Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

CREA - ENEA - Israel Workshop

WORKING TOGETHER FOR SUSTAINABLE AGRI-FOOD SYSTEMS

SESSION 1: SUSTAINABLE WATER MANAGEMENT IN SEMI ARID CONDITIONS

Development and diffusion of integrated water and energy technologies for sustainable food productions

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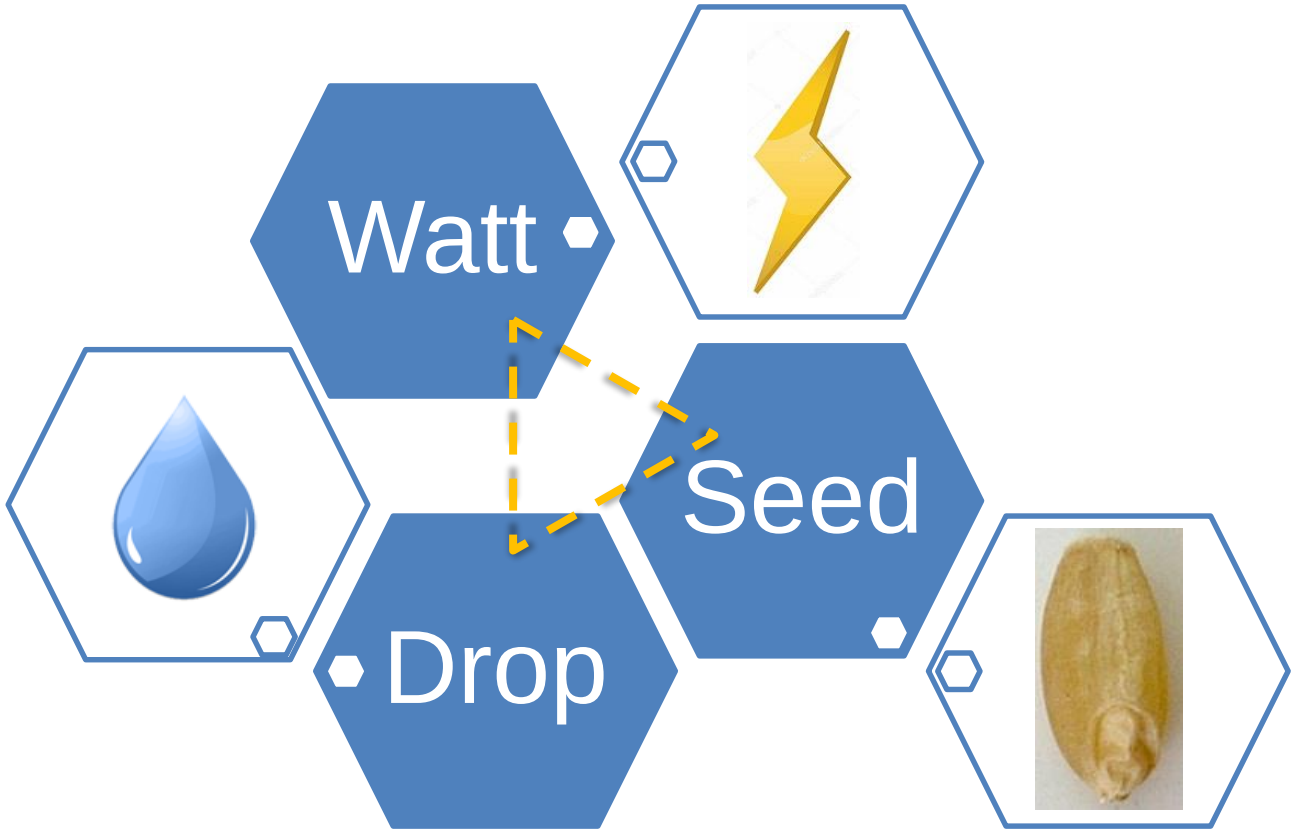
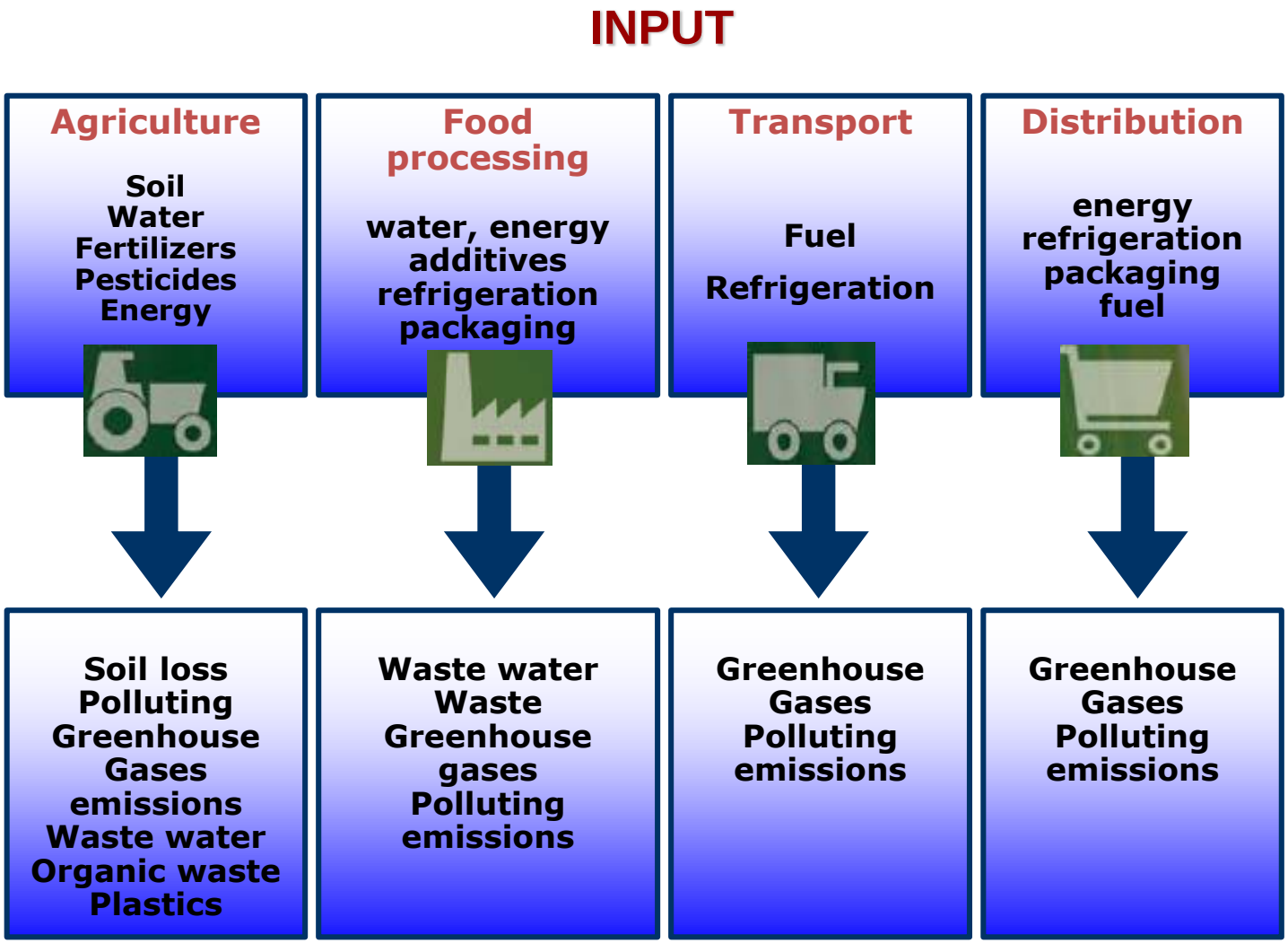
Drops and watts count

