Assessment for adding value to side-flows

The FORKLIFT tool –a fresh approach

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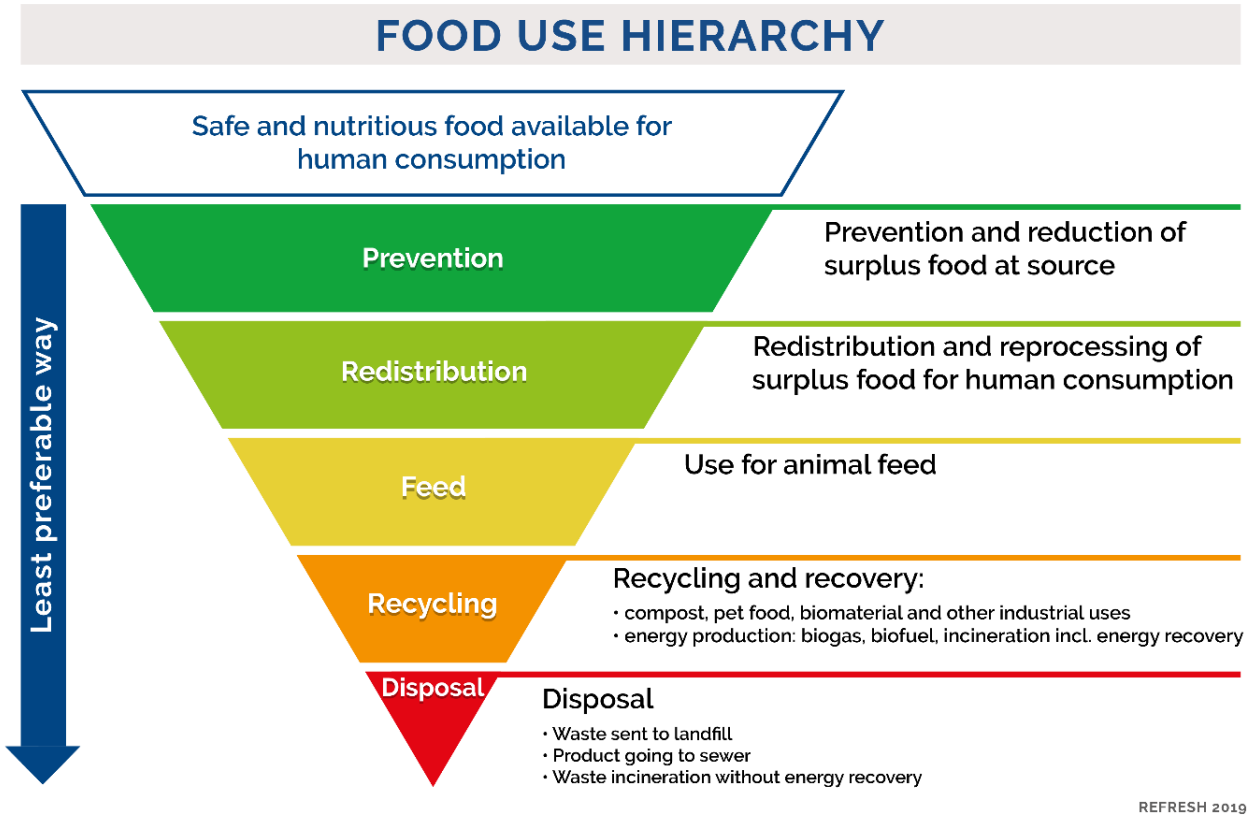
Adding value to side flows from food processing

