El papel de las energías renovables en la economía circular y la Transición Energética

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01

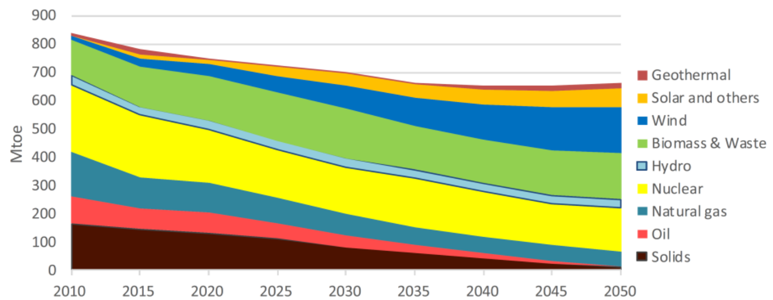
La transición energética y renovables 2030 y 2050

La transición energética

- El objetivo final es la reducción de GEI.
- La forma en que se llegará a esa reducción está muy basada en la competencia LCOE.
- Existe un objetivo a 2030 que exige medidas que no nos van a llevar a cumplir en 2050.
- Disponemos de la tecnología y medios para llegar a 2030.

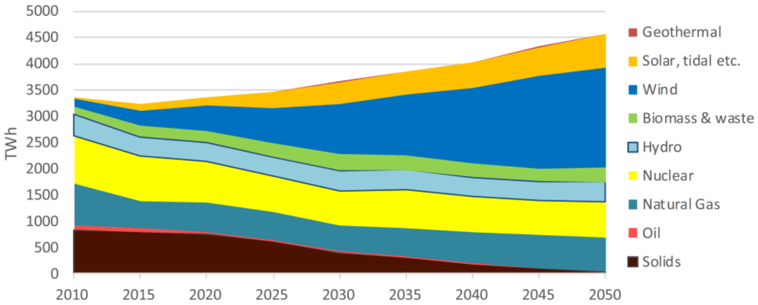
Transición energética 2030

Figure 7: Primary energy production in the Baseline



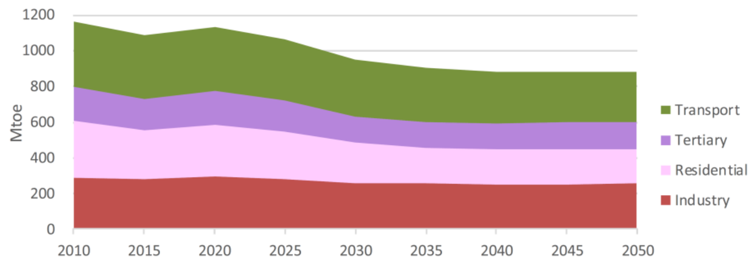
Source: Eurostat (2010, 2015), PRIMES.

Figure 8: Gross electricity generation in the Baseline



Source: Eurostat (2010, 2015), PRIMES.

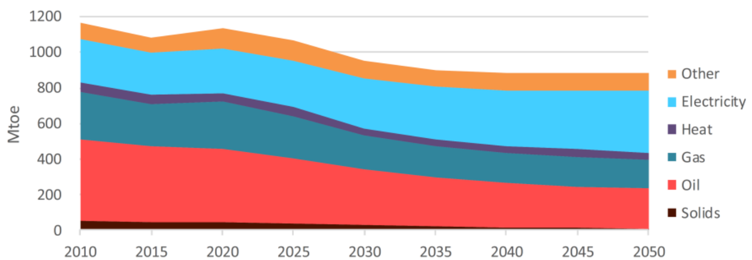
Figure 9: Final Energy demand by sector



Note: "Tertiary" includes the energy consumed in the agricultural sector.

Source: Eurostat (2010, 2015), PRIMES.

Figure 10: Final Energy demand by fuel/energy carrier



Note: "Other" includes biomass and waste.

Source: Eurostat (2010, 2015), PRIMES.

