Environmental Sustainability of Valorizing Food Waste in Animal Feed Production - Case of Grape Stem

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FEED FROM FOOD INDUSTRY BY-PRODUCTS

Turn food industry by-products into secondary feedstuffs via circular-economy schemes

NEWFEED PROJECT

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Project Aim

- Develop and adopt alternative animal feeds, setting up a circular economy approach in the livestock production by turning food by-products into high value secondary animal feedstuff.
- Increase the Mediterranean livestock sustainability by valorizing local food industry by-products to reduced environmental impact and costs.

Total Budget:	€ 2.202.371,84
Project Duration:	48 months (1/7/2021 - 30/6/2025)

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

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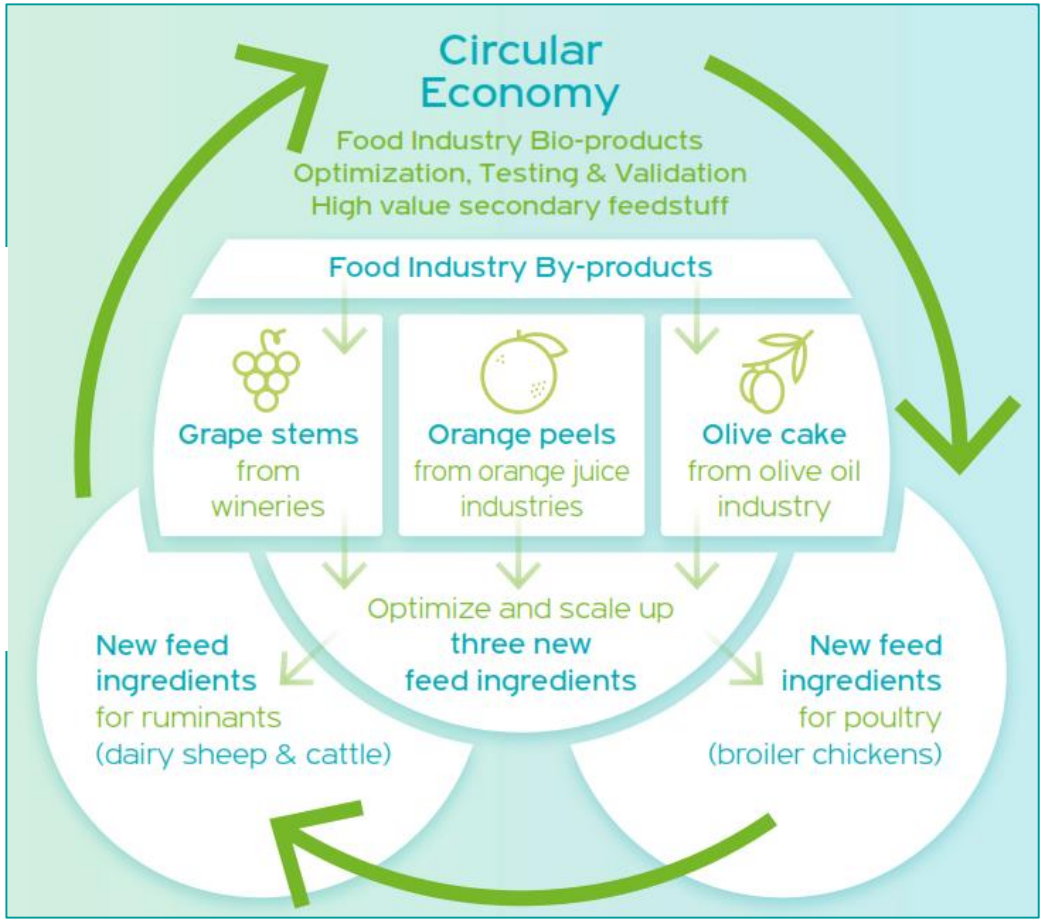
Project Partnership

AZTI · NEIKER · Riera Nadeu · UAGA · BAI GORRI · cesfac · Heliopolis University for Sustainable Development · SEKEM DEVELOPMENT FOUNDATION · iSiS · ΣΞΒΤ · ELGO-DIMITRA · UNIVERSITY OF WESTERN MACEDONIA · ORTA DOĞU TEKNİK ÜNİVERSİTESİ MIDDLE EAST TECHNICAL UNIVERSITY

Three value chains



Case Study 1
Grape Stem

Life Cycle Analysis

Wine Production and By-products

- The worldwide grape production: 75 MT; wine production: >250 MHL /year
- Winery by-products such as grape stems, pomace, and lees are not fully utilized and are often discarded in open areas or landfilled, causing environmental impacts.
- On the other hand, the high polyphenol content is of great interest in animal nutrition, contributing to oxidative stability.
- But these by-products are rich in lignin, interfering with their digestability.

