MODELING BIOMASS FOR ENERGY USES: RESULTS FOR FRANCE

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with IFP, FCBA, INRA in the Valerbio Project Funded by TUCK Foundation

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Overview of the presentation

- Context
- Objectives
- Model and assumptions
  - Scenarios
  - Resources analysis
  - Technologies description
- Results
- Conclusion and perspective

Context

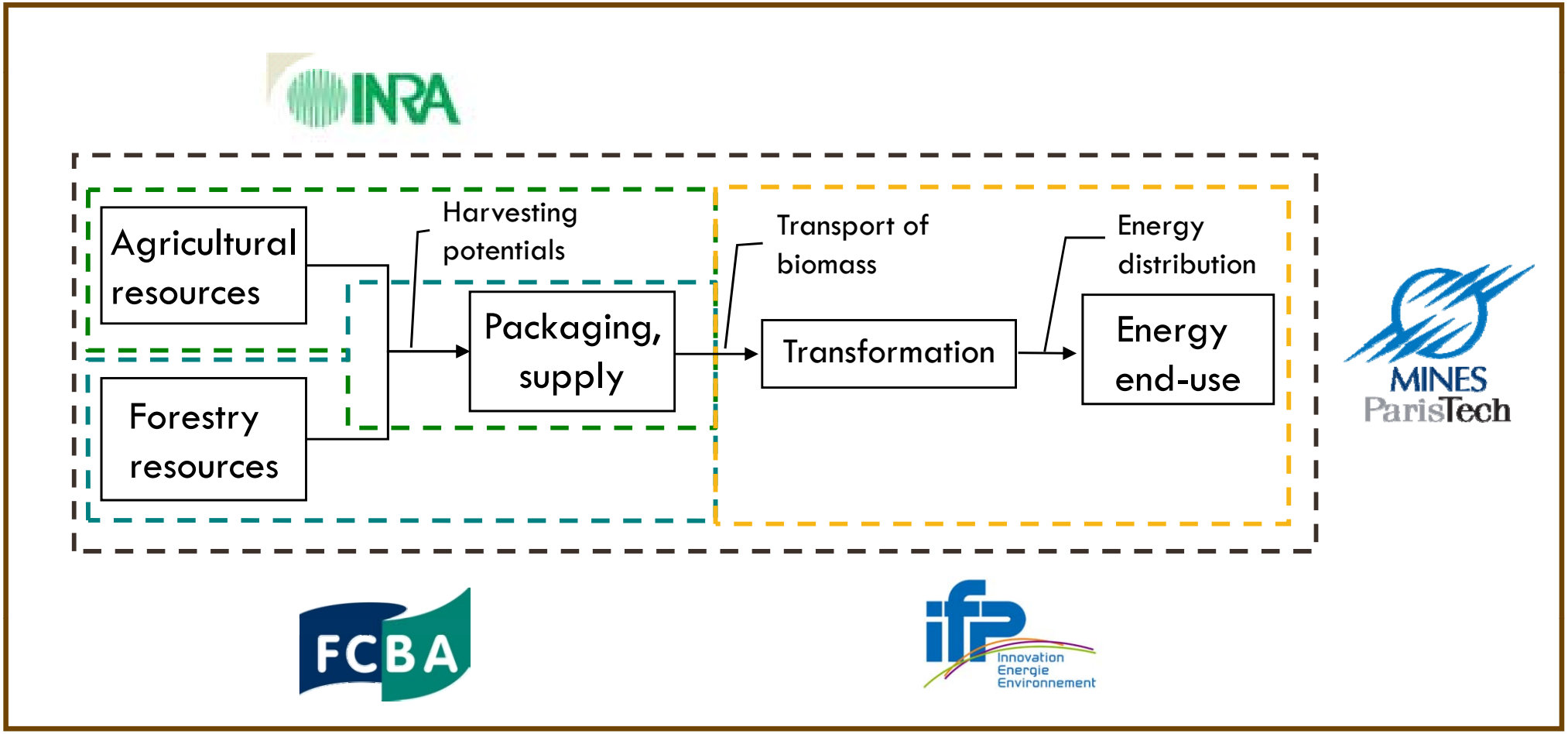
- Fossil fuel scarcity and environmental concerns are good drivers for renewable alternatives studies
  - How to assume the continuity of liquid fuel?
  - Are biofuels an acceptable and sustainable solution?
  - Which biomass can be use?
  - Which landfield is available without competition with food?
  - Which rate of incorporation as a substitution?
- To answer these questions prospective studies are helpful to policy makers

Objectives

- The VALERBIO project dealt with assessing the potential of biomass for energy use in France
  - Detailed representation of biomass sources (agriculture and wood products)
  - Regional representation of the biomass sources
  - Economical evolutions of biomass sources
  - Rich technological database (1st and 2nd generation)

Objectives

- The VALERBIO project is funded by the TUCK foundation
- Collaboration between FCBA, INRA, IFP, and Mines ParisTech



