SCIENZA PER L'AMORE

BIOHYST

Consiglio Nazionale delle Ricerche

HYST TECHNOLOGY

FOOD AND SUSTAINABLE ENERGY FROM BIOMASSES

CNR - Area Ricerca Roma 1 - Montelibretti (Rome) - 23rd February 2012

Meeting proceedings

“WELCOME GREETINGS”

Renzo Simonetti

Head of Research Area, CNR Rome 1

Welcome to all those present, guests, directors of the RM1 Research Institute, section managers and researchers. I would like also to greet the territorial representatives – first and foremost the mayor of Montelibretti, Professor Catania – who are all here to give testimony to how the territory, together with us, is interested in all studies and experiences connected to important issues like these. I will make a brief presentation to explain what a research unit is and what activities are carried out, in particular, in Research Area Rome1.

Research Area Rome1 was born in the early 70s when, to improve its scientific network, the CNR (Italian National Research Council) decided to create a series of centres distributed across Italy. Following the model of an American Campus, these research poles are configured as centres where, in an area with a single technical-logistic support, skills and institutions converge in order to carry out studies and research activities.

This centre is located between the provinces of Rome and Rieti and comprises 17 research centres. Our area collaborates with the Rome Universities, La Sapienza and Tor Vergata, and with the Arezzo centre of the Sabina Universitas; with the provinces of Rome, Rieti and Viterbo and other research centres. Among these I would like to mention the CRA (Agricultural Research Council), a centre with which we are developing a growing synergy and some of whose researchers are present in this room today.

Within Area Rome1 we have institutions of national and international importance, whose activities cover all sectors. Regarding the environment, for example, we have the Institute of Atmospheric Pollution (IIA - l'Istituto sull'Inquinamento Atmosferico), the Water Research Institute (IRSA - Istituto di Ricerca sulle Acque), the Institute of Environmental Geology and Geoengineering (IGAG - Istituto di Geologia Ambientale e Geoingegneria). In the cultural heritage sector our centre is home to the Institute for the Conservation and Valorization of Cultural Heritage (ICVBC - Istituto per la Conservazione e la Valorizzazione dei Beni Culturali), the Institute for the Study of Italic and Ancient Mediterranean Civilization (ISCIMA - Istituto di Studi sulle Civiltà Italiche e del Mediterraneo Antico) and the Institute for Technologies Applied to Cultural Heritage (ITABC - Istituto per le Tecnologie Applicate ai Beni Culturali).

I wish to recall the important role played by ISCIMA and ITABC researchers in excavations that brought to light the ancient necropolis of Colle del Forno, dating from the late seventh and early sixth century BC. These excavations were carried out using the most modern instrumental technology for the detection of buried structures and they now give us an accurate picture of the cultural and social evolution of the ancient Sabine city of Eretum.

As regards agriculture and chemistry sectors, I wish to extend a warm greeting to the Representative of the Institute of Agricultural Biology and Biotechnology (IBBA - Istituto di Biologia e Biotecnologia Agraria) and the Director of the Institute of Chemical Methodologies (IMC - Istituto di Metodologie Chimiche), who I can see in the audience.

A warm welcome also to the Representatives of the Institute of Agro-environmental and Forest Biology (IBAF - Istituto di Biologia Agroambientale e Forestale), whose director is currently responsible also of the Department of Earth and Environment and the representative of the Institute of Biomedical Engineering (ISIB - Istituto di Ingegneria Biomedica).

I would also like to mention the other institutions present in Area Rome1: the Institute of Crystallography (IC - Istituto di Cristallografia), the Institute of Inorganic Methodologies and of Plasmas (IMIP - Istituto di Metodologie Inorganiche e dei Plasmi), the Institute for Complex Systems (ISC - Istituto dei Sistemi Complessi), the Institute of Structure of Matter (ISM - Istituto di Struttura della Materia), the Institute of Nanostructured Materials (ISMN - Istituto per lo Studio dei Materiali Nanostrutturati), the Construction Technologies Institute (ITC - Istituto per le Tecnologie della Costruzione) and the Institute of Industrial Technologies and Automation (ITIA - Istituto di Tecnologie Industriali e Automazione).
In 2002, the Research Area Rome1 launched its web portal, becoming the seat of coordination and development of national and international programmes as well as a technological window. Acquired and developed potentials are therefore made available to scientific communities, industries, enterprises, local authorities and all stakeholders.
In 2005, our longstanding commitment was not only maintained but was further developed with the renewal and increased potential of the infrastructure for the management of our telecommunication network. This infrastructure is connected with a similar infrastructure of the Tor Vergata Research Area Rome2 via cutting-edge wireless technology. Recently the connection has been extended to our head office in Piazzale Aldo Moro in Rome. The wireless network allows us to transfer data and information at very high speeds, at the same time connecting us and providing a service throughout the area, above all to local authorities who often have difficulty in transferring data.

"HYST TECHNOLOGY FOR SECOND GENERATION BIOFUELS"

Professor Pierpaolo Dell'Omo

Department of Astronautical, Electrical and Energy Engineering at La Sapienza University of Rome

At the Department of Astronautical, Electrical and Energy Engineering in La Sapienza University of Rome, we have been performing studies on aspects of HYST technology related to the field of biofuels. However, HYST is of great interest also in other very important sectors, in particular the food sector. My presentation will be followed by that of Professor Luca Malagutti, of the Department of Animal Sciences at the University of Milan, who will illustrate HYST possibilities in the animal feed industry, then that of Dr. Francesca Luciani, of the Istituto Superiore di Sanità (Italian National Health Institute), who will illustrate applications for this technology in the food industry, particularly in the area of functional foods.
To begin with, let us see what HYST technology is about. HYST is a technology specifically designed to disaggregate biomass, at the same time minimizing the energy consumption required for processing. The raw material, which is conveyed in an air flow, is subjected to collisions that "break down" biomass. The system consists of three fundamental components: a) pneumatic circuit in which the material is conveyed, b) milling stages, inside which collisions occur, c) classifiers that separate the material disaggregated via collisions into three different flows according to particle size and chemical composition. **Slide 3** shows a centrifugal grinder, a second and third disaggregation device are concealed under the casing in the upper part of the machinery, while visible in the lower part are the classifiers and the three flows of material produced: G (Gross), M (Medium), F (Fine).
This system, as illustrated in the slide, is an industrial unit capable of processing 1 to 5 tons of material per hour.
Let us now consider applications for this technology in the field of biofuels. Second generation biofuel production must contend with difficulties in conversion of lignocellulosic materials to energy: the so-called "recalcitrance" of lignocellulose. In fact, the graph (**slide 4**) shows how the production of methane obtained by subjecting straw and vine prunings to anaerobic digestion processes is well below production obtained from corn and corn silage (which contain large amounts of starch and are in fact intended for human and animal consumption). Therefore, biomass must be subjected to a *pretreatment* which makes energy conversion easier.
HYST technology is used precisely to pretreat biomass before it is subjected to conversion processes, such as anaerobic digestion.
HYST pretreatment allows optimal energy use of the biomass processed, in this specific case cereal straw. The graph in **slide 5** shows that, once it has been pretreated with HYST, straw produces more methane than that produced with corn silage, which is the reference energy crop. Even product F has a yield of methane equal to that of corn grain, an excellent result for straw.
Furthermore, if we compare results obtained using HYST with those available in literature, we can observe that HYST produced the best results from cereal straw as raw material (**slide 6**).
A high methane production is not enough to make pretreatment valid, it is also necessary to contain the energy used during processing, otherwise it would use up more than what is produced. HYST is able to make excellent use of the energy required for disaggregation, minimizing energy consumption: 20-30 kWh per ton of material processed against about 500-1000 kWh required by other systems of pretreatment.
In conclusion, HYST technology reveals itself as an excellent system for the pretreatment of lignocellulosic biomass for the purpose of converting it into biomethane: with low operating costs and ready to kick off at an industrial level.

The study of the entire production process has enabled us to estimate that HYST biomethane will have a production cost of about 0.54 € per litre of gasoline equivalent, well below the estimated cost for first generation biomethane (0.67 € per litre of gasoline equivalent) and comparable with the cost of gasoline (0.52 €/l). This cost will be significantly lower than that of the biofuels we are currently importing largely from abroad (bioethanol and biodiesel), roughly equal to 1 € per litre of gasoline equivalent.

HYST, therefore, is our best option for starting industrial productions of second generation biofuels. We not only expect low production costs, but also an actual start-up of the agro-energy supply chain. With the 10 million tons of lignocellulosic residues generated by agriculture in Italy it is possible to meet 5% of energy needs in the Italian transport sector and , thanks to the rules established by the EU for second generation fuels, achieve the European target of replacing 10% of energy requirements.

Finally, let us see how HYST technology fits into the global technical and scientific scenario. In 2011, articles appeared in a major scientific journal (Powder Technology) illustrating the first results obtained with pretreatment technologies that involved successive steps of disaggregation and classification (sieving) of straw; more or less what we saw accomplished with the HYST system. However, this research is still confined within research labs, with equipment that can work only a few kilograms of material against several tons per hour processed by the HYST system. Many of the issues debated, such as an excessive consumption of energy, have already been resolved by HYST. This technology has already achieved the necessary development for industrial use, while the undergoing line of research to which it belongs is still confined to the level of laboratory achievements (**slides 14-15**).