Waste valorization for animal feed production

- Need for sustainable development in terms of the safe reuse of waste biomass.
- Production of high-value secondary feedstuff for dairy sheep from waste grape stems using a circular economy approach has been suggested as a sustainable option:

  - Non-hydrolyzed prototype
  - Hydrolyzed prototype

Non-hydrolyzed Prototype

Grape stem
1 tn

Grinded grape stem
1 tn
18 ° brix

69 % humidity
19 % sugars

Water ratio
1:1

Liquor
0.78 tn
6.2 ° brix

Washed grape stem
1.23 tn

79.5 % humidity
5-7 % sugars

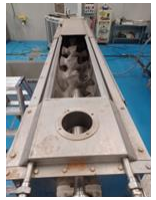
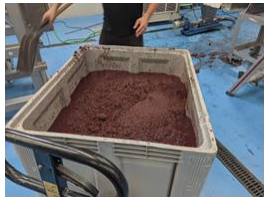
Other applications

Dried grape stem
0.34 tn

10 % humidity
1-2 % sugars











Hydrolyzed Prototype

Water ratio 1:1

Grape stem 1 tn

Crushed grape stem 1 tn 18 ° brix

Liquor 0.78 tn 6.2 ° brix

Washed grape stem 1.23 tn

Other applications

Hydrolyisis

NaOH (0.5 %) ratio 1:1.25

Neutralised hydrolysis water 1.9 tn

Hydrolysed grape stem 0.90 tn

Hydrolysed and dried grape stem 0.28 tn

The environmental benefits and impacts of this valorization strategy?

- The environmental impacts of turning waste grape stems into high-value secondary feedstuff for dairy sheep were quantified through LCA!

Life Cycle Assessment

Functional Unit: **1 ton of animal feed produced**

System Boundary: Cradle to Grave

Inputs: Pilot plant data

Software Tool: SimaPro 9.3.0.3

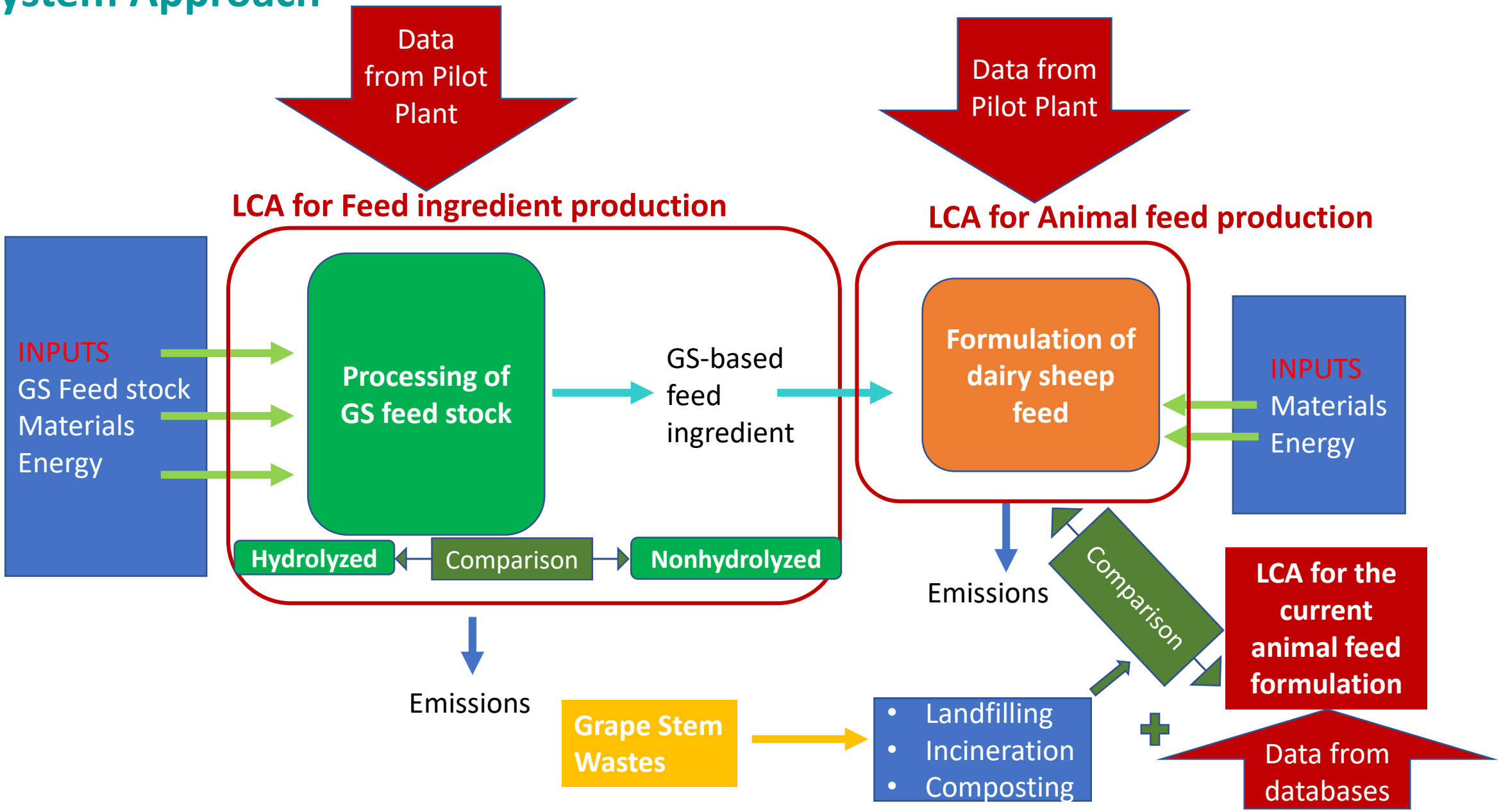
Database: Ecoinvent 3.7 (primarily)

