Long term energy transition scenario analysis for the city of Donostia

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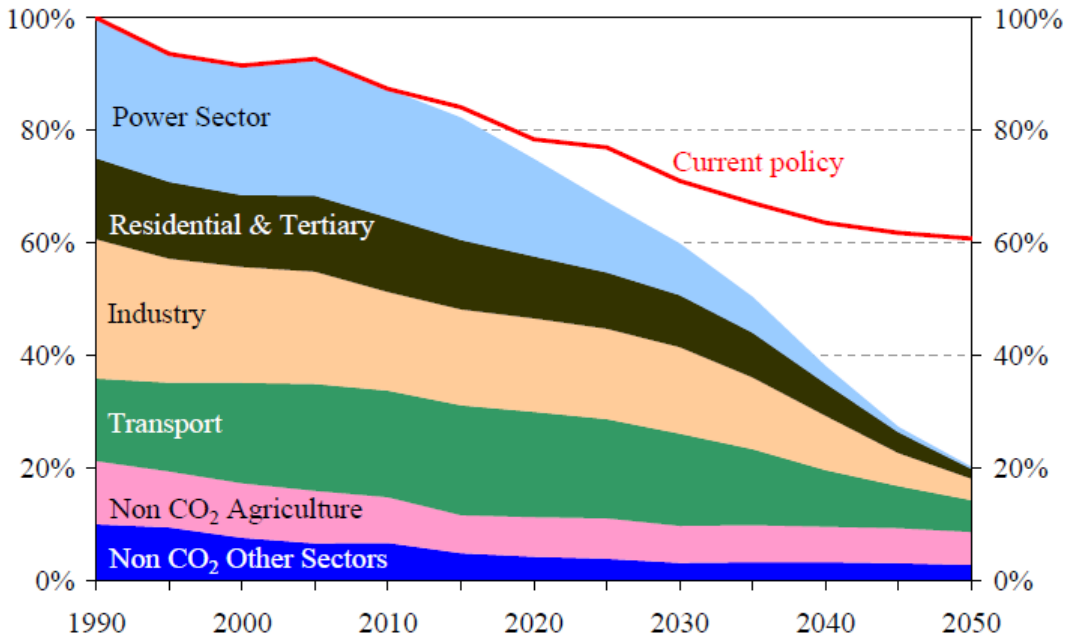
1- INTRODUCTION – ENERGY TRANSITION SCENARIOS FOR CITIES

