The energy autonomy of Reunion island confronted with land use conflicts

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SUMMARY

- Context
- Research questions
- Methods
- Results
- Conclusions

I- CONTEXT & SCOPE

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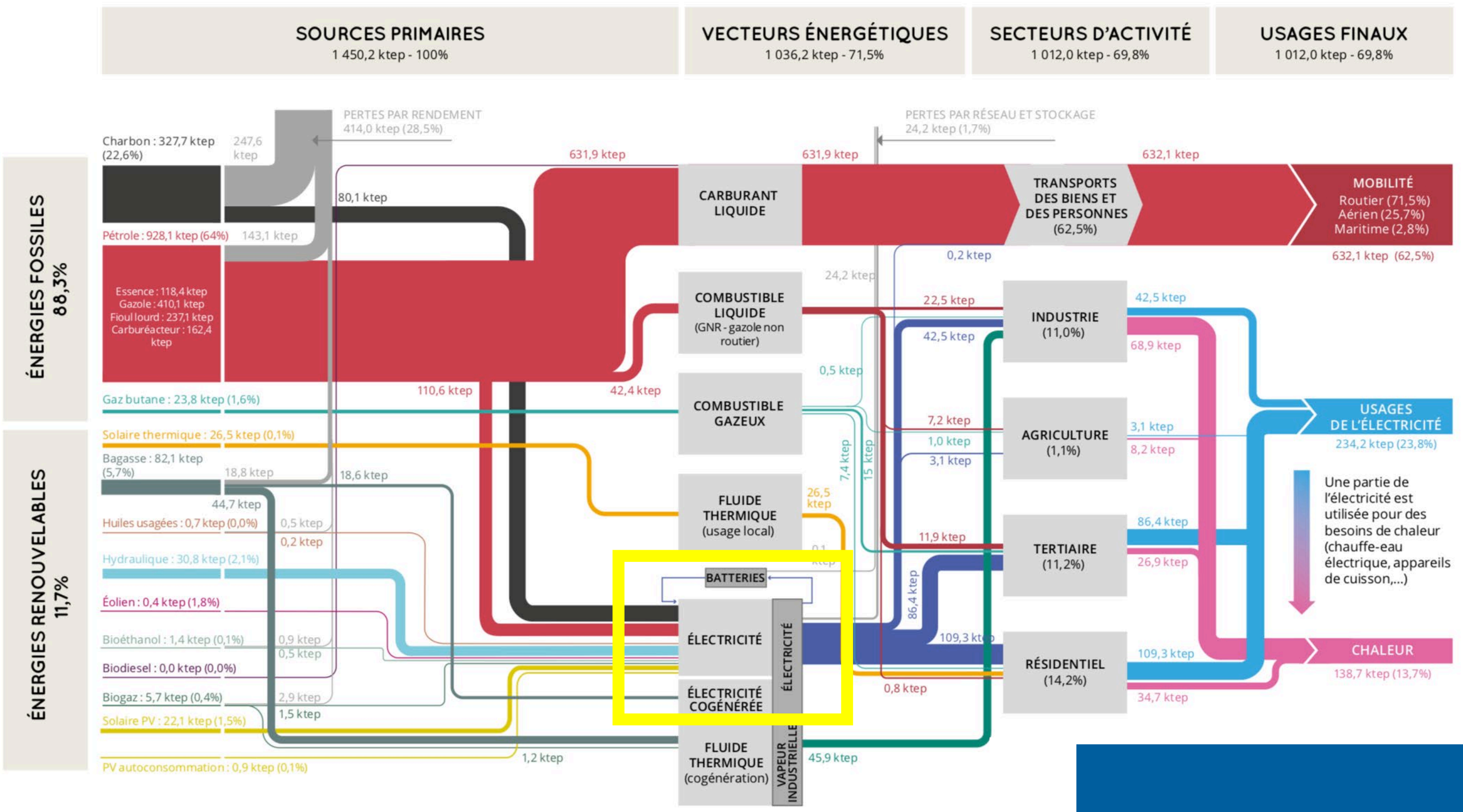
REUNION ISLAND

French overseas department & region

- **Population** : 870 000
- **2 seasons: rainy season (January - March) & dry season (May - November)**
- **Sunshine**: 2,500 h/year (equivalent to the sunniest regions in France)

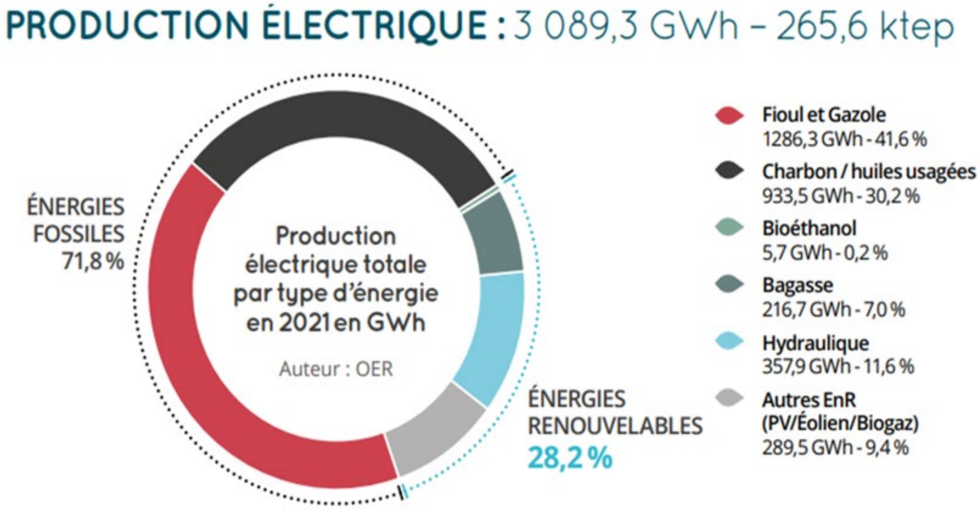
ISLAND'S ENERGY SECTOR

Energy system



Source : OER, 2022

Power sector



Installed Capacities : 931,8 MW

Challenge : Heavy dependence on imported fossil fuels

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SCOPE OF THE STUDY

- Energy transition law: energy autonomy for NIZ by 2030
- Regional Chamber of Agriculture of Reunion : food autonomy
- Land constraints on the island ➔ Conflict between energy & food autonomy