NEXUS approach to deal with food security and sustainability issues

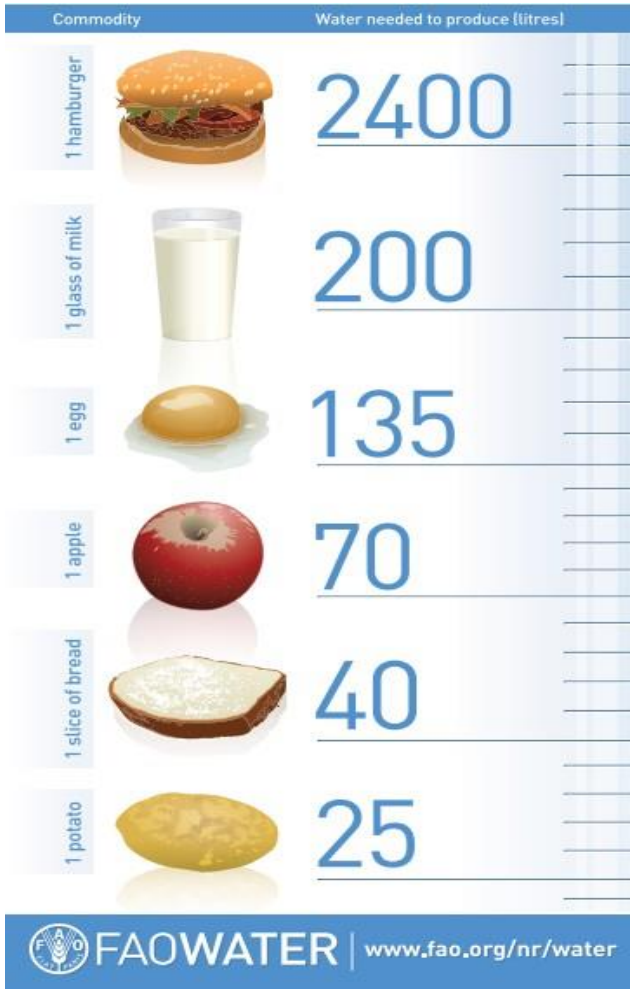


Water **E**nergy and **F**ood interlinkages

Analysing the whole agro-food chain

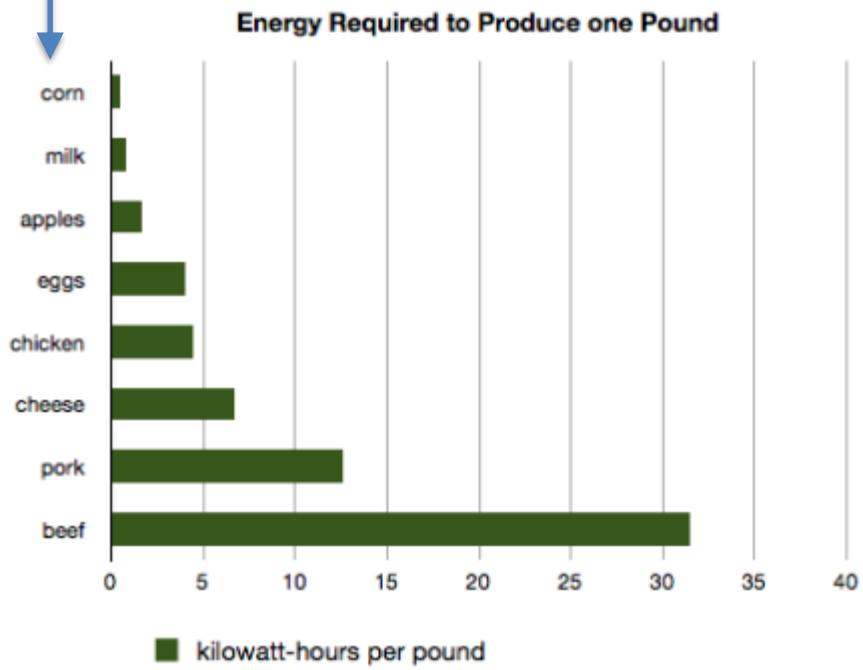


Each drop counts, each watt count



Water (liters) per unit of food

Energy (kWh) per unit of food



What are the right approaches and strategies?

Do we really need to develop NEW technologies to deal with NEXUS?

Seems to be more effective to spread (and adapt) available solutions and opportunities to get significant results in terms of productivity and yields

Water scarcity is a growing issue and to cope with we need both, but in two different timelines

In the shorter time we need to diffuse, disseminate, by innovation and adaptation to different social, economic and technological context, what is available nowadays

Spreading BAT and experiences to increase resiliences of agri-food chain production

Researches focused on Nexus

Main ENEA basic and applied researches related to NEXUS

Many activities have been carried out in the last decade that are linked to water, energy and food issues trying to address the sustainability paradigma with the aim of using less resources for unit of food

Mainstream research areas	*Specific for agrifood sector*
• Water saving	• Water recovery in agri-food industries
• Water recovery	• More efficient greenhouses
• Water quality and reclamation	• New crops for dry environment
• Wastewater management	• Renewables technologies for agroindustry.
• Renewables technologies.	• Energy saving in the agri-food industry
• Energy saving	• Farm Renewables integration
• Industry renewables integration	• WasteWater reuse for irrigation
• Sustainable production	• Conservation Agriculture & Precision farming

A selection of research/cooperation activities

A showcase of eco-innovations along the agri-food chain with different applicability level, innovation and research needs

