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Industrial Biotechnology in Italy: current status, R&D needs and cooperation opportunities

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Industrial Biotechnology: features & potential

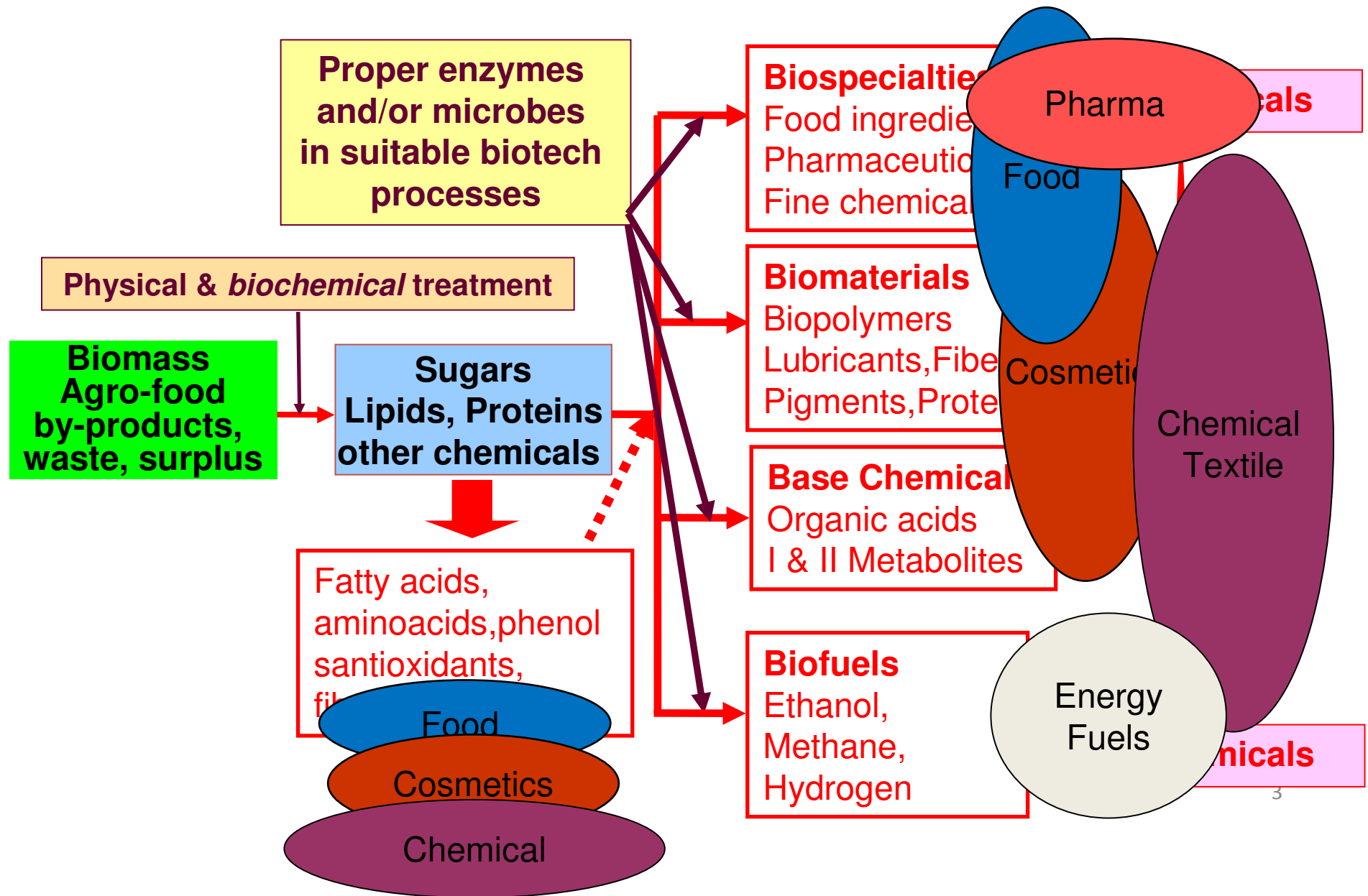
Industrial Biotechnology uses enzymes and/or microorganisms in tailored bioreactors/processes to produce:

- some conventional chemicals and materials (i.e., vanillin, cephalixin, polyesters, etc.) through pathways ensuring lower energy and water consumption, waste and CO₂ generation;
- compounds not obtainable through chemical routes (i.e., chiral compounds, novel I & II metabolites, etc.);
- a variety of biobased chemicals (reagents or building blocks for novel and conventional synthetic pathways), materials and fuels from biomass by reducing the dependency of current industry from the expensive and polluting fossil sources.