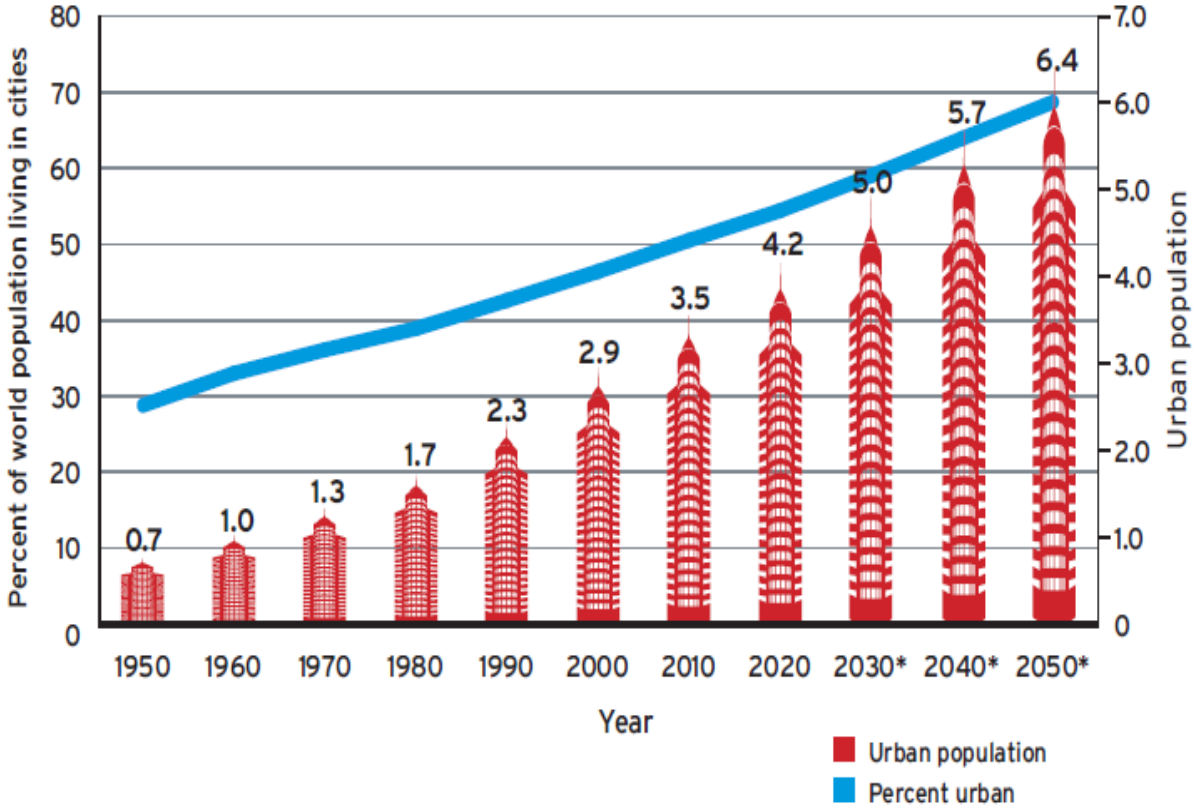
- High social and economic costs generated by the environmental context.
- Exploring plausible pathways for the decarbonisation of the energy system of countries is becoming increasingly urgent
- Building and energy sectors have the greatest potential for cutting emissions
- Energy is a key resource that is used in all the economic sectors



Source: EU GHG emissions towards an 80% domestic reduction (1990=100%)

1- INTRODUCTION – ENERGY TRANSITION SCENARIOS FOR CITIES

- Cities have been attracting large population inflows from rural areas (70% of the world's GHG emissions)
- Their role in environmental emission reduction and their potential for economic growth, employment and social wellbeing creation is widely acknowledged.