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Model and assumptions

Model description

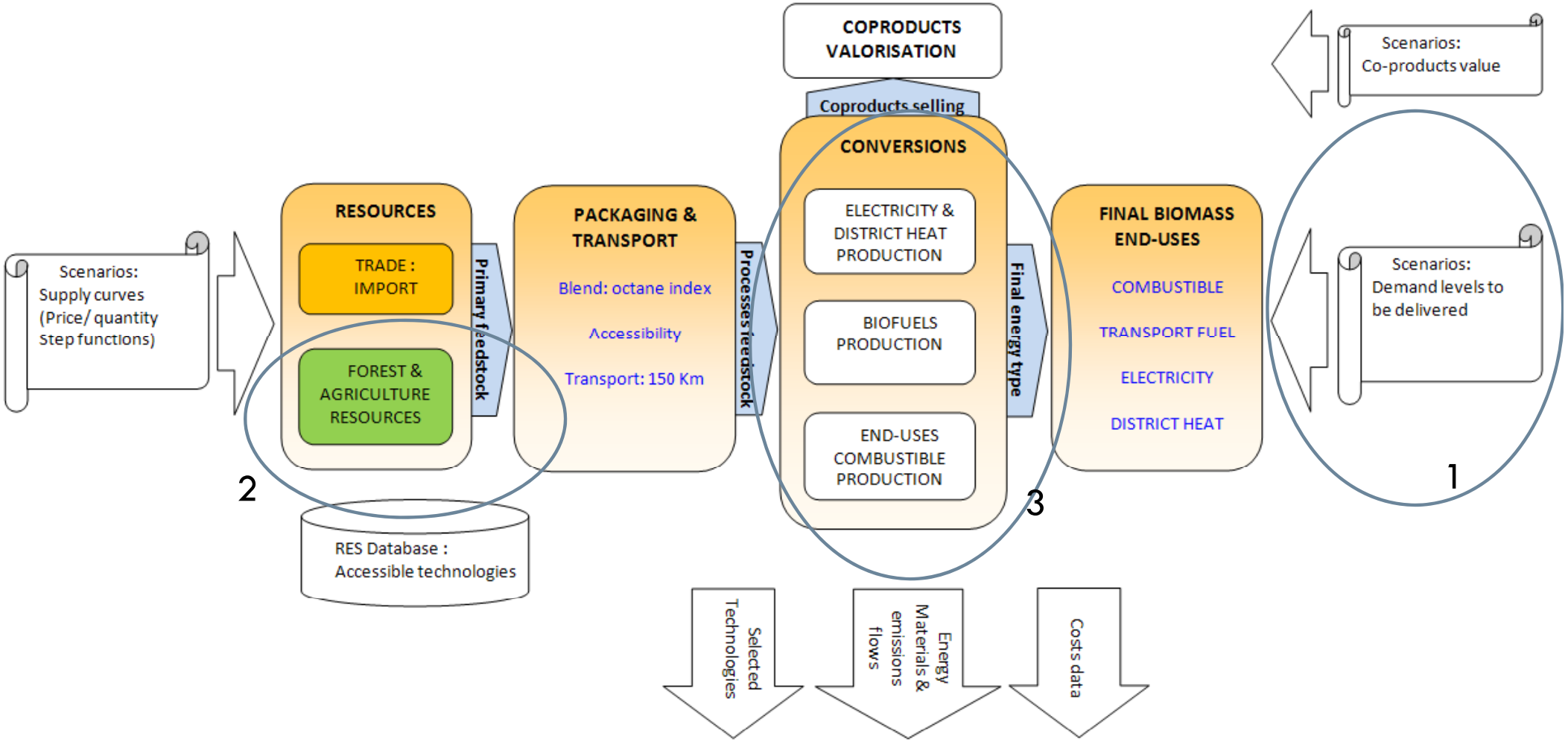
Resources analysis

Scenarios

Model description

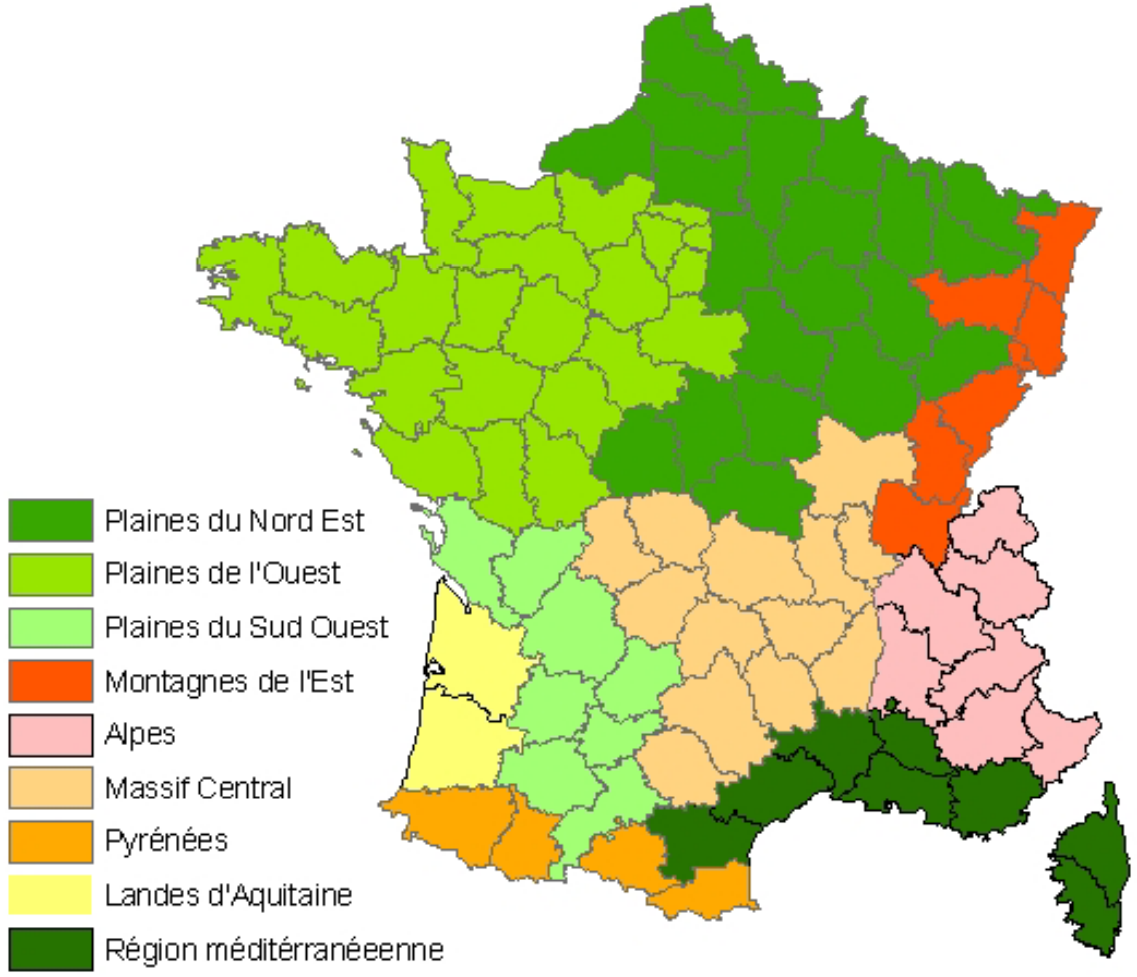
- French MARKAL/TIMES Bottom up model is used
  - Time horizon is 2005-2050
  - Demand driven (fuels) and given energy prices
  - All sectors included in the demand forecast
- We only deals with available landfield for energy without food competition
  - Base on marginal and useless landfields
- Detailed technology database including the most promising 2nd generation biofuel production (including co products)

Reference Energy System



Detailed spatiality for landfield

- Pertinent regions for agricultural and wood resources
- Each region has a detailed economic description (cost of production and transport by resource)
- Realistic evolutions and bounds on region's potentials



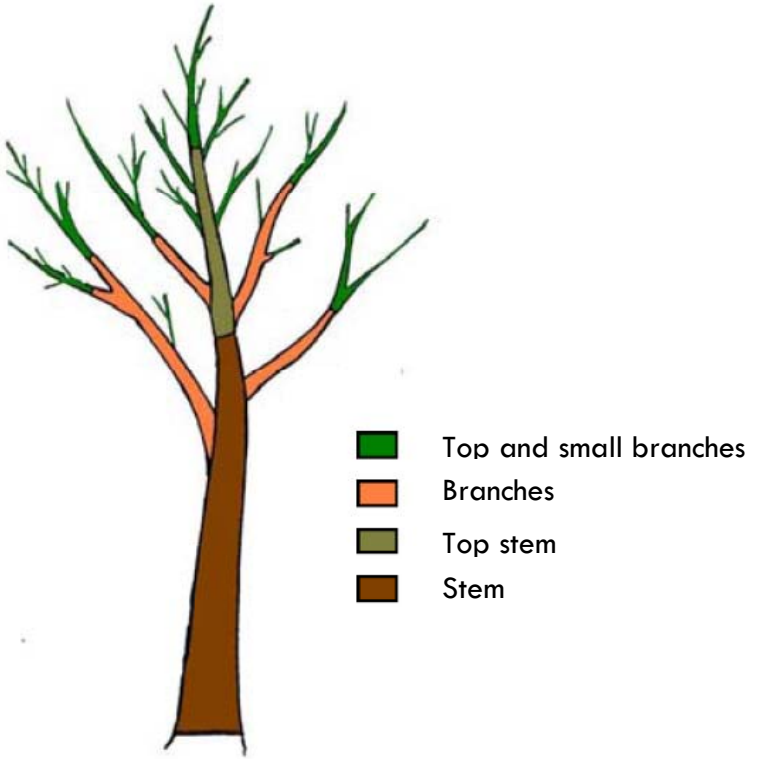
Studied resources

	Starch crops						Sugar crops
	Maize grain	Maize straw	Wheat grain	Wheat straw	Triticale grain	Triticale straw	Sugar beet
Generation	1st	2nd	1st	2nd	1st	2nd	1st
Bio-diesel							
Bio-ethanol	X		X		X		X
FT-diesel		X		X		X	
Bio-HVO							

	Oil crops			Woody crops	Grassy crops	Forestry products
	Rapeseed	Sunflower	Soya bean			
Generation	1st, 2nd	1st, 2nd	1st, 2nd	2nd	2nd	2nd
Bio-diesel	X	X	X			
Bio-ethanol				X	X	X
FT-diesel				X	X	X
Bio-HVO	X	X	X			

Studied resources

- Forestry products are separated into:
  - Three types
    - Big wood (stem)
    - Medium wood (top stem & large branches)
    - Small wood (crown & small branches)
  - Four accessibility classes
    - Easy
    - Moderately difficult
    - Difficult
    - Very difficult



Scenarios

- 3 levels to describe about 50 scenarios
  - **Resources**: combination of agricultural products, wood and Short Rotation Coppice (SRC).
  - **Demands**: several level of bio-energy demands
  - **Technologies**: development's limitations for specific technologies (processes for ethanol production, BtL)
- Commodities
  - **Fuels**: direct use of biomass (heat, cogeneration)
  - **Liquid fuels**: direct use of biofuel
  - **Electricity**: use of electricity produced with biomass (by cogeneration or co-product)

Potential scenarios

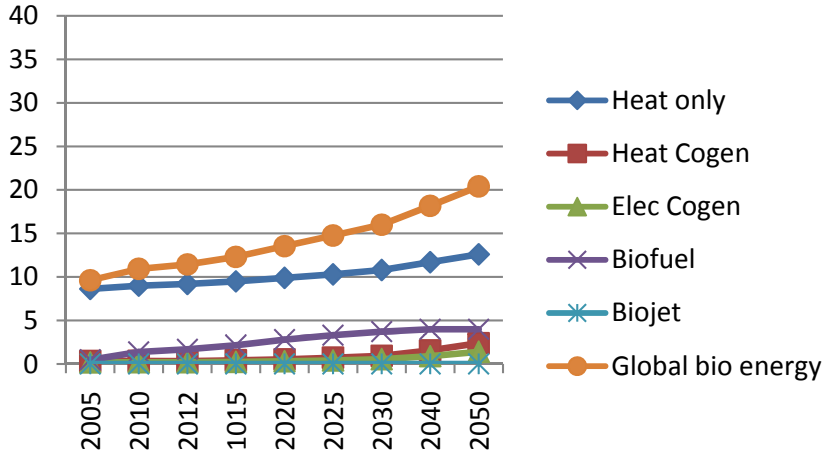
- 3 level scenarios
  - P1: BAU (Business As Usual)
  - P2: Dynamic wood (wood is mostly use for non energy applications)
  - P3: All for energy (biomass mostly use for energy)
- For each, 2 kinds of prices for biomass (high and low)

