



Activated carbon by co-pyrolysis and steam activation from particle board and melamine formaldehyde resin:

techno-economic evaluation

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Promoters

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1



Table of content

- 1. Introduction: Activated Carbon**
2. Objective
3. Cost-benefit analysis
 - Methodology
 - Process design
 - Results
4. Conclusion



Introduction

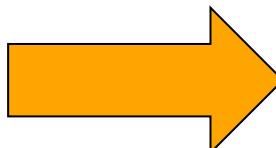
Activated carbons → large number of applications

→ water treatment

→ chemical and pharmaceutical processing

→ air and gas purification

→ ...



Average growth 5.2% / year

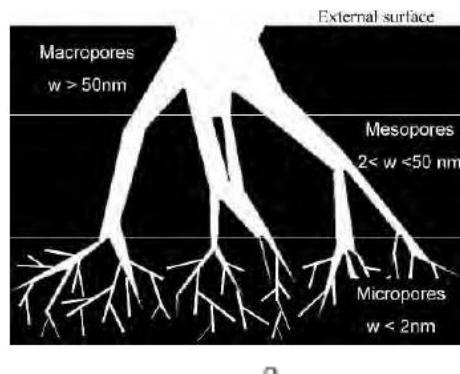
1.2 Mt/Year by 2012

Standard AC 2,25 – 3,30 kEUR/t (2008)

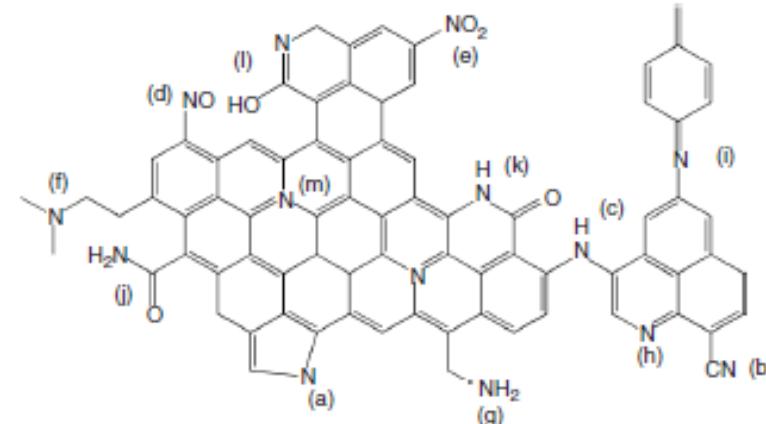
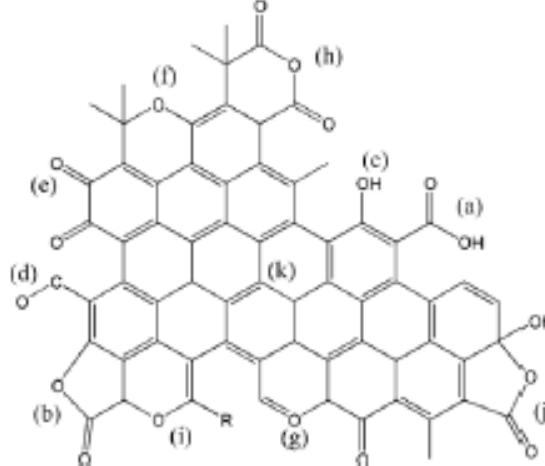
Specialty AC 3,3 – 6,0 kEUR/t (2008)

Introduction

Activated carbons → Normal low N (~0.5%)