RESEARCH QUESTIONS:

- WHAT IS THE ISLAND'S CAPACITY TO MEET ITS ELECTRICITY DEMAND FROM LOCAL RESOURCES ?
- WHAT LAND-USE PLANNING POLICIES WOULD OPTIMIZE REUNION'S ELECTRICAL & FOOD SELF-SUFFICIENCY BY 2050 ?

II- METHODOLOGIE

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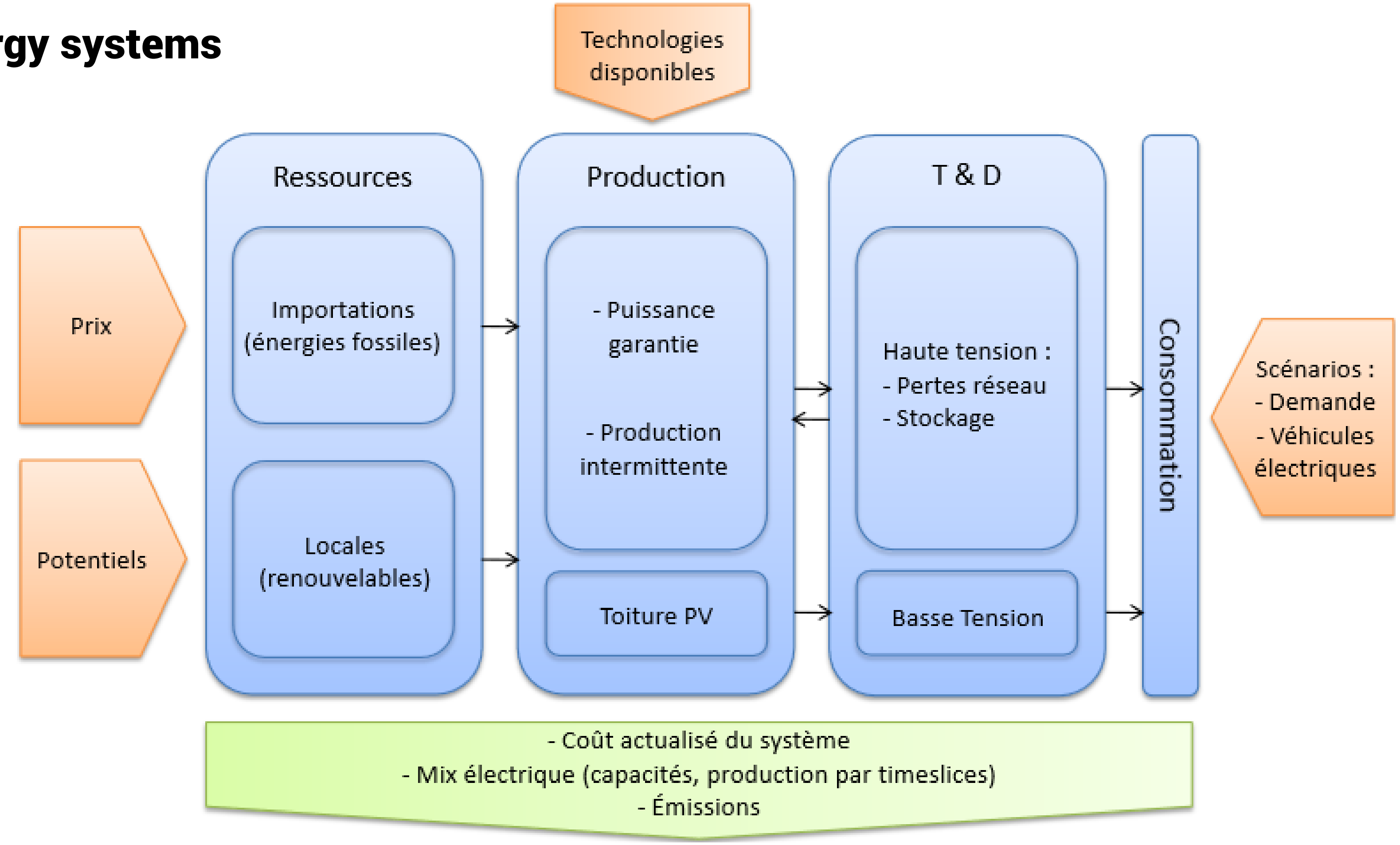
ENERGY SYSTEM MODELING - TIMES

- **Long-term development of energy systems**
- **Decision & Policy making**



Power system model TIMES-Réunion, Source : Drouineau, 2011

- **Time slices:**
  - 2 Seasons
  - 8 periods in the day
- **Horizon 2008 - 2030**

POTENTIAL OF LOCAL RESOURCES

RES POTENTIAL

Technologies	Potential (MW)	
	Installed	Future (2050)
Hydro	134 MW	25 MW
Wind	17 MW	189 MW (50 offshore)
Marine	0 MW	15 MW
Geothermal	0 MW	15 MW

SOLAR POTENTIAL

PV	Potential (MW)	
	Installed	Future (2050)
Parking lot shadings	9	21
Ground-mounted	27	67
Roof-top	133	903