TECNOLOGIA HYST

Dalle biomasse alimenti ed energia sostenibile

CNR - Area della Ricerca Roma 1

Montelibretti (Roma), 23 febbraio 2012 ore 10.00 - 13.00

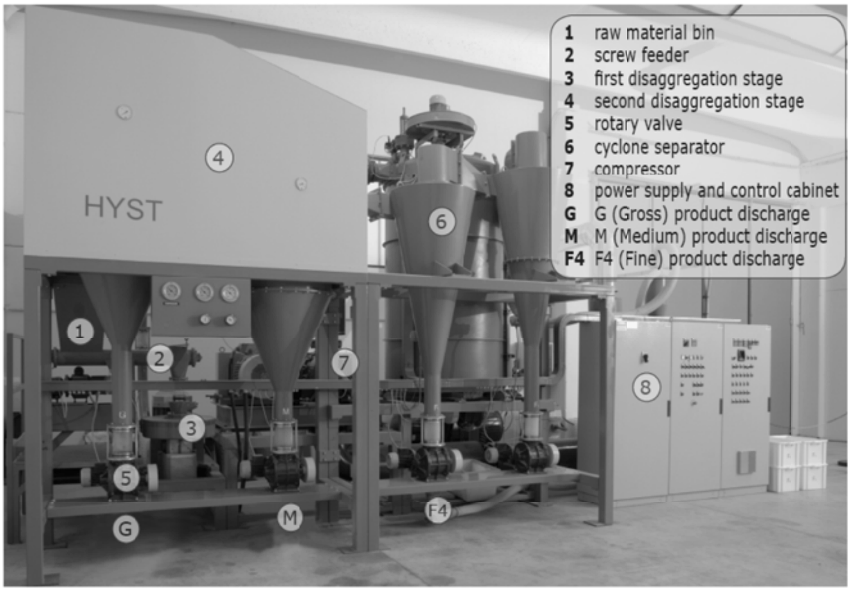
LA TECNOLOGIA HYST PER BIOCARBURANTI DI SECONDA GENERAZIONE

Pier Paolo Dell'Omo

Dipartimento di Ingegneria Astronautica, Elettrica ed Energetica

Università di Roma La Sapienza

HYST: COME FUNZIONA



La biomassa viene trasportata da una corrente d'aria

e disgregata per mezzo di processi d'urto (di vario tipo)

Ai vari stadi di urto sono interposti step di classificazione del materiale.

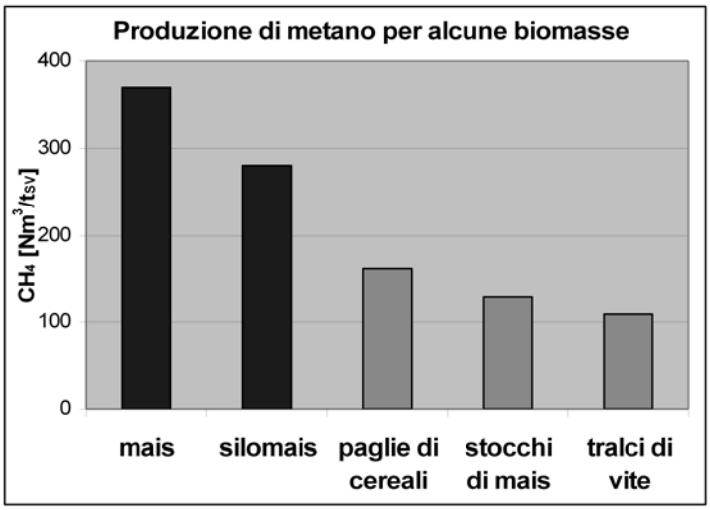
L'intero sistema è concepito per rendere minimi i consumi energetici.

Produce tre correnti di materiale con diversa granulometria e composizione chimica (G, M, F).

Dispositivo di scala industriale *(capacità 1-5 t/h)*

BIOCARBURANTI DI SECONDA GENERAZIONE: LE DIFFICOLTA'

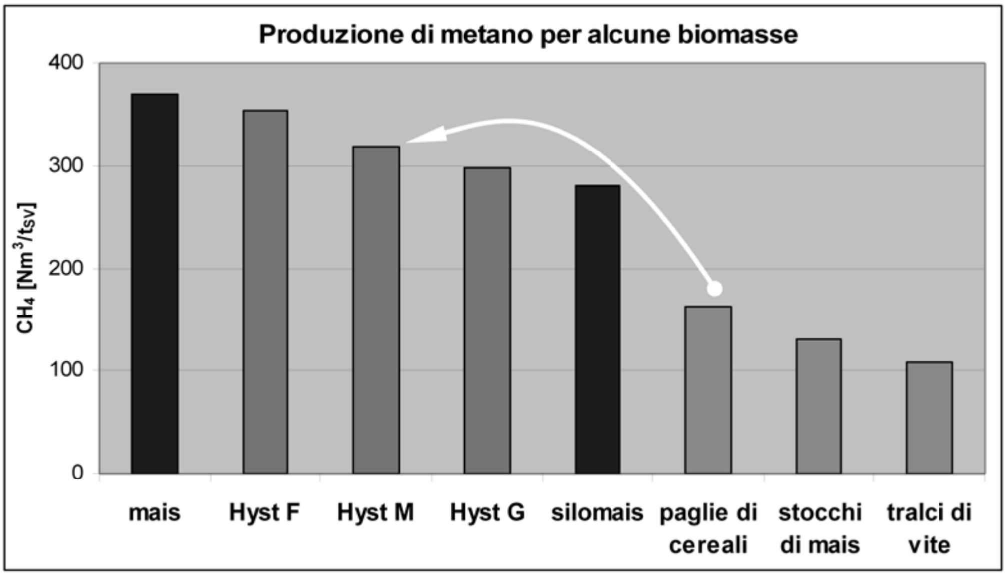
Difficoltà di idrolisi della cellulosa ed emicellulosa (*recalcitranza*)



Scarsa produzione di metano delle lignocellulose rispetto a biomasse amidacee

E' QUINDI NECESSARIO RICORRERE A UN PRETRATTAMENTO DELLA BIOMASSA

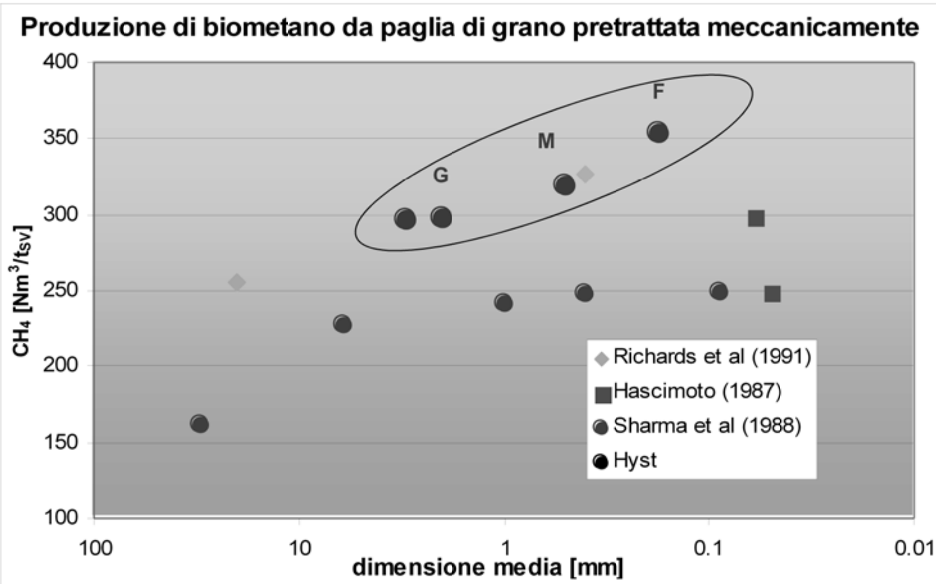
PRETRATTAMENTO HYST



- Ottimi risultati dalla paglia con produzioni superiori a quelle del silomais
- Per la frazione F produzioni comparabili a quelle delle cariossidi

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

PRETRATTAMENTO HYST

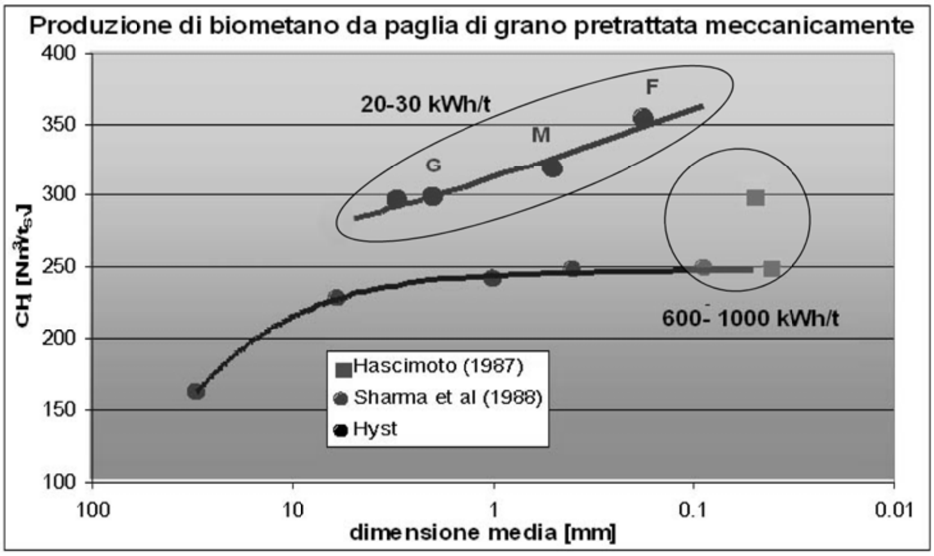


Le rese in metano sono tra le più alte osservate per pretrattamenti di natura meccanica.

MA NON É TUTTO...

