



UNIMORE
UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA



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FIRENZE

DAGRI
DEPARTMENT OF AGRICULTURE
FOOD, ENVIRONMENT AND FORESTRY

Embassy of Italy in Tel Aviv, Israel



**Heat stress and other common
features of Precision Livestock
Farming (PLF) Nov 9, 2020**



**WG3 – Improvement of
livestock housing,
assessment and control of
thermal comfort in hot
climates**

Dr. Agr. Pierpaolo Martini
Prof Matteo Barbari
Prof Giuseppe Rossi
Prof Alberto Muscio

Energy saving and use of renewable resources initializes sustainable cows environment

Improvement of livestock housing in hot climates and Greenhouse Gases (GHG) & ammonia reduction

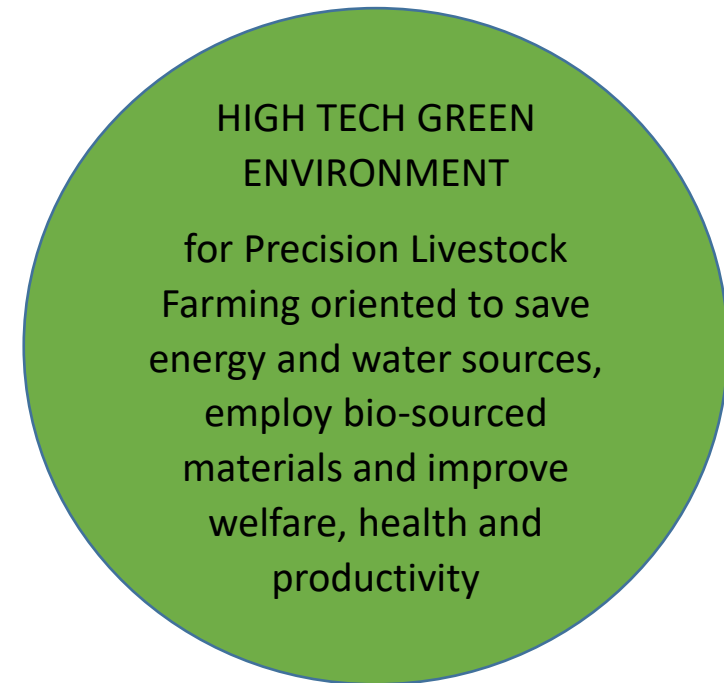
Israeli – Italian R&D proposal concerning an innovative and sustainable multilayered roof

Assessment and control of thermal comfort of dairy cows

Proposal of Israeli - Italian Investigations

●
...and what about the future point ?

Our aim is to *ignite* the cooperation between Italy and Israel in order to rise new common development opportunities according with **Green Deal**





Providing innovative solutions for animal housing:

Freewalk cattle farming systems can elevate animal welfare, health and manure quality, and at the same time be appreciated by society.

Combination of housing and grazing can produce positive effects.



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Reducing Greenhouse Gases GHG and ammonia emissions by means of climate smart cattle farming systems:

Innovative housing and manure handling systems:

- composted bedding material, separation of faeces and urine
- artificial floor systems, manure cleaning robots



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ERA-NET
SUSAN

EUROPEAN RESEARCH AREA ON
SUSTAINABLE ANIMAL PRODUCTION

11 Partners
(2 extra-UE)

11 partners

- University of Ljubljana
- Wageningen UR
- University of Kassel/University of Giessen
- Università degli Studi di Firenze
- Technical University of Munich
- Norwegian Institute of Bioeconomy Research
- Swedish University of Agricultural Sciences
- National Agricultural and Food Centre (Slovakia)
- **Agricultural Research Organization (Israel)**
- University of Kentucky
- HBLFA Raumberg-Gumpenstein

