# ALTERNATIVES TO INCREASE ECONOMIC PROFIT IN ANAEROBIC DIGESTION

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## 1. Keywords

Anaerobic digestion, dark fermentation, lactic acid fermentation, technoeconomic analysis

## 2. Highlights

- Organic waste valorization through chemicals and biogas was assessed.
- Biogas economic profit increases when combined with other anaerobic technologies.
- Lactic acid and dark fermentation were assessed separately.
- Dark fermentation showed the highest profit, 296 USD/t_VS

## 3. Purpose

Unlocking value from organic waste is a feasible idea, in contrast to the disposal of these organic wastes into landfills, that has an associated cost ranging from 40–400 USD/t [1]. Anaerobic digestion, for the production of biogas and digestate, has been historically the chosen technology for the treatment of complex organic residues. However, the conversion of biomass to bulk chemicals is 3.5 to 7.5 times more profitable than its conversion to fuels/energy [1]. This is the main motivation for this techno-economic analysis. In recent years, several mixed culture anaerobic technologies, has emerged. Among these technologies are dark fermentation and mixed culture lactic acid fermentation. The interest in these "new" technologies is their value products, with market prices more attractive than methane and digestate. Their average prices are 400 USD/t and 15 USD/t, respectively.

## 4. Materials and methods

The present techno-economic assessment is based on relevant literature data, and using conservative assumptions [2-14]. The assessed scenarios are: A1) anaerobic digestion – methane sold to the grid; A2) Anaerobic digestion – power generation; B1) Mixed culture lactic acid fermentation; B2) Polylactic acid fermentation; C1) Dark fermentation – hydrogen and methane sold to the grid; and C2) Dark fermentation – purified acetic acid and butyric acid.

## 5. Results and discussion

The highest profit is obtained by dark fermentation with separation and purification of acetic and butyric acids, i.e. 296 USD/t_VS (47 USD/t_foodwaste). Figure 1 shows the return on investment (ROI) and the payback time for all the assessed scenarios. From the ROI perspective scenario (B2) polylactic acid, generates the highest ROI, 98%. From all the assessed scenarios, only (A2) biogas to power, does not generates ROI, assuming that tipping fees/subsidies are minimal. This is due to the high cost of the combined heat and power generator and the low prices for electricity and digestate sold as soil improver. The best payback time was obtained for scenario (B2) polylactic acid, 7.8 years.

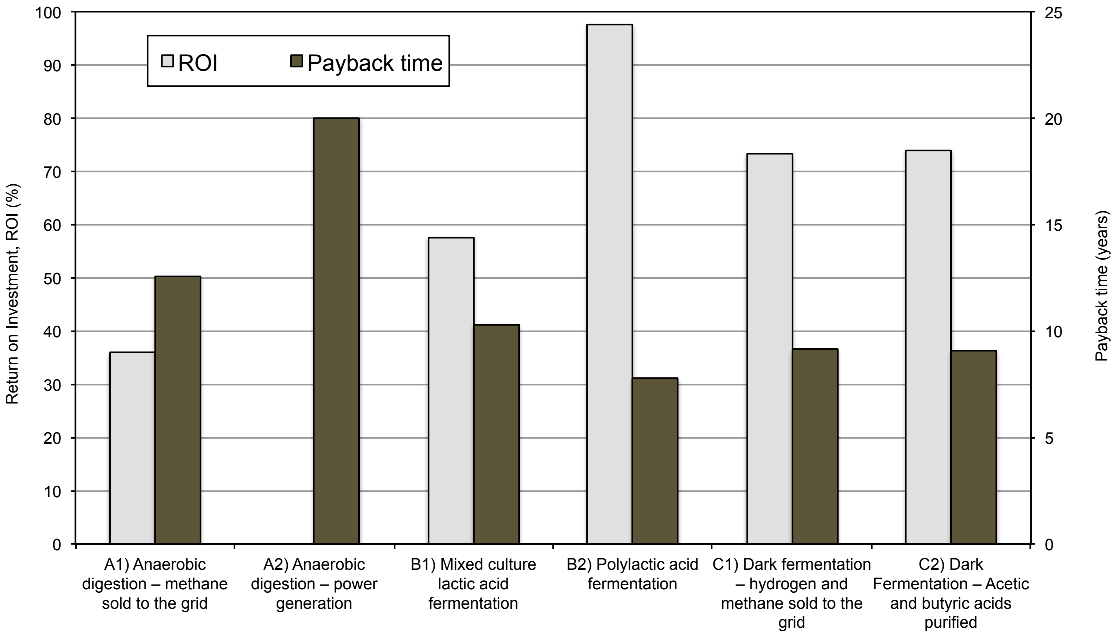


Fig. 1. Return on investment (ROI) and payback time for the different assessed scenarios. All the scenarios were evaluated in a time frame of 20 years, with an annual interest of 5%.

## 6. Conclusions and perspectives

The present techno-economic analysis has shown that profitability of food waste conversion to bulk chemicals, e.g. lactic acid or butyric acids, can be increased 5 to 16 times when compared to the base scenario, i.e. production of methane (sold to the grid). From the profit, ROI and payback time perspectives, the present technoeconomic analysis suggests a change in focus from biogas/biohydrogen into butyric acid and polylactic acid production from food waste. These results suggest that industry may refocus effort on bulk chemicals, e.g. butyric acid and/or polylactic acid, rather than only focussing on biofuels as $H_2$ and $CH_4$

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