Thus, Industrial Biotechnology would contribute remarkably to improve the sustainability and competitiveness of current chemical, cosmetic, textile and energy industry. Further, if agrofood-industry by-products, wastes, and surplus are adopted as feedstocks, it provides solutions for also increasing the sustainability of the food industry.



More sustainable bio-processes & bioproducts from by-products and wastes

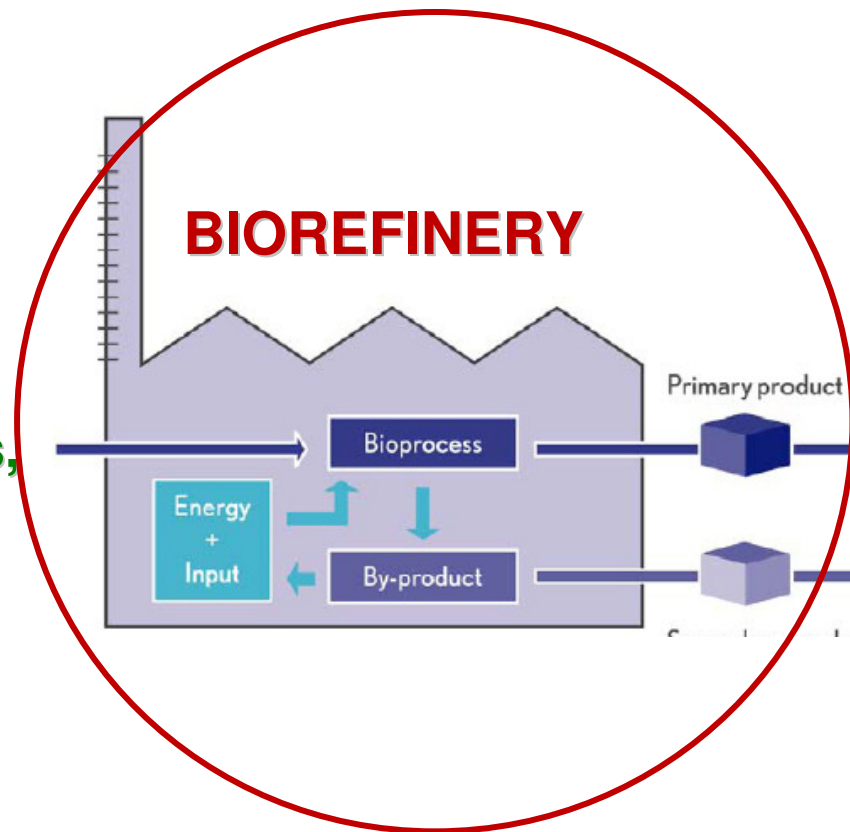


Integrated, multipurpose biorefinery

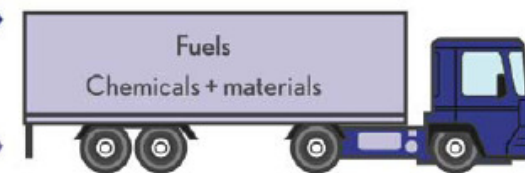
Towards a bio-based society: an integrated, multipurpose biorefinery

Biomass

Agro-food byproducts, surplus (effluents, waste)

