

DEVELOPMENT OF BIO-ENERGY SECTOR AND ITS LINKS TO FOREST MANAGEMENT AND FOREST INDUSTRIES

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Outline of the presentation

- Bio-energy production in Sweden
- TIMES bio-energy model
- Results
- Conclusions

Bio-energy production in Sweden



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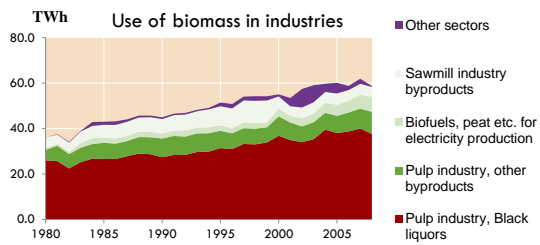
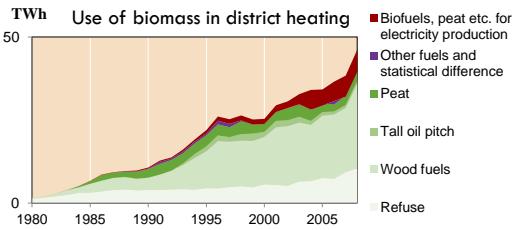
Bio-energy production in Sweden

TIMES bio-energy model

Results

Conclusions

- Bio-energy production is a major source of renewable energy in Sweden
- Rapid development of bio-energy production
- Bio-energy production is largely based on woody biomass sources
- Agricultural sector supplies only 1% of biomass sources used for energy purposes



Source: Swedish Energy Agency: Energy in Sweden, facts and figures 2009, ET 2009:29

Bio-energy production in Sweden



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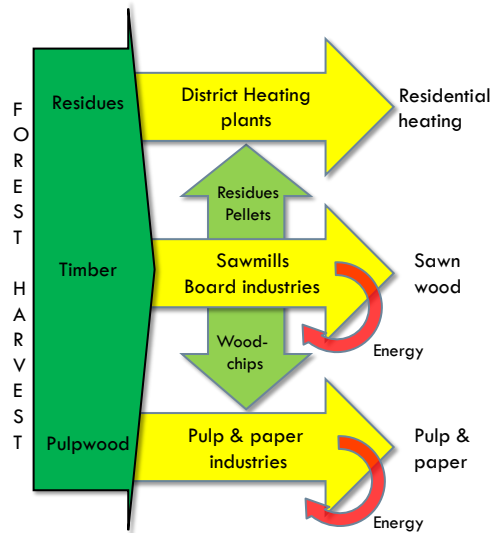
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- Growth of the bio-energy sector has induced:
 - Competition for woody biomass sources
 - Higher cost of biomass sources
 - Change in forest management
 - Little change in agricultural sector

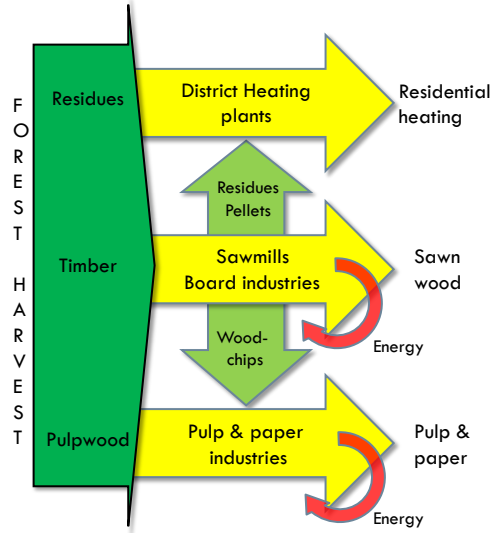


Bio-energy production in Sweden



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Bio-energy production in Sweden	TIMES bio-energy model	Results	Conclusions

- What will a continued growth of the bio-energy production bring?
 - ▣ Forest management?
 - ▣ Use of biomass sources?
 - ▣ Competition for biomass sources?