Subventions	Amount (€/kWc)
Photovoltaic check	25
Self-consumption incentive	80

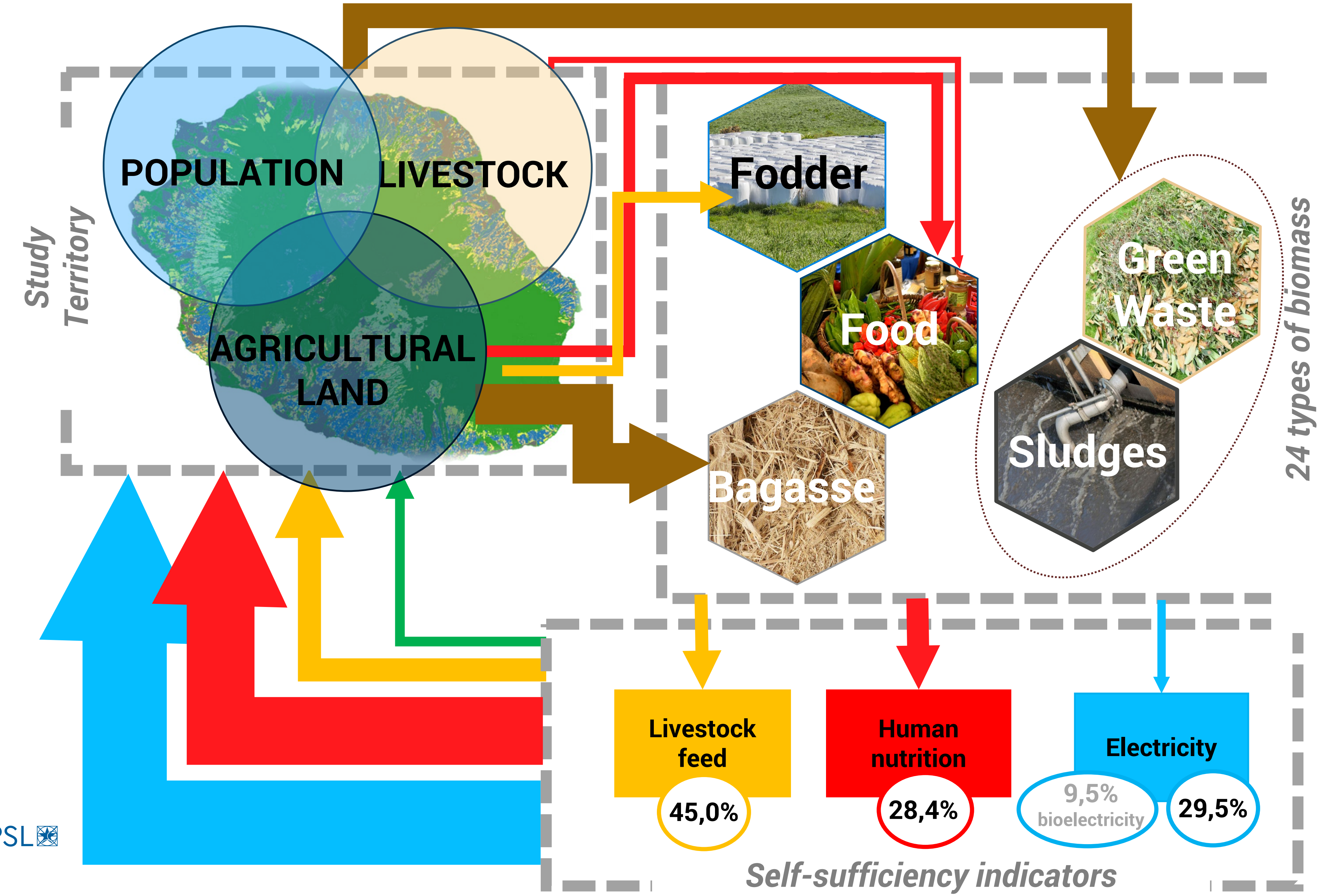
BIOMASS SECTOR

Technologies	Forecast 2028 (MW)	Forecast 2028 (GWh)
Biomass (elec)	470	1500
Gazeification	4	20
Waste	17	230
Methanisation	8	25

- Conversion of thermal power plants to biomass
  - Resources : 500 000 t / year necessary
- Local resources: based on the food model structured by Valentin Russeil

Source : PPE (2022), Horizon Réunion, ADEME (2018), Ministère de l'Économie, des Finances et de la Souveraineté industrielle et numérique (2022)

MODEL LINKING LAND USE AND SELF-SUFFICIENCY



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LOCAL RESOURCES & VALORIZATION

Ressources
Sewage sludge (Municipalities + Industries)
Biowaste
Vinasse
Molasses
Effluents (slurry/manure)
Meat and fish waste