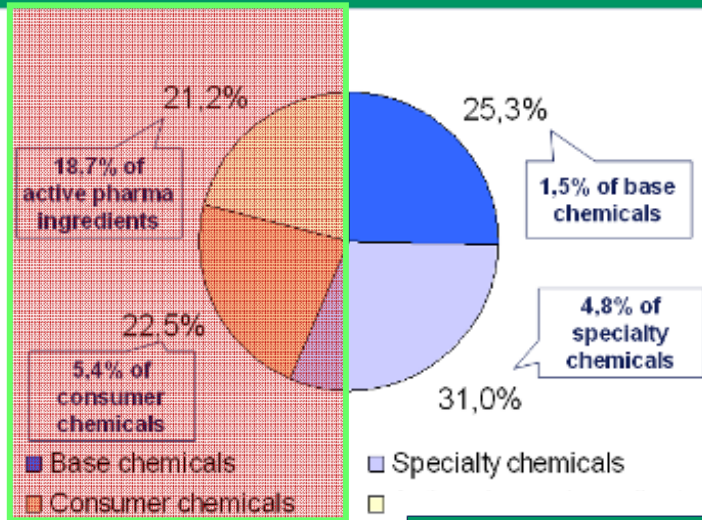


Biobased Chemicals, Materials and Fuels



Improved competitiveness by biomass feedstocks & bioprocessing

€ 48 billion, 2007

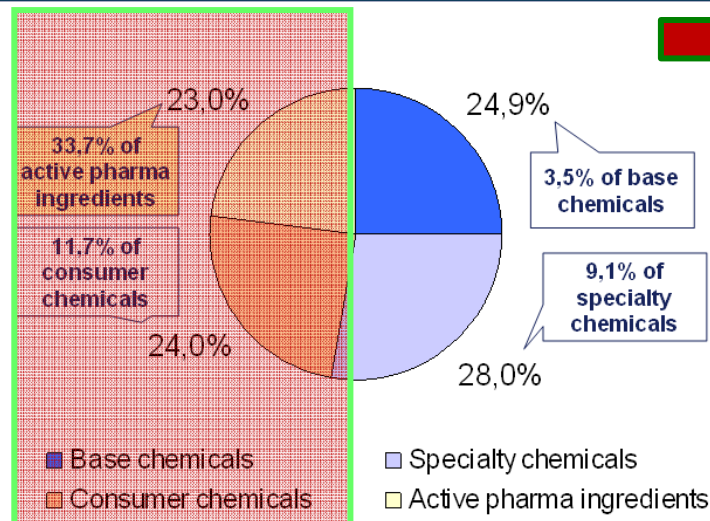


World sales of biotech-made biobased products

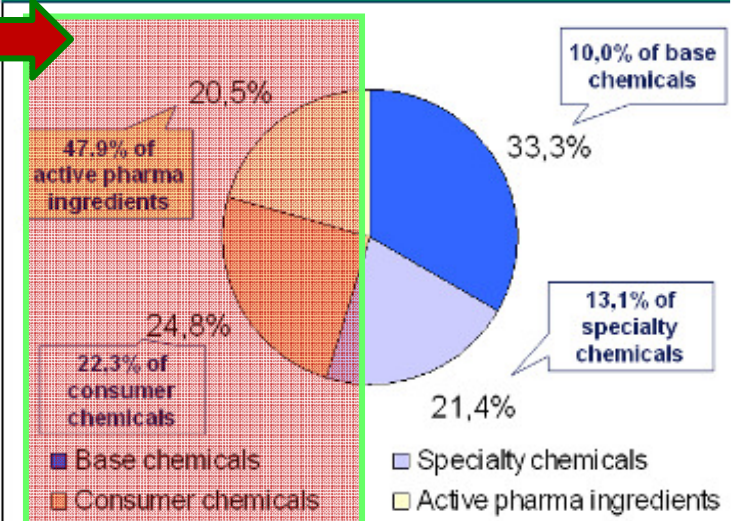
2007: 48 bil € (3,5% of total chemical sales)
 2012: 135 bil € (7,7% of total chemical sales)
 2017: 340 bil € (15,4% of total chemical sales)

