Considering tree growth in the strategic optimisation of the poplar-for-paper supply chain in Flanders, Belgium

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SSAFR-15, 21-august-2015

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Poplar wood (*Populus sp.*) is (relatively) important

- Use in Belgium (30.528 km^2):
  - 555 000 m³ per year
  - 20 companies, 1000 direct jobs
- For:
  - Paper & Packaging
  - Timber
  - MDF & Veneer
  - Bioenergy
  - (Matches), …

- Region of Flanders (13:521 km^2): 20.000 ha but declining

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Poplar plantations in Flanders
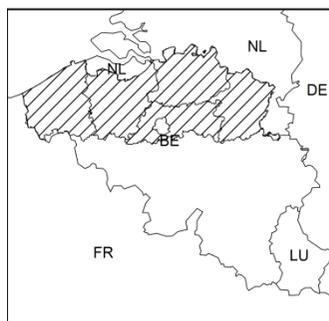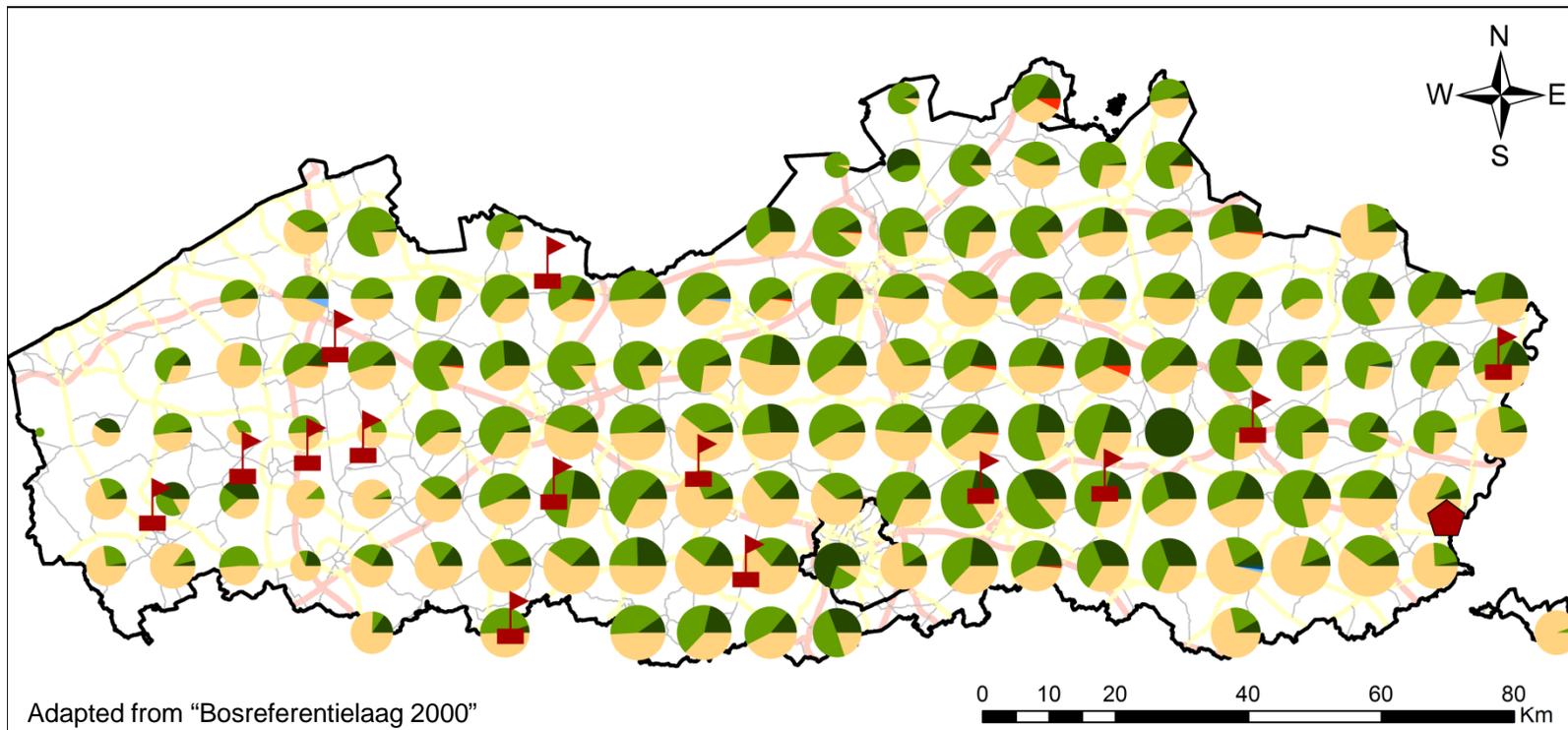
Adapted from "Bosreferentielaag 2000"