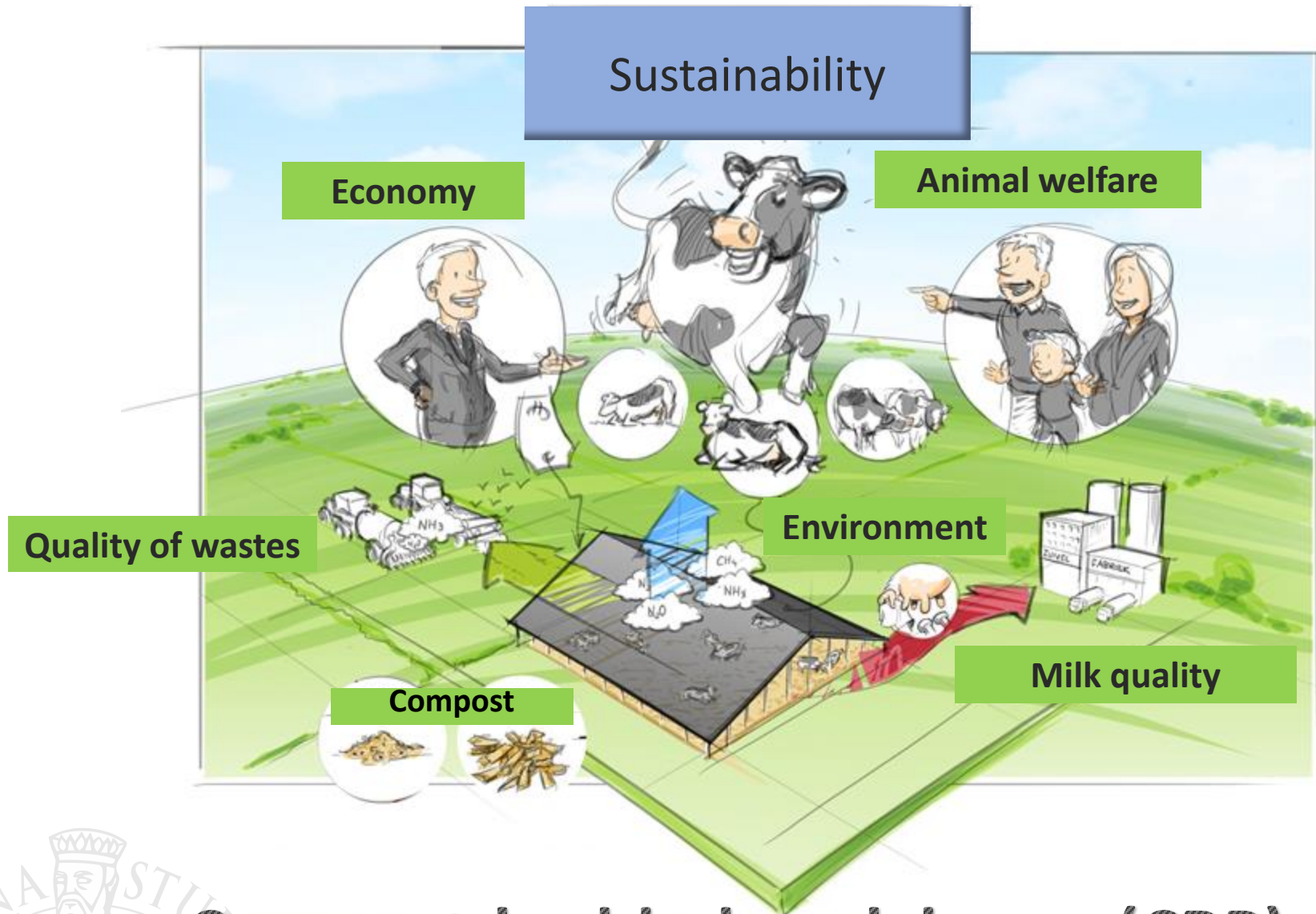
Develop economic sound free walk farming systems elevating animal welfare, health and manure quality, while being appreciated by society



Duration: 36 months (28 May 2017 – extension till 31 October 2020)