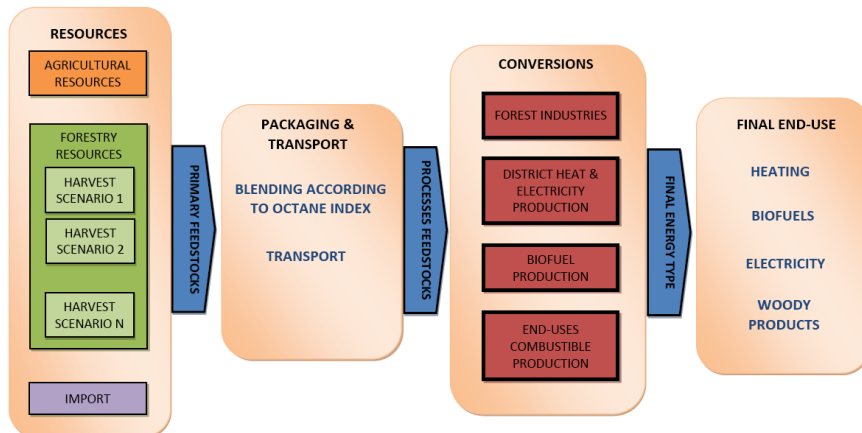


TIMES bio-energy model



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Bio-energy production in Sweden	TIMES bio-energy model	Results	Conclusions

- General outline of the TIMES model



TIMES bio-energy model



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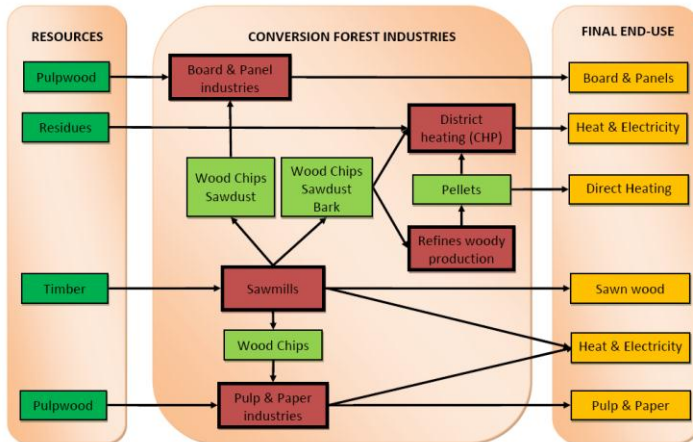
Bio-energy production in Sweden

TIMES bio-energy model

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- General outline of the flow of forest biomass



TIMES bio-energy model



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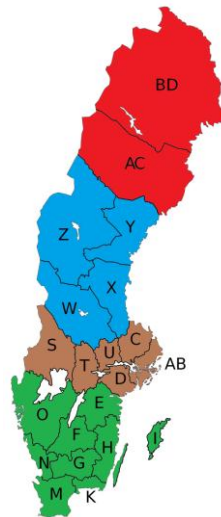
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- Sweden is divided into four regions
- Cost-supply curves of resources on regional or national level
- Agricultural crops in terms of: Starch, Sugar, Oil, Woody, and Grassy crops
- 1st and 2nd generation biofuel conversion technologies



AB – Stockholm
C – Uppsala
D – Södermanland
E – Östergötland
F – Jönköping
G – Kronoberg
H – Kalmar
I – Gotland
K – Blekinge
M – Skåne
N – Halland
O – Västra Götaland
S – Värmland
T – Örebro
U – Västmanland
W – Dalarna
X – Gävleborg
Y – Västernorrland
Z – Jämtland
AC – Västerbotten
BD – Norrbotten

TIMES bio-energy model



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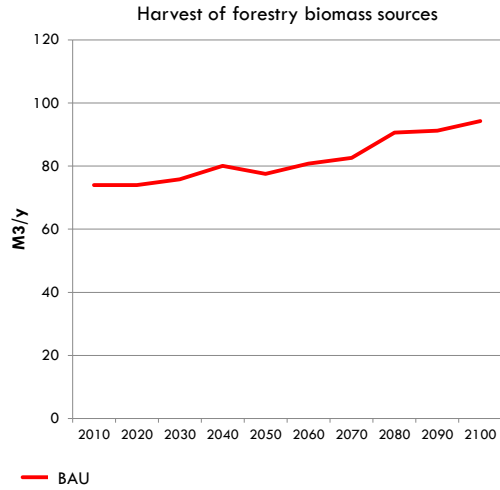
Bio-energy production in Sweden