Legend

- Saw mill
- Sappi Lanaken
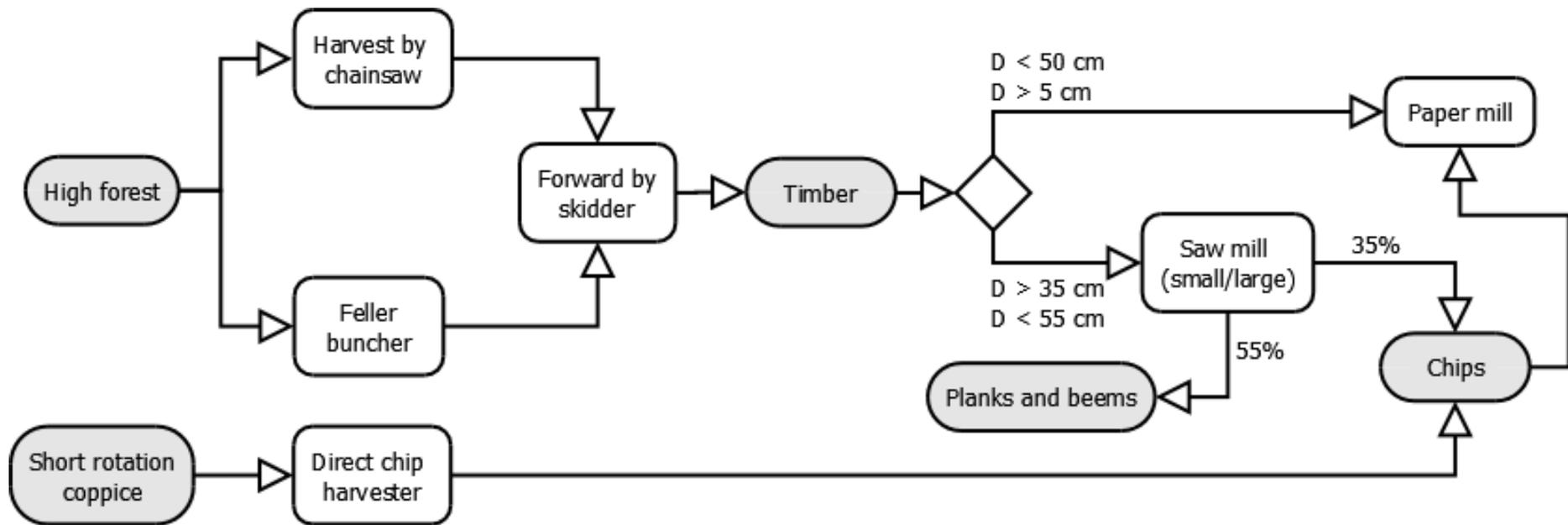- Flemish border

Poplar

Log Tot_ha

2,8

- HH (0-5 y)
- HH (6-10 y)
- HH (11-15 y)
- HH (15-20 y)
- HH (21-25 y)
- HH (26-30 y)
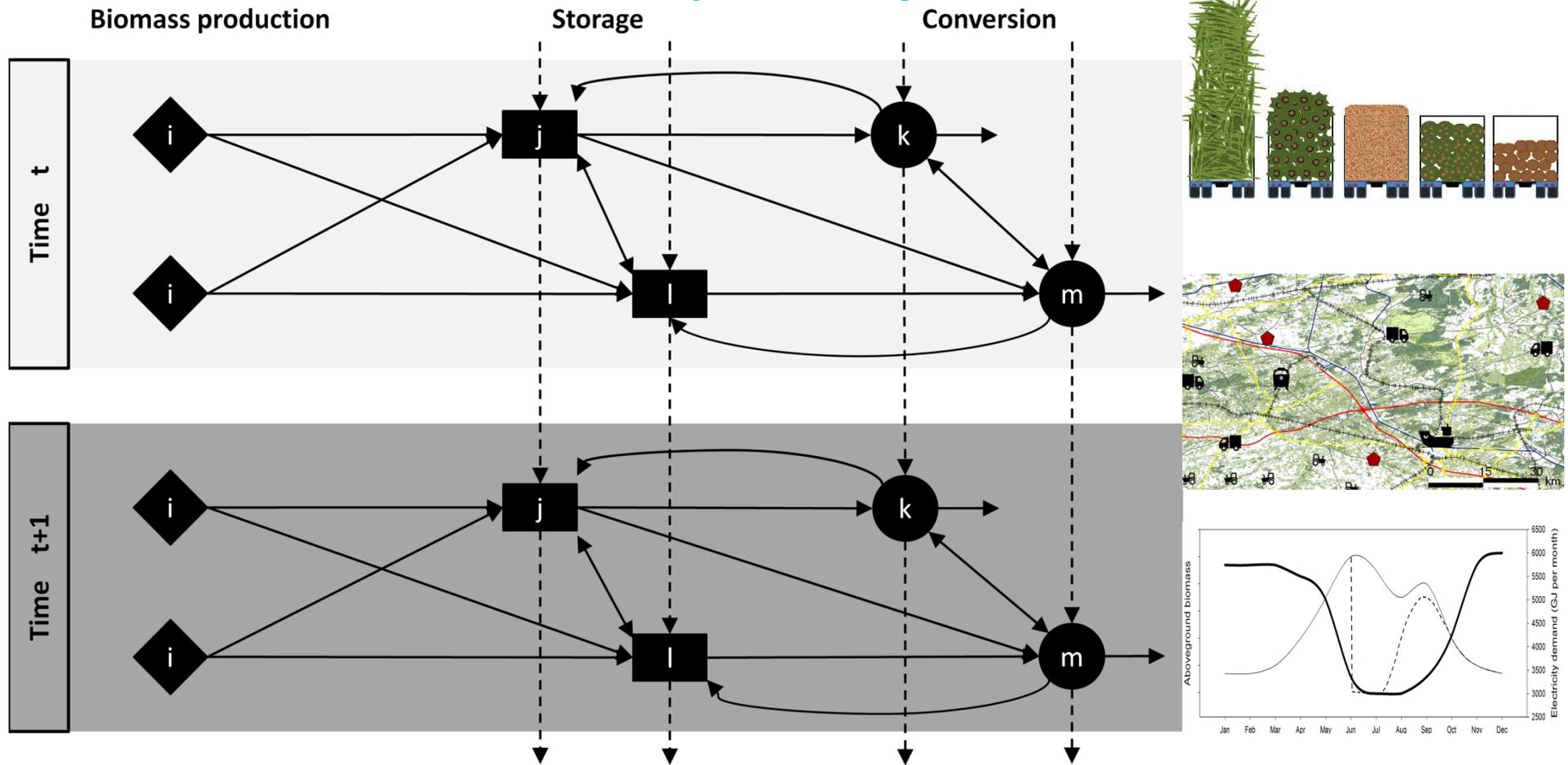- HH (31-35 y)
- HH (36-40 y)
- SRC (0-5 y)
- SRC (6-10 y)