Impact Analysis Method: Recipe 2016 (H)

Impact categories

Midpoint	Endpoint
Global warming	Human Health
Stratospheric ozone depletion	Ecosystems
Ionizing radiation	Resources
Ozone formation, Human health	
Fine particulate matter formation	
Ozone formation, Terrestrial ecosystems	
Terrestrial acidification	
Freshwater eutrophication	
Marine eutrophication	
Terrestrial ecotoxicity	
Freshwater ecotoxicity	
Marine ecotoxicity	
Human carcinogenic toxicity	
Human non-carcinogenic toxicity	
Land use	
Mineral resource scarcity	
Fossil resource scarcity	
Water consumption	

System Approach



LCA Results for Animal Feed Ingredient Production

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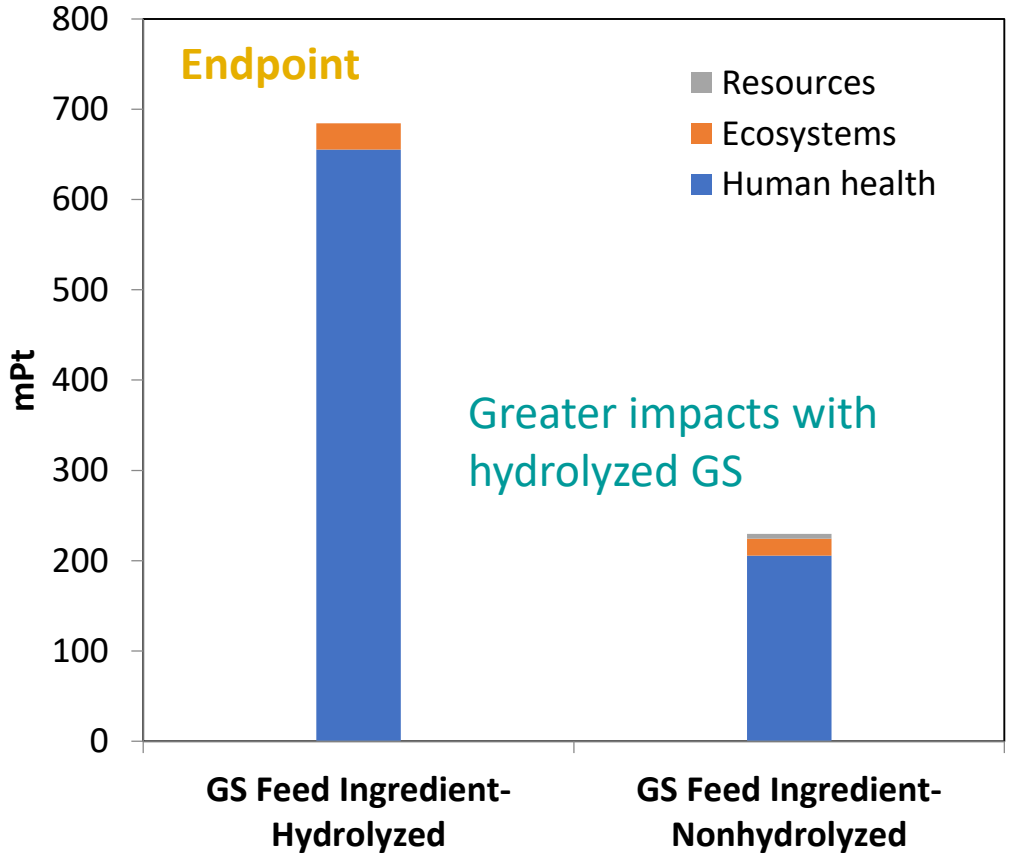
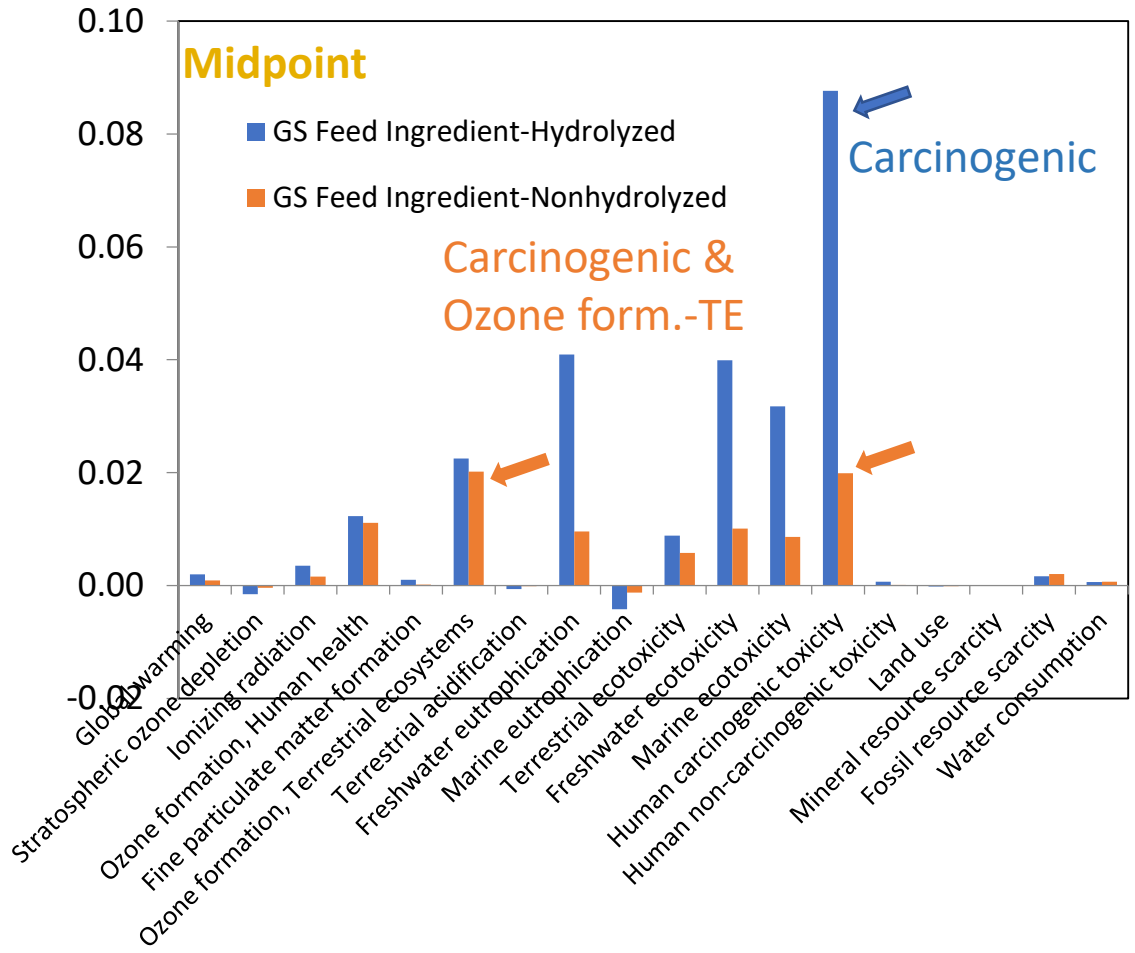
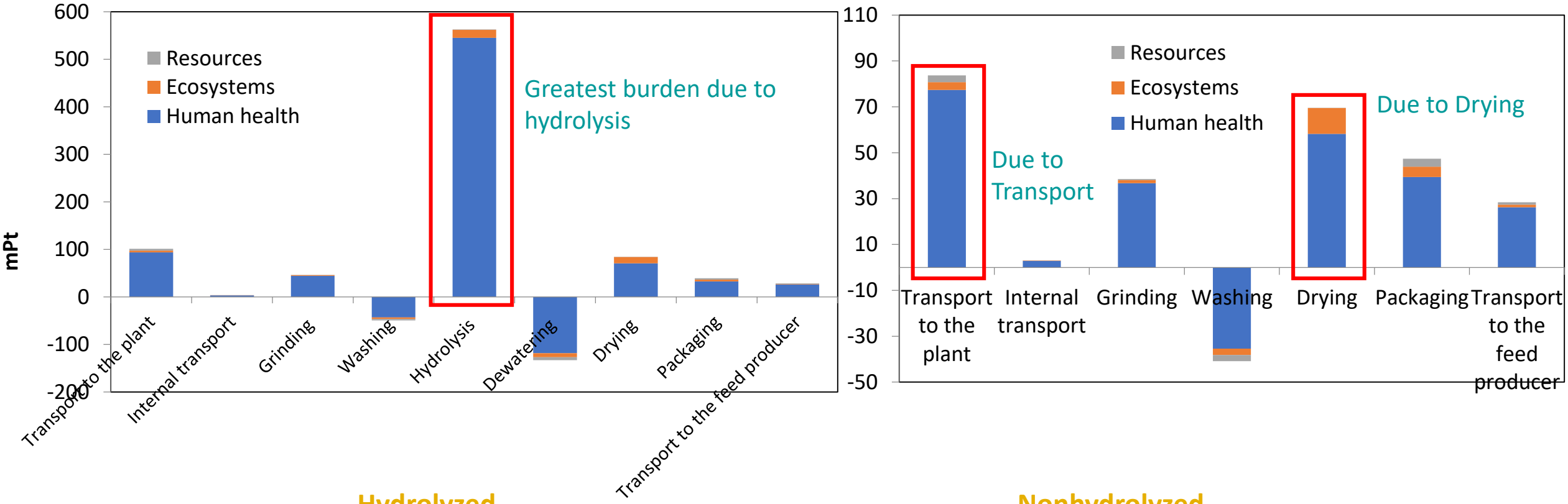