G. Festel (OECD workshop, Vienna, January 2010)

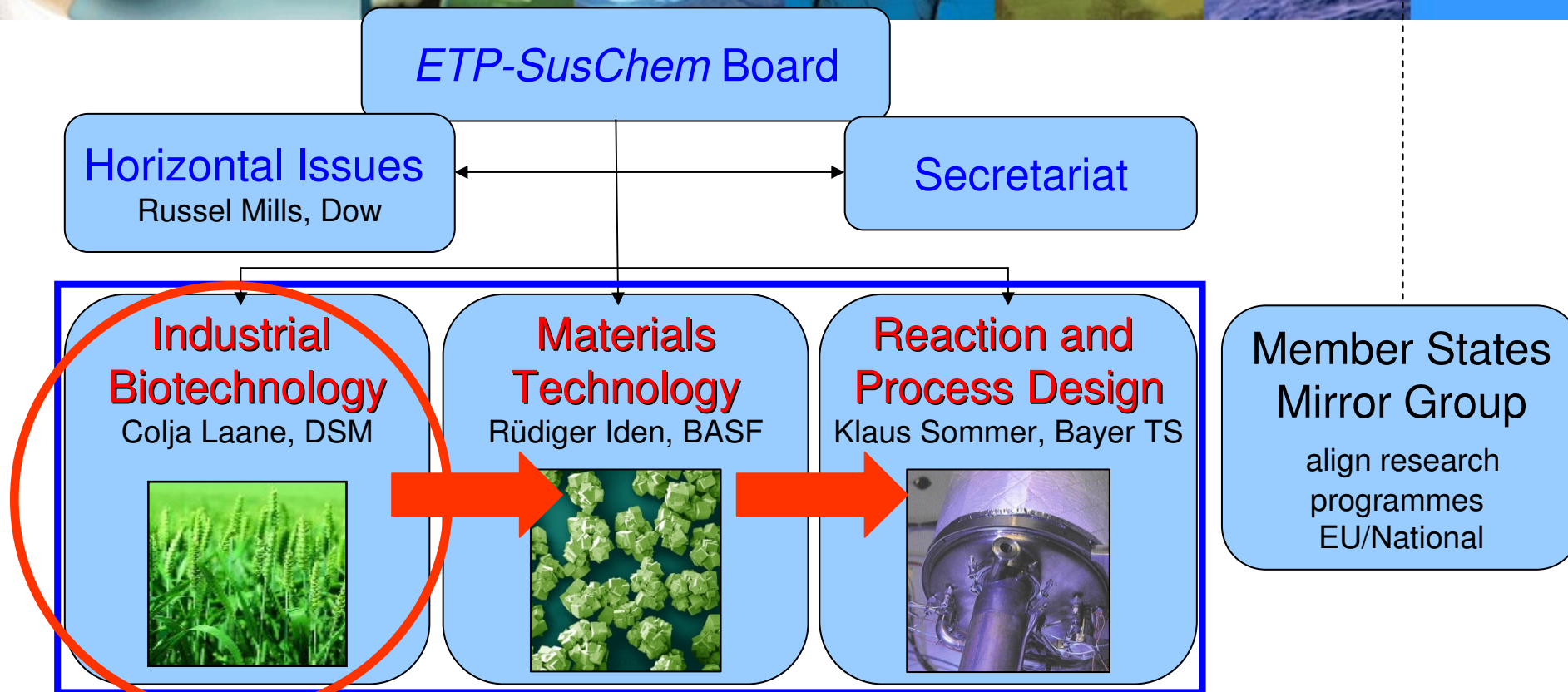
€ 135 billion, 2012



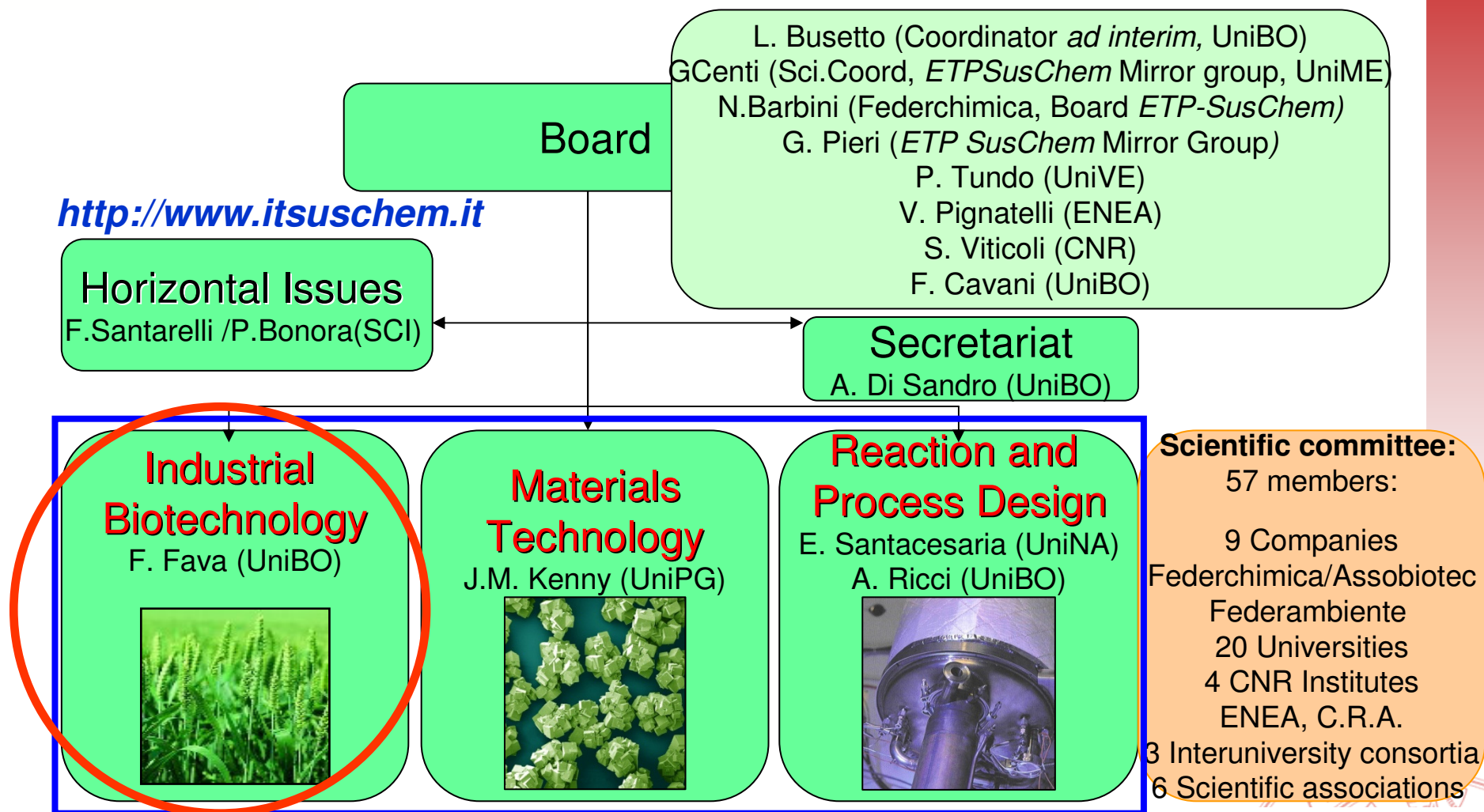
€ 340 billion, 2017



ETP-SusChem Structure (2004-2007)





Initiated in 2004 by Cefic and EuropaBio. Aimed at identifying industrial driven R&D priorities and strategies for boosting IB and innovation/competitiveness in the sector of sustainable chemistry for fulfilling Europe's vision of a sustainable and competitive knowledge-based economy.



Promoted by the University of Bologna in March 2006 under the auspices of **CRUI**, in cooperation with **Federchimica, CNR, SCI, ENEA, 9 Interuniversity Consortia**, several scientific/environmental associations, Centers of Excellence, Banks, etc.

Industrial Biotechnology in Italy: a survey

Universities	Industries & Spin off	Research Centers
<p>Polytechnic of Milano Polytechnic of Torino Polytechnic of Marche University of Bari University of Basilicata University of Bologna University of Cagliari University of Calabria University of Camerino University of Caserta University of Catania University of EasternPiedmont University of Ferrara University of Firenze University of Genova</p>	<p>Agrifutur srl, Alfianello, Brescia Agri2000 Soc. Coop. Bologna Agrolabo S.p.A, Scarmagno, TO AlfaWassermann S.p.A., Bologna Biospehere SpA, Bertinoro (FC) BioDec srl. Casalecchio di Reno (BO) Bioman Srl, Colleterto Giacosa (TO) Biopaint Srl, Colleterto Giacosa (TO) Biosearch Ambiente srl. Torino Biotecnologie BT Srl, Todi, Perugia Cestec S.p.A.Milano CSL SpA, Zelo Buon Persico Diaspa S.p.A.</p>	<p>Center for Biocatalysis & Bioeng. of Macromolecules (NSF) CIRPEB Napoli CNR Bari CNR Istituto di Chimica Biomolecolare, Catania CNR Istituto di Chimica Biomolecolare, Napoli CNR Sesto Fiorentino (FI) CNR, Istituto di Chimica del Riconoscimento Molecolare, Milano Int. Centre for Genetic Studies</p>