Transport network

- Highway
- National road
- Regional road

Poplar-for-Paper supply chain
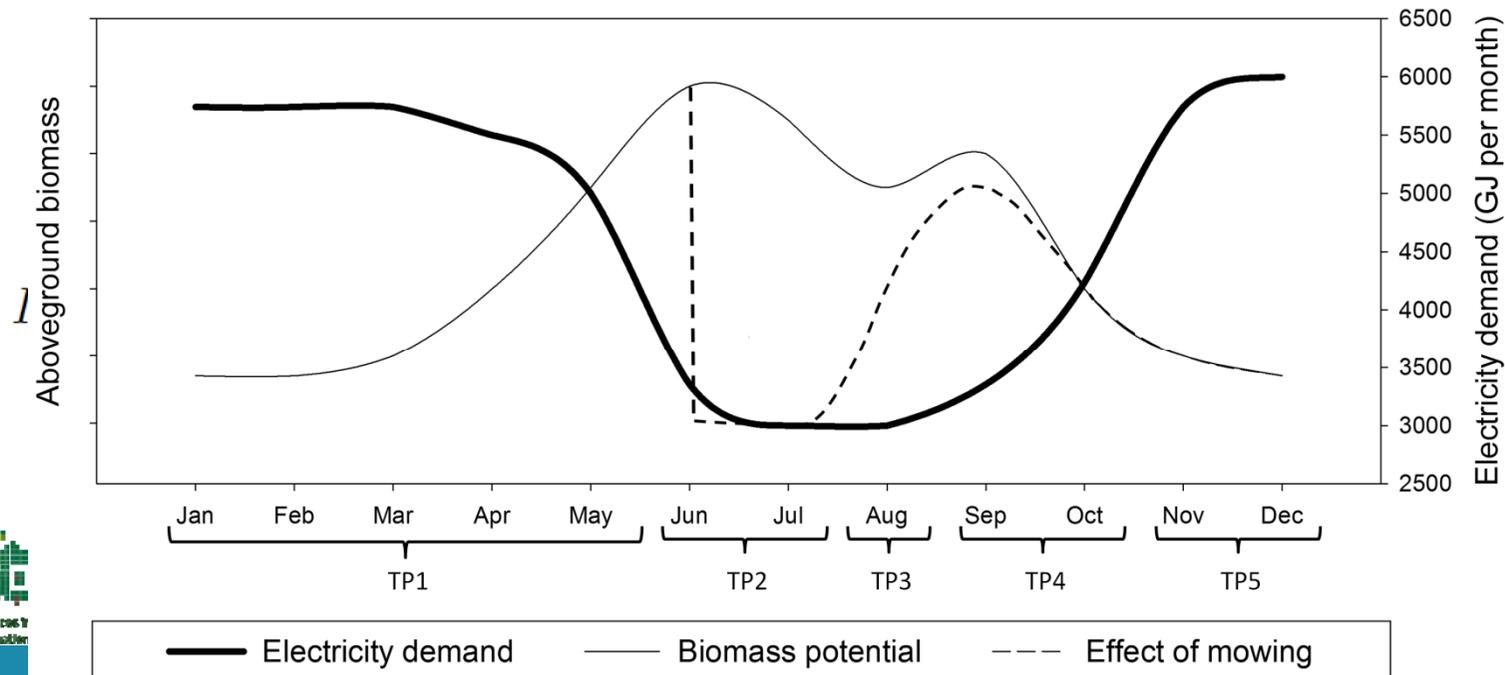
t-OPTIMASS (multi-period MILP)

De Meyer, A., Cattrysse, D., Van Orshoven, J. (2015a). A generic mathematical model to optimise strategic and tactical decisions in biomass-based supply chains (OPTIMASS). *European Journal of Operational Research, 245* (1), 247-264.

