

# Modelling the energy transition of the south-east region of France: the role of hydrogen for the integration of variable renewables

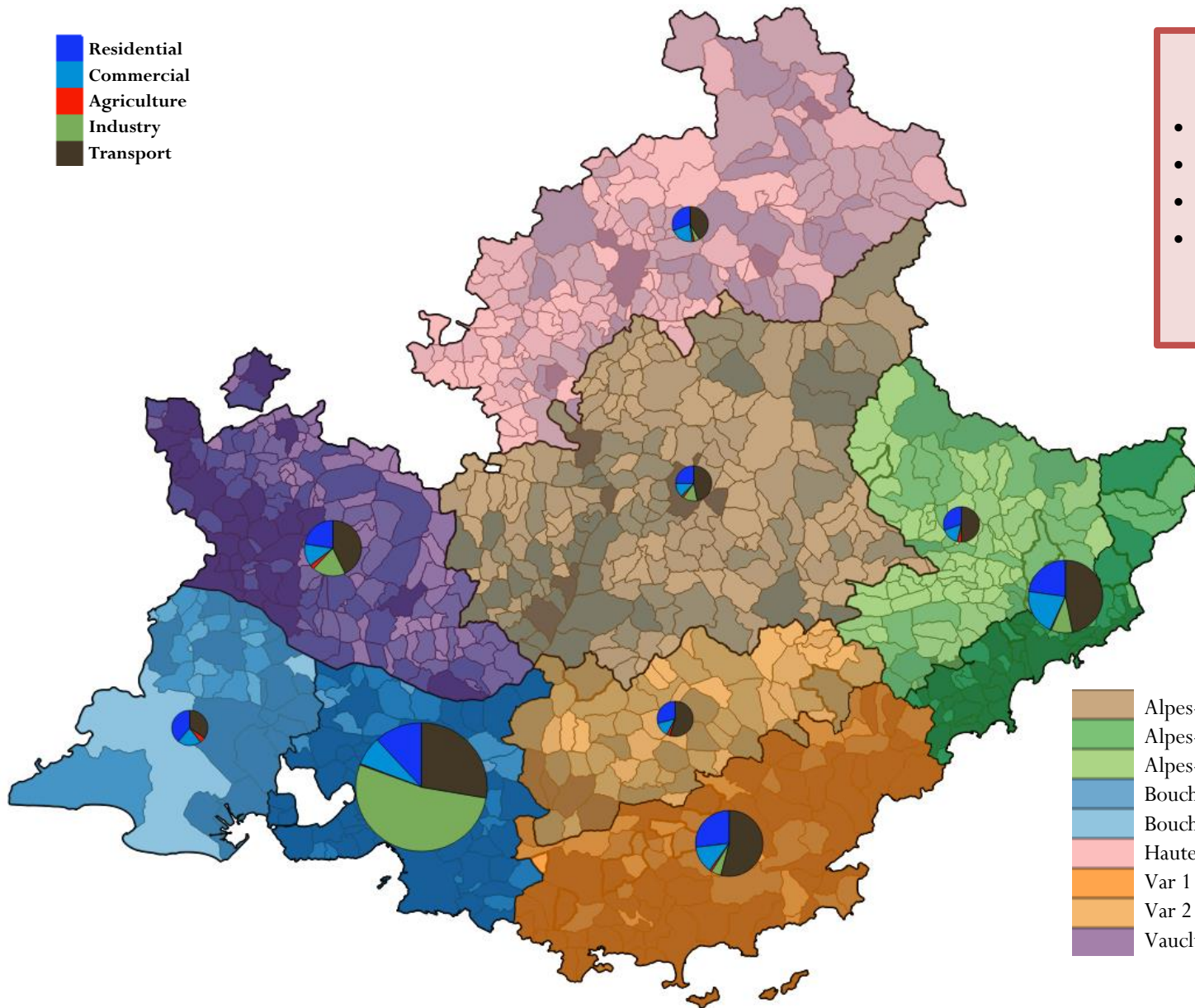
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# Energy demand