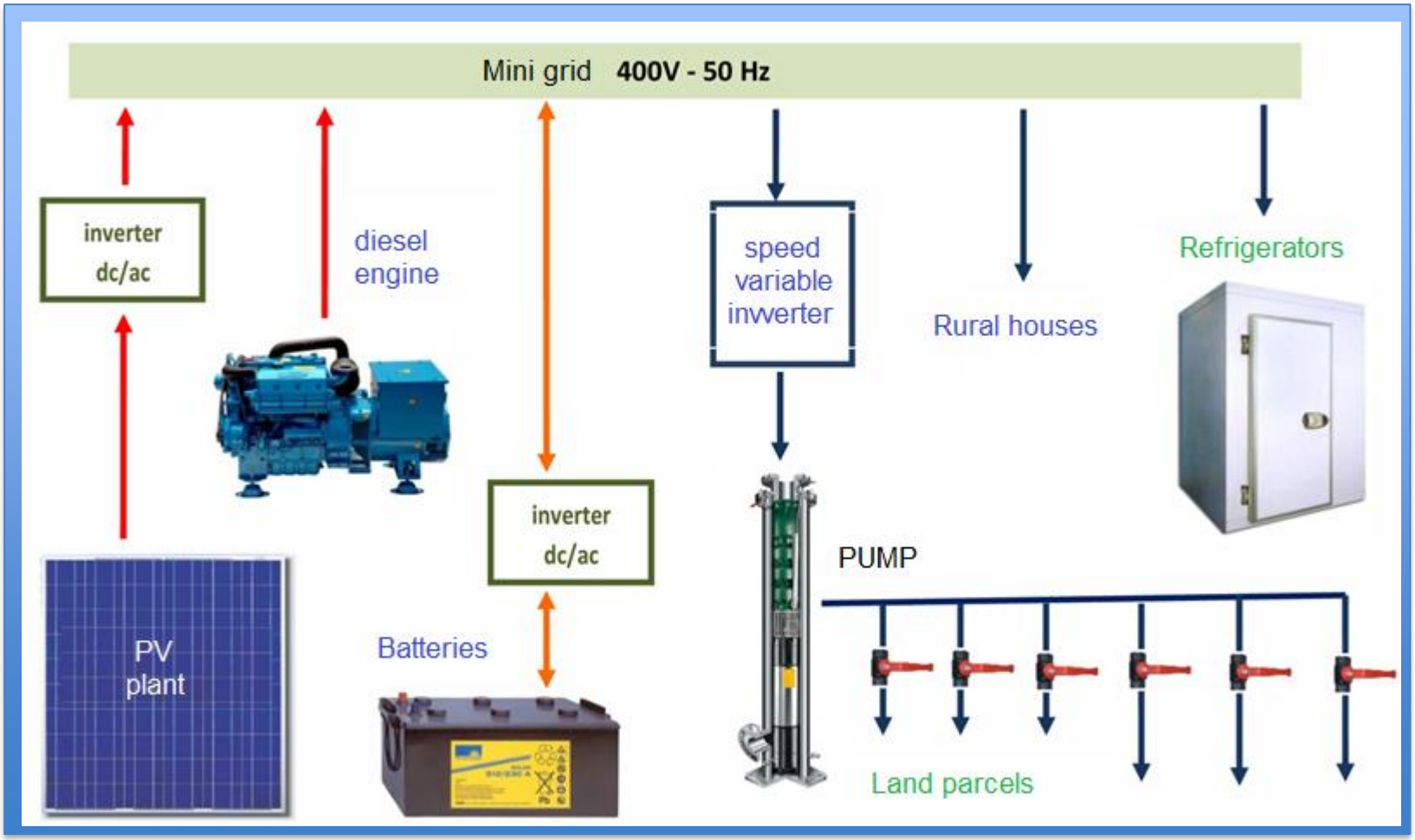
- Integrated solar systems for water pumping, irrigation and regrigeration
- Wastewater and energy recovery in the agri-food sector
- Anaerobic digestion to produce biogas, from residues, and power for agrifood industries

Nexus and irrigation schemes

- In large agricultural areas irrigation depends from energy availability for pumping and water distribution
- Energy cost for irrigation is a main issue and could affect farmer revenues
- There is a large use of fossil fuel (diesel engine) to provide energy for pumping
- Using renewables could decrease the cost of water pumping
- There is a large difference in irrigation systems efficiency
- In LDC affordable and reliable energy systems are a priority for farmers
- Technologies are available but their real implementation needs still research efforts to properly adapt and make it more cost-effective

Cooperation efforts: irrigation systems in Senegal

Providing PV systems for irrigation and to power a cold room for food storage



Source: Project FREDDAS - GREEN CROSS ITALY – ENEA (2012-2015)

