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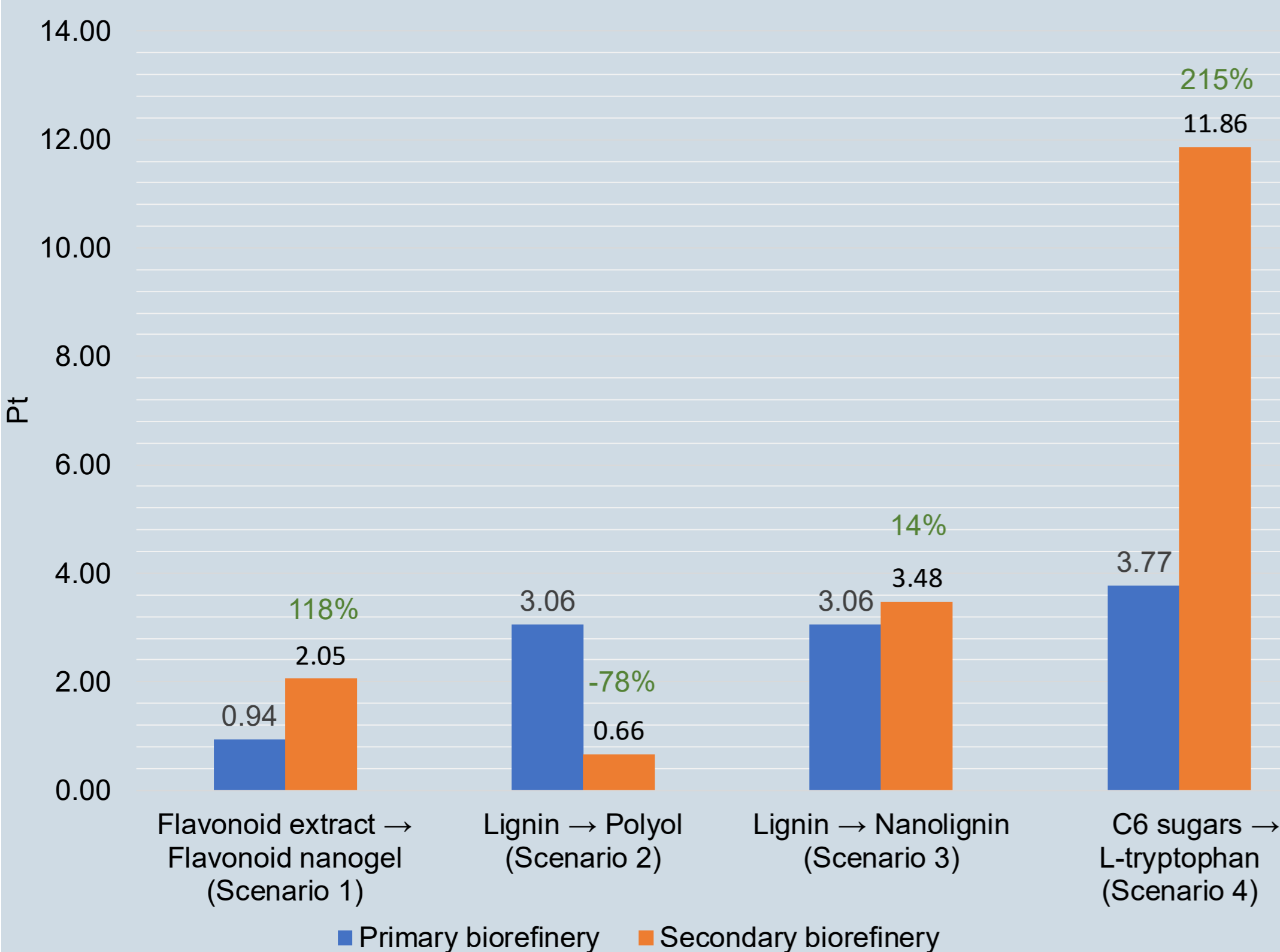


Fig. 1. Environmental impact change from primary to secondary biorefinery stages across four scenarios