Agricultural products potential	Wood potential	SRC potential	Global potential	
S1A -PB (PB for Moderate price)	S1-F		BAU	P1
S1A –PH (PH for High price)	S1-F		BAU	P1b
S2A –PH	S2-F	S2-SRC	Dynamic wood	P2
S1A –PB	S2-F	S2-SRC	Dynamic wood b	P2b
S2A -PH	S3-F	S1-SRC	All for energy	P3b
S2A -PH	S3-F	S2-SRC	All for energy	P3

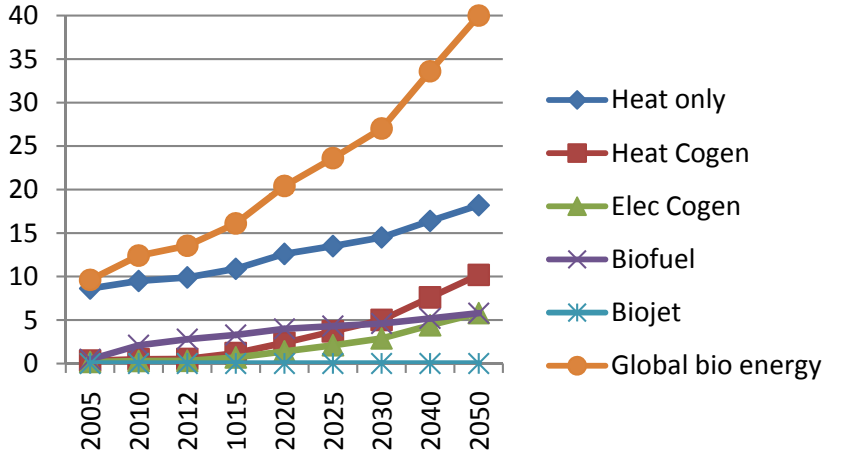
Demand scenarios

- 3 levels of imposed production for bio-products: prepared in accordance with Public Policies

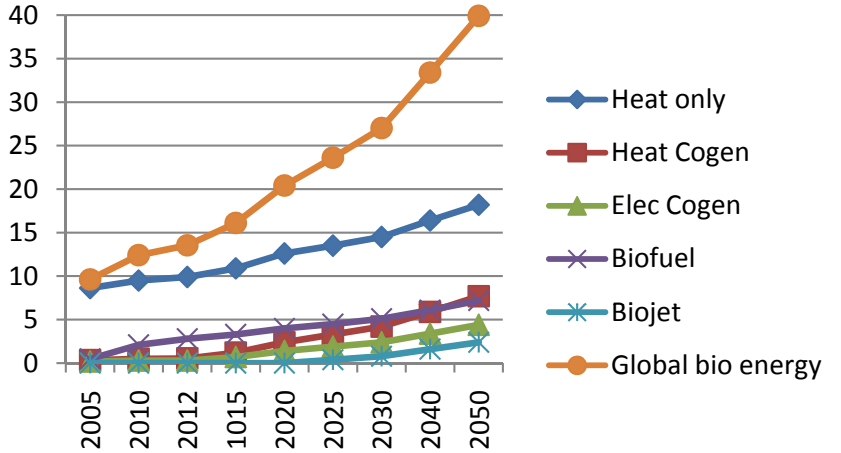
- D1: 20 Mteo



- D2: 40 Mteo + cogen development



- D3: 40 Mteo + biojet development



Processes for biofuels production

- Economical values for all of the processes
- Valorization of the production of heat and power
- Valorization of the Co-products

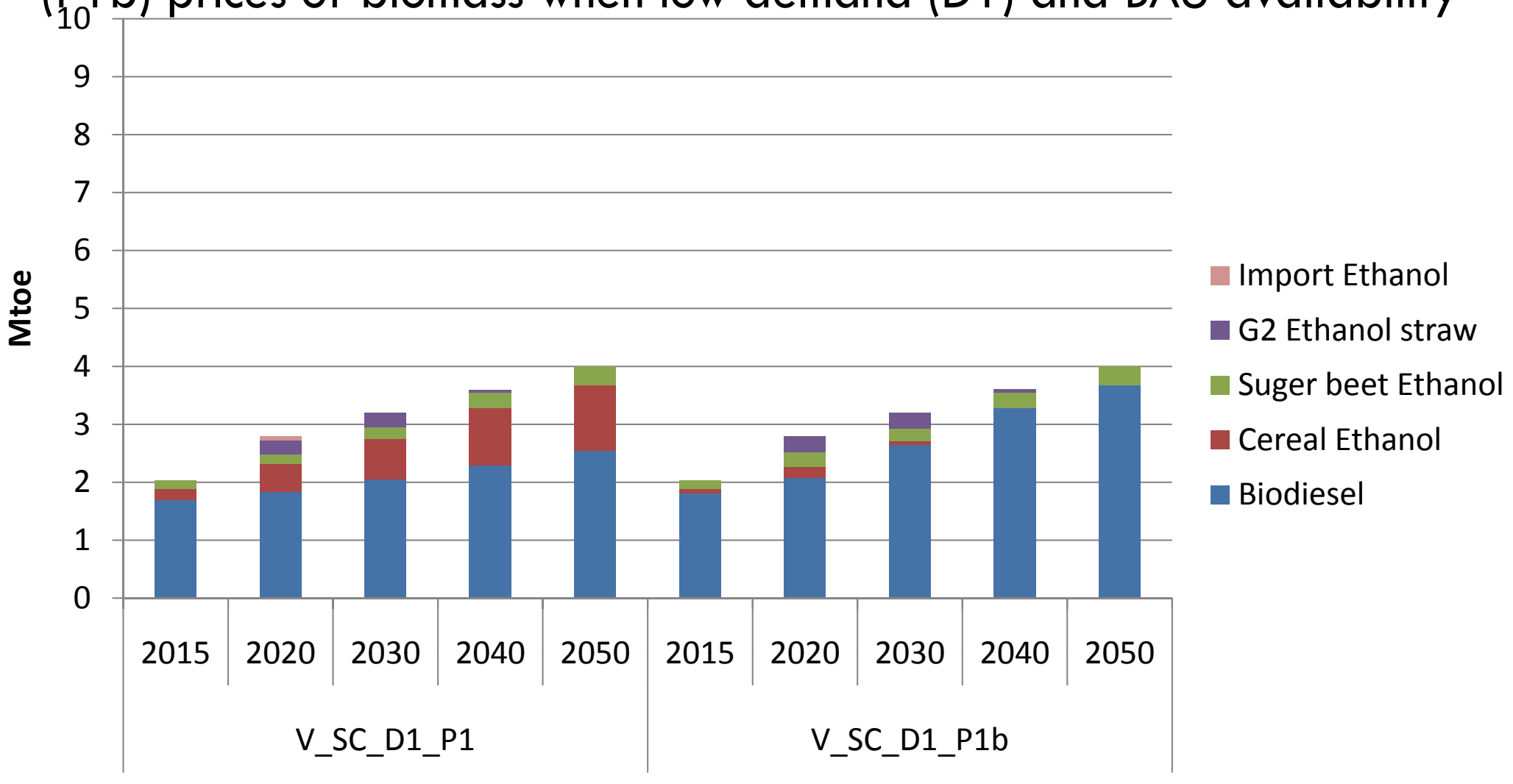
Process	Description
BTL wood	FT (Fischer-Tropsch) with wood
BTL straw	FT- with straw
G2 Ethanol straw	2nd generation Ethanol – wood
G2 Ethanol wood	2nd generation Ethanol – straw
Sugar beet Ethanol	1st generation Ethanol- sugar
Cereal Ethanol	1st generation Ethanol – cereal
Import Ethanol	Ethanol from importation

Results

- Mix of technologies
- Biomass uses
  - Agricultural products
  - Forestry products