Innovation needs for reliable PV Systems

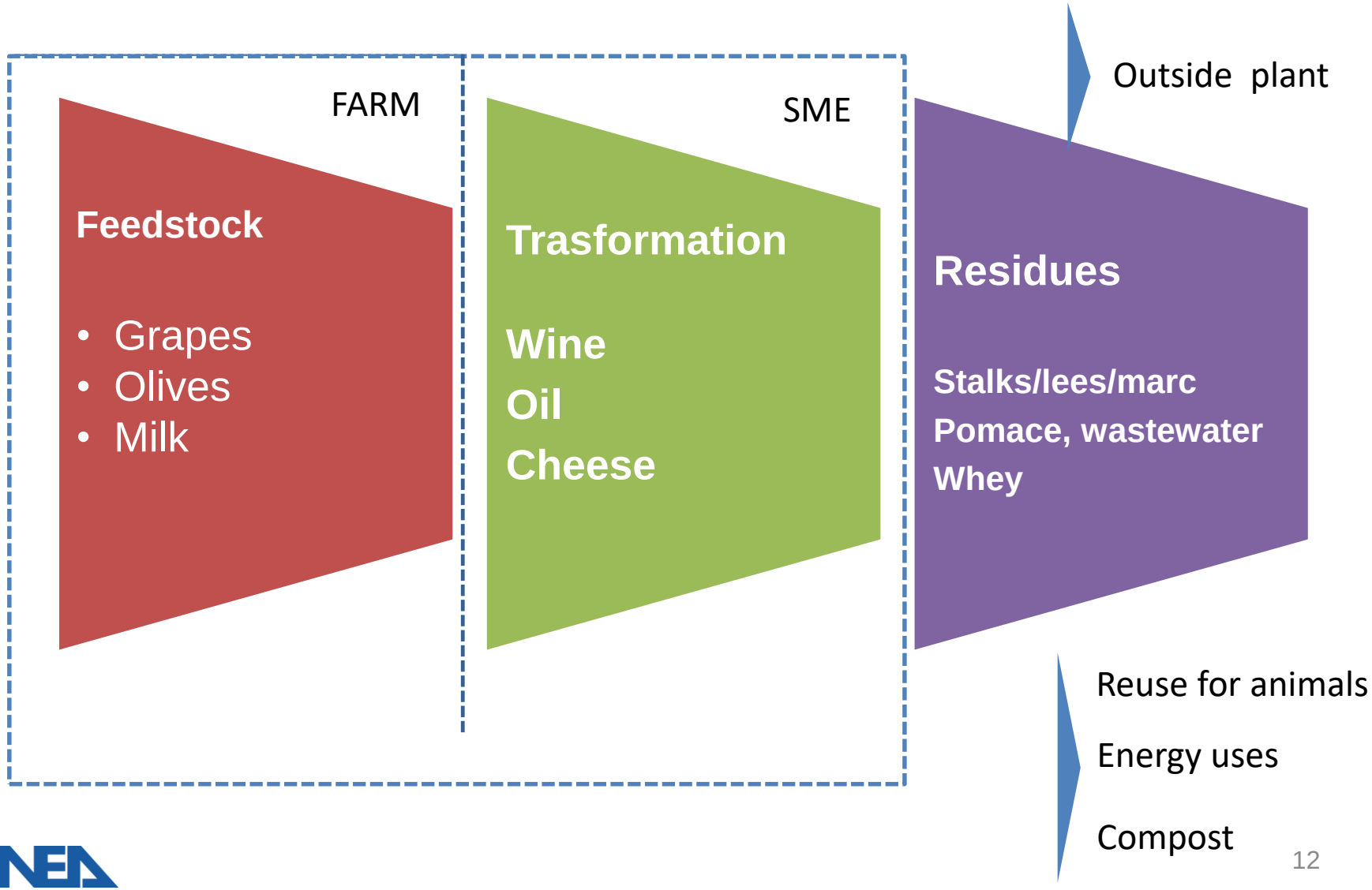
Pumps, PV modules and Irrigation systems are well known but…..there is the need to study and test technology integration and reliability

- **Adaptation to different social context and several final users: farmers, food enterprises (refrigeration), households**
- **Integration with traditional systems (engines) or with wind power**
- **Developing easy to use tool to make proper technical economic design of PV systems for rural electrification**
- **Developing low cost maintenance and assistance systems**
- **To identify and overcome barriers (social, economic, technical) to their introduction and diffusion**

