



ASSESS THE TRANSITION TO A CIRCULAR ECONOMY FOR THE ENERGY SYSTEM: LONG-TERM ANALYSIS OF THE CASE OF THE SOUTH-EST REGION OF FRANCE

17 June 2021

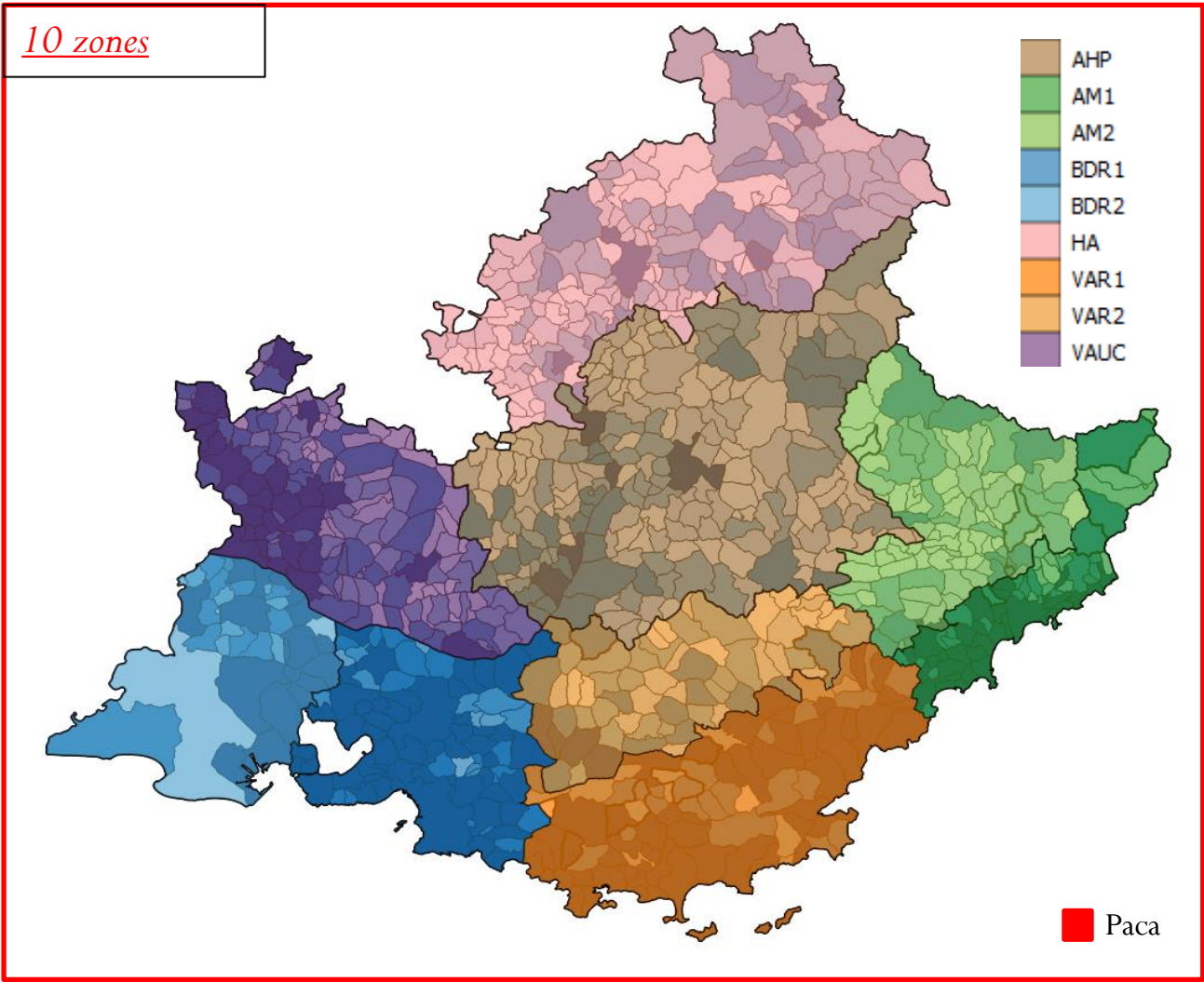
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Context



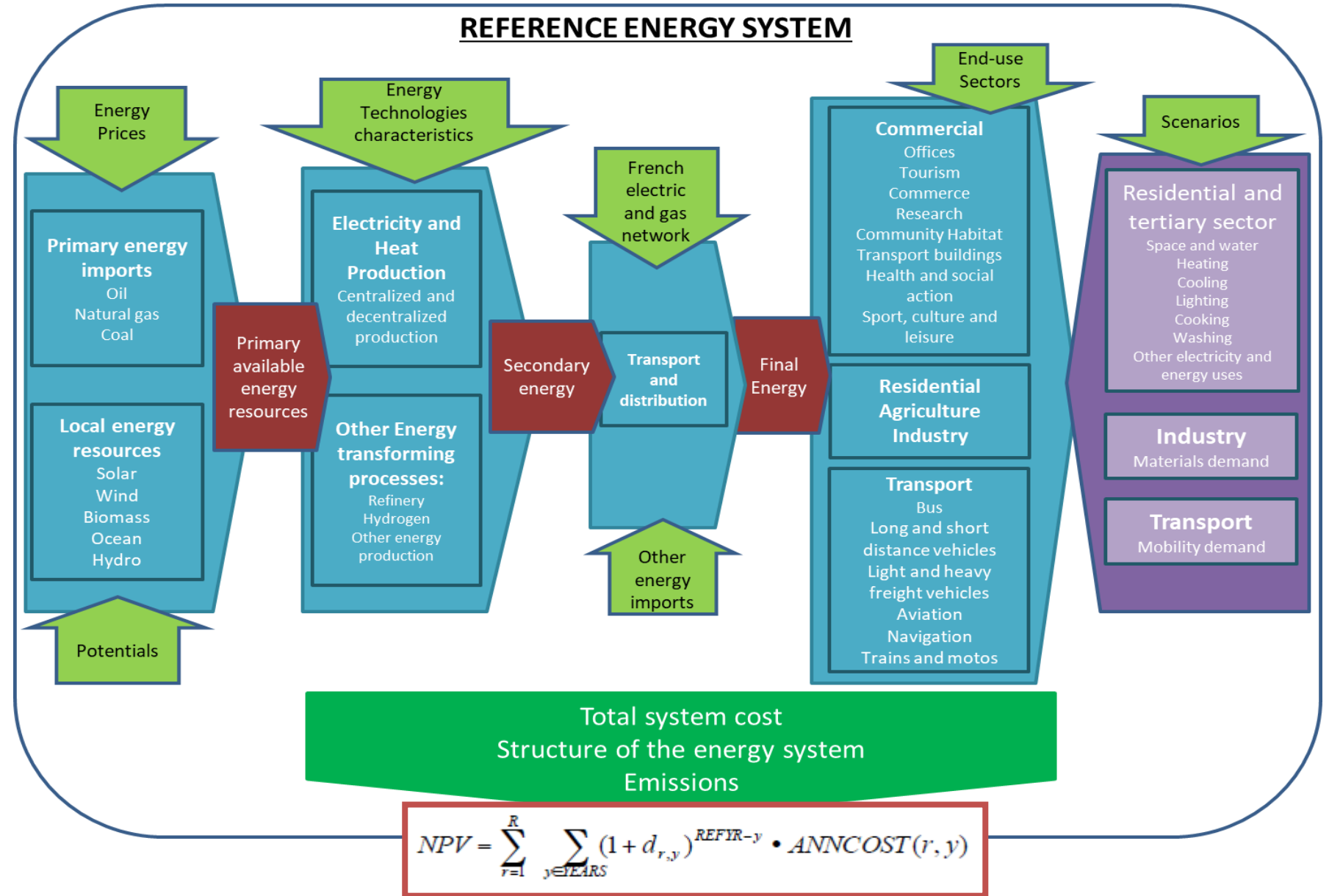
- Objective: Analyze, through a prospective model, the options for low-carbon energy transition and circular economy in the SOUTH PACA region
- Main questions:
 - Integrate circular economy issues into the region's energy system long-term model
 - Evaluate the region's energy-climate policies
 - How to transform the various national guiding documents into regional energy policies?
 - Where and how to develop renewable energy potentials?
 - How the region can contribute to national decarbonisation goals?