<p>University of Insubria University of Parma University of Pavia University of Perugia University of Pisa University of Pordenone University of Roma Tor Vergata University of Salerno University of Siena University of Teramo University of Trieste University of Verona University of Viterbo</p>	<p>Resindion srl, Binasco (MI) SERECO BIOTEST Perugia Sograt Chemicals srl SPES s.c.p.a, Fabriano (AN) Synbiotec srl, Camerino (MC)</p>	<p>Associazione Italiana Energia del Legno (AIEL) Associazione Interreg. Olivicola Medio Adriatico (AIOMA) Confederazione Italiana Agricoltori (CIA) Consorzio Nazionale Olivicoltori (CNO) LIBI, Laboratorio Internazionale di Bioinformatica, Bologna Bioindustry Park Canavese spa. Colleterto Giacosa (TO) Parco Tecnologico Padano, Lodi Associazione Biocatalisi e Bioseparazioni ANBI (Associazione Nazionale Biotecnologi Italiani) Interuniversity Consortium INSTM Interuniversity Consortium CIRCC Interuniversity Consortium CIRCMSB Interuniversity Consortium INBB Interuniversity Consortium CIB Consorzio di Ricerche Applicate alla Biotecnologia (CRAB)</p>
<p>40 Universities, 30 Companies, 15 Research Centers (CNR, ENEA, C.R.A., etc), several Interuniversity consortia, technology parks and scientific associations participated in the survey.</p> <p>Information on 178 national and European projects (over 130 of them of large dimensions) and on 44 national Companies were collected (survey performed in 2007-2008).</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>		