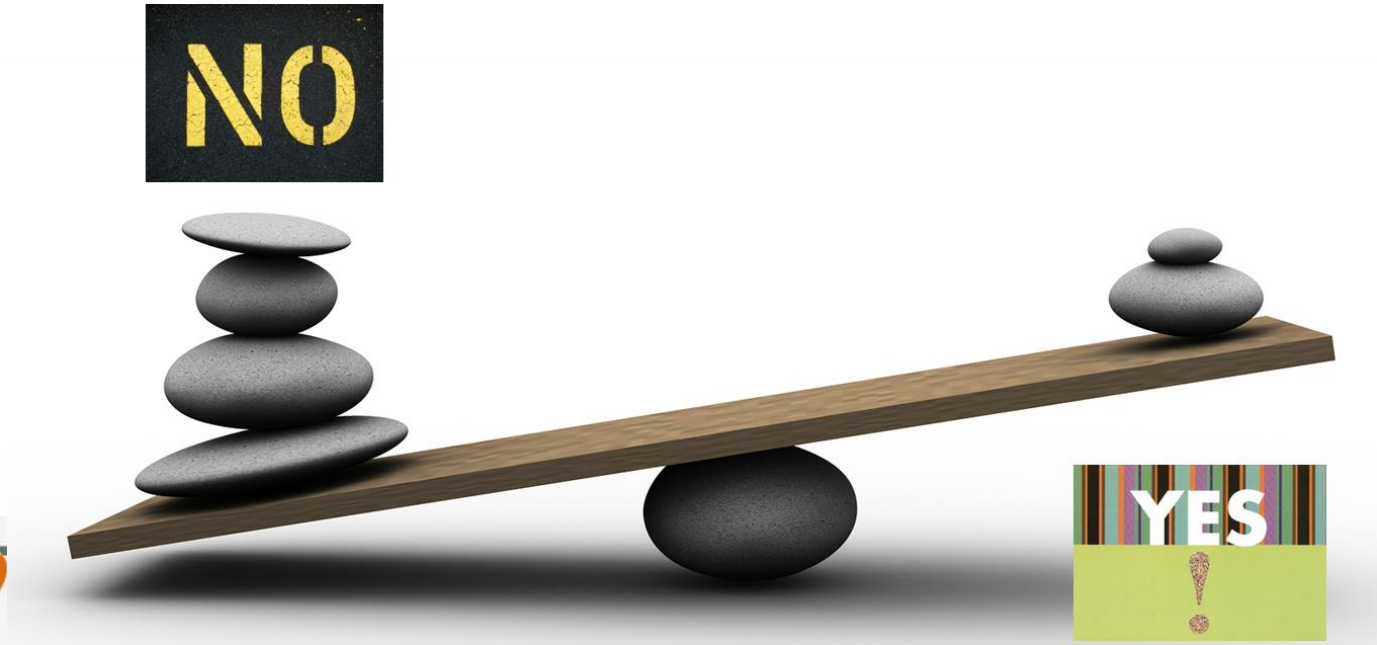


Source: UN, Department of Economic & Social Affairs, Population Division.

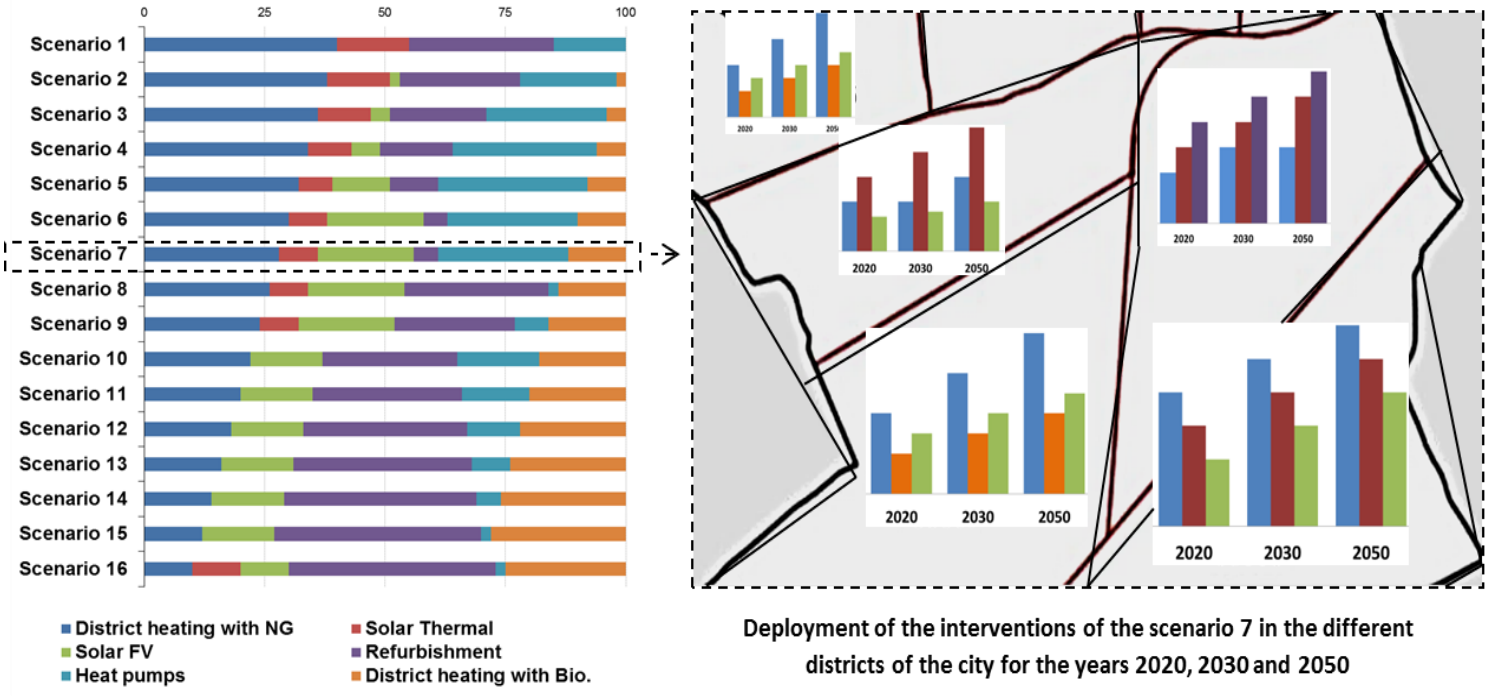
Energy planning of cities is becoming increasingly complex:

- Rapid urbanisation and necessity of transforming the urban environment to a fossil fuel-free future
- Increasing use of resource and energy
- Many energy efficiency measures and new infrastructures and technologies for low carbon energy generation need to be integrated within the city boundaries.

Do we understand the medium and long-term effects generated by the implementations and investments made in our cities?



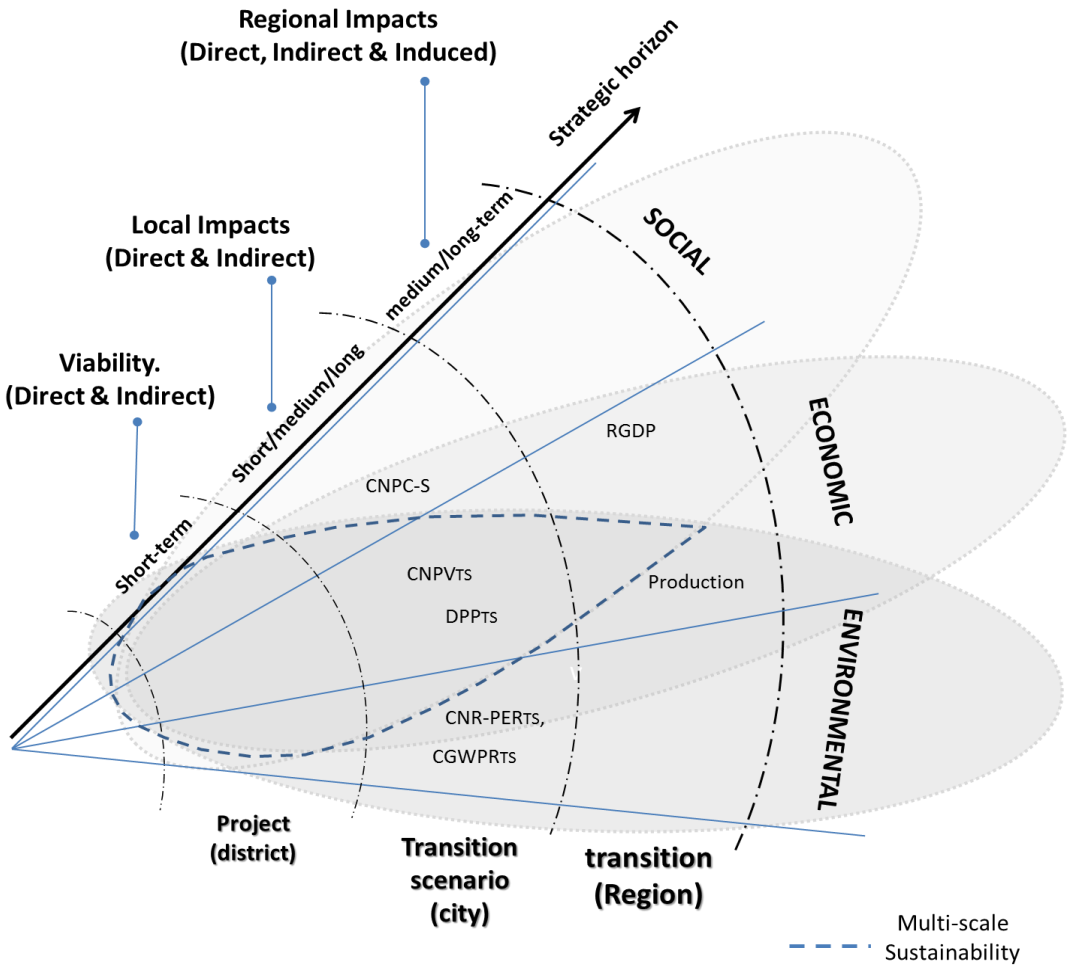
- These types of holistic methodological approaches are not commonly used for city analysis.
- City energy planners need to combine various complex methodologies and tools with different time steps, scales and approaches, for which clear linkages are still unavailable.



