require less energy during the production phase. For the user, the better roadholding and less fuel usage will certainly be good news.

New opportunities from nature therefore appear countless. Some time ago the president of the Bridgestone Americas Center for Research and Technology, Hiroshi Mouri, said there are at least 1,200 different plant species, from which to extract rubber for the tyre industry. Obviously they

Share of consumption of synthetic rubber by country in 2012



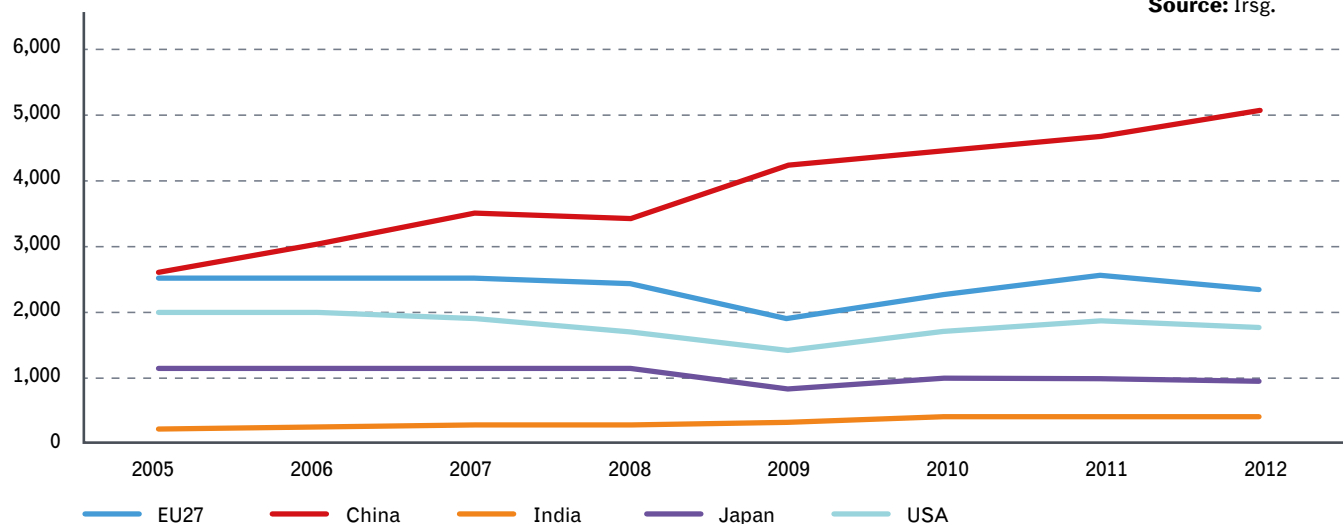
are not all convenient, they do not all grow at every latitude and they do not have the same environmental impact.

The crisis, be it economic, environmental or war related, is the mother of all inventions. The use of dandelion for tyre production is not a novelty. In the Soviet Union it had been used since 1922 but it was during the Second World War that its cultivation was boosted. And the same was done by the United States, Spain, Great Britain, Sweden, Germany, Australia and New Zealand. Today like in the past, research is the only solution to the crisis. ●

There are at least 1,200 different vegetable species from which to extract rubber for the tyre industry.

Consumption of synthetic rubber in key markets (thousands of tons)

Source: Irsig.



The European Path to Bioeconomy Runs through Clusters

by Mario Bonaccorso

Who are the major protagonists of the European bioeconomy? Clusters. From France to the Netherlands, from Germany to Italy, in the Old Continent many countries aggregate small and medium enterprises, research centres, universities and – occasionally – investors, driven by the motto “working together to compete”.

Mario Bonaccorso

is a finance and economy journalist. He works in Assobiotec, the Italian Association for the development of biotechnology.

Long gone are the days when the big enterprises of the early capitalism used to rule from within the innovation processes, from basic research to the marketing of new products. Nowadays such innovation processes are governed by large, complex and structured production chains, with various economic and non-economic actors, often with a local connotation, influencing their characteristics and results. An interest in clusters is not merely linked to their economic potential but also to their value as a planning tool by public intervention on the environment.

With the term bioeconomy – meant as an economy using biological resources as input for food, feed, energy and industrial

production – we refer to a metasector worth 2 trillion euro in Europe, creating 22 million jobs, representing 9% of the overall workforce, according to the data released by the European Union. This implies that clusters with an interest in bioeconomy can include agriculture and food industry, green chemistry and industrial biotechnologies.

The only European cluster directly inspired by bioeconomy is Central Germany's **Bioeconomy Cluster** (<http://www.bioeconomy.de>) based in Halle (Saxony-Anhalt), where a variety of partners in the industrial and research fields work towards the use of non-food biomasses for energy and new materials production. In the Saxon city, timber, chemical, plastic material and plant-engineering industries team up to build a dedicated regional centre for bioeconomy where the common objective is to expand rapidly from local workshops to industrial production.



With an area of 1,300 hectares the chemical site Leuna is the largest chemical complex in the Federal Republic of Germany. This is equivalent to 1,800 soccer fields.

Interview

The Bioeconomy Needs Basic Regional Structures

Interview with **Horst Mosler**, CEO of BCM – Bioeconomy Cluster Management GmbH, the company that manages the cluster for the bioeconomy based Halle, Germany



© Michael Deutsch

Mr. Mosler, what is the role of clusters in promoting the development of the bioeconomy in Europe?

There are many industries involved in the formation of the new economic sector bioeconomy. Therefore it is necessary to establish connecting points. The bioeconomy itself needs basic regional structures in which resource-efficient material flows and value chains can be developed. Therefore clusters are an excellent type of organization. They are linking both the industry and science on the subject of bioeconomy as well as transforming regional approaches into pan-European strategies. Another important task is the expert advice to government, authorities and the promoters of economic development in the European Union. E.g. we are supporting Saxony-Anhalt to get internationally known as a European model region of the bioeconomy.

What differentiates BioEconomy Cluster from all other European clusters which are involved in the bioeconomy?

The BioEconomy Cluster is not specialized on one single industrial sector. The specialization is focused on defined value chains on the base of non-food-biomass as raw material. Accordingly, there is a wide diversity in the range of cluster actors in the field of science and research, forestry and timber industry, construction industry, chemical industry, plastics industry, the automotive, mechanical engineering and plant construction, or the energy industry. With approximately 40% of German beech wood stand the cluster region also has a significant biomass potential, which can be activated for material use.

A real unique selling point is the integration into an established chemical region. The industrial park in Leuna is the chemical site with the largest area in Germany.

First biorefineries have been built there in the pilot and demonstration scale.

What is the governance of your cluster?

We are still a very young cluster. With the ambitious idea to establish a model region in Central Germany for the bioeconomy in Europe, 15 partners from industry and research have gathered in 2011. The consortium applied with success on the Leading Edge Cluster Competition announced by the German Federal Ministry for Science and Research. Our cluster actors are organized in the association BioEconomy e.V. since 2012. The development of the cluster is accompanied by an advisory research cooperation of the German Biomass Research Center, the German Environmental Research Center and the HHL Leipzig Graduate School of Management.

Currently there are R&D projects with a total budget of about 80 million euros operated in the cluster in line with the funding of the Leading Edge Cluster Competition. In addition the state of Saxony-Anhalt, core region of the BioEconomy Cluster is promoting the further cluster development. In 2014 the federal state government has anchored the combination of chemistry and bioeconomy in its current lead market strategy as a part of the regional innovation strategy.

How can the different clusters work together to support the economic growth in Europe?

Cross-cluster cooperation is a central approach in this process. To accelerate innovations and new economies it is important to identify and use thematic intersections. Through the systematic transfer of technology and the exchange of knowledge at an international level the market position of the European industry can be strengthened significantly.

And how important is international cooperation for the bioeconomy?

In a globalized economy, purely regional activities are not competitive any more. This is also applicable for the bioeconomy.

To attract eligible industry partners we put a strong emphasis on international visibility.

So we are member of the ECRN project council, where 20 European regions are connected and take part in an international public private partnership between industry and the EU, the Biobased Industries Consortium, promoting pilot- and demo-plants in international cooperation.

How important is the industry-university relationship for the bioeconomy?

This relationship is of course of significant importance. Firstly, the fundamental research takes place in universities. Based on these results the research institutes for Applied Sciences and their industry partners can operate together in the research and development of new processes and products and finally the commercialization of bioeconomical approaches. Especially in our bioeconomy there is a lot of potential for new materials with unique skills that could arise from renewable resources.

On the other hand universities and educational institutions are important partners for the professional training, advanced training and study programmes to prepare specialists for a biobased economy. The implementation of the bioeconomy leads to new job profiles that we are developing together



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(Interview continued) *with our partners in education. Once more our cluster region offers excellent conditions, for example, with the HHL Leipzig Graduate School of Management, the Martin-Luther-University Halle, the Anhalt University of Applied Sciences and the training academy BAL at the Leuna chemical site.*

What are, from your point of view, the strengths and weaknesses of the European bioeconomy?

An explicit strength can be multi-product biorefineries. The European approach of the bioeconomy already is addressing a whole range of platform chemicals. A lot of production processes are developed in the pilot or demonstration scale, while in overseas countries isolated individual concepts are often dominating. Overall, the way of an integrated approach of the bioeconomy in Europe is followed more consistently. However, especially in the area of biorefineries, the new market approaches barely fit into the existing business of the companies. Here we need new operating models that are based on diversification strategies.

What legislative measures are still lacking in the European Union for ensuring a coordinated and sustainable development of the bioeconomy?

What we need is a clear legal framework promoting the motivation to convert from the fossil to a biobased economy or at least to establish a certain share of sustainable materials. What has led in the fuel sector to new products and drop-in solutions might work as an incentive mechanism in the material field. Also in the construction industry guidelines and regulations stimulating the use of biobased products and building systems could accelerate the demand.

In October 2012, German Chancellor Angela Merkel inaugurated the Fraunhofer Centre for Chemical-Biotechnological Processes CBP in Leuna, an innovative core of the Bioeconomy Cluster. At the biorefinery centre – unrivalled in Europe – processes are developed through a combination of chemical and biotechnological methods to allow extraction of basic chemical products from biomass for possible industrial use. It took twenty months and an investment of 53 million euro to open this cutting-edge centre, available to both universities and industries. “CBP is a milestone in the way towards the future of bioeconomy” claimed Chancellor Merkel on that occasion. She also believes that the Leuna Centre is “an excellent example of redevelopment of East Germany”.

The fact that Germany means business in bioeconomy and that part of its growth strategy is based on clusters is shown by the prominent role played by **Cluster Industrielle Biotechnologie (CLIB 2021, <http://www.clib2021.de>)**, of North Rhine-Westphalia, which combines German excellence in the field of research and development, production and marketing in all sectors of bioeconomy. Clib2021 was born in 2007, when the agglomerate of the North Rhine-Westphalia state won the public procurement by the Ministry for Federal Research and Innovation, being awarded 20 million euro in public funds. In April 2009, the CLIB-Graduate Cluster was created, a joint initiative of three universities within the cluster: Tu Dortmund, Bielefeld and Heinrich Heine of Düsseldorf.

Germany’s great manufacturing is heavily present: Altana, Basf, Henkel, Evonik, Lanxess and Bayer. In addition, there are over forty SMEs, universities and high-calibre research centres such as Fraunhofer, associations, banks and venture capital (since research must be funded). Clusters also include foreign members such as the A.N. Bach Institute of Biochemistry of the Russian Academy of Sciences, with which since 2010 the CLIB has started a coordination programme of scientific projects in the field of biotechnology or the Belgian Bio base Pilot Plan. The international nature of the cluster appears from the strong international relations that over the years have reached agreements with Brazil, Canada and Malaysia. The cluster is an independent entity, requiring stakes by its members according to their ability-to-pay principle and able to create a turnover.

The fact that Germany means business in bioeconomy and that part of its growth strategy is based on clusters is shown by the prominent role played by Cluster Industrielle Biotechnologie.

Interview

Clusters Serve as Technology as well as Market Radar

Interview with **Manfred Kircher**, Chairman of the Advisory Committee of Clib2021



What is the role of clusters in promoting the development of the bioeconomy in Europe?

Clusters sharing a joint vision and bringing together established and young companies, research institutions and investors pioneer bioeconomy value chains. Through the accumulated know-how of all members clusters serve as technology as well as market radar, thus identifying market trends and bioeconomy solutions early. Clusters support their members gaining competitive advantage.

What differentiates CLIB2021 from all other European clusters which are involved in the bioeconomy?

CLIB2021 is unique both through its membership and its strategy: multinational chemical industries provide the critical market for new technologies and products; young companies push bio-process, bio-products as well as instruments; research institutions provide the necessary science and train the next generation and investors promote and develop start-ups. To ensure leadership and competitiveness CLIB is open to international members. In addition regional pillars of competence are addressed because as any cluster CLIB needs a strong home base.

How can the different clusters work together to support the economic growth in Europe?

Clusters are different due to specific regional strengths and stakeholders, e.g. industrial players. Some might be strong in feedstock production, other in processing, commercialization, science or specific markets.

Clusters should on the one hand focus on their home region but on the other reach out. Synergistic cooperation of clusters will result in cross-regional value chains, thus growing the economy.

Clib2021 is a German regional cluster, open not only to all the German players but also to the players of the rest of the world. How important is the international cooperation for the bioeconomy?

30% of our members are located beyond Germany in Europe, North-America, Russia, China and South-East Asia. From the very beginning CLIB pursued not only sector- but also border-crossing value chains. In our understanding the bioeconomy is a global issue targeting on a meaningful share of the world economy – concerning the flow of feedstock and goods but also the exchange of technologies and know-how. Therefore, CLIB

addresses regional as well as international value chains by providing suitable communication platforms.

What is the governance of Clib2021?

CLIB is a non-profit association governed by the board. Board members are recruited from the membership groups industry, Sme (small and medium-sized enterprises), academia and investors. An international advisory board representing the very same groups is supporting the board. The cluster management is financed by membership and services fees.

Did you set up the CLIB graduate cluster? How important is the industry-university relationship for the bioeconomy?

The bioeconomy is in the true sense of the word science and knowledge-based. Therefore fast and efficient transfer of science into applicable technologies is crucial. The CLIB Graduate Cluster contributes in many respects: i) Disciplines esp. relevant for the bioeconomy attract talented graduates; ii) through the industrial internship young scientists get in contact with industrial research questions and iii) many of these graduates will start their career in Sme or industry, thus transferring academic know-how into the practicable economy. By the way, this program is financed by North Rhine-Westphalia's innovation ministry (MIWF), thus proving the catalyzing role of CLIB in realizing this state's bioeconomy strategy.

What are, from your point of view, the strengths and weaknesses of the European bioeconomy?

Let's begin with strength: Europe has a widely recognized track record in industrial leadership, outstanding infrastructure and cutting-edge academic as well industrial Research & Development. Europe's diversity gives us the opportunity to search for the best regional bioeconomy concepts in a competitive but also synergistic way. Regional clusters are the motors of such partnering models. Last but not least Europe starts from the well-established bioeconomy in agriculture, forestry, fishery and related industries and has a clear vision till 2050. However, pushing new technologies into industrial practice and markets takes too long. Raising private capital for investments is easier elsewhere.

The negative response from the general public concerning specific technologies is another hurdle. All these issues – shortening time to market, providing attractive investment opportunities and gaining public acceptance – are addressed by CLIB.

(Interview continued)

What legislative measures are still lacking in the European Union for ensuring a coordinated and sustainable development of the bioeconomy?

The European bioeconomy has to prove itself internally against fossil-based value chains and externally against other global regions. Both aspects need to be addressed by European legislation. If you ask for my personal opinion cost of feedstock is crucial and legislation should care for competitiveness of domestic bioeconomy feedstock with fossil resources and global markets. In this context legislation should look at the bioeconomy in the wider sense of a cyclic economy and promote industrial side streams

such as CO/CO₂ as a sustainable carbon source. The chemical sector which generates in Europe significant value and employment should get the same attention as the currently prioritized energy and fuel sector.

