

**Catia Bastioli**

# **A CIRCULAR APPROACH TO BIOECONOMY**

**an opportunity to decarbonise  
the economy and reconnect  
it with society**



Edizioni  
Ambiente



**Catia Bastioli**

# **A CIRCULAR APPROACH TO BIOECONOMY**

**an opportunity to decarbonise  
the economy and reconnect  
it with society**



**Edizioni  
Ambiente**

Catia Bastioli

**A CIRCULAR APPROACH TO BIOECONOMY**

**Based and adapted from “Innovazione e infrastrutture della bioeconomia per riconnettere economia e società”, lectio magistralis by Catia Bastioli on the occasion of conferral of her Honorary Degree in Materials Engineering by the University of Palermo, Department of Civil, Environmental, Aerospace and Materials Engineering**

© 2017, Catia Bastioli

© 2017, Edizioni Ambiente

Via Natale Battaglia 10, 20127 Milano

[www.edizioniambiente.it](http://www.edizioniambiente.it)

tel. 02.45487277, fax 02.45487333

**COVER:** Mauro Panzeri

**INFOGRAPHICS:** Michela Lazzaroni

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or any medium, without written permission given by the publisher.

ISBN 978-88-6627-221-2

Printed in May 2017 at GECA Srl,  
San Giuliano Milanese (Milan), Italy

*Printed in Italy*

## CONTENTS

<b>PREFACE</b>	6
<b>INTRODUCTION</b>	8
<b>TOWARDS A NEW DEVELOPMENT MODEL BASED ON THE CIRCULAR BIOECONOMY</b>	9
<b>WHY WE NEED A NEW DEVELOPMENT MODEL</b>	9
<b>THE ROLE OF RESEARCH AND INNOVATION AND OF TECHNOLOGIES IN ECONOMIC AND SOCIAL DEVELOPMENT: THE NEW PARADIGMS</b>	10
<b>THE BIOECONOMY TO RECONNECT THE ECONOMY WITH SOCIETY</b>	11
<b>THE NOVAMONT CIRCULAR BIOECONOMY MODEL: THREE PILLARS FOR TERRITORIAL REGENERATION AND DECARBONISATION</b>	13
<b>THE CREATION OF BIOECONOMY INFRASTRUCTURES</b>	15
<b>RAW MATERIALS OBTAINED FROM DEDICATED AGRICULTURAL CHAINS WITH SYNERGIES IN FOOD PRODUCTION</b>	20
<b>PRODUCTS AS SOLUTIONS</b>	23
<b>THE CASE-STUDY OF CARRIER BAGS AND THE ZERO-ORGANIC WASTE PROJECT</b>	28
<b>CONCLUSIONS</b>	34



There is a much more at stake than industry and agriculture in this reconnection: there is the antidote against the increasing poverty that fuels populisms jeopardizing our democracies. The social fabric is not something separate from the industrial world: industry, agriculture and the environment, academy and school institutions, the world of consumption and labor must work together for a common project of development where virtuous cooperation – at a time so highly critical on many fronts – could take the place of sterile position battles.

## PREFACE

In 1988, while working as a researcher within the Montedison group, I began applying my knowledge of chemistry on agricultural raw materials and waste of the Ferruzzi group in order to develop bioplastics. I was leading a research team and I believed strongly that science and technology could improve the world and people's lives. I still remember the great emotion of the first time I was able to engineer a bioplastic and patent it: at that stage I had no idea that we had invented yet another of the millions of products which were overcrowding the planet, without a thought for production and consumptions models.

What I learned while creating the value-chain of bioplastics and biochemicals, which is what I have undertaken since then and what has been occupying much of my life, is that any innovation and technology, even the best kinds, can have negative effects unless they are developed with the required wisdom, especially when renewable raw materials are concerned.

This became increasingly clear to me with the advance of globalisation. I experienced the distortions of an increasingly globalised and financialised economy, on an ever larger scale and with increasingly short-term objectives, aimed solely at securing a profit, to the detriment of the quality of life of the many and of natural capital. I saw regions become increasingly marginalised and preyed upon by global groups in search of places to produce products at the lowest possible cost; I saw the cultural and economic impoverishment of entire social classes and regions. The wealth generated in the past by high-impact manufacturing operations was replaced by unemployment and pollution, borne by the local areas.

The financial crisis of Montedison in 1996 led to the end of



our adventure into the world of renewable raw materials in this Group. At that time I was already convinced of the potential of renewable raw materials but I could also see the importance of finding models to ensure these precious resources were used efficiently. I then decided to devote all my efforts to experimenting, together and around the renewable products being developed, a systemic approach which would have started from the local areas. I was interested in focusing on shared projects based on innovative, diversified and integrated technologies which could create added value and reduce environmental impact, convert decommissioned sites and create opportunities for skilled employment. We looked at Italian local areas as open air laboratories in which to develop a new inclusive, shared culture and in which quality standards could be tested and verified in the field. This experiment requires re-establishing trust between institutions, innovative industries, academia, the world of work and of the environment as well as of consumption, and a cultural growth for all of us.

Great strides have already been made and there is still a great deal to be done in creating the Italian bioplastics and biochemicals value-chain, but I believe that the balance has been positive so far and that this is a story worth telling and ready to be multiplied.

## INTRODUCTION

As I have said on other occasions, Novamont's adventure is not a solitary journey and would not have been possible without the contribution of so many people – researchers, engineers, environmentalists, business owners, the world of cooperatives and associations, representatives from institutions and the financial sector – who believed in our model and supported it, helping to steer a straight course even during the hardest times.

This dissertation will focus on the model of territorial regeneration, on which I have been working on for so many years and which involves the construction of what I call the infrastructures of the bioeconomy, imagining a new relationship between science/technology and society. In particular, I will explore how we can reconnect the economy with society and relaunch competitiveness through a model of continuous innovation applied to the local areas and their traditions and problems in order to concentrate on diversified quality rather than undifferentiated quantity. I will talk about what has been created in the bioplastics and biochemicals sector with a view to a real sustainable development, providing a detailed analysis of the three pillars on which the Novamont model is based: the bioeconomy infrastructures, integrated agricultural value-chains and the development of innovative products designed as opportunities to find solutions to problems affecting society. I will try to explain how the results obtained and what still remains to be done by Novamont can represent an opportunity for a real acceleration of sustainable development, starting from the issues covered by the Italian Bioeconomy Strategy, recently launched, with multiple benefits from an environmental, economic, social and especially cultural perspective.