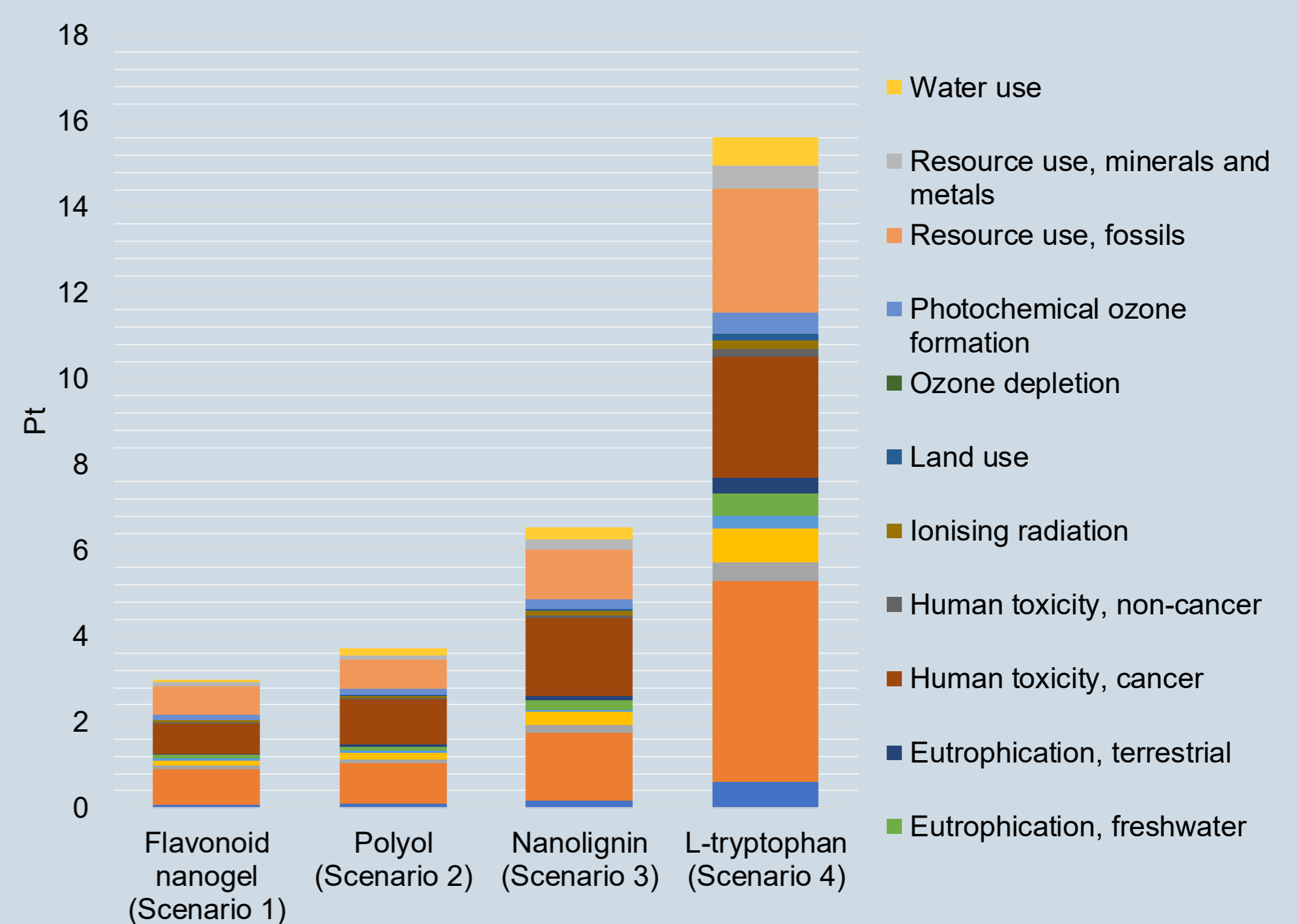


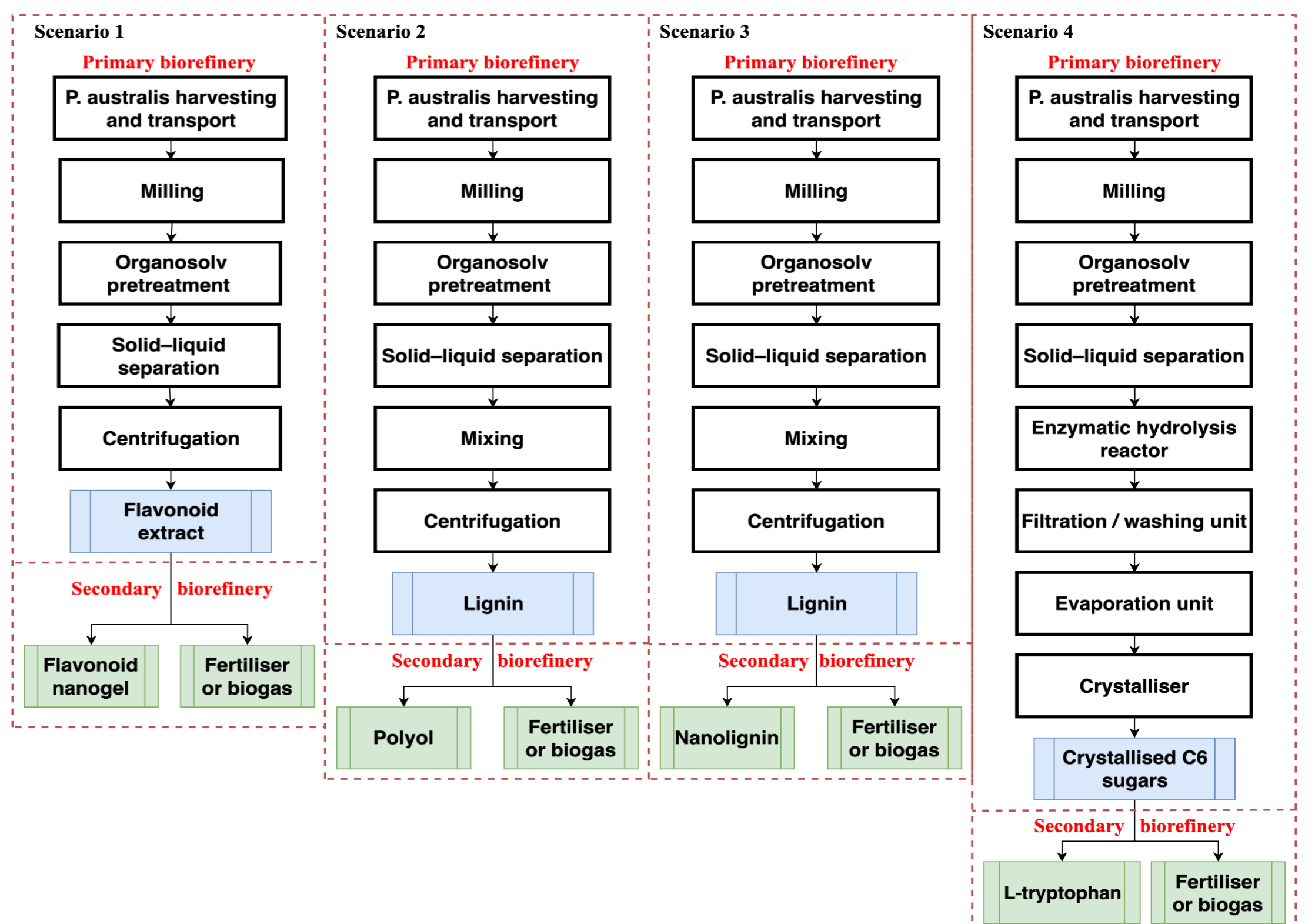
Fig. 2. Comparison of four scenarios based on single score results (per functional unit: 1 tonne of *Phragmites australis* biomass)

## Introduction

Common reed (*Phragmites australis*) is widely distributed in Latvian wetlands and has traditionally been considered a problematic plant due to its rapid spread. However, its potential as a renewable bioresource has not been sufficiently explored. *Phragmites australis* consists of approximately 33 – 36% cellulose, 20 – 22% hemicellulose, and 24% lignin, making it suitable for a cascade biorefinery approach. This enables the production of multiple product streams and creates opportunities for the development of high value-added products.

## Methodology

- Conducted in accordance with ISO 14040 and ISO 14044
- Functional unit: 1 tonne of *Phragmites australis* biomass
- Evaluated scenarios:
  1. Flavonoid extract → flavonoid nanogel
  2. Lignin → polyol
  3. Lignin → nanolignin
  4. C6 sugars → L-tryptophan
- Modelling software: SimaPro 10.3.
- System boundary: cradle-to-gate
- Impact assessment method: Environmental Footprint 3.1.
- LCI data sources:
  - Scientific literature
  - Ecoinvent 3.11. database



## Results

Impact category	Unit	Flavonoid nanogel	Polyol	Nanolignin	L-tryptophan
Climate change	Pt	0.84	0.93	1.57	4.69
Resource use (fossils)	Pt	0.66	0.69	1.17	2.89
Human toxicity (cancer)	Pt	0.70	1.06	1.83	2.81
Particulate matter	Pt	0.13	0.17	0.30	0.78
Other categories (sum)	Pt	0.67	0.88	1.67	4.51
Total	Pt	2.99	3.72	6.54	15.67

Table 1. Comparison of main environmental impact categories across scenarios (EF 3.1 method)

## Conclusion

- Dominant impact categories: Climate change, resource use (fossils), human toxicity (cancer)
- Total environmental impact across scenarios:
  - Flavonoid nanogel (2.99 Pt)
  - Polyol (3.72 Pt)
  - Nanolignin (6.54 Pt)
  - L-tryptophan (15.67 Pt)