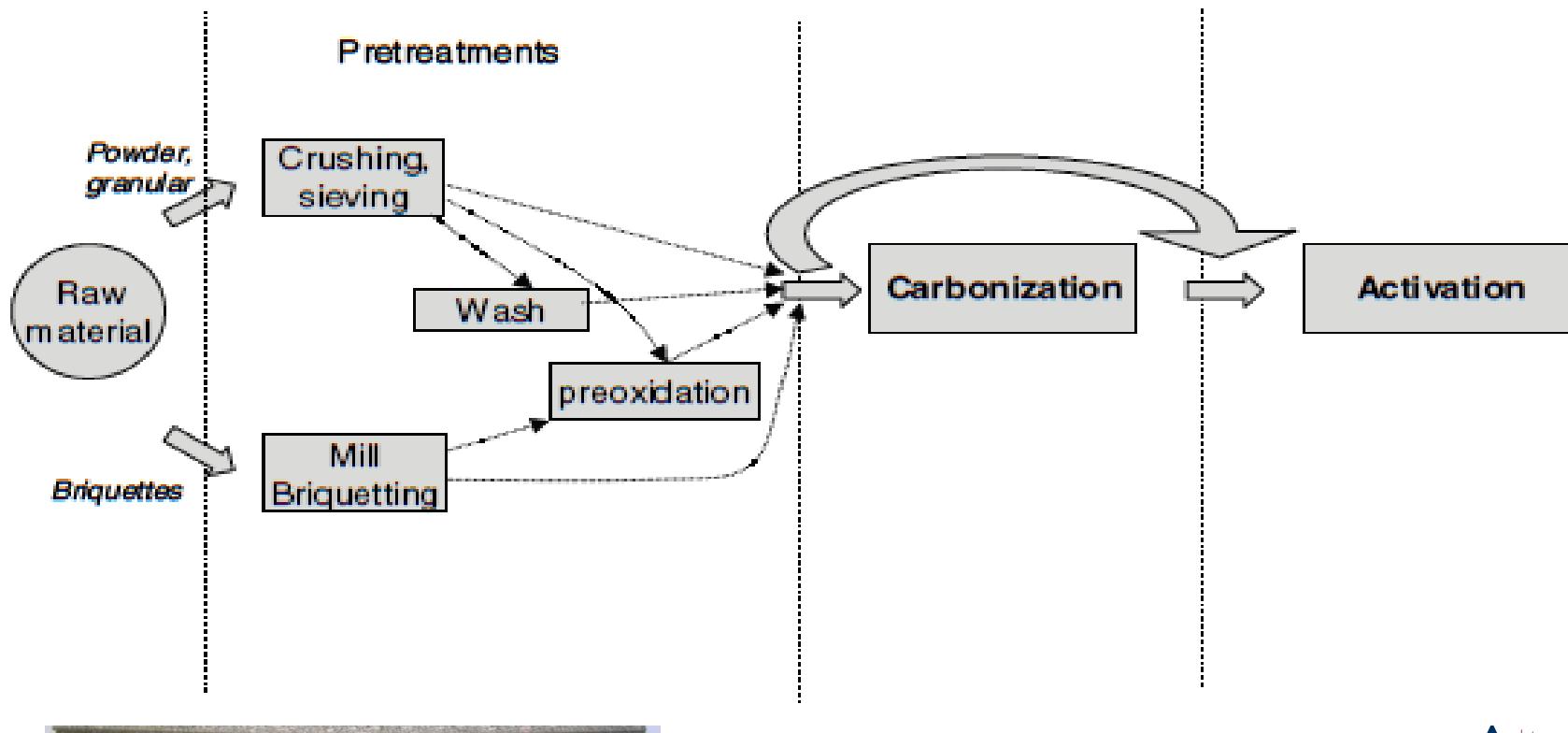


→ N **key parameter** for adsorbents, catalytical activity and catalyst supports



Introduction

N introduction → treatment with N-reagents
→ **Raw material**



T.J. Bandosz, Surface Chemistry of Carbon Materials, in: P. Serp, J.L. Figueiredo (Eds.), Carbon Materials for catalysis, John Wiley & Sons Inc., New Jersey, 2009, pp. 45–92.



Table of content

1. Introduction: Activated Carbon
2. **Objective**
3. Cost-benefit analysis
 - Methodology
 - Process design
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4. Conclusion



Objective

Investigation of the feasibility for the production of nitrogenised activated carbon from PB and MF waste streams.