COMPOST BARN

HIGH WELFARE FLOOR



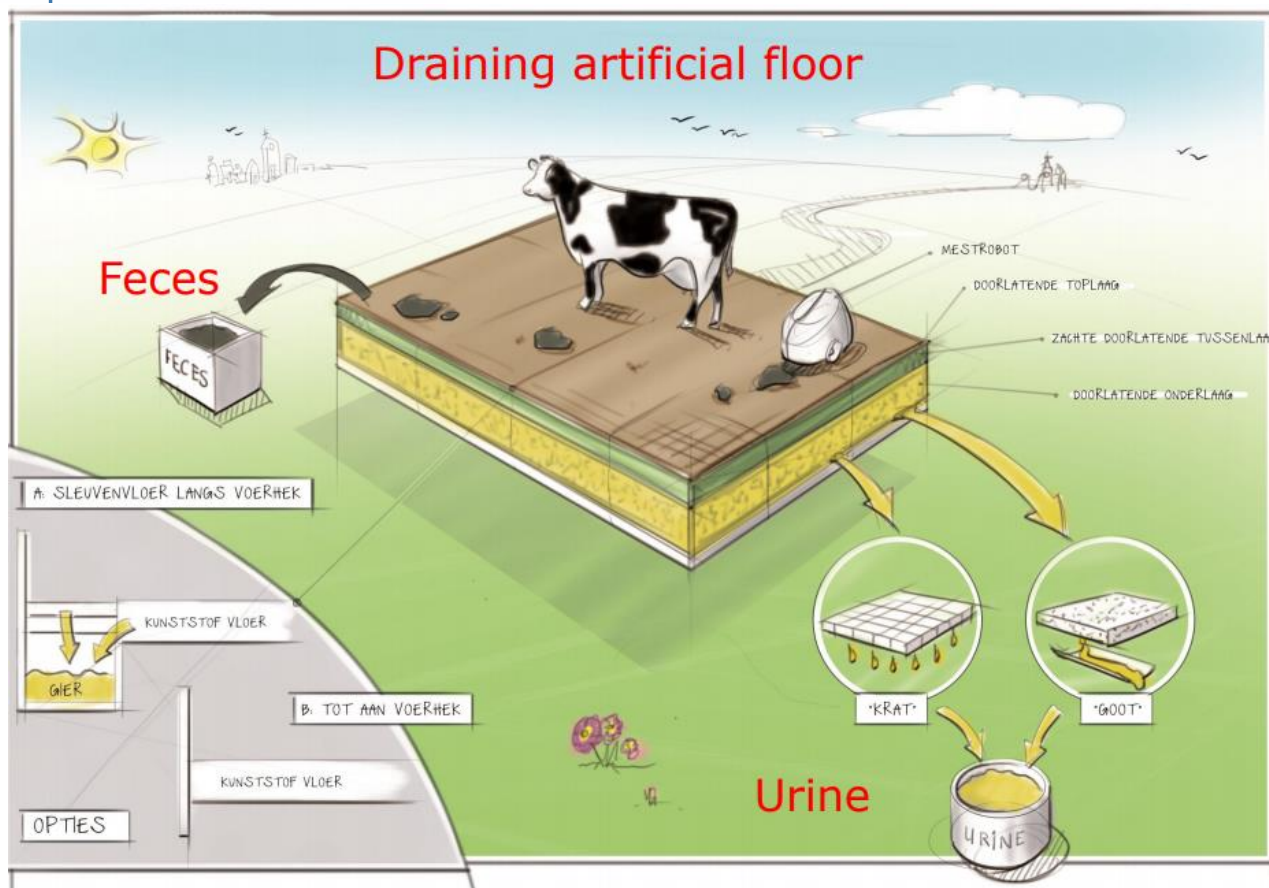
Compost-bedded pack barns (CBP)



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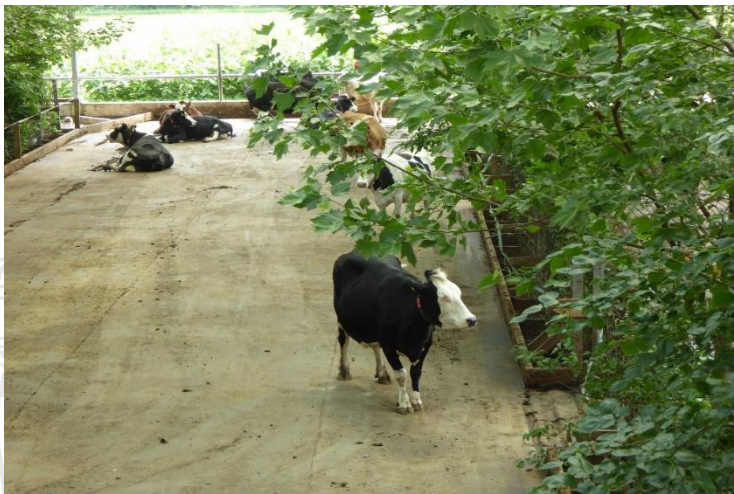


The “**High Welfare Floor**” is still experimental, but a very challenging concept