Transición energética 2030

Figure 14: Total GHG emissions and split ETS/non-ETS (MtCO$_2$eq)

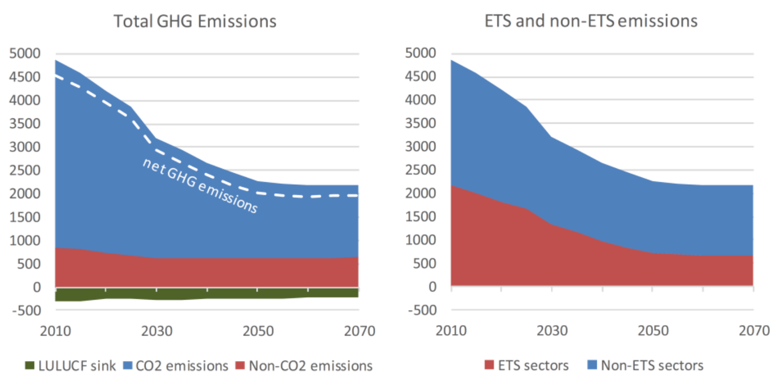
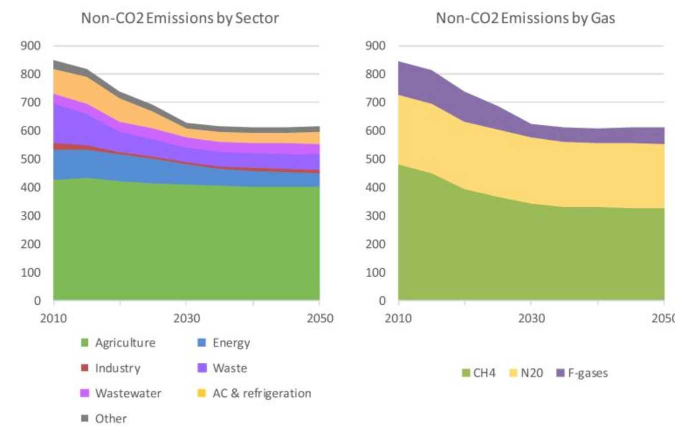
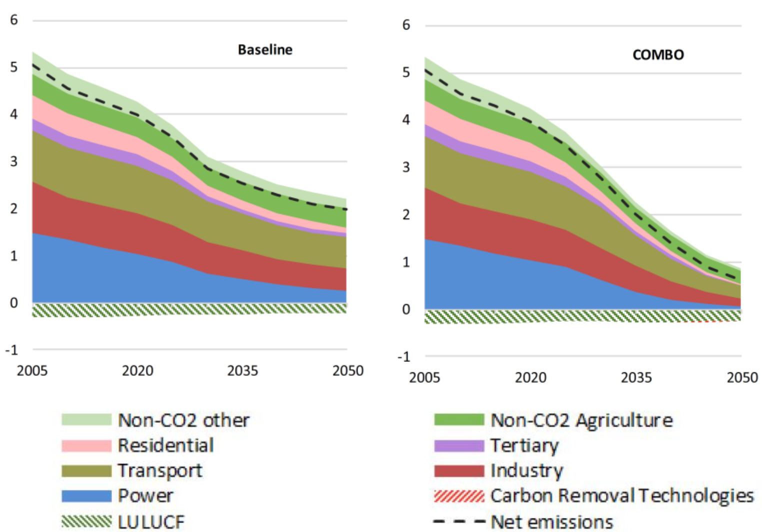


Figure 12: Baseline projections of non-CO$_2$ emissions by sector and by gas (MtCO$_2$eq)