Generally legislation should set the frame but leave the technical and economical formation of the bioeconomy up to the stakeholders. Managing these stakeholders efficiently and successfully will be the focus at CLIB in the coming years.

German clusters are part of a strategy ("Bioeconomy 2030") coordinated by the Federal Ministry of Research and Innovation outlining the national approach resulting in a post-oil economy, thanks to the use of renewable resources and biomasses. It also created a Federal Bioeconomy Council, an institution whose task is to come up with proposals to submit to the central government. Manufacturing and academia have to build strategic alliances along the whole production chain of bioeconomy in order to receive federal funds.

"Bioeconomy 2030" and the creation of the Federal Bioeconomy Council have had a significant impact on the European debate, speeding up the launch of the Union strategy "Innovation for growth – A Bioeconomy for Europe" in February 2012.

From Germany to France it is a short step. To single out the most representative cluster of the French bioeconomy one needs to head for Picardy. It is the point of convergence of world competitiveness of Industries and Agriculture Resources best known as **IAR Pole** (<http://www.iar-pole.com>), specialized in green chemistry and industrial biotechnologies: almost 200 active members, not just from Picardy but also from the Champagne-Ardenne Region, working together for an economy based on the use of renewable sources. It is the French industrial sector at its best: Michelin, Roquette, Veolia, Faurecia, Total but also L'Oreal, Danone and Lacoste, just to mention a few.

Near Reims, the capital of Champagne-Ardenne, the IAR Centre houses the European Institute of Biorefinery, one of the biggest in the world. Every year it transforms 3 million tons of biomass (beetroot, wheat, lucerne) into sugar, glucose, starch, nutritional alcohol, surgical spirit, ethanol and active ingredients for cosmetics. The French cluster is characterized by the principles of sharing and synergy: the Centre in Reims also

includes a shared R&D lab (ARD), an industrial demonstration plant (Biodemo) and a research centre that links several colleges of further education (CEBB). In Reims a new project is also being developed, FuturoI, for the production of second-generation biofuels that do not use biomass from crops.

While the main characteristic of the IAR Centre is synergy, the second is internationalization. The French cluster is not limited to regional scale but boasts partnerships with Europe, Canada, USA, Japan, Brazil and India. In the Old Continent, it is actively collaborating – together with the York University's Green Chemistry Centre of Excellence – to the creation of a biorefinery intercluster. The French bioeconomy panorama also includes **Axelera** (<http://www.axelera.org>), a Chemistry and Environment cluster of Lyon & Rhône-Alpes Region specialized in green chemistry and recycling of materials; **Agrimip**, Agri Sud-Ouest Innovation (<http://www.agrisudouest.com>), a cluster for agriculture and the agricultural and food industry of the Aquitaine and Midi-Pyrénées Regions; and **Xylofutur** (<http://www.xylofutur.fr>) a cluster focused on paper of the Aquitaine Region. In march 2011, these clusters together with the IAR Centre created the United Bioeconomy Clusters (UBC), an association aiming at sharing a national strategic development vision focused on green chemistry and presenting French bioeconomy in a unified way abroad.

Recently, in Italy as well, a series of clusters devoted to bioeconomy have been created. Once again, this highlights the importance of teaming up when dealing with the challenges posed by the development of this metasector. The creation and development of eight national technological clusters was promoted in 2012 by the Ministry of Education, University and Research with the aim to identify opportunities – clusters organized by companies, universities, private

or public research institutions and individuals focused on innovation and active in different national areas – able to act as catalysts of sustainable economic growth both at local and national level.

The most important is surely the national green chemistry technological Cluster created by three of the major players in the Italian bioeconomy: Novamont, Versalis (Gruppo ENI) and Biochemtex (MossiGhisolfi Group), in collaboration with Federchimica, the Italian Federation of Chemical Industry.

The goal of the green chemistry cluster, which adopted the acronym **SPRING – Sustainable Processes and Resources for Innovation and National Growth** (<http://www.clusterspring.it>), is to promote the development of bioindustries in Italy through an integrated innovation approach to relaunch Italian chemical industry characterized by environmental, social and economic sustainability and to stimulate research and investment in new technologies. The goal is to boost national and international competitiveness in the field of biobased products and to pursue EU's most recent guidance on bioeconomy.

SPRING has over one hundred members operating on different levels in bioeconomy and representing Italian excellence in this field: big industrial players, biotech SMEs, universities, research centres, institutions, regional innovation centres and many others promoting innovation and technological transfer.

The actions of the Cluster, which has appointed Catia Bastioli (Novamont's managing director and true leader of the Made-in-Italy bioeconomy) as its president, are characterized in the short and long run by four main pillars: the promotion of a cascading use of biomass closely connected with agriculture and local biodiversity; the development of innovative technologies and efficient processes for the creation of integrated, third-generation biorefineries; the market-driven development of biobased products and devising green public procurement and bioeconomy incentive actions both at regional and national level.

"Agriculture meets chemistry" is the slogan chosen by **Biobased Delta** (<http://www.biobaseddelta.nl>), a bioeconomy cluster in the Southwest of the Netherlands, to highlight the importance of agricultural residues for biobased industrial innovation. For chemistry in particular, since the Dutch cluster is part of a bigger chemical one created by Antwerp, Rotterdam and Ruhr Regions.

Biobased Delta is home to Biorizon, a shared research centre (in partnership with Ghent Bio Base Europe Centre of Education to Bioeconomy) specialized in the development of technologies for the production of aromatic compounds from renewable sources to be used in high-performance materials, chemical products and coating. Its aim is ambitious: in the coming years to be one of the three main world players

*The goal of the green chemistry cluster **SPRING** is to promote the development of bioindustries in Italy through an integrated innovation approach.*

The Crescentino Biorefinery owned by MossiGhisolfi Group, the first plant for the production of second-generation biofuels in the world.



in this kind of research. To this end it has pursued and intensive activity of international partnerships, from Brazil to Canada. In January 2014 a memorandum of understanding was also signed in Reims, at the headquarters of the IAR centre, by Willem Sederel, CEO of Biobased Delta, and by President François Hollande, to promote the use of Biorizon by the French manufacturing sector.

Besides, other initiatives of the Dutch cluster include a green chemistry Campus, a startup accelerator for renewable-sources-use innovation. In the headquarters of Sabic Innovative Plastics (a company controlled by the Saudi petrochemical colossus Sabic) in Bergen op Zoom, small and big businesses, research centres, universities and government institutions work closely in an open innovation

environment to develop strictly biobased technologies able to exploit agricultural and food residue flows.

In a nutshell, from North to South, the European approach to bioeconomy is based on clusters that become the real driving force behind development and innovation, a tool able to promote a partnership between different actors and the rapid exchange of knowledge. Experts claim that all this generates a competitive environment that creates favourable opportunities for new businesses and new jobs.

Interview

Thanks to Cluster SPRING, we are Building the Italian Bioeconomy Starting from Local Areas

Interview with **Catia Bastioli**, President of SPRING, Italian National Technological Cluster of Green Chemistry



SPRING is the youngest European Cluster in the field of the bioeconomy. What were the objective it was created for?

The Cluster SPRING was born in 2012 in response to a public call by the Italian Ministry of Education, University and Research, with the aim of giving birth to a national platform with a common vision: to start from bioeconomy and local territories in order to boost the growth of the country. An ambitious purpose, however, which does not come out of the blue. SPRING relies on a very solid base of skills, know-how, demonstrator plants already present in Italy, which are the result of years of investments in research, as well as of the will of some industrial actors to generate case studies that could give a contribution in the development of an Italian model of bioeconomy, integrating different skills and disciplines: from agriculture, to chemistry, to waste management.

Who are the Cluster actors and what is its governance structure?

The Cluster SPRING was created as a non-profit association, and currently counts nearly a hundred ordinary members. They are all realities operating in different ways in the field of bioeconomy and representing the Italian excellence along the value-chain of "green chemistry": large industry players, SMEs, regional innovation clusters, trade and local associations, development agencies, foundations, and many other actors in the area of technology transfer and environmental communication. Among these, we must mention also the main public research centres referring to the Ministry of Education, University and Research and the Ministry of Agriculture and Economic Development, as well as some of the most prestigious universities in the country. SPRING can

also count on the support of eight Italian regions, whose local policies meet with the Cluster objectives and are strongly oriented towards bioeconomy. The Cluster is presided over by a Board of Directors, composed of representatives elected by four Committees, respectively established for Industrial Innovation, Public Research, Dissemination and Territorial Development.

In what way can SPRING contribute in speeding up and strengthening the Italian transition towards a more sustainable model of development?

The big challenge that Italy is facing is territorial regeneration, which means to aim towards a common national objective starting from local areas and enhancing their specificities, giving rise to new agro-industrial supply-chains and using innovative technologies able to reconvert obsolete or disused plants and create new employment and growth opportunities. SPRING intends to face this challenge and encourage the development of Italian bioindustries and investments in new technologies, aware that the concept of "green" chemistry does not only mean new more sustainable products, but also new models and a new common culture, able to bring together very different groups of interest – often on contrary opinions – through sharing a common project of territorial regeneration.

In general, what is in your opinion the role of clusters in encouraging the development of bioeconomy in Europe?

The role of national clusters operating in the field of bioeconomy should be that of mobilizing the country-system towards common objectives, in order to define a strategy that could start from local

areas and their specificities. In this respect, Clusters represent the ideal tool to have European regional differences converge into a unified development model, while preserving at the same time the peculiarities related to the history, productive model and geographical aspects of each Member State.

Italy is one of the few countries in Europe still without a National Strategic Plan for Bioeconomy. How do you interpret this gap?

Italy has not formalized its National Strategic Plan yet but, in some ways, it already represents a model of bioeconomy. Consider for example the virtuous case of bioplastics, which offer solutions able to turn environmental problems – such as organic waste – into resources. Cases like this show that Italy is largely capable to give origin to highly innovative and systemic models, examples both in terms of competitiveness and of international consensus. Let's also point out the important effort currently being carried out to implement the upstream integration of the bioplastic supply-chain, the innovations in the field of second-generation sugars and the project of relaunching petrochemistry in synergy with new technologies based on renewable resources. However, it is essential to be able to rely on a clear national strategy, that could identify among its priorities the push of products able of reducing the costs of externalities on environment, health and society and whose production could represent a real opportunity of restart in areas affected by crisis. Only in this way the economic and cultural leap – which Italy is prepared for at a technological level – will be possible.

What are the fundamental points that an Italian national plan should include?

Italy, compared to other countries, presents a number of preconditions that favour the transition towards a development model based on bioeconomy: from its geographical features to the structure of the agricultural sector, from infrastructures to the research know-how in the field of bioplastics and chemistry for renewable sources. Let's not forget the obsolescence of some industrial sectors, not competitive anymore due to lack of innovation over the years, and which might end up blocking huge resources if not replaced or integrated by innovative and vital sectors – able of rethinking quality and environmental performance of products and their production system. An Italian plan should therefore consider all these preconditions and turn them into strengths, starting from the available technologies ready for scale jumping. The aim is to trigger re-industrialization and territorial regeneration, in terms of a positive contamination of various compartments, creating added value and generating new employment – not only in the chemical industry, but also along the whole supply chain – as well as new interactions among agriculture, industry and social fabric.

Another key issue is that of standards. In order to boost Italy's growth, it is essential that the virtuous processes described above – besides leading to positive impacts of research on the industrial sector – could drive at developing new products that

meet high quality standards. These standards must be able to “raise the bar”, focusing on territories and minimizing the environmental costs for citizens.

In order to achieve all this, however, it is necessary to overcome the concept of product in its individuality, and to consider it as a part of a system of production-consumption-disposal and in relation to its externalities.

Finally, biorefineries integrated in local areas, through the creation of public-private partnerships, have the potential of multiplying business initiatives and educational projects that can help new start-ups, while offering high-quality training opportunities to young graduates, college graduates, PhD doctors and all those people that have left the labour market.

What are, in your opinion, the strengths and weaknesses of European bioeconomy?

European bioeconomy can boast of technological leadership positions immediately exploitable and already patented, with recently-built or under-construction production plants, against a phenomenon of deindustrialization that is affecting traditional chemistry and other industrial sectors. What needs to be improved are the instruments, both financial and policy-related, that can allow a rapid industrial growth of sectors offering solutions to significant environmental problems, through the recognition of the cost of externalities generated by traditional products. This would present the triple benefit of promoting scale-jumping of the related technologies, of reducing environmental costs, and of acquiring a comparative advantage promoting the export of higher-value products and reducing commodity imports. Speed is a key issue in this sense: it is necessary to change direction, and to intervene on the speed of innovation in order to avoid product obsolescence to result in high costs of deindustrialization and imports.

Is there a particular measure that you would like to recommend to the new President of the European Commission, Mr Junker, in order to stimulate bioeconomy?

Bioeconomy can become a key driver for the development of Europe, if managed with a holistic and system-based approach able to integrate industry, agriculture, environment, education, research, finance and the labour market. It needs to focus on agricultural raw materials, local scraps and the technologies that Europe has developed and is currently developing, following a logic of efficient use of the resources available in every local area and always respecting their specificities and culture – while enhancing a series of high-quality products from integrated long supply-chains. To this end, it would be essential to give birth to an Interdisciplinary Committee for the management of the Bioeconomy Strategy, that should avoid what happened in the past with narrow sectorial approach. Let's just think about energy, which is a service: every specific measure should never leave out of consideration its possible effects on agriculture and industrial supply-chains.



Urban Mine

by Emanuele Bompan

Milan has become an international leader in organic waste collection and recycling. Renewable Matter analyses how one of Italy's most interesting projects was conducted.

Emanuele Bompan, journalist and urban geographer, deals with environmental journalism since 2008.

Better than Germany. Beyond San Francisco. This project is attracting a host of administrators and experts wishing to study and analyse it. It is Italy's pride and joy. The subject of such attention is Milan's programme for organic waste management. Launched in 2012, it is now the world's most efficient and sustainable organic waste collection system, involving families and private businesses (restaurants, canteens, etc.). Once a back-marker among main European cities, Milan has jumped ahead in less than two years. If in 2012 less than 30 kg of wet waste per capita per year were collected, in 2013, it soared to 56 kg and in 2014, it is expected to exceed 95 kg per person per year. An impressive amount, over 120,000 tons of organic waste per year. More than any other city in the world with a population of over one million.

The urgency of tackling the organic waste issue is deftly summarized by sustainable economy guru Lester Brown, author of *Plan B 4.0* and interviewed by the author. "Soil nutrients geography is changing. The soil is being depleted of substances such as potassium, phosphate and nitrates, which absorbed by fruits and vegetables, flow and concentrate in cities where they

eventually end up in the sewage system, altering the balance of rivers and sea waters. This cycle must be broken."

According to Mr. Walter Ganapini, former Milan councillor in charge of the environment, "organic waste composting could be a strategy for improving Italy's soil". Italy, even in the fertile Po Valley, has a low organic substance level in its soil, only 3%. In France, just to give you an idea, it is 6%. So, non-artificial organic material redistribution is essential.

"We must also take into consideration the ensuing climate change issue" explains Mr. Ganapini. "If organic waste is not adequately managed it can contribute significantly to the emissions of climate-changing gases."

According to Prof. Davide Figliuolo, a researcher at Università Statale in Milan, composting of Organic Fraction of Municipal Solid Waste through separate collection (OFMSW in technical terms) is able to capture directly 17.6 kg of CO₂ per ton. If avoided emissions are taken into account, deriving from the non use of chemical fertilizers and peat as a structuring material, the total of non-emitted CO₂ amounts to 65.3 kg per ton of wet waste managed.

Implementing OFMSW management projects such as that of Milan could easily become a



Interview

The Milan model

Interview with
Pierfrancesco Maran



Pierfrancesco Maran is councillor in charge of environmental and transport affairs for the Municipality of Milan and is one of the administrators engaged in the launch of the OFMSW collection project, talked to *Renewable Matter* to explain the Public Administration's role in this project.

How was the idea of reintroducing organic waste collection in Milan conceived? Was it initially met with opposition?