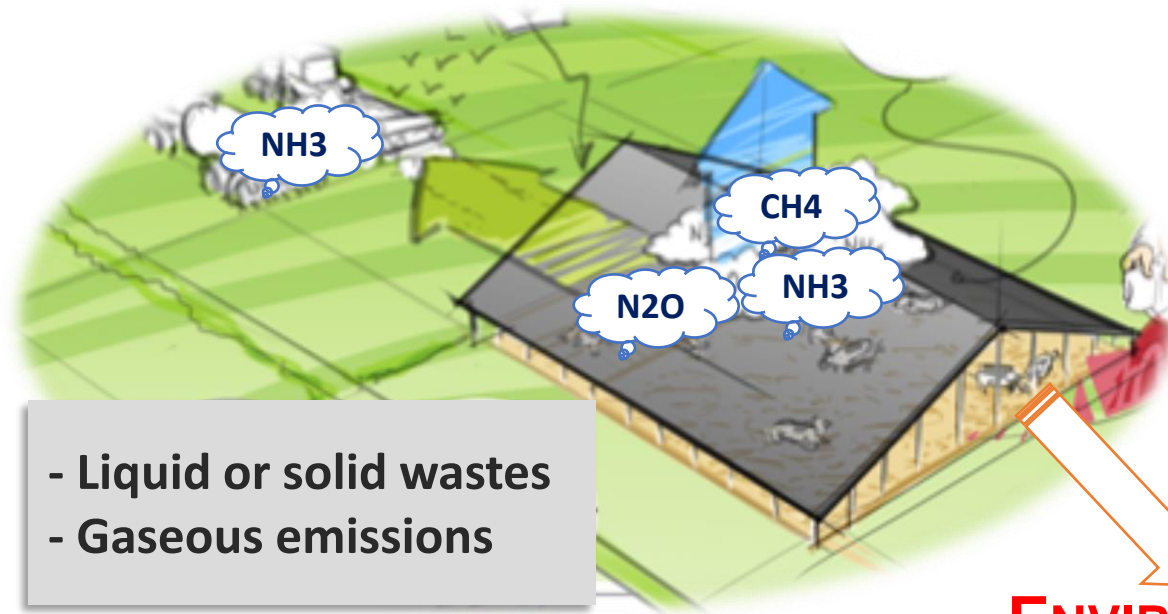
- **immediate separation of animal waste.**
- the artificial floor is **composed by several layers.**
- **Liquid drains through the floor** into a **drainage layer** below and removed from the barn.
- **Solid manure** remains on the floor surface, to be automatically cleaned by a **robot.**



Cow Garden with High Welfare Floor mainly in the resting area of the animals
low trees and **shrubs** inside the barn aimed at providing a more natural living environment



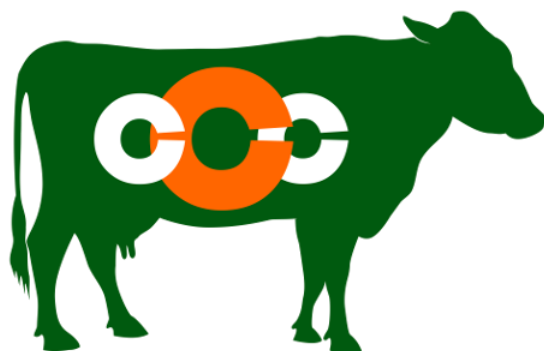
Sustainability



- Liquid or solid wastes
- Gaseous emissions

**ENVIRONMENTAL
PROBLEMS**

Climate Care Cattle Farming Systems



farming

www.CCCfarming.eu

List of participants

Participant name

- 1 Wageningen Research - coordinator
- 2 University Firenze
- 3 Latvian University of Life Sciences and Technologies
- 4 Justus Liebig University Giessen
- 5 Polish National Research Institute of Animal Production
- 6 Lithuanian Institute of Animal Science
- 7 Scottish Rural University College
- 8 French Livestock Institute de L'Elevage
- 9 INRA UMR PEGASE
- 10 UMR 1069 Sol Agro & Hydro Systèmes
- 11 UMR Ecosystème Prairial

Associated partners

- 12 University of Kentucky
- 13 Federal University of Lavras
- 14 ARO Volcani Center

Short name

Short name	Country
WR	The Netherlands
UNIFI	Italy
LLU	Latvia
JLU	Germany
NRIAP	Poland
LUHS	Lithuania
SRUC	UK
IDELE	France
INRA PEGASE	France
INRA SAS	France
INRA UREP	France
KU	USA
UFLA	Brazil
ARO	Israel

Start-End date: 01.01.2020-31.12.2023

Project duration 36 months

FACCE
ERA-GAS



ERA-NET SUSAN

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era-net

The objective is to develop climate smart cattle farming systems which reduce GHG and ammonia emissions while maintaining sustainable social-economic farm businesses

GHG + NH₃
measurements with
rapid methods in
over 50 study farms
in 7 countries

GHG + NH₃ emissions

GHG + NH₃
measurements with
**traditional and
innovative methods**
in experimental farms



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Innovative method for GHG and NH₃ emission monitoring

Role of drones in assessing GHG emissions from farms



Aim:

To develop a novel system integrating GHG and NH₃ sensors with an Unmanned Aerial System, in order to perform a real-time measurement of gas concentration at farm scale