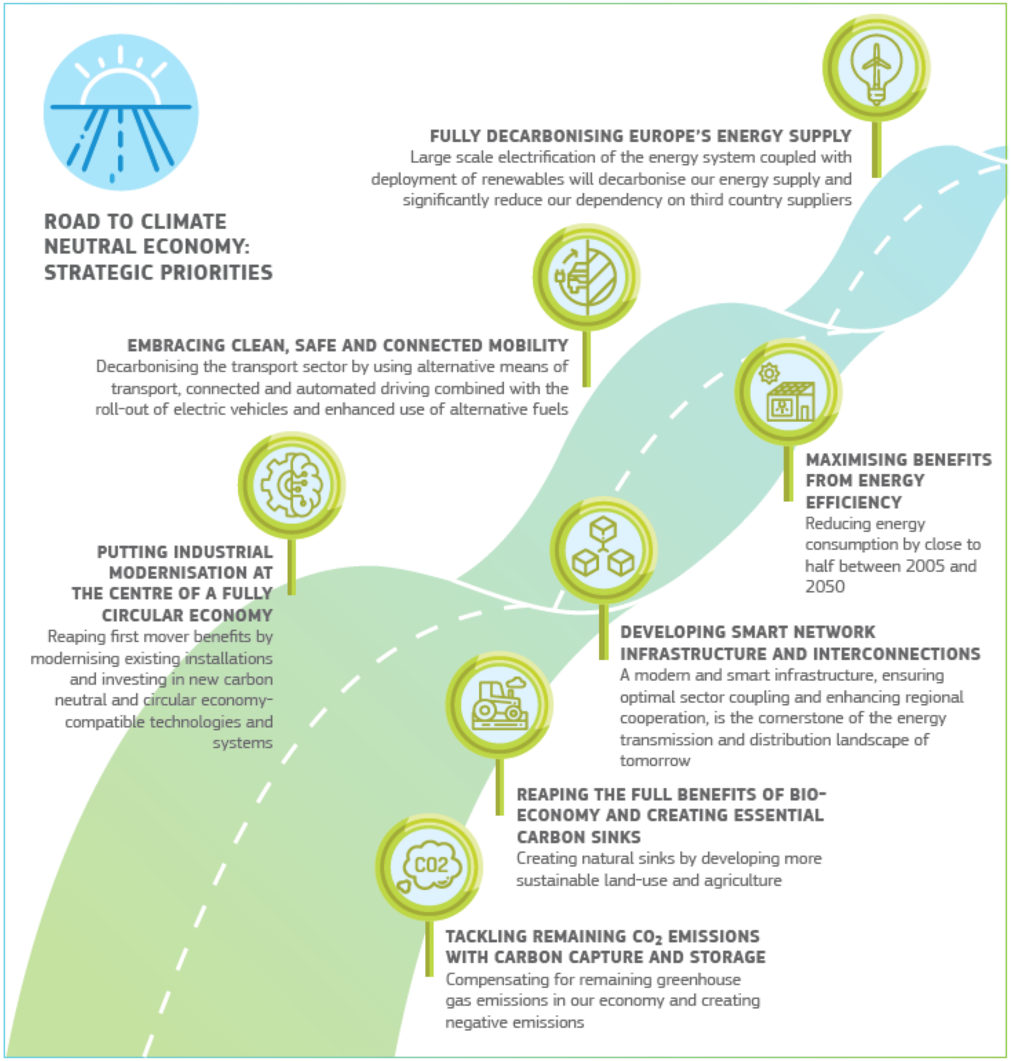




	2030	2050
• Esperado	2030	2050
– BAU	-30%	-
– PNIECs	-40%	-
– Políticas EU	-46/48%	-62/64%
• Paris	-	2050
– 2ºC		-80%
– 1.5ºC		-90/100%

T.E. 2050 – Paths / 8 Vías

- "Well below 2ºC Ambition"
  - **-80% GEI 1990**
  - Zero/neutral carbon carriers
    - Electricity – ELE
    - Hydrogen – H2
    - E-Fuels – P2X
  - Energy Efficiency – EE
  - Circular Economy - CIRC
- "Bridge between 1.5 – 2.0 ºC" -
  - **90% GEI 1990**
  - COMBO: ELE + H2 + P2X + EE + CIRC
- "Achieve 1.5ºC Change"
  - **-100% GEI 1990**
  - COMBO + BECCS + CCS - 1.5TECH
  - 1.5TECH + 'CIRC+' - 1.5LIFE