→ in function of processing rate and mixing ratio



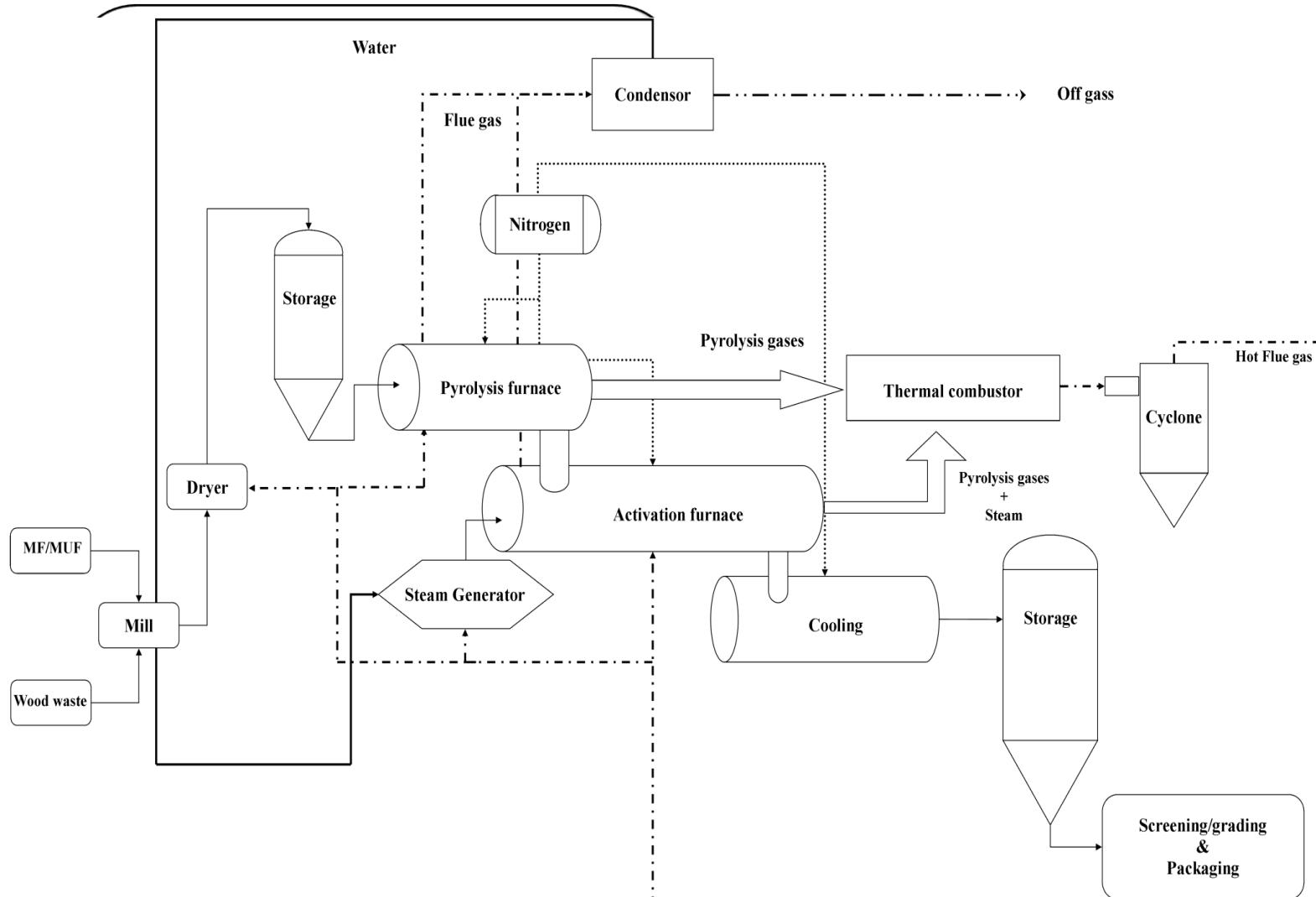
Table of content

1. Introduction: Activated Carbon
2. Objective
- 3. Cost-benefit analysis**
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4. Conclusion



