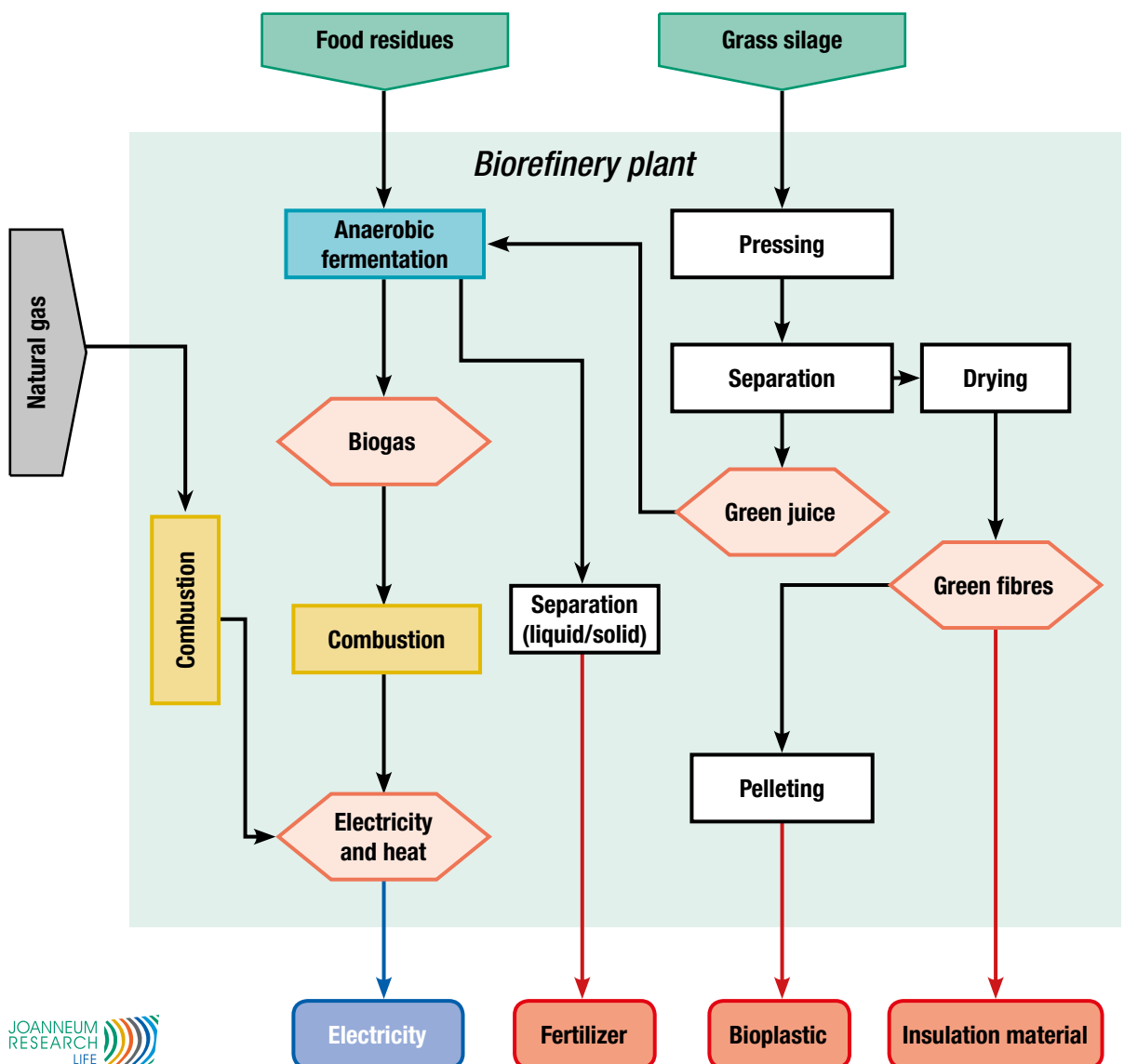


## 4-platform (biogas, green juice, green fibres, electricity&heat) biorefinery using grass silage and food residues for bioplastic, insulation material, fertilizer and electricity