T.E. 2050 – Paths / Caminos

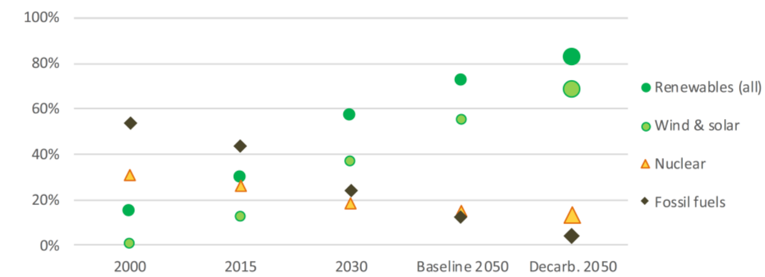
Table 1: Overview of main scenario building blocks

Long Term Strategy Options

	Electrification (ELEC)	Hydrogen (H2)	Power-to-X (P2X)	Energy Efficiency (EE)	Circular Economy (CIRC)	Combination (COMBO)	1.5°C Technical (1.5TECH)	1.5°C Sustainable Lifestyles (1.5LIFE)
Main Drivers	Electrification in all sectors	Hydrogen in industry, transport and buildings	E-fuels in industry, transport and buildings	Pursuing deep energy efficiency in all sectors	Increased resource and material efficiency	Cost-efficient combination of options from 2°C scenarios	Based on COMBO with more BECCS, CCS	Based on COMBO and CIRC with lifestyle changes
GHG target in 2050	-80% GHG (excluding sinks) ["well below 2°C" ambition]					-90% GHG (incl. sinks)	-100% GHG (incl. sinks) ["1.5°C" ambition]	
Major Common Assumptions	• Higher energy efficiency post 2030 • Deployment of sustainable, advanced biofuels • Moderate circular economy measures • Digitilisation • Market coordination for infrastructure deployment • BECCS present only post-2050 in 2°C scenarios • Significant learning by doing for low carbon technologies • Significant improvements in the efficiency of the transport system.							
Power sector	Power is nearly decarbonised by 2050. Strong penetration of RES facilitated by system optimization (demand-side response, storage, interconnections, role of prosumers). Nuclear still plays a role in the power sector and CCS deployment faces limitations.							
Industry	Electrification of processes	Use of H2 in targeted applications	Use of e-gas in targeted applications	Reducing energy demand via Energy Efficiency	Higher recycling rates, material substitution, circular measures	Combination of most Cost-efficient options from "well below 2°C" scenarios with targeted application (excluding CIRC)	COMBO but stronger	CIRC+COMBO but stronger
Buildings	Increased deployment of heat pumps	Deployment of H2 for heating	Deployment of e-gas for heating	Increased renovation rates and depth	Sustainable buildings			CIRC+COMBO but stronger
Transport sector	Faster electrification for all transport modes	H2 deployment for HDVs and some for LDVs	E-fuels deployment for all modes	Increased modal shift	Mobility as a service			• CIRC+COMBO but stronger • Alternatives to air travel
Other Drivers		H2 in gas distribution grid	E-gas in gas distribution grid				Limited enhancement natural sink	• Dietary changes • Enhancement natural sink