## **TOWARDS A NEW DEVELOPMENT MODEL BASED ON THE CIRCULAR BIOECONOMY**

### **WHY WE NEED A NEW DEVELOPMENT MODEL**

Being able to live well within the limits of nature is the great challenge of our century, a challenge which requires immediate action and which can only be faced with individual commitment and widespread, well-informed policies. We need a critical reappraisal of the culture of production and conservation to overcome the one of waste. This will not be a simple process, due to an approach to the market which over the years transformed us to mere consumers, jeopardising our capacity to understand the history and the “soul” of the products.

To live within the limits of nature we must overcome our own limits and be clearly aware of our responsibility for climate change and the central importance of natural resources. Our mindset and our established habits are in fact the greatest obstacle to trying new models, making us short-sighted, feeding selfishness, arrogance and ignorance, holding back the process of change and prolonging the current structural crisis indefinitely.

The dominant economic model of the final decades of the 20th century and the first decade of the 21st century is largely linear, designed to create increasingly standardised products which generate wealth for the few to the detriment of many.

It is a largely inefficient development model which wastes raw materials, energy, human resources. It provokes marginalisation, violence, abuse, illegality, ignorance and disregard for people. What’s more, we have accelerated the impoverishment of natural heritage.

Natural systems are open systems, and can adapt to changes

through gradual evolution. According to the thermodynamics of irreversible and non-linear processes, for which Ilya Prigogine received the Nobel Prize in Chemistry, when changes are too sudden and intense can result in a fast transition from one steady state to another with catastrophic effects. This is why man's ability to manipulate ecosystems, causing them to mutate quickly without knowing all of the complex effects, is particularly dangerous: this especially when the power to generate these accelerations lies with those whose sole motivation is economic benefit beyond any systemic control.

Science and technology have in some way been enslaved to this wasteful model: technology has never been so accessible, nor the potential for creation and destruction so great. For decades we have been unable to use it wisely. The astonishing availability of technical means, in a context of rootless globalisation without strong political will capable of giving central importance to the quality of life of local areas, has created uncontrollable global instability.

#### **THE ROLE OF RESEARCH AND INNOVATION AND OF TECHNOLOGIES IN ECONOMIC AND SOCIAL DEVELOPMENT: THE NEW PARADIGMS**

Freeman Dyson, the Princeton physicist, once said: "Technology is a gift of God. After the gift of life it is perhaps the greatest of God's gifts. It is the mother of civilisations, of arts and of sciences". However, as recent history has shown, technology has been used within a wasteful, linear model and is now held responsible for the excessive consumption of natural resources and environmental degradation to the point where we now foresee the possibility of real catastrophes.

It is therefore necessary to establish the foundations for tech-

nology to make a significant contribution to the efficient use of resources decoupling the development from the consumption of raw materials, as well as the reconnection between the economy and society. It concerns a wise use of technology, which calls into question the policies and the model of the society we live in.

We need high politics, mindful of what is at stake and the risks for humanity, capable of involving communities, of promoting international agreements, laws and regulations focused on the preservation of the world's stock of natural resources as an opportunity for development. We need to start thinking how to deeply change energy and industrial infrastructures.

Politics needs to imagine a space for so-called “prosumers” at the root of a widespread economy, capable of promoting structural changes in the banking and financial system and having a profound effect on training and education.

But politics alone will not be capable of promoting this paradigm shift without the active participation of informed communities which can grow by experiments to achieve real change on the ground. For this reason I believe it is fundamental to create case studies which are able to involve communities, introducing continuous innovation at the service of the local areas and their traditions and cultures: otherwise it will be hard to achieve the acceleration necessary to prevent us from reaching the point of no return.

## **THE BIOECONOMY TO RECONNECT THE ECONOMY WITH SOCIETY**

There can be no solution to get out of the crisis and an increase in stability without recreating solid roots of industrial sustainable development in the local areas, with the involvement of local communities.

The bioeconomy, intended as territorial regeneration, can become a unique opportunity to reconnect the economy with society, overcoming the current rootless model based on expansion and undifferentiated quantity, in order to enhance the value of regional diversity and the quality and origin of products through a combination of tradition and innovation. Of course, when we think of bioeconomy we do not mean large quantities of low-cost biomass available anywhere on the planet.

On the contrary, we mean adopting the circular approach of integrated, interconnected and interdisciplinary value-chains, where the soil and its quality and biodiversity and the efficient use of resources, with respect for human dignity, become the focus of cultural, as well as industrial, environmental and social regeneration.

This type of culture is created in the field, by sharing territorial projects which can act as a catalyst for other multiple initiatives, where building and learning together make it possible to establish trust and respect between stakeholders, as well as wealth for the many, without producing waste.

This is by no means an utopia, and thanks to the pioneering work conducted over many years in Italy and our long-standing culture of local areas, our country could play a leading role in this fundamental evolution and help stimulate change. Today Italy has important examples of the system-based economy and may become a positive template for a new development model, using its “untapped” capital and bringing it into play through local projects delivering economic, social and environmental sustainability.

From this perspective, Novamont has been working for many years with conviction and intensity to create a systemic value-chain project capable of transforming the results of our research into flagship plants, the first of their kind in the world.

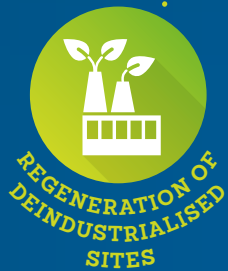
## **THE NOVAMONT CIRCULAR BIOECONOMY MODEL: THREE PILLARS FOR TERRITORIAL REGENERATION AND DECARBONISATION**

Novamont was born in 1989 as Fertec (Ferruzzi Ricerca e Tecnologia), the strategic research centre of the Montedison group, which at the time contained the largest European agro-industrial group, Eridania-Beghin Say, and Montecatini, one of the most important chemicals multinationals.

Fertec was tasked with building a bridge between two worlds which until then had been completely separate, starting from the agricultural raw materials of Eridania-Beghin Say and exploiting the chemical technologies available at Montecatini. The results of Fertec research were supposed to lead to Montedison's third development strand.