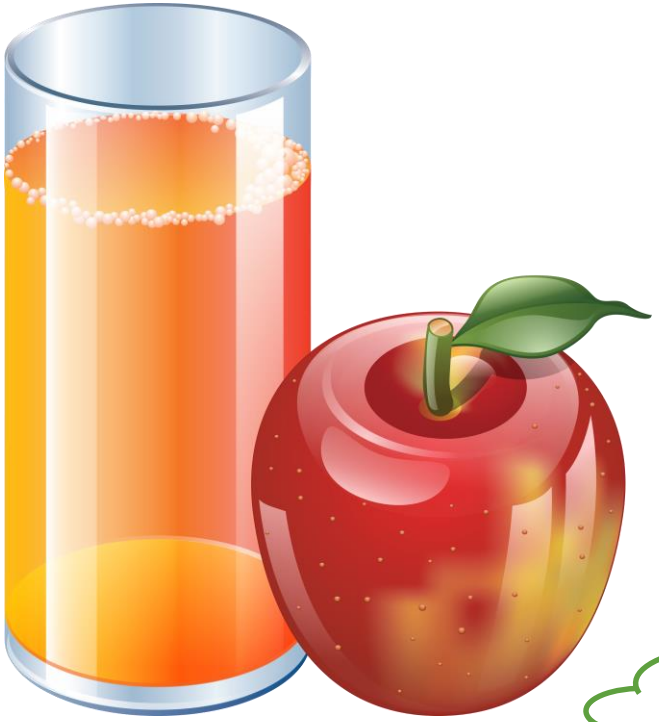


Apple pomace from juice and cider production

0, 7 million tonnes AP in EU

1 kg apple:

0,7 kg juice
0,3 kg pomace and sludge



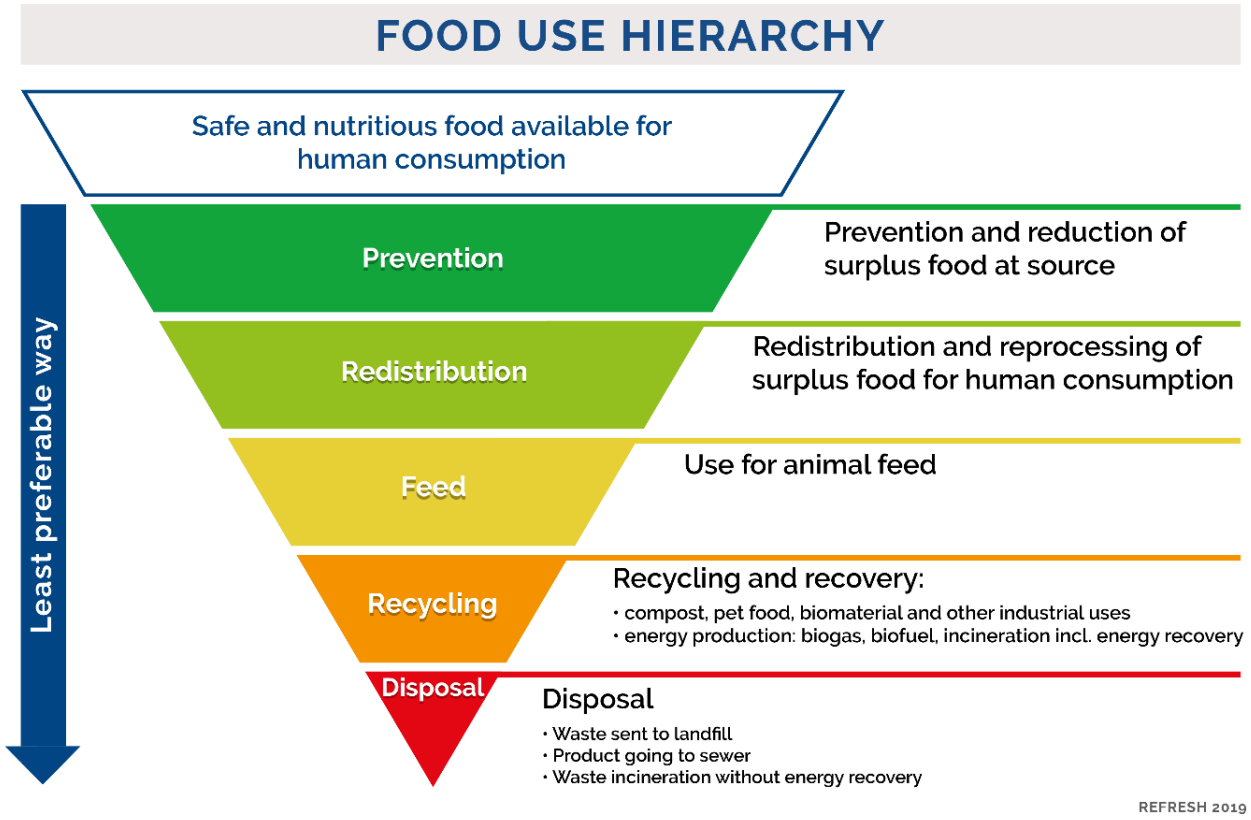
Pectin?

Biogas?

Feed?

Landspread?

Adding value to side flows from food processing



How does the current handling compare to other options?