Model structure

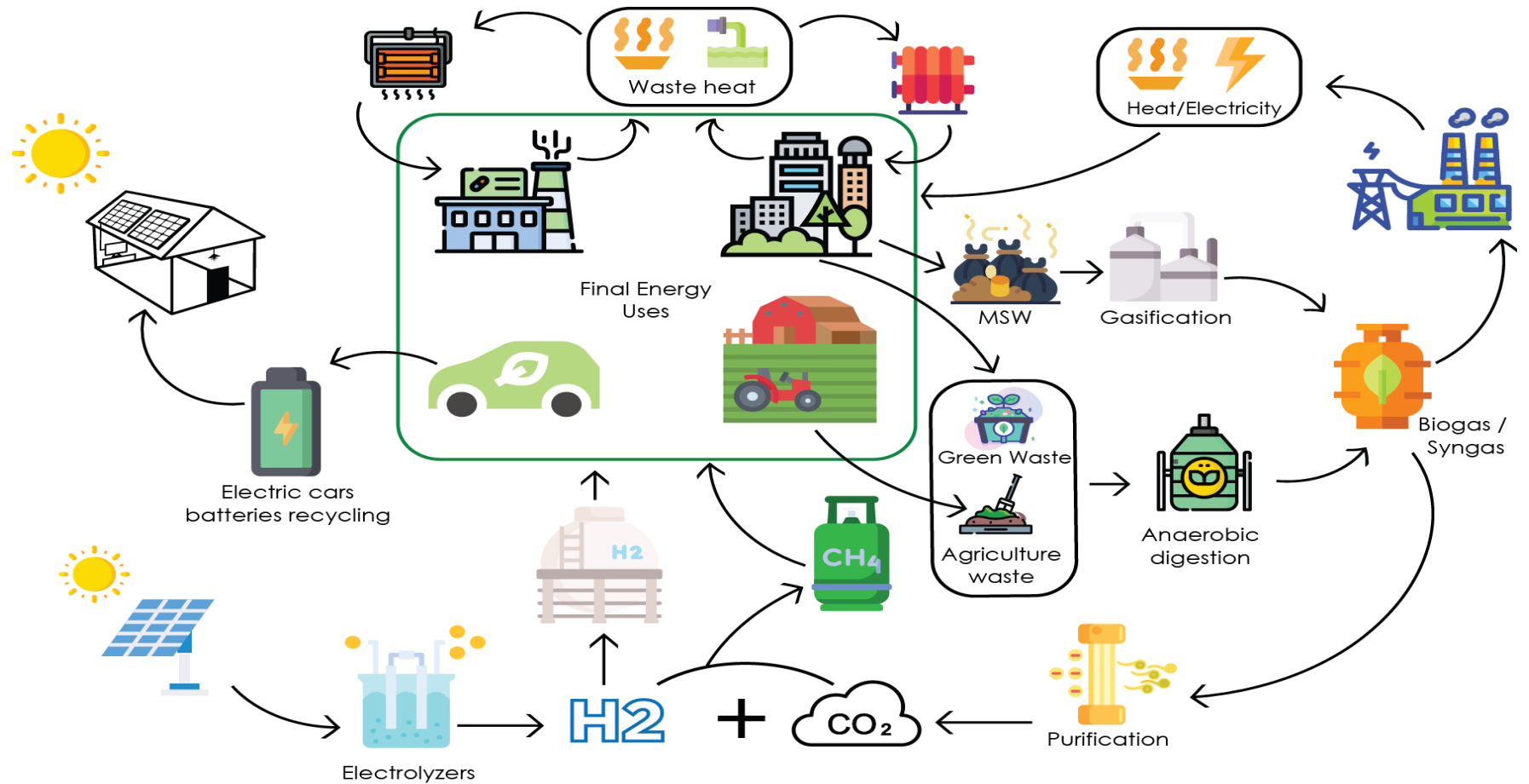


- Departments-zones
- Electricity production by sector
 - Consumption by sector of activity and by type of demand (housing, transport, industry, agriculture)
 - Potentials of renewable energies
- PACA
- Power and gas networks
 - Energy exchange hub
 - Aviation consumption
 - Transport consumption (not coming from the PACA region: 15% of the consumption of private vehicles; 22% of heavy goods vehicles)
 - Refinery