SAPIENZA UNIVERSITÀ DI ROMA

PRETRATTAMENTO HYST: EFFICIENZA ENERGETICA

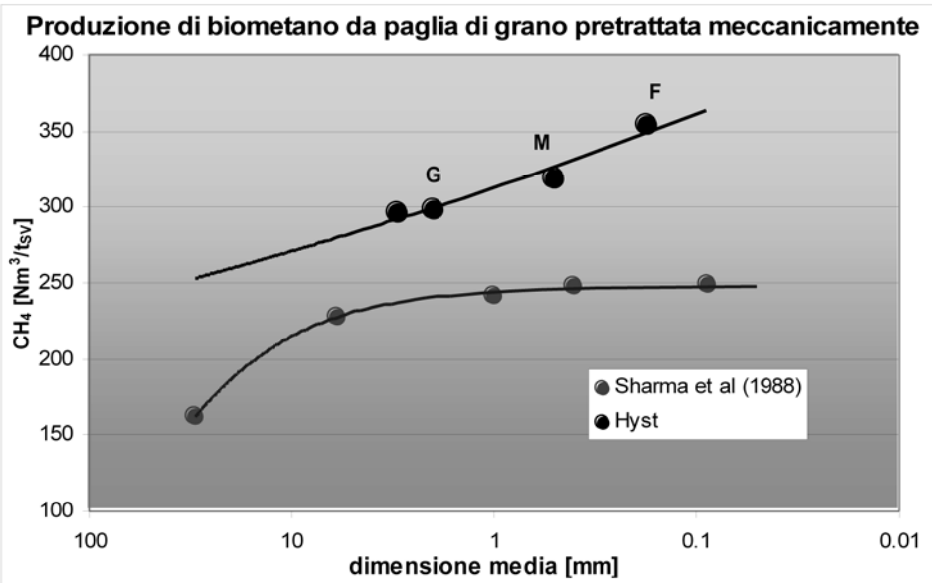


Pretrattamenti chimici e/o termochimici sono onerosi e richiedono il recupero dei chemicals

Pretrattamenti di tipo fisico richiedono grandi quantità di energia (fino al 30% dei consumi del processo)

HYST: ridotto consumo di energia elettrica

PRETRATTAMENTO HYST: EFFICIENZA ENERGETICA



Ottimale utilizzo dell'energia di "disgregazione"

PRETRATTAMENTO HYST

IN CONCLUSIONE IL PRETRATTAMENTO HYST CONSENTE:

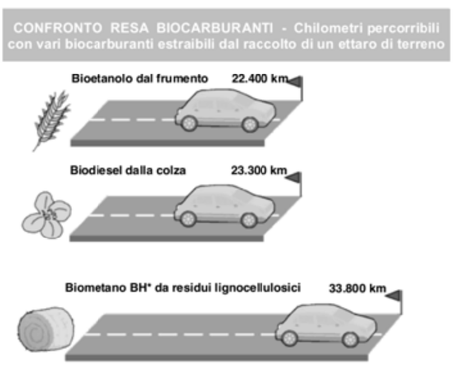
- **Elevate produzioni di metano da paglie di cereali sottoposte a digestione anaerobica**
- **Prodotti a bassa granulometria *(farine di paglia)* che si miscelano ai fanghi del digestore senza galleggiare**
- **Ridotta richiesta di energia elettrica *(20-30 kWh/t – 3-4 €/t)***
- **Ridotti costi di gestione *(non occorrono addetti all'unità)***

QUINDI:

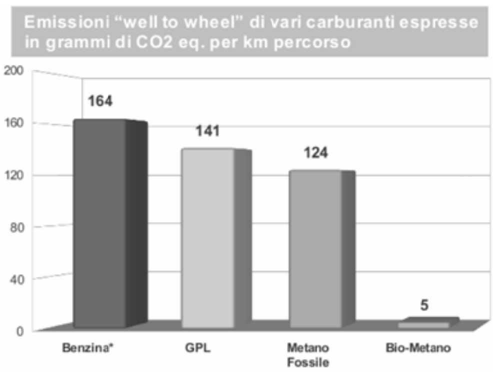
HYST E' UN OTTIMO PRETRATTAMENTO PER PRODURRE BIOMETANO PER AUTOTRAZIONE DI SECONDA GENERAZIONE

PRETRATTAMENTO HYST: EFFICIENZA ENERGETICA

IL BIOMETANO E' UN OTTIMO CARBURANTE:

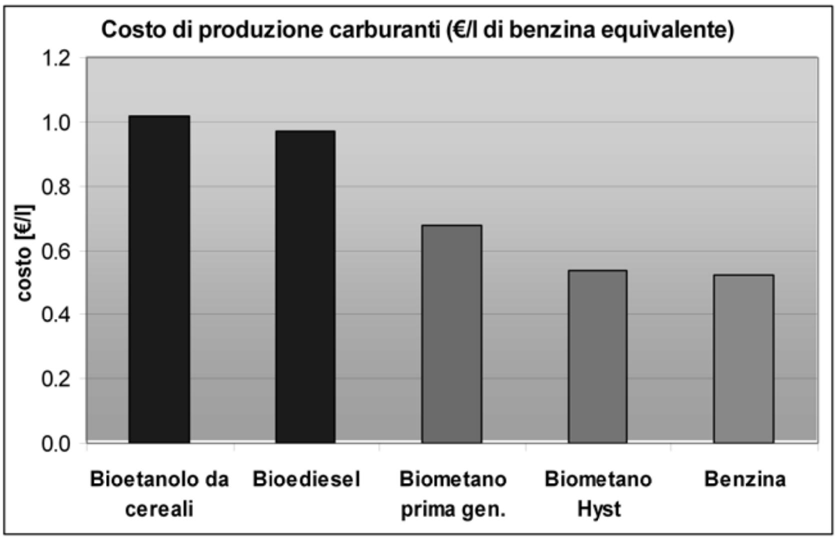


Elevata efficienza energetica



Ridottissime emissioni GHG

BIOMETANO HYST: I COSTI



- Costi di produzione inferiori a quelli dei biocarburanti di prima generazione
- Costi di produzione comparabili a quelli dei carburanti tradizionali

BIOMETANO HYST: FATTIBILITÀ

In Italia sono già operanti oltre 700 impianti biogas, quindi il biometano (risultato della purificazione – upgrading- del biogas) è una opzione reale, non un progetto dimostrativo.

•

10 milioni di tonnellate di residui lignocellulosi prodotti dalle attività agricole consentirebbero di coprire circa il 5% del fabbisogno energetico del settore dei trasporti italiano.

•

In base alle regole stabilite dall'Unione i biocarburanti di seconda generazione sono premiati con un doppio valore energetico. Quindi il biometano Hyst può consentire il raggiungimento della soglia del 10% prevista per il 2020.

Consiglio Nazionale delle Ricerche — BioHYST — SCIENZA PER L'AMORE

HYST E LO STATO DELL'ARTE DELLA RICERCA

Powder Technology 208 (2011) 266–270

Contents lists available at ScienceDirect

Powder Technology

journal homepage: www.elsevier.com/locate/powtec

Successive centrifugal grinding and sieving of wheat straw

Gabriela Ghizzi D. Silva *, Stéphane Guilbert, Xavier Rouau

UMR1208 Ingénierie des Agropolymères et Technologies Emergentes – INRA, CIRAD, SupAgro Montpellier, Université Montpellier 2, France

Apparecchiature da laboratorio 3-6 kg/h

HYST

Apparecchiatura industriale 1000-5000 kg/h

SAPIENZA UNIVERSITÀ DI ROMA

Consiglio Nazionale delle Ricerche — BioHYST — SCIENZA PER L'AMORE

HYST E LO STATO DELL'ARTE DELLA RICERCA

STATO DELL'ARTE	HYST
Processi a scale di laboratorio 3-6 kg/h	Processo industriale 1500-5000 kg/h
necessità di operare in numerosi passi successivi per evitare eccessivo riscaldamento	nessun riscaldamento
Si ritiene che la frazione fine sia quella di peggiore qualità per la trasformazione in biocombustibili	**rese di conversione in biometano estremamente elevate riduzione significativa del contenuto di H_2S**
Associazione dei disgregatori centrifughi con altri sistemi per disgregare la struttura lignocellulosica: allo studio	già realizzata e operativa
eccessivi consumi energetici rendono ancora improponibile l'utilizzo industriale	**consumi energetici estremamente ridotti**

SAPIENZA UNIVERSITÀ DI ROMA

HYST TECHNOLOGY FOR ANIMAL FEED

Professor Luca Malagutti

University of Milan- Department of Animal Sciences

My presentation focuses on HYST technology applied to certain agricultural by-products used in animal feed.

The use of agricultural and agro-industrial by-products in animal feed is an ancient practice that has always been carried out since it is the best way to give value to products considered waste.

Some of these – for example, citrus pulp (from citrus juice industries), beet pulp (residues from sugar extraction processes) and brewers grains (residues from beer production) – are characterized by high nutritional values, expressed in UFL (forage unit for milk production), reaching values close to those of top quality cereal flour (**slide 2**). Others – such as cereal straw or corn stalks or wheat bran – are characterized by lower nutritional values (**slide 3**), but are nevertheless used. Indeed, straw is essential in the diet of dairy cows and beef cattle, and bran in porker feed.

The parameter that most reduces the nutritional value of these products is certainly lignin (slide 4). Lignin is a complex organic polymer of the cell wall, consisting of phenolic compounds. It is a non-degradable molecule and is characterized by a particular web-like structure that encrusts the plant cell walls preventing availability of nutrients.

Several studies have indicated that increased content of lignin in a matrix reduces digestibility of dry matter of animal feed (**slide 4** – graph on the left) or the conversion into ethanol of the carbohydrates present in organic matrices intended for the production of energy (**slide 4** – graph on the right). Therefore, the possibility of treatments that reduce the negative effect of lignin is definitely an opportunity to be seized.