LCA Results for Animal Feed Ingredient Production

Endpoint



Hydrolyzed **Nonhydrolyzed**

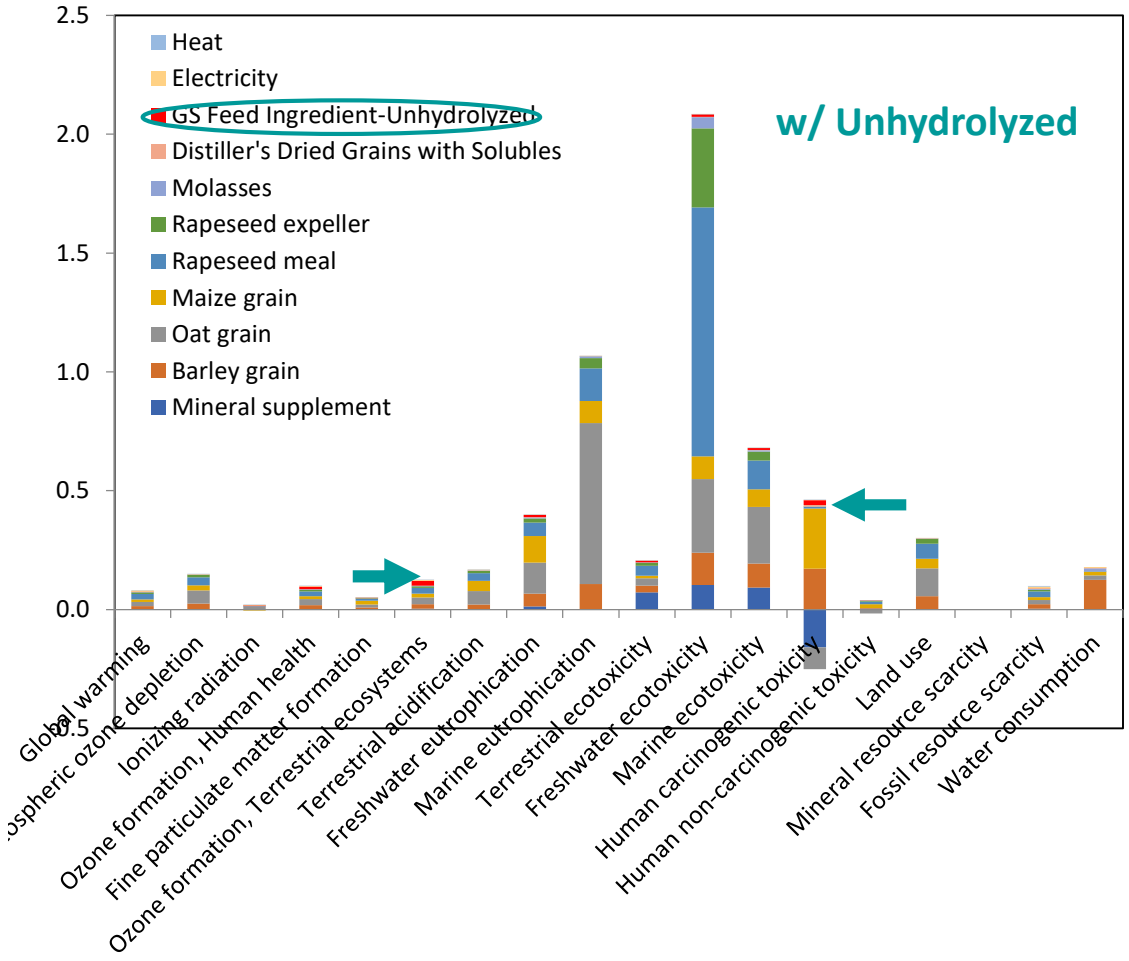
Process impact contributions

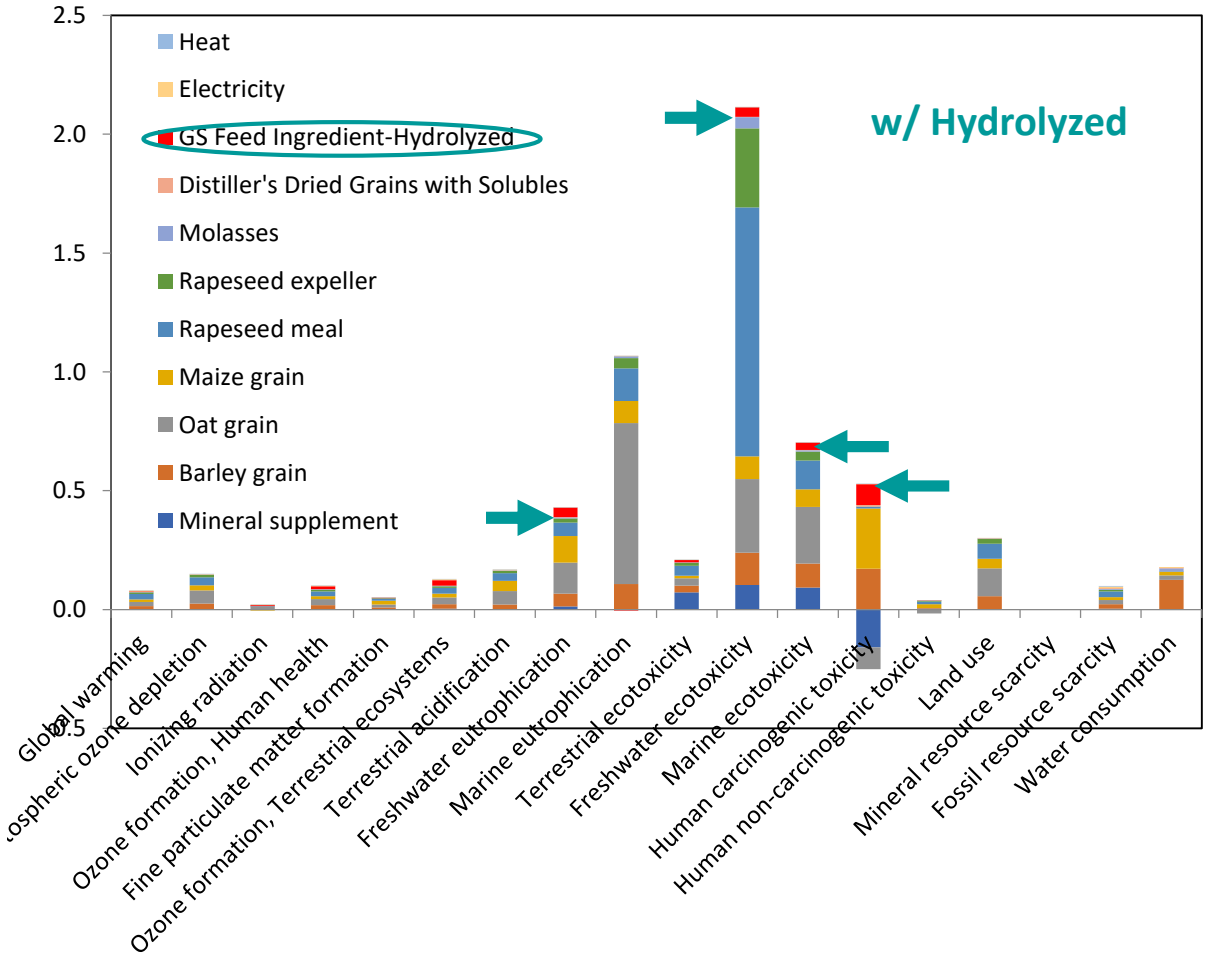