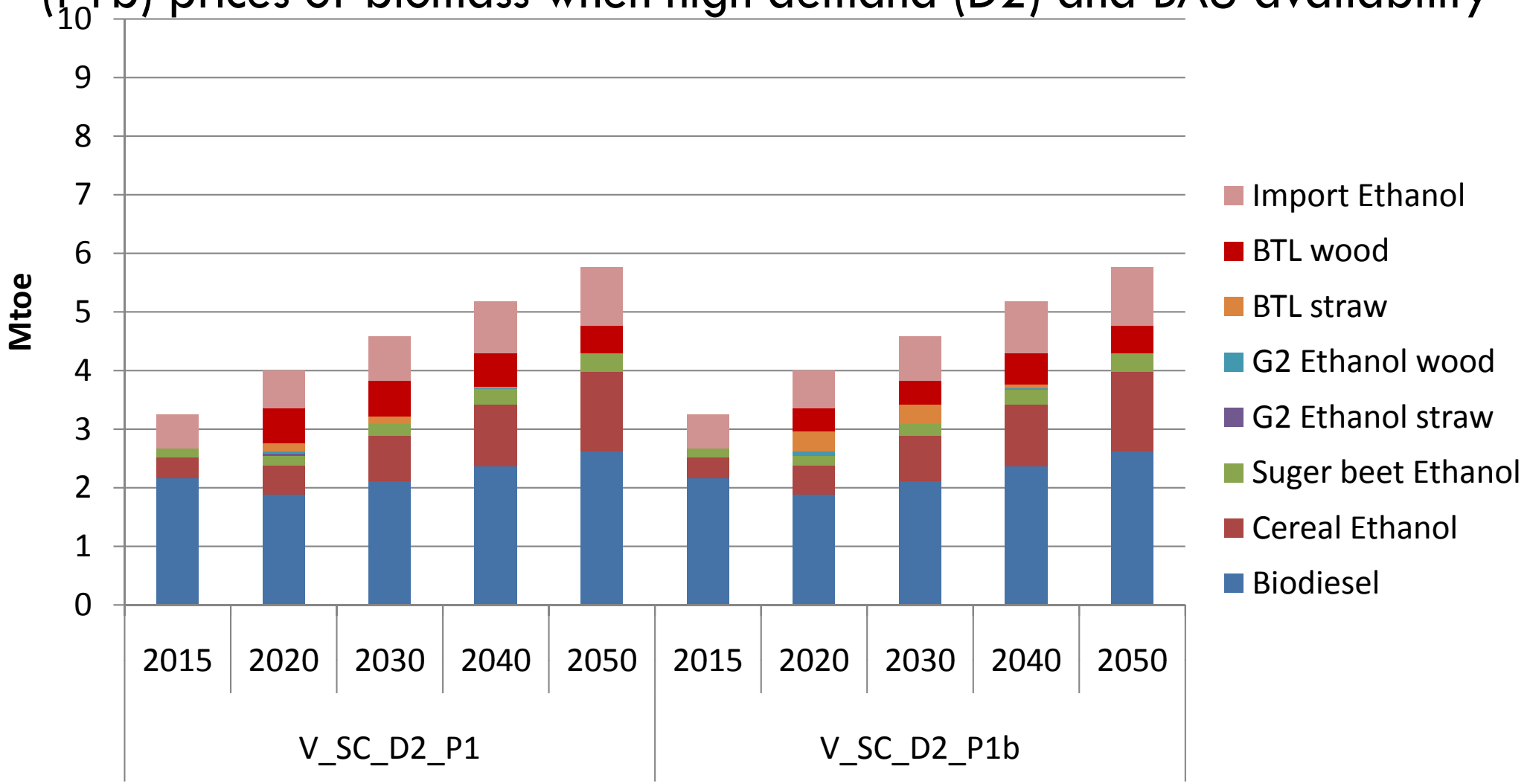
Technologies mix

- Mix of technologies for biofuel production for moderate (P1) and high (P1b) prices of biomass when low demand (D1) and BAU availability



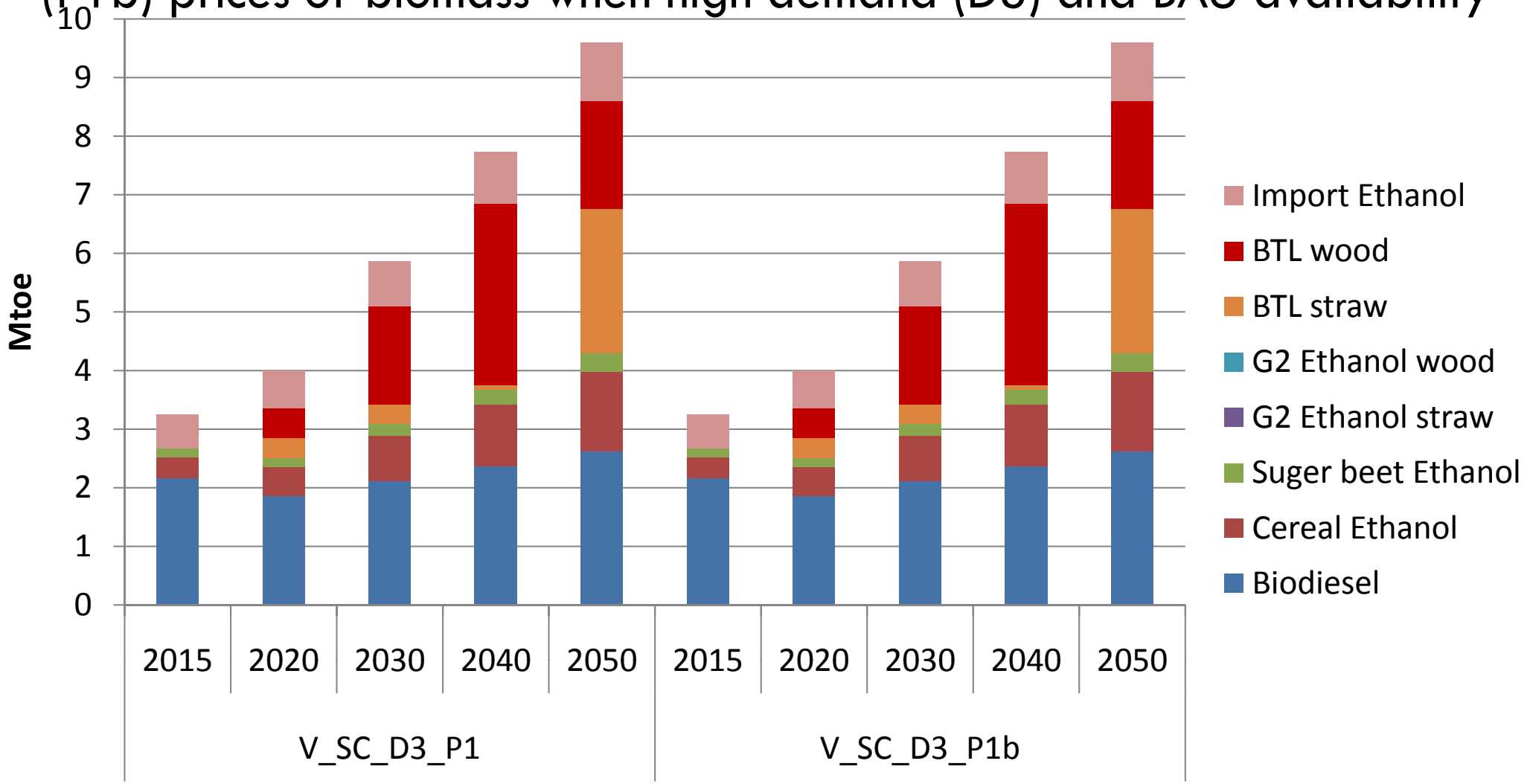
Technologies mix

- Mix of technologies for biofuel production for moderate (P1) and high (P1b) prices of biomass when high demand (D2) and BAU availability