Fertec became Novamont and lost its strategic role in 1992 with the Montedison crisis. In 1996 the company was sold by Montedison and bought by the Intesa-San Paolo merchant bank and other institutional investors that believed in the project. Today Novamont is a consolidated industrial reality which grew out of an exciting and difficult experience and whose foundations are continuous innovation and strong ethical commitment.

Novamont is known around the world as a pioneer of the bioeconomy, particularly in the bioplastics sector. Having started out as a research centre it first became a profitable independent company and then a group of companies which has one of the largest investments in the Italian chemical sector, with a network of production and research sites throughout Italy and a global sales network. Today Novamont has built and is building in abandoned sites in Italy flagship plants, first in the world, using its original proprietary technology. The project,



...transforming world-first technologies into flagships. Biorefineries intended as bioeconomy infrastructures, interconnected with each other and connected with the local areas

...and designed to tackle real societal challenges. Elements of a system which provide concrete solutions to problems going far beyond the product itself

...through the valorisation of marginal lands and not in competition with food production, integrated in the local areas and connected with the bioeconomy infrastructures



pursued with conviction for over twenty years, of building a bioplastics value-chain integrated both upstream and downstream and favouring those applications which ensure the efficient use of resources, has enabled Novamont and its partners to establish themselves as a coherent and credible example at a European and international level of a real bioeconomy case study: a case study which starts with bioplastics and focuses on building chains, from farming on marginal lands to end products, in different market sectors which go well beyond bioplastics themselves.

Its development model, which looks to the bioeconomy as a means of territorial regeneration, is essentially based on three pillars: the creation of the bioeconomy infrastructures, the development of integrated agricultural value-chains and products seen as solutions.

### **THE CREATION OF BIOECONOMY INFRASTRUCTURES**

First and foremost, territorial regeneration means taking decommissioned sites and regenerating them thanks to original technologies and through the establishment of flagship plants, the first of their kind in the world. These plants are not designed as white elephants, but as “bioeconomy infrastructures”, biorefineries integrated in the local areas and interconnected: real seeds starting points for new value-chains, partnerships and alliances. Each plant therefore represents an opportunity for debate about how to collaborate in creating a formidable acceleration project based on existing achievements in order to inspire different stakeholders and multiply the results.

Novamont is currently involved in six sites undergoing re-conversion and reindustrialisation, and to date a total of four original and replicable technologies have already been creat-

## Novamont factsheet

Novamont has made a relevant effort in recent years to industrialise its cutting-edge technologies, in terms of both financing and research, at a level which is not that common in Europe: 500 million euro invested in plants, 200 million euro invested in research and development, multidisciplinary projects implemented in collaboration with other leading companies in Italy and abroad and over 600 direct jobs and 1,500 indirect jobs generated. Over the years Novamont has been developing a solid portfolio of around 1,000 patent cases, ranging from starch-based polymers, with the evolution of the technology of complexed starches towards highly concentrated and stable emulsions, to that of Origo-Bi® biodegradable polyesters, using a continuous process in Patrica (Frosinone) in the Mater-Biopolymer plant. Or else, the development of a range of materials under the Mater-Bi® brand which can be composted in a composting cycle while simultaneously improving heat and mechanical resistance, taking it to the level of traditional plastics like polystyrene and polythene in specific applications; or the design of new materials with outstanding barrier properties, as well as molecular alloys with interesting characteristics which have yet to be fully tested. More recently Novamont has developed a wide variety of processes and products connected with its own integrated biorefinery. It should also be mentioned the patent portfolio in the field of vegetable oils and in particular of the processes for oxidative cleavage of the Matrica plant (a joint venture between Novamont and Versalis),

as well as the development of fermentation processes for the production of monomers for the Origo-Bi® range of polyesters. Within the scope of white biotechnologies, Novamont built a partnership with the American company Genomatica which led to the establishment of Mater-Biotech and the construction of the first dedicated production plant for 1,4 Butanediol from the fermentation of sugars using a specifically engineered *Escherichia coli* strain.

Novamont's activity also covers the agricultural sector, with a particular interest for dryland crops, genetics, agronomy, as well as for the design of machines more suitable for cultivation, for the extraction of oil and of the protein pan and active molecules from seeds, and for the extraction of sugars from lignocellulosic biomass and roots.

There is also a strong activity of applications development both in the areas of plastics and of monomers and chemical intermediates, which are now available thanks to Matrìca and Mater-Biotech. This last sector focuses on plasticisers to replace phthalates, bio-lubricants, bioherbicides and many other applications. Recently, Novamont research has developed its own technology for producing a series of monomers and polymers for captive use, which will enable the strengthening of existing strategic partnerships and the creation of new alliances. This is a complex system of integrated technologies with low environmental impact. The objective is to create an industrial "demo" to enable the product to be used in certain demonstration applications over the coming years. That will enable the production of the fifth generation of Mater-Bi®.

# Novamont Bioeconomy Infrastructures in Italy





**HEADQUARTER  
AND RESEARCH CENTRE**

Novara - Piemonte



**MATER-BIOTECH (100% NOVAMONT)  
FLAGSHIP FOR 1,4 BDO PRODUCTION THROUGH  
FERMENTATION PROCESSES**

Adria (RO) - Veneto



**MATER-BI PRODUCTION  
AND R&D ON INTERMEDIATES FROM RRM**

Terni - Umbria



**MATER-BIOPOLYMER (100% NOVAMONT) PRODUCTION  
OF POLYESTERS FROM VEGETABLE OILS**

Patrica (FR) - Lazio



**BIOTECHNOLOGY RESEARCH CENTRE**

Piana di Monte Verna (CE) - Campania



**MATRÌCA**

**Flagship for azelaic and pelargonic acids, their esters,  
plasticisers, bioherbicides, basis for biolubricants  
Integrated agricultural value chain under development**

Porto Torres (SS) - Sardegna

ed: the technologies at the base of family of products under the Mater-Bi® brand, which include the complexation of starch, other polymer alloys and the related processes according to application areas; the Origo-Bi® polyesters and the related production processes; the azelaic and pelargonic acid, through the oxidative cleavage of vegetable oils without the use of ozone; the 1,4 butanediol obtained through the fermentation of sugars using suitably engineered microorganisms. The bioplastics made from fourth generation Mater-Bi® are the result of the combination of these four technologies.