De Meyer, A., Cattrysse, D., Van Orshoven, J. (In press). Considering biomass growth and regeneration in the optimlisation of biomass supply chains. *Renewable Energy*, Available online 5 August 2015
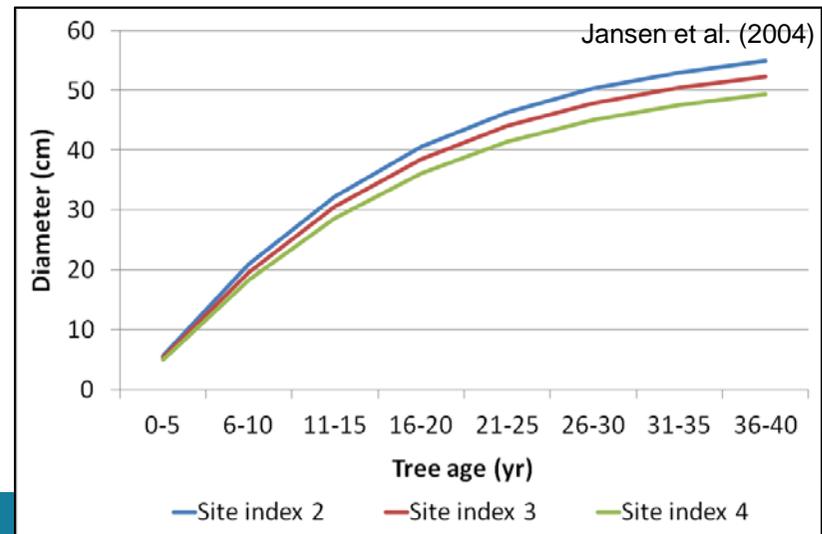
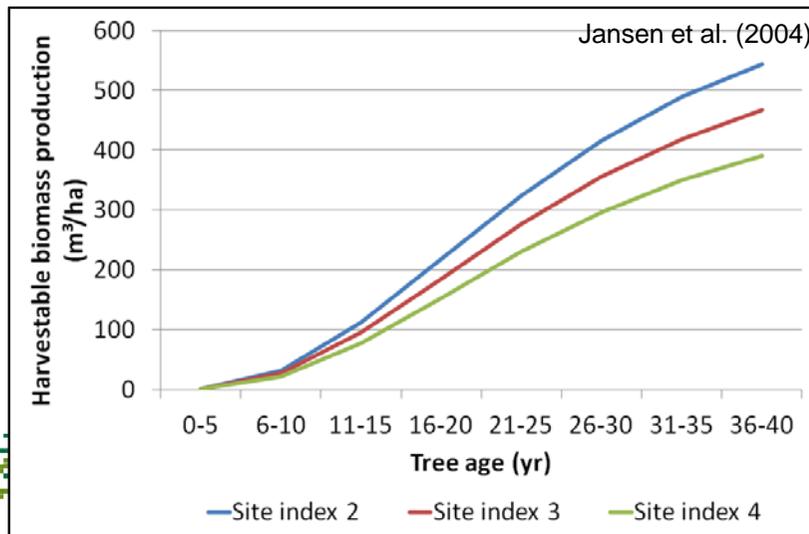# t-OPTIMASS

- (Herbaceous) Biomass growth and regeneration

$$SUPmax_{it}^f = \begin{cases} AREA_i^f \cdot HBP^f \\ \qquad\qquad\qquad\qquad \forall\ i \in I, f \in F, t = 1 \quad (a) \\ \\ \sum_r \left(sH_{it-1}^r \cdot \gamma_H^{rf} \right) + \sum_r \left(sNH_{it-1}^r \cdot \gamma_{NH}^{rf} \right) \\ \qquad\qquad\qquad\qquad \forall\ i \in I, r \in F, t > 1 \quad (b) \end{cases}$$

-

Considering differential poplar growth in space and time with t-OPTIMASS

Adapted from "Bosreferentielaag 2000"