Process
Methanisation
Bioethanol Distillery

Energy Valorization → Biogas / Bioethanol → Electricity

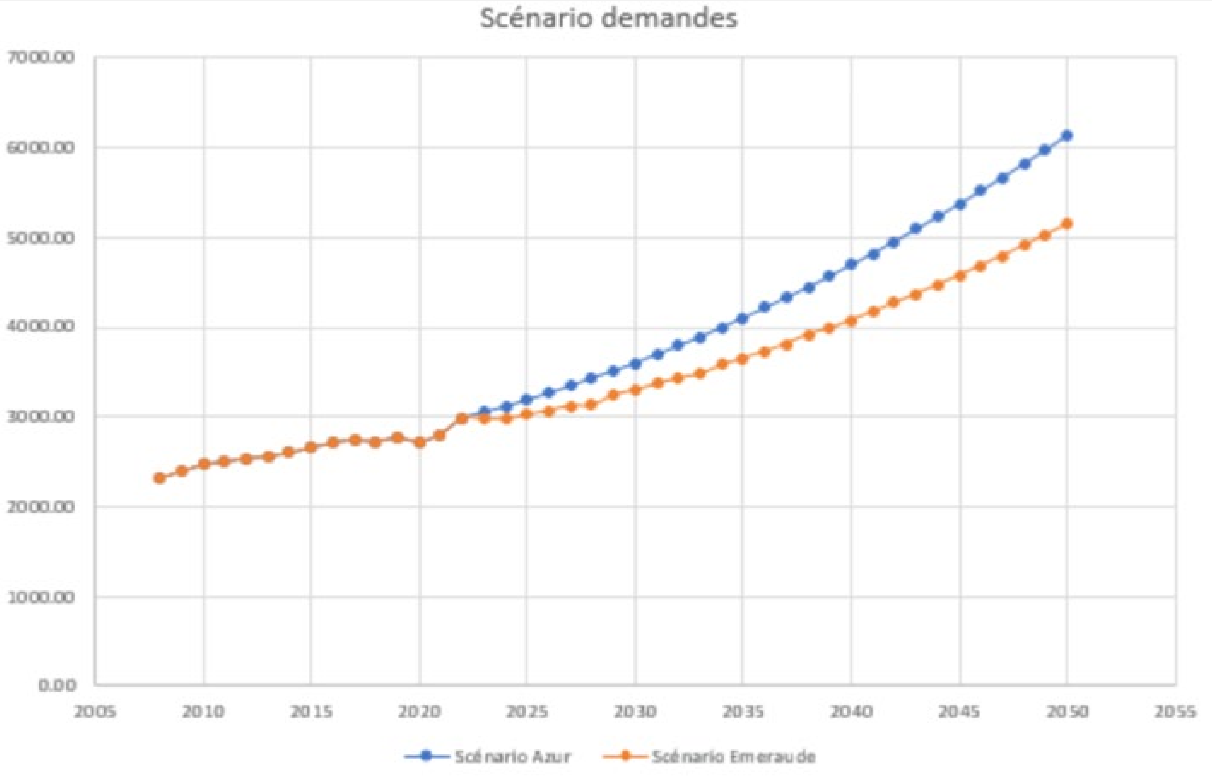
- Gas sector
- Transport

Ressources
Bagasse
Cane fiber
Cane straw
Fuel wood / pallets

Process
Combustion
Gazeification

Electric Valorization → Electricity

ELECTRICITY DEMAND TRENDS



- Data from EDF's 2022 Forecast Report
- Extrapolation from 2038 to 2050

	Population	GDB per capita	EVs
AZUR	High	High	Electrification
EMERAUDE	Basic	Low	High Electrification

Source : EDF, 2022

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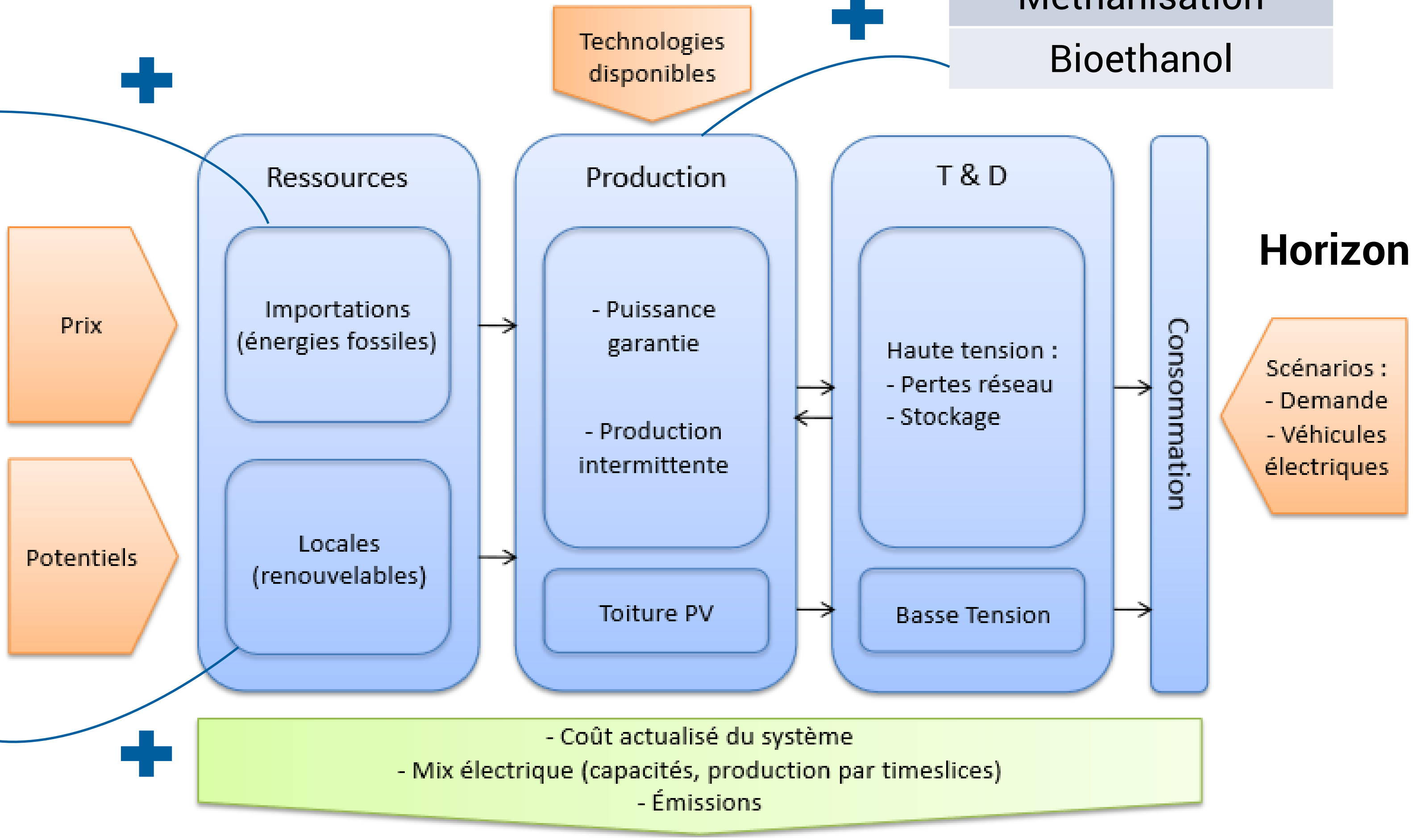
ADAPTED MODEL TIMES-REUNION