In order to achieve this important result, over the years the company has developed a highly inter-disciplinary systemic approach, creating multiple partnerships and involving various areas of research including polymers synthesis, materials science, technologies for the transformation of plastics, organic chemistry applied to renewable raw materials, white biotechnologies, chemical engineering, energy efficiency, agronomy, microbiology and plant genetics, the ecology of products and systems and waste management.

#### **RAW MATERIALS OBTAINED FROM DEDICATED AGRICULTURAL CHAINS WITH SYNERGIES IN FOOD PRODUCTION**

The construction of integrated agro-industrial value-chains based on the sustainable use of biomass is a decisive element in ensuring that the model is successful. As a matter of fact, renewable raw materials do not represent the solution to all the problems of pollution and to declining oil supply: agricultural crops are not all alike and even the same crops can have a completely different impact depending on the geographic area in which they are grown.

It is therefore important to promote regional biodiversity,

multiplying the opportunities coming from the study of different plant raw materials and local waste products, minimising transportation and maximising the creation of knowledge circuits and multidisciplinary projects with the various local stakeholders (universities, research institutes, high schools, voluntary associations, the agricultural sector, institutions and small and medium-sized companies). This means to concentrate our strategic development lines on virtuous systems, whose essential points become the efficient resources management and the focus on local areas.

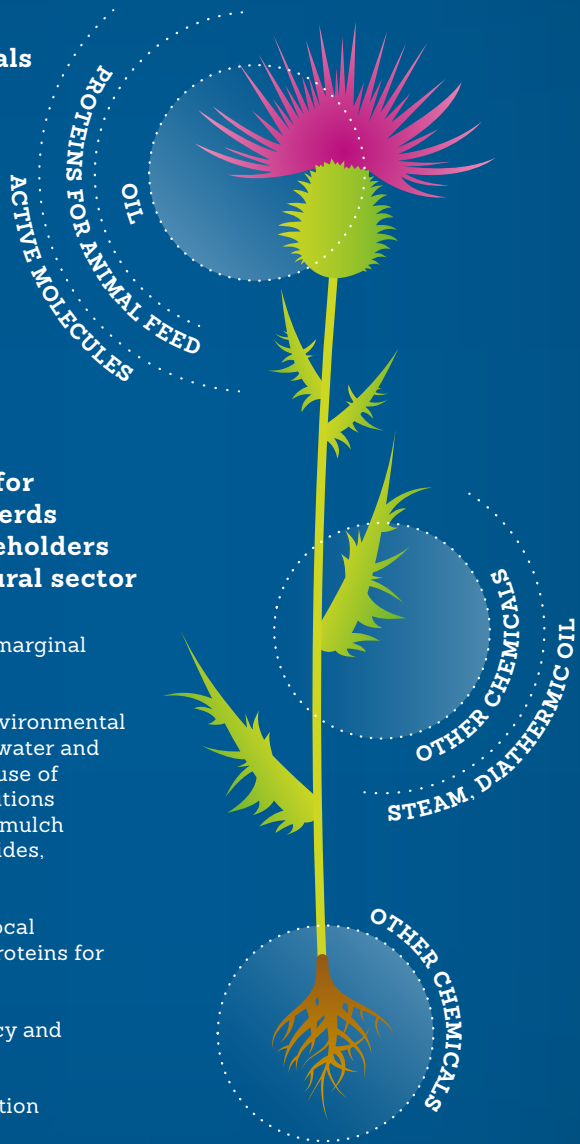
To achieve this goal, for many years we have been working with the academic world and with leading Italian and international research institutes to identify and study oleaginous dryland crops with potential industrial applications, which can be grown on marginal lands unsuitable for traditional crops. I am referring in particular to cardoon. Our research in this sector is wide-ranging: from evaluating agronomic aspects and genetic enhancements, to optimising the mechanisation of farming activities, extracting active compounds, oils, protein flours and sugars, to agricultural engineering and developing solutions for the agricultural world, in order to resolve specific problems associated with the end-of-life of certain items (for example mulching film, clips and pheromone dispensers which biodegrade in the soil).

Starting from the integration with crop-growing activities, particularly those with low environmental impact and reduced water consumption, it is possible to build multi-product value-chains while offering new possibilities for open innovation. Targeted value-chain projects can support multiple purposes: creating additional production and income opportunities, especially for areas of the country where there are marginal lands

## Outputs for the bioplastics and biochemicals value chain

## Opportunities for farmers, shepherds and other stakeholders in the agricultural sector

- Valorisation of marginal rural areas
- Reduction of environmental impact for soil, water and air through the use of sustainable solutions (biodegradable mulch films, bioherbicides, biolubricants)
- Availability of local production of proteins for animal feed
- Energy efficiency and independency
- On-field innovation approaches





or where crops are being changed, thereby avoiding any competition with food crops; offering edible protein substances to the livestock sector; reducing the environmental impact on the soil, water and air by using innovative solutions such as biodegradable mulching films, bioherbicides to control infestations and biolubricants; supplying bioplastics and biochemicals; and creating a whole range of synergistic products for the agro-industrial sphere.

By following this approach we have been collaborating with farmers and farming associations through initiatives which have been able to accelerate and drive the creation of partnerships. In January 2015 we signed a strategic agreement with Coldiretti, the Filiera Agricola Italiana (FAI) company and Consorzi Agrari d'Italia (CAI) in particular to promote cardoon production. This dryland crop can be used to produce oil, good quality protein flour and inulin for food. It is also a good source of biomass which meets the needs of the Novamont biorefinery to obtain low environmental-impact bioproducts, which also ensure the efficient use of resources according to a cascading model, and conditions which are beneficial to farmers. At present about 1,000 hectares are being used for experiments.

## **PRODUCTS AS SOLUTIONS**

The choice of the applications on which to focus the development of the value-chain products is another key aspect of the territorial regeneration model pursued by Novamont. Our objective has always been to help resolve real problems faced by society, not simply to launch products to replace others which are already on the market. The new products now available for use in Europe thanks to the value chain created by Novamont, together with its partners, are therefore parts of a system provid-

ing concrete solutions to problems much more challenging than the products themselves. The products obtained in this way are not just important because they are biobased: they are a part of a virtuous value-chain that, starting with a product, drives an integrated system, with a wide range of opportunities to be seized.