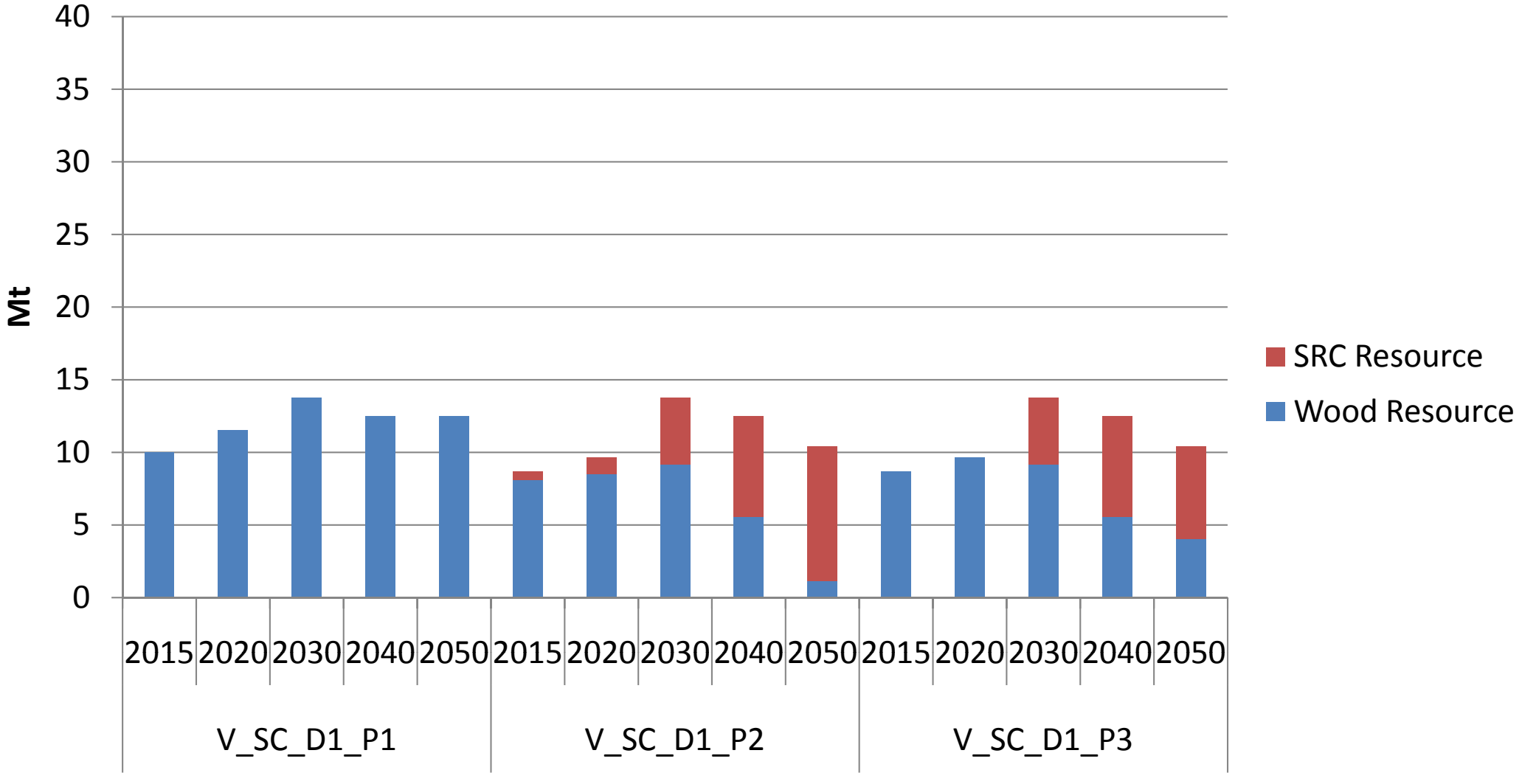
Technologies mix

- Mix of technologies for biofuel production for moderate (P1) and high (P1b) prices of biomass when high demand (D3) and BAU availability