Process
Combustion
Gazeification
Methanisation
Bioethanol

Importation
Bioethanol
Biodiesel de Colza
Fuel wood

Ressources
Sewage sludge
Waste
Sugar Cane
Effluents (slurry/manure)



Horizon 2008 - 2050

Model TIMES-Réunion, Source : adapted from Drouineau, 2011

III- SCENARIOS ELABORATION

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LONG-TERM SCENARIOS

Scenario	Description	Constraints	Elec. Demand
BAU	Linear extrapolation of current spatial dynamics	- Authorized coal and fuel oil - PV linear extrapolation	Azur
ALIM	Territorial planning policies in favor of food self-sufficiency	-Multiannual Energy Program objectives (MEP) - No Ground-mounted PV	Emeraude
BIOELEC	Land and biomass preferentially oriented towards bioelectricity	- MEP Objectives - Methanisation & Gazeification • Subventions 10-20 %	Emeraude
PLAN	Combination of the two objectives	- Objectifves MEP & Regional Biomass Plan - No Ground-mounted PV - Methanisation & Gazeification • Subventions 10-20 %	Emeraude

IV- RESULTS

TIMES-REUNION

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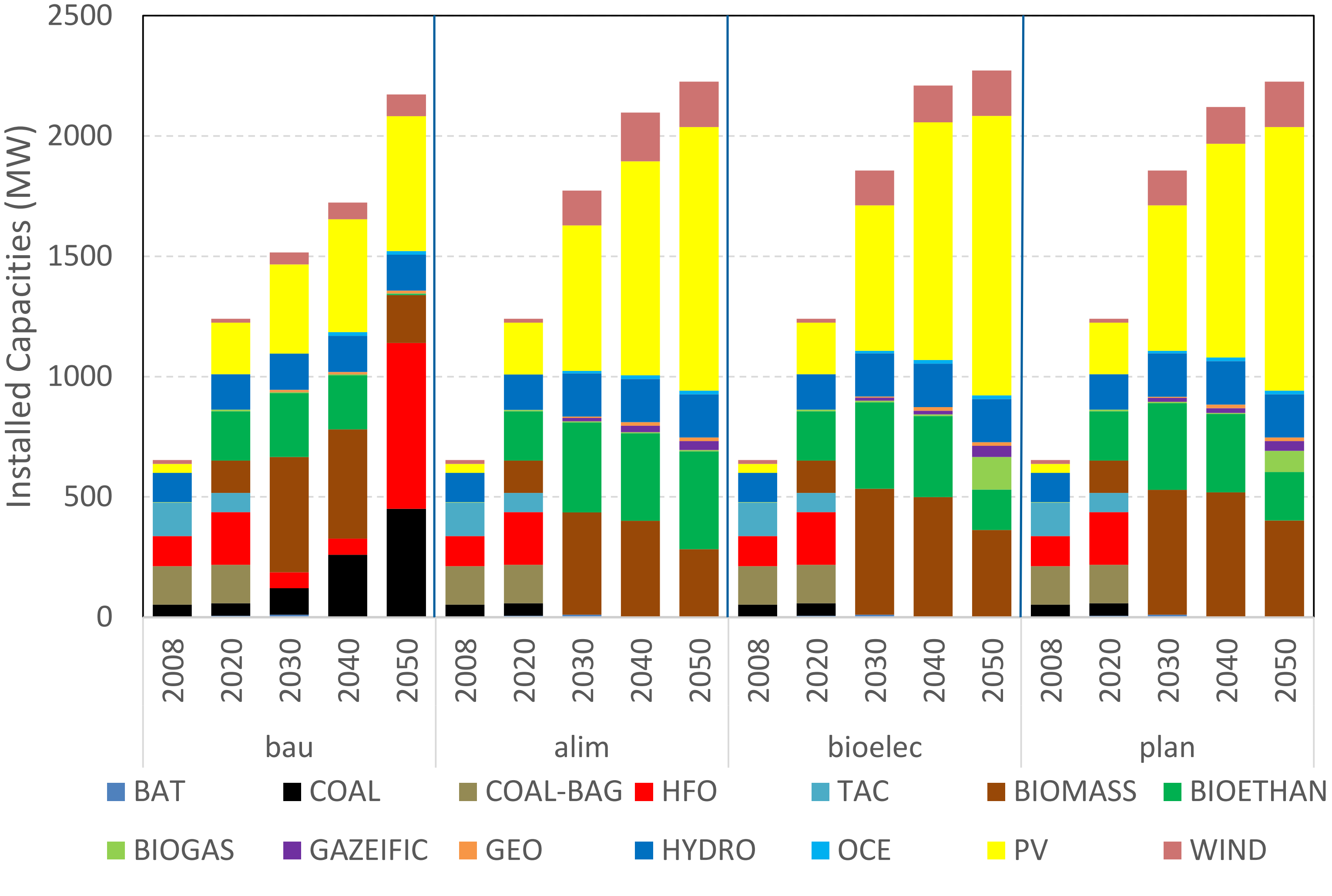
EVOLUTION OF THE POWER MIX