- Residential
- Commercial
- Agriculture
- Industry
- Transport

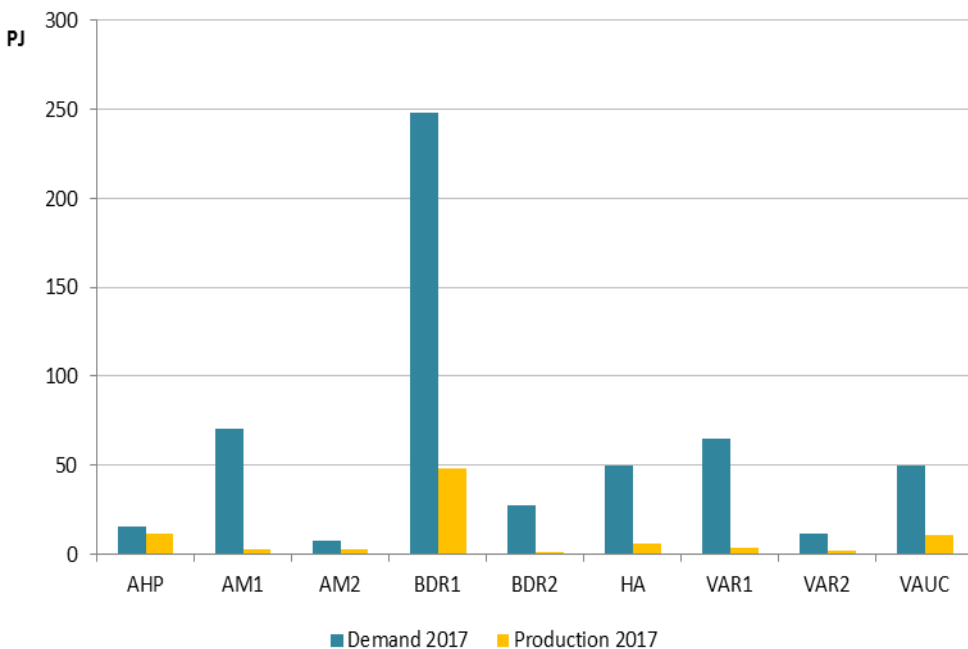


## High energy consumption

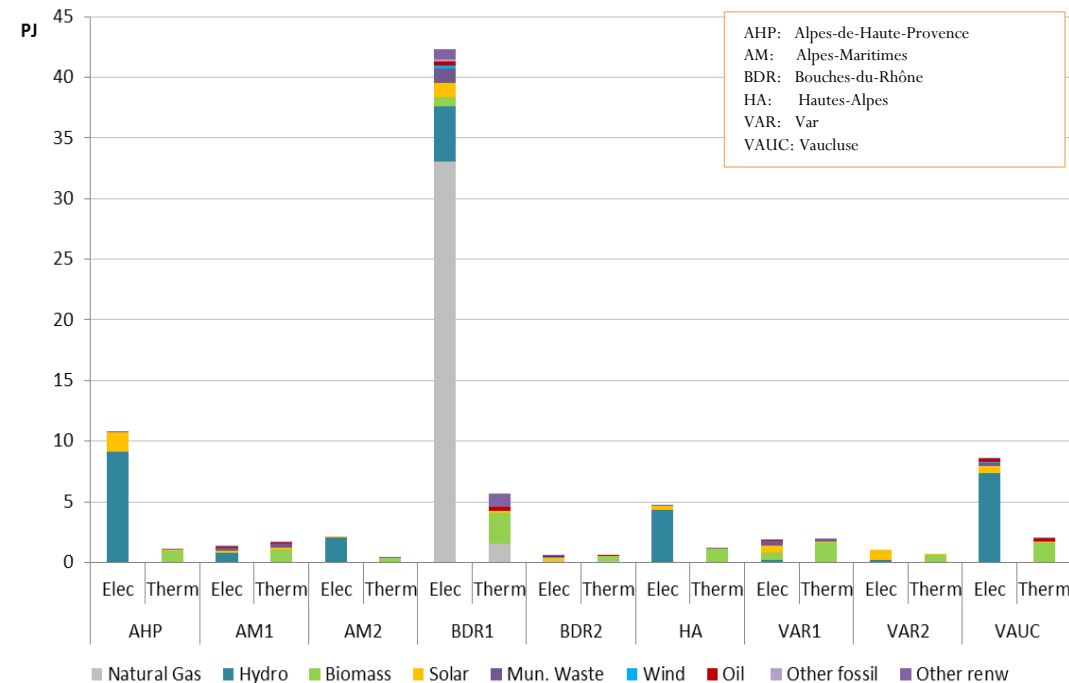
- 12 Mtoe in 2017 (4<sup>th</sup> in France) (509 PJ)
- 65 % fossil fuels
- 30 % electricity
- 80 % of the energy consumption concentrated next to the littoral