LCA Results for Animal Feed Preparation

Animal Feed Diet for Dairy Sheep

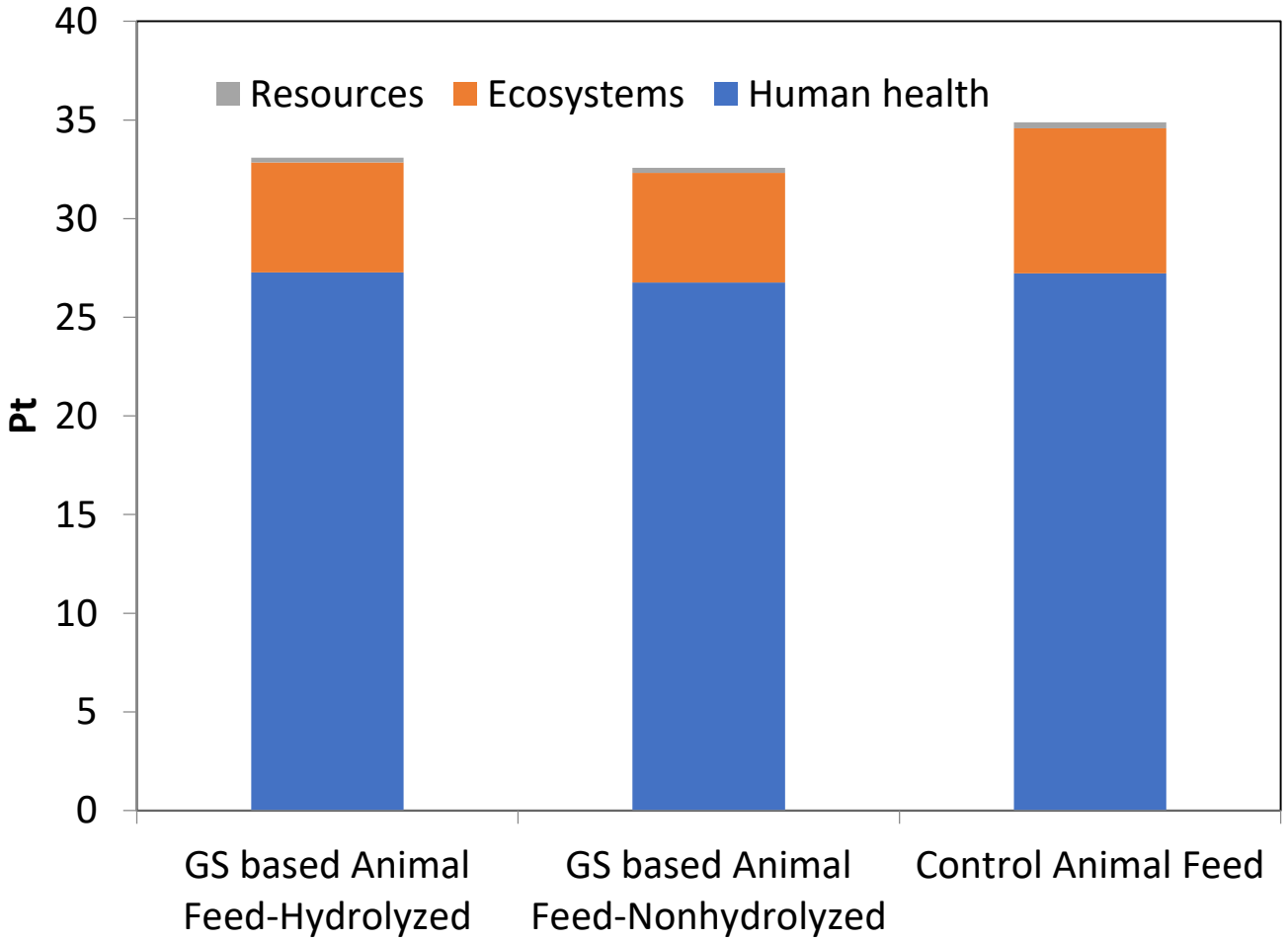
Ingredient	Control (kg/ton)	w/ GS hydrolyzed (kg/ton)	w/ GS nonhydrolyzed (kg/ton)
Barley grain	50	190	190
Oats	530	240	240
Maize	100	150	150
Distiller dried grain	0	50	50
Rapeseed meal	210	160	160
Rapeseed oil	50	50	50
Molasses	30	30	30
Vitamin & mineral	30	30	30
GS based feed ingredient	**0**	**100**	**100**