TIMES SUD PACA model



The perspective of the circular energy system for the SUD PACA region

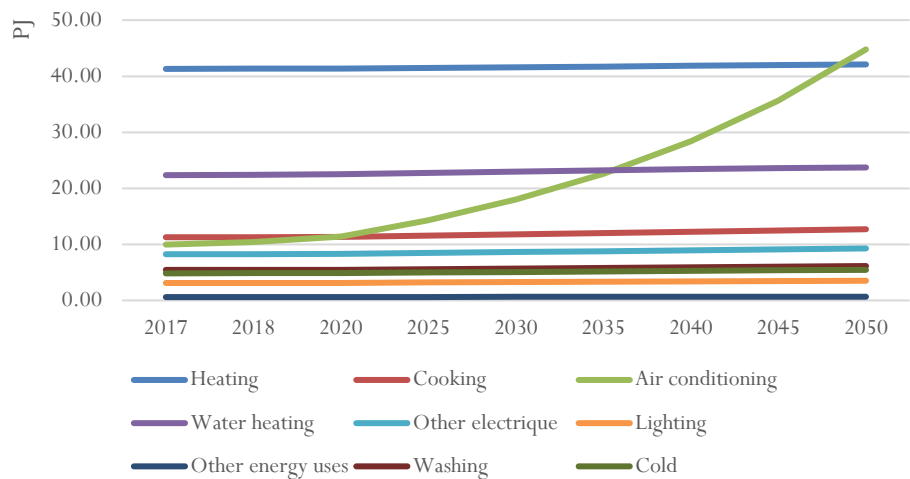


A circular energy system wants to **dissociate environmental impact from energy system's activity** by **redesigning the way of consuming, and producing**, through the application of the 4 R's namely "**reduce, reuse, recycle and recover**", always seeking to **minimize the consumption of energy resources**, and looking towards producing **zero waste and pollution**, with a **systemic approach** at the moment of its implementation.

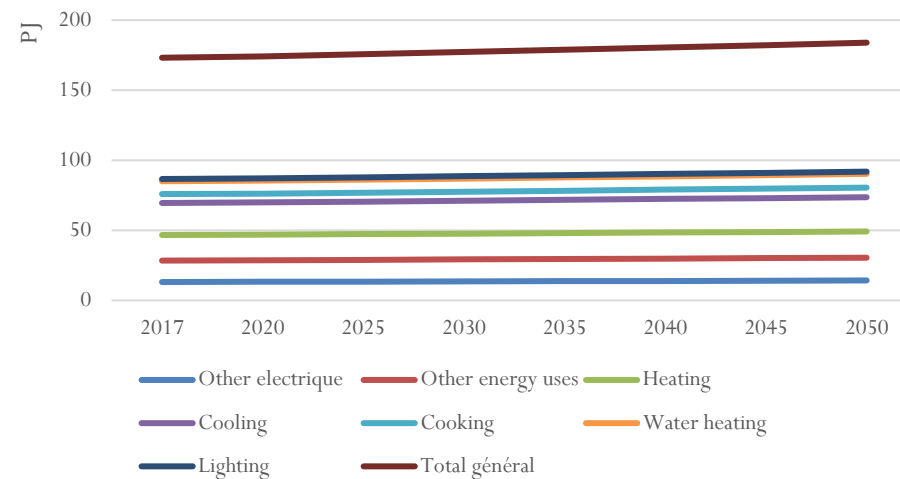
Scenarios - the demand



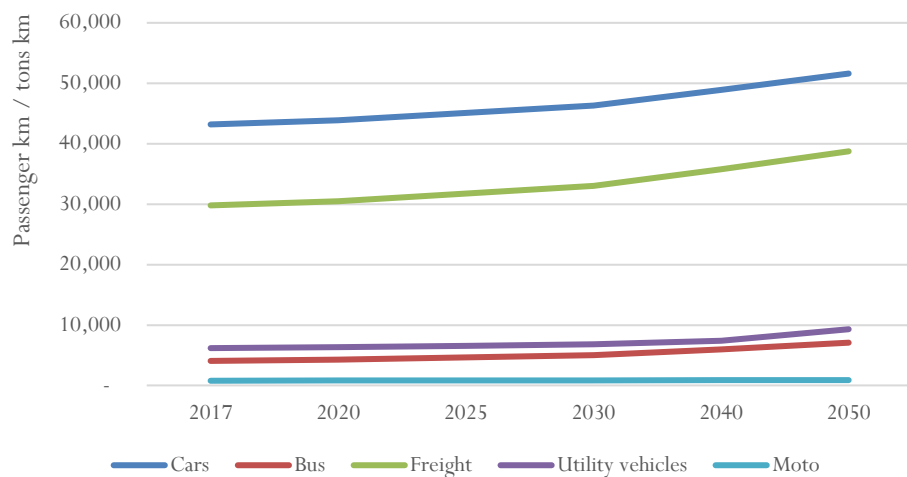
Residential



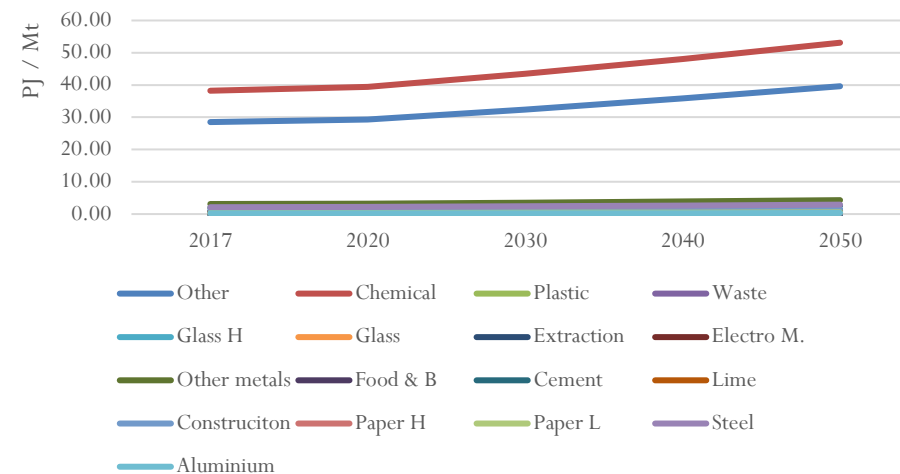
Commercial



Transport



Industry



The scenarios

- Reference : This scenario aims to explore the evolution of the energy system according to trends, which take into account policies established in the region and France before the base year
- Sraddet : How the policies proposed by the SUD PACA region will shift the development of the regional energy system
- Circular economy : Evaluate how integrating a circular economy perspective can shift the development of the energy system of the SUD PACA region