# Final energy production by department of the SUD PACA Region in 2017

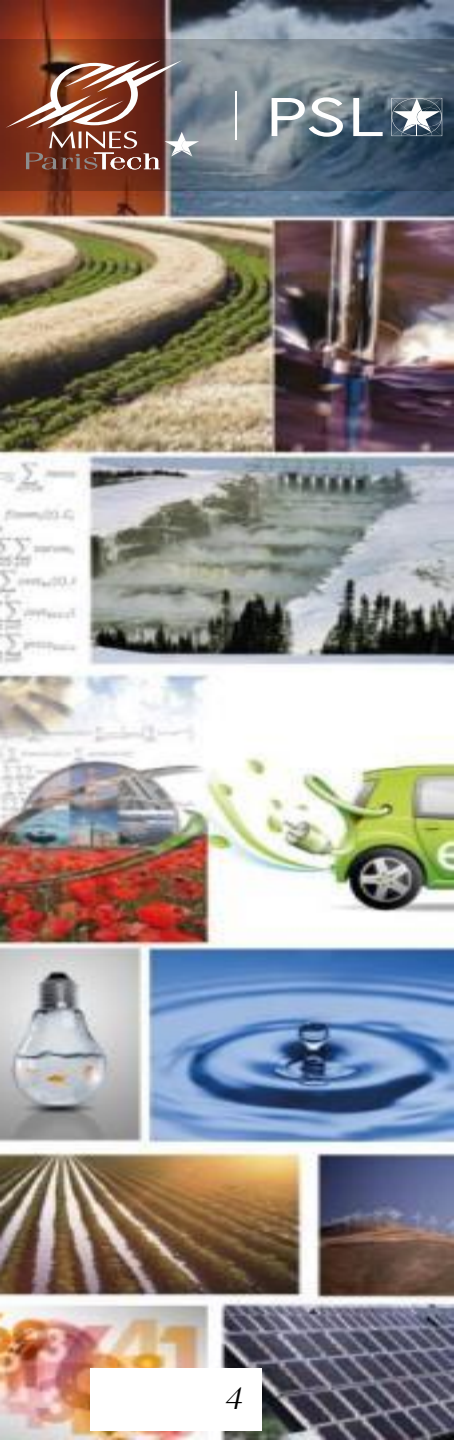
Departments' production vs demand



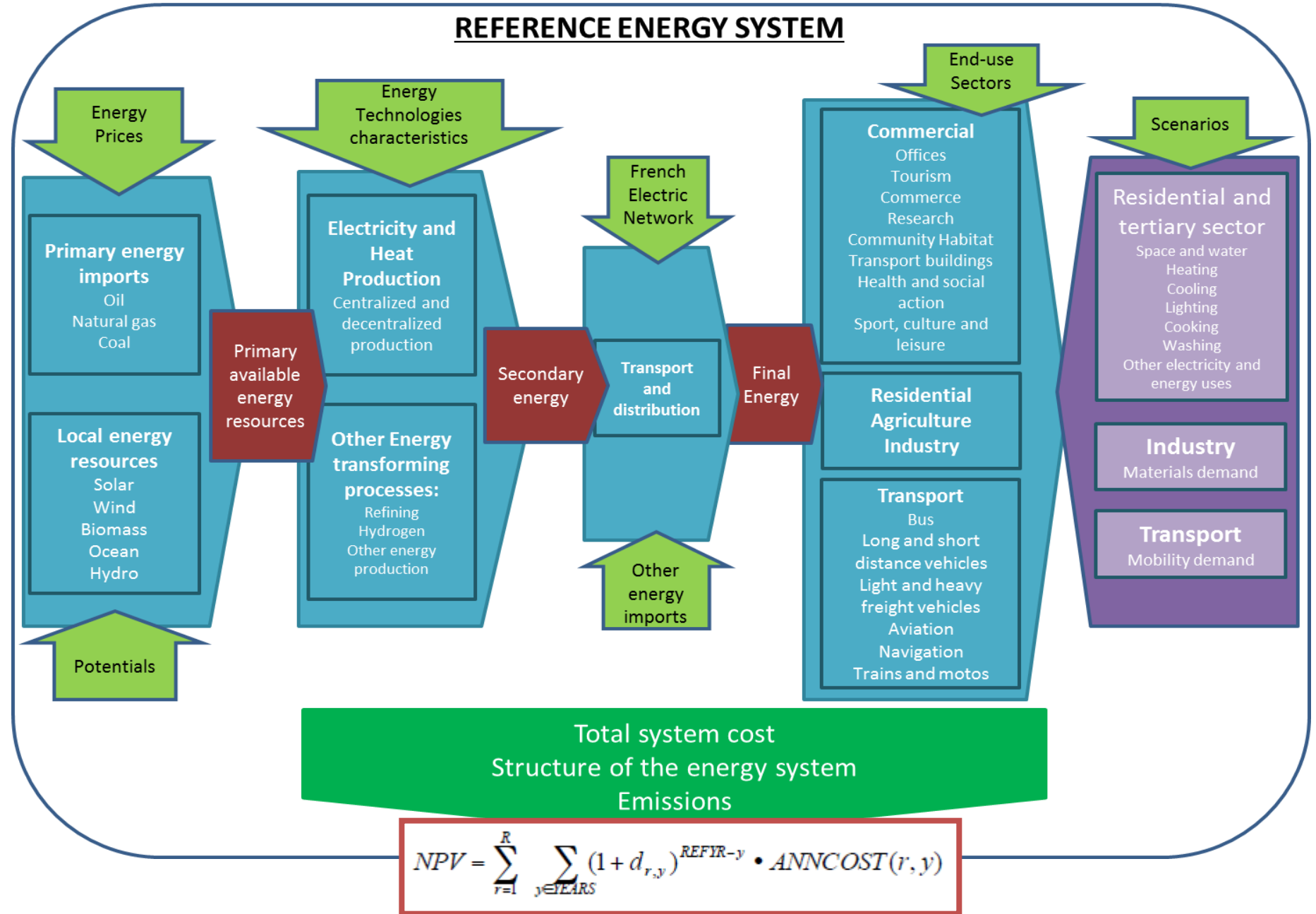
Final energy production