Legend

- Saw mill
- Sappi Lanaken
- Flemish border

Site index
- Site index 2
- Site index 3
- Site index 4
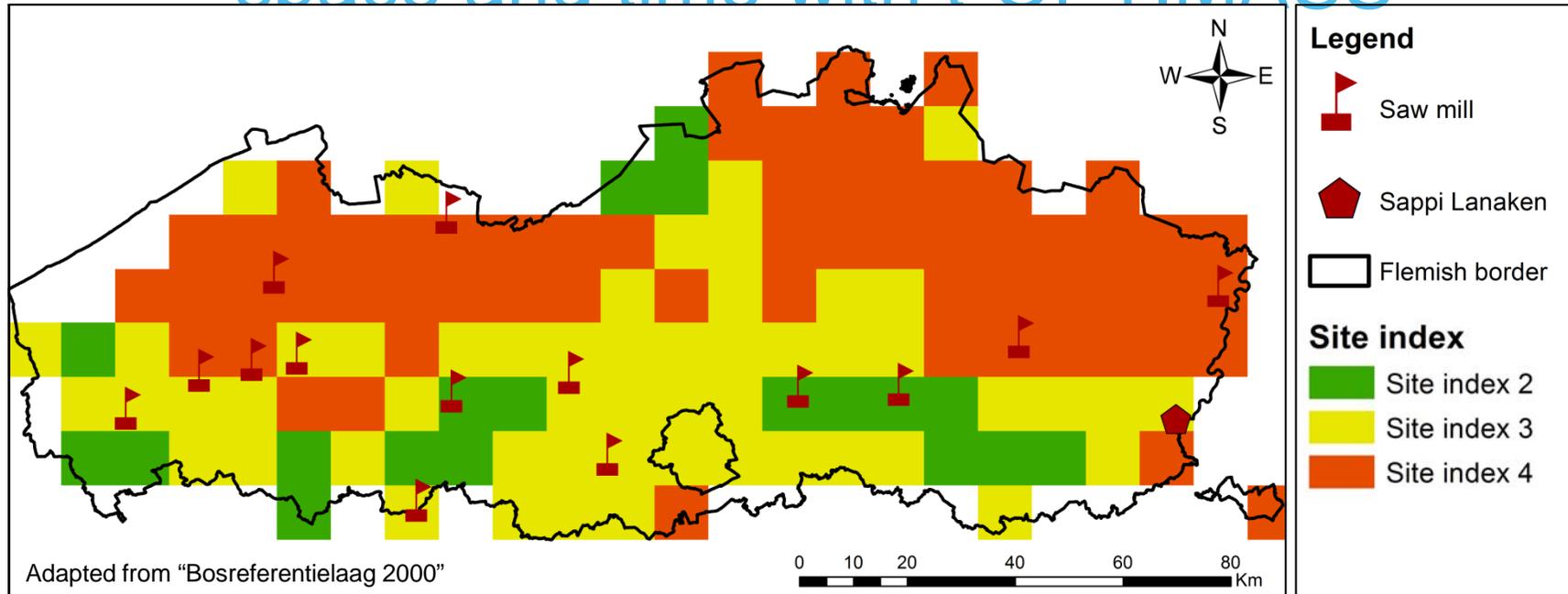
Results: Allocation for maximal profit of paper mill
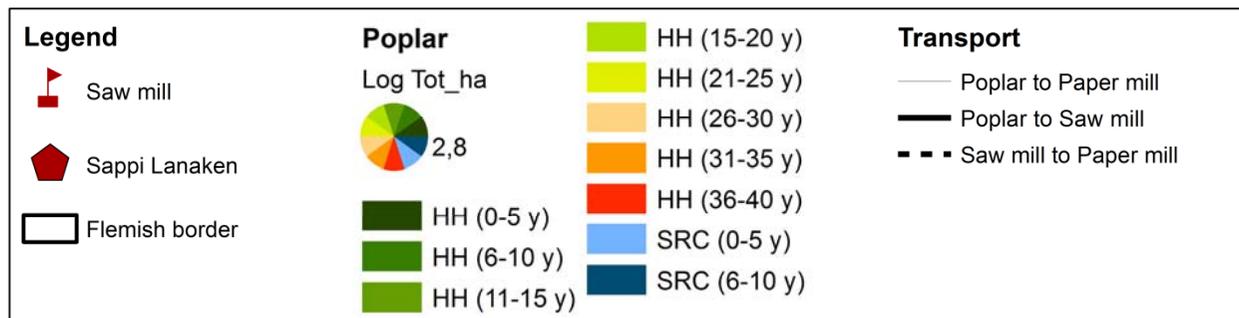## (planning horizon of 10 years)

1st of two 5 year periods

NL — 202 752 m³ chips
FR — 166 214 m³ chips
DE — 180 224 m³ chips
FL — 450 810 m³ chips

Legend

- Saw mill
- Sappi Lanaken
- Flemish border

Poplar

Log Tot_ha — 2,8

- HH (0-5 y)
- HH (6-10 y)
- HH (11-15 y)
- HH (15-20 y)
- HH (21-25 y)
- HH (26-30 y)
- HH (31-35 y)
- HH (36-40 y)
- SRC (0-5 y)
- SRC (6-10 y)