### Part A: Biorefinery plant

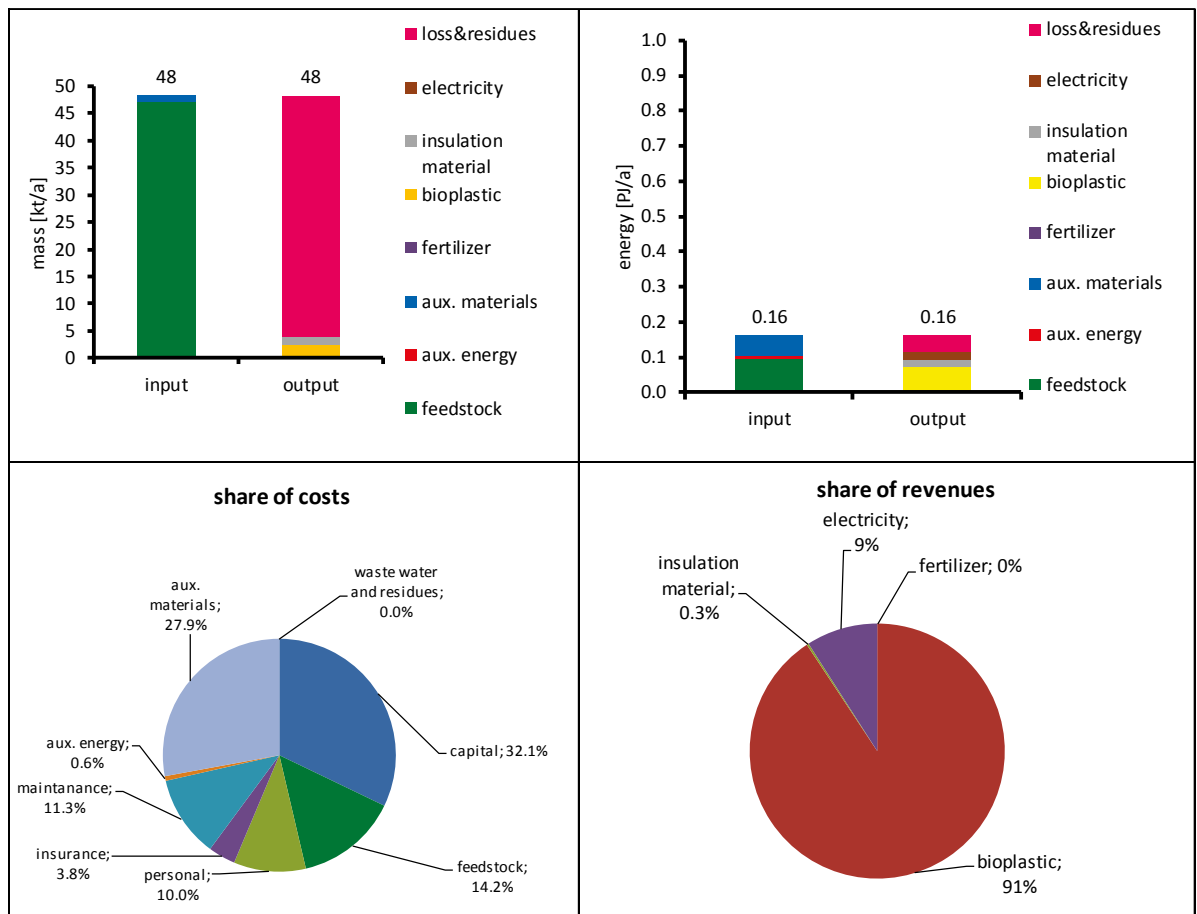
The “4-platform (biogas, green juice, green fibres, electricity&heat) biorefinery using grass silage and food residues for bioplastic, insulation material, fertilizer and electricity” converts grass to biogas and biobased products. The grass silage is mechanically pressed and then separated in a liquid phase (“Green juice”) and solid phase (“Fibres”). After drying the fibres are used as insulation material or are further pelletized to be used as an ingredient for bioplastic. The green juice is used to produce biogas in an anaerobic fermentation. Food residues are used as an additional feedstock for the biogas fermentation.