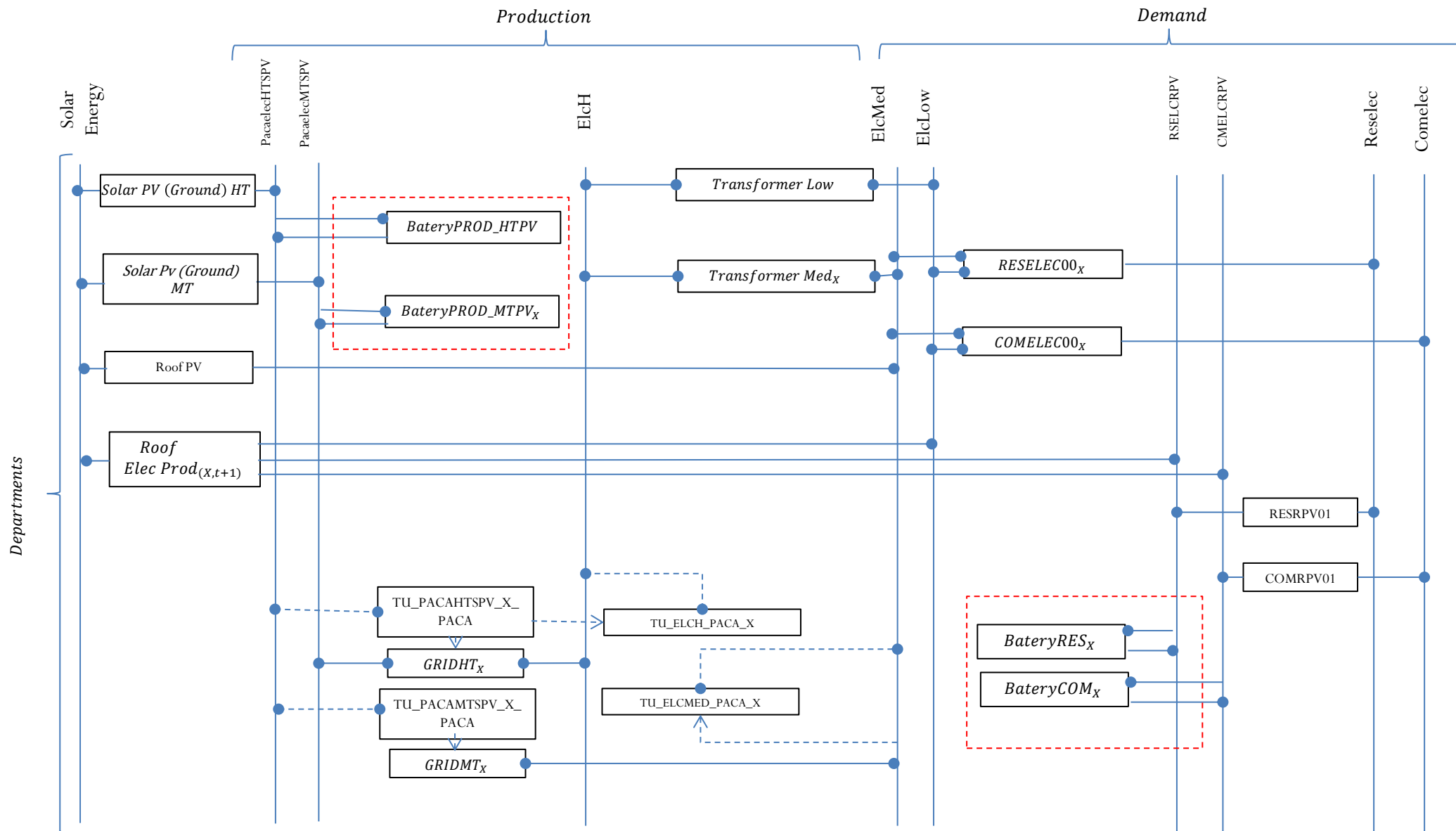
- Low energy production compared to consumption (17 % of the demand)
- Energy production mainly comes from fossil fuels (46 %)
- Production concentrated in the BDR1 (54 %)