Strengthening separate collection and reintroducing organic waste collection was one of the most important points of Giuliano Pisapia's electoral programme. At city level, we cannot talk about environmental policies without wet waste collection that entails a drastic reduction of waste collection. There was no opposition. Milan had already tried wet waste collection in the past and then it was suspended, so its people were already "used" to the idea of separate wet waste collection.

Wet waste collection is expensive. What are the economic, environmental and social benefits for city dwellers?

Considering that separate collection of recyclable waste is provided for by Italian and European regulations, the benefits of wet waste collection for city dwellers are above all of environmental nature: organic waste does not end up in an incinerator (in Milan, nearly no waste ends up in a landfill) but is processed so as to produce compost to be used in agriculture and energy from the production of biogas.

What is the role of the municipality in the success of this project, considered one of the best the EU? What are the advantages of having private partners such as Novamont?

Pisapia's town council will and vision were determining factors in strengthening separate

collection and the operational and financial support of private partners was crucial to carry out this project. This collaboration resulted in a very important cultural revolution.

How important was it to find a way to explain the collection to both Italians and immigrants?

Communication in nine foreign languages is vital in a multi-ethnic city such as Milan. Here many foreigners work as cleaners and keepers. The PULIamo app has proved to be a useful tool for reaching the young and students coming from other cities where separate collection is not widespread or other people not used to this activity.

Are you promoting the Milan Model in other Italian municipalities?

Across Italy there are small municipalities that are doing very well in separate waste collection but the Milan Model is very interesting for other major cities. We are particularly proud because foreign cities delegations (Paris, London, Shanghai, Berlin, Saint Petersburg, San Francisco, Barcelona and Oporto) have often expressed an interest in knowing our door-to-door separate waste collection, especially for organic waste.

Will there be other urban composting projects such the experimental one carried out at Cascina Cuccagna last year? Are there projects for this purpose in urban vegetable gardens?

Yes, absolutely. There are several projects either underway or about to start, especially in schools. Milan is adapting very well to this new lifestyle. Not only at home, but also in offices, in public spaces, in restaurants and bars separate collection is becoming more and more popular by the day.

The communication at the heart of the project: detailed information in the kit for the collection plan, simple and effective explanations to encourage citizens.



conservative strategy for many other urban areas. Besides compost, from the organic fraction it is possible to generate energy from anaerobic digestion and biogas production. Organic waste, which amounts to a third of Northern Italy cities' waste, could become an urban asset in its own right. "As long as it is carefully managed and it can produce the hoped-for results."

In Milan, this process has turned into reality. According to an ISPO survey, 90% of the citizens are backing the project, while a small minority thinks it is useless. This means that OFMSW has become part of the city's collective imagination. The Municipality involved agencies such as AMSA (Milan's utility company for environmental

services) and Novamont, a company that opened Italy's first biorefinery, have worked with great professionalism. Let us see how.

A Story of Waste

Milan had already launched an experimental project on OFMSW collection in the mid-1990s. Nevertheless, in 1999 it was suspended because the quality of collected waste was unsatisfactory. A commercial waste incentive (canteens, restaurants etc.) was preferred.

"The project took off in the Bonola area" explains Mr. Ganapini, who at that time was responsible for managing the 1995 waste emergency in Milan.

Milan's programme for organic waste management is now the most efficient and sustainable system in the world.

Micro-composting and Short Supply Chain

In Milan, there are several wet-waste micro-recycling initiatives. The most interesting is that carried out in 2013 for six months by Cascina Cuccagna. The Cascina (farmstead) is already located in an area served by AMSA door-to-door wet waste collection. Nevertheless, the consortium, led by Mr. Andrea Di Stefano, came up with the idea of trying a zero-km compost production model to show people “the fruits” of wet waste collection. They created a composter to produce a fertilizer to be used in the Cascina’s vegetable garden, by residents and in local urban vegetables gardens, gardens and balconies.

Thus the Erica Cooperative set up a prototype of “community composter” that in six months “digested” a total of 2.6 tons of organic waste (mainly donated by the Esterni Group’s restaurant called “Un posto a Milano”) transforming them in its

fermentation and sterilization chambers in sustainable compost. Residents were able to see how organic waste fed into the composter was ground and mixed with a dry structuring agent (pellets) and then stored in a chamber where fermentation took place, accelerated by the presence of material already fermenting. Forty days of “transformation” and then the product is ready to use.

In six months, Cascina Cuccagna transformed 2.6 tons of wet waste, producing 40 kg of compost for every 100 kg of wet waste in 3-4 weeks. A good example of composter that citizens’ associations, urban vegetable gardens groups and other “urban agricultural” contexts can implement cheaply. A real short waste supply chain.

“But the council led by Albertini made a huge mistake deciding to close down prematurely the wet waste collection. This created the perfect conditions that led Milan to overshoot the targets of the EU Waste Directive. And probably the biggest mistake was to close down the model composting plant in Muggiano in 2005 commissioned by the Letizia Moratti’s administration”, mayor of Milan and famous for her wild promotion of incinerators, including the much-disputed Acerra plant in Campania.

In 2011, with the new Milan Mayor, Mr. Giuliano Pisapia, his campaign very much focused on environmental issues (waste, cycle paths, urban parks, pollution fighting), organic waste collection was given new impetus, thanks also to the commitment of Mr. Pierfrancesco Maran, councillor in charge of environmental and transport affairs.

“There was an immediate concurrence of interests between AMSA and the Municipality of Milan which, in early 2102, led to a four-step project, dividing the city in as many areas to carry out experiments in order to evaluate the feasibility study of such process”, explains Ms. Paola Petrone president of AMSA, interviewed by *Renewable Matter*. The process took off rapidly without any problems in one area after the other. Wet waste collection in the North-West area, the last to be launched, started on 30th June 2014,

thus offering 100% coverage of the Municipality of Milan’s area. A result than many thought impossible.

The Mechanics of a Project

The rapid implementation of OFMSW collection is based on a careful mix of managing skills and a global strategic vision. According to Mr. Enzo Favoino, teacher at Parco di Monza Agricultural School, and one of the experts who took care of the implementation of the project, “in this kind of projects logistics is crucial. To this end, a preliminary study was carried out to optimize collection, identifying what strategies to adopt and how to lay out equipment (buckets and bins) with a detailed census of the area carried out by AMSA to map existing facilities and possible issues”.

AMSA seized the opportunity of implementing its own mapping of collection points and went from house to house to decide where it could locate its bins, assessing blocks of flats’ space and suggesting solutions where space was limited. The company registered and classified in its database as many as 55,000 collection centres.

“In some cases we had to ask neighbours to provide space for *ad hoc* collection areas or we had to provide communal collection boxes.” According to Mr. Favoino, besides a study of



the collection context, in blocks of flats it was crucial to find a door-to-door collection strategy able to maximize people's comfort and to meet caretakers' and maintenance companies' requirements.

Communicating Recycling

"Although the whole project had been carefully planned, it can be argued that communication was key to its success." Ms. Paola Petrone and Mr. Pierfrancesco Maran are convinced of this as well as all interviewees. Without a detailed communication campaign, such surprising results would not have been achieved. An actual campaign to conquer "citizens' hearts and minds": convincing about one and a half million people, with different social and cultural backgrounds, is no mean feat.

The adopted strategy was one of great operations: exploiting every available channel with simplicity and pragmatism. "The first action was to send two

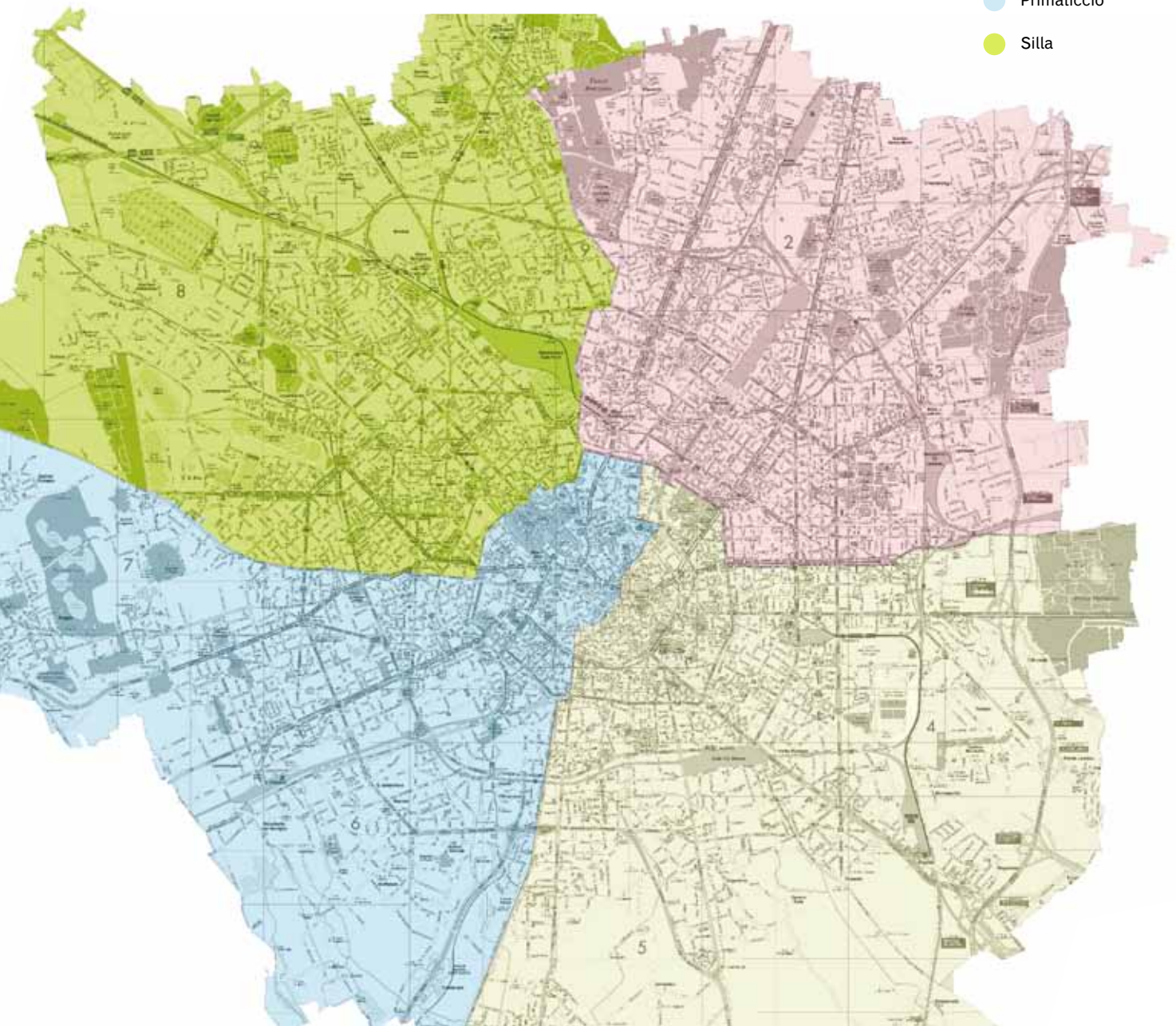
letters to every family living in Milan presenting the project and illustrating in a simple way how to collect organic waste", Mr. Petrone explains. "Then we opened a dedicated telephone service to solve any doubt or puzzlement. Data show that in the first few months AMSA and Comune (municipality) hotline received an average of one hundred calls per week. The joint venture acted directly meeting citizens, caretakers and condominium managers to illustrate the project in details. We organized meetings with all district committees; we set up information stalls in neighbourhood fetes and demonstration composting projects." Even in the most difficult and degraded districts, trying to explain the project to foreign families that have often very little information on correct waste management.

This is why all information literature was made available in nine languages. On amsa.it website instructions are available in Spanish, French, Sinhalese, Arabic, Ukrainian, Chinese and Romanian. A careful choice made taking into

Map of separate collection: following a policy of check & balance has been introduced progressively by dividing Milan in four zones.

Districts

- Olgettina
- Zana
- Primaticcio
- Silla



consideration Milan's ethnic make-up. However, paper communication played the most important role: leaflets were hung up in all waste collection areas and provided to all home units during the painstaking distribution (defined as "Habsburg-like" by AMSA) of OFMSW starter kits. In the 2.0 era, there was also an app to illustrate how to make efficient use of the brown bin.

Private sector support was also crucial. Novamont, a bioplastics colossus, donated one million Mater-Bi bags, a type of plastic patented by the company. "This was a very important collaboration for AMSA" Ms. Paola Petrone explains, "that was crucial for the carrying out this project". Compostable bioplastics bags, which are waterproof, hygienic and breathable, are essential when using anaerobic digestion and composting plants. Bag compostability is a fundamental characteristic in order to guarantee the quality of collected material. Although today, thanks to the law banning plastic bags, many people use bioplastic bags, supplying 25 Mater-Bi bags helped educating people. In many towns, the main problem facing OFMSW collection is non-compostable plastic bags. Thanks to this supply, citizens start to get used to bioplastics.

According to Mr. Christian Garaffa, Novamont managing director, the majority of small shops still uses bioplastics bags correctly. A thorough application of national regulations on carrier bags would improve the service (for further information on carrier bags, please read Mr. Francesco Ferrante's article in this issue of *Renewable Matter*.)

Economy of Waste

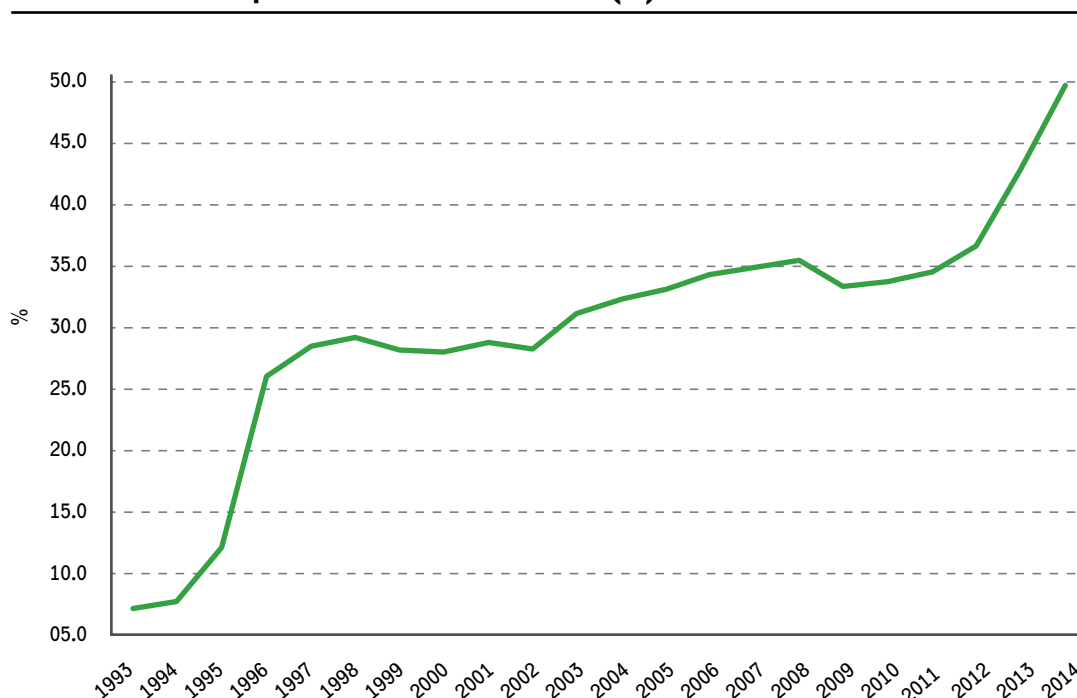
It cannot be denied that collecting and reusing OFMSW through separate collection entails extra costs. Nevertheless, according to a 2010 official study carried out by Regione Lombardia, costs tend to fall with higher separate collection rates, this is due to savings in waste disposal and revenue from recyclable materials. However, according to AMSA and local authority interviewees, in reality it is seen as an extra cost. "But if we take into consideration positive impacts on the environment and on public health, we can identify some savings" Ms. Paola Petrone argues.