- Environmental impacts
- Costs
- Market

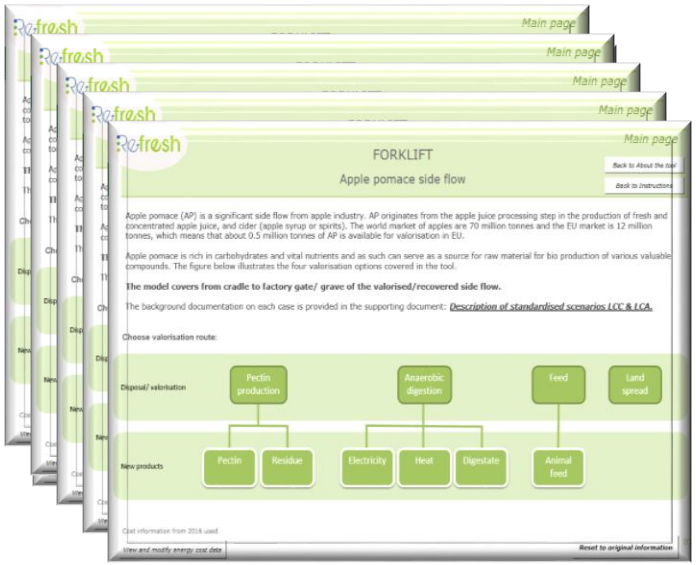
Science based

In REFRESH we have created a tool for practitioners to help out: FORKLIFT

FORKLIFT spreadsheet tools

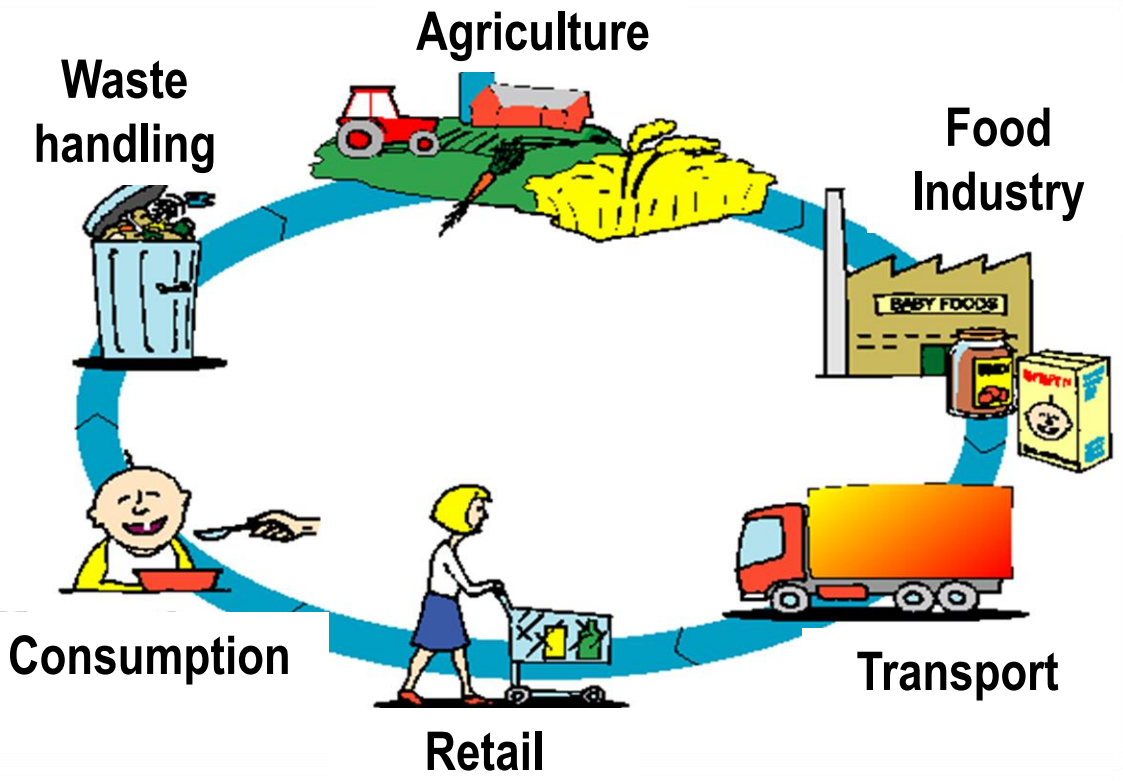
- FORKLIFT (FOod side flow Recovery LIFe cycle Tool) aims at providing stakeholders with a hands-on tool helping to gain a general understanding and highlight the environmental impacts and costs for selected valorisation routes, focusing on selected parameters.