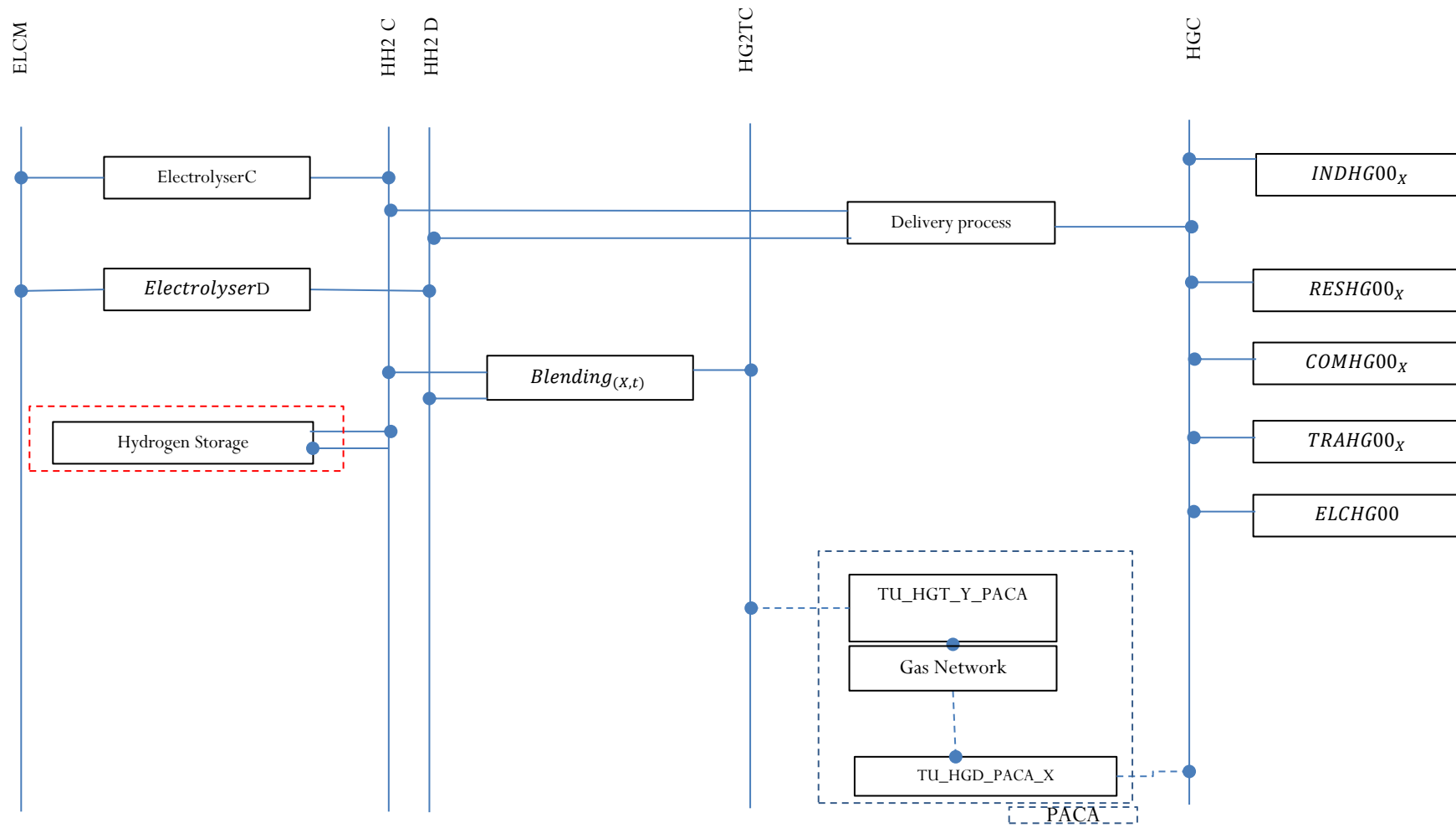
# The TIMES-SUD<sub>PACA</sub> model



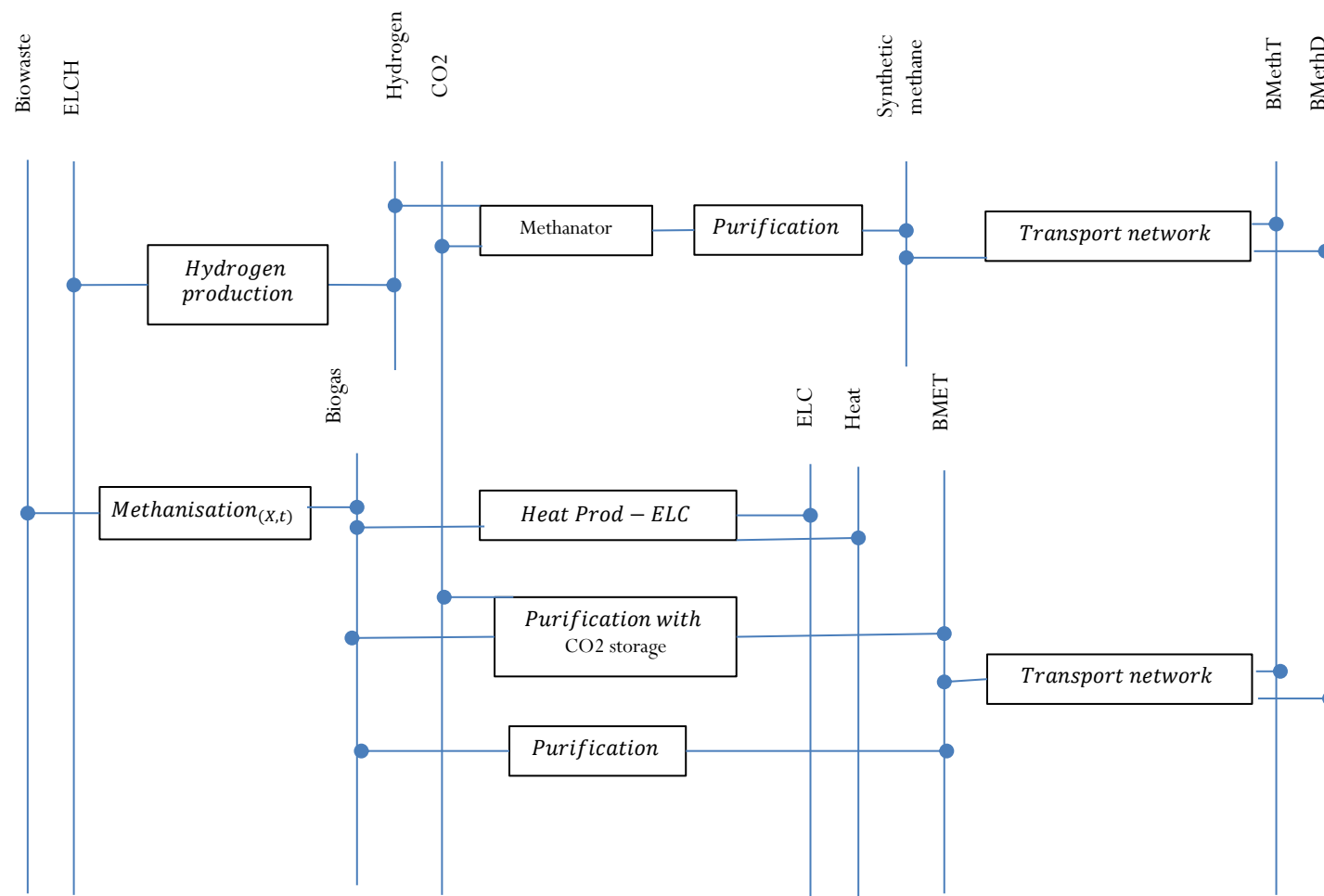
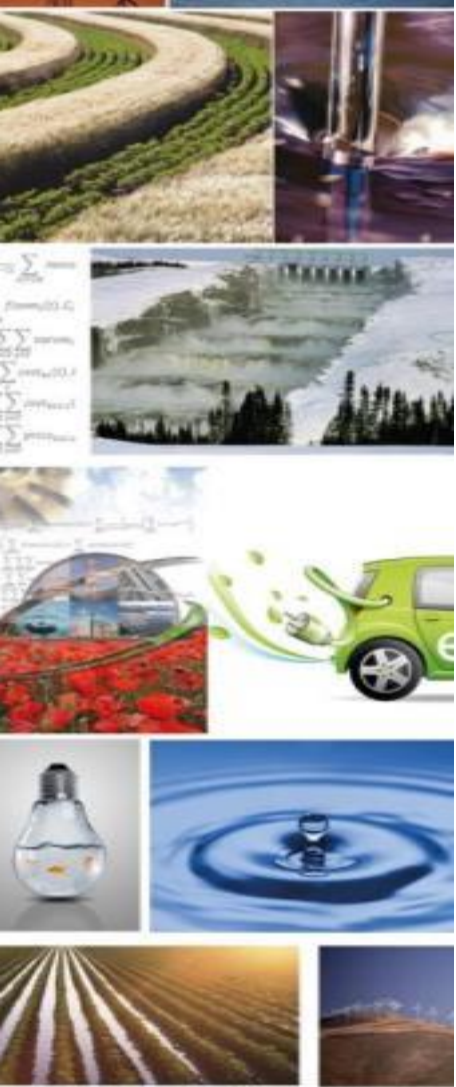
# TIMES-SUD<sub>PACA</sub> model : Electric system



# TIMES-SUD<sub>PACA</sub> model – Hydrogen production



# TIMES-SUD<sub>PACA</sub> – biogaz production



***SER - biogas production***

# The scenarios

**1. Reference (RF) :** What is the optimal solution found by the model based on local energy potentials. No new technologies allowed



Demand follows past trends

**2. SRADDET (SR):** Integrates the main strategies proposed by the region in terms of energy production



The region targeted a 30 % demand reduction for 2050



**3. New technologies (NT):** How the use of hydrogen and other power-to-gas technologies can transform the energy system