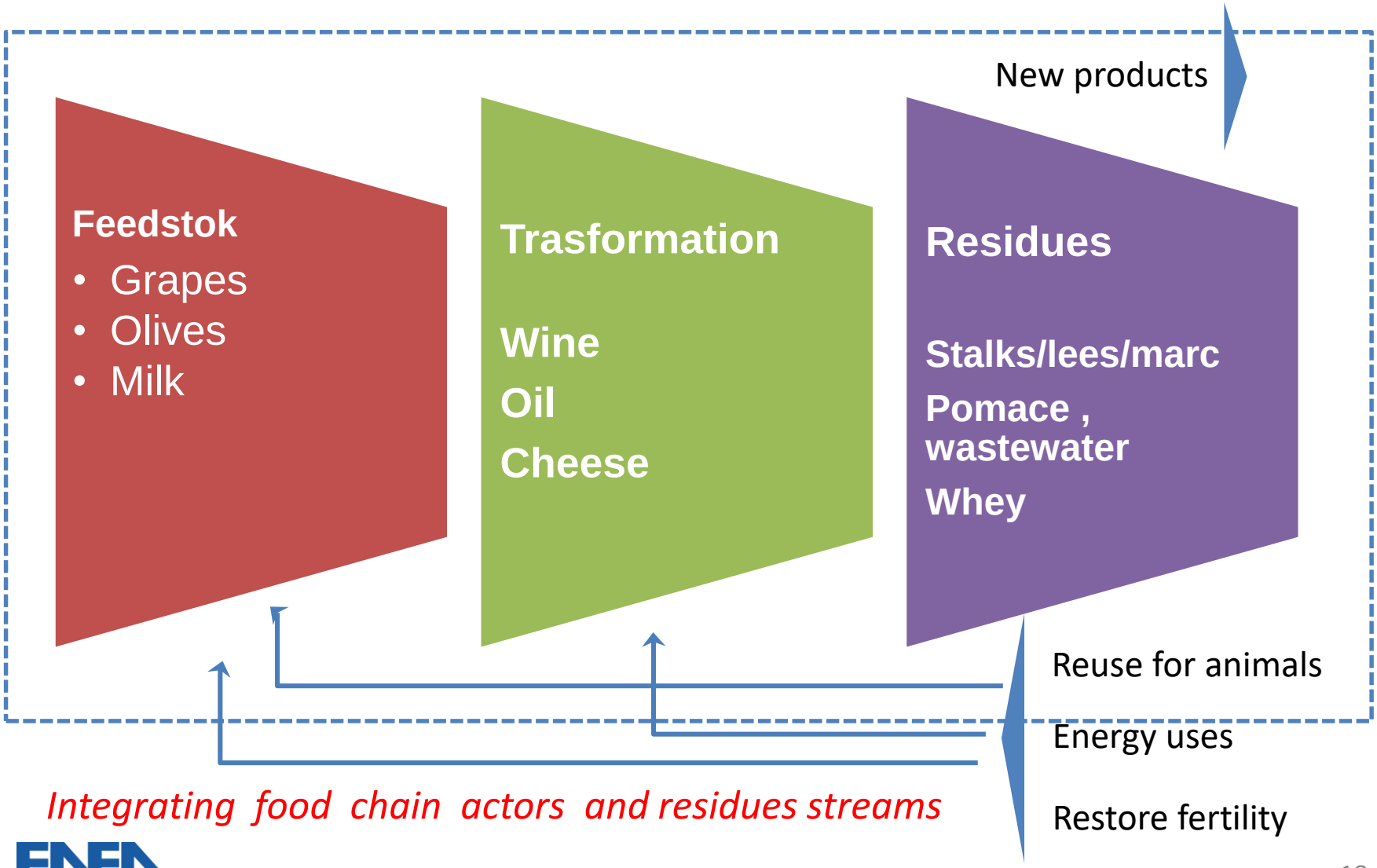
Agri-food industry Nexus issue

- Food conservation and production needs energy (thermal and electric);
- Food industries use water at different stages: washing, plant cleaning;
- Mediterranean countries with their typycal food chains produce large amounts of organic residues;
- Economic as well as environmental cost to manage or dispose it could be quite high for food enterprises;
- New legislation and EU environmental and energy goals impose to change SMEs attitudes and behaviour;
- Residues are not waste but potential raw materials for new products;
- Opportunities for water saving and recovery, as well as energy saving and production, is large.