These are not easy estimates. But when taking into account emissions of greenhouse gases and particulate, nutrients given back to the soil thanks to the distribution of compost to local farmers and biogas production as a source of renewable energy representing an alternative to fossil fuels, it is easy to understand its advantages.

According to Mr. Favoino, changes in costs of alternative methods to organic waste collection must also be taken into account. "Thirty years ago, landfill disposal was cheap, but today landfill costs have risen due to compulsory pre-treatments to avoid biogas and leachate production. In the medium term, incineration costs also show an upward trend due to emission regulations requiring more and more sophisticated treatment technologies." In reality, the more we recycle, the more we save. The situation though varies from country to country according to Michael Kern, a waste management expert at Witzenhausen-Institut. "In countries

For every ton of wet waste managed the total CO₂ non-emitted is 65.3 kg.

Trend of separate collection 1993-2014 (%)



Milan on top of the world: the introduction of staff has accelerated the share of separate collection for years struggled to increase.

Where Waste Ends up

Approaching the tipping area that every day receives articulated vehicles with 30-ton loads, a careful visitor is surprised that the private plant in Montello (Bergamo) – a 35-hectar plant with a 12-hectar roofed area – does not give out the strong smell characterizing so many waste collecting plants. Here, through an isolated system, Milan's organic waste, as well as other areas', is transformed into biogas and then into compost. The method adopted at this plant consists of a pre-treatment of waste followed by anaerobic digestion (in order to produce biogas used to generate electricity and thermal energy) and by a final aerobic composting stage of sludge deriving from dehydrated digested material

in order to produce quality organic fertilizer.

Thanks to its digesters, the plant's emission reduction amounts to 75,000 tons of CO₂ per year.

All the thermal energy produced by the Montello plant is used to run its services and facilities (i.e.: to warm up its digesters); electricity is also used to run the plant while the surplus is fed back to the grid. The Montello Plant has a 10-MW generation capacity. Compost is given to farms free of charge.

Info

<http://www.amsa.it>

<http://www.novamont.it>

Bad habits: despite the project's success there was a decrease of attention of the citizen in correct waste separation.

where incineration costs are low, incinerating competes with organic waste collection and it is more difficult to promote OFMSW management.”

“Italy though” Mr. Favonio adds, “has introduced intensive and optimizing models of separate collection that offer the chance of containing collection costs compared with traditional Central European models. As shown by official sector studies, this is a strategy that enables to increase separate waste collection by 20 to 70% without entailing a real cost increase. Of course, this is true in the medium and long term, when operative models can be optimized; in the short term pre-existing conditions can reasonably become conditioning elements.”

In Milan, for citizens and local government officials alike, this is undoubtedly a positive experience and it does not really matter if it is slightly more expensive. It is something to be proud of and it helps the environment. The project has risen a great deal of interest both at national and international level. “We have received delegations from Paris, Stockholm, Shanghai and Berlin. We have had many exchanges and we are often invited to illustrate the project” Mr. Petrone says.

Rome seems to be one of the few cities that has not yet contacted Milan. ●



CO₂: From Climate Killer to Resource

An Innovative Process for “Zero Emission” Methane Production

by Fabrizio Sibilla

© Franco Volpato / Shutterstock



Turning carbon dioxide (CO₂) from polluting waste into a high added-value product by using microorganisms is what Krajete GmbH is doing, a young Austrian company operating in the field of industrial biotechnology.

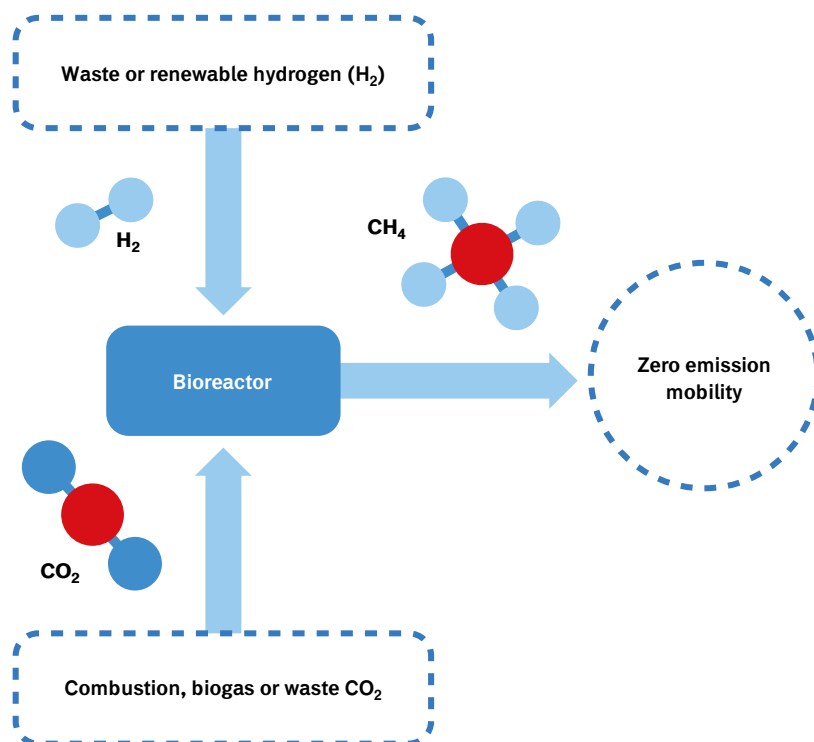
It started operating in 2002, when Alex Krajete left for California with a degree in chemistry under his belt obtained from the University of Innsbruck. After a PhD at Berkeley University, at the California Institute of Technology (Caltech) in Pasadena the Austrian researcher started investigating the transformation of CO₂ into methane by using microorganisms. He struck gold in this research field. So much so that back in Europe, Dr. Krajete carried on his studies turning them into a business, first a one-man company (2011) and then Krajete GmbH (2012), where five more researchers with a PhD joined him. Collectively, they primarily research into the use of CO₂ but also into synthesis gas (a blend of carbon monoxide, CO, and hydrogen, H₂), for the production of methane as zero emission fuel for motor transport. The methane obtained in this way is a fourth-generation biofuel, in other words its production does not require photosynthesis.

“Fourth generation biofuels – as Krajete researchers point out – are also known as biofuels without biomasses and are based on hydrogenation of CO₂ into energy dense molecules (methane, methanol and higher alkanes)”.

Today Krajete GmbH boasts a series of patents covering the transformation of renewable energy or waste hydrogen into methane (see [figure 1](#)).

The Austrian start-up operating field is the so called Power to Gas (PtG, see box) through biotechnology, with a robust process able to support both the input of non-purified CO₂ (and therefore knocking down the costs involved in the preparation of raw material), and pressure and purity variations in the supply of hydrogen. Such

Figure 1 | **Krajete process for renewable methane**



process flexibility enables to use hydrogen from the cracking phase of hydrocarbons, which does not necessarily require production of hydrogen through water electrolysis. Krajete is therefore able to use its biotechnological process both with renewable and fossil raw materials, thanks to the great operational flexibility of his process (see [figure 2](#)).

Over a three-year period, the company researchers, whose headquarters are based in Linz, managed to identify a series of microorganisms able to turn CO₂ and H₂ or synthesis gases into methane with high productivity, operation flexibility and robustness and established a starting point to devise a scalable methanation process, with easy manoeuvrability and ideal for solutions nationwide, for instance the upgrade of raw biogas into biomethane or the reutilization of CO₂ produced during fermentation for bioethanol and its conversion into biomethane. As a result, the yield per hectare of biofuels is considerably higher, with improved environmental sustainability.

Methanation, a process developed by Linz and Vienna universities within a doctoral theses sponsored by Krajete itself, has been producing methane on a 10-litre scale for over two years, with samples of real gas provided by customers and synthesis gas produced with the most varied purity and contaminants specifications. The bulk of data collected since the first experiments to date has been the base of a simulation process that has provided further in-depth knowledge of methanation and a good

Between 2012-2014 **Fabrizio Sibilla** has worked at the nova-Institut GmbH as a consultant in the bioeconomy. He currently works as a Business Development Manager to Krajete GmbH.

Power to Gas

Power to Gas (PtG or P2G) is a recent concept introduced to the general public by Audi. Renewable energy peaks surplus in the electric grid is used to split water into hydrogen and oxygen through electrolysis. Then, in a reaction between hydrogen and CO₂, methane is obtained in a chemical or biotechnological catalyst. Methane produced through PtG is also known as e-gas because it is derived from electricity.

Figure 2 | LCA of the Audi A3 TCNG

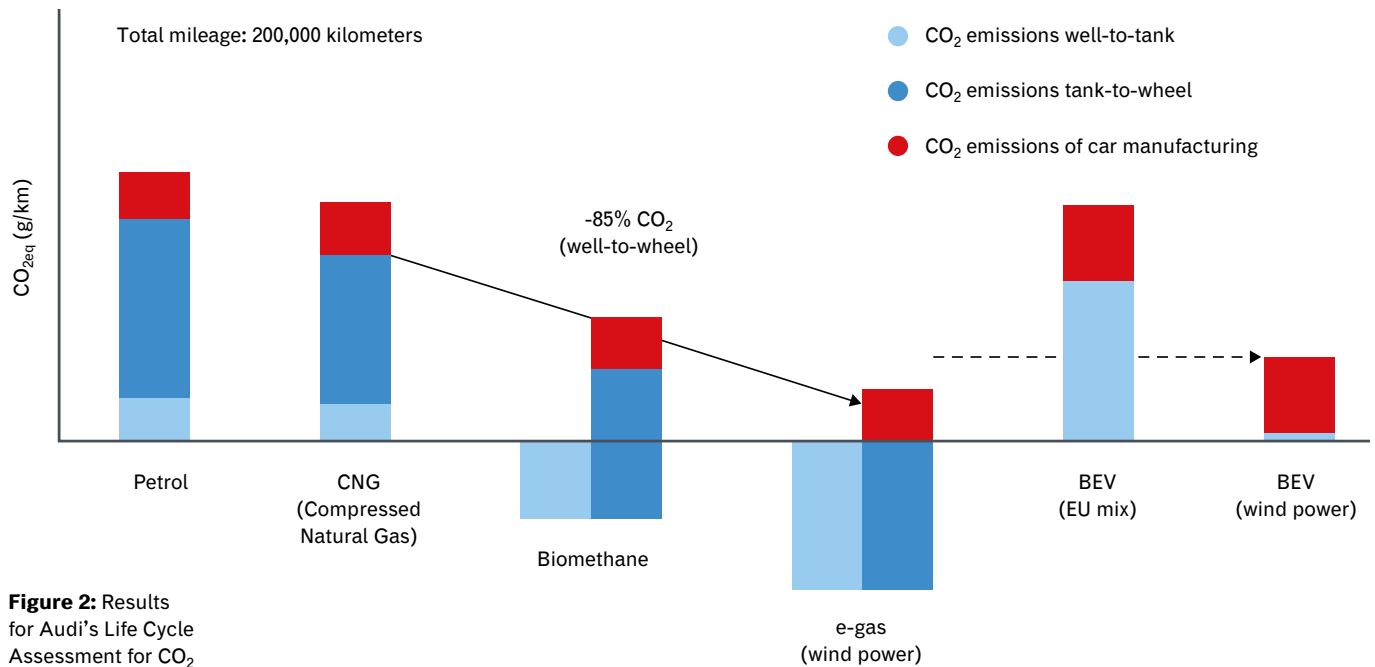


Figure 2: Results for Audi's Life Cycle Assessment for CO₂ emissions of a synthesis methane-powered car and an electric one powered with renewable energy (copyright Audi 2012).

understanding of its performance first as a pilot plant and then as a production one. "All this – as they like to point out at Krajete – has been standing on its own two feet, that is, without the input of public or private investors, just thanks to the cash flow generated through bilateral contracts with companies interested in this process (mostly car and cement factories and steel plants)."

The Linz-based company targets the motor transport zero-emission methane market. This is why Krajete is focusing mainly on Italy, traditionally one of Europe's major transport methane markets with over 800 million kilograms of motor transport methane sold in its one thousand refuelling stations and with nearly one million vehicles on the road.

and the "recharging time" is considerably shorter (2-3 minutes for a methane-powered car compared to 30 minutes to half recharge a battery in a Tesla Motors supercharger at best, or over 8 hours for a "homemade recharge").

Krajete GmbH aims at offering an alternative for zero-emission transport thanks to its renewable methane intending to provide users with a solution compatible both with present infrastructure and cars and able to improve air quality in urban areas. ●

Info

<http://www.krajete.com>

Italy – Krajete assures – is the European leader in the production of methane-powered standard cars (Fiat Group), in the development of methane-adaptation technology (Landi Renzo and Tartarini Auto produce the world's most advanced adaption kits) and in the aftermarket fitting.

"Zero emission" methane, when used in a methane-powered car, allows to zero CO₂ emission in vehicles. A methane-powered car refuelled with renewable methane (biomethane from biogas or PtG methane) has the same CO₂ emissions of an electric car powered only with renewable energy (see figure 2) but with the following advantages: costs are significantly lower compared to an electric car (in Europe, the average price of a methane-powered Volkswagen Golf is about € 22,000 while that of an electric Volkswagen Golf is around € 37,000); there are many more methane refuelling stations compared to electric ones for motor transport,

Motor transport methane

Methane is one of the best fuels available on the market, offering numerous advantages compared to traditional fuels. A petrol litre equivalent of methane costs less than half; its octane performance is higher than petrol (120 octanes for methane, 98 for conventional petrol). Moreover, methane enables a 10% CO₂ reduction compared to an equal petrol engine, it reduces noise and, more importantly, it does not emit unburnt material or particulate, thus improving the air quality in urban areas. For further information on motor transport methane, please consult the Natural & bio Gas Vehicle Association website (<http://www.ngvaeurope.eu>).



Used Oil: 30 Years of Green Economy

by **Roberto Coizet**

It generated an economic value of about 3 billion euros. It prevented the emission of 1.1 million tons of greenhouse gases. It created thousands of jobs. It managed to reuse half of what can be collected. It contributed to the fact that 5 million tons of potentially highly polluting waste were not dispersed in the environment with a devastating impact.

Roberto Coizet is the President of Edizioni Ambiente and Coordinator of the “Development of Ecosystem Services” team of States General of the Green Economy.

According to COOU (the Italian Compulsory Consortium of Used Oils), the evaluation of its 30 years of activity is a chance to think over the potential offered by a recycling model of a substance which is fundamental to the industrial system. This model could be replicated in other sectors with a very positive impact both at economic and environmental level.

The data are all collected in the “Green Economy Report”, edited by the Italy’s Foundation for Sustainable Development. Its aim was to highlight not only the environmental performances of the Consortium, but also the wider impact of its 30-years activity on the environment, the economy

and the social structure of Italy. The following shows the importance of its commitment to innovation in the entire productive cycle: “Looking at the historical series of Lubricating oil sales (decreasing) in relation to GDP (increasing), it is evident that there exists an inverse relationship between lubricating oil and wealth produced: it is a case history that shows how innovative processes can reduce the use of consumers goods by maintaining (or even improving) the quality of service”.

The history of COOU is particularly significant as it shows that it is possible to redress a very critical situation thanks to a strategic choice that managed to combine environmental protection and economic value.

The collection and regeneration of used oil started in a difficult and remote period: both initiated within a “Far-West scenario”. It takes place during the 30’s “autarchy”, when the regeneration of used oil still was at a very rudimentary stage; impurities were removed through a rough filtration process: **buckets**



and women's stockings were often the only available instruments that could be used as a filter. Obviously, during the Second World War the main concern was survival, while environment was a very minor issue.

In the aftermath of the war the situation in this sector improved only at a quantitative level: environmental regulations and fiscal probity remained a mirage.

The discovery of illegal trade in the oil sector, the "scandalo petroli" of the 70's, seems to close the time of tolerated abuses. However, in the lubricants field, fiscal exemption for regenerated oil is very generous and many people turn a blind eye on controls. Illegal use of lubricants in the market is quite common: with important amounts of new lubricating oil sold as recycled oil in order to pay lower taxes.