Sector Eléctrico

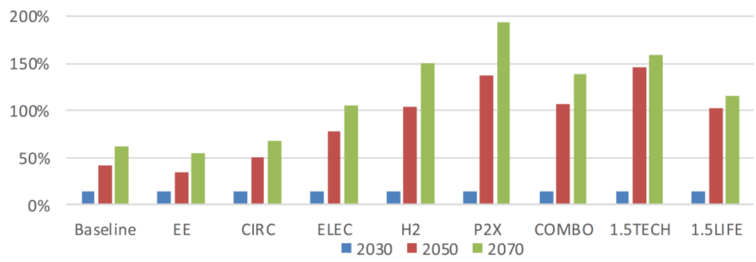
Figure 23: Shares in power generation



Notes: 1. The shares of renewables, nuclear and fossil fuels sum to 100%. Wind & solar is a component of renewables. 2: The "Decarb. 2050" points are the averages across all decarbonisation scenarios per category. These scenarios provide very similar power mix in 2050, with renewables ranging from to 81% to 85% (wind & solar alone from to 65% to 72%), nuclear from 12% to 15% and fossil fuels from 2% to 6%.

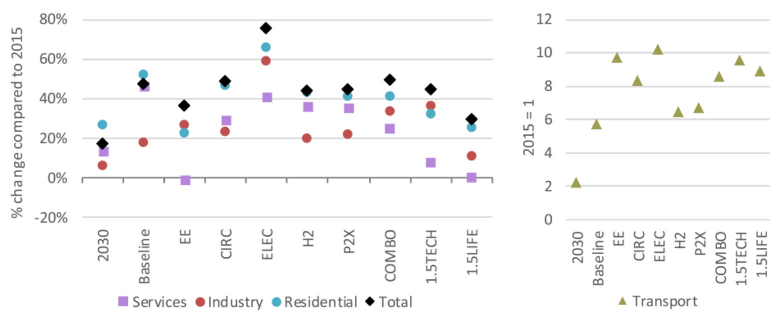
Source: Eurostat (2000, 2015), PRIMES.

Figure 22: Increase in gross electricity generation compared to 2015



Source: Eurostat (2015), PRIMES.

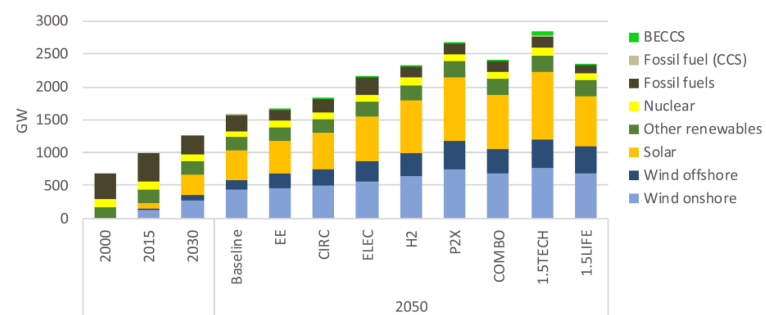
Figure 21: Changes in final electricity consumption in 2050 compared to 2015



Note: left graph: % change compared to 2015 for total, residential, services and industry; right graph: ratio between 2050 and 2015 for transport.

Source: Eurostat (2015), PRIMES.

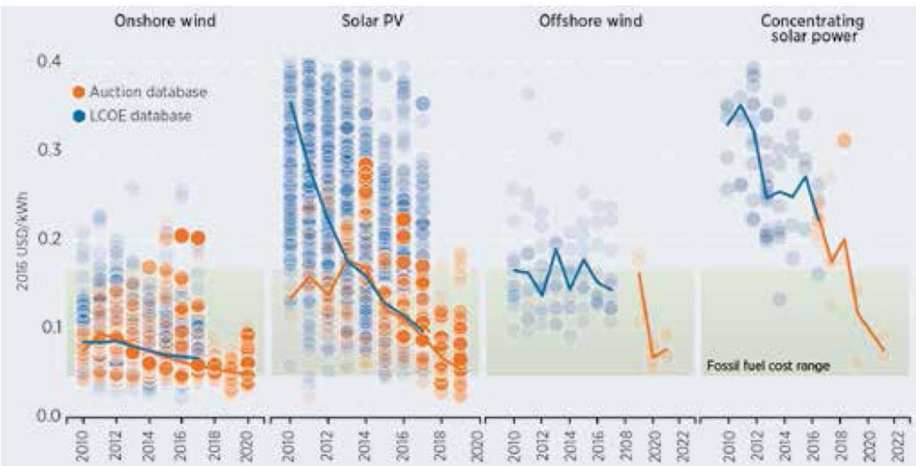
Figure 24: Power generation capacity



Source: Eurostat (2000, 2015), PRIMES.