In the past other types of treatment were carried out, chemical (with soda or ammonia) or mechanical (shredding or grinding), in order to break down the particular structure of lignin and try to increase, in this way, the availability of nutrients in the treated matrix.

HYST technology can break down the structure of biomass and it can increase availability of nutrients. In a series of tests conducted in our Department at the University of Milan, some by-products were subjected to treatment with HYST technology: namely, wheat bran, wheat straw and straw from corn stalks shredded to a length of less than 1cm (**slide 5**). HYST technology proved able to separate the treated biomass into three fractions: the first with a larger particle size called G, the second with intermediate particle size, called M, and the third finer fraction called F (**slide 6**). These three fractions obtained from each one of the matrices treated were tested chemically and biologically to determine their nutritional value. Chemical tests revealed, for all three matrices, an increase in nutrients, in particular in crude protein and starch, and a reduction in NDF (neutral detergent fibre), ADF (acid detergent fibre) and ADL (acid detergent lignin) in Fraction F compared to base sample (**slide 7,8 & 9**).

Biological tests were carried out on the three fractions of all the matrices to estimate the nutritional value (**slide 10**). NDF digestibility – the plant fibre fraction is essential in diets, especially in the diets of ruminants – was determined with an *in vitro* method, the Ankom Daisy Incubator, which entails incubation of food sample with rumen fluid and a buffer solution. In addition, also *in vitro*, gas production was determined and digestibility of organic substance and final nutritional value was calculated according to Menke and Steingass. Nutritional value was estimated and expressed in UFL using the Menke equation which combines chemical parameters (crude protein ether extract) and parameters derived from biological analysis (gas production in 24 hours). Gas production is the estimate of fermentability which is related to/in function of the energy contained in the food.

The equation proposed by Menke was used also to estimate the digestibility of the organic substance. Apart from gas production, other analytical parameters considered were ash and crude protein. A progressive increase was observed in gas produced from the incubation of a food sample going from base sample to Fraction F. This means an increase of the energy contained in the sample and improved digestibility of organic matter and NDF. As a result, the UFL value, which expresses the final nutritional value of the sample (**slide 11**), was equal to 1.07 for wheat bran (**slide 12**), a value similar to that of cereal flour. Even for cereal straw (**slide 13**) and straw from corn stalks (**slide 14**) we can observe and increase in digestibility and therefore in the nutritional value of Fraction F. However, if compared with the base sample it is not only the digestibility of Fraction F that increases. If we calculate the overall digestibility of the organic substance of the three fractions and compare it with the digestibility of the base sample we can observe that, with regard to bran (**slide 15**), there is an increase of 4% (from 74.5% to 77.4%); with regard to cereal straw there is an increase of 5% (**slide 16**) and for corn straw the increase is greater than 4% (**slide 17**).
Again considering the three fractions as a whole, as far as NDF digestibility of wheat straw is concerned no differences were found (**slide 18**), while an increase of more than 3% was found in straw derived from corn stalks (**slide 19**) and in bran digestibility increased by as much as 12% (**slide 20**).
With regard to the finer F fractions obtained from all three of the products treated (**slide 21**), nutritional value expressed in UFL showed an increase of more than 20% compared to the raw sample. An increase that is as high as 33% for corn straw, which, of the three matrices, is decidedly inferior from a nutritional point of view.
Taking into account the overall nutritional value of the three fractions compared with the raw sample, wheat bran shows an increase of 4.1%, and cereal straw and corn stalks show an increase of over 6% (**slide 22**).
In conclusion we can say that HYST technology applied to agricultural by-products resulted in: separation of fractions with different chemical characteristics useful for diverse purposes (food, feed and production of bioenergy); production of a finer fraction of high biological value, comparable to top quality flour from wheat or other cereals with an increase in digestibility and nutritional value with respect to the initial raw product.

Consiglio Nazionale delle Ricerche

BioHYST

SCIENZA PER L'AMORE

LA TECNOLOGIA HYST

PER GLI ALIMENTI ZOOTECNICI

DIPARTIMENTO DI SCIENZE ANIMALI

Luca Malagutti

Università degli Studi di Milano

Dipartimento di Scienze Animali

Consiglio Nazionale delle Ricerche

BioHYST

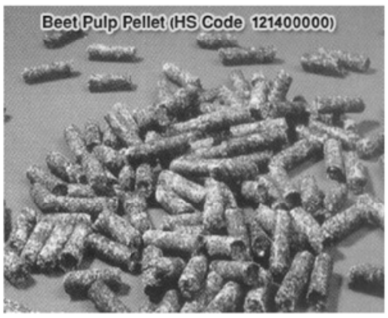
SCIENZA PER L'AMORE

IMPIEGO DEI SOTTOPRODOTTI AGRICOLI E AGROINDUSTRIALI IN ALIMENTAZIONE ANIMALE

ALTO VALORE NUTRITIVO

Pastazzo di agrumi

UFL: 0.97



Polpe di barbabietola

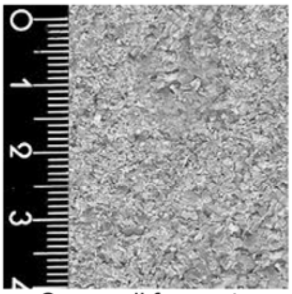
UFL: 1.05

Trebbie di birra

UFL: 0.91

IMPIEGO DEI SOTTOPRODOTTI AGRICOLI E AGROINDUSTRIALI IN ALIMENTAZIONE ANIMALE

BASSO VALORE NUTRITIVO



Crusca di frumento

UFL: 0.78

Paglia di cereali

UFL: 0.42

Stocchi di mais

UFL: 0.52

La lignina è un complesso polimero organico della parete cellulare, costituito da composti fenolici

Molecola Indegradabile

Riduce la Digeribilità dei Principi Nutritivi

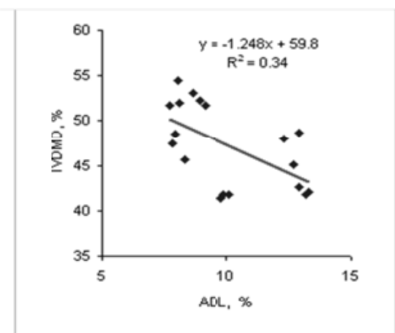
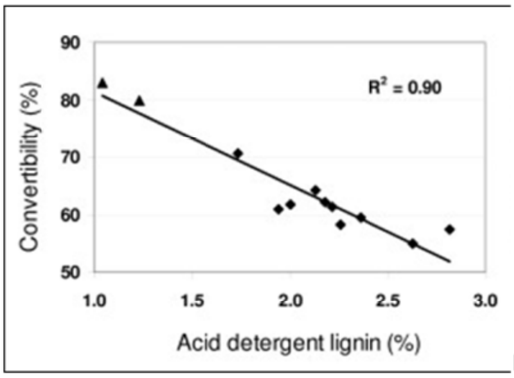


Figure 4. Relationship between IVDMD and ADL content

Kamalak et al. 2004



Lorenz et al. 2009

TRATTAMENTO CON TECNOLOGIA HYST DI:

- Crusca di Frumento
- Paglia di Cereali
- Paglia di Mais (Stocchi trinciati a 0.5-1 cm)

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

ATTIVITÀ SVOLTE

- Separazione di 3 Frazioni: **G** **M** **F**
- Analisi Chimica
- Analisi Biologica e Valutazione Nutrizionale

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

ANALISI CHIMICA DELLE FRAZIONI DI CRUSCA DI FRUMENTO

CAMPIONE	SS	PG	EE	NDF	ADF	ADL	Ceneri	Amido
Crusca Base	85.86	17.53	3.39	44.85	14.56	6.82	6.38	15.53
Crusca G	88.74	16.95	3.00	48.91	15.24	8.36	7.18	14.04
Crusca M	88.27	18.39	3.93	48.03	15.35	8.33	7.13	16.78
Crusca F	87.78	18.82	3.63	17.64	6.31	2.46	3.53	37.67

Valori espressi in percentuale del contenuto di Sostanza Secca

ANALISI CHIMICA DELLA PAGLIA DI CEREALI

CAMPIONE	SS	PG	EE	NDF	ADF	ADL	Ceneri
Paglia Base	89.89	7.29	1.36	63.36	39.60	4.59	8.70
Paglia G	90.54	6.44	0.85	69.10	42.13	4.84	7.48
Paglia M	90.75	7.54	1.31	62.68	37.83	5.26	8.76
Paglia F	90.67	10.14	1.93	48.13	24.25	2.47	11.93

Valori espressi in percentuale del contenuto di Sostanza Secca

ANALISI CHIMICA DELLA PAGLIA DI MAIS

CAMPIONE	SS	PG	EE	NDF	ADF	ADL	Ceneri	Amido
Paglia Base	88.66	4.37	1.30	71.25	50.85	8.16	9.47	4.77
Paglia G	90.34	3.60	0.93	73.75	52.69	7.87	7.97	3.52
Paglia M	89.12	5.11	1.41	66.66	44.54	9.15	12.65	5.04
Paglia F	88.44	8.65	2.88	47.20	32.47	11.04	17.17	11.85

Valori espressi in percentuale del contenuto di Sostanza Secca

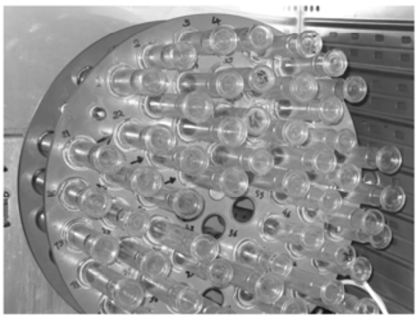
Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

ANALISI BIOLOGICA

Stima del valore nutritivo:

- Digeribilità dell'NDF: Metodo Ankom Daisy Incubator
- Gas Production e Digeribilità della Sostanza Organica:

  Metodo *in vitro* di Menke e Steingass



UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

Consiglio Nazionale delle Ricerche | BioHyst | SCIENZA PER L'AMORE

STIMA DEL VALORE NUTRITIVO

Calcolo delle Unità Foraggere Latte secondo l'equazione di Menke

UFL /kg SS = ENL / 7,113

dove

EN**L** (MJ/kg SS) = 0,54 + 0,0959 GP24 + 0,0038 PG + 0,0001733 EE
GP24: produzione di gas, espressa in ml/200mg SS in 24 ore
PG: proteine grezze, espresse in g/kg SS
EE: estratto etereo, espresso in g/kg SS.