The biogas is used in a CHP plant with an internal combustion engine to produce electricity and heat. The heat demand of the biorefinery is higher than the heat produced from biogas, so additionally natural gas is used to supply the heat. For electricity it is vice versa, the electricity production is higher than the electricity demand of the biorefinery. Therefore the excess electricity is sold to the grid. The residues of fermentation are separated in a solid and liquid fraction, which are used as fertilizer. This type of biorefinery is already realised in several countries.



### 4-platform (biogas, green juice, green fibres, electricity&heat) biorefinery using grass silage and food residues for bioplastic, insulation material, fertilizer and electricity

|                             |                                 |   |                   |                     |          |
|-----------------------------|---------------------------------|---|-------------------|---------------------|----------|
| <b>State of technology:</b> | commercial 2013                 | <b>Biorefinery Complexity Index</b>                 | 28 (3/7/8/10)     |                     |          |
| <b>Country:</b>             | EU 27                           | <i>(P.roducts/P.latform/F.eedstock/P.rocesses.)</i> |                   |                     |          |
| <b>Main data sources:</b>   | VDI 6310, JOANNEUM RESEARCH     |   |                   |                     |          |
| <b>Products</b>             |                                 | <b>Auxiliaries (external)</b>                       |                   |                     |          |
|                             | fertilizer                      | 0 [kt/a]  | electricity       | 0 [PJ/a]            |          |
|                             | bioplastic                      | 2.5 [kt/a]  | heat              | 0.01 [PJ/a]         |          |
|                             | insulation material             | 1.4 [kt/a]  | polypropylen (PP) | 1.3 [kt/a]          |          |
|                             | electricity                     | 0.02 [PJ/a]   | urea              | 0.01 [kt/a]         |          |
| <b>Feedstock</b>            |                                 | <b>water content [%]</b>                            | <b>Costs</b>      |                     |          |
|                             | [kt/a]                          |   | investment costs  | 17 [Mio €]          |          |
|                             | grass sillage                   | 7   | 65.0%             | feedstock costs     | 14 [€/t] |
|                             | food residues                   | 40  | 80.0%             | number of employees | 10 [#]   |
| <b>Efficiencies</b>         |                                 | <b>mass</b>   | <b>energy</b>     |                     |          |
|                             | input to products               | 8%  | 72%               |                     |          |
|                             | input to transportation biofuel | 0%  | 0%                |                     |          |