Cost-benefit analysis: methodology

Proces Design



Vanreppelen, K., Kuppens, T., Thewys, T., Carleer, R., Yperman, J., and Schreurs, S.: Activated carbon from co-pyrolysis of particle board and melamine (urea) formaldehyde resin: A techno-economic evaluation. Chem Eng J, Vol. 172, No. 2-3: p. 835-846, 2011



Table of content

1. Introduction: Activated Carbon
2. Objective
3. Cost-benefit analysis
 - Methodology
 - Process design
 - **Results**
4. Conclusion



Cost-benefit analysis: Results

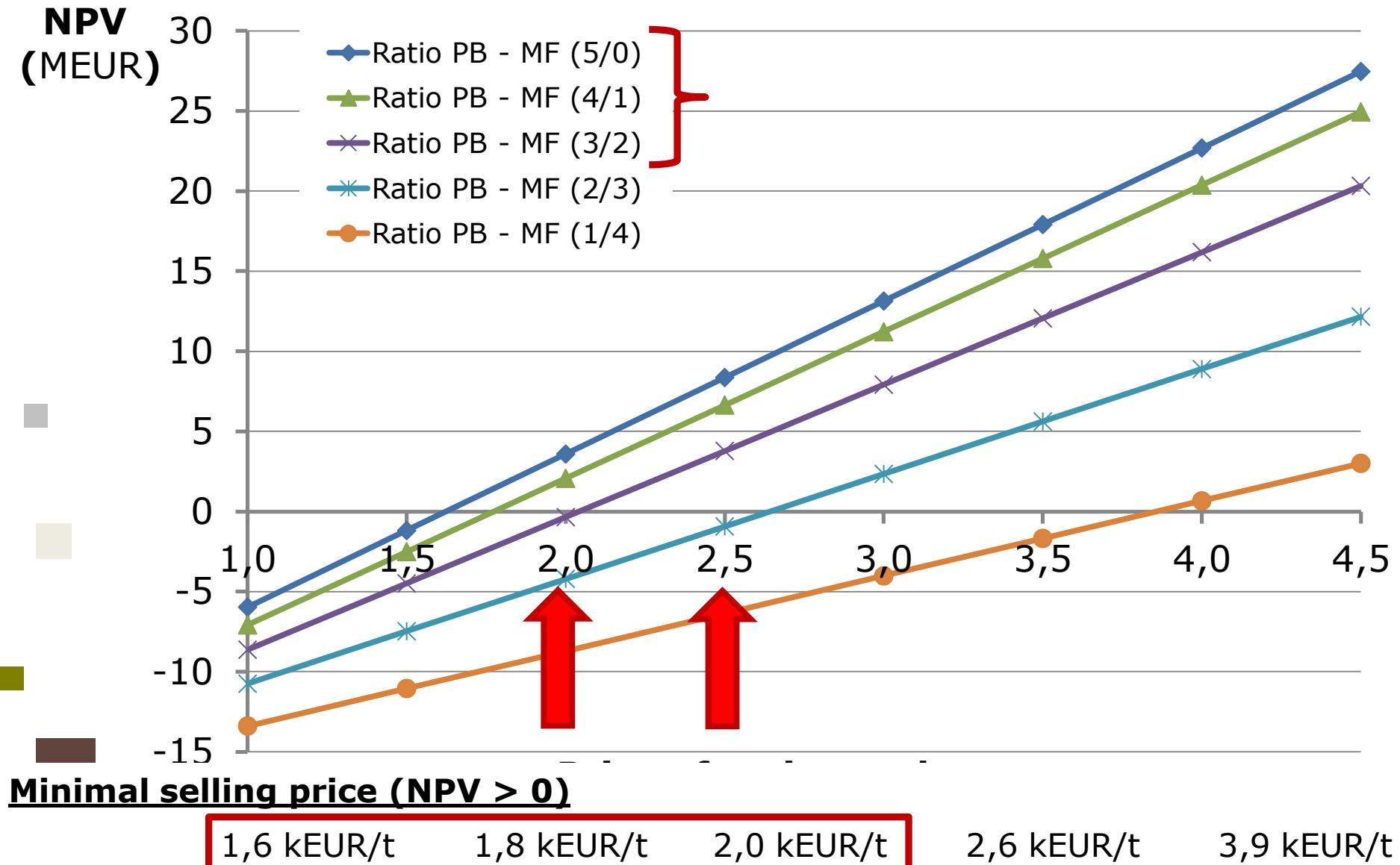
	PB – MF (5/0)	PB – MF (4/1)	PB – MF (3/2)	PB – MF (2/3)	PB – MF (1/4)
AC Yield (wt%)	22	21	19	15	11
Ultimate analysis					
(% dry and ash free)					
C	91 ± 1	85 ± 4	86 ± 2	83 ± 2	83.4 ± 0.7
N	2.24 ± 0.04	4.3 ± 0.2	7.35 ± 0.07	9.6 ± 0.3	14 ± 1