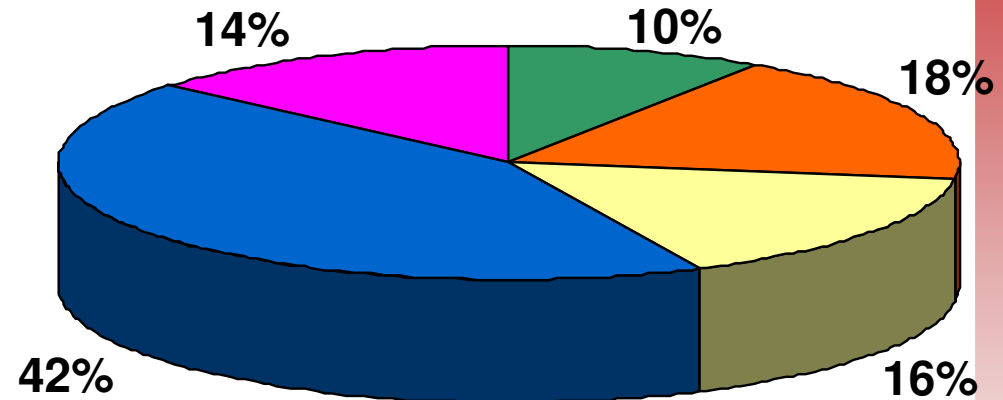
Industrial Biotechnology Industry in Italy

Industries reviewed: 44

70% SMEs, 15% spin-offs;

80% mono-product, with a
avery few R&D employees;

75% in the North Italy.



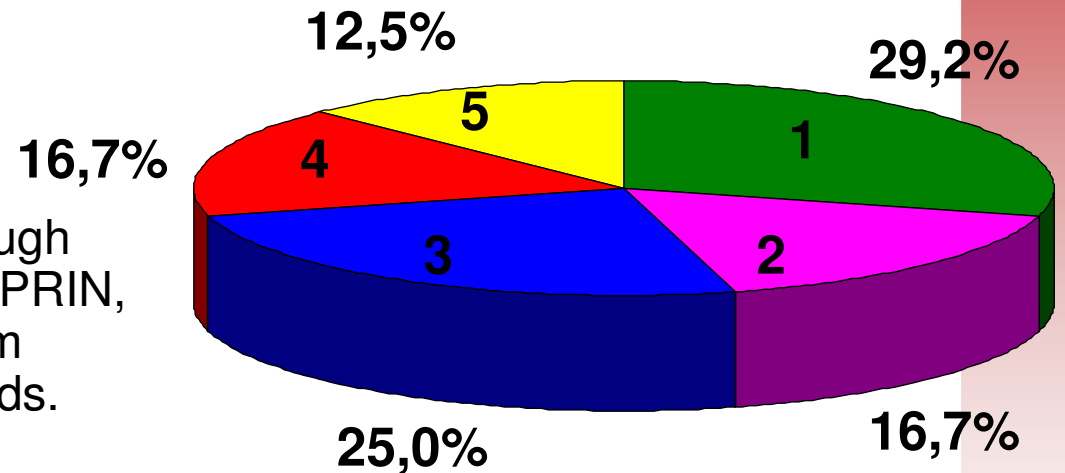
The Italian Industrial Biotech sector is fragmented. However, it has shown a considerable growth, especially in terms of R&D dedicated companies. Some national SpA Companies (i.e., Novamont, ENI, Mossi-Ghisolfi, etc) are rapidly incorporating biotech knowhow and tools in their productions.

Survey on R&D projects

Project reviewed: ~130

90% National and 10% EU.

80% of national projects financed through public funds (90% from Ministries -via PRIN, FIRB, FISIR, POR, CNR- and 10% from Regions) and 20% through private funds.