Normalized Impacts: Animal Feed Preparation



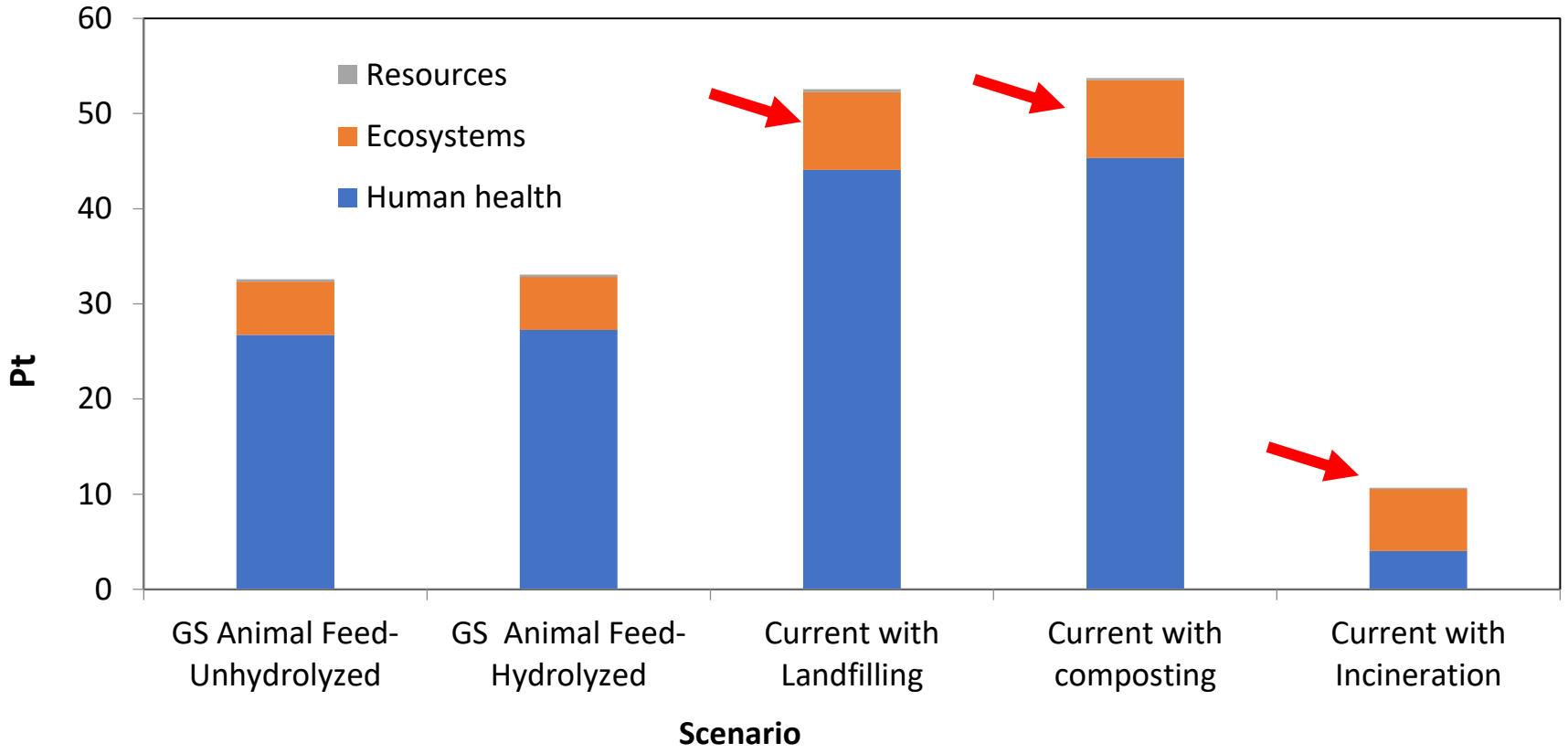


Control vs GS-based Feed



No remarkable difference!

Valorization vs Current Situation



- Less burden than the current situation with control feed + composting & landfilling, but higher than + incineration

Conclusions

Feed Ingredient

- Hydrolyzed GS has a remarkably higher impact (69%) than unhydrolyzed one.
- NaOH consumption plays a critical role in the proposed valorization process.

Animal Feed

- When integrated into the animal feed this remarkable difference almost disappears.
- The proposed valorization process is superior to the disposal scenarios of composting (62%) and landfilling (59%), though not for incineration (-68%).

The proposed valorization process offers a good sustainable option for the livestock sector.

Thank you for listening...