KEY ELEMENTS FOR 2050

Capacities (MW)

	BAU	ALIM	BIOELEC	PLAN
BIOETHAN	0	405	170	200
BIOGAS	4	6	140	90
BIOMASS	200	280	360	400
GAZEIFIC	0.2	35	45	40

Electricity production (GWh)

	BAU	ALIM	BIOELEC	PLAN
BIOETHAN	8	1350	420	500
BIOGAS	15	4	190	120
BIOMASS	830	0	1600	1720
GAZEIFIC	1.6	290	270	230

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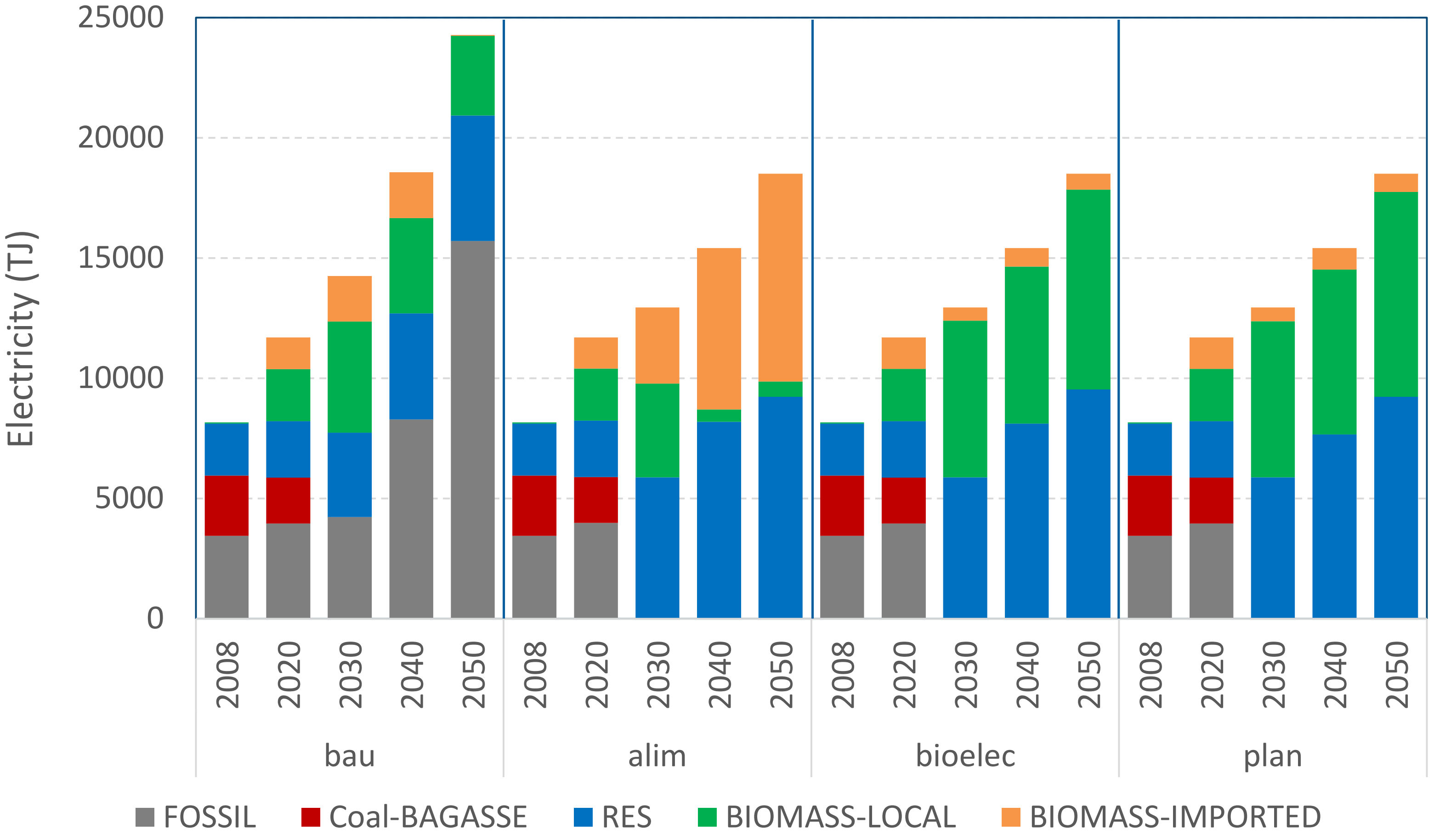
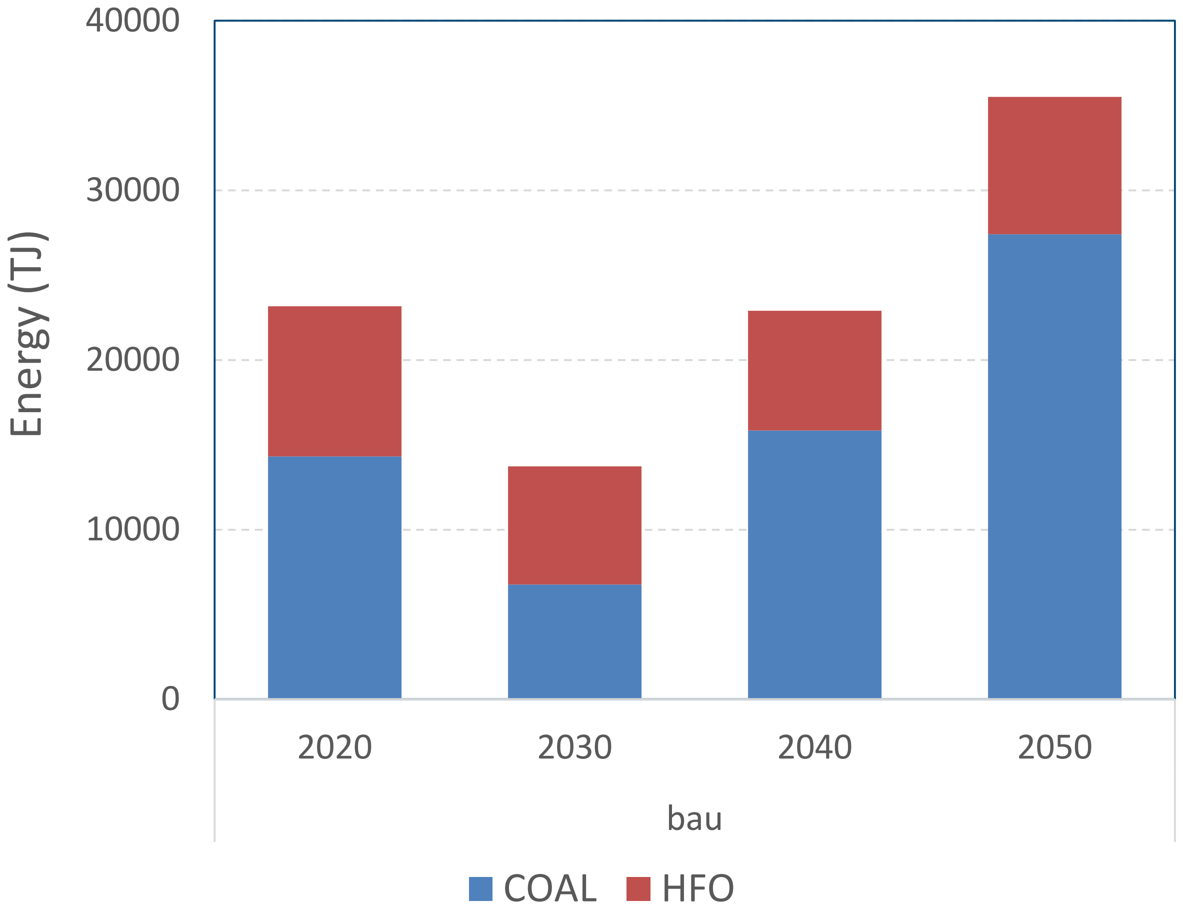
ELECTRICITY GENERATION BY TYPE