The results of drone surveys have to be cross-referenced with ground based gas measurements

System design





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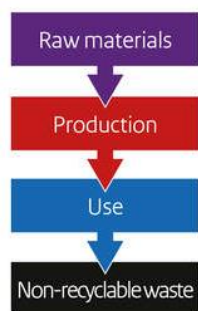


ISRAELI-ITALIAN PROPOSAL RESEARCH

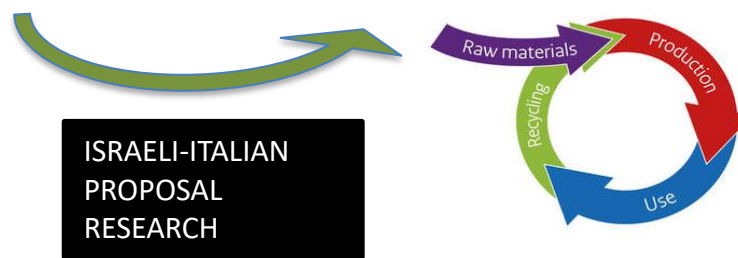
- S2UPREMO (Sustainable Solar-reflective Units of green Phase-change and REcyclable Materials from Organic sources)
- joint research proposal recently submitted in the framework of bilateral Italian–Israeli cooperation (Scientific Track 2020)
- **Sustainable and innovative multilayered roof for hot climates**
 - solar-reflective “cool” coating
 - bio insulation material
 - a high-inertia substrate made of phase change material (PCM) components all made of bio-based recycled materials



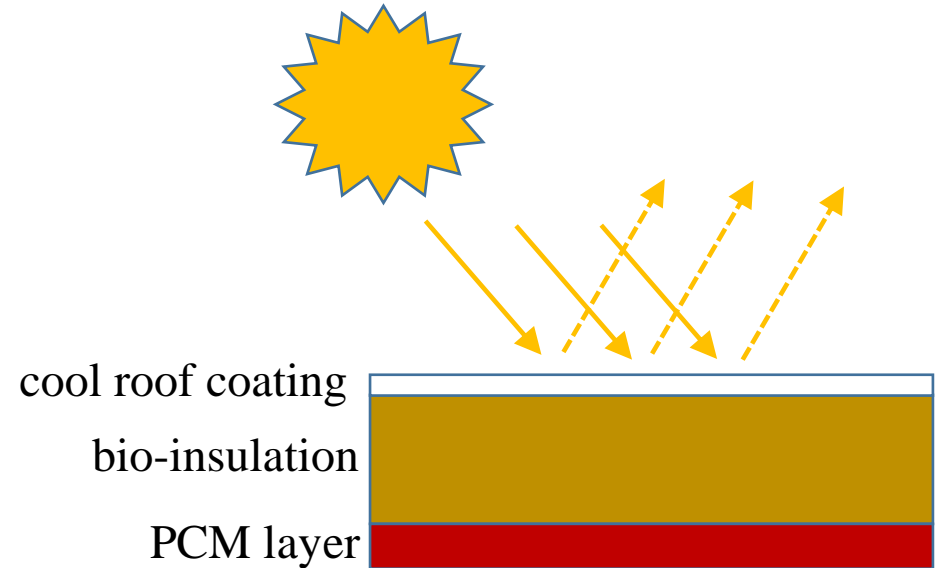
Linear economy



Circular economy



EELab of Univ. Modena & Reggio Emilia is an ISO/IEC 17025 accredited laboratory for certification of solar reflective materials



- A solar reflective cool roof limit absorption of solar radiation
- An insulation layer with also significant thermal inertia limit penetration of the outer thermal cycle
- A phase change layer can made null the inner thermal cycle



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Innovation and ecological sustainability of each component of composite roof

	Source	Material	Green house gas emission	End of life cycle / degradable	Consumption of environmental resources and energy
Cool roof paint	waste food oil	binder	Limited	recycled	chemical conversion
	Recycled glass or ceramics	pigment	limited	recycled	machining (grinding, etc.)
Bio insulation	Date palm leaves, straw	Fibrous organic matter	zero	yes	harvesting and transport
	bio plastic	Thermo forming bio polymers	Limited	yes	chemical conversion
PCM	biological	fatty acids	limited	recycled	limited
	recycled glass	filler	limited	recycled	machining (grinding, etc.)