- Food side-flows covered in the tool:
  - Apple pomace
  - Blood from slaughtering
  - Brewers' spent grain
  - Tomato pomace
  - Whey permeate
  - Rapeseed press cake



FORKLIFT uses a Life Cycle Approach

- LCA: environmental impacts from cradle to grave
- E-LCC: all costs (real money flows) associated with the life cycle of a product



How does FORKLIFT work?

- Models processing options, GHG and generic costs for **one tonne** of a side flow.
- Actual costs on labour and equipment can be added
- Background data, GHG and costs, for energy, transports, processing are included for various countries and can be modified.
- The impacts are split between main product and side-flow based upon the value (economic allocation).
- Compares the results from the model (GHG and costs) with similar products on the market

Refresh

Main page

FORKLIFT

Apple pomace side flow

Back to About the tool

Back to Instructions

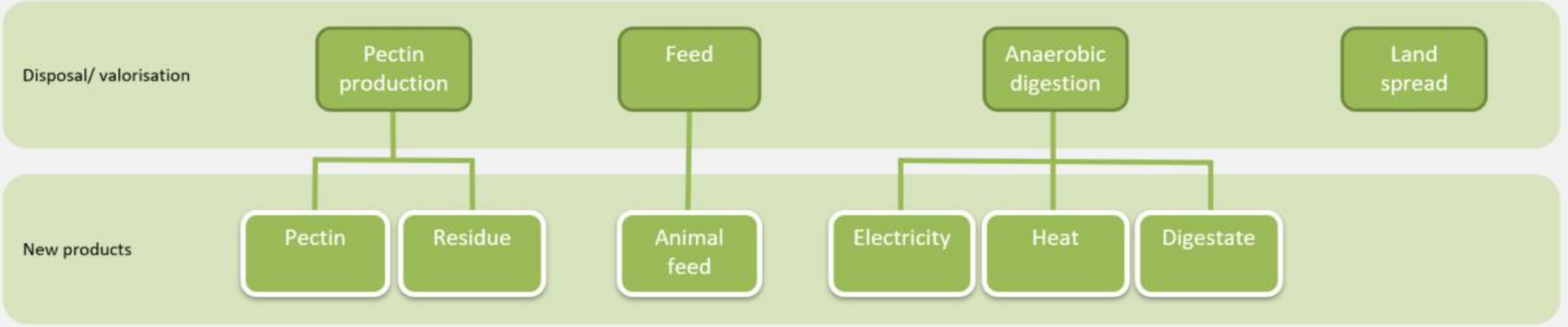
Apple pomace (AP) is a significant side flow from apple industry. AP originates from the apple juice processing step in the production of fresh and concentrated apple juice, and cider (apple syrup or spirits). The world market of apples are 70 million tonnes and the EU market is 12 million tonnes, which means that about 0.5 million tonnes of AP is available for valorisation in EU.

Apple pomace is rich in carbohydrates and vital nutrients and as such can serve as a source for raw material for bio production of various valuable compounds. The figure below illustrates the four valorisation options covered in the tool.

The model covers from cradle to factory gate/ grave of the valorised/recovered side flow.

The background documentation on each case is provided in the supporting document: ***Valorisation spreadsheet tools.***

Choose valorisation route:



Default cost information from 2015-2018 period used

View and modify energy cost data

Reset to original information

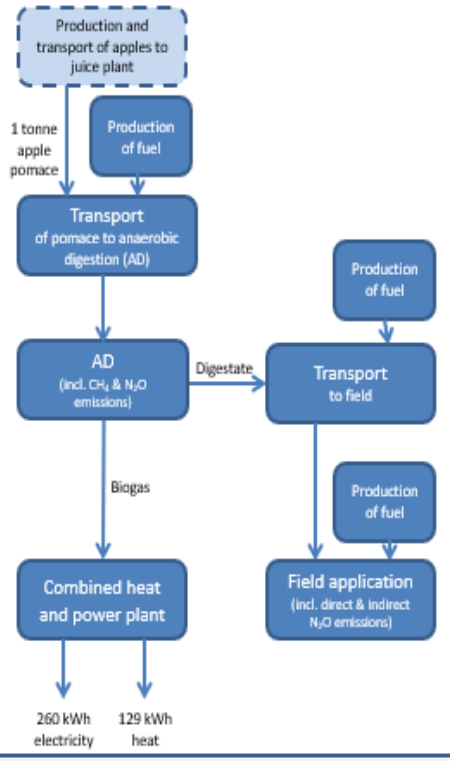
Refresh

Overview page

Production of heat and electricity with anaerobic digestion

Return to Main Page

Schematic of valorisation route



The figure above illustrates the processes that are taken into account in the calculation of GHG emissions and costs for using the apple pomace to produce biogas. The environmental impact and cost from the upstream processes are included if the apple pomace carries an economic value (therefore in dotted line). An average value of production and transport of apples to a juice producer has been assumed (0.33 kg CO_2eq./ kg apples).

The pomace is transported to the AD plant by truck.

Inputs

1. Market value of the side flow (/)

What is the revenue for the side flow?

0,0 [€/tonne side flow]

What is the relative revenue for the side flow? (/)

0,0 [%]

2. Choose country (/)

EU - European average

3. Energy costs only? (/)

Labour, capital and disposal costs are NOT added

Add additional costs

Change details Here you can view and change the parameters with largest effect on the results. Check/ amend detailed information

Results

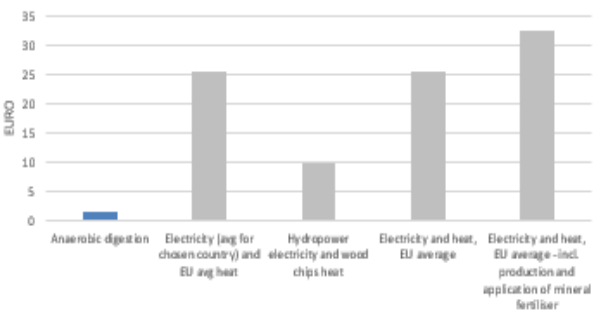
1 tonne of apple pomace results in 260 kWh electricity and 129 kWh heat

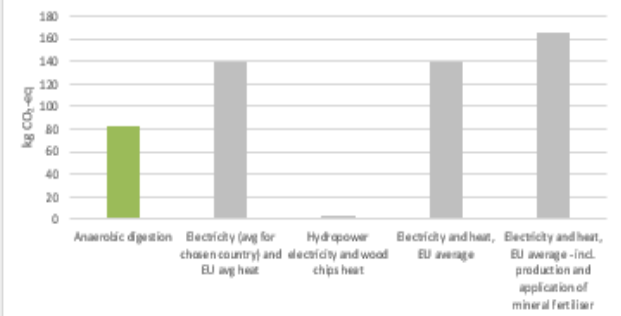
The graphs illustrate:

Production of 260 kWh electricity and 129 kWh heat with anaerobic digestion compared to production of heat and electricity by other means.
The comparison is made for several combinations of heat and electricity production.
Please note that only the bars to the left in each graph represent anaerobic digestion.

Save this scenario

Show saved scenarios





Labour and capital costs have NOT been added

Apple raw material:
0.33 kg CO2 eq/ kg apples

Average EU inhabitant:
24 kg CO2 eq/ day

Detailed results in FORKLIFT

Refresh

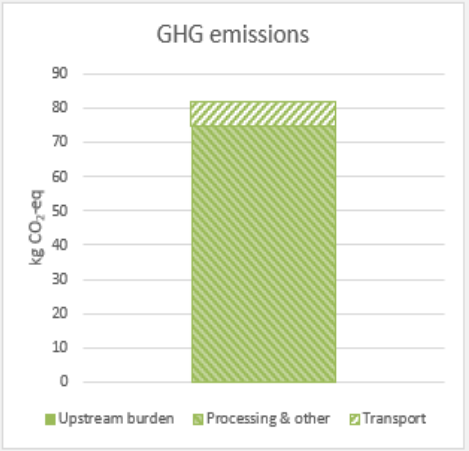
Detailed results

Anaerobic digestion

To Overview Page for Anaerobic digestion

1 tonne of apple pomace results in 260 kWh electricity and 129 kWh heat

The graphs illustrate:
Production of 260 kWh electricity and
129 kWh heat with anaerobic digestion