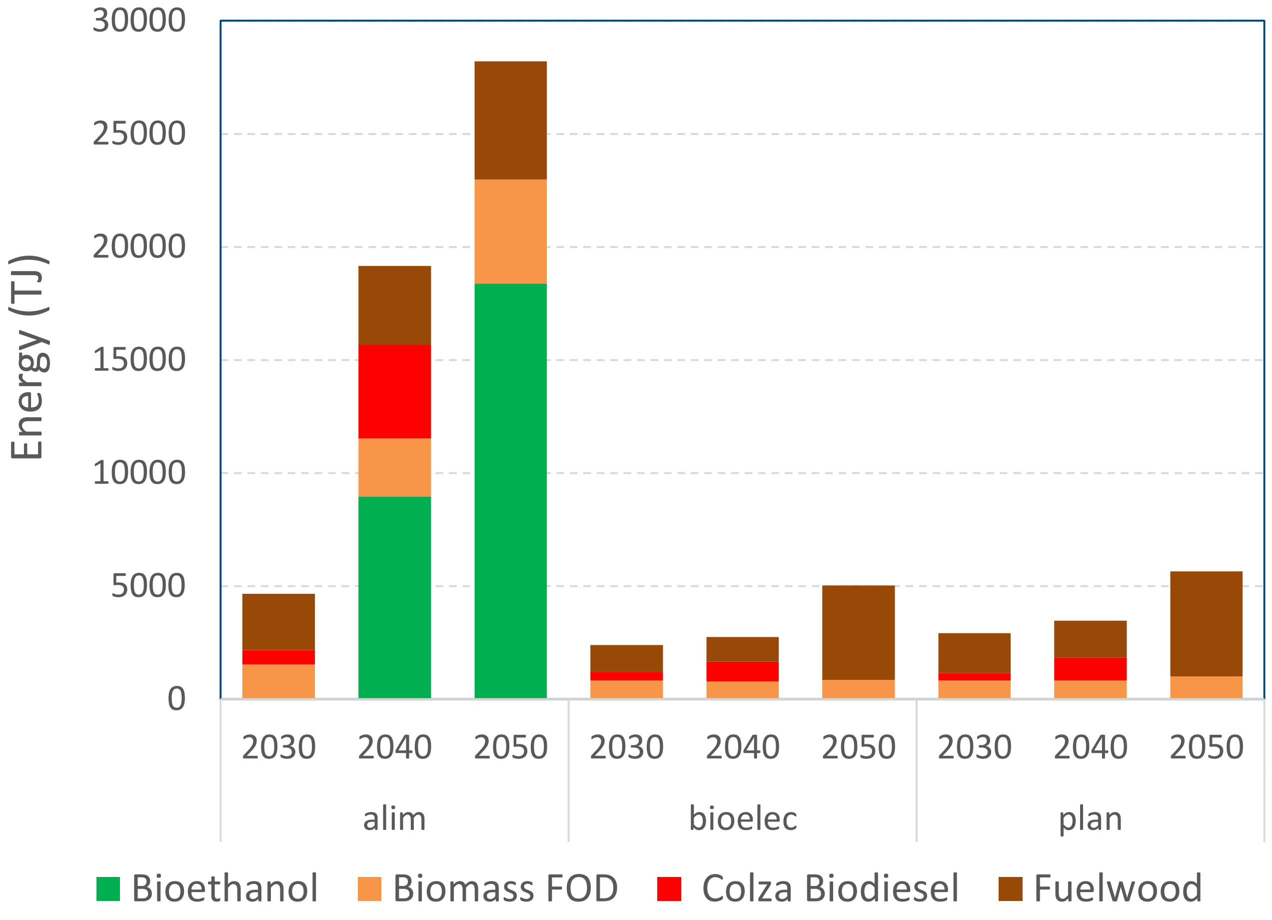


KEY ELEMENTS FOR

Scenario	RES	BIO-LOCAL	BIO-IMPORT
BAU	22 %	13 %	0 %
ALIM	50 %	3 %	47 %
BIOELEC	52 %	45 %	3 %
PLAN	50 %	46 %	4 %

RESOURCES IMPORTS





V- CONCLUSIONS
& discussion

CONCLUSIONS

- Reunion Island is facing a crucial challenge in terms of the future of its territorial development.
- The choice between energy and food self-sufficiency is crucial to the evolution of the electricity mix and the energy imports.
- The results of TIMES-Reunion show that the biomass sector can cover a significant proportion of electricity demand, as can renewable energies.