AC from PB → N: 1,5 – 2 wt% → 2,0 kEUR/t (Girods *et al.* 2009)

We expect → 2,0 kEUR/t – 2,5 kEUR/t



Cost-benefit analysis: Results





Cost-benefit analysis: Results

Are the obtained results valid??

- only in case of **100% certainty** of the base variables
- some variables are uncertain by definition, others might change the NPV strongly if its value changes slightly
- **Monte Carlo sensitivity simulation**

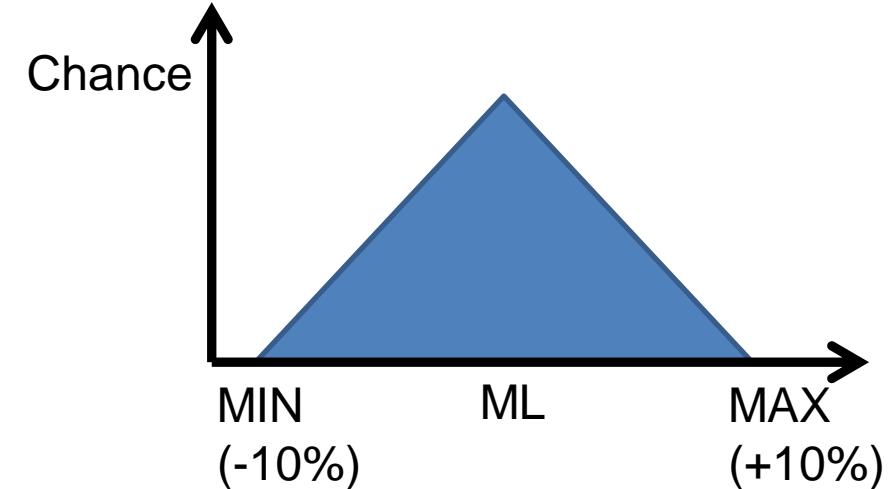
Cost-benefit analysis: Results

Monte Carlo simulation

→ Total Capital Investment; Electricity Cost; Water Cost; Delivered feed cost; Discount rate; Liquid nitrogen cost; Char output; AC output; Staff cost / shift;

Annual working hours facility

→ Triangulair distribution



→ Calculation of numerous NPVs (10 000 runs)