In particular, our initial challenge was to develop low-impact bioplastics in order to resolve certain environmental problems associated with end-of-life, which could go far beyond the new material developed. One example is that of waste, which is a huge problem in our country and in Europe. If produced in a lower amount and properly reused, waste could become a resource. Let's take organic waste, which is perhaps the "best" demonstration of the meaning of a lack of a systemic culture. Vast quantities of food and garden waste are still sent to landfill, demonstrating a lack of awareness of the precious value of organic waste. This represents around 35-40% of total waste, and when sent to landfill it becomes dangerous as it can ferment and produce methane and percolates, which can end up in groundwater. This is why landfill sites must be managed for at least 50 years after their closure, an incredible waste of public resources.

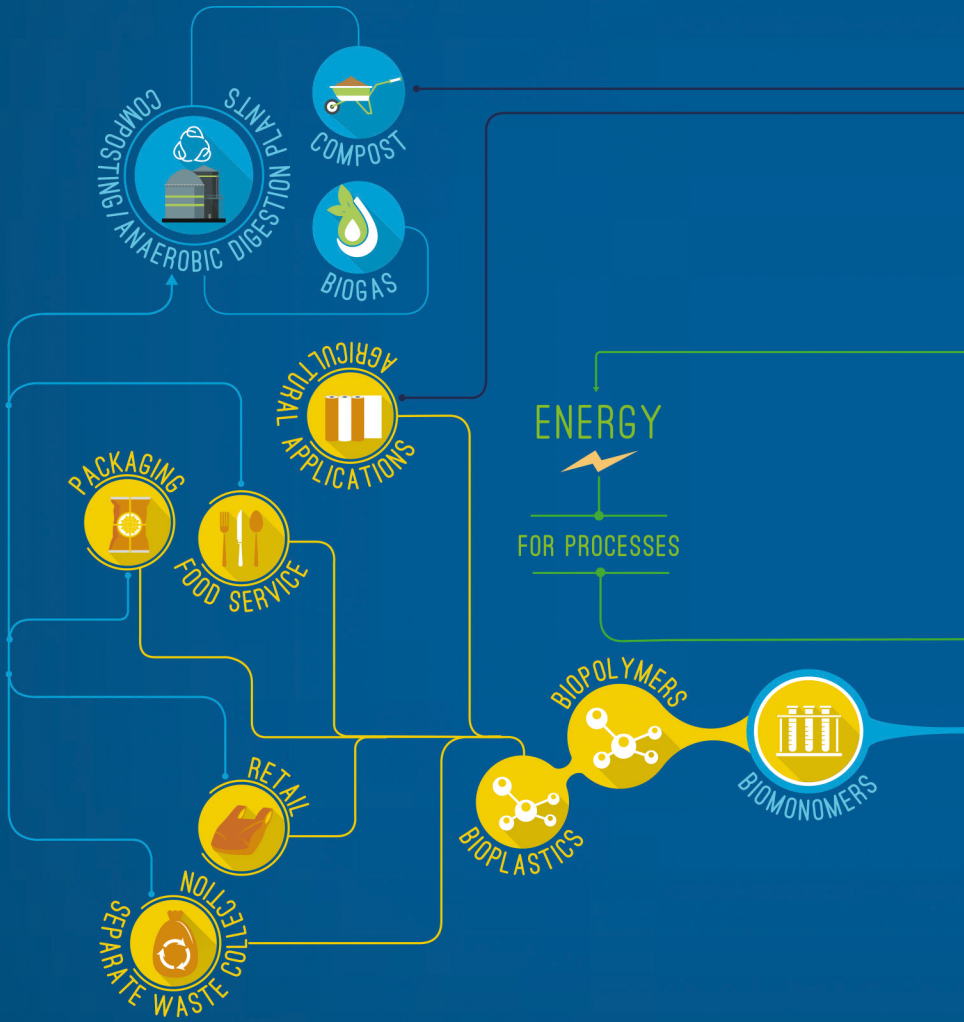
Organic waste can instead be transformed into a wonderful product like compost, which can also be combined with the production of biogas. When used in farming, compost combats the desertification of the soil, reduces water requirements, limits the effects of eutrophication typical of chemical fertilisers and makes plants more disease-resistant. We have been founders of the Consortium of Italian Composters and have been working with this Consortium and other waste experts for over 20 years, in order to improve systems for separate collection, combining the effects of compostable, breathable