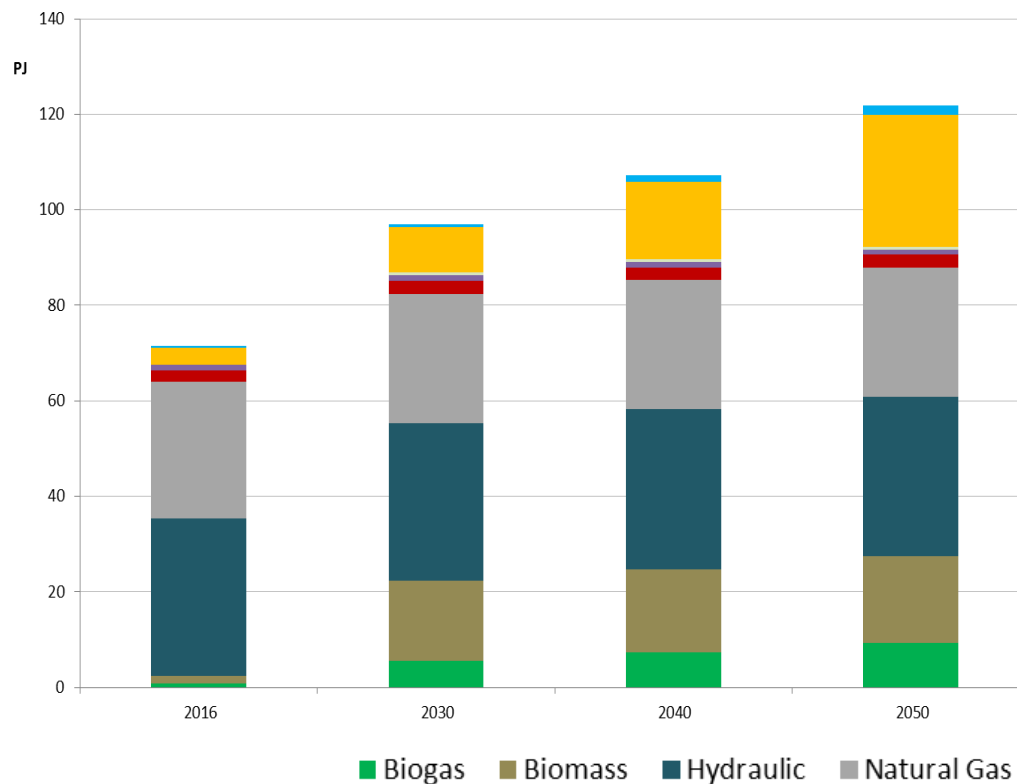
Production (MW)		2012	2020	2025	2030	2050
Electricity	Hydroelectricity	3 073	3 756	3 929	3 956	4 100
	Wind	45	557	1068	1597	3305
	Solar	596	6912	9779	11730	46852
	Biomass	0	141	172	172	172
Thermal	Heat recovery	1199	2 749	3 611	4 300	6546
	Solar thermal	20	509	781	998	2065
	Biomass	80	352	514	650	1283
	Methanisation	14	71	162	267	570
	Gasification	0	55	153	267	586
TOTAL		5 027	12 353	16 558	19 637	65 479

Intermittent renewables represent around 75 % of the established electricity capacity in 2050