- The optimal solution is "BIOELEC", as it is the least costly and the least dependent on energy imports.

PERSPECTIVES

- Introduce innovative technologies such as agrivoltaics
- Add the option of new batteries
- Shift to an energy system -> Introduction of gas, heat, transport, etc..

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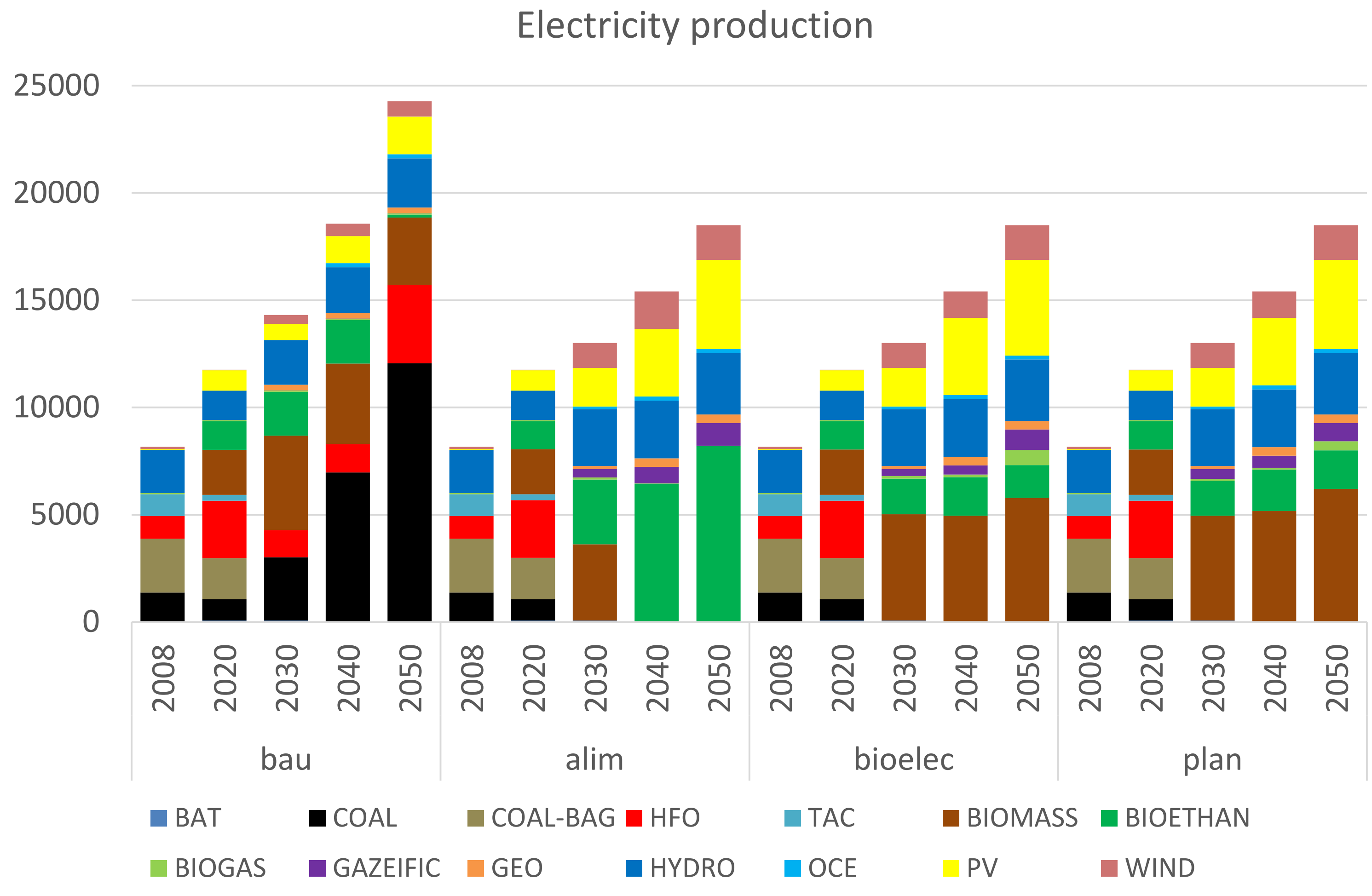
THANK YOU FOR YOUR ATTENTION

ANNEX

Tableau 1 : Couts totaux annualisés du système électrique

Scenario	BAU	ALIM	BIOELEC	PLAN
Objective Function (B€)	8.223	8.644	8.177	8.209

ANNEX



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