Agri-food chain residues traditional pathway

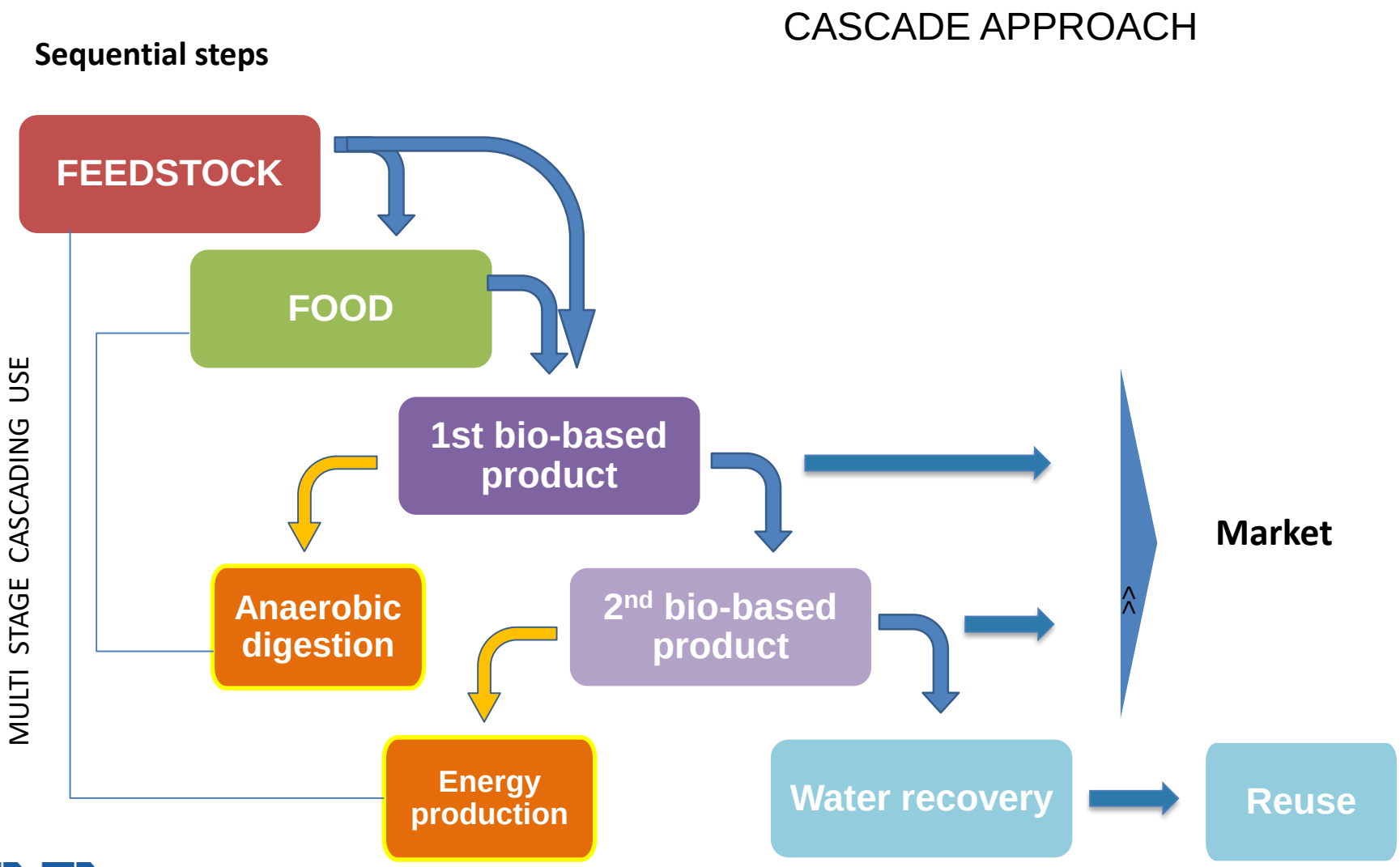


Chain integration and new by-products

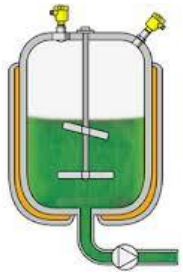


Integrating food chain actors and residues streams

Recovering value, energy and water



Dairy sector: protein, lactose and water recovery from whey



WHEY

Water

Retentate

UF A=6m²

UF/DF

Q= 7000 lt/h

Permeate

Permeate

Retentate (whey protein)

Retentate (whey protein)

NF DL A=8,5m²

Q= 2000 lt/h

Permeate

Lactose

NF DK A=8,5m²

Q= 2500 lt/h

Permeate (**Water**+Salt)

Bioreactor

Sequential membranes for Micro Ultra Nano and reverse osmosis application

Demonstration and test plants

Ceramic and Polymeric Filtration plant for pilot scale testing

Installed at production plant to be tested directly on fresh residues production

They are mobile and could be adapted to be powered by PV systems

ENEA plants at milk production plant in Apulia: PON project Be & SAVE, 2015

A.D. for energy production

Anaerobic digestion process in different configuration and operational conditions (T) dealing with different organic substrates