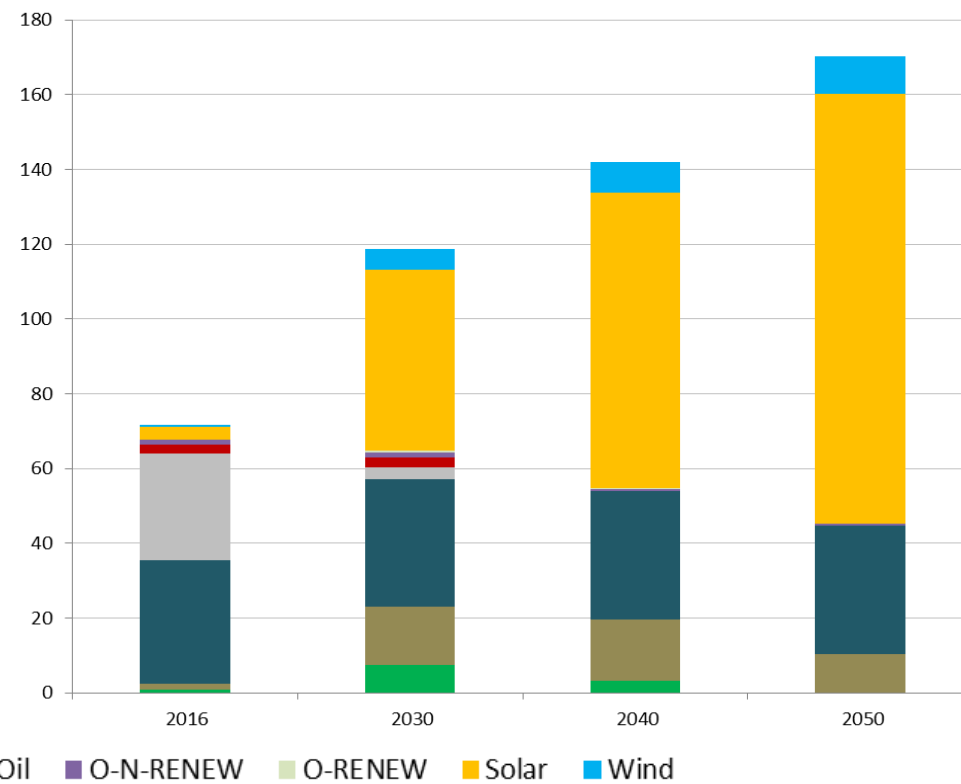


# Possible pathways – Power production

Reference scenario - RF



Scenario SRADDET - SR

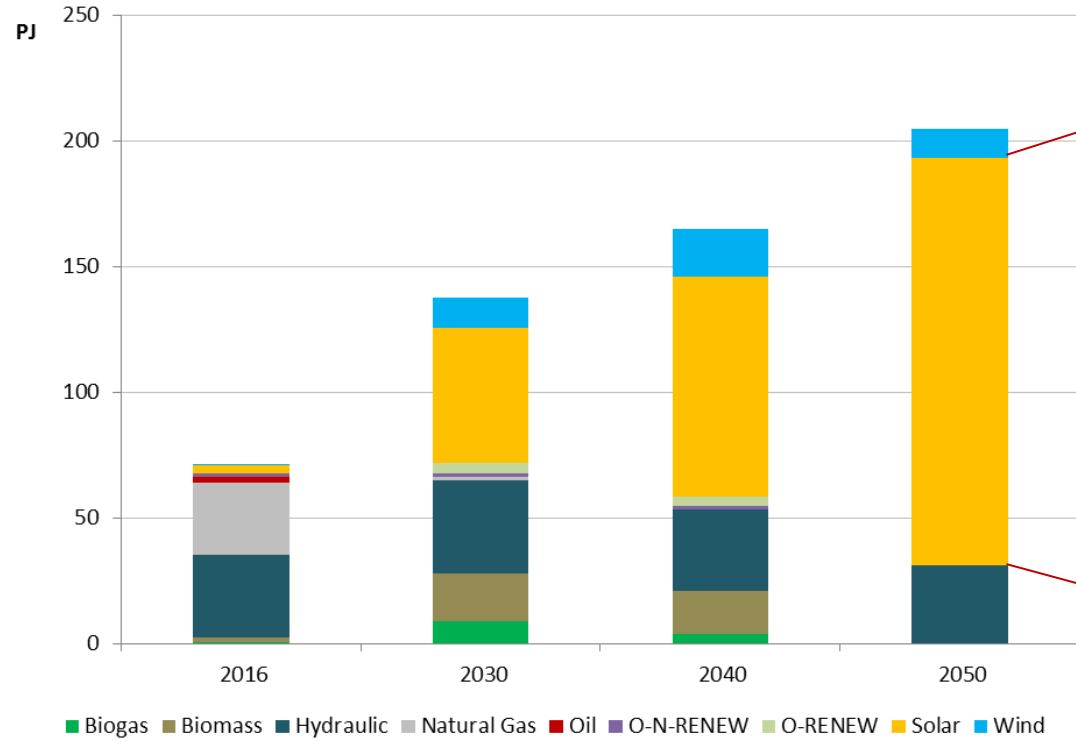


- In 2050, renewable energies represent **75 %** of the total power production in the RF, while in the SR there is no power production coming from fossil fuels.
- Bioenergies are used to produce **23 %** of the electricity in the RF, and just **6 %** in the SR.
- Solar energy represents **68 %** in the SR, and **23 %** in the RF.
- Production in the SR is **30 %** higher than in the RF

# Possible pathways – Power production



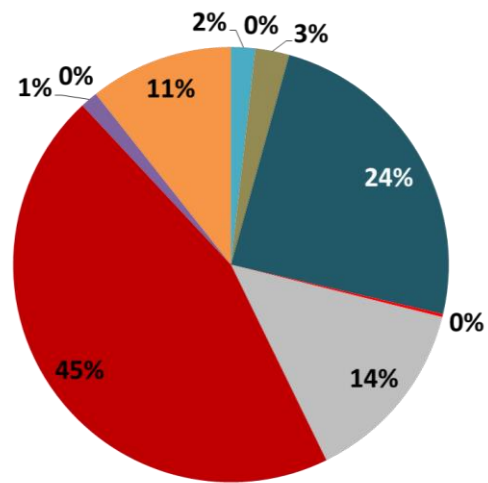
New technologies scenario



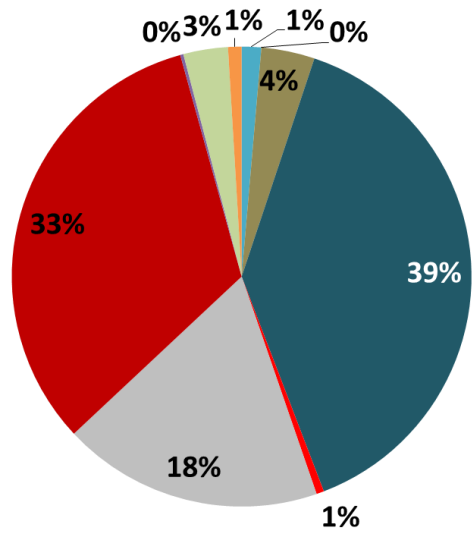
- Production is 20 % higher than the SR:
  - Higher electricity demand due to the hydrogen production
  - Decrease of electricity coming from the rest of France