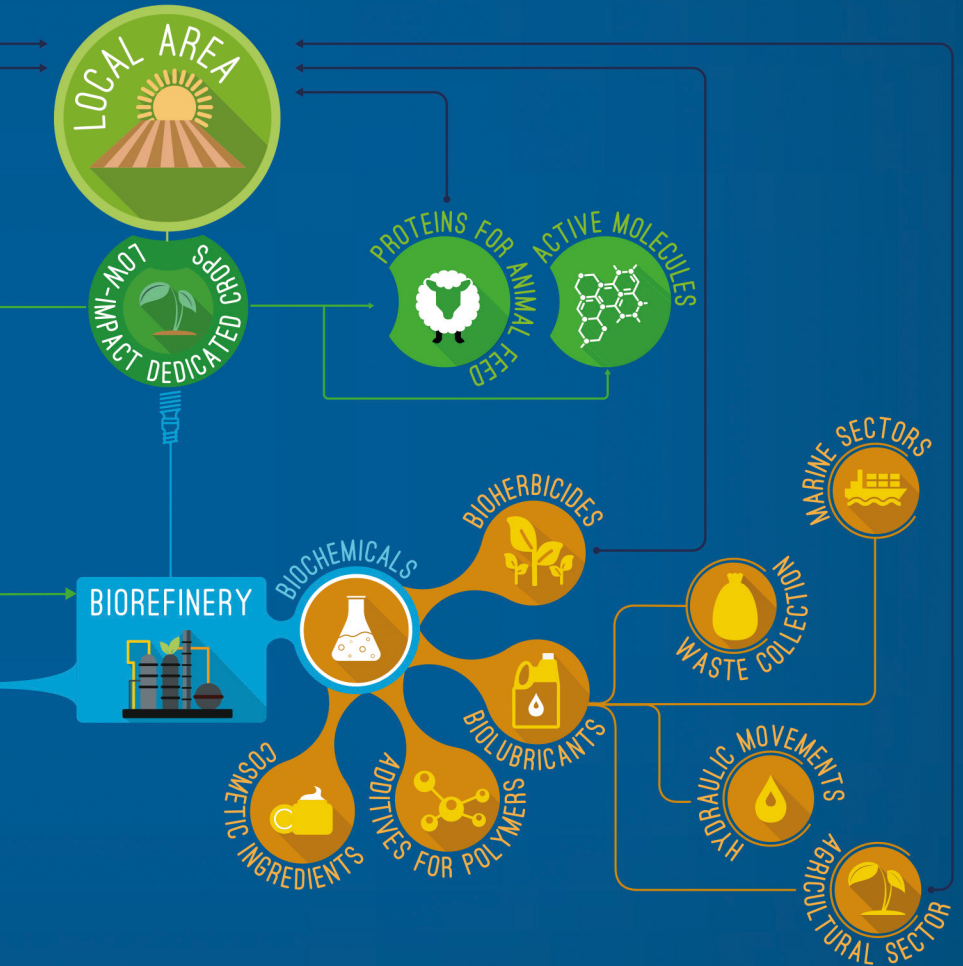
materials with vented kitchen bins, thereby allowing for the loss of weight of organic waste during collection and preventing bad smells, avoiding anaerobic fermentation. It was therefore possible to increase the quantity and quality of the organic waste collected and to transform it into useful soil improvers. This simple model has been growing significantly in Italy – today we have a city like Milan which represents an international example, collecting a huge quantity of organic waste (around 100 kg/inhabitant) of excellent quality (<5% of pollutants), and transforming it into humus for the soil, biogas and also bio-methane.

There are rules governing compost in Italy which are among the most advanced in Europe. The Consortium of Italian Composters, for example, has launched a quality mark for compost. In addition, the use of biodegradable and compostable plastics for applications which represent the greatest risk of polluting organic waste with plastics – such as bags for fruit and vegetables and for waste collection, foodservice products, food labels, coffee capsules, food packaging and above all carrier bags, which are considered among the greatest polluters of organic waste – has helped significantly improve the quality of organic waste. Carrier bags, which were once a great pollutant, now represent for city councils an opportunity to have free access to bags which can be reused for separate collection.

This has enabled the creation of long-term partnerships, not just with composters and public authorities, but also with big brands, processors, large-scale wholesale distribution and associations. The structure is in place for a new, more ambitious project entitled “Zero Organic Waste in Landfill”, launched by the Kyoto Club and the Sustainable Development Foundation and which a whole range of industrial and environmental or-

# The biorefinery integrated in the local area





ganisations have signed up to, in preparation for a strong position from Italy in relation to the Waste Framework Directive as part of the Circular Economy package being discussed at the European level.

By promoting these applications we have been able to achieve benefits not just in terms of waste management, but also in the bioplastics value-chain, with the revitalisation of upstream and downstream areas, the reactivation of industrial and research sites, private investments in cutting-edge technology and plants and the development of new value-chains and new bioproducts – such as biolubricants, bioherbicides and cosmetic ingredients from renewable raw materials – always with the aim of providing a concrete solution to important social and environmental problems.

#### **THE CASE-STUDY OF CARRIER BAGS AND THE ZERO-ORGANIC WASTE PROJECT**

The case-study of carrier bags provides an example of how products born out of this model represent a point of connection, a negative starting point which in time becomes positive.

Italy, with its pioneering legislation on biodegradable carrier bags, has shifted from being in breach of European rules to becoming a leader country. It has managed to build bridges between industry, the environmental sphere, academia and agriculture, and under the Italian Presidency of the EU it managed to complete a complex legislative process for the adoption of a directive on carrier bags which led various Member States to adapt their own legislation in this policy area. The lively debate which has taken place at the level of the EU and the Member States has helped raise awareness about the problem of pollution from plastics and has also drawn attention to organic waste

and the virtuous solutions which have been applied by some and which could be fully adopted by everyone.

Thanks to what has been achieved in Italy, carrier bags are becoming a symbol of the possible paradigm shift, for which we must look afresh upon the most insignificant objects surrounding us to reinvent them and accelerate the reconfiguration of systems of production and consumption in order to meet the triple challenge posed by the efficiency of resources, the resilience of ecosystems and the wellbeing of people.