PATENTS

BARBARI MATTEO, CONTI LEONARDO, MONTI BERNARDO, MONTI MASSIMO, ROSSI GIUSEPPE, ROTINI FEDERICO, TOGNI MARCO (2016)

A method for producing sustainable composite materials designed for the production of elements for structural or non-structural use, and the material obtained in: **PCT WO2017025786**

National Patents

BARBARI MATTEO, CONTI LEONARDO, MONTI BERNARDO, MONTI MASSIMO, ROSSI GIUSEPPE, ROTINI FEDERICO, TOGNI MARCO (2015)

Materiale composito sostenibile atto alla produzione di elementi per impiego strutturale e non strutturale in edilizia – Brev. Naz. per invenzione industriale **ITUB20153019**

BARBARI MATTEO, CONTI LEONARDO, MONTI BERNARDO, MONTI MASSIMO, ROSSI GIUSEPPE, ROTINI FEDERICO, TOGNI MARCO (2015)

Metodo di realizzazione di materiali compositi sostenibili atti alla produzione di elementi per impiego strutturale e non strutturale in edilizia – Brev. Naz. per invenzione industriale **ITUB20153007**



The product, useful for bio – insulation and agricultural and industrial packaging is made under a press and the pressure can be chosen according to the final uses.

Phase 1 - Preparation of the mould



Phase 2 - Compression of the mould



Phase 3 - Treatment with microwaves



**No water needed
during the process**



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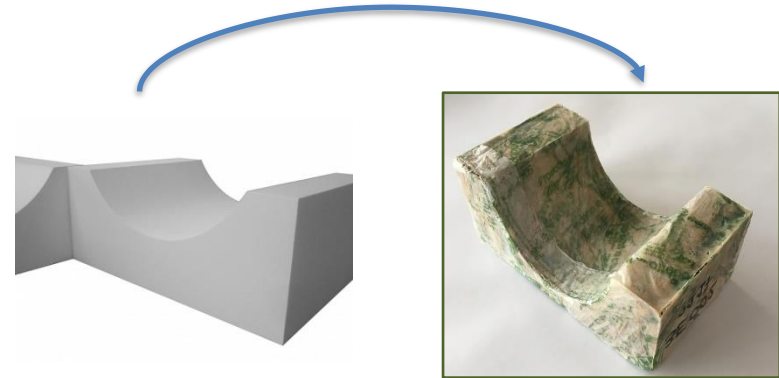
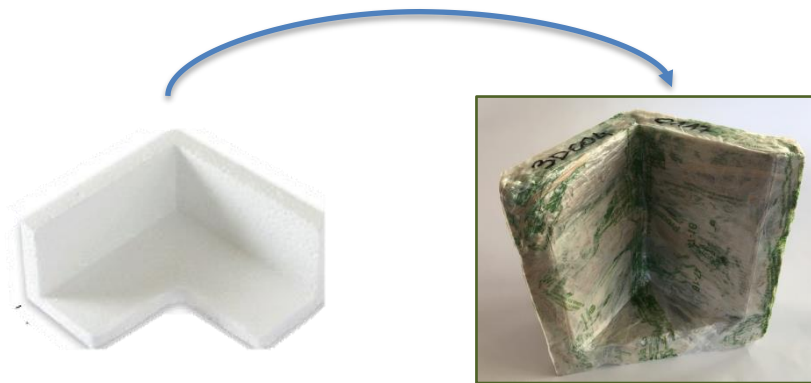
Heating the composite material in the compressive state up to melting to obtain an extensive honeycomb structure:

- tri-directional lattice of bioplastic material
- formed by a set of closed cells connected both together and to the outer casing and adherent to the straw.



Compostable





Technology and its advantage

- versatility of the material
- high sustainability
- can be employed in different sectors:
- Insulation, agricultural and industrial packaging etc
- gives a feeling of genuineness