Scenarios - Reference scenario: assumptions for the production sector



- Follows trends from past years for energy production and consumption
- Electricity from the French electricity grid is reduced by 15% in 2050
- Gas from the gas network can increase by 10% in 2050
- The region can use 21 PJ (20% of gas consumption in 2017) of bio methane from the French gas network in 2050
- Increased use of gas and electricity in the transport sector
- 50% mobilization of buildings renovation potentials
- Important use of heat recovery technologies in the habitat sector
- Bicycles can cover up to 10% of mobility demand



PJ	Energy	2017	Annual growth	2050
Electricity	Biogas	0.84	1.00%	4.90
	Biomass	1.41	0.50%	2.75
	Wind	0.42	0.00%	0.81
	Hydro	28.65	0.10%	35.00
	Waste	1.53	0.00%	2.30
	Solar	5.51	8.00%	127.97
	Fossil	35.54	0.00%	35.54
Thermal	Biomass	9.92	1.00%	14.43
	Heat pumps	17.00	5%	32.68
	Heat Network	1.43	2.00%	5.22
	Solar thermal	0.64	1.00%	0.88
	Fossil	2.32	0.00%	2.32
	Electricite			209.27
	Thermal			57.18

P2G PROJECTS			
Jupiter 1000	1 GW	2020	Electrolysers
	0.02 PJ	2021	Methaners
HYGREEN	12 MW	2025	Electrolysers
	435 MW	2030	
Valhydate	7500 t/an	2025	Waste hydrogen valorisation
HynoVAR	7	2030	Hydrogen bus
	404 kg/j	2030	Hydrogen production
HyAMMED	8	2025	Hydrogen freight vehicles

Scenarios – SRADDET: supply assumptions

- No new fossil power plants
- Electricity from the French electricity grid is reduced by 50% in 2050
- Gas from the gas network can increase by 10% in 2050
- Increased use of biogas and biomethane
- 100% mobilization of buildings renovation potentials
- Increased use of gas and electricity in the transport sector
- Higher use of heat recovery technologies in the habitat sector
- Bicycles can cover up to 15% of mobility demand
- Modal share of private vehicles from 1.2 to 1.35

Regional hydrogen plan				
		2027	2032	
Freight transport	units	100	630	
Utility vehicles	units	540	2280	
Buses	units	86	260	
H2 production	tH2/year	16000	28800	
Injection into the gas network	tH2/year	3000	5400	

SRADDET’s Energy production objectives

Production (PJ)		2017	2020	2025	2030	2050
Electricity	Biomass	1.41	2.88	4.42	4.42	4.42
	Wind	0.42	0.99	2.21	2.78	5.40
	Hydro	28.65	29.12	31.02	31.02	33.20
	Solar (ground)	5.51	6.27	8.90	6.57	29.47
	Solar (rooftop)	-	1.30	6.47	20.47	78.57
Thermal	Biomass	9.92	6.67	3.79	4.79	9.38
	Methanization	1.73	1.73	2.19	3.60	7.39
	Gasification	-	0.00	2.06	3.60	7.60
	Solar (thermal)	0.62	0.62	1.74	2.21	4.47
TOTAL		48.27	49.57	62.80	79.45	179.90



Scenarios – Circular energy system

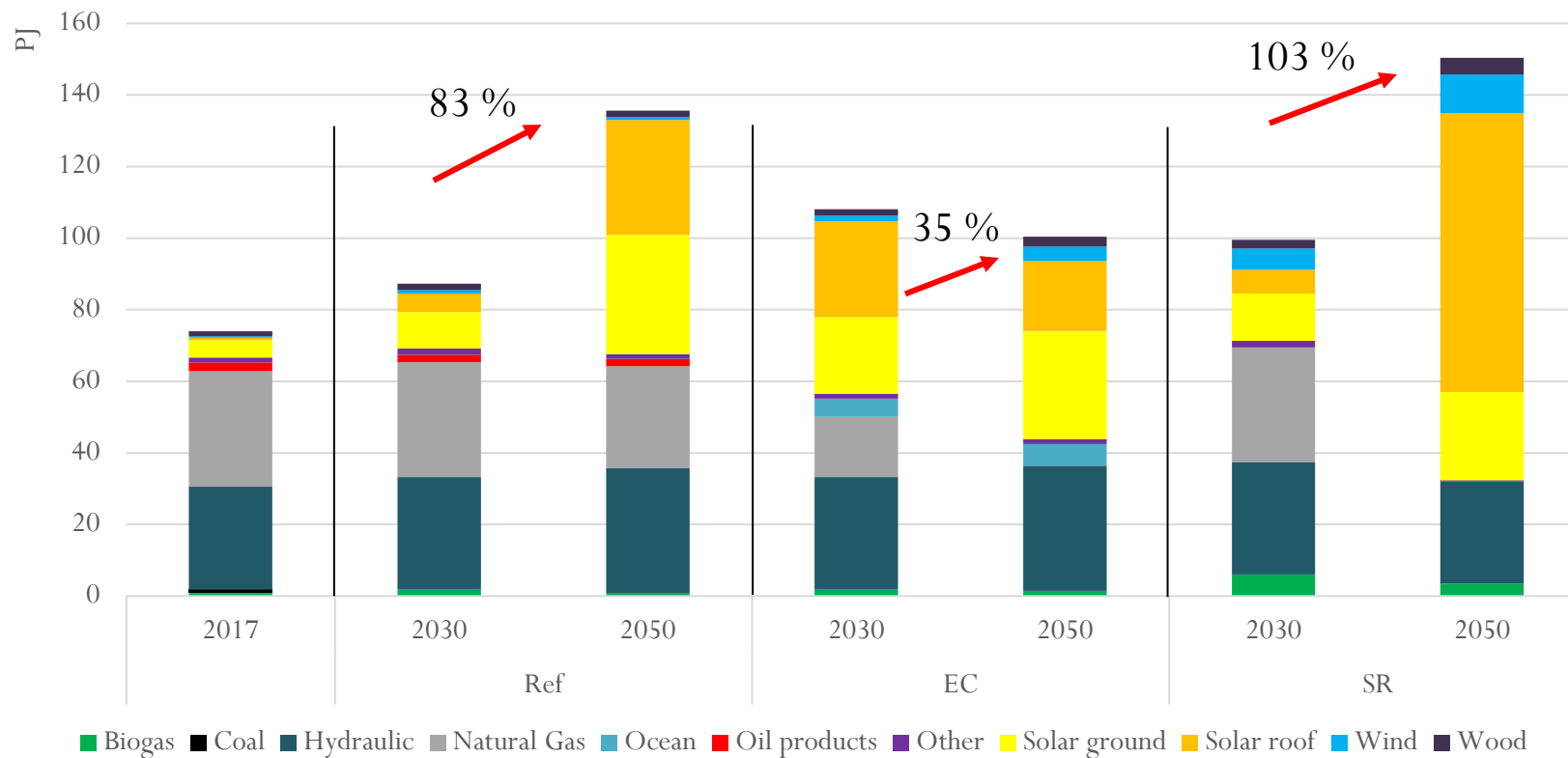
- Maximize the reuse of resources that otherwise would have been thrown away
- Prioritize the recovery of resources in order to increase the efficiency of the system
- Reduce emissions
- Reuse products by giving them a second life
- Integrate a shift in behavior in terms of how energy is consumed