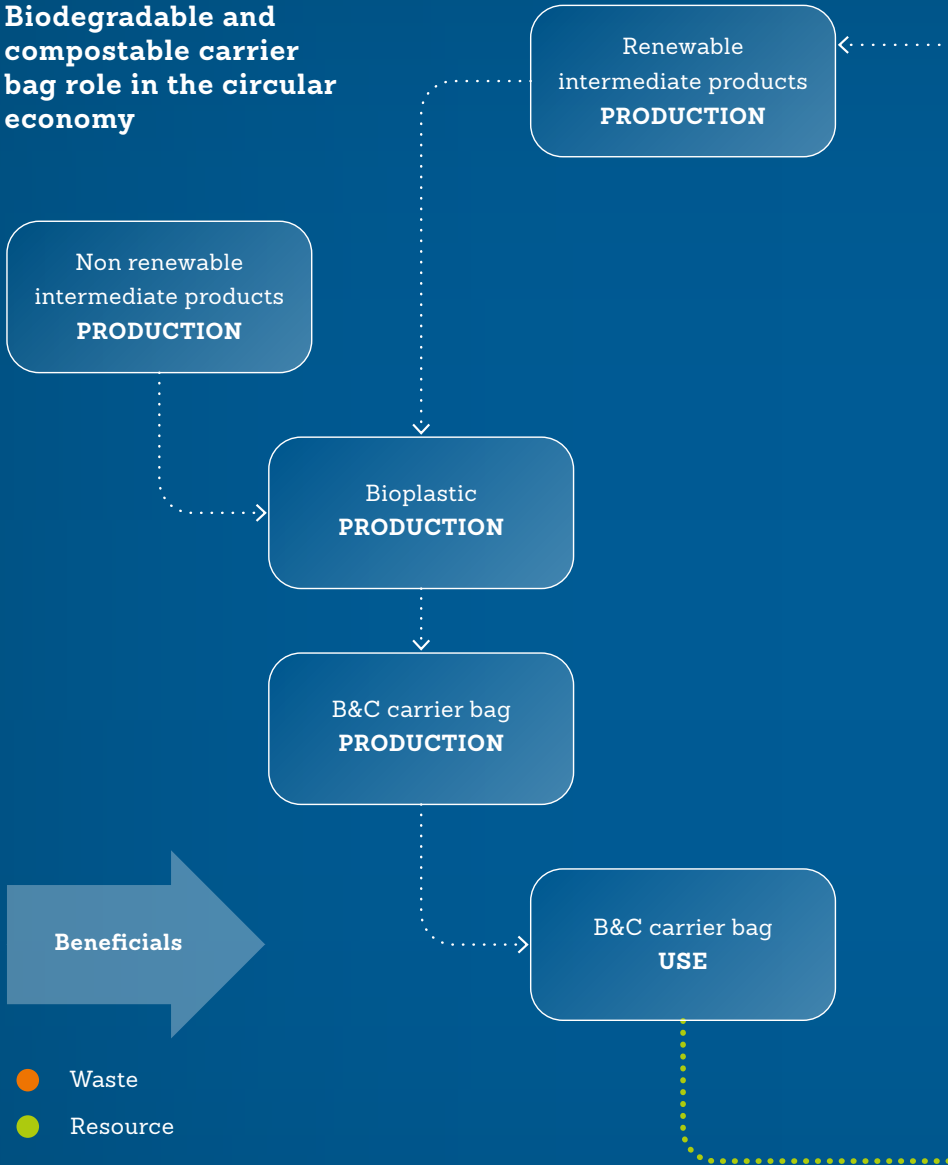
A recent analysis performed from a life cycle thinking perspective highlights the impressive decarbonization potential coming from an almost complete diversion of organic waste from landfill in Italy and the role of biodegradable and compostable carrier bags in achieving this objective.

Every year an estimated 10 million metric tonnes of organic waste is produced and about 6 million metric tonnes organically recycled in Italy.

The Life Cycle Analysis (LCA) analysis shows that the implementation of a waste system based on separate collection of organic waste and the re-use of compostable and biodegradable carrier bag has substantial positive effects on greenhouse gas (GHG) emission reductions. The analysis shows that this is the consequence of shifting from disposal by landfill into waste recovery by organic recycling (e.g. composting).

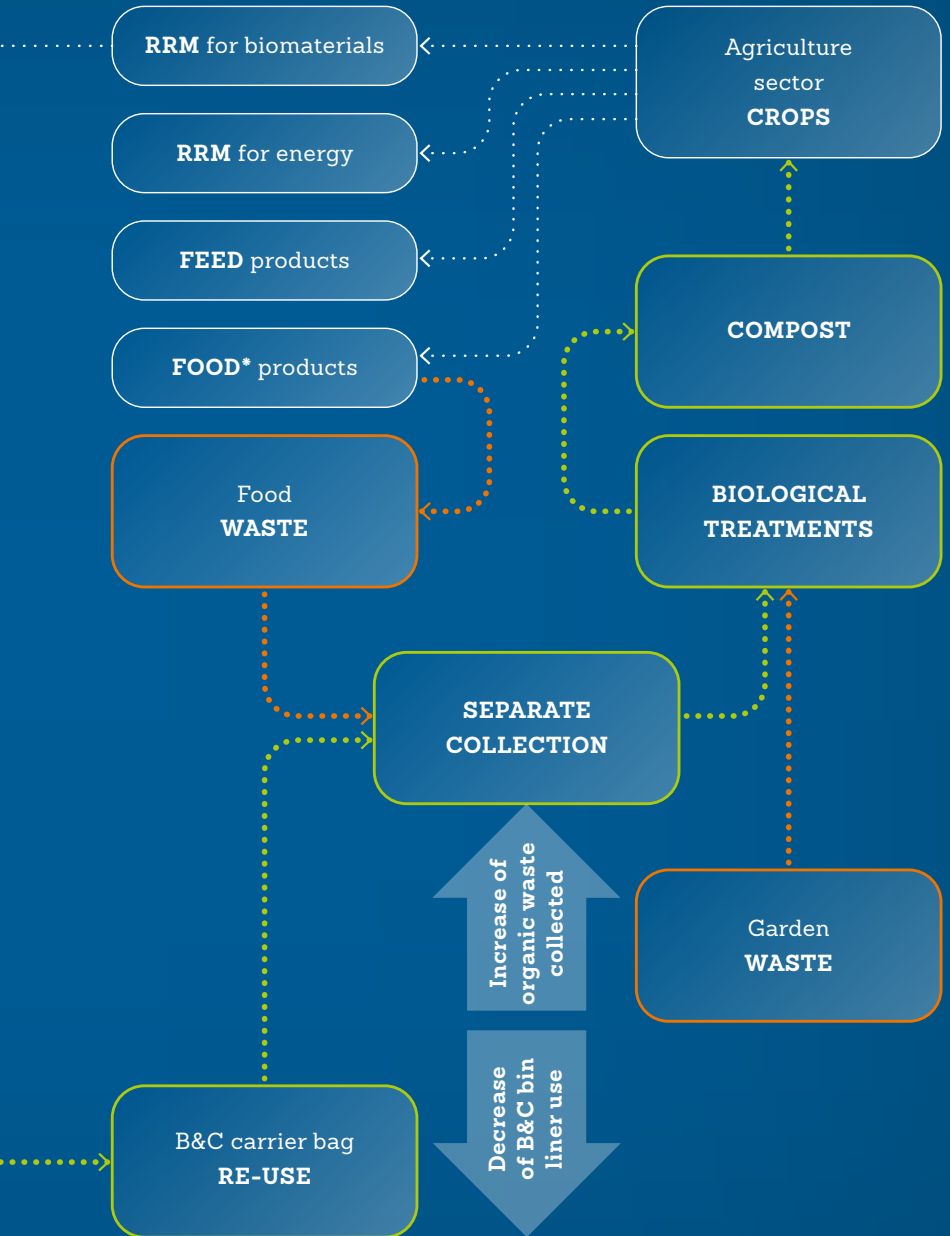
What would be the environmental consequences if the organic waste produced in Italy were totally collected using biodegradable and compostable bags and recycled? This would mean an extra 4 million metric tonnes per year collected thanks to best practices based on the biodegradable and compostable carrier bags reused as waste bags by citizens. The overall GHG balance caused by this shift is shown in figure “GHG emission balance