The economic advantages are relevant, but very little of the profits are invested in the improvement of the plants and in safety measures.

From an industrial and environmental point of view in the following decade things really start to change: increasing pressure from the EU forces the adoption of new regulations. It is in this framework that COOU was created in 1984.

Its birth was dictated more by environmental concerns, rather than an advanced industrial vision.

At that time the collection cycle in Italy was in a phase of evolution: six regeneration refineries were active, as well as a fair amount of used oil collectors, often equipped with inadequate working gear.

Under pressure from COOU, things started to change, also thanks to public opinion which was getting increasingly alarmed by the consequences of environmental pollution. The Consortium implemented a strong media communication campaign directed primarily at the actors in the automotive sector (garages, mechanical workshops, corporate fleets) as well as those in the industrial sector. The campaign, however, was also directed at the general public, in order to involve millions of people in prevention, by explaining that four kilos of used oils, a standard car motor oil change, can pollute a surface as big as a football field, if improperly discharged into the sea. This message was sustained by a growing operational campaign. The age **of tolerated dumping and risky discharge is over**; today Storage tanks are built in a rigorous manner,

Four kilos of used oils, a standard car motor oil change, can pollute a surface as big as a football field, if improperly discharged into the sea.



it is mandatory to use pumps and filters; the collected used oil is fully analyzed and safety is a primary concern.

In 2003 we saw a new change in quality: the new Consortium Management propose a new approach to evaluate used oil production: the targets of collection seemed achieved but the newly improved methods of calculations of the amount of oil which is lost during the usage (evaporation, absorption) also considering the technology evolution (modern cars consume far less oil), show that in reality the oil left in circulation is much more than originally thought. There is a need for further efforts in the collection process.

This widespread effort in the collection process tends to promote, more and more, regeneration which now intercepts over 90% of recuperated oil; used oil combustion on the other hand starts to decrease, while particular attention is directed towards used oil polluted by dangerous substances which needs to be thermo-destroyed.

This represents an example of compliance with European regulations on waste destination, which in the sector put Italy at the top of good practices

(the average percentage of regenerated oil in the EU is around 50%).

Info

<http://www.coou.it>

The impact of these policies has left a mark not only in terms of environmental protection, but also in the economic sector (a quarter of lubricant base oil comes from regeneration, with a significant impact on crude oil imports), as well as in the labour market.

The evolution of the Consortium chain, oil production, collection and regeneration, has been truly impressive: instead of the old and precarious structures, we have now 72 modern and highly structured Companies; **over 90% of collectors is certified** according to **ISO 14001** and the main regeneration plants have an Emas registration.

Now, with a market that tends to go global and with competition for waste recycling becoming harder and harder, Italy finds itself facing yet another challenge. The excellent performance in used oil collection and regeneration systems represent an important starting point in this challenge for efficiency, safety and productivity. ●

Made and ReMade in Italy

by **Roberto Rizzo**

Suppose we wanted to buy a kitchen utensil, like a saucepan. At first glance, they all look the same: after all, for the purpose of cooking pasta or frittata, they all serve the same function. Actually, the saucepans we see on the shelves in shops have different characteristics because the manufacturing processes and the raw materials used for their production differ.

Roberto Rizzo

is a science journalist. He is specialized in energy and environmental issues and since 2010 teaches at Master of Scientific Journalism at Sissa of Trieste.

If “made in Italy” production represents an added value linked to mainly local manufacturing (and often to prestigious design), the fact that a saucepan is made from recycled materials is a unique further added value – environmental in this specific instance.

ReMade in Italy – the first Italian association to have developed a technical procedure to certify traceability and content of recycled materials – revealed the “behind the manufacturing scene” of “made in Italy” products, obtained with recycled materials.

When we think of “made in Italy” products, fashion, cuisine and interior design immediately spring to mind. Nevertheless, there is a whole new sector – production from recycled

materials – where Italy has a lot to say and suggest.

ReMade in Italy’s objective is raising awareness about “made in Italy”’s recycling and culture. Such no profit association was created in 2009 by Regione Lombardia, Milan Chamber of Commerce, Conai (Nation Packaging Consortium) and AMSA. To this end, ReMade aims at creating a viable framework in order to develop real tools to rate recycled products on the market.

Today, a number of consortia, associations and other actors in the recycling sector (Pannello ecologico, Ecodom and Ecopneus, to name but a few) support ReMade, and many companies manufacturing recycled products are already ordinary members. All of their products are strictly made in Italy.

The idea of creating an association for the promotion of recycled “made in Italy” started with exhibition-conferences organized by Regione Lombardia several years ago on recycling and separate collection. The presence of recycled products, often combined with very appealing design, proved very successful with the public. The activity between 2009 and 2011 attracted more and more innovation-oriented

Figure 1 | **Label issued by ReMade in Italy**



businesses, signing important agreements with other associations in this sector and several stakeholders. Recently, ReMade in Italy has also worked with the Ministry for the Environment on the analysis of the ecological footprint of some products obtained through recycling in specific production chains.

From Eco-Labeling to Accredited Certification for Recycling

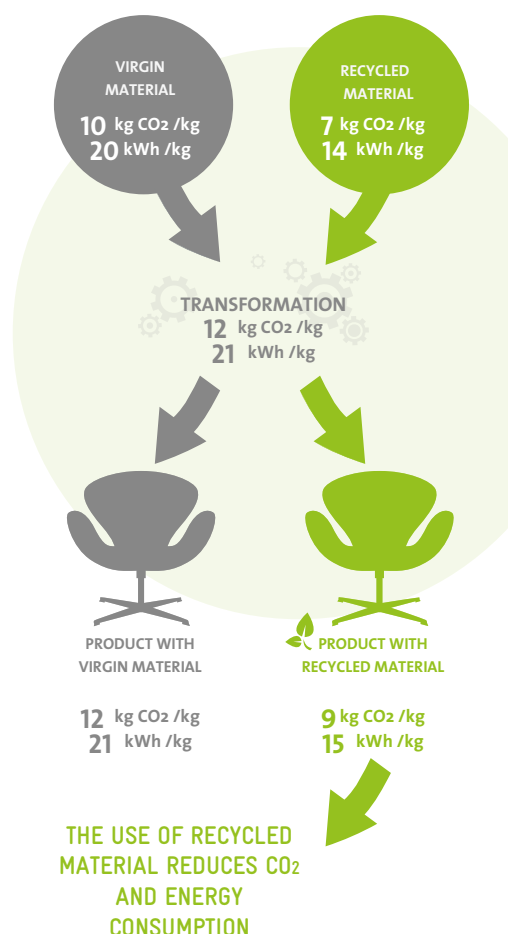
To help companies communicate their commitment in recycling, ReMade in Italy uses a label (**figure 1**) on products and materials. The information shown is corroborated by the association's Scientific Committee according to scientific procedure to the highest standards. The label not only highlights the quantity of recycled material within the end product, but the climate-changing emission savings (expressed in CO_{2eq}) and energy use savings, linked to recycling. This information alone shows how the recycled products are eco-friendly, quite apart from the savings of virgin raw and regenerated materials inherent in the concept of recycling (**figure 2**).

Somewhere along the line, within the association, members asked themselves a question: within the complex and varied panorama of voluntary eco-labelling in Italy and Europe, what are the criteria to recognize the degree of reliability of the information that eco-labelling intend to communicate? In practice, when we read "100% recycled" on any product, where does 100% come from?

This question triggered a debate within the association that led from voluntary eco-labelling to an accredited certification scheme. This seems the best way to guarantee the highest degree of reliability of information about recycling of a product, thus meeting the needs of conscious buyers – both private and public – to be informed with transparency and objectivity about what they purchase, mistrusting self-declarations that oftentimes, although not always, are on the verge of greenwashing.

"After the first stage of activities, the association made sure that a third party oversaw the information on the label. There is a need for a qualified and objective institution that comments on the environmental information of products, other than the party issuing the label, so that information can be as reliable and

Figure 2 | Environmental benefits of recycling



Producing a ton of paper with recycled materials saves 178 kg of CO₂, about 84% of emissions compared to its production with virgin material.

accurate as possible." This is how Simona Faccioli – ReMade's General Manager – explains the reason behind the accredited certification scheme, on the basis of the association's technical specifications estimated by Accredia beforehand. Accredia's assessment was carried out in order to ascertain whether the certifications issued according to the scheme, on the basis of technical specifications, meet all the requirements for accreditation.

It thus guarantees the certification system's impartiality with no risk of a conflict of interest. The production process and supply chain audit is based on the technical regulations developed by ReMade in Italy inspecting the traceability of raw materials, the substance of recycling, the absence of potentially-toxic substances and optimal conservation of products. Only highly-trained inspectors can conduct audits in the production facilities. If the product does get certified, we can be sure that the producer pays particular attention to the raw materials employed, the inspection during the production stages, compliance

When we read "100% recycled" on any product, where does 100% come from?

Figure 3 | Some certified products

with regulations and extreme care right up to the final output.

So, in Italy as well as Europe, Remade in Italy is the first accredited certification scheme entirely devoted to recycling for inspecting the traceability of materials during the production process and for checking, in percentage terms, the recycled content of a certain product.

How the “ReMade in Italy” Scheme Works

Certifying bodies, willing to become qualified product inspectors able to deliver certification, first must contact and communicate their interest to ReMade in Italy that will then grant them a temporary approval based on the satisfaction of certain technical and training requirements. From that moment, bodies have a year to carry out experimental inspections and to obtain Accredia’s final accreditation (or from a “similar” accreditation institution in another European country) to deliver certification according to the ReMade in Italy Scheme. Bodies authorized to deliver ReMade in Italy Certification can be found in the association’s website (www.remadeinitaly.it).

ReMade in Italy Certification can be granted to recycled materials and semi-finished products containing recycled materials and end products with recycled materials. ReMade in Italy catalogue already boasts over one hundred products (some examples can be found in **figure 3**) ranging from building materials to information technology products, such as regenerated cartridges for printers, to eco-design products and street furniture, such as benches and play areas, to fashion, apparel and stationery items. Certification is granted to those producing “made in Italy” items. To establish this, the association abides by the following regulations: the product must already have the “made in Italy” label, alternatively, its main production cycle or final manufacturing that transform its physical, dimensional, and performance characteristics or its contents must be carried out in Italy.

As far as recycling is concerned, the product must contain at least 10% of recycled material in weight. 10% in weight of each material used must come from recycling. In case of composite products, every single component must be analysed. Let us take into consideration a wooden table with metal legs. The percentage of recycled wood and metal must be checked

and then the whole product is certified. This seems to be appreciated by manufacturers. Other certifications, similar from a formal point of view, analyse and certify only one component of the product. On average recycling figures exceed 50%. The low 10% entry level is justified by the fact that recycling technologies performances vary according to the type of material processed.

Certification Advantages

ReMade in Italy Certification helps businesses intending to submit a tender for green procurement, also known as Green Public Procurement (GPP). Current regulations on tenders rule that eco-labels, if conceived respecting the publicity and impartiality requirements, can demonstrate a product's compliance with the procurement's environmental standards. ReMade in Italy Certification is recognised by GPP; this means that if a product is certified, its compliance with environmental standards is already recognised. ReMade in Italy Certification is explicitly stated as a probative requirement in ministerial orders regulating, for each sector, the process public administrations must follow (by law) for their green procurement. As everybody knows, this market is strategically important to stimulate the use of recycled materials, thus putting into practice one of the green economy's main guidelines.

Clear, transparent and simple eco-labels are beneficial both for businesses that have to be inspected only once, then they can use them every time they intend to submit a tender, and for public administrations because they allow them to save money and resources when checking participants' credentials.

Seeing is Believing: ReMade in Italy's Sustainable Product Catalogue for Expo 2015

In 2013, ReMade's commitment focused on an important project: drawing up a catalogue of sustainable and innovative Italian products (SiExpo 2015) available to Expo Milano 2015 planners and organizers as recognition of good practices to implement sustainable policies amongst participating countries preparing their pavilions. The catalogue was approved and subsidized by Expo Spa and Camera di Commercio di Milano (Milan Chamber of Commerce). It is an important tool made available to participating countries for free, as an incentive to use eco-friendly and innovative products and it represents somehow the coronation of the important work carried out by Expo following

the "Guidelines for sustainable solutions" and "Guidelines for Green Procurement" through which the Organizing Committee of this world event has promoted the application of environmentally-sustainable practices by participating countries.

Listed products (currently more than 300 available on www.sioxpo2015.it) include construction and fitting-out materials, furnishings, street furniture, packaging and fair equipment and are included because they meet ecological sustainability (content of recycled materials, absence of noxious substances, energy efficiency, etc.) and innovation requirements. ReMade in Italy and Material Connexion Italia (the biggest international research and consultancy centre specialised in sustainable and innovative materials) has collaborated to this project. A real opportunity for change. ●

Info

www.remadeinitaly.it
www.sioxpo2015.it

Scientific & Technical Partner:

Ministero dell'Ambiente
 e della Tutela
 del Territorio e del Mare

ReMade in Italy is a project by:



Figure 4 | SiExpo2015 Catalogue Advert

SIEXPO2015
 SUSTAINABILITY AND INNOVATION FOR EXPO 2015

VUOI RENDERE VISIBILI I TUOI PRODOTTI GREEN PRESSO EXPO 2015?

SIEXPO È IL CATALOGO DEI PRODOTTI ECOSOSTENIBILI E INNOVATIVI A DISPOSIZIONE DI ALLESTITORI DI EXPO 2015

ARREDO PER INTERNI
 COSTRUZIONI E ALLESTIMENTI
 ARREDO URBANO
 PACKAGING
 COMPLEMENTI FIERISTICI

ADDERISCI SUBITO
 WWW.SIEXPO2015.IT

È UN PROGETTO DI:
 REMADE IN ITALY
 MCX Material Connexion Italia

CON IL CONTRIBUTO DI:
 EXPO MILANO 2015
 CAMERA DI COMMERCIO MILANO

MAIN SPONSOR:
 CONAI

PARTNER:
 E.A.

ALTRA PARTNER:
 GREPPINORE

SiExpo 2015 is a catalogue of ecosustainable and innovative products available to Expo2015 planners and organizers.

The Virtuous Circle of Regeneration

by Roberto Rizzo



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Regenerating used oils may sound simple, almost artisan business, but in order to achieve this target with a high quality product and significant figures, three requirements – anything but simple and banal – are necessary.

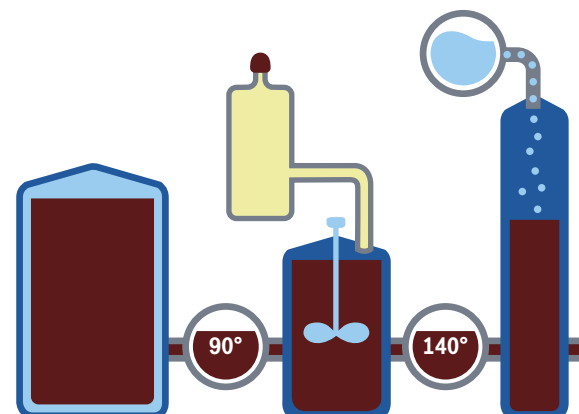
The first is a company with structured and complex know-how, of the same technological level needed to turn crude oil into petrol or into a widely-used product. The second is a widespread and efficient technical facility for collection. The third is informed and aware public opinion, namely an advanced society, able to conduct effective communication campaigns to protect the environment.

An overview of Viscolube will enable to grasp the full complexity of such raw material recovery technology applied to used oils.

The company produces re-refined base oils that make 25% of Italy's lubricating oil sales and has two facilities, one in Pieve Fissiraga (Lodi) and one in Ceccano (Frosinone), with a treatment capacity higher than that of the totality of used oil collected in Italy each year. Such numbers as well as a series of patents regulating one of the most internationally widespread re-refining processes make Viscolube Europe's leading company in the regeneration of automotive and industrial waste oils.