Proposed objectives		
100%	Industrial waste heat	
100%	Waste water heat	
100%	Sludge	
100%	Municipal, agriculture and green waste	
100%	Buildings renovation	
15%	CCU	
Personnes par véhicule particulier	1.70	People by car
Modal shift	Personal mobility vehicles can cover up to 17% of cars mobility demand and buses can cover up to 7% in 2050	
Air heat pumps	15% more than in the reference scenario	
Tidal energy	3 GW	
Wind	3 times the reference scenario	
No new fossil power plants		

! Includes the regional hydrogen plan

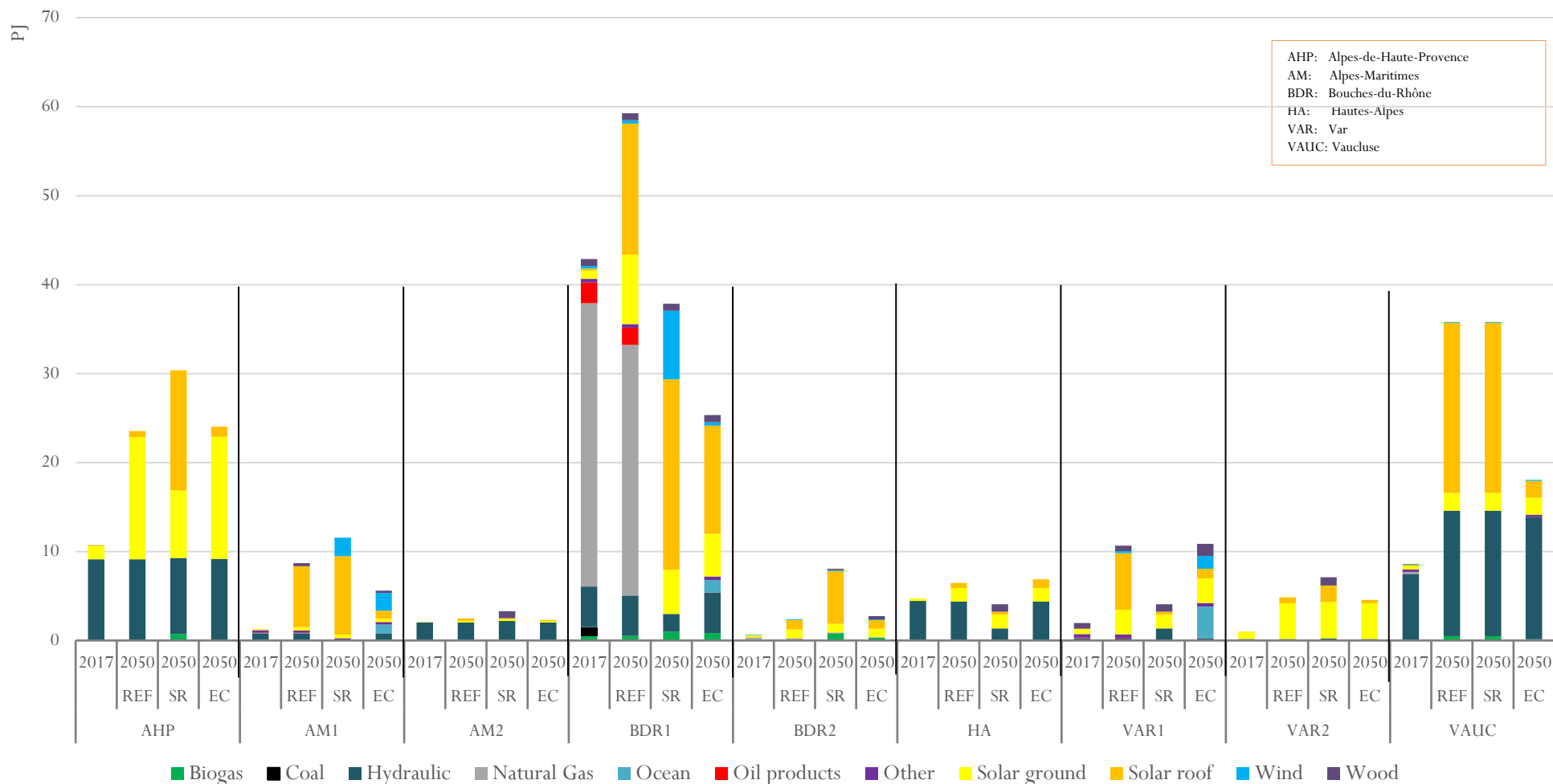


Results – Regional electricity production



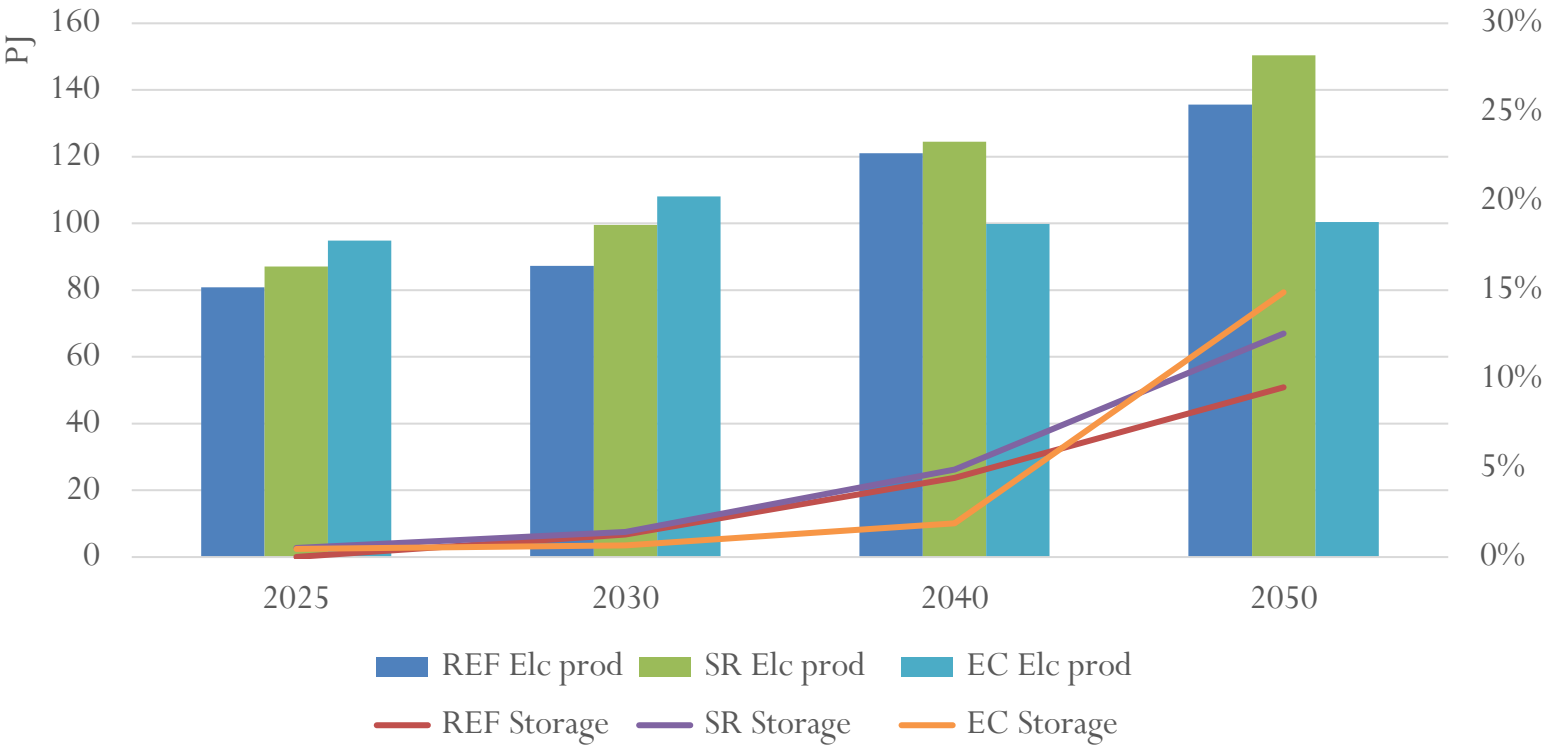
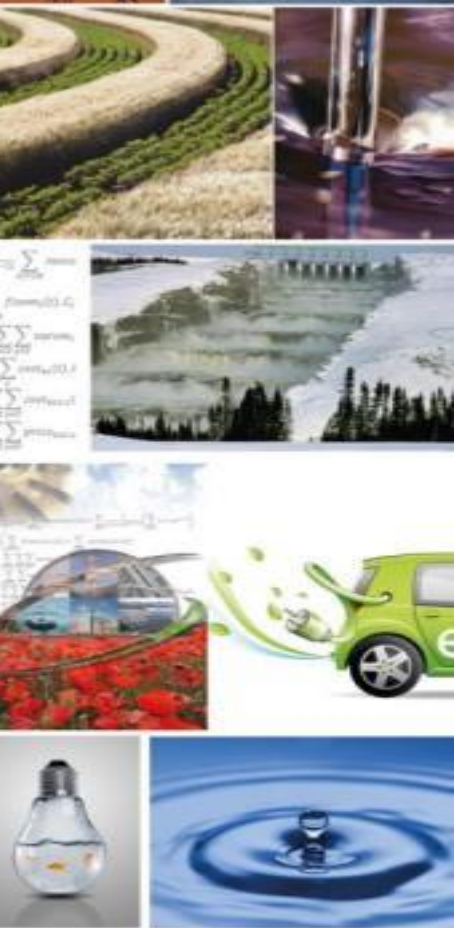
- In 2050 the use of fossil fuels represent **22%** of electricity production in the reference scenario, while they account for less than 1% in the SR and CE scenario
- Total power production in 2050 in the CE scenario is the lowest among the studied scenario as it presents a lower electricity demand
- The electricity production achieved in 2050 in the SR scenario complies with a little bit more than 50% of the objectives established in the SRADDET

Results – Electricity production by zone



- Electricity production is concentrated in the BDR1 in the reference and SR scenario while it is more distributed among the territories in the CE scenario
- Wind production is developed mainly in the BDR1, while tidal energy is mostly used in the VAR1 zone
- Hydroelectricity is developed mainly in the VAUC zone

Electricity storage



- Hydro storage and batteries have been used to store electricity
- Hydro storage has been developed mainly in the AHP zone
- Batteries have been used mostly in high consuming areas as they have been used to store electricity from roof photovoltaic panels