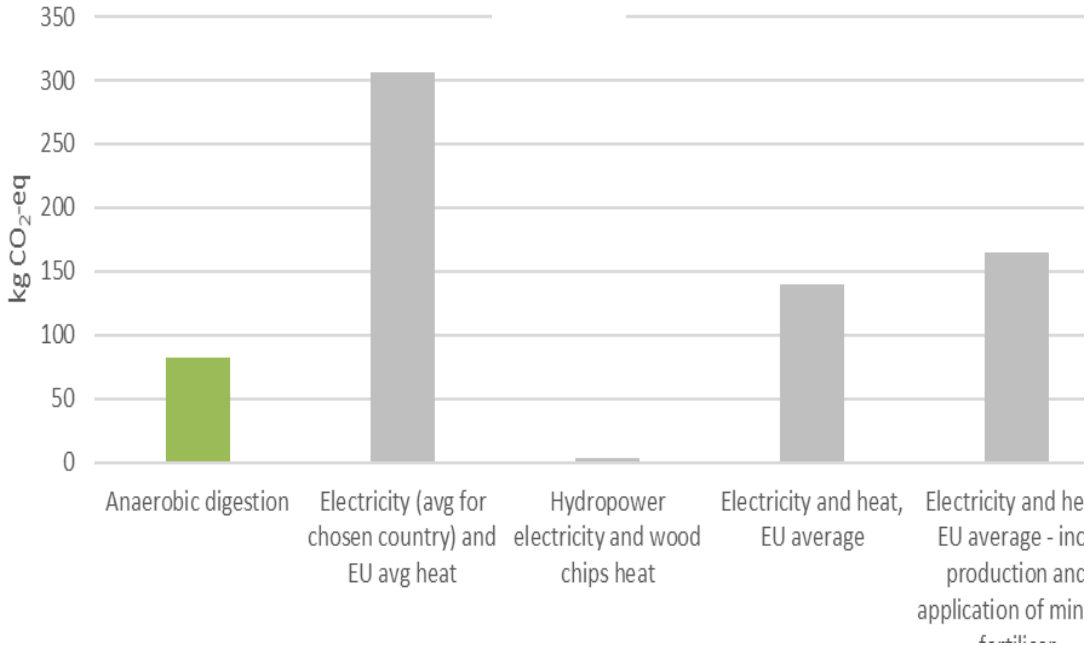


		Preset information:	Change to following information:
Transport of pomace to AD			
Type of transport	(i)	Tractor, single trailer, 50% LF	
Distance to AD plant	(i)	20	[km]
Transport of digestate to the field			
Type of transport	(i)	Tractor, single trailer, 50% LF	
Distance to field	(i)	20	[km]