# Biodegradable and compostable carrier bag role in the circular economy

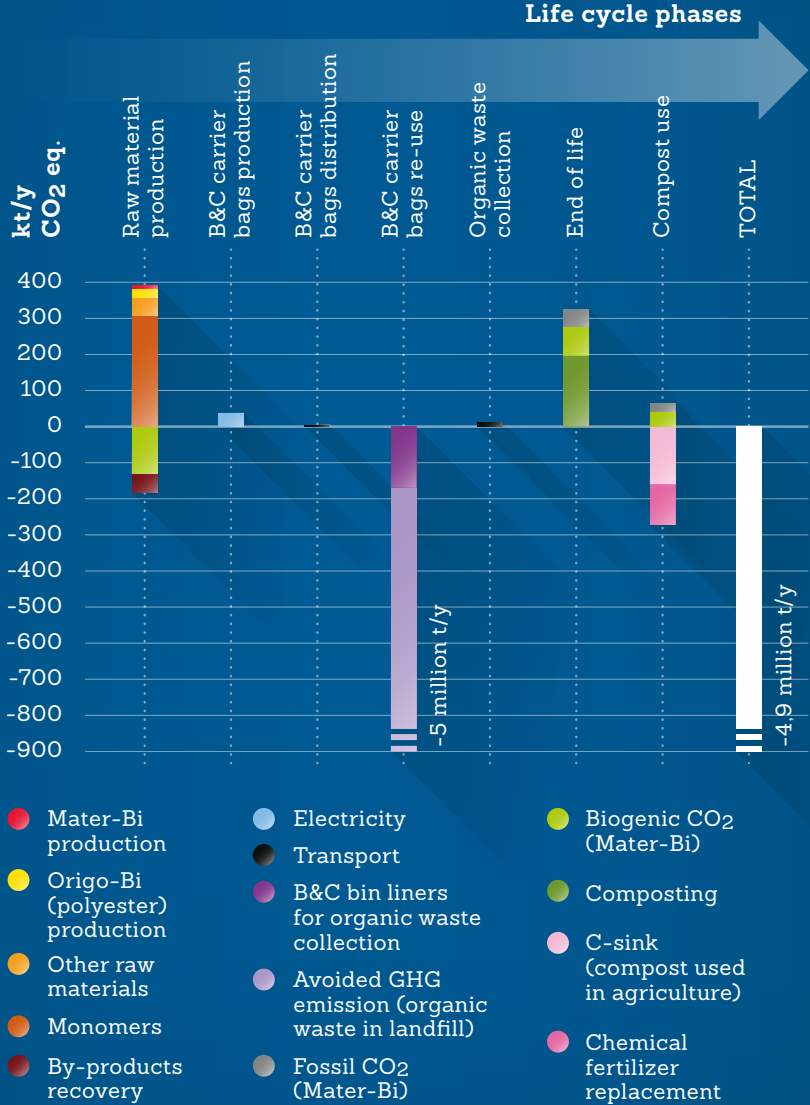


\* By 2030: increase of demand +50%





# GHG emission balance in case of zero organic waste in landfill in Italy with the use of 100 kt/y of IV generation bags



in case of zero organic waste in landfill in Italy with the use of 100 kt/y of IV generation bags”.

The benefits linked to the diversion from landfill to recovery of organic waste collected with biodegradable and compostable waste bags and the application of compost in agriculture are amazing with a net result of about -4.9 million metric tonnes of CO<sub>2eq</sub>/y.

## CONCLUSIONS

It is clear that the crisis becomes a question that is linked above all to time: the time necessary for systemic projects already in place to be rolled out nationwide, overcoming the culture of today and of the appearance over concrete achievements. If policies are not able to capitalise on the system-based economies and on the territorial regeneration projects that are created, the costs of “not doing anything” will be dramatically higher.

Today it is extremely important to be able to count on managers and business owners, as well as investors, academics and institutions, who truly understand the value of natural capital and social stability and incorporate them in their industrial and development plans. We cannot continue with an approach based simply on maximising profits; instead we must develop a systemic vision with which to oppose the culture which has contributed to the current wasteful model. We must ensure that the efficient use of resources and the elimination of waste are given central importance, transforming local problems into business opportunities, capable of extracting value from the preservation of natural and social capital and lending significant economic weight to the externalities generated by the various models of production and consumption, and participating in the cultural change which is essential for adopting a new and more virtuous development model.

We have said that the change must first of all be cultural, and therefore the educational aspect plays a decisive role. We need interdisciplinary and systemic training which overcomes the paradigm of individual leadership and competence, embracing topics such as ethics, so that we are women and men first and scientists, entrepreneurs and engineers second. Otherwise,

as Bertolt Brecht recalls in *Life of Galileo*, “If the scientists [...] limit themselves to piling up knowledge for knowledge’s sake then science can be crippled and your new machines will lead to nothing but new impositions. You may in due course discover all that there is to discover, and your progress will nonetheless be nothing but a progressive estrangement from mankind”.

The crisis we are experiencing is in some ways the result of resistance to changing the model. We must be able to reconnect the economy with society through the bioeconomy, because in this reconnection lies much more than industry and agriculture: it contains the antidote to the growing poverty which feeds populism, threatening our democracies.

Innovation in the service of territorial regeneration plays a fundamental role in building bioeconomy infrastructures: not white elephants, but interconnected biorefineries rooted in the local areas, in order to create a development network that is truly sustainable because it is able to involve communities. My hope is that what Novamont has built so far could represent a virtuous model and the starting point for an acceleration involving all the stakeholders interested to cooperate in Italy, Europe and the other extra-European countries.



This book is printed on FSC forest friendly paper.  
The FSC logo identifies products which contain paper from  
forests managed according to strict environmental,  
economic, social standards defined by the Forest Stewardship Council



ISBN 978-88-6627-221-2