© Claudio Gianetto



Thanks to its technological leadership, Viscolube is able to produce lubricating base oils with characteristics and properties that equal – and occasionally exceed – those of new oils as shown by the recent testing carried out by several local governments in Savona, Genoa and Perugia. And it also helps the environment in that every regenerated ton of base oil enables average CO₂ savings of 40% compared to the production from crude, thus avoiding combustion or thermodestruction. At a later stage, some additives are supplemented to Viscolube's regenerated base oils – containing very low levels of sulphur and aromatic compounds – in order to produce the finished lubricating oil used for industrial purposes (hydraulic oils, compressors, bearings, industrial gears etc.) or for the automotive sector.

The Revivoil Process

The company, founded in 1963, produces not only lubricating base oils but also diesel and bitumen. It re-refines used oils through the so-called **Revivoil** process, developed and patented by

Viscolube in collaboration with **Axens**, a French company which is one of the world's leading businesses in the development of refining processes. The collaboration with Axens enables Viscolube to exploit the familiar hydrofinishing technologies used in crude oil refineries while adapting them to smaller-scale applications. The Revivoil process consists of three stages (see Box). The first two (preflash and thermal deasphalting processes) have been developed and designed by Viscolube, with a limited contribution by Axens. In the third stage (hydrofinishing) the opposite was the case. Viscolube's base oils are separated in three grades according to their viscosity (very light, light and heavy base oils), with various applications for automotive or industrial uses. On average, from 100 kg of anhydrous waste oil, about 60 kg of regenerated base oil and 25-30 kg of diesel and bitumen are obtained. With the Revivoil process, the regeneration efficiency is 10% higher. The bitumen produced by Viscolube has characteristics suitable for the bituminous coating market, especially in the building industry.

Every regenerated ton of base oil enables average CO₂ savings of 40% compared to the production from crude.

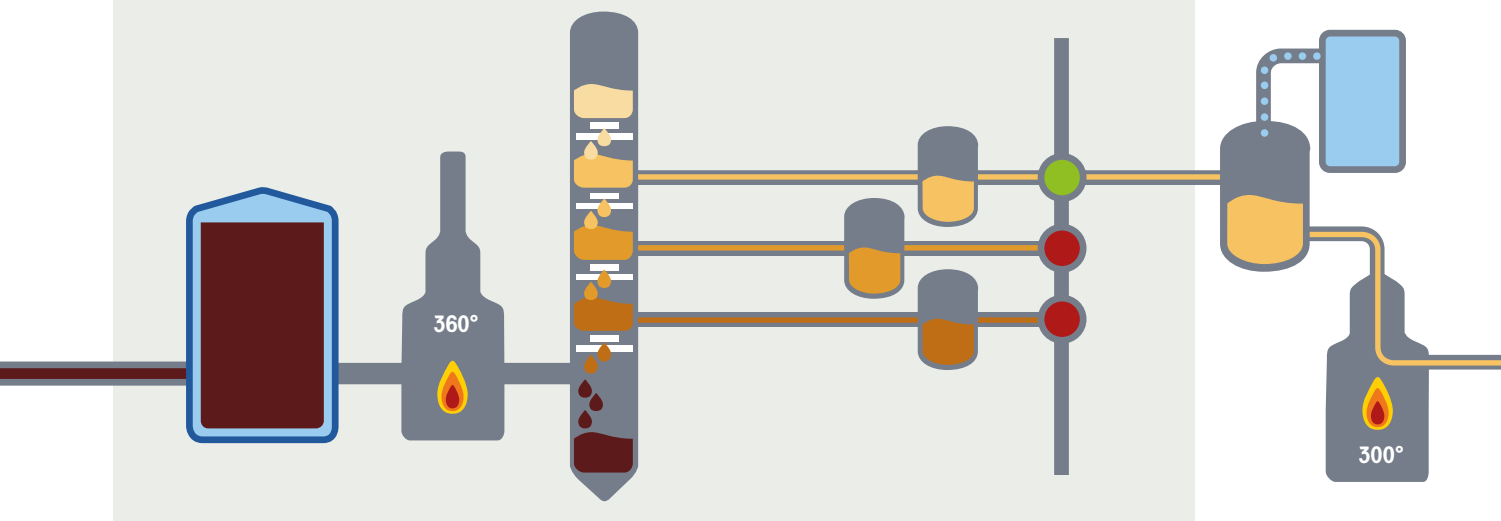
The Revivoil process

Revivoil involves high-pressure hydrogen treatment to produce oils low in sulphur and saturated elements and with a reduced content of aromatic compounds. The process consists of three stages.

- **Preflash.** The used oil is heated at 140 °C then it goes through a distillation column with a certain degree of vacuum, in order to separate water from light hydrocarbons.
- **Thermal deasphalting.** The dehydrated product is distilled at about 360 °C in a vacuum deasphalting column (Tda); at the bottom, asphalt product and bitumen are produced which are simultaneously

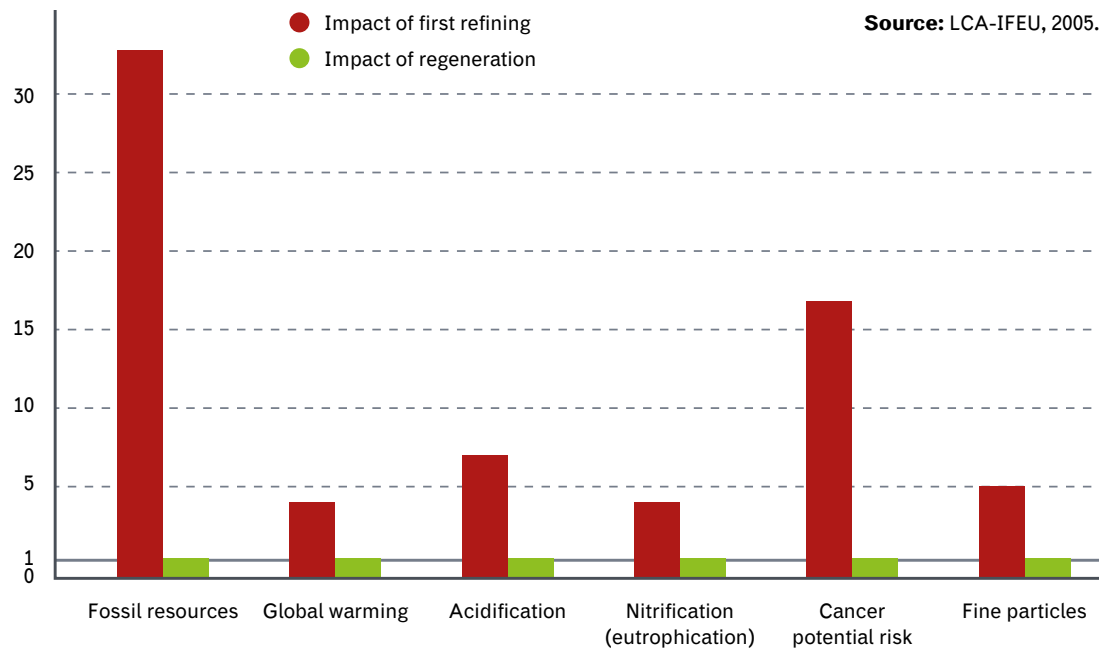
distilled into three lateral oils graded according to their viscosity. At the top, a semi-finished diesel is obtained.

- **Hydrofinishing.** It is the adjustment and stabilization stage. Oil and hydrogen are heated at 300 °C in an oven. They then go through a reactor with a catalyst facilitating the reaction of hydrogen with the unsaturated compounds, sulphur and nitrogen. On their way out of the reactor, the liquid and gas phases are separated and the polluting compounds are extracted. The end result is a transparent oil with very low content of sulphur and polynuclear aromatic (Pna).



The re-refining of used oils respects the environments, enabling to upgrade waste, to contain the dependence on non-renewable source producing countries, and to reduce significantly the environmental impact of lubricants.

The environmental benefits of regeneration



“The implementation of the green economy’s policies – as Viscolube’s CEO Antonio Lazzarinetti puts it – involves regenerating. It enables, through a technologically-advanced process such as Revivoil, an efficient use of resources while improving the management of natural capital and the environmental quality of life.”

Confirming this environmental commitment, Viscolube decided to register its products with **REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)**,

the European regulation that came into force in June 2007 aiming at rationalizing and improving the legislative framework concerning chemicals within the European Union.

“It is about – as Marco Codognola, Viscolube’s Sales, Procurement Purchase and Business Development Manager says – a non-mandatory registration for those businesses dealing with regeneration, with a significant added value in the chemical industry in general and in the lubricants sector in particular. We decided to register to highlight the fact that our products have the same characteristics as new oils and our clients can rely on the high and certified quality of our products and production process.”

Info

www.viscolube.it



The importance of technology

“The development of cutting-edge technologies is the supporting element underpinning various waste reutilization processes, but in the treatment sector this is not always the case”, claims Antonio Lazzarinetti. “Regenerating waste oil means it has to undergo complex chemical-physical processes to eliminate its dangerousness while restoring the properties of the original raw material. Our excellence stems from the know-how we have built up over decades of dedicated work, combining operating and plant-engineering experience with the results of a highly-intensive activity of our R&D centre. It is only by constantly improving our plants and processes that we can offer the domestic as well as the international markets a competitive product.”

Over the years, the business has invested heavily in the modernization of its facilities: in 1991, millions of euros were spent for the first thermal desasphalting plant; in 2002, 25 million euros for the hydrofinishing technology; in 2011, 6 million euros for the treatment of lower-quality oils, despite the absence of any legal requirements.

Most of Viscolube's improvements of the production cycle, though, come from the engineers' invention as well, since they are constantly faced with the problems of a complex production cycle. Indeed, in the last few years this has led to plant-engineering innovations such as centrifuges and dewaxing systems, already present in the industrial world but engineered so that they could be adapted to the oil regeneration cycle.

Future Projects

Over the coming months, the company intends to further the expansion of the production of the regenerated base oils, from the current 100,000 tons per year, setting up an industrial plan for the plant upgrading. Also, a new initiative will be launched shortly, aimed at raising awareness on the use of regenerated oils in about 150 Italian municipalities, in order to promote green public procurement.

"We hope", says Marco Codognola, "that the growth in our production will be able to find new opportunities on the Italian market: today, 30% of our sales reach the international market and 70% the domestic one. In Italy, due to the economic crisis, the availability of used oil has declined. It peaked in 2008, with a collection of about 220,000 tons, while we currently collect 175,000 tons. Overall, in 2007, in Italy the total sales of lubricant oils totalled 540,000 tons, while they currently amount to 390,000 tons per year. Given the high appreciation of our technologies and thanks to our success on the foreign markets, we trust that the increase in our production will be able to succeed on foreign markets, in case the Italian one remains stable."

In addition, Viscolube turns to the foreign markets with the sales of facilities and technologies: there are about ten facilities around the world that are licenced to use Viscolube technology.

"Right now – concludes Marco Codognola – we are looking at the Chinese market very closely, where the sales potential for lubricant oils is twenty times higher than that of the Italian market and China's domestic production deficit is 50%: of the 8 million tons of annual demand – with an exponential growth – 4 million tons are imported. As a result, it would be important to develop a local supply chain for the production of regenerated base oils. In the



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regenerating sector, China's technological level is lagging behind Italy by 10-15 years, so our technology could both offer a real solution to the pressing environmental issues besetting China and an opportunity to produce a fundamental component for the industrial as well as the automotive sector at home." ●

PLASTiCE Project: Promoting Sustainable Plastics in Central Europe

by Andrej Kržan

Andrej Kržan

is the coordinator of National Institute of Chemistry, Laboratory for Polymer Chemistry and Technology, Ljubljana, Slovenia, and project coordinator.

Polymer research has a long and rich tradition in Central Europe, where it has contributed to the development of polymer science and technology and has been a powerful supporting factor behind economic growth.

Development in the region, comprising eastern parts of Western Europe (Austria, Germany and Italy) and ex-socialist countries in the strip from Poland in the north to Croatia in the south, followed different patterns. One resulted

in a University dominated system and the other included a strong position of academy institutes. More recently, these differences have decreased through the common emergence of an applied orientation involving SMEs, technology incubators, knowledge transfer centres etc. designed to foster greater cooperation between science and industry.

Although sustainable polymers, including biopolymers and bioplastics, have emerged during the last decade or so as one of the fastest



Young and plastics: to reach out to the next generation, a debate competition on the topics of sustainable plastics and bioplastics was organized with four high schools in Slovenia.



growing segments of the plastics industry, the same trend did not apply to Central Europe, particularly in its eastern part that has been lagging behind significantly. Today there are no important bioplastic producers in this area. The reasons behind this state of affairs are linked, in a “chicken and egg” way, to the low consumption of these materials both in the plastics converter industry and among end-users, be it commercial or individual. The situation indicates a marked disconnect with the otherwise strong polymer research sector that received significant investment over the recent period.

In accordance with its full title (that is “Innovative Value Chain Development for Sustainable Plastics in Central Europe”), the PLASTICE project was designed to bridge the existing disconnect. It was setup to include the entire plastics value chain, spanning from producer, through to converter, retailer, up to waste management, connected to a strong group of knowledge institutions (institutes, universities and a regional consortium for innovation and technology transfer). To underline the regional approach, partners came from four EC countries (Italy, Slovenia, Slovakia and Poland). The project was implemented through the Central Europe Programme (<http://www.central2013.eu/>) co-funded by the European Regional Development Fund.

Despite the crucial involvement of research institutions the project was not an R&D project but was rather focused on establishing the framework conditions for a wider acceptance of new sustainable plastics throughout the value chain. During the initial phase of the project, we carried out a situation analysis mapping both needs and existing capacities. Very quickly it became apparent that in virtually all segments of the value chain, with perhaps the exception of the polymer production segment, the lack of available information and knowledge about the nature and opportunities offered by bioplastics was the key

obstacle to wider uptake. To address this issue, the dissemination of unbiased, scientifically supported information directed to a wide group of targets comprising SMEs, industry, policymakers, educators, end-users, consumers, the general public and, finally, waste management was of the utmost importance for the entire duration of the project, to the point of constituting one of its key actions.

To feed the dissemination goal, the project team established channels for information distribution involving the pooling of contacts with external partners while also relying heavily on electronic routes: web sites, social media and online video channels. A number of materials for distribution were also prepared. Among these, numerous publications of varied complexity, offering all from basic concepts to an analysis of R&D availability in the area, from technology reviews to standardization and certification information.

The principal publications are: “A Roadmap for Action – From Science to Innovation in the Value Chain” and the Transnational Advisory Scheme entitled “Bioplastics – Opportunity for the Future” that offers comprehensive information about the field. A descriptive brochure on bioplastics for use in High schools was also very well received.

In order to provide practical information, a series of case studies were carried out in collaboration with industrial partners. Case studies focused on application developments in different segments (food contact products, hygiene/sanitary products, agricultural products, packaging) to examine specific products with widely differing material requirements. These case studies were all described in detail and resulted in 4 prototypes. Two technology showcase case studies were carried out, concerning an integrated retail distribution/waste collection/composting system and a full-scale composting test involving compostable plastics. Another set of

All publications are available for download.



Launch conference: four international conferences and many national events were organized during the duration of the project aimed at academics and practitioners.

Info

www.plastice.org

Facebook:

www.facebook.com/PlasticeSlovenia

YouTube: www.youtube.com/user/plasticeproject

National Information points: www.sustainableplastics.eu

Issuu: <http://issuu.com/plasticeproject>

plastice





PLASTiCE Project in summary

Full title

Innovative Value Chain Development for Sustainable Plastics in Central Europe

Budget

5,353,764.70 € (85% ERDF funds)

Duration

36 months (extended to 42 months, April 2011 – September 2014)

Partners

13 from 4 EC countries:

- Slovenia (National Institute of Chemistry, Slopak, Mercator, Plasta and Centre of Excellence PoliMaT)
- Slovakia (Polymer Institute of Slovak Academy of Sciences, Slovak University of Technology in Bratislava and HrKo)
- Italy (University of Bologna, Aster and Novamont)
- Poland (Polish Academy of Sciences – Centre of Polymer and Carbon Materials and Cobro – Packaging Research Institute)

The lack of information and knowledge on the characteristics and the opportunities offered by the bioplastics is the main obstacle to their diffusion.

studies looked at testing markers for bioplastics identification based on UV master batches, UV print and IR print. Furthermore, an LCA case study on shopping bag options, involving a comparison of compostable bags to alternatives, stands as a methodological showcase. All case studies were described in detail and were made available. The project also established certification portals to enable bioplastic based products made in Slovenia and Slovakia to be certified (according to a Polish model). Hence, companies can carry out the certification process in their own language and receive internationally recognized certificates.