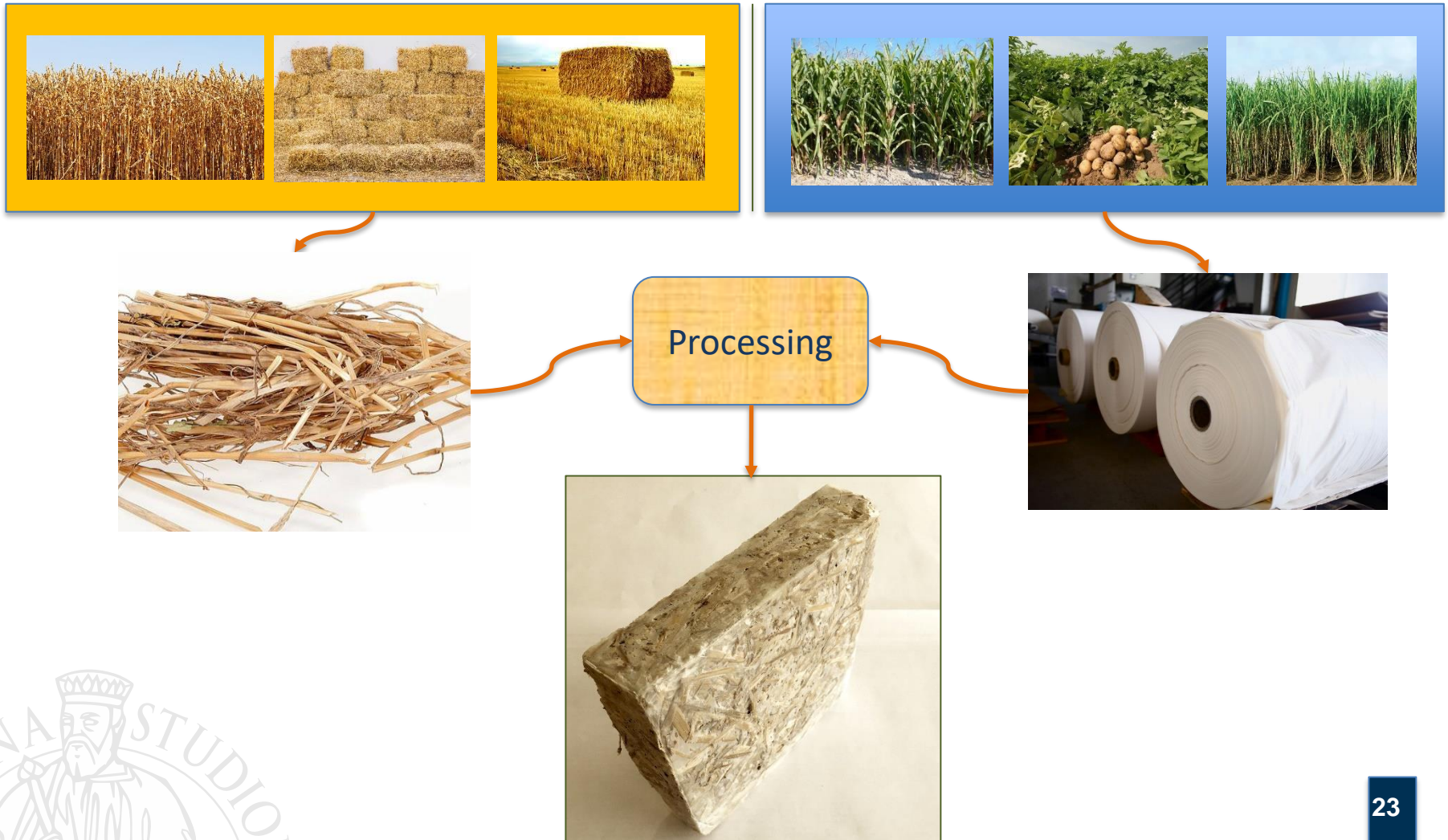
density range	90-400	kg/m ³
compression range	1-13	N/mm ²
straw/bioplastic	70-90/30-10	%



Leaves for the production of panels



In Italy the bio insulation prototype is made of a composite material with **straw** (and other organic fibers) and **bioplastics** (bio-polymers).



The Challenge

In Israel the proposal concern the realization of bio insulation panels made of a composite material with **date palm leaves** and **bioplastics**.

Israel is a relevant producer of date palm fruits in the world, creating a big environmental problem for leaves recovery



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From waste to resources



Assessment and control of thermal comfort in hot climates

- Models of dairy cows well-being
- Math simulations of thermo - hygrometric balance inside livestock housing
- Advanced Sensors
- Artificial intelligence analysis



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Proposal of Israeli – Italian Investigation

aimed to improve thermal
comfort inside livestock
housing

- Bio insulation material
- Sustainable multilayered
roof model
- Full scale experiment in
Israel inside livestock
housing



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Focusing on Israeli – Italian Investigations of innovative bio insulation material also employable for packaging

- Date palms leaves in Israel, organic waste right now
- Bioplastic supply and Thermal properties monitoring in Italy
- Opportunity of technological scouting for any economic opportunity, high tech network, Start Up





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Dairy cows building Golan, 2002 Israel

- Focusing on Full scale Investigations in Israel

assessment and control of thermal comfort inside livestock housing of dairy farms





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Tools for assesment and control of thermal properties

Many indexes are available in literature:

General equation (CIGR):

$$THI = aT_{db} + bT_{wb} + c$$

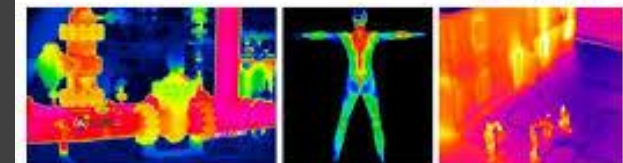
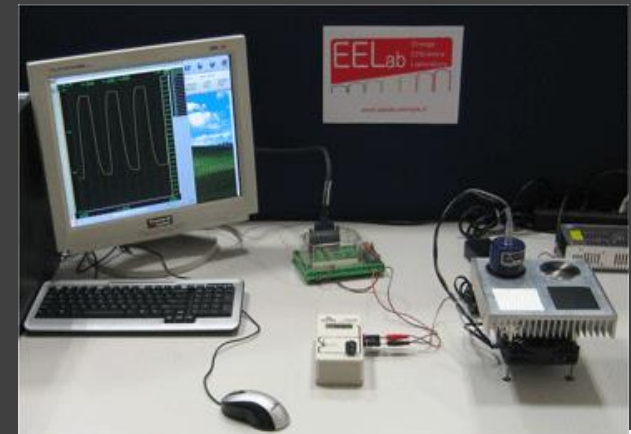
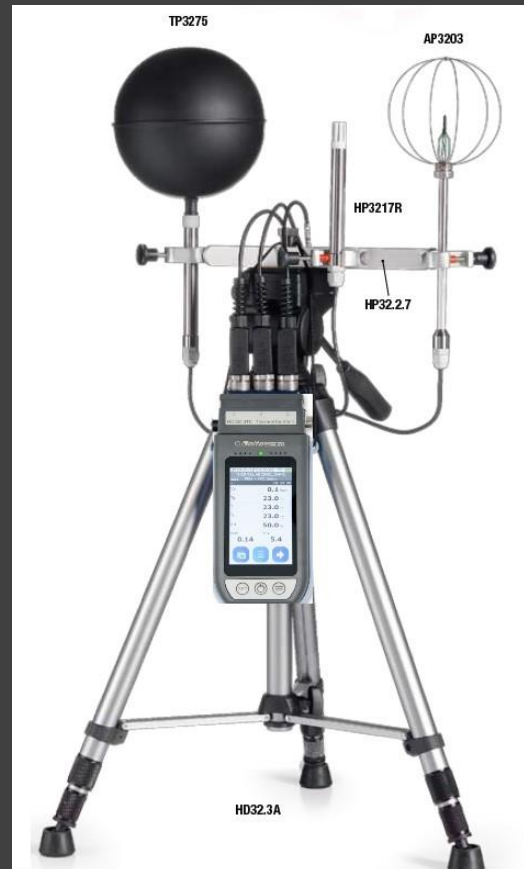
T_{db} dry-bulb temperature

T_{wb} wet-bulb temperature

a, b, c constants depending on species

$$THI (cows) = T_{db} + 0,36T_{dp} + 41,2$$

More advanced indexes can be developed by including a larger set of thermal properties and environmental parameters



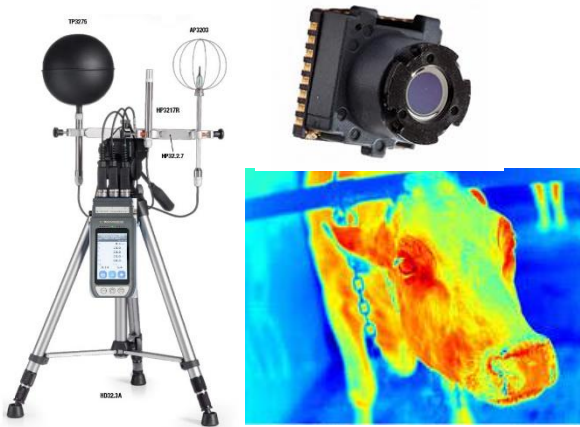


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Full scale Investigations for assessment and control of thermal comfort

- The idea is to compare thermo–hygrometric conditions of two groups of cattles , one under traditional roof and the other under a sustainable multilayered roof prototype
- Our aim is to find correlation between:
- thermo hygrometric conditions and perceived well being (health and welfare) of animals
- thermo hygrometric conditions and physiological parameters of heat stress monitored with specific PLF sensors on board of animals.

Artificial Intelligence
Analysis to process
big data



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For further info pierlead@gmail.com

Thank for your attention ...on cow welfare !!