Cost-benefit analysis: Results

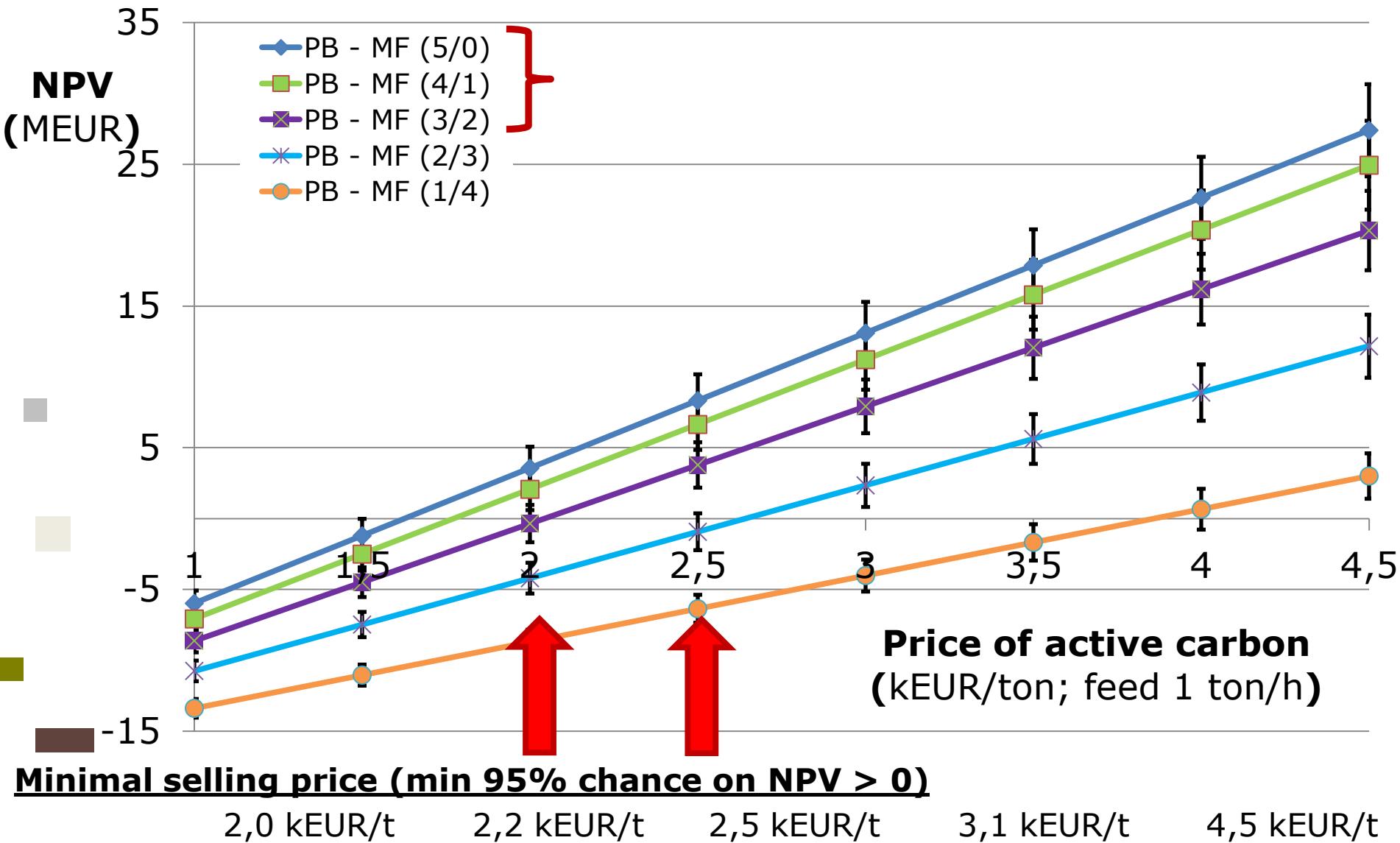




Table of content

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2. Objective
3. Cost-benefit analysis
 - Methodology
 - Process design
 - Results
4. Conclusion

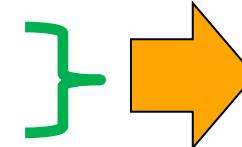


Conclusion

Really encouraging results are obtained for a profitable production of nitrogenised AC !

Even as the current assumptions start from a rather pessimistic scenario

- In situ incorporation of N
- Ability to reuse 2 waste streams
- The feasibility depends largely on the
 - AC yield
 - the product quality



Future research



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