The strong promotional activity, powered by PLASTiCE as part of its dissemination effort, involved numerous presentations at various national and international events, the organization of seminars and workshops and 4 international conferences. This work was linked to online video content production. More than 100 videos have been produced which have attracted considerable attention through the project's YouTube channel. The wide-ranging action included sponsoring of a film premiere that attracted approximately 1,000 visitors and the distribution of a movie on plastic waste management that involved many showings.

Finally, the project program called for the establishment, in all partner countries, of national

information points (NIPS) on bioplastics so that they may act as central information sources. Judging by the interest for NIPS coming from third countries, it is apparent that the online section may easily be replicated elsewhere. By engaging partners from other EU member states, within and outside Central Europe, and from neighbouring countries (Balkans, Turkey and Egypt) and several more distant countries (China, Brazil, Indonesia and USA) an interesting network has been established. We believe that the network represents a great potential platform on which to build new initiatives in the field of bioplastics.

The PLASTiCE project shows that active promotion produces significant results that translate into raised awareness and practical actions. Key components of success are: the regional dimension of the project team, the involvement of stakeholders representing the entire value chain, and the mission to promote general concepts that benefit the entire sector. ●



A New Frontier for Start-Ups

by Carlo Pesso

Carlo Pesso, Study
Center Edizioni Ambiente.

As the business of renewable matter expands across material streams, Giaura – an European Space Agency (ESA) spin-off based in Amsterdam – offers a highly innovative approach to CO₂ capture.

“Giaura stems from the ancient Greek words for earth and air” says Max Beaumont, the 30-year-old founder of the company, “because it turns the Earth’s biggest waste stream, namely CO₂, to a resource. And by doing so it may generate a profitable and sustainable business.”

The origin of Giaura is breathtaking: recycling of exhaled, CO₂ rich air back to initial conditions... for astronauts in spacecrafts.

Maintaining an appropriate gas mixture is key to the survival of astronauts as they spend long periods on international space missions. Furthermore, CO₂ extractors must both be compact and highly efficient in order to save energy. Accordingly, over a period of 15 years

and with a budget of 70 million euros, ESA, in partnership with other space agencies including NASA, developed many of the initial groundbreaking solutions. One of the most successful ones involves the use of tiny porous beads about 3 mm in diameter. The beads offer a contact surface area of 250/350 square meters per cubic centimeter covered with a special substance that “captures” CO₂ as the air flows through the beads. As soon as the beads are saturated, they can be “cleaned” and the CO₂ harvested. In space, the cleaning process or “regeneration” of the beads takes just over 11 minutes and uses the solar energy produced by solar panels on the spacecraft.

Former ESA staff members Max Beaumont, master degree in physics, Alexander Gunkel, master degree in business and mechanical engineering and Bardia Alaei, sustainability marketing expert, decided to bring this concept down to Earth.



Fonte: nasa.gov

***Giaura transforms
the largest flow of waste
on the planet, CO₂,
in a resource.***

Supported by ESA's incubator program (www.esa.int), the European Institute of Innovation and Technology's Climate-KIC program (eit.europa.eu/eit-community/climate-kic), YES!Delft (an initiative by Delft University of Technology, The City of Delft and TNO Companies) and award winning start-up accelerator Startupbootcamp (startupbootcamp.org), they adapted the technology to terrestrial conditions, developed a prototype and found their entry market. As a result, today, Giaura is the first company to have a commercially viable product capable of capturing CO₂ directly from the ambient air. Furthermore, its four direct competitors in Direct Air Capture (DAC) – including Bill Gates' Carbon Engineering – are still a few months away, if not more, from working out a definitive commercial product.

Giaura has managed to turn spacetechnology into cleantech, both in practical and, most importantly, in economic terms. The regeneration of the CO₂ filtering beads operates at temperatures between 60 °C and 100 °C while capturing between 0.5 and 8% CO₂ (per weight) depending on the carbon dioxide concentration in the surrounding air. Hence, the cost of adopting and running the new technology has become reasonable.

The next step consisted in developing a similarly innovative business concept to ensure the diffusion of the technology. However, it appears that, here on Earth, the best way forward is to pick among the most successful existing business models. The best candidate is the Intel model:

it provides chips for computers just as Giaura intends providing its CO₂ capture technology for everyday products. Hence, licensing and partnership agreements are at the heart of the firm's strategy.

By then, the team of young entrepreneurs raised first private investment and attracted a solid group of advisors comprising: Richard Hsieh, a Harvard economist who acquired 18 years' experience in global investment banks; Stef van Grieken, an inspiring entrepreneur and Google program manager; Ivo de la Rive Box, who augmented technical know-how by providing experience on smart thermostats; Martijn Arts, a major Dutch marketing expert; and Matthijs Ingen-Housz, a dynamic lawyer who is a world reference on private equity and startups.

Because many industrial processes require carbon dioxide, the field for application developments is extremely vast. The following partial list will give an idea of its breadth: pharmaceuticals, food processing and preservation, wine making, coffee decaffeination, Enhanced Oil Recovery (EOR), beverage carbonation, horticulture (greenhouses), gas purification, bio-fuel production, steel manufacturing, metal working (welding), pulp and paper processing, fire suppression, water treatment, electronics, pneumatics, polymer processing and scuba diving. Nevertheless, the emerging DAC technology is still considered expensive in comparison with conventional methods of supplying CO₂. This is why an innovative market approach is required which

includes growing from markets with low CO₂ requirements into bigger ones, step by step, while advancing the capabilities of the technology.

Accordingly, the Giaura team established a three-step market development strategy. Step one involves the establishment of a licensing agreement, which is now being finalized, with a major player of the aquarium industry. There are over 15 million aquariums in Europe and most of their owners are keen to watch their fish swim in the midst of lush vegetation. As vegetation flourishes, they confront with dwindling levels of carbon dioxide that is soaked up by photosynthesis. Soon this causes the vegetation to falter. A sad result given the care and attention deployed by each affectionate owner. The device developed by Giaura solves this problem by extracting CO₂ from the surrounding air and pumping it into the aquarium. Estimates are that, only by covering a fraction of the actual market, this initial market holds a revenue potential in the order of 24 million euros.

Step two is more ambitious but no less realistic in terms of practical impacts. It involves adding a Giaura chipset within air conditioning systems. Although air conditioning is a net contributor to atmospheric CO₂ build-up and global warming, it is here to stay since it contributes maintaining optimal living and working temperatures in otherwise overheated ambients. Not only, by including the Giaura solution, air conditioning will further improve indoor living and working conditions by preventing excess CO₂ build up in confined environments. Typically, an excess proportion of CO₂ causes lack of concentration, headaches, dizziness and even nausea. In rare but extreme working conditions, it may lead to unconsciousness and death. In most cases, the lighter of these symptoms are not associated with indoor CO₂ buildup (i.e oxygen decrease). Needless to say, this market is huge and interests companies such as Philips, Quby and Honeywell. A prudential estimate values it at about 178 million dollars.

The third step is bolder. It involves the development of a Giaura product solution for the biofuel market. Closing the loop by capturing carbon dioxide, and turning it into a fuel, stands as the ultimate solution to many of our problems. Its economic implications are breathtaking. The Giaura startup is a young team, built around a space-proof technological innovation tied into an earth-proof business model. It is clearly setting the new frontiers of innovation. ●



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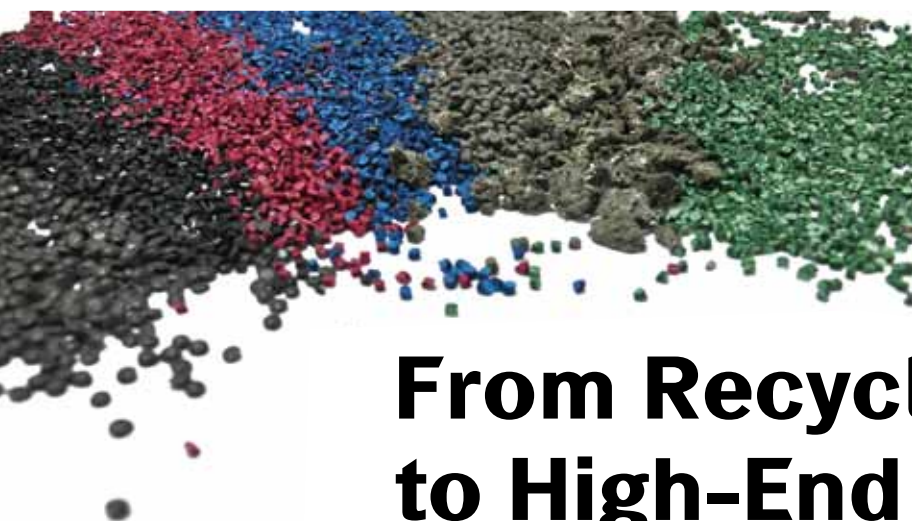
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Potential diffusion' fields

1. wine making
2. metal working
3. pulp and paper processing
4. aquariums
5. tyres production
6. electronics
7. decaffeination

Info

getinvolved@giaura.com
<http://giaura.com/>



From Recycling to High-End Products

by **Marco Moro**

Marco Moro is editor in chief at Edizioni Ambiente.

Every time we throw a plastic bottle, a carrier bag, a net, a tub or a yogurt pot into a bin for separate waste collection, we take it for granted that packaging will be recycled and probably we don't ask ourselves how that process is going to happen, if there is an efficient industry behind it, a logistic system and a reference market so that material – one day – will indeed be fed back into the production cycle. And in Italy we don't even think that most of the plastics collected through separate waste collection are not recycled but are sent to waste-to-energy plants for energy recovery instead. A huge waste of matter.

Plastics with or without Market Value

Plastics can be conveniently classified into two large groups: those with market value, such as Pet or Pe bottles, that are recycled through well-established channels and strong end markets and those with no market value, such as mixed plastics (Plasmix) from separate waste collection, since their heterogeneity makes recycling more

complicated and costly. Indeed, every polymer has its own peculiarities and melting points that prevent a linear recycling process as opposed to homogeneous polymers.

This is why mixed plastics are mainly used for energy recovery. Unfortunately though, in Italy, they are typically separated at source, as opposed to other European countries where this does not happen. In Italy, citizens are asked to commit to separating plastics at source, to pay for source separation of waste and for waste selection plants, although ultimately they end up in waste-to-energy plants.

The Research Project and Economic Sustainability

Since somebody thought – rightly or wrongly – that separating plastics at source was appropriate, we might as well try to recycle them. This is why, in 2009, a research project co-funded by Regione Toscana and co-ordinated by Pont-Tech in conjunction with PontLab and the Department of Chemistry

A new industrial policy must boost matter renewability as it did with renewable energy.

and Industrial Chemistry of the University of Pisa, started. An experiment that in 2013 led to the opening of the Revet Recycling plant, with a 5 million euro initial investment, that showed that mixed plastics from separate waste collection can be recycled and converted into matter replacing virgin raw material. It also demonstrated that such recycling is sustainable both from an environmental and economic point of view (all the more so if supported by the same benefits and tax concessions as waste-to-energy facilities).

“From an economic viewpoint – as Revet Recycling’s chairman Valerio Caramassi explains – in Italy, mixed plastics recycling is affected by red tape and inappropriate subsidizing that clash with the European institutions’ guidelines for correct waste cycle management favouring recycling, matter renewability and energy recovery. A new industrial policy – concluded Valerio Caramassi – must boost matter renewability as it did with renewable energy.”

A Quality Product for High-End Manufacturing

Since July 2013, the Revet Recycling Granule Production Plant in Pontedera (Pisa) has received selected mixed plastics from nearby Revet Spa Selection Plant and has recycled them mechanically, producing granules for the plastics transformation and moulding (injection or blow) sector. In Tuscany alone, there are over 600 SMEs transforming plastics and their market is not limited to Italy, judging from the big bags of granules destined to other European and non-European countries. This is proof that they produce quality material with performance characteristics similar to those of virgin material but with the advantage of lower and stable costs thanks to the fact that they are not affected by oil price fluctuations.

The basic colour of Revet Recycling granules is grey but thanks to the plant’s mixer, a wide range of colours can be obtained to satisfy customers’ specifications. Such products boast the IPPR (Institute for the promotion of recycled plastics) PSV label (Plastic second life) necessary for Green public procurement (GPP).

Revet Recycling (51% owned by Revet Spa and 49% by Refri – Gruppo Unieco) uses renewable matter and by paying particular attention to





the whole production cycle, from the finished product to the blend of polymers best suited for any particular requirement, it is able to substitute virgin material even in the manufacturing of high-end products such as fittings for the automotive industry.

Social and Environmental Sustainability

EU directives and national laws favour matter recycling over energy recovery. In Italy, to make sure that from a climate-changing emissions point of view, heterogeneous plastics recycling is preferable to energy recovery, in 2012, E-Cube, a consulting firm, carried out an ecological footprint evaluation comparing two industrial processes that can be applied to mixed plastics from separate collection.

The **Process Carbon Footprint** (expressed in tons of CO₂ equivalent) made it possible to calculate and compare greenhouse gas emissions linked to materials recycling and energy recovery with unequivocal results: taking into account the combustion stage, the total emissions of the “Preparation to energy recovery” scenario (waste-to-energy process) amount to 37,358.8 t CO_{2eq} per year (that is 2,400 kg CO_{2eq} per ton of treated waste). As to the matter recovery scenario (production of granules and plastic profiles), total emissions amount to 4,585.6 t CO_{2eq} per year (that is 290 kgCO_{2eq} per ton of treated waste).

The Industrial Process

Revet Recycling Plant uses cutting edge technology — in Italy there are only two other similar plants, one in Lombardy and one in Veneto — and it was designed to process 15-20,000 tons of Plasmix per year (this is the quantity of mixed plastics produced in Tuscany through separate collection). Mixed plastics are loaded onto a belt and conveyed to a grinder (2,500-3,000 kg/h) where they are ground into chips smaller than 40 millimetres in diameter. Ground plastics are then moved to a buffer where transport screws feed them to a prewash tank. This is where a first selection is carried out: heavier particles, mainly debris and polyester,

sink and are discarded (about 25%), while floating particles are sent to two centrifuges (16 rps) that separate plastic materials from wash water and solid pollutants.

In the second washing tank, mixed plastic materials are further refined, losing their remaining impurities (about 5%). The material thus obtained is fed to two centrifugal dehydrators (1,400 rpm) and compacted by two presses and is then stocked in a second buffer.

The material is now ready to be recycled. Plastic materials are put on a dispenser belt taking them to an agglomerator. In the mixing chamber, thanks to the friction and pressure generated by a counter-rotating twin-screw extruder, the melting point is reached (about 220 °C). The flow (1,600-2,000 kg/h) is fed to an extruder, where it is homogenized and freed from residual gases by an endless screw (300 mm in diameter). A self-cleaning filter eliminates all remaining impurities. Once cooled and solidified, the material is ground to the desired diameter (<3 mm), put through a vibrating sieving machine and stocked in a mixing silo, ready for manufacturing cycles. ●

Info

www.revet-recycling.com

Mixed plastics from separate waste collection can be recycled and converted into matter replacing virgin raw material.



Columns

Draught from Berlaymont

The New Juncker Commission: High Speed Link or Slow Business as Usual?