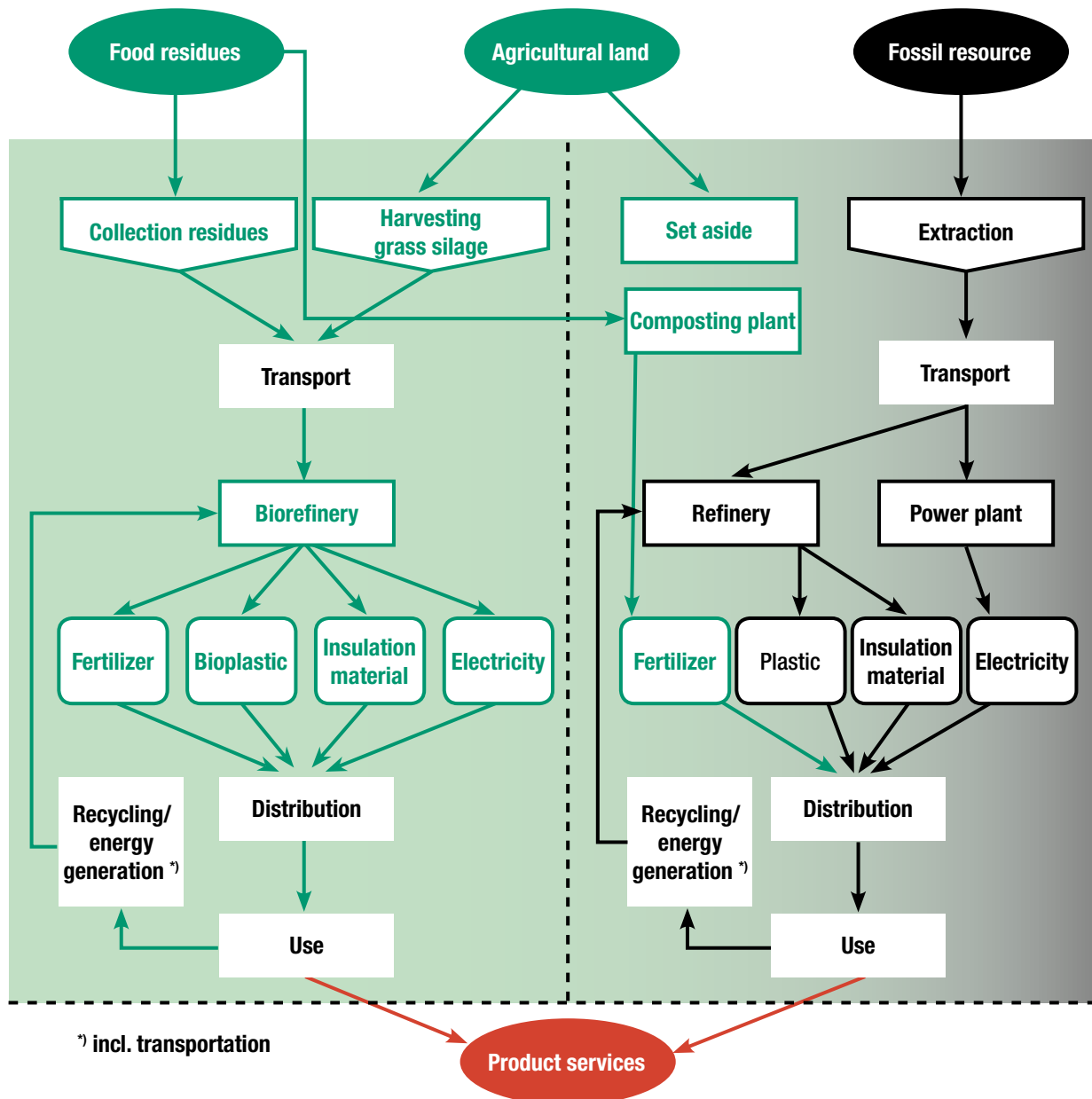


## Part B: Value Chain Sustainability Assessment

The method of the sustainability assessment - economic and environmental – is given in Annex 1. The main assumptions and modelling choices are documented in Annex 2. The Annexes are available on the webpage of Task 42: [www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)

**4-platform (biogas, green juice, green fibers, electricity&heat) biorefinery using grass silage and food residues for bioplastic, insulation material, fertilizer and electricity**

**Conventional reference system**



## Whole value chain

| Greenhouse gas emissions |                      |                            |
|--------------------------|----------------------|----------------------------|
|                          | range                |                            |
| biorefinery              | 5.5 (5.1 to 6.3)     | [kt CO <sub>2</sub> -eq/a] |
| reference system         | 21 (20 to 24)        | [kt CO <sub>2</sub> -eq/a] |
| saving                   | -74% (-69% to -85%)  | [%]                        |
| Cumulated energy demand  |                      |                            |
| fossil                   |                      |                            |
| biorefinery              | 0.07 (0.07 to 0.08)  | [PJ/a]                     |
| reference system         | 0.28 (0.26 to 0.32)  | [PJ/a]                     |
| saving                   | -74% (-69% to -85%)  | [%]                        |
| total                    |                      |                            |
| biorefinery              | 0.17 (0.16 to 0.2)   | [PJ/a]                     |
| reference system         | 0.30 (0.28 to 0.34)  | [PJ/a]                     |
| change                   | -42% (-39% to -48%)  | [%]                        |
| Agricultural area demand |                      |                            |
| feedstock                | 700 (650 to 800)     | [ha/a]                     |
| Costs                    |                      |                            |
| annual costs             | 4.5 (4.2 to 5.2)     | [Mio €/a]                  |
| specific costs           | 1,150 (1100 to 1300) | [€/t]                      |
| Revenues                 |                      |                            |
| annual revenues          | 5.5 (5.1 to 6.3)     | [Mio €/a]                  |
| specific revenues        | 1,410 (1300 to 1600) | [€/t]                      |