Final energy consumption



Housing

Industry

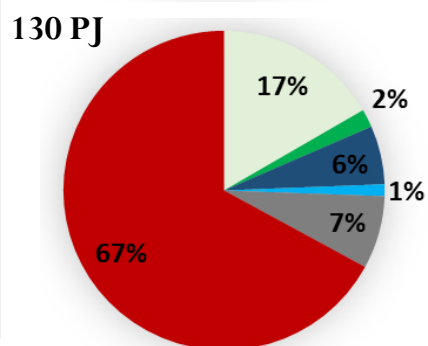
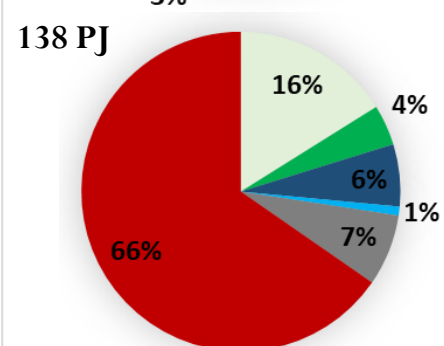
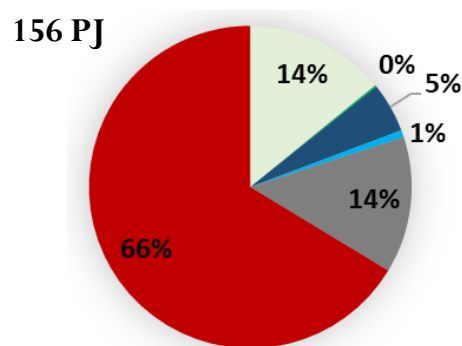
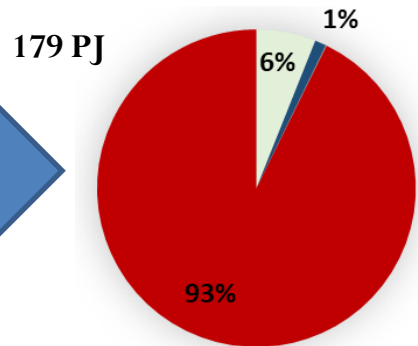
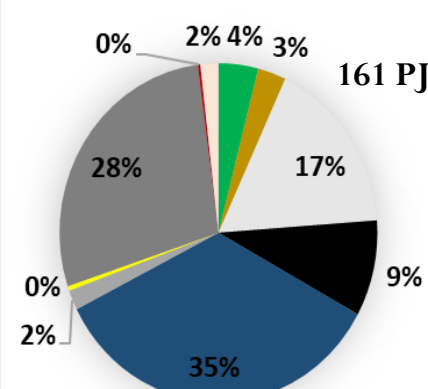
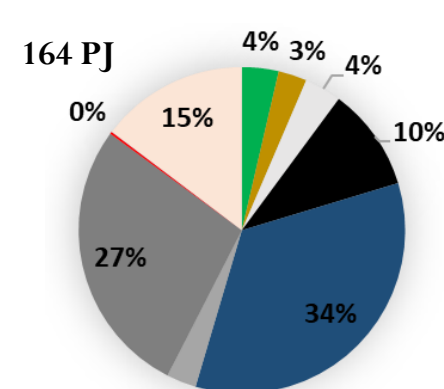
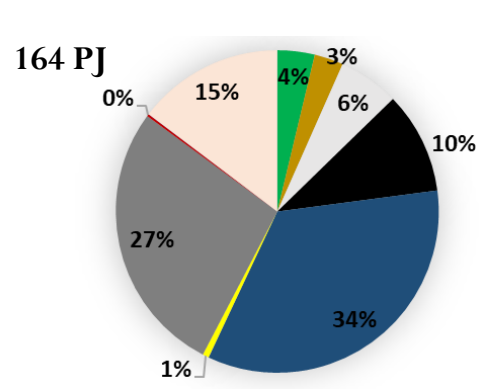
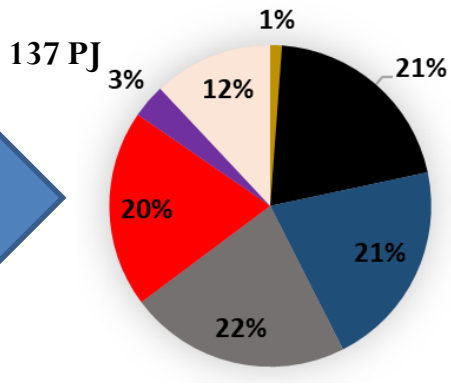
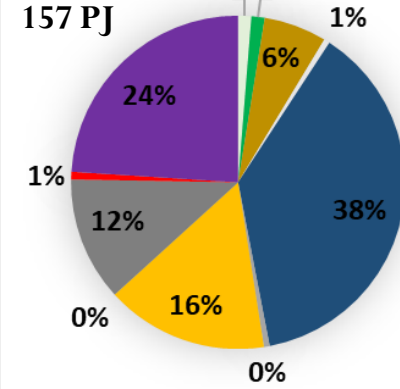
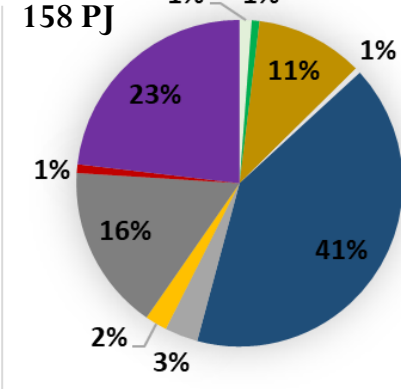
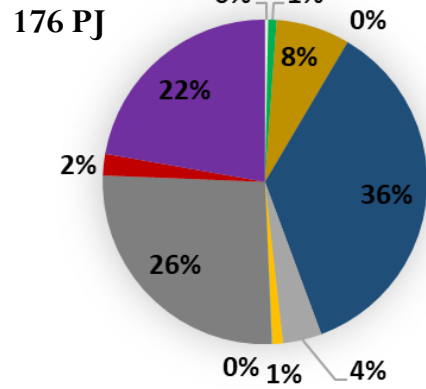
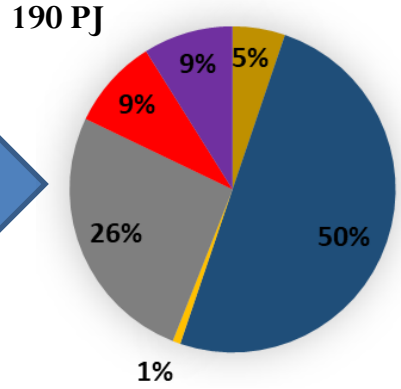
Transport