Deployment of the interventions of the scenario 7 in the different districts of the city for the years 2020, 2030 and 2050

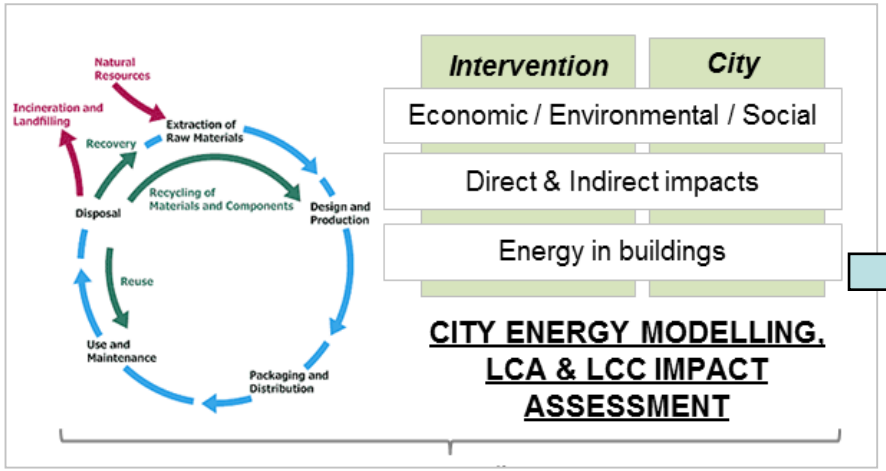
2- METHODOLOGICAL APPROACH

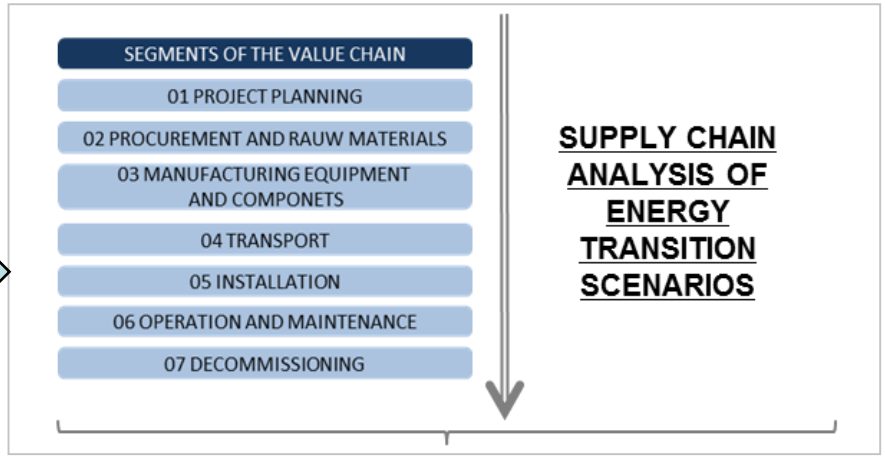
- Methodology for the ex-ante impact assessment of alternative energy transition scenarios for cities linking energy modelling with holistic impact assessment