Joanna Dupont-Inglis

has specialized in Environmental Sciences at University of Sussex and Nantes. In February 2009 she has joined EuropaBio, the European Association of bioindustries, and from April 2011 she directs the field of industrial biotechnology.



Rarely has Europe's biobased policy community been infused with such a potent cocktail of speculation, expectation, anticipation and hope, mixed with a liberal dash of uncertainty.

The unveiling on September 10th of President Jean Claude Juncker's top priorities and proposed new structure, that with which he intends to "shake things up", has triggered the desired effect: it has caused much distraction. Moreover, it took the spotlight off the proposed new group of Commissioners – initially at least. With euroscepticism and disillusionment at an all-time high, the College of the Commission – which brings together 7 returning Commissioners, 5 former Prime-Ministers and several Deputy Prime-Ministers – is broadly thought to offer a strong line-up. One that is capable of tackling the challenges facing the new mandate. But, how such a team of political heavyweights will work together within the President's new proposed structure remains to be seen.

The rationale behind the restructuring, praised by many as being both bold and clever, is the need to focus on economic growth and job creation. The new structure features seven Vice Presidents, many of whom stem from smaller EU member states and stand at the centre-right of the political spectrum. They will be in charge of the newly created project teams of Commissioners, pooling the necessary portfolios to tackle top line priorities. Each project team will focus on a specific end goal, including boosting growth in jobs and investment, and developing a resilient energy Union with a forward-looking climate change policy.

As it stands, this new approach, aimed at slicing through well-established policy silos, could hold promise for cross cutting policy issues such as the development of a competitive and sustainable bioeconomy. Biobased industries continue to seek a more holistic, coherent, supportive and predictable approach to foster the transition towards the bioeconomy. Indeed, the envisaged structure may well facilitate this course. The benefits of EU biobased industries should also resonate well among thought leaders within the

new Commission for their potential to help tackle climate change while reducing dependence on fossil-carbon imports, and creating jobs, growth, and innovation whilst stimulating investments in Europe.

In this new context, the role played by Finnish Vice President, Jyrki Katainen, will be of key relevance for biobased industries, since he will steer the Project Team on Jobs, Growth, Investment and Competitiveness. In particular, within three months, the Vice President will coordinate and present an ambitious package that, in President Juncker's words, "should enable the mobilization of up to €300 billion in additional public and private investment in the EU economy over the next three years". Mr. Katainen will be responsible for overseeing the design and implementation of the novel package which should prioritise support for the development of a smart, sustainable bioeconomy, enabled by biobased industries, in order to deliver on President Juncker's overall objectives.

Biobased industries are united in their fervent wish that the new Commission should tackle the need for deployment of the demand-side commercial stimulation measures, finalised by the Lead Market Initiative group on biobased products and left largely in a limbo since their publication in 2011. Elżbieta Bieńkowska, Polish Commissioner for Internal Market, Industry, Entrepreneurship and SMEs, could play a crucial role in ensuring implementation of these recommendations, delivering the support promised for biobased products and industrial biotechnology through the Commission's new industrial policy.

Phil Hogan – the incoming Irish Agriculture and Rural Development Commissioner – steps in after the conclusion of the lengthy and difficult Common Agricultural Policy negotiations to play a key role in the Transatlantic Trade and Investment Partnership trade discussions (TTIP) as well as towards contributing to the jobs, growth and investment package. President Juncker has requested him to ensure that spending on rural development provides new employment opportunities and increased competitiveness

while contributing towards energy efficiency and emission reductions. Biobased industries and other sectors within the bioeconomy see a clear role for themselves, provided that appropriate rural development and regional funding programmes are put in place to help establish and support new value chains and partnerships. Ensuring a sustainable supply of competitively priced feedstock of consistent quality and quantity is an essential for biobased industries to flourish and for Europe to make the transition to a lower carbon economy, using renewables as its basic feedstock rather than fossil carbon sources. Championing agricultural productivity and sustainability is key, as is the development of measures to support collection, storage and transportation of renewable raw materials, especially agricultural residues.

Accessing combined funding for innovative, high value added, high financial risk, emerging clean tech industries, such as those represented by the biobased sector, is a major hurdle for the industry. Facilitating such access will be key to attracting future private investment and to overcoming the dependence on the fossil-based “business as usual” approach. As yet, however, industry remains baffled by the complexities, inconsistencies and overwhelming administrative labyrinth of combining regional, national, Horizon 2020 and Eib funding, amongst other budget lines. Simplifying and harmonising these funding rules and aligning basic funding principles will be fundamental to boosting green jobs, growth, markets and biobased industry confidence in Europe.

In this respect, President Juncker mandated Carlos Moedas, the Portuguese Commissioner for Research, Science and Innovation, to play an influential role by contributing to the Project Team run by Vice President Katainen. His background in investment, banking and engineering should serve him well to help drive the initiative and attract investment while easing access to funding. This will involve working closely with the Romanian Commissioner for Regional Development, Corina Crețu. A considerable opportunity lies in the use of combined funding to leverage the results of the EU’s € 20 billion worth Investment Innovation Package, including the € 3.7 billion Public Private Partnerships (PPPs) for biobased industries, which Mr Moedas will undoubtedly consider.

Surprisingly, the mandate given to Danish Competition Commissioner, Margrethe Vestager “to mobilise competition policy tools and market expertise, so that they contribute, as appropriate, to the jobs and growth agenda, including in the area of industrial policy” indicates that Mr Juncker expects this powerful Directorate to take a strong economic approach. Biobased industries hope that this will incorporate further State Aid Modifications in order to free up funding for high financial risk innovative investments, including

flagship and first commercial biorefinery plants. This would help pave the way towards successful commercialisation of biobased products. Furthermore, it would contribute to reversing the migration of industrial biotech leaders and know-how overseas towards more attractive business environments.

Biobased industries will closely follow a second key Commission Project Team: that which focuses on delivering a “resilient energy union with a forward looking climate change policy”. This group’s mandate includes the pooling of resources, the combining of infrastructures and the diversification of energy sources to reduce the high energy dependency of several Member States. Clearly, the Commissioner in charge of this portfolio will be working closely with Spanish Commissioner Cañete for Climate Action and Energy Policy, and with the Commissioner for Transport and Space to ensure that the EU plays a leading role in promoting low carbon technologies within international climate negotiations. Advanced biofuels can and will play a key role here in delivering solutions for land and air transportation. In this respect, biobased industries are keen supporters of a more predictable, longterm, science based approach to policy making in this field. In addition, the adoption of specific and binding targets for advanced biofuels, either as part of the Renewable Energy Directive or based on the US Renewable Fuel Standard, would help deliver environmental and socioeconomic benefits.

However, concerns over the Union’s capacity to secure energy supplies may cause some policy makers to underestimate or, worse, to lose sight of the benefits offered by biobased industries. As the shockwaves of the ongoing geopolitical crises (in Ukraine and the Middle East) continue to cause concern, serious and viable biobased opportunities may simply be overlooked. Indeed, recently one senior European official spoke of the imminent possibility of several member states needing to choose between energy supplies for domestic heating or for the powering industry, with the latter losing out if energy supplies were to be disrupted during the winter months. The Maltese Commissioner, Karmenu Vella, in charge of the Portfolio for Environment, Maritime Affairs and Fisheries has an apparently more distanced link to the jobs and growth agenda. He is tasked with assessing the state of play of the circular economy package “in light of the first reactions of the European Parliament and Council to see whether and how it is consistent with our jobs and growth agenda”. In other words, even for the new Commission, it remains unclear how environmental policy developments may become drivers for the creation of sustainable jobs and economic growth.

All in all, the new Commission faces significant challenges both in terms of redefining

itself, winning back the hearts and minds of European citizens and putting in place essential contingency plans to tackle the grand challenges facing Europe, so that its role in maintaining and creating prosperity be fully realised.

President Juncker has set the scene for change through a bold move to transform the way in which his Commissioners will work together across policy sectors. Bold political moves are exactly what is needed to get the EU back on track and to deliver solutions to tackle the combined threats of climate change and energy and food security, while ensuring economic recovery.

Industrial biotech and biobased industries will play a critical role on the journey towards delivering these objectives. Along the way, the support of all relevant policy sectors is needed.

It will require a departure from the comfortable and well established status quo, but perhaps this Commission will rise to the challenge. ●

Bieconomy and Environment



LEGAMBIENTE

Stefano Ciafani

is National Vice Chairman of Legambiente. He was an advisor for the Commission's enquiring committee on the waste cycle of the XIV legislature and member of the Steering Committee on the management of EEEW.



The navigation map of the waste investigation in the Italian seas conducted by Green Schooner (Goletta Verde) in summer 2014 is available on www.legambiente.it/marinelitter.

After monitoring the floating waste for 87 hours and observing 1,700 km of sea by Legambiente's Green Schooner (Goletta Verde) and by the Accademia del Leviatano in the summer of 2014, the picture of the marine litter besetting the Italian coastline gained new important data. In the Italian seas, up to 27 floating waste items have been spotted per square kilometre (sq.km), 90% of which were plastic. Along Goletta Verde's course, the observation team spotted a waste item every 10 minutes.

There are significant differences amongst the various seas surrounding Italy. The Adriatic Sea has been identified as the most polluted, with 27 floating items of waste per sq. km of sea, mainly plastic bags (totalling 41%) and plastic fragments (22%). This area stands out for the quantity of plastic waste due to fishing (20% of the total) registered after monitoring Italian seas.

The Tyrrhenian Sea boasts a superficial density of 26 items of waste per km² and the highest percentage of plastic waste (91%). Noteworthy is that 34% of floating waste is made up of bottles (refreshments and detergents) exceeding plastic bags (29%). The Ionian Sea seems healthier, with "only" 7 items of waste per km².

4 items of waste have been found in the across-the-border leg between Civitavecchia and Barcelona, monitored by Accademia del Leviatano, although only wastes over 20 cm have been taken into consideration and in deep sea. In other routes Goletta Verde monitored wastes from 2.5 cm up (75% of the total is made up of wastes under 20 cm).

The sea areas most affected by marine litter are: Castellammare di Stabia's coastline (with 150 wastes per km²), Abruzzo's coastline facing Giulianova (with over 100 wastes per km²) and the sea washing the Gargano area between Manfredonia and Termoli (over 30).

The observation was carried out according to the scientific protocol developed by the Department

for the Protection of nature – Ispra – and by the Department of Biology of the Pisa University, using the waste grading Ospar/Tsg-ML. Even though far from the levels of the plastic vortex in the Pacific Ocean, plastic poses a serious environmental problem for all the seas of the planet. According to Fao's General Fishery Council for the Mediterranean, over 6 million tons of human dangerous and solid materials are discharged into the sea every year. It goes without saying that the repercussions on the environment, the economy and the marine fauna are undeniable. Suffice it to think that the ingestion of waste is one of the main death causes amongst sea turtles. Not to mention the impact of microplastics (the smaller fragments generated through degradation of larger materials) that, if swallowed directly or involuntarily by marine fauna, enter the food chain.

The huge quantity of spotted waste gives us a clear picture of what the sea bottom hides, since the floating waste is only the tip of the iceberg of a bigger problem. It is estimated that 70% of waste entering the marine ecosystem sinks. Due to the current laws and the absence of collection and disposal networks in the harbours, fishermen are thus encouraged to throw into the sea waste accidentally trapped in their nets.

Tackling the issue of sea waste is one of the European priorities of the Marine Strategy, the 2008/56 directive devoted to the sea environment aiming at the achievement of a good ecological state for the water of each member state by 2020, based on 11 descriptors, one of which regarding waste.

Over the last 30 years, the world's plastic production has soared exponentially and such non-biodegradable products have contributed enormously to environmental and sea pollution. In the last few years, Italy, thanks to the ban on non-compostable plastic bags has created a unique discontinuity amongst industrialized countries, promoting innovative industrial policies

of green chemistry and changing the lifestyle of Italians who used such products excessively (in the last 3 years, in Italy, the use of disposable plastic bags has halved). It is high time Europe finally adopted the directive bill that has already been largely discussed and voted on at first reading by the previous European Parliament in order to extend Italy's best practice to the rest of the Old Continent which is also called

upon to solve the problem of plastic pollution in the Mediterranean Sea. It is no coincidence that plastic bags spotted during last summer by Legambiente and Accademia del Leviatano's monitoring in the Tyrrhenian Sea (29% of the total) were by far less than those found in the Adriatic (41%), a sea which is also polluted by the Balkan countries where the plastic bags ban does not exist. ●

The Blue Yonder

Portugal Returns to Sea

Ilaria Nardello

is an Industry Research Specialist at the National University of Ireland, Galway. A biological oceanographer with thirteen years of research experience spent between the USA and EU, her interests are now focused on Industry-University collaboration for sustainable innovation, with a special interest in the marine bio-resources sector.



The Portuguese national marine jurisdiction is one of the largest in Europe, 18 times the size of the country's emerged land. However, in the past thirty years, possibly since it joined the European Union and became distracted by the opportunities of our common agricultural policies, the country has overlooked their enormous and deeply rooted maritime heritage. Only recently, renewed interest in their blue assets has urgently surfaced.

In the wake of its biggest modern economic crisis, which brought the country's GDP down from an all time high of USD 252 billion, in 2008, to USD 212.5 billion, in 2012, Portugal's government just revised its plans and renewed its commitment for a long-due "return to the sea". Driven by the European Union's Marine Strategy Framework Directive (2008), which aims to protect the marine environment as the resource base upon which marine-related economic and social activities depend; and guided by the innovation and job creation prospects of the recent EU Blue-Growth Strategy; the Portuguese National Ocean Strategy (NOS), 2013-2020, is a country's passionate and exemplary call to re-direct the exploitation of their marine resources towards the sustainable creation of high value-added products.

As related by Capitain João Fonseca Ribeiro, Director General for Maritime Policy, the Portuguese marine sector only accounts for 2.7-2.8% of the country's Gross Domestic Product. Traditional activities such as fisheries – the tenth economic sector in Portugal, and ship-building are the main pillars there. The strategy should convince national and foreign stakeholders to invest in the innovation of the traditional blue-economy sectors as well as in the development of novel activities. The expectation is to almost double the contribution of the direct marine sector activities and reach 5% of GDP, by 2020.

Aquaculture is a most promising industry in Portugal. With an ever-increasing global demand for food and proteins, this sector has already grown by 35% from the production level

of 2011 and is projected to sustain a production of 40 kilotons/year, in the near future. High potential for return on investments is established for tourism, and anticipated for the more innovative sectors, such as marine biotechnology R&D, marine mineral extraction and marine renewable energy. When including secondary and induced activities, the blue economy could rapidly grow to cover a third of Portugal's wealth. The likelihood of a positive outcome is strengthened by a recent proposal to the Commission on the Limits of the Continental Shelf (Clcs) for the extension of Portugal's continental shelf. If approved, the Portuguese Exclusive Economic Zone (EEZ) will increase to about 2.1 million km² and extend to a marine area 40 times the size of Portugal – as large as the whole European land territory, and corresponding to 4% of the Atlantic Ocean surface. With this variable scale of operations, NOS governance will adopt a rather flexible approach, with a notion that a bigger scale entails broader responsibilities.

The main challenge for the realization of the NOS, as well as the whole European Blue-Growth agenda, is the development of the knowledge and technology bases, which will be required to enable the extraction of the envisaged potential of the marine. In this long-term perspective, it is of paramount importance that a collaborative spirit is adopted in the creation and application of that knowledge; starting with territorial cooperation programs within the marine region of competence and, beyond, at the pan-European level; and, finally, realizing the common interests of that territorial continuum determined by the Atlantic Ocean. Only a shared detailed comprehension of the value of the oceans will allow a sensible response to the development opportunities arising from the deep. ●

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The National Technology Cluster of Green Chemistry SPRING has the objective of triggering the growth and the development of biobased industries in Italy, through an holistic approach to innovation, aimed at revitalising Italian chemistry in the name of environmental, social and economic sustainability and to stimulate research and investments in new technologies, in constant dialogue with the actors of local areas and in line with the UE most recent policies on bioeconomy.

www.clusterspring.it