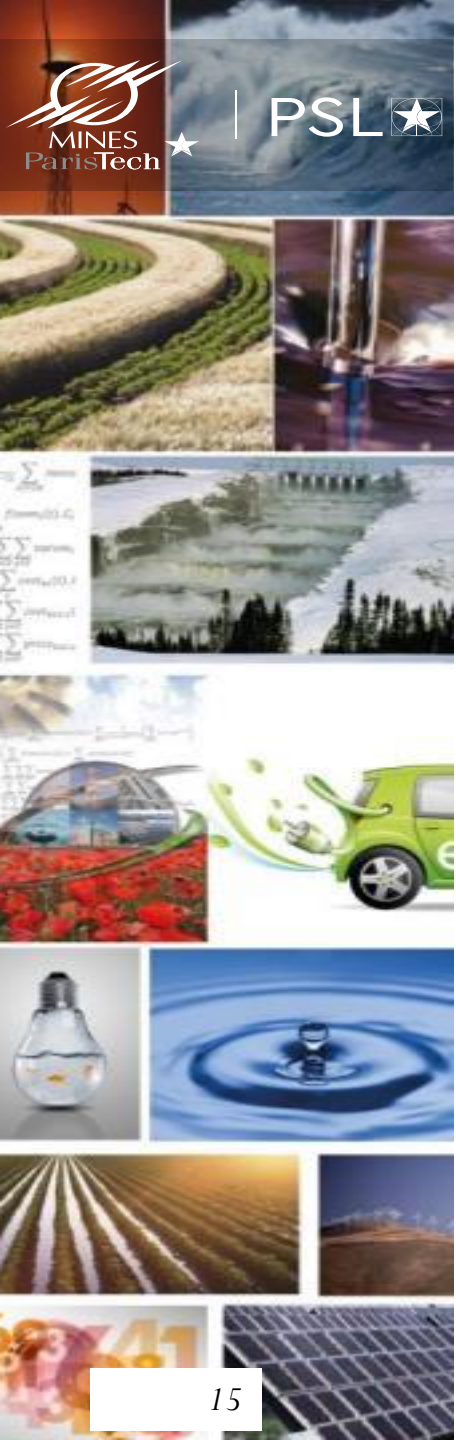
2017

Reference

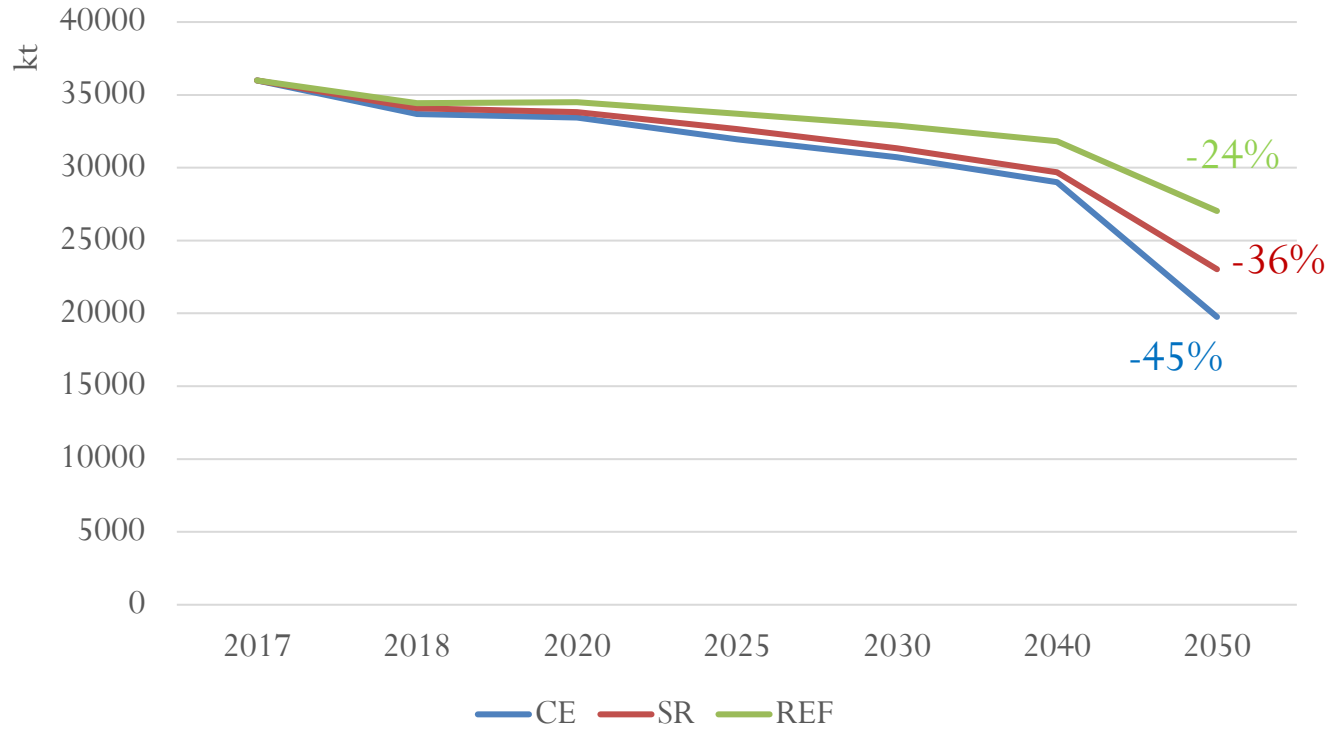
SRADDET

Circular Economy





Total CO2 emissions



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.
- The recovery of waste heat should be prioritize as it has proven to have a great potential to decarbonize the habitat sector, increasing also the efficiency of the whole system.
- The use of batteries to store roof PV production is key to allow a greater development of the technology
- It is required higher efforts to allow the introduction of clean alternative energies into the transport sector. Supporting the development of an hydrogen market seems key to decarbonize this sector.
- Implementing a CE perspective in the development of an energy system can allow greater environmental results.



THANKS FOR YOUR ATTENTION

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Thesis co-financed by ADEME and the SUD Provence-Alpes-Côte d'Azur Region and in partnership with Schneider Electric

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