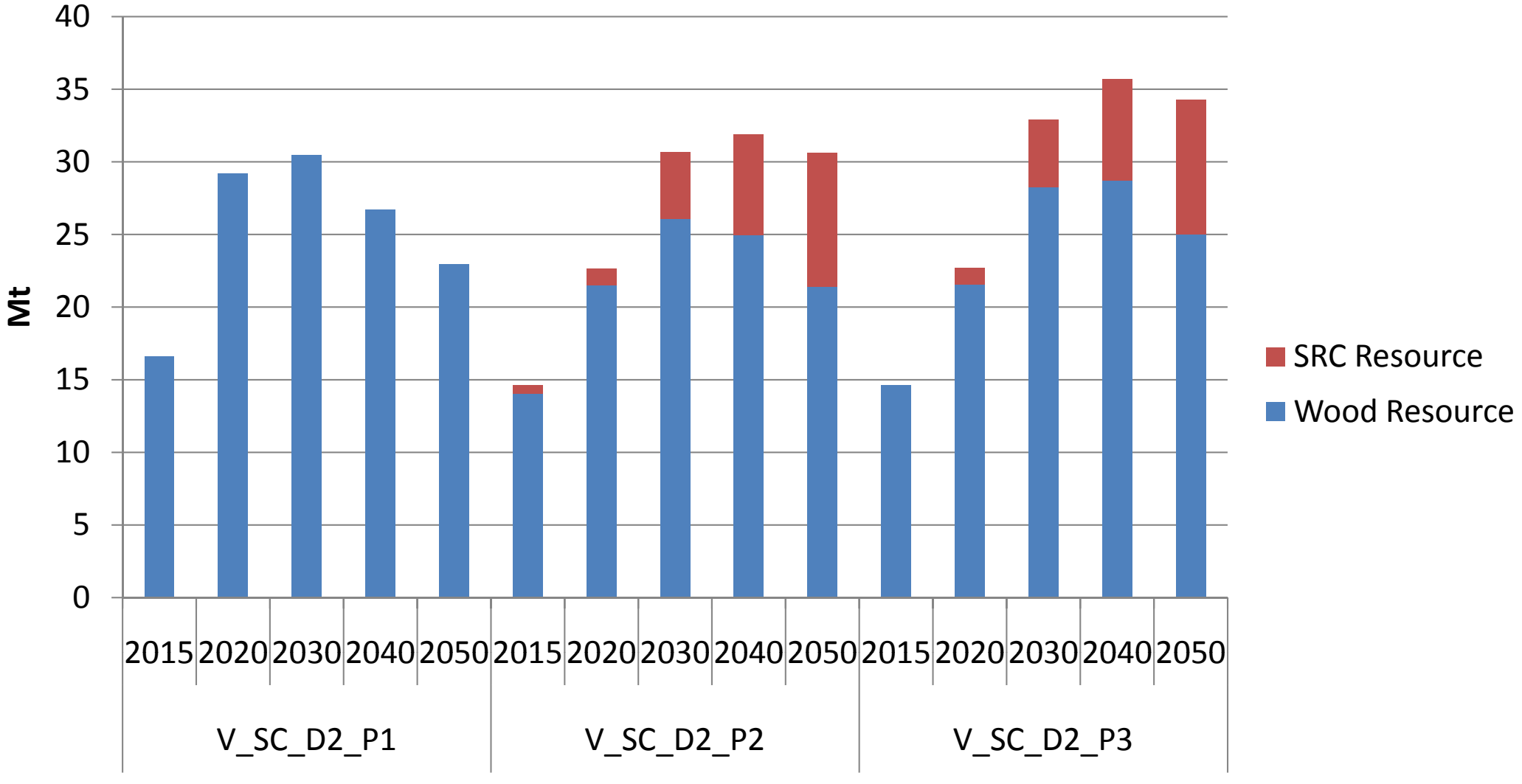
Wood resources

- Resources repartition by usages for D1 scenario



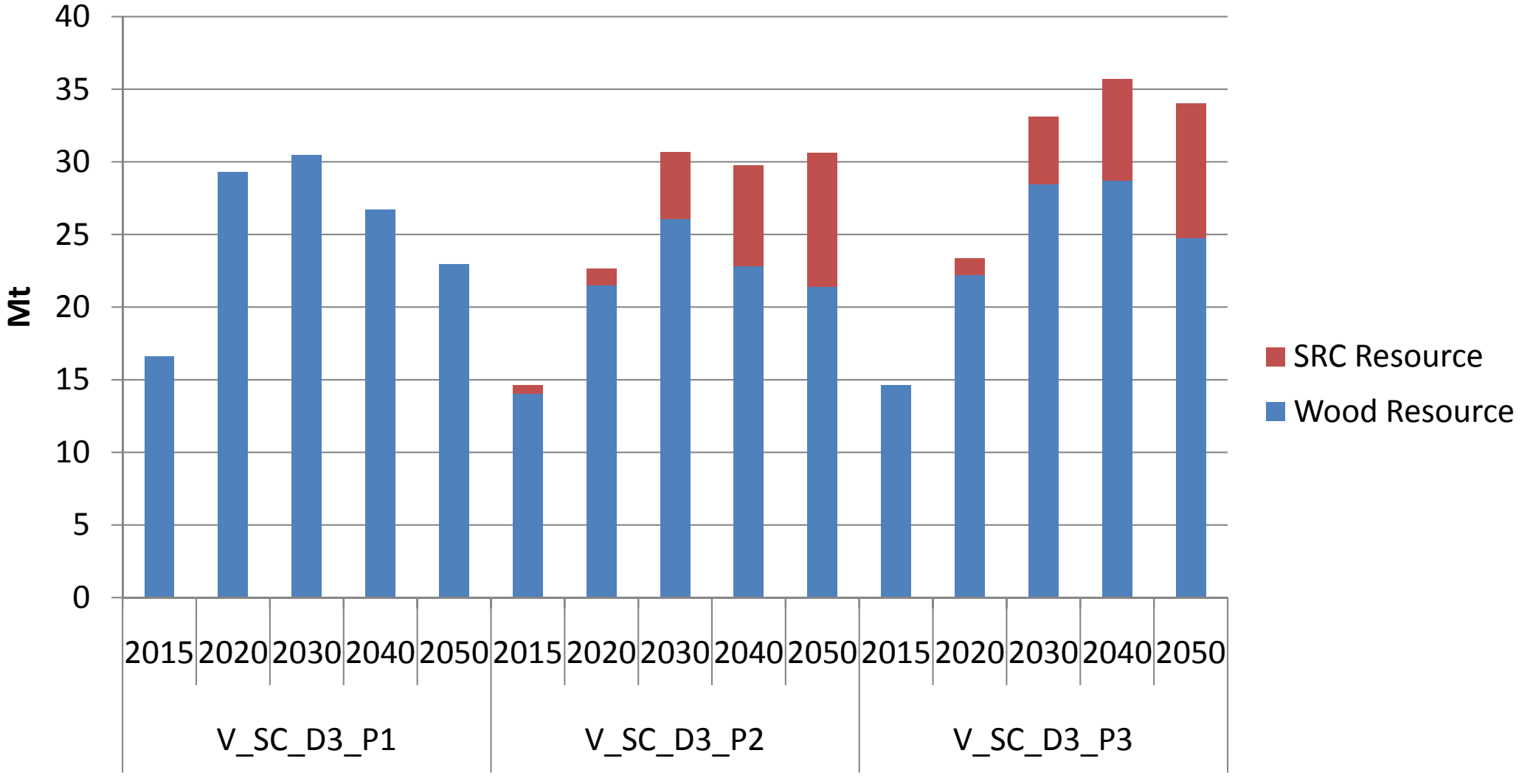
Wood resources

- Resources repartition by usages for D2 scenario



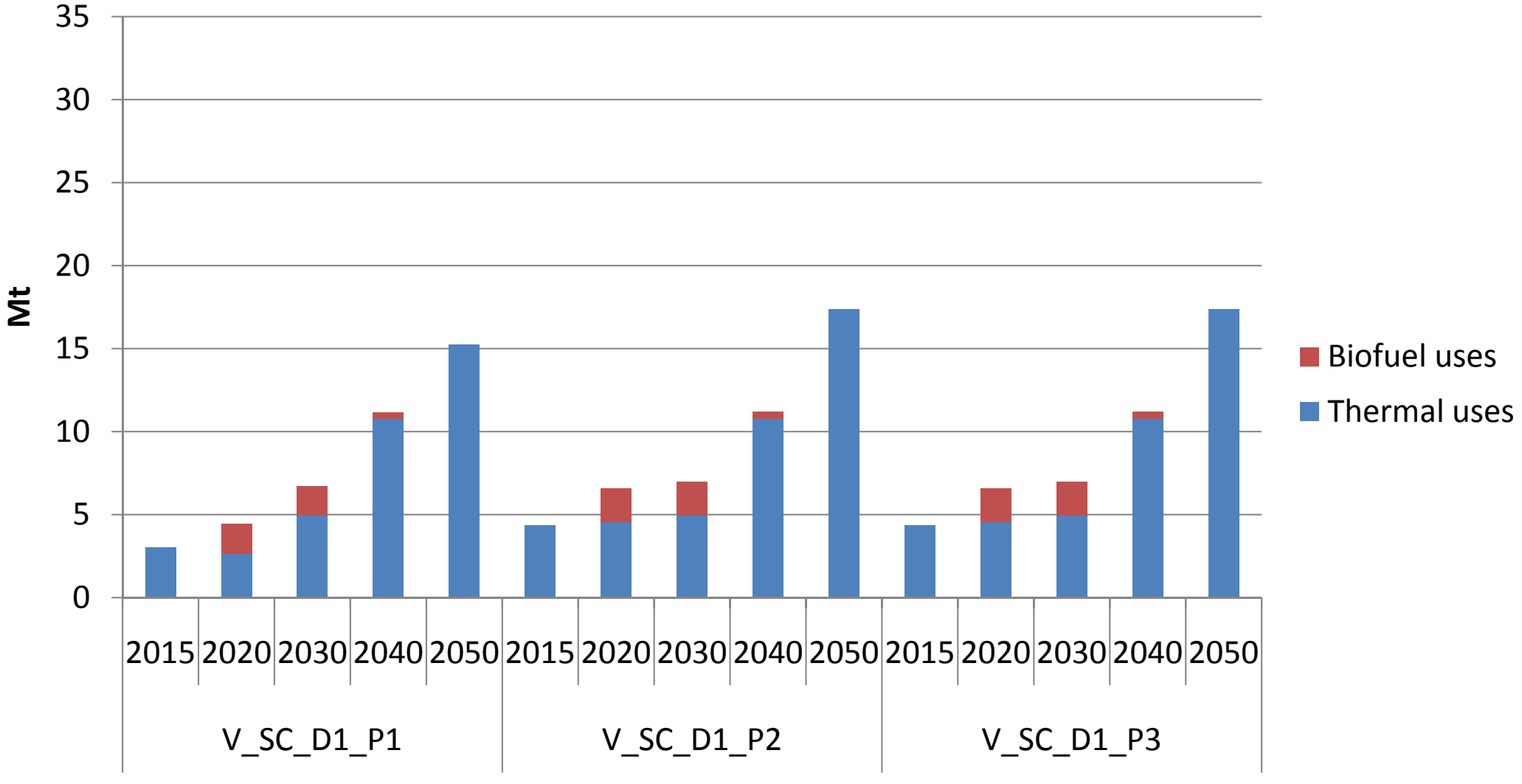
Wood resources

- Resources repartition by usages for D3 scenario



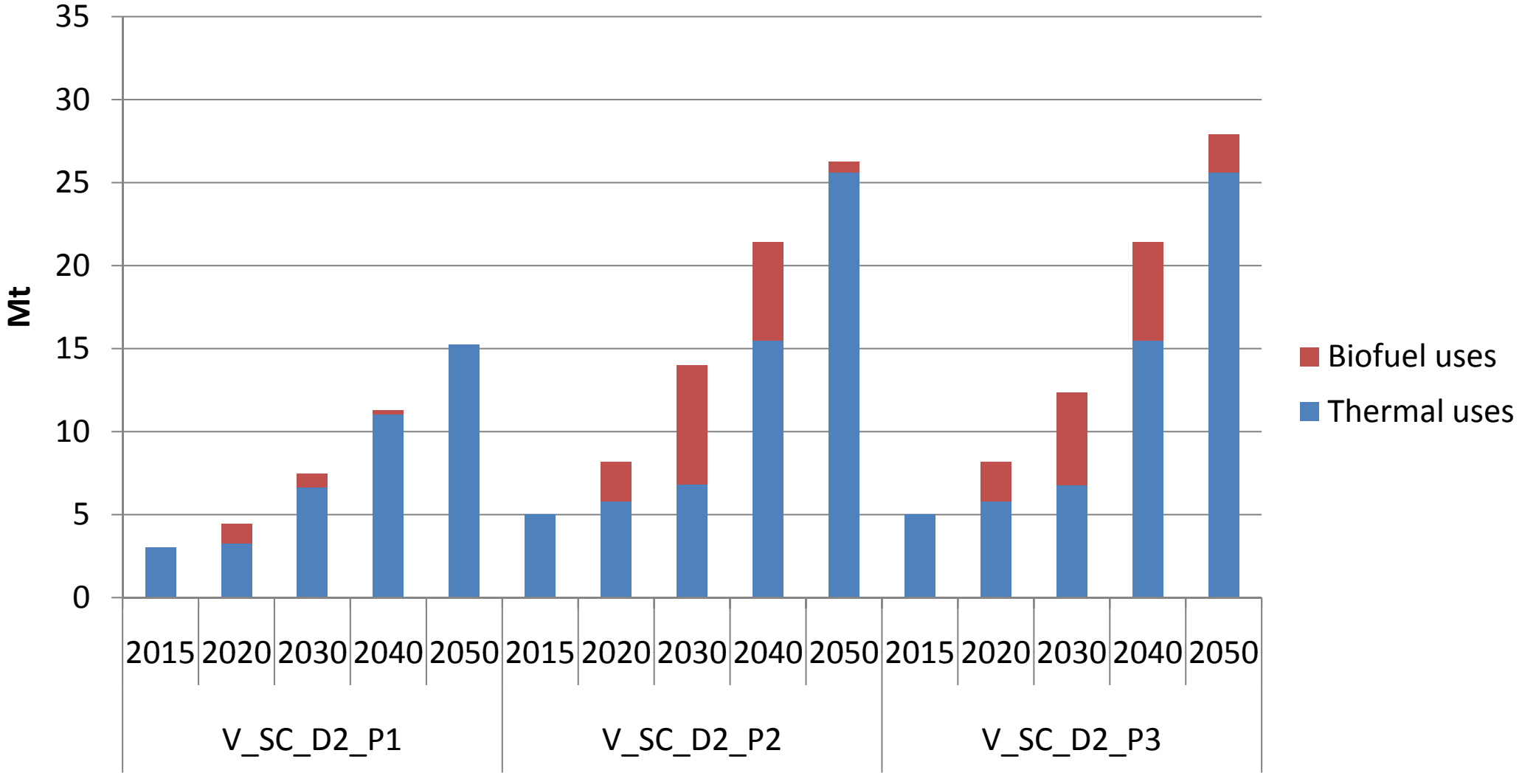
Straw valorization

- Resources repartition by usages for D1 scenario



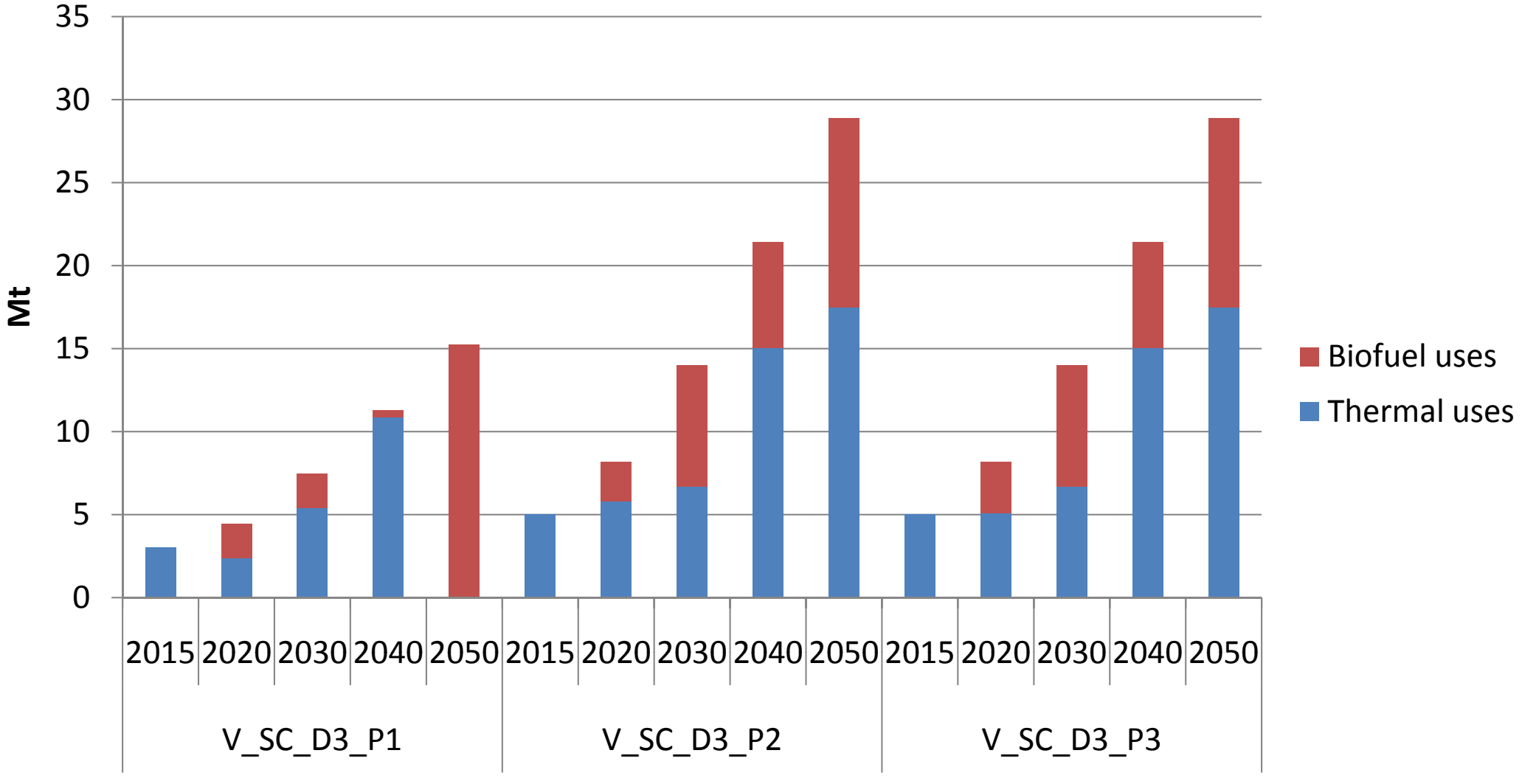
Straw valorization

- Resources repartition by usages for D2 scenario