- 1) **New or improved biocatalysts and/or bioreactors/bioprocess**
- 2) **New strategies & tolls for the integrated valorization (biorefinery) of biomass and agrofood byproducts, wastes, effluents and surplus**
- 3) **Lab scale production of fine-chemicals, metabolites, flavors, heterologous proteins, enzymes, and microbes (including probiotics)**
- 4) **Production of biopolymers/fibers from biomass/agrofood by-products**
- 5) **Production of biogas, bioethanol and biodiesel from biomasses and agrofood byproducts, wastes, effluents and surplus**



***IT-SusChem* Official Website**

www.itsuschem.it

At the website:

Platform Vision Document (in English and in Italian)

Developed through a 3 months national consultation and submitted to the main Italian Ministries and Scientific Authorities and to DG Research offices, ETP-SusChem & related ETPs

List of *IT-SusChem* Stakeholders and Endorsement

News

Events

Press Coverage

Italian participation in FP7 projects on bioenergy production

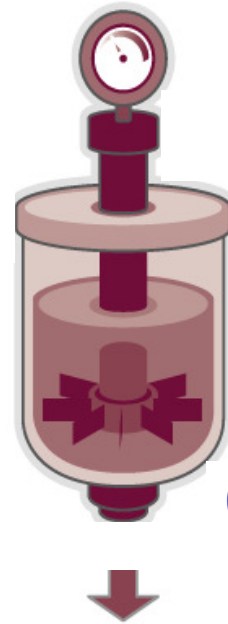
Acronym	Project name	Duration	Organization
GREENSYNGAS	<u>Advanced cleaning devices for production of green syngas</u>	2008-2011	University of Bologna
BABETHANOL	<u>New feedstock and innovative transformation process for a more sustainable development and production of lignocellulosic ethanol</u>	2009-2013	University of Udine
NEMO	<u>Novel high performance enzymes and micro-organisms for conversion of lignocellulosic biomass to ethanol</u>	2009-2013	University of Milan-Bicocca Chemtex
BIOLYFE	<u>Second BIOethanol process: demonstration scale for the step of Lignocellulosic hYdrolysis and Fermentation</u>	2010-2013	ENEA, Agriconsulting
SWEETFUEL	<u>Sweet Sorghum, an alternative Energy Crop</u>	2008-2010	University of Bologna

Italian participation in FP7 projects on biomass and biowaste biorefineries

Acronym	Project name	Duration	Organization
CROPS-2-INDUSTRY	<u>Non food-crops suitable for the new biobased industry</u>	2009-2012	University of Bologna
FORBIOPLAST	<u>Forest resource sustainability through bio-based-composite development</u>	2008-2012	University of Pisa
NAMASTE	<u>Conversion of fruit and cereal processing by-products into food/feed ingredients</u>	2010-2013	University of Bologna
PROSPERE	<u>Conversion of meat processing by-products/wastes into proteins and biomolecules also for the chemical ind.</u>	2009-2012	University of Parma
ECOBIOCAP	<u>Conversion of agrofood biowaste into advanced biopolymers for packaging</u>	2011-2014	Univ. of Bologna Univ. La Sapienza Novamont
EUROBIOREF	EUROpean multilevel integrated BIOREFinery design for sustainable biomass processin	2010-2014	CIRCC (University Consortium Chemical Reactivity and Catalysis)
SUSTOIL	<u>Developing advanced biorefinery schemes integrated to existing oil production/transesterification plants</u>	2008-2010	University of Foggia