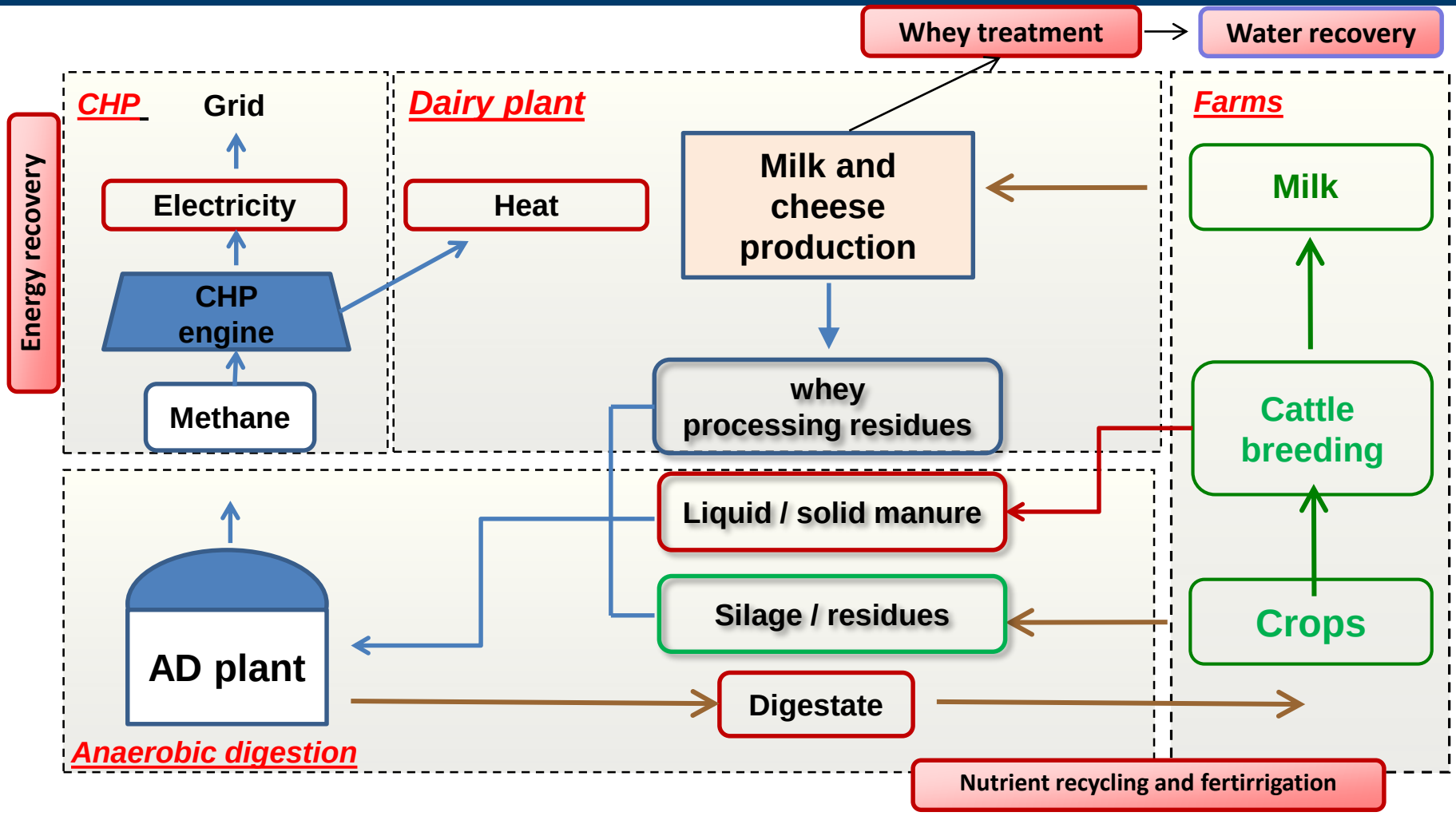
Full scale AD plant with enzyme treatment

Upgrading of a full scale AD plant for fruit processing residues treatment

GoBioM Project Biomethane production optimisation

Pre-treatment systems aimed at improving the organic substrates digestion - Lab scale trials to evaluate and set the operational parameters of hydrolysis process - Pilot scale CSTR reactor for testing – Analysis microbiological community involved in the AD process – Improving fermentation processes

Farms and dairy plant for local symbiosis



A close relationship between local enterprises and farms to share residues, energy, inputs, exploiting synergies and avoiding environmental costs

There are large opportunities to save water, energy, increase input use efficiency and sustain food security with current technologies

Affordable and reliable technologies are available must be promoted, subsidized and spread to contribute substantially to the agrifood system sustainability

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ENEA contributors

- Marco Stefanoni for renewables integration for water pumping and irrigation

- Luigi Petta and Valerio Miceli for wastewater reclamation, residues recovery and by-products

ENEA

WASAG
The Global Framework on Water Scarcity in Agriculture