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

Consiglio Nazionale delle Ricerche | BioHyst | SCIENZA PER L'AMORE

VALORE NUTRITIVO DELLE FRAZIONI DI CRUSCA DI FRUMENTO

CAMPIONE	GP24 ml /200mg SS	DSO %	NDFD %	UFL /kg SS
Crusca Base	48.9	74.5	59.8	0.89
Crusca G	48.9	75.4	66.4	0.89
Crusca M	48.5	75.9	66.3	0.89
Crusca F	57.8	84.2	69.4	1.07

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

VALORE NUTRITIVO DELLA PAGLIA DI CEREALI

CAMPIONE	GP24 ml/200mg SS	DSO %	NDFD %	UFL /kg SS
Paglia Base	33.0	53.8	51.4	0.57
Paglia G	35.1	53.8	47.6	0.58
Paglia M	34.2	54.6	48.7	0.58
Paglia F	43.1	65.8	62.5	0.72

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

VALORE NUTRITIVO DELLA PAGLIA DI MAIS

CAMPIONE	GP24 ml/200mg SS	DSO %	NDFD %	UFL /kg SS
Paglia Base	28.3	46.4	44.9	0.48
Paglia G	25.4	42.8	41.6	0.44
Paglia M	32.6	50.7	48.4	0.55
Paglia F	37.1	61.7	56.7	0.64

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

DSO CRUSCA BASE: 74.5%

DSO Crusca G : 75.4 * 42%

DSO Crusca M : 75.9 * 38%

DSO Crusca F: 84.2 * 20%

77.4% **+ 4%**

Consiglio Nazionale delle Ricerche
BioHYST
SCIENZA PER L'AMORE

DSO PAGLIA DI CEREALI BASE: 53.8%

DSO Paglia G : 53.8 * 42%

DSO Paglia M : 54.6 * 38%

DSO Paglia F: 65.8 * 20%

56.5% **+ 5%**

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

DSO PAGLIA DI MAIS BASE: 46.4%

DSO Paglia G : 42.8 * 44%

DSO Paglia M : 50.7 * 45%

DSO Paglia F: 61.7 * 11%

48.4% **+ 4.3%**

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

NDFD PAGLIA DI CEREALI BASE: 51.4%

NDFD Paglia G : 47.6 * 42%

NDFD Paglia M : 48.7 * 38%

NDFD Paglia F: 62.5 * 20%

51.4% ==

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

NDFD PAGLIA DI MAIS BASE: 44.9%

NDFD Paglia G : 41.6 * 44%

NDFD Paglia M : 48.4 * 45%

NDFD Paglia F: 56.7 * 11%

46.3% **+3.1%**

NDFD CRUSCA BASE: 59.8%

NDFD Crusca G : 66.4 * 42%

NDFD Crusca M : 66.3 * 38%

NDFD Crusca F: 69.4 * 20%

67.0% **+12%**

VALORE NUTRITIVO

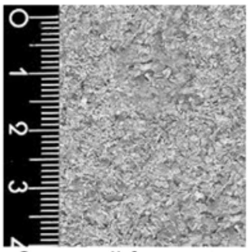
Paglia Cereali Base	Paglia Mais	Crusca Base
UFL: 0.57	UFL: 0.48	UFL: 0.89
+25%	**+33%**	**+20%**
Paglia Cereali F	Paglia Mais F	Crusca F
UFL: 0.72	UFL: 0.64	UFL: 1.07

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

VALORE NUTRITIVO

Incremento UFL

4.1% **6.7%** **6.5%**



Crusca di frumento

Paglia di cereali

Stocchi di mais

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE ANIMALI

CONCLUSIONI

La tecnologia HYST applicata a sottoprodotti agricoli ha determinato:

- Separazione di frazioni diverse per caratteristiche chimiche utilizzabili con finalità differenti
- Produzione di una frazione Fine ad alto valore biologico
- Aumento della digeribilità e del valore nutritivo rispetto al prodotto di partenza

APPLICATIONS FOR HYST TECHNOLOGY: BY-PRODUCTS FROM AGRO-FOOD INDUSTRIES FOR THE FUNCTIONAL FOOD SECTOR

Dr. Francesca Luciani

Istituto Superiore di Sanità (Italian National Health Institute) *CRIVIB*

After having talked about energy and animal feed, let us now take a look at HYST applications in the agro-food industries. By-products deriving from milling cereals are a goldmine of nutrients. Bran, for example, is made up of the integument of the caryopsis, but also contains a fraction which is rich in nutrients: the aleurone.

Cereal milling by-products are currently used for livestock and carry most of the nutrients present in the caryopsis: proteins of high biological value, rich in essential amino acids such as lysine; more than 70% of vitamin B6; more than 50% of vitamin B5; more than 33% of vitamin B1; the greater part of Fe, Zn, Mg, K.

The grinding process is not able to separate the aleuronic portion, which is rich in nutrients, from the integument of the caryopsis (**slide 2**).

Processing wheat bran with HYST technology resulted in meal with a high protein content (up to 24% protein), rich in Vitamin E and B vitamins and rich in minerals (magnesium, iron and zinc). Professionals in this field know that grain flour with a high content of protein can at the most contain 14% of protein.

Also the quantity of vitamins and minerals is very high. According to EC Regulation n.1924/06 on nutrition and health claims with provisions for labelling, the flour obtained from processing bran with HYST can be defined as high protein food, high in vitamin B3, iron and zinc, as well as a source of all the other elements (**slide 3**).

A comparison between HYST flour and other types of flour shows that the protein content in HYST flour is twice that of type '0' wheat flour and 1.6 times higher than that of wholemeal flour. And that's not all: the protein content of the HYST product is 1.2 times higher than that of fortified flours such as *Wheat Soy Blend*, used in food programmes such as World Food Programme and obtained, for example, by adding to wheat flour 25% soy flour, which is high in protein (**slide 4**).

With regard to micronutrients, a comparison between HYST flour and other types of flour shows a significant abundance. Flour obtained from bran through HYST processing offers even better nutritional characteristics than flours enriched with nutrients according to USDA standards. The HYST product is totally natural and has a higher content of micronutrients than that of an artificially fortified product: in fact, 100 grams of HYST flour contain the recommended daily dose of vitamin B3 (**slide 5**).

From soft wheat bran we get flour that is high in protein and micronutrients with an extraction yield ranging between 15 and 20%. The high content of vitamins, Fe and Zn makes it a suitable product for the functional food market, as well as for regular food purposes (**slide 6**).

Functional foods have not yet been precisely defined by European legislation. In general, a food can be considered functional if it gives satisfactory evidence of having positive effects – effects that go beyond the normal nutritional effects – on one or more specific body functions. Due to its high content of elements or nutrients, functional food can make a real and measurable contribution to health and well being and/or reduction of disease risk. Examples of functional food are foods that contain minerals, vitamins, fatty acids or dietary fibres and those enriched with biologically active substances, such as plant-sourced active ingredients or other antioxidants.

From our observations we conclude that HYST products can represent a concrete response to problems related to undernutrition and malnutrition (**slide 7**). Indeed, the global milling industry transforms about 350 million tons of wheat annually, producing about 80 million tons of by-products. With current extraction yields we have the potential of producing 12-15 million tons of food flour with the characteristics described above.

6,500,000 children under the age of five die every year of hunger and malnutrition. HYST would make available more than two tons of flour a year for each child.

Regarding the issue of food quality, we know that malnutrition is as serious a problem as hunger and that greater access to vitamins and zinc could save more than 680,000 children every year (WFP Annual Report 2007). Available data show that HYST flour, obtained from cereal by-products, can alleviate problems related to extensive deficiencies of protein, vitamin A, group B vitamins and zinc.

What prospects do HYST applications have in the food sector? The next steps will aim at extending experimentation to biomass found locally in developing countries, in order to proceed by defining the nutritional characteristics of the products obtained and their yield.

Subsequently, nutrition requirements will be assessed, together with defining usage possibilities of the products in the local diet.

Let's take an example from FAO data on production of cereals in 5 African countries (**slide 8**). According to calculations, we would have a product with a nutrient content that could be used to supplement local dietary needs, in the quantities shown in the table. These estimates were made starting from bran as a cereal milling residue, and considering an average yield of 15% of 'HYST flour' obtained by processing these products with our technology. Naturally, we need to continue our experimentations to verify our theoretical projection and the composition of the resulting products. Potentially this technology can be applied to any residues from agricultural processing. Recycling other types of industrial residues and minimizing waste would open up interesting prospects for the realisation of new products that are high in nutrients to be used for human consumption.