Transport

- Poplar to Paper mill
- Poplar to Saw mill
- Saw mill to Paper mill

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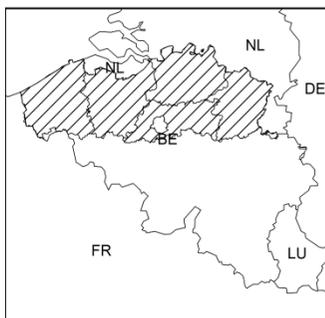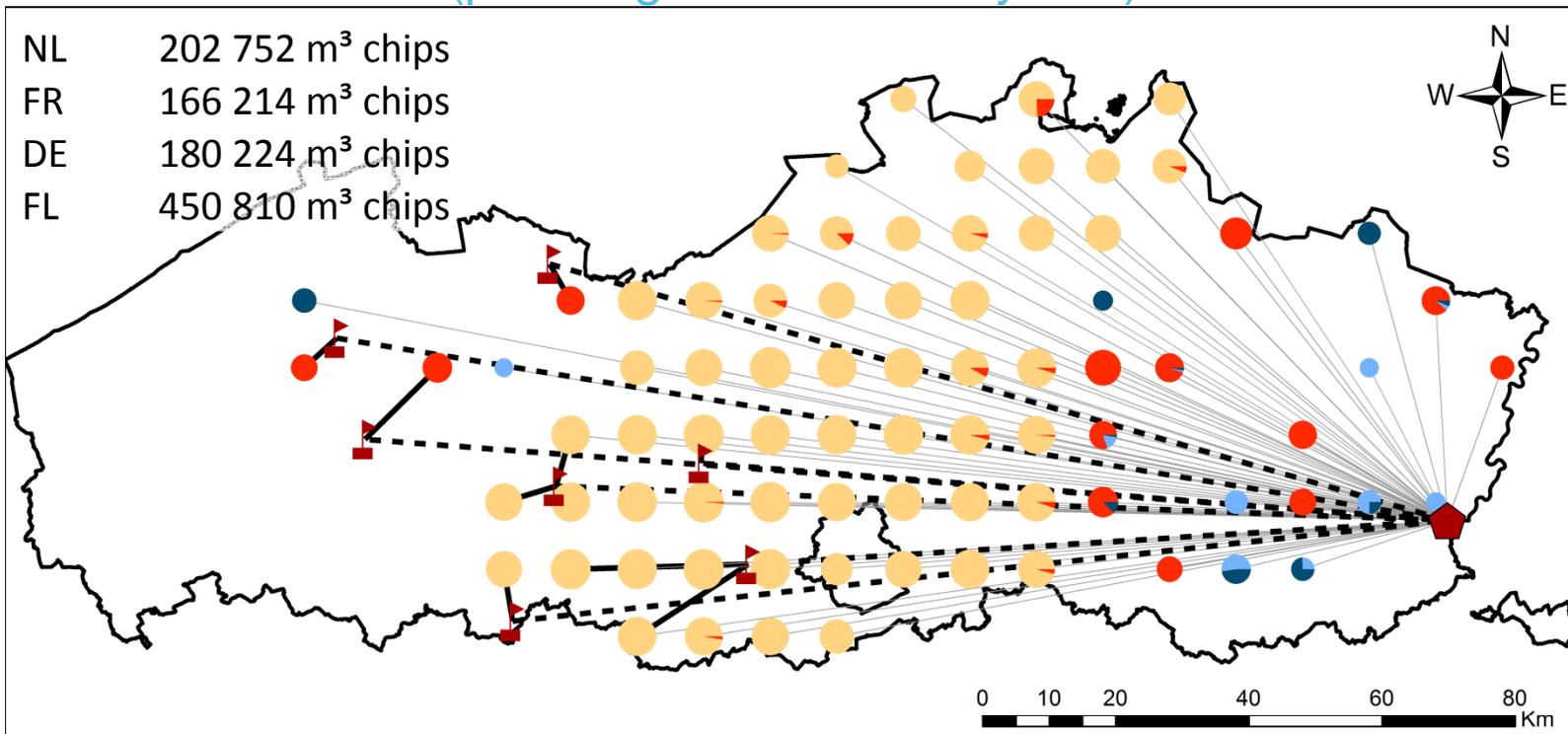
Results: Allocation for maximal profit of paper mill
(planning horizon of 10 years)

2nd of two 5 year periods

NL   202 752 m³ chips
DE   52 580 m³ chips
FL   744 668 m³ chips

Legend

Saw mill

Sappi Lanaken

Flemish border

Poplar

Log Tot_ha

2,8

HH (0-5 y)
HH (6-10 y)
HH (11-15 y)

HH (15-20 y)
HH (21-25 y)
HH (26-30 y)
HH (31-35 y)
HH (36-40 y)
SRC (0-5 y)
SRC (6-10 y)

Transport

Poplar to Paper mill
Poplar to Saw mill
Saw mill to Paper mill

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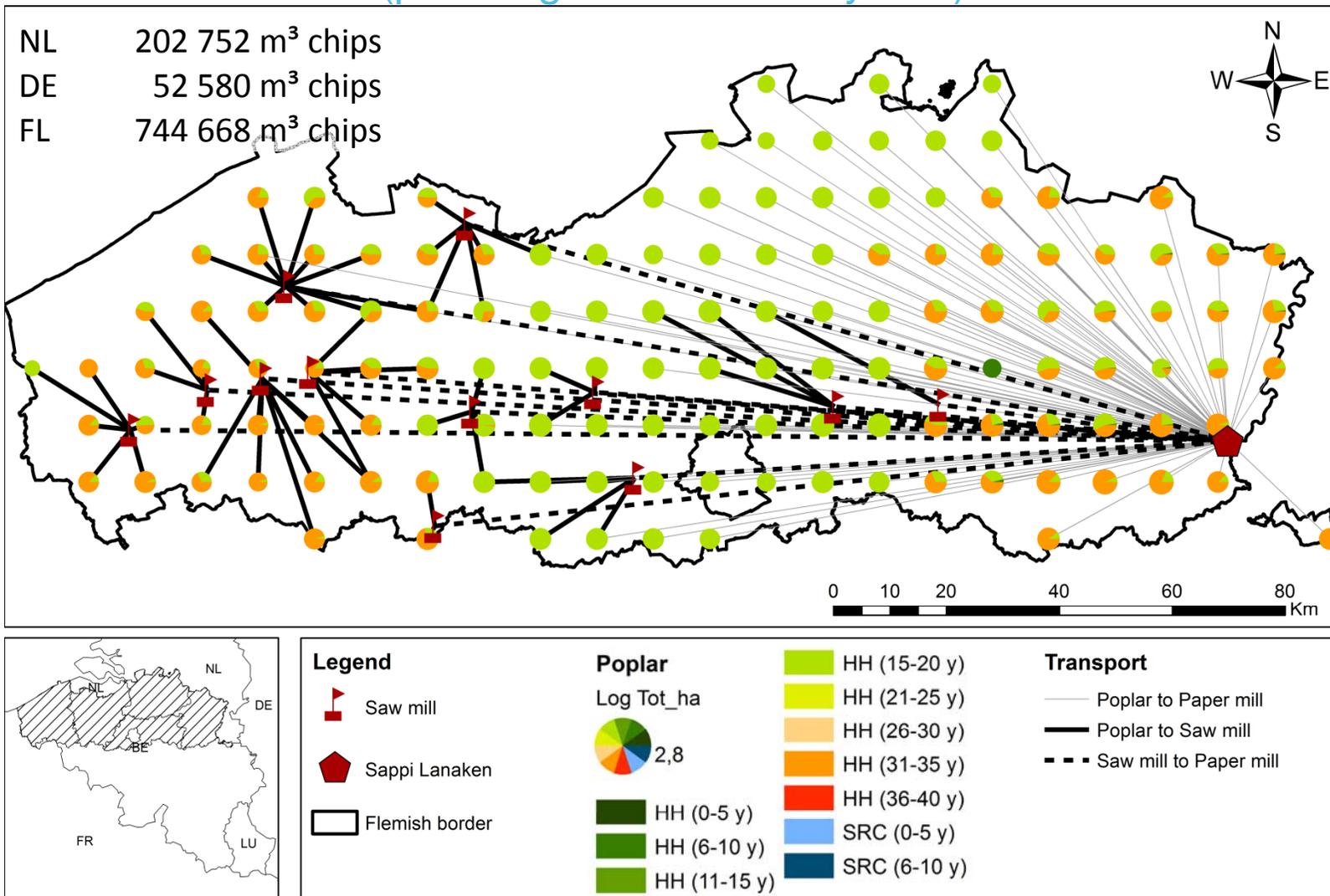
Results: How long without replanting?