Sector Eléctrico

Figure 2: The levelised cost of electricity for projects and global weighted average values for CSP, solar PV, onshore and offshore wind, 2010-2022



Source: IRENA Renewable Cost Database and Auctions Database.

FIGURE 2. Growth in Global Renewable Energy Compared to Total Final Energy Consumption, 2005-2015

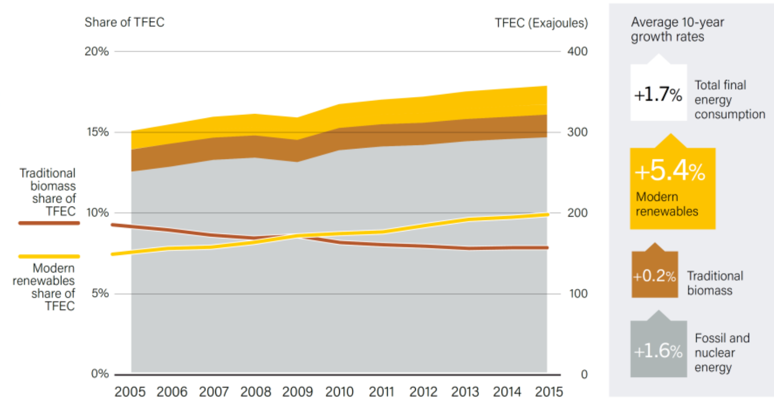
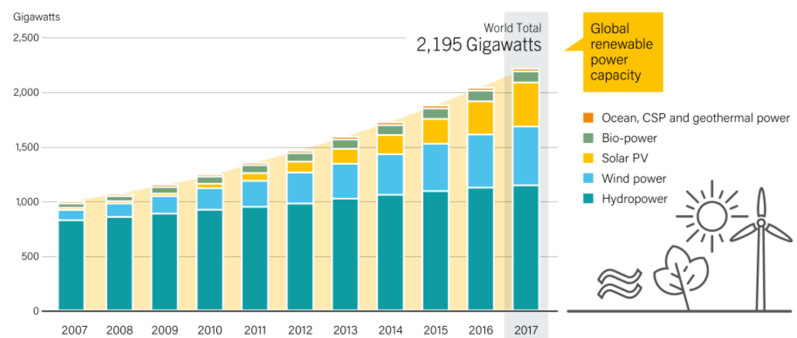


FIGURE 5. Global Renewable Power Capacity, 2007-2017



Sector Transporte

Figure 58: CO_2 emissions from transport in 2050 (in $MtCO_2$)[342]

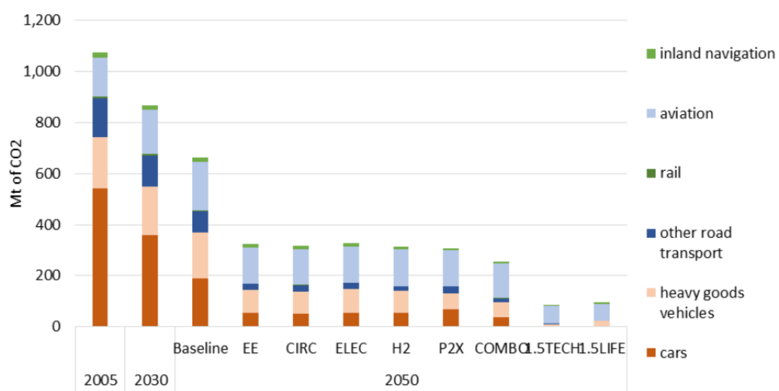


Figure 54: EU international maritime fuel mix in the Baseline and decarbonisation variants