Consiglio Nazionale delle Ricerche

BIOHYST

SCIENZA PER L'AMORE

APPLICAZIONI DELLA TECNOLOGIA HYST: SOTTOPRODOTTI DELL'INDUSTRIA AGRO-ALIMENTARE PER L'ALIMENTAZIONE FUNZIONALE

Francesca Luciani
Istituto Superiore di Sanità
CRIVIB

I SOTTOPRODOTTI DELLA MOLITURA DEI CEREALI: UNA MINIERA DI PROTEINE E MICRONUTRIENTI

I sottoprodotti della molitura sono attualmente unicamente destinati al bestiame e portano con loro gran parte dei nutrienti presenti nella cariosside:

•proteine ad alto valore biologico, ricche di un aminoacido fondamentale: la lisina

•oltre il 70% della vitamina B6

•oltre il 50% della vitamina B5

•oltre il 33% della vitamina B1

•la maggior parte di Fe, Zn, Mg, K t

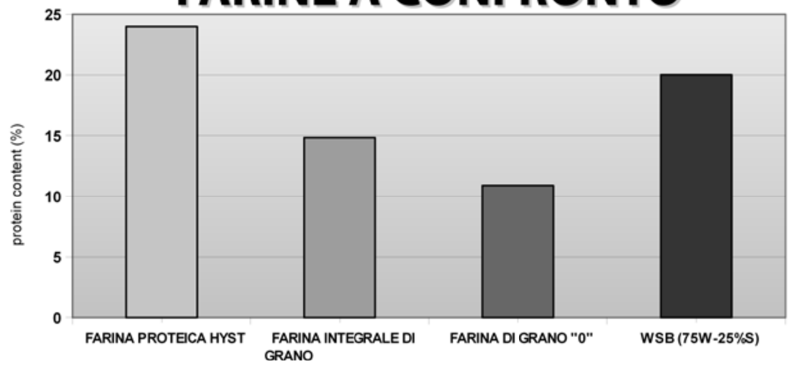
LA FARINA HYST DA CRUSCA DI GRANO

MACRONUTRIENTI [% s.s.]			
			etichettatura secondo reg. CE n. 1924/06
Proteine	21-24	%	ad alto contenuto di proteine
Amido	48-55	%	
Lipidi	3,3-3,5	%	
Fibre	12,5-18	%	
Minerali	3,5-4	%	

MICRONUTRIENTI [% s.s.]			
			etichettatura secondo reg. CE n. 1204/06
Vitamina A	64	μg/100 g	
Vitamina E	1,3	mg/100 g	fonte di Vitamina E
Tiamina (Vit. B1)	0,87	mg/100 g	fonte di Vitamina B1
Niacina (Vit. B3)	18,3	mg/100 g	ad alto contenuto di Vitamina B3
Ac. Pantotenico (B5)	2,4	mg/100 g	fonte di Vitamina B5
Acido folico (Vit. B9)	39	μg/100 g	fonte di Vitamina B9
Ferro	9,7	mg/100 g	ad alto contenuto di ferro
Zinco	6,6	mg/100 g	ad alto contenuto di zinco
Magnesio	305	mg/100 g	fonte di magnesio

Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

FARINE A CONFRONTO



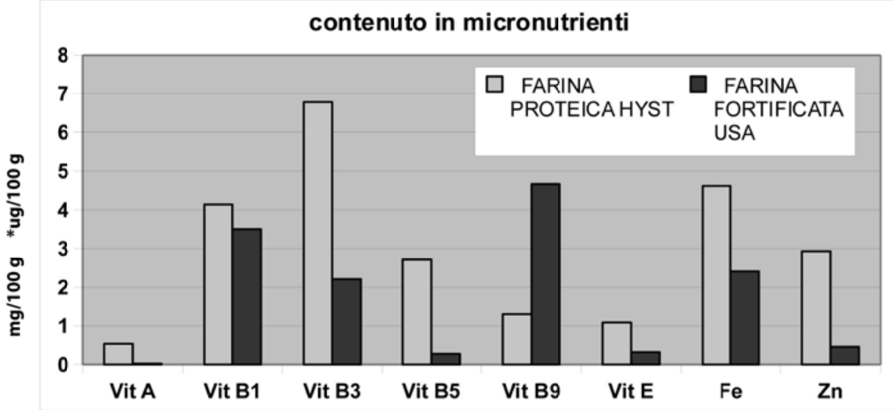
WSB: wheat-soy blend

CONTENUTO PROTEICO:

due volte quello di una comune farina "0"

1,6 volte quello di una farina integrale

1,2 volte quello di mix proteici utilizzati in programmi alimentari (i.e. WFP)



Enhanced flour composition from USDA National Nutrient Database for Standard Reference, Release 23 (2010)

CONFRONTO CON UNA FARINA FORTIFICATA:

- **il prodotto HYST è totalmente naturale**
- **ha un contenuto di micronutrienti superiore a quello di un prodotto fortificato artificialmente**
- **100 g di farina HYST contengono la dose giornaliera consigliata di vitamina B3**

PROSPETTIVE FUTURE NEL SETTORE DEGLI ALIMENTI FUNZIONALI

- Dalla crusca di frumento tenero si ottiene una farina ad contenuto di proteine e micronutrienti con una resa di estrazione che varia tra il 15 e il 20%. L'elevato contenuto di vitamine, Fe e Zn la rende un prodotto idoneo, oltre che ai normali utilizzi, al mercato funzionale.

- Sebbene non esista ancora una precisa definizione dalla legislazione europea, un alimento può essere considerato funzionale se dimostra di avere effetti positivi su una o più funzioni specifiche dell'organismo, che vadano oltre gli effetti nutrizionali normali, in modo tale da essere rilevante per il miglioramento dello stato di salute e di benessere e/o per la riduzione del rischio di malattia.

- Esempi di alimenti funzionali sono i cibi che contengono determinati minerali, vitamine, acidi grassi o fibre alimentari e quelli addizionati con sostanze biologicamente attive, come i principi attivi di origine vegetale o altri antiossidanti

Consiglio Nazionale delle Ricerche

SCIENZA PER L'AMORE

PRODOTTI HYST: UNA RISPOSTA CONCRETA AI PROBLEMI DI SOTTONUTRIZIONE E MALNUTRIZIONE

QUANTITÀ:

- L'industria molitoria globale trasforma ogni anno circa 350 milioni di tonnellate di frumento, producendo circa 80 milioni di tonnellate di sottoprodotti.
- Con le attuali rese di estrazione abbiamo la potenzialità di produrre 12-15 milioni di tonnellate di farine alimentari con le caratteristiche viste in precedenza.
- 6,500,000 bambini sotto i 5 anni di età muoiono ogni anno per denutrizione e malnutrizione, ci sarebbero oltre due tonnellate/anno di farina ciascuno.

QUALITÀ:

- La malnutrizione è un problema grave quanto la fame vera e propria.
- Un migliore accesso alle vitamine e allo zinco salverebbe oltre 680.000 bambini l'anno *(WFP Annual Report 2007)*.
- Le farine HYST da sottoprodotti dei cerali possono alleviare problemi connessi deficit estesi di:
  - Proteine
  - Vitamina A
  - Vitamine del gruppo B
  - Zinco

Consiglio Nazionale delle Ricerche

SCIENZA PER L'AMORE

PRODUZIONE DI CEREALI IN AFRICA

* from FAO website:
http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor

	Cereals* (year 2010, tons)	bran residues (estimated, tons)	HYST cereal flour (15% theoretical yield, tons)
Burkina Faso	4.522.746	678.412	101.762
Cameroon	2.805.400	420.810	63.122
Rwanda	745.579	111.837	16.776
Senegal	1.767.822	265.173	39.776
Somalia	257.590	38.639	5.796

BioHYST

SCIENZA PER L'AMORE

HYST TECHNOLOGY IN SUPPORT OF DEVELOPING COUNTRIES

Luca Urdich

"Scienza per l'Amore" Association

My presentation aims to show how the opportunities offered by HYST technology, previously outlined, can be used as part of the humanitarian project promoted by the *Scienza per l'Amore Association.*
In fact, HYST technology stems from the commitment of a group of people united by a passion for study and for the sciences applied to solving human problems. These people have supported the research carried out by Engineer Umberto Manola for 20 years, sensing the potentials to concretely address food shortages in developing countries.
Delivering positive responses both to food and energy sectors, the results obtained from HYST technology have proved them right.
In many African countries, the development of food and livestock sectors is conditioned by insufficient quantities and poor quality of food, and scarcity of water and arable land. Not infrequently, added to this is the use of land for energy crops, making the situation even more critical. Indeed, problems that are interrelated and complex to the point that addressing each one individually does not lead to satisfactory solutions. HYST deactivates this condition because it overcomes current technological difficulties by offering an innovative system that anticipates what, in scientific publications of the sector, researchers hope to achieve in 10-20 years time.
This is why the project is called "*Bits of Future: Food for All*".
To meet such articulated requirements we have devised a pilot project that creates a complete production cycle. It integrates the HYST unit with a breeding farm and a biogas plant in order to fulfil three functions:

- meet nutritional needs of the local population concerned;
- achieve self-sufficiency in energy and water resources and supply neighbouring communities even with no infrastructures;
- carry out experiments, in collaboration with national and international research centres, on other local plant biomass.

More specifically, the projects developed for Senegal and the countries in the Horn of Africa are based on the use of cereal straw which is the main if not at times the only food available during dry seasons – despite its not being suitable for the needs of livestock due to low nutritional value.
This slide (**slide 3**) shows the HYST facility (n°1) which is configured to obtain from cereal straw 2 fractions with different characteristics:

- one fraction, containing the greater part of the nutrients, to be used as feed in the farm;
- one fraction, no longer usable as feed, to be fed into the biogas plant.