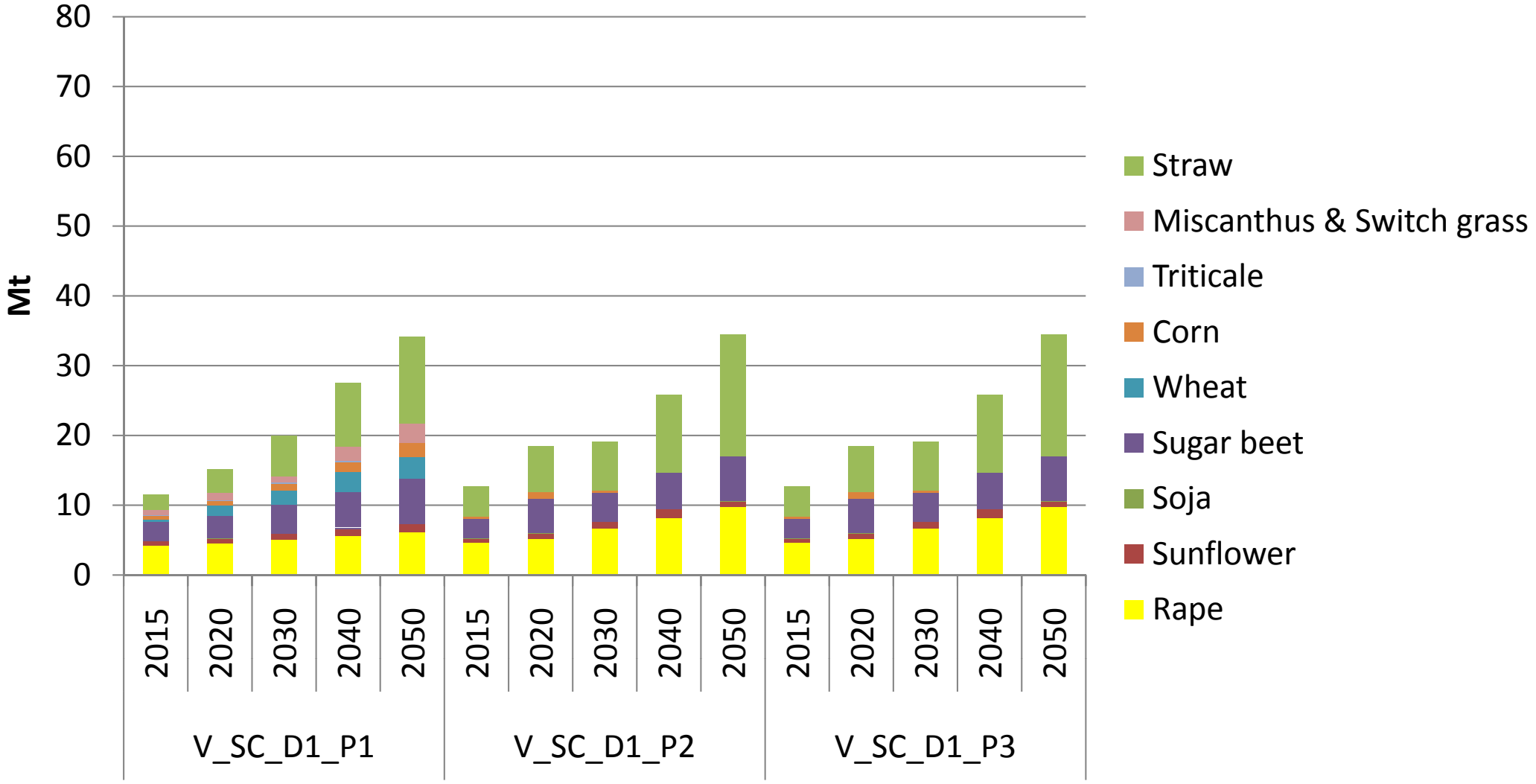
Straw valorization

- Resources repartition by usages for D3 scenario



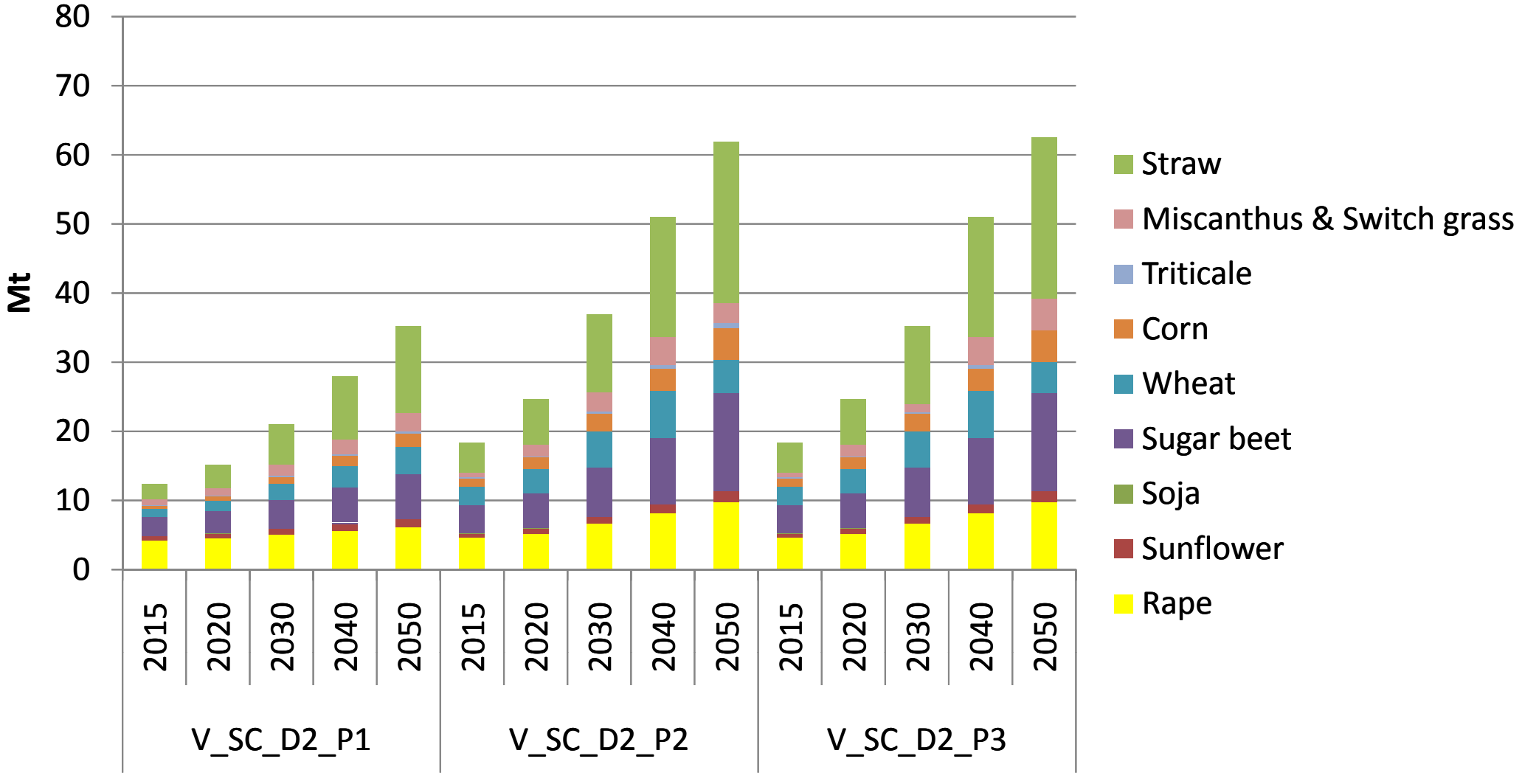
Agricultural resources

Agricultural products resources for D1 scenario



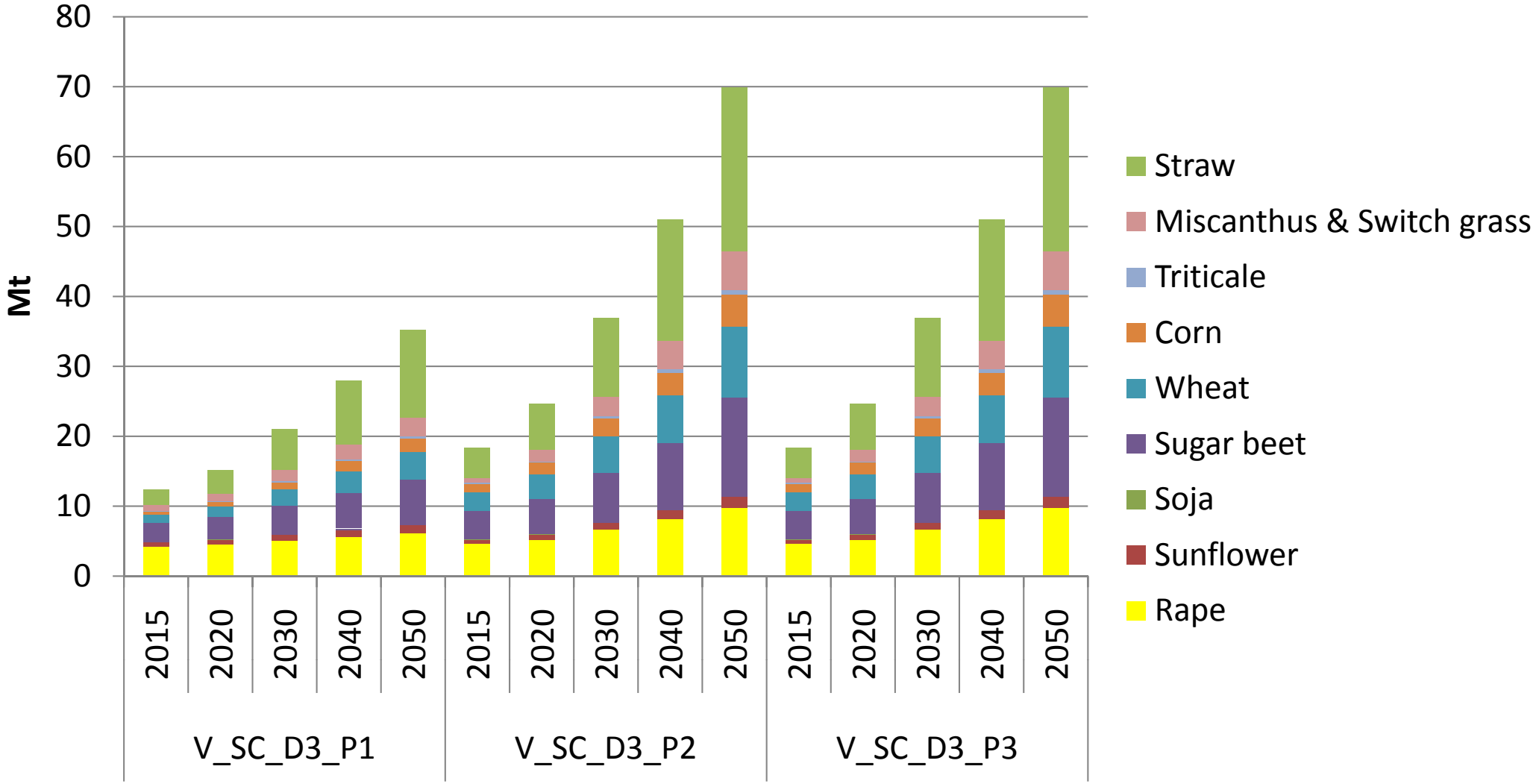
Agricultural resources

Agricultural products resources for D2 scenario



Agricultural resources

- Agricultural products resources for D3 scenario



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Conclusion & perspective

Conclusions & perspectives

- Possible paths for the mix of technologies for given scenarios
- First objective at 20 Mtoe can be reached
- The scenarios at 40 Mtoe are too ambitious with our hypotheses
  - Lack of Technologies availabilities
  - Lack of bio resources
- The model has shown the possibilities of arbitration for imports of wood and ethanol
- The strong role of BtL and straw have been revealed
- Detailed potentials for biomass with their evolution for each region
  - Permit to assess the future implantation of conversion unit

THANK YOU
FOR YOUR ATTENTION