TIMES bio-energy model

Results

Conclusions

- Fixed potential of agricultural crops
- Potential of forest biomass is endogenously computed
- A set of forest harvest scenarios are considered
- Each harvest scenario is:
 - Applicable
 - Longt-term sustainable



TIMES bio-energy model



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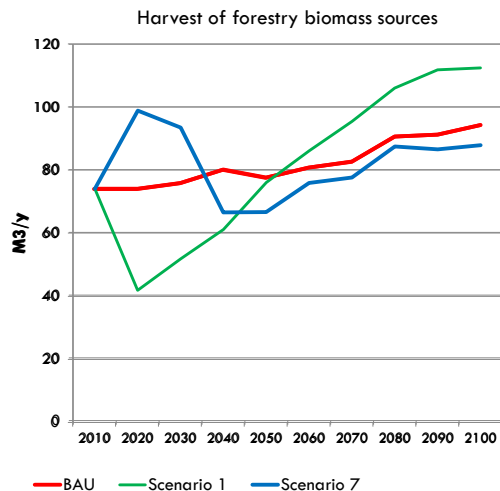
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TIMES bio-energy model



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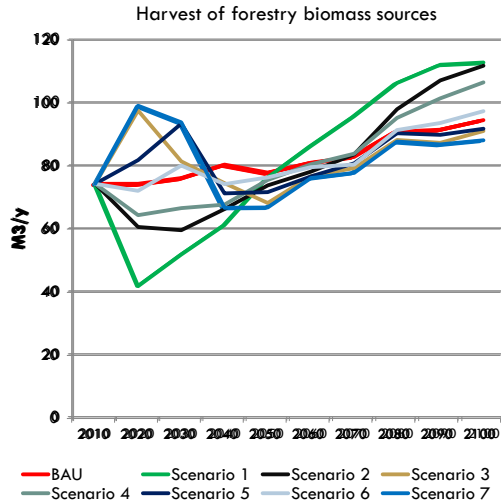
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TIMES bio-energy model



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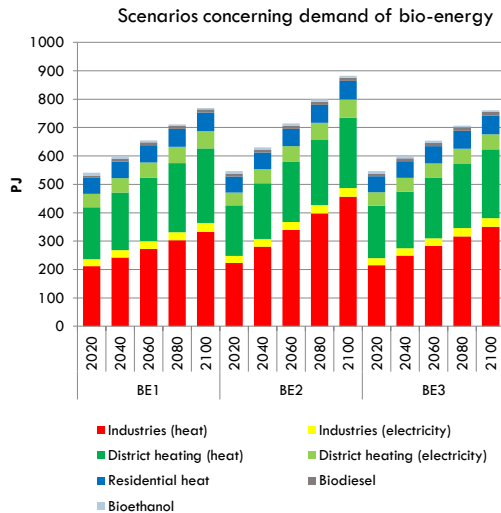
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Conclusions

- Scenarios for sensitivity analysis:
 - Demand of bioenergy
 - Demand of woody products
 - Cost of agricultural biomass sources
 - Supply of agricultural biomass sources



Results



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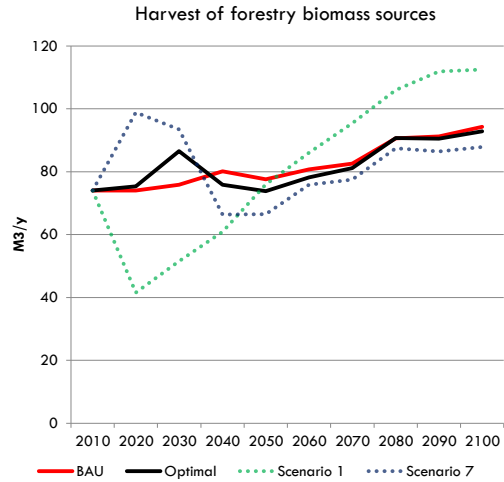
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- Small change in forest management
- Optimal forest harvest level is promoting:
 - ▣ High short-term harvest
 - ▣ Low mid-term harvest
 - ▣ BAU end-term harvest
- Optimal forest harvest was surprisingly robust to scenarios