Around the HYST unit we have the farming structures (n° 5, 6, 7), the biogas plant structures (n°3) and the water tanks (n°4).
The graph in slide 4 illustrates the virtuous circle triggered by processing straw with HYST. It is important to note that the quantity of flour intended for human consumption remains intact because the actual grains (caryopsis) are not fed into the HYST unit, only cereal straw is used.
The feed thus obtained is intended for animal husbandry to produce meat and milk. This animal food product is considerably better than that previously available since both nutritional content and digestibility have been increased significantly. The ability to ensure adequate nutrition throughout the year eliminates a major cause of death of livestock due to exposure to pests and diseases during seasonal migration to new pasture grounds. A high percentage of the feed produced can be placed in

the local market, since it is not used in the breeding site, thus encouraging development of the feed sector.
The manure, however, is fed into the biogas plant in order to increase available material for the digester. In addition, the biogas plant is fed with HYST matrices in order to generate electricity to power the entire complex.
With the energy produced it is possible to:

- meet on-site consumption requirements;
- distribute energy in the surrounding neighbourhood to meet the needs of domestic and productive activities already present or start up new ones;
- extract water from underground to supply the plant, the population and irrigate crops.

The digested part, that is the residue from biogas processing, is an excellent fertilizer and can be used in farm lands to restore their content of organic substance, whose deficiency is a very serious problem in some agricultural areas of Africa (for example the groundnut basin of Senegal).
The effectiveness of HYST technology in processing the different biomass available locally makes it possible to design sites for different breeds of animals with specific needs, in order to respond to such factors as: local customs and dietary habits, characteristics of the internal market and possible opportunities for export.
Therefore, with HYST technology it is possible to produce energy without taking land away from food production, thus avoiding to further reduce the already insufficient resources. Furthermore, using up waste such as straw means avoiding environmental impact caused from cutting down trees and shrubs in order to obtain new land and from spreading non-food crops such as jatropha, which in turn cause local imbalances in the ecosystem.
In conclusion, we can say that HYST technology is the missing piece that promotes a synergy of these three sectors – agriculture, breeding, energy – through a mutual exchange of products and waste. It optimizes the use of available biomass and initiates sustainable processes that safeguard the environment.
The purpose of the humanitarian project "*Bits of Future: Food for All*" is not that of bringing aid, which at times has the opposite effect of destabilizing the local economy. Indeed, the objective is starting up stable processes that lead to self-sufficiency in food and energy sectors, enhancing both local workforce and biomass for the welfare of the population.

Consiglio Nazionale delle Ricerche

BIOHYST

SCIENZA PER L'AMORE

LA TECNOLOGIA HYST A SOSTEGNO DEI PAESI IN VIA DI SVILUPPO

Luca Urdich

Associazione Scienza per L'Amore

Consiglio Nazionale delle Ricerche

BIOHYST

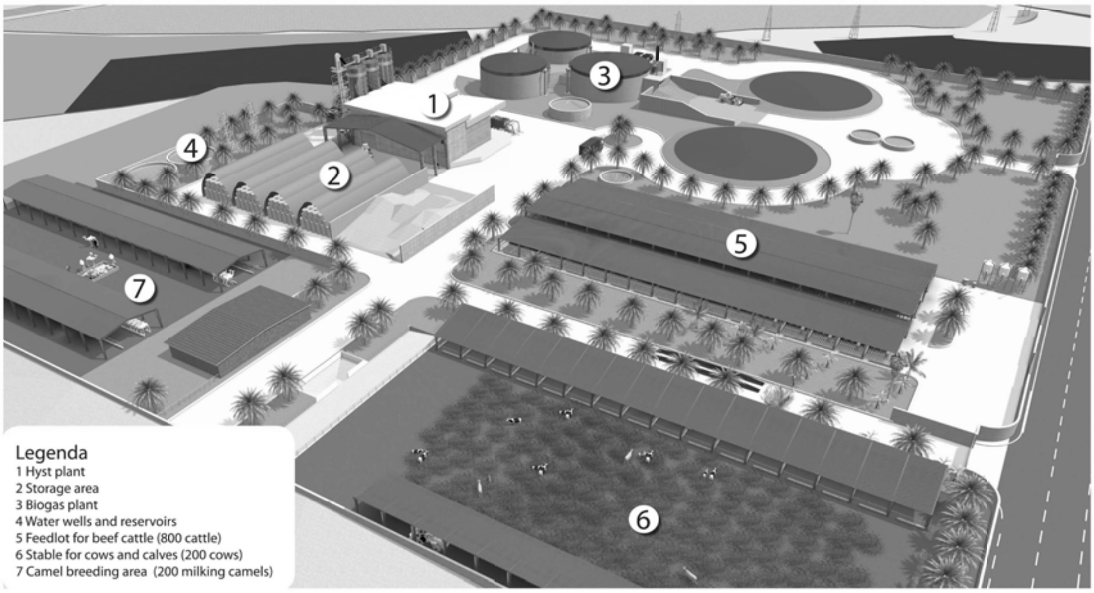
SCIENZA PER L'AMORE

HYST: PROGETTO PILOTA

Il progetto pilota assolve a tre funzioni:

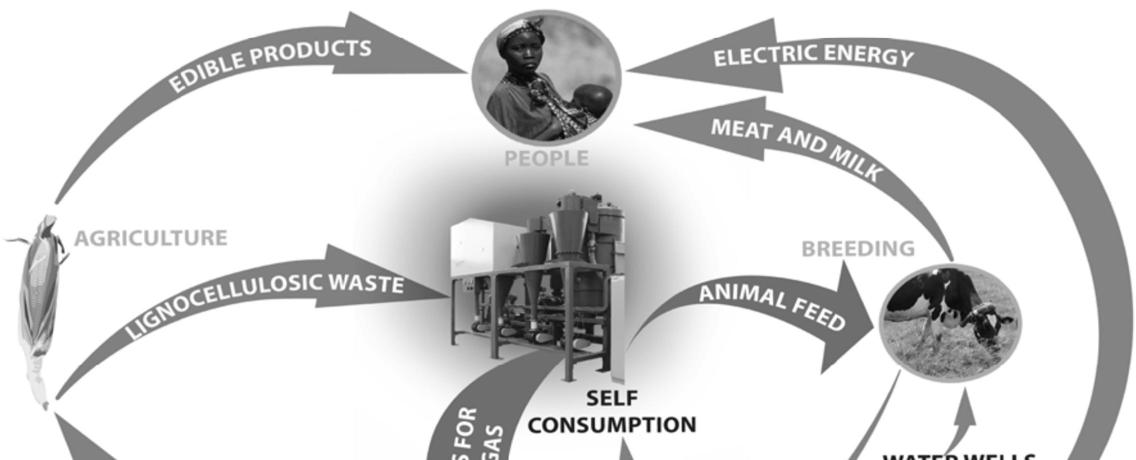
- Soddisfare le necessità alimentari ed energetiche;
- Essere autosufficiente da un punto di vista energetico e idrico, e rifornire le comunità limitrofe anche in aree prive delle infrastrutture necessarie;
- Sperimentare, in collaborazione con istituti di ricerca nazionali ed internazionali, il trattamento di altre biomasse vegetali locali.

AN INTEGRATED PROJECT FOR FOOD SECURITY, GREEN ENERGY AND AGRICULTURE DEVELOPMENT



Consiglio Nazionale delle Ricerche
BIOHYST
SCIENZA PER L'AMORE

AN INTEGRATED PROJECT FOR FOOD SECURITY, GREEN ENERGY AND AGRICULTURE DEVELOPMENT



ECONOMIC PROSPECTS: THE ITALIANO SCENARIO

Dr. Daniele Lattanzi

BioHyst

I wish now to draw attention to the economic and regulatory framework of this project. The previous presentations illustrated the importance of the scientific achievement obtained with HYST technology and the potential that this technology can express in various sectors.
Scienza per l'Amore funded the research which led to this technology and promoted the humanitarian project connected to it. However, this result should be considered as only the starting point. The association has commissioned the BioHyst Company, the only holder of the present and future developments of HYST technology, to monitor the implementation of *Bits of Future*. To move the project forward, BioHyst plans to start marketing plants in industrialized countries, allocating profits to supporting the humanitarian purpose. It is therefore necessary to explore the economic aspects and the regulations in force today in Italy and Europe, and then try to understand together what scenarios can open up.
Let us begin with a rather delicate issue: biofuels. As Eng. Pierpaolo Dell'Omo already explained, there has been a strong trend in this sector leading to a shift from first generation fuels to second generation fuels.
In this respect Europe has set itself some rather ambitious goals. In fact, Directive 2009/28/CE on the promotion of the use of energy from renewable sources calls for a 10% minimum target for renewable fuels in transport to be achieved by 2020.
More specifically, Italy set itself a 3% target and in 2009 already achieved 3.9%. The problem is that these biofuels are not from Italian agriculture. We had to import them from other countries for a total cost of around 1 billion euros.
Let us make an estimate: by 2020 the quota of renewable energy in transport is fixed at 4.5%, meaning therefore that we will have to import goods worth 1.7 billion euros in order to meet this quota (**slide 2**).
This is why we require second generation technologies that do not use agricultural crops for energy purposes and, at the same time, keep within the constraints of sustainability and emission limits. The difficulty lies in finding a solution that meets all the requirements. And indeed, the answer could well be HYST technology. In fact, with this technology we would already be covering 4.5% of energy needs in the Italian transport sector, simply by using the 2.5 billion cubic metres of biomethane that can be produced from agricultural by-products and the straw left unused in fields. This way we would also solve those problems that often accompany the disposal of these agricultural processing residues.
According to EU rules, which give double value to second generation biofuels, using this straw would comply with 9% of energy requirements: we are within an ace of the 10% target set for 2020 (**slide 3**).
This can be realized entirely from raw materials produced on Italian fields. Instead of spending billions of euros without even achieving half the requirements, we could produce value of up to 2 billion euros. In addition, this would create 12000 new jobs, setting in motion not only the agricultural sector but also all the allied industries. This would generate investments of about 5 and a half billion euros.
Moreover, this technology could be introduced in areas considered undeveloped such as Southern Italy, which is very rich in those very crops that can be used for HYST processing.