Major R&D needs for Industrial Biotechnology

Reactor



1. Novel enzymes and microorganisms
4. Biocatalyst function & optimization

5. **Biocatalyst process design**

2. Microbial genomics & bioinformatics
3. Metabolic engineering & modeling

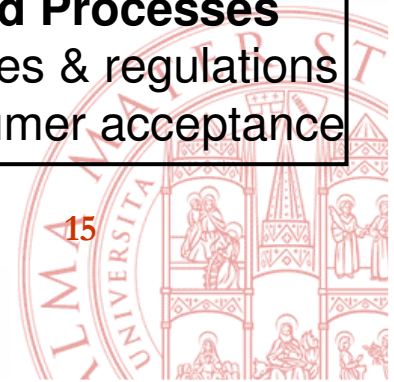
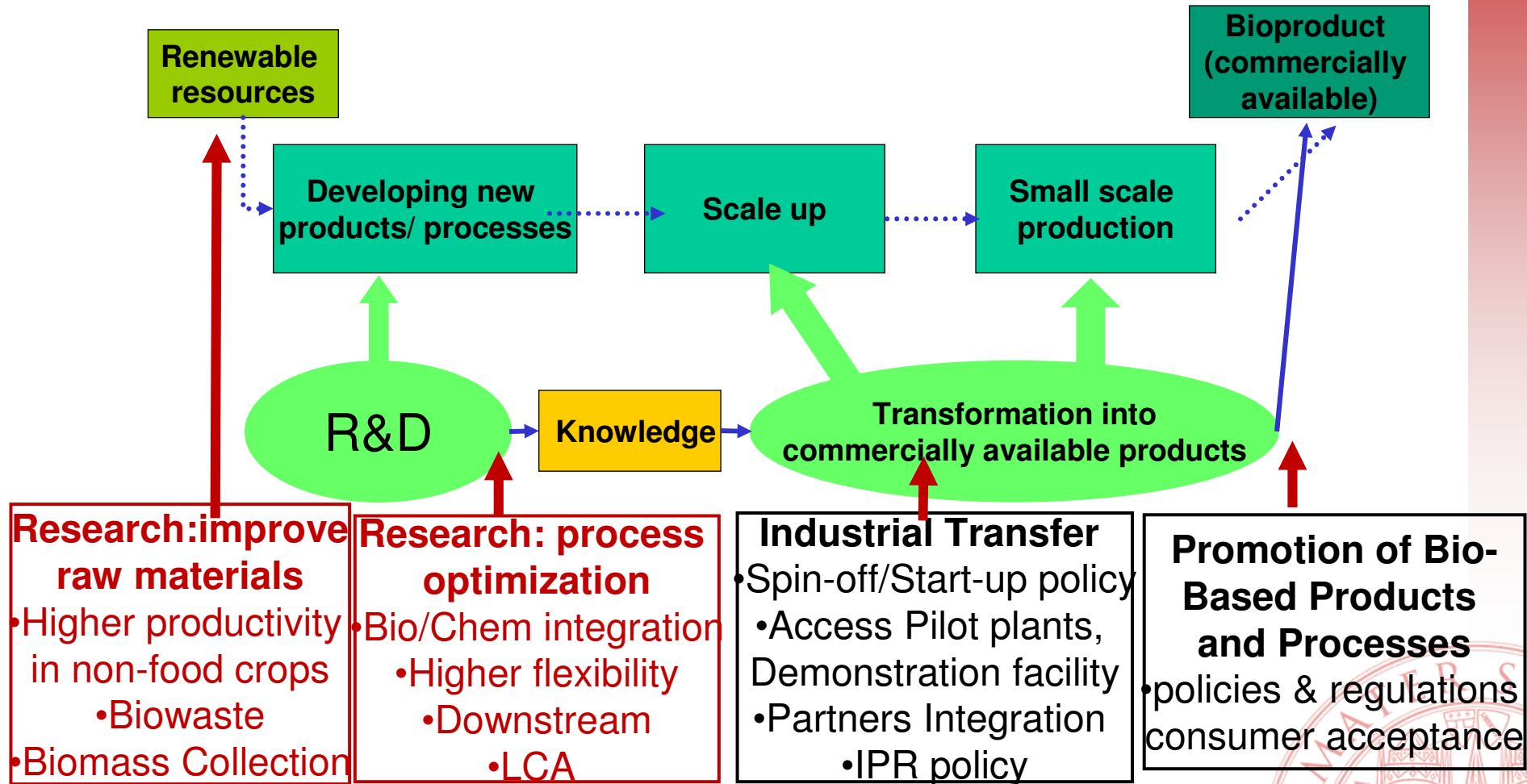
6. **Innovative fermentation science & engineering**

7. **Innovative downstream processing**

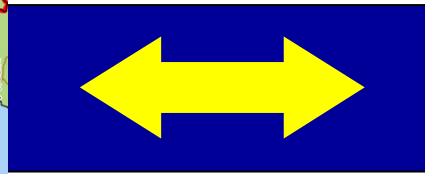
Biofuels, new biochemicals and bioproducts from biomasses, byproducts, wastes

- **Biofuels (bioethanol, biogas, bioH₂)**
- **Fibers, bio-based materials and bio/microbial polymers**
- **Fine & specialty chemicals**

Other challenges for Industrial Biotechnology



Industrial Biotechnology: a strategic opportunity to exploit together.....



Thank you