Results



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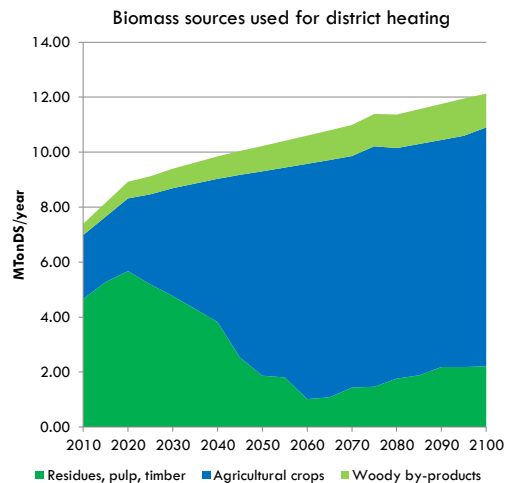
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- Large change in use of biomass sources
- Particular high impact for district heating plants
- High amounts of energy crops will be used
- Logistics chain needs to be adapted



Results



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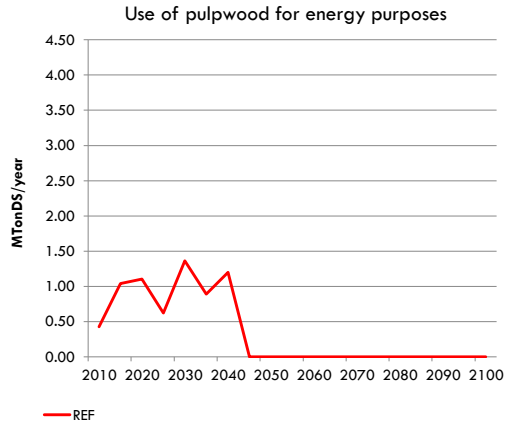
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- Large change in competition for biomass sources
- No pulpwood used for energy purposes after 2045 in all scenarios



Results



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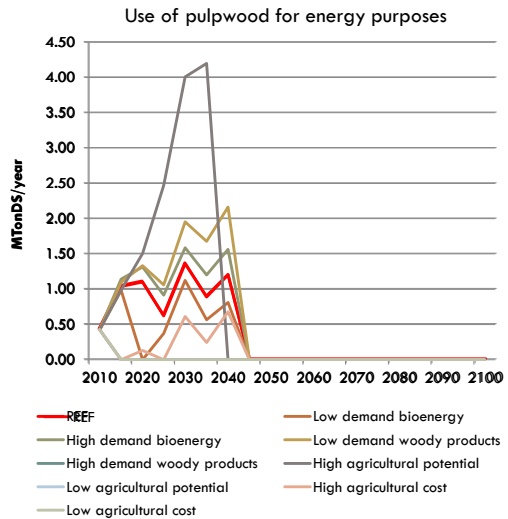
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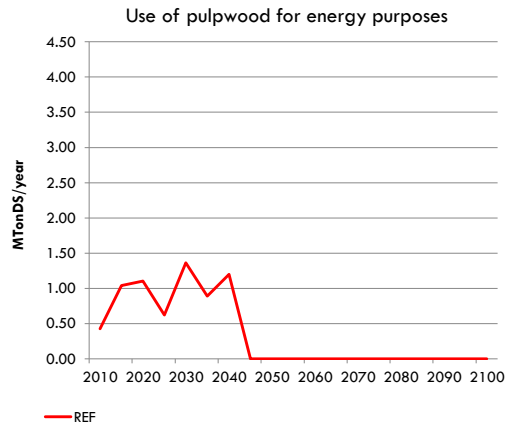
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Conclusion



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Conclusions

- Analyzed implications of a continued growth of the bio-energy sector
- Incorporated forest industries and possible adaptations of forest management in TIMES bio-energy model
- A short term increase in the forestry harvest level may be expected and beneficial
- Large-scale production of energy crops would be beneficial
- Farmers may need incentives to grow energy crops
- Logistics chain of energy crops needs to be developed