In light of HYST's technical and economic characteristics, the incentive system would need revising because this technology is revolutionary to the extent that it would change the whole bio-energy scenario (**slide 4**).
We would bring into the market an environmentally sustainable product (in accordance with EU regulations) at a very low cost, with prices comparable with those of gasoline, and in addition bring more added value and create jobs.
This kind of project deserves to be brought not only to the attention of scientific institutions (which is why we are here today) but also of the economic and political world. Biofuels, human nutrition and animal feed are key elements in any economy.
In Italy, as of January 1st 2012, we have moved to a more restrictive regulation: in 2017 ethanol produced from cereal grains, biodiesel from rapeseed, etc will be leaving the scene and in 2018 this will include even sugar beet (**slide 6**).
The longstanding debate on energy derived from food crops would become history with HYST technology.
To take another example, flours obtained from HYST processing are positioned at the top of the functional market of bakery products, by virtue of their biological characteristics and their high content of micronutrients. This means being able to enter into markets worth 200 billion euros, among which the market for bakery products (12 billion USD per year) is considered one of the leading sectors for the economy of the future (**slide 7**).
At this point, it is appropriate to schematize (**slide 8**) the impact that HYST technology could have on the Italian economy.
Sectors most directly involved would be: agriculture, energy and power. However, introducing this technology would also involve collateral sectors such as credit and finance, automotive and advanced services. Investments triggered by this technology would relate to infrastructures, mechanical installations, logistics and transport. As already stated, it would create new jobs and new professionals. We would not only have economic value in the investment stage, but also in the final consumption stage.
Ministries that could be involved are those of Economy, Economic Development, Agriculture and Forestry Activities, Environment, and University and Research. At present we are carrying out a series of talks with the heads of technical and economic ministries concerned. It is commonly known that, at European level, Germany is considered the benchmark for the biogas sector, and that it is also able to export technology.
The moment HYST technology should start operating on the market this role could be covered by our country. Scientific literature does not present results equal to those we obtained from HYST. I do believe it is crucial to exploit this advantage.
It would be necessary to devise projects and applications that can generate value without repercussions on public spending, and without cannibalizing existing sectors.
Given the excellent results, we might even start thinking of entering other fields like, just to name a couple, natural chemistry and pharmacopoeia sectors.
Natural chemistry sectors, along with fossil fuels, are evolving very rapidly, especially in the United States. With regard to pharmacopoeia, however, HYST processing could obtain, without any chemical process or synthesis, active ingredients at the base of medical products sourced from natural substances.
After more than 15 years of research, HYST technology has now become industrialized. Today, with these results and economic data to support us we can think of a real and concrete project.
The next step will be to present HYST technology to a political and economic panel.

Consiglio Nazionale delle Ricerche

BIOHYST

SCIENZA PER L'AMORE

PROSPETTIVE ECONOMICHE: IL PANORAMA ITALIANO

Daniele Lattanzi
BIOHYST

I BIOCARBURANTI

Aspetti regolamentari e prospettive future

Obiettivo della Direttiva 2009/28/CE sulla promozione dell'uso dell'energia da fonti rinnovabili prevede di **coprire il 10%** del fabbisogno energetico del settore trasporti da carburanti rinnovabili per il 2020, l'Italia aveva fissato il raggiungimento della quota del 3% per l'anno 2009 ed ha raggiunto il **3,47%**.

Tali biocarburanti non provengono però dall'agricoltura italiana.

Per importare biodiesel e olii vegetali abbiamo speso **circa 1 miliardo di euro**.

Per il 2012 la quota di energia rinnovabile nel settore trasporti è fissata al **4,5%;** per soddisfarla si importeranno beni per circa **1,7 miliardi di euro**.

HYST È LA TECNOLOGIA CHE TUTTI CERCANO:

finalmente una tecnologia di seconda generazione

Con i 2,5 miliardi di metri cubi di biometano producibili grazie a Hyst dalle paglie e dai sottoprodotti delle attività agricole potremmo già oggi coprire il 4,5% del fabbisogno energetico del settore trasporti italiano. In base alle regole stabilite dall'unione - che assegna valore doppio ai biocarburanti di seconda generazione- è come aver ottemperato al 9% del fabbisogno energetico dei trasporti, ad un soffio dall'obiettivo del 10% fissato per il 2020.

In Conclusione

L'obiettivo europeo di sostituzione del 10% dei carburanti tradizionali con prodotti sostenibili, che oggi pare irraggiungibile, può anche essere superato con la tecnologia Hyst. Tutto questo può essere realizzato interamente con materie prime prodotte sul territorio italiano e non utilizzate.

Invece di spendere miliardi di euro di biocarburanti e materie prime per non soddisfare neppure la metà di quanto necessario, potremmo produrre beni per miliardi!

Consiglio Nazionale delle Ricerche BIOHYST SCIENZA PER L'AMORE

Utilizzo delle paglie residue dalle attività agricole per produzione di biometano

Secondo il modello di business proposto si potrebbe essere in grado di:

a) sostituire il 17% dei consumi nazionali di benzina con carburante prodotto dai residui che giacciono nei nostri campi;

b) produrre fatturati per circa **2 miliardi di Euro l'anno**

c) creare oltre **12.000 nuovi posti di lavoro** nella filiera agroenergetica e oltre;

d) catalizzare investimenti per circa **5,5 miliardi di Euro**

e) Concentrare il progetto di partenza in aree oggi considerate "depresse" come il **Mezzogiorno** ma ricche delle materie prime utilizzate

f) **raggiungere in anticipo**, e con le sole risorse dell'agricoltura nazionale, gli obiettivi comunitari di riduzione delle emissioni nel settore trasporti del **2020**

g) **ridurre** radicalmente **gli incentivi** statali destinati alle bioenergie

MANCANO INFATTI GLI STRUMENTI TECNOLOGICI PER REALIZZARE GLI OBIETTIVI 2020

Dal 1° gennaio 2012 sono operativi i criteri di sostenibilità dei biocarburanti stabiliti dall'UE, molto più stringenti rispetto al passato, il cui scopo è incentivare solo i biocarburanti che garantiscano un adeguato risparmio di emissioni serra rispetto ai carburanti tradizionali.

Le prime vittime sono state il biodiesel prodotto dall'olio di palma e dalla soia che non rispettano i parametri di sostenibilità. Dal 2017 usciranno di scena anche l'etanolo prodotto da cereali comunitari e il biodiesel da colza; l'anno successivo sarà la volta dell'etanolo da barbabietola da zucchero e del biodiesel da girasole.

Insomma, nel panorama attuale non ci sono filiere produttive in grado di ottemperare agli impegni comunitari, perché mancano sul mercato dei biocarburanti sostenibili economicamente e a livello ambientale.

La tecnologia HYST è la risposta a queste esigenze!

INDUSTRIA ALIMENTARE

Progetto: produzione di farine pregiate utilizzando i sottoprodotti dell'industria molitoria tradizionale (CRUSCAMI)

a) Le farine ottenute con trattamento HYST si posizionano al vertice del mercato funzionale dei prodotti da forno in virtù delle caratteristiche biologiche e per l'alta contenuto di micronutrienti

b) valore di mercato mondiale: 200 mld di cui dei prodotti da forno 12 miliardi di USD l'anno ed è ritenuto uno dei settori trainanti per l'economia del futuro in virtù delle tendenze alimentari in atto

c) consentirebbero di ridurre di oltre il 25% l'import di grani di alta qualità, oggi usati per vari prodotti finali (pane, pasta, dolci etc)

d) risparmio per circa un valore di 300 milioni di euro ogni anno e conseguente auto produzione con materie prime disponibili in Italia.

SINTESI DELLE ATTIVITÀ IN PROGRAMMA

Settori	Agricoltura, Energia, Alimentazione
Investimenti	Ricerca, Infrastrutture, Meccanica fine, Logistica e Trasporti
Occupazione	Figure professionali nuove ma pronte
Valore economico	Energie rinnovabili , prodotti per alimentazione zootecnica ed umana
Settori collaterali	Credito e finanza, Automotive, terziario avanzato
Ministeri coinvolti	Economia, Sviluppo Economico, Attività agricole e forestali,Ambiente, Università e Ricerca
Modello economico	l'Italia può divenire esportatore delle applicazioni della tecnologia all'estero (benchmarck Germania con tecnologia su biogas, che è nettamente al di sotto dei risultati Hyst)

LA NOSTRA VISIONE RELATIVA ALL'IMPATTO DELLA TECNOLOGIA IN ITALIA

Obiettivo: Sfruttare il vantaggio competitivo raggiunto con questa tecnologia attraverso le potenzialità evidenziate e quelle non ancora espresse

Strategia : Individuare i settori economici sui quali si vuole operare, coinvolgendo gli attori necessari (energia , alimentazione umana e zootecnica)

Piano: definire una serie di Progetti/applicazioni con portino valore, investimenti, consumi e occupazione, senza avere ricadute negative su spesa pubblica e senza cannibalizzare settori economici in uso.

Necessità: definire una cabina di regia che garantisca una governance sul progetto, le azioni da compiere, gli attori da coinvolgere ed i tempi da mantenere.

Prospettive: Cominciare a pianificare da subito ed insieme agli istituti di ricerca una serie di collaborazione per puntare alle applicazioni potenziali ma già iniziate che la tecnologia consente, che sono considerate altamente strategiche:

- ***Chimica naturale (Green Chemistry)***
- ***Farmacopea***