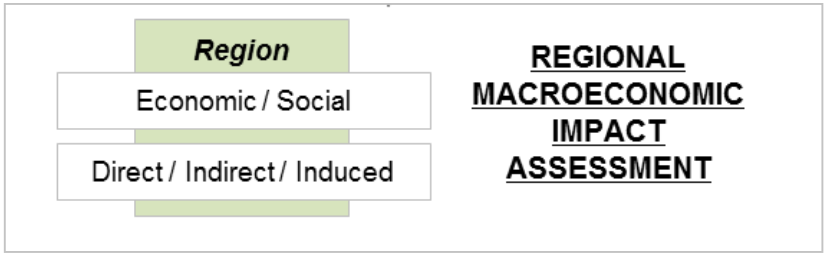


- Cumulative Net Present Value (CNPV)
- Cumulative Net Present Cost-Social (CNPC-S)
- Cumulative Global Warming Potential Reduction (CGWPR)
- Cumulative Non Renewable Primary Energy Reduction (CN-RPER)
- Regional Gross Domestic Product (RGDP)
- Regional Production (RP).

2- METHODOLOGICAL APPROACH







Boundaries

	A0	A1-A3	A4-A5	B2	B4	B6
Environmental						
City scale		X			X	X
Socioeconomic						
City scale	X	X	X	X	X	X
Regional scale	X	X	X		X	

3- CASE STUDY – DONOSTIA-SAN SEBASTIÁN

- Five districts covering more than the 40% of the city's building stock:

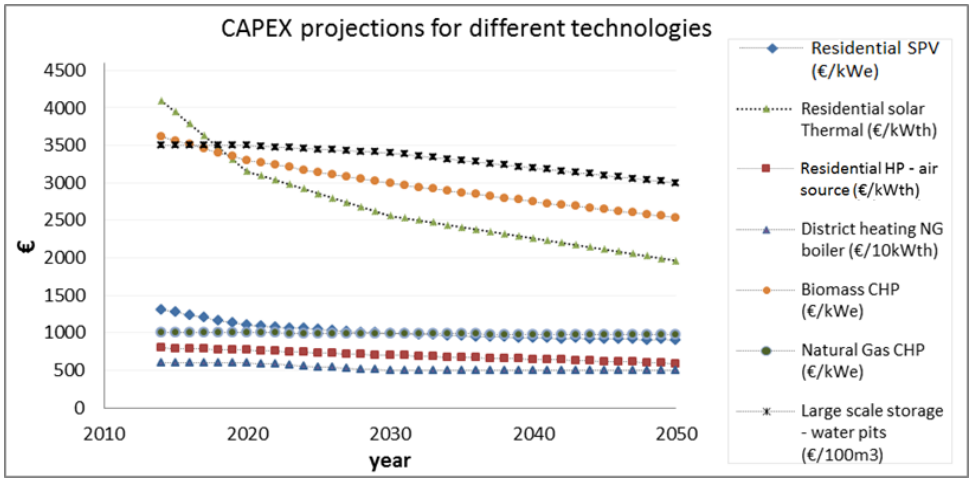
Energy demand (GWh/year)					
	Heating	**DHW**	**Cooling**	**Electricity**	
Residential use	185.8	25.6	-	88.6	
Office use	5.1	-	6.4	13.5	
Use of fuel (GWh/year)					
	NG	**Electricity**	**Gas oil**	**Biomass**	**Other LF**
Residential and office use	215.2	148.5	33.3	2	2.1

- Interventions included in the scenario; central heating biomass boilers (CHBB), heat pumps (HP) and passive interventions for buildings (PIFB).
  - A total of 4.4 millions square meters of heated floor area of residential buildings is refurbished progressively during the 50 years period .
  - A total of 23,795 existing heating systems are replaced progressively during the 50 years period.