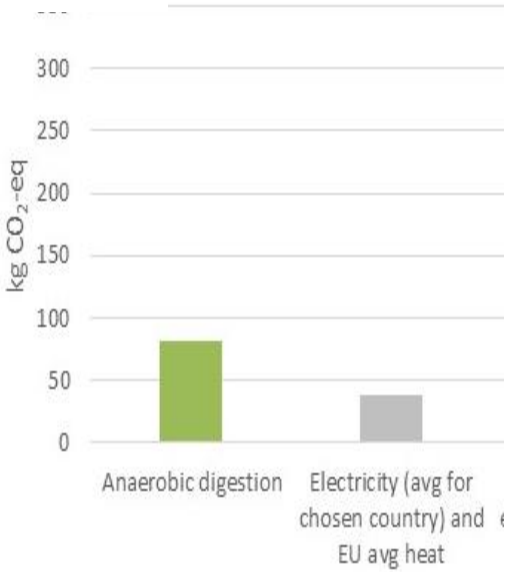
Reset information

GHG emissions from biogas production from 1 tonne of apple pomace

Estonia

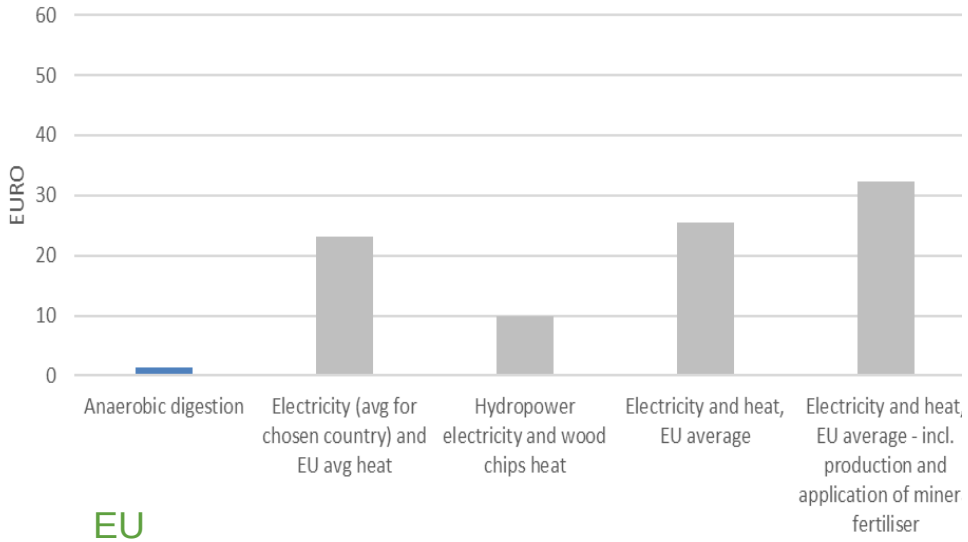


Norway



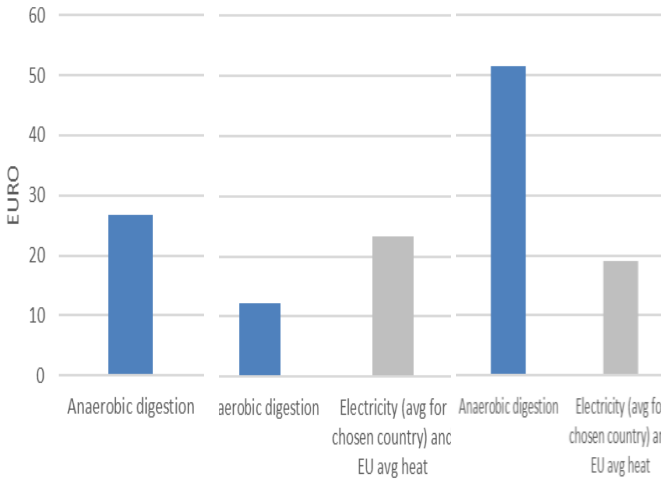
Costs for biogas production

Added costs: 1 person hour/tonne AP

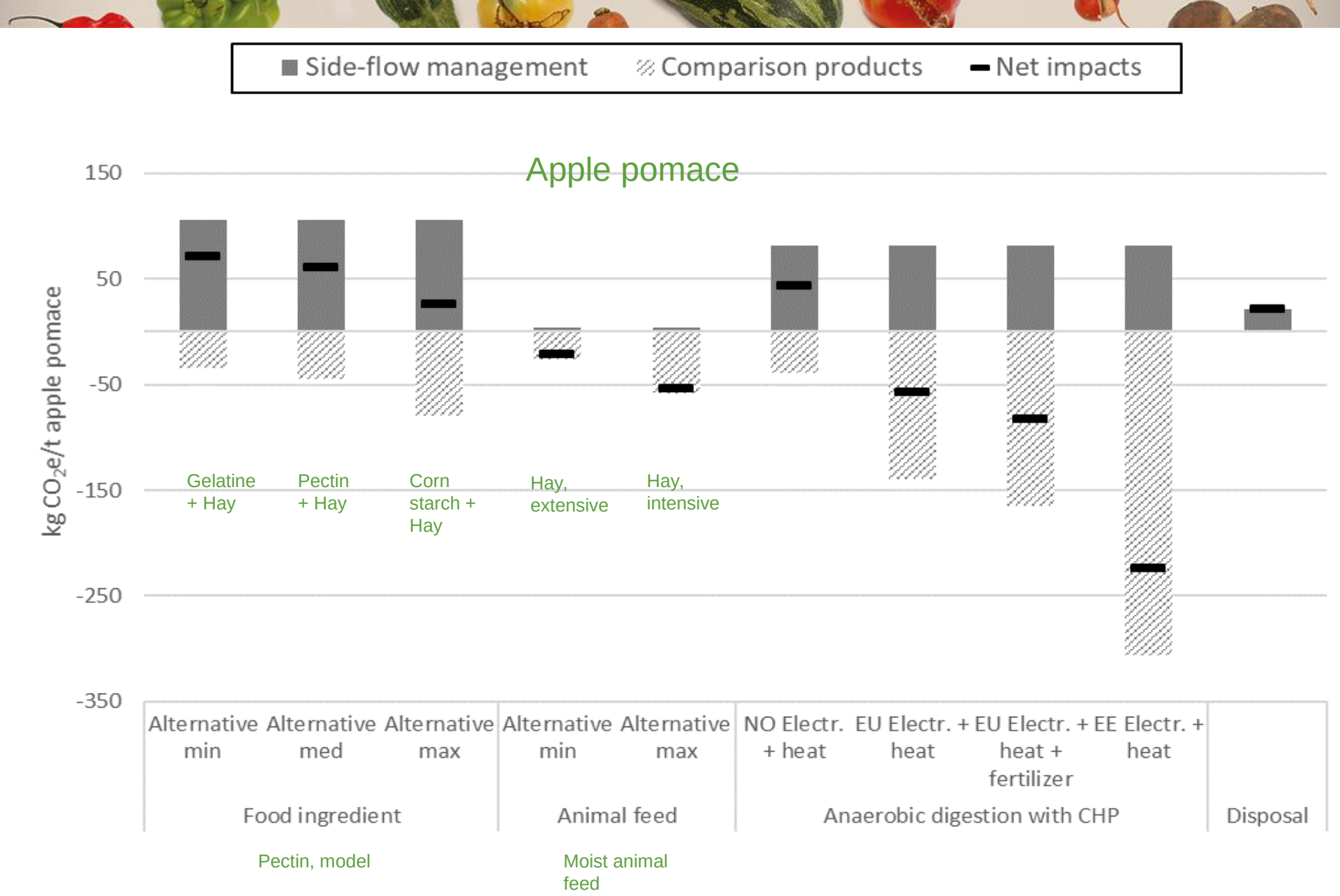


EU

Costs for energy, transports, processing



EU Estonia Norway


Side-flow management
Comparison products
Net impacts
Apple pomace
kg CO_2e/t apple pomace
150
50
-50
-150
-250
-350
Gelatine + Hay
Pectin + Hay
Corn starch + Hay
Hay, extensive
Hay, intensive
Alternative min
Alternative med
Alternative max
Alternative min
Alternative max
NO Electr. + heat
EU Electr. + heat
EU Electr. + heat + fertilizer
EE Electr. + heat
Food ingredient
Animal feed
Anaerobic digestion with CHP
Disposal
Pectin, model
Moist animal feed

Concluding remarks and recommendations

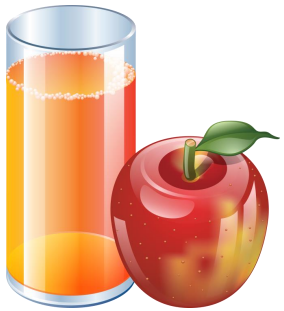
Any intervention should be assessed from an environmental perspective *as well as an economic perspective* and address the low hanging fruits first.

- **Food use hierarchy** a good way of understanding roughly how to think
- **FORKLIFT** is good starting points for understanding the process in its context and a *first* step for making informed decision on how to improve