Legend:
- Average quantity of chips from local Poplar (ton/y)
- Average quantity of imported chips (ton/y)
- Poplar not harvested at the end of the period (ton)
- Profit (€/y)
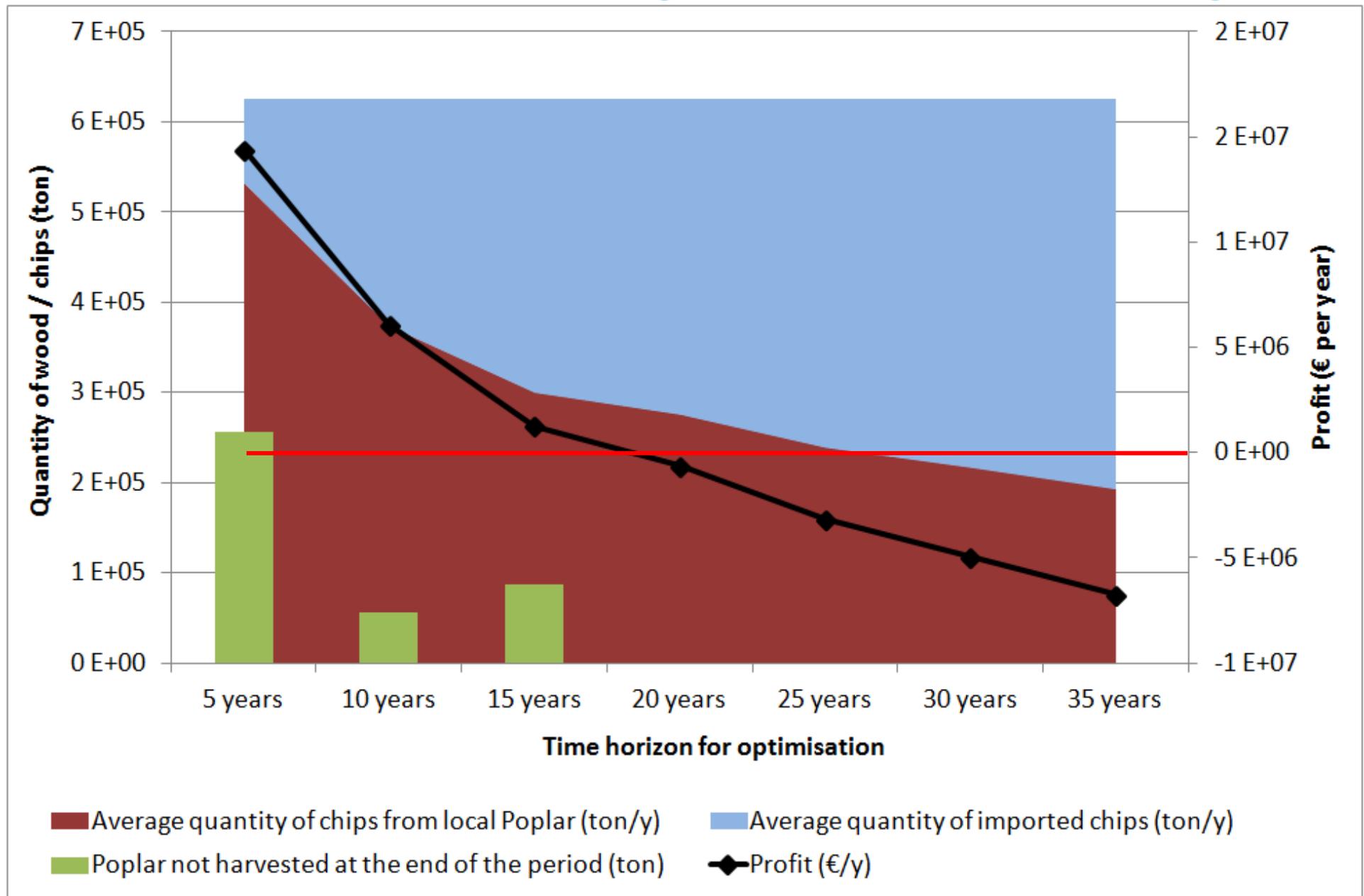
Results: How long with replanting?
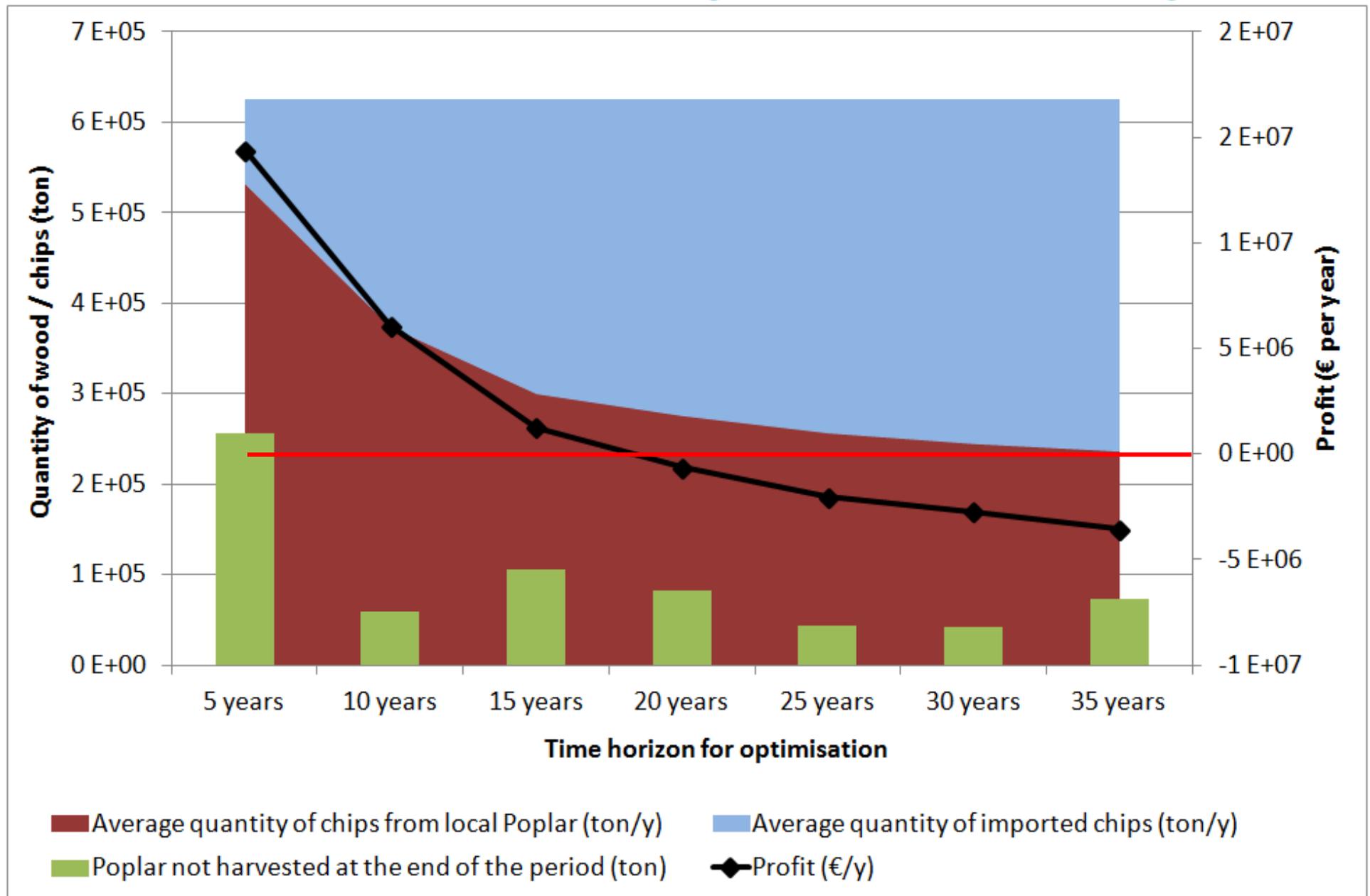
Conclusions: Poplar-for-Paper

- Tree diameter required by industry and site productivity are decisive

- Use of local poplar is preferred (cost, environment)

- Strategic planning of poplar wood usage needed to make the best out of declining stocks

- Moreover, replanting and extension must be encouraged,

  o Pioneer species for ecological afforestation

  o Polluted soil remediator

  o Valuable source for bioenergy production (SRC)

Conclusions: t-OPTIMASS

- Users ?

    o Governmental bodies, consultancy agents, etc. interested in a macro-analysis of various kindsof biomass supply chains

    o Biomass suppliers, owners of facilities, investors, etc. for planning and evaluation once the supply chain is operational

- What ?

    o Evaluation of biomass potential, feasibility of facilities, etc.

    o Scenario evaluation

    o Support dialogue

Conclusions

- FOCUS:

  o What ?

    - 7 FP SME-targeted collaborative RTD project

    - "Advances in Forestry Control and Automation Systems in Europe"

  o Goal ?

    - Improve sustainability, productivity, and product marketability of forestbased value chains

  o How ?

    - Innovative technological platform for integration of real-time data collection technologies with planning and control tools

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