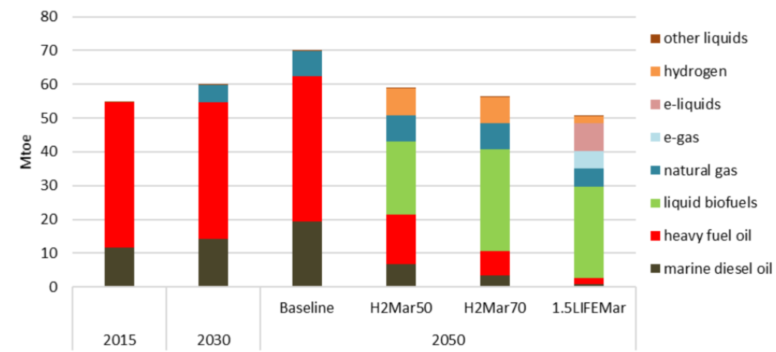


Figure 49: Shares in total cars stock by drivetrain technology in the Baseline and scenarios reaching -80% to net zero emissions by 2050

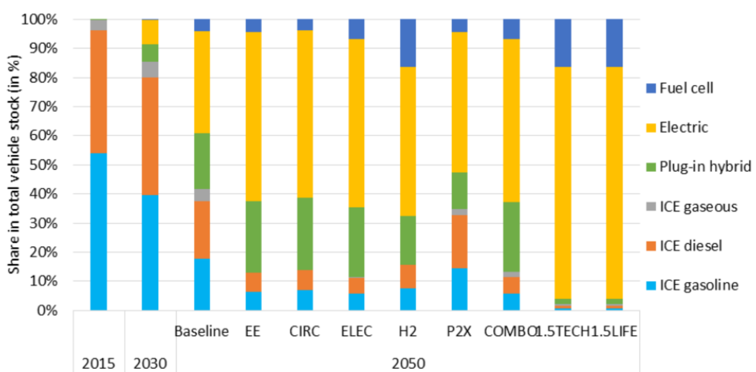
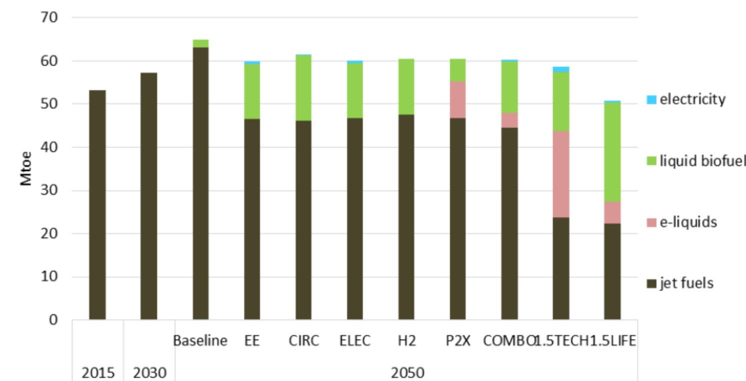
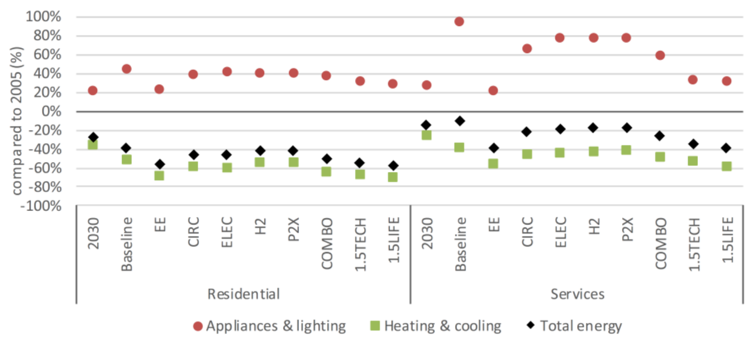