# Final energy consumption

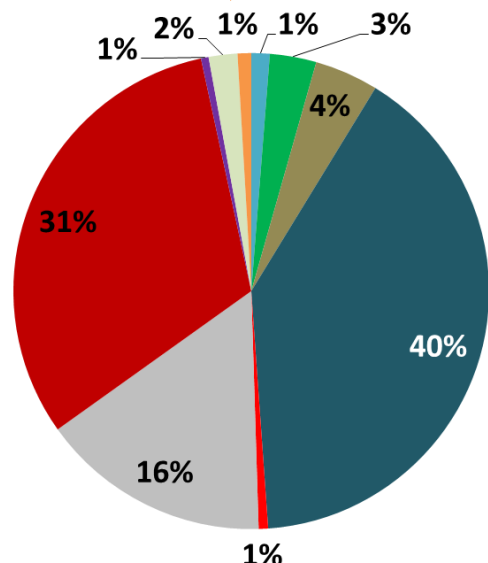
2016



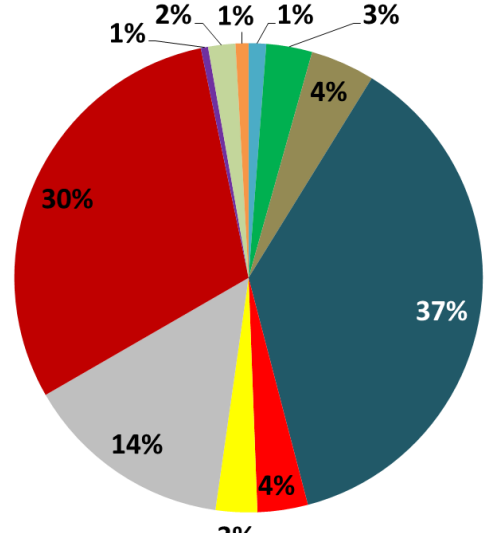
2050



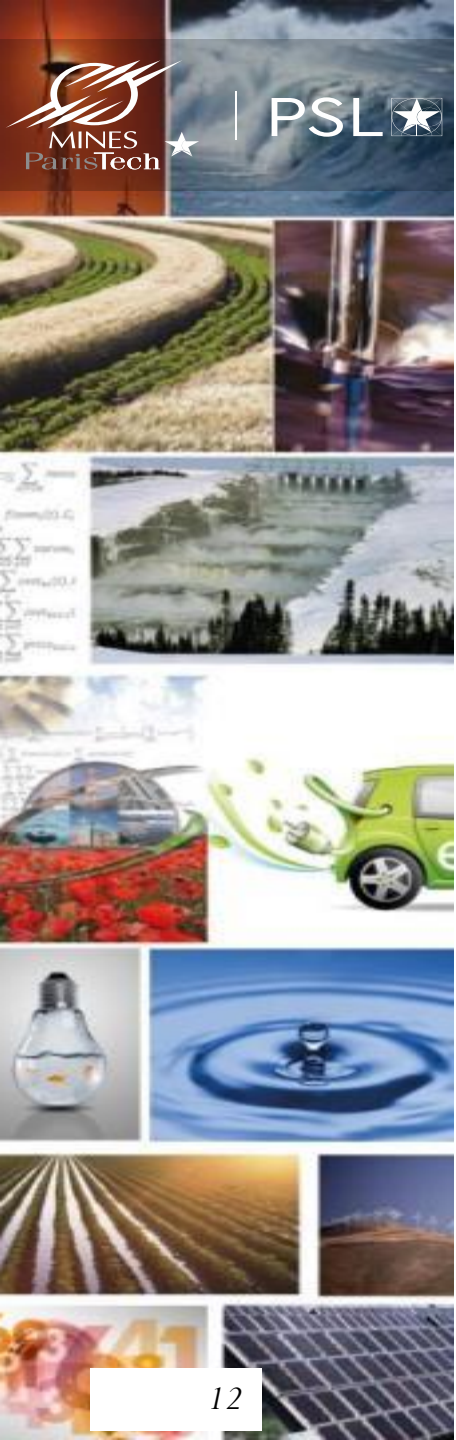
Reference scenario



SRADDET



New technologies

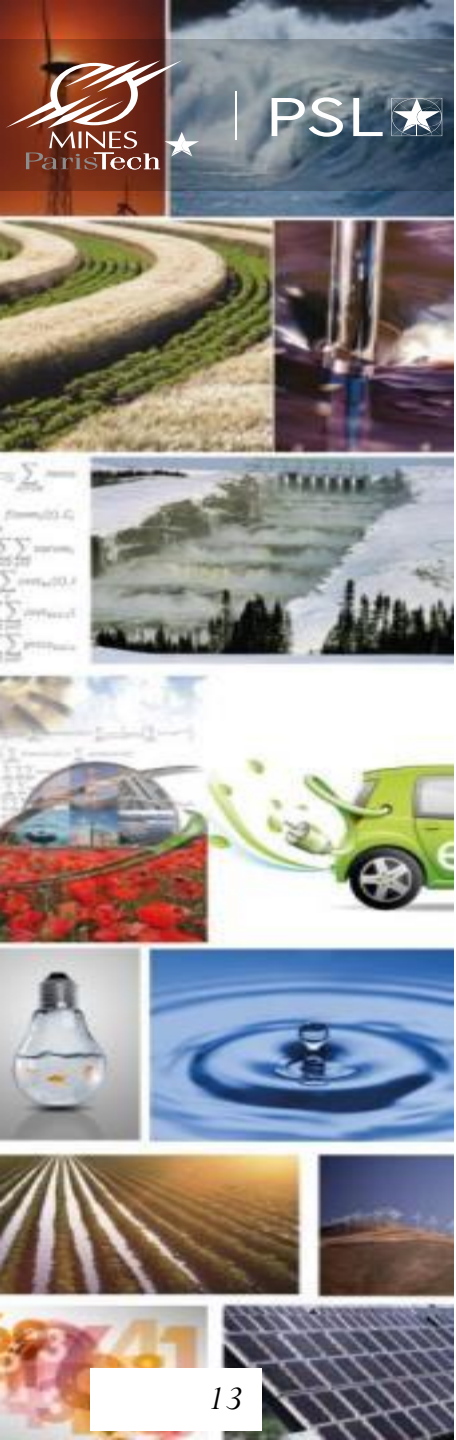


# Hydrogen consumption in 2050



Around 20 PJ  
consumed in  
2050

- Habitat: Heating 68 %
- Industry – steam production 31 %
  - Chemical
  - Food & beverages
  - Other industries
- Transport 1 %
  - Buses
  - Private vehicles



## Conclusion

- The region is in the path towards the decarbonization of its energy system, with the decrease of fossil fuels consumption and the development of clean technologies
- Further efforts are needed in order to increase the part of cleaner technologies in final consumption, and reach the objectives established by the region
- The integration of power-to-gas technologies seems to be a key factor in the path towards an energy transition of the energy system of the SUD PACA region



# THANKS FOR YOUR ATTENTION

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