- For decisions on investments and communication **full LCAs and LCC should be performed.**

The impact of market and infrastructure as well as the context for an intervention /valorisation option should be considered.

Thank you for your attention!

Questions?



References

Davis, J., De Menna, F., Unger, N., Östergren, K., Loubiere, M., Vittuari, M., 2017. Generic strategy LCA and LCC - Guidance for LCA and LCC focused on prevention, valorisation and treatment of side flows from the food supply chain, Report of Horizon 2020 funded EU project REFRESH. Download at https://eu-refresh.org/results

Östergren, Karin; Scherhaufer, Silvia; De Menna, Fabio; García Herrero, Laura; Gollnow, Sebastian; Davis, Jennifer; Vittuari, Matteo., 2018. D5.4 Simplified LCA & LCC of food waste valorization, Description of standardised models for the valorisation spreadsheet tool for life-cycle assessment and life-cycle costing, Report of Horizon 2020 funded EU project REFRESH. Download at https://eu-refresh.org/results

Unger, N., Davis, J., Loubiere, M., Östergren, K., 2016. Methodology for evaluating environmental sustainability, Report of Horizon 2020 funded EU project REFRESH. Download at https://eu-refresh.org/results

REFRESH 2018: FORKLIFT - Valorisation spreadsheet tool.https://eu-refresh.org/forklift-assessing-climate-impacts-and-costs-using-food-side-streams