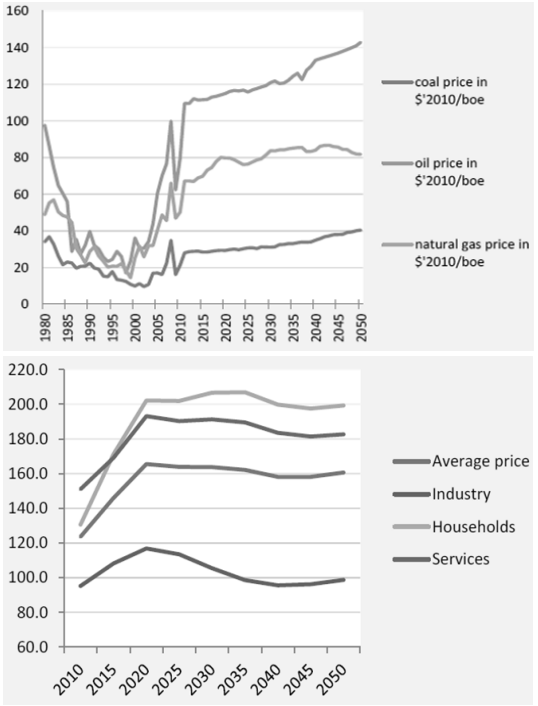
New technology	Replaced NG fired boilers		Replaced Gas oil fired boilers		Replaced Electric systems	Replaced Other fuels systems
	Individual	Central	Individual	Central		
CHBB	10%	100%	-	100%	-	-
HP	90%	-	100%	-	100%	100%

MAIN CHARACTERISICS OF THE SCENARIO

- An annual implementation rate of 2% has been set for building refurbishment
- Energy Price escalators
- Discount rate
- Energy technology cost trends



CAPEX projections for different technologies for the time frame 2013 to 2050. Based on (ETRI 2014) and (Danish Energy Agency and Energinet.dk 2012)



Fuente: EU Energy, Transport and GHG Emissions Trends to 2050. (EC, DG for Energy, DG for Climate Action and DG for Mobility and Transport, 2013).

4 – RESULTS ant the end of the transition period

	CNPV (M€)	CNPC (M€)	DPP (years)
Scenario	-12.2	338,4	More than 50

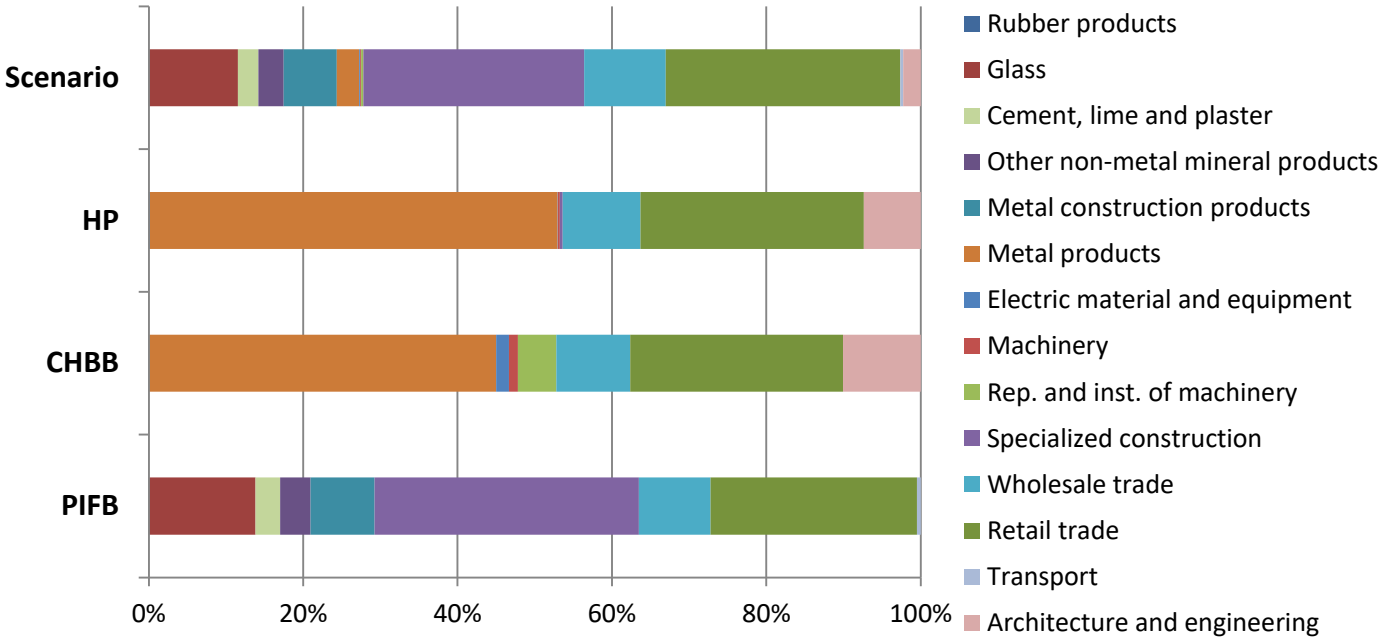
- Negative CNPV results in 2067
- Although the investments in new heating and DHW systems have a dynamic payback period lower than 50 years, if they are combined with building refurbishment interventions, the energy transition scenario shows a negative cash flow at the end of the period
- Total costs for citizens, which considers initial investment, the costs of energy and the O&M and system replacement costs during the 50 years transition period is 338,4 M€.

4 – RESULTS ant the end of the transition period

	CGWPR ($TnCO_2eq$)	CNRPER (MWh)
Scenario	1.4E+06	7.1E+06

- Emission savings of 64% with respect to the values of 2007 would be achieved in the city by 2067.
- Emissions savings and the non-renewable primary energy savings are negative at the beginning of the transition period due to the emissions and embodied energy related to other stages of the life cycle apart from the use stage.
- Those negative effects occur throughout the transition period due to the progressive implementation of interventions, but they are rapidly compensated

4 – RESULTS ant the end of the transition period



- Disaggregated shock of each intervention
- Shock corresponding to the total city energy transition scenario (In cumulative discounted domestic costs in basic prices)
- Proportion in which the production of commodities would be increased in the Basque Country

4 – RESULTS ant the end of the transition period

	Regional GDP		Regional Production	
	(M€)	(Multiplier)	(M€)	(Multiplier)
Scenario	72.2	0.82	146.2	1.65

- Direct, indirect and induced effects
- The scenario would induce an impact equivalent to an increase in the GDP of the Basque Country of 0.12% and close to 1.26% of the GDP of Donostia-San Sebastián.
- Multiplier of 0.82 for GDP and a multiplier of 1.65 for Production
- An increase of between 9% and 22% in the impacts created when the induced impacts are also considered.

5 - CONCLUSIONS

- The impact assessment results provide a variety of criteria that can be used in order to evaluate from a wide perspective the effects of the implementation of the scenario.
- Substitution of existing heating and DHW systems by a combination of biomass-fired central heating boilers and heat pumps with building refurbishment is very positive in terms of CO_2 emission and non-renewable PE savings.
- However, current and expected future prices of these interventions do not ensure cost savings for citizens in the defined period.
- Policy mechanism designed to accelerate investment on building refurbishment as well as the incorporation of other interventions to the transition scenario can help to balance the global economic cash flow of scenarios across the transition period.
- This type of regional indicators are interesting mainly for an strategic vision and to understand the potential of the impact generated due to the replication of interventions in other areas of the city or in other cities of the region.

Thank you