Figure 52: Aviation fuels mix in the Baseline and scenarios reaching -80% to net zero emissions by 2050 in 2050



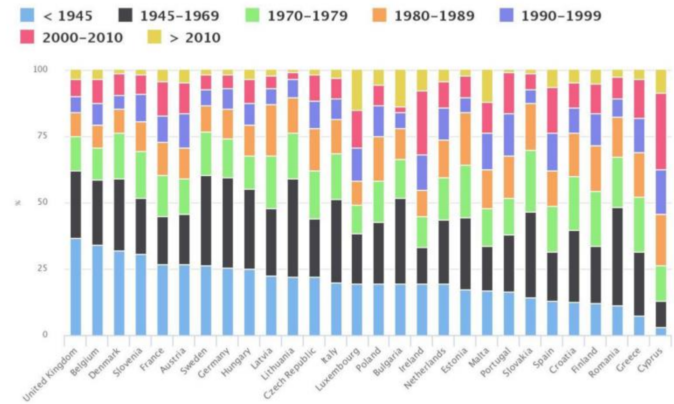
Edificios

Figure 39: Evolution of the energy consumption in buildings in 2050 (compared to 2005)



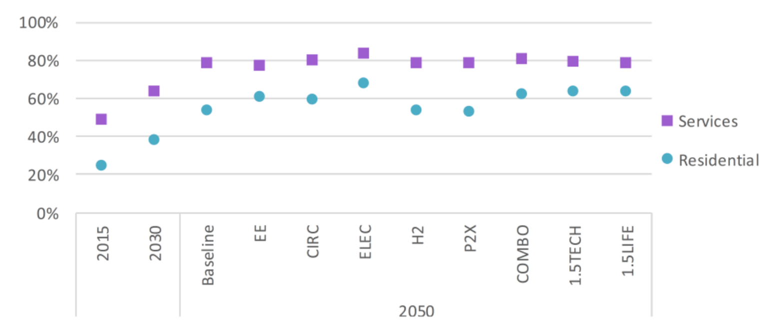
Note: "Heating and cooling" includes space heating, water heating, cooking and air cooling.
Source: Eurostat (total sectoral energy consumption in 2005), PRIMES.

Figure 37: Breakdown of residential building by age category (2014)



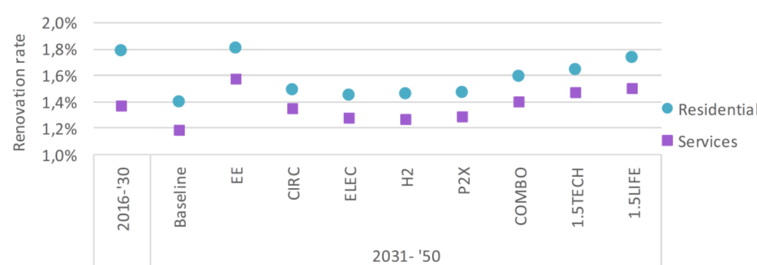
Source: Building Stock Observatory[240].

Figure 42: Share of electricity in final energy demand buildings



Source: Eurostat (2015), PRIMES.

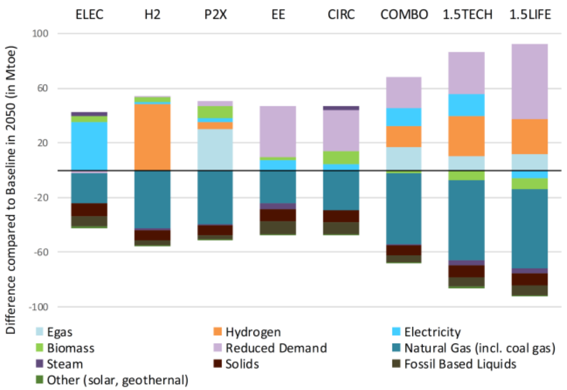
Figure 41: Average yearly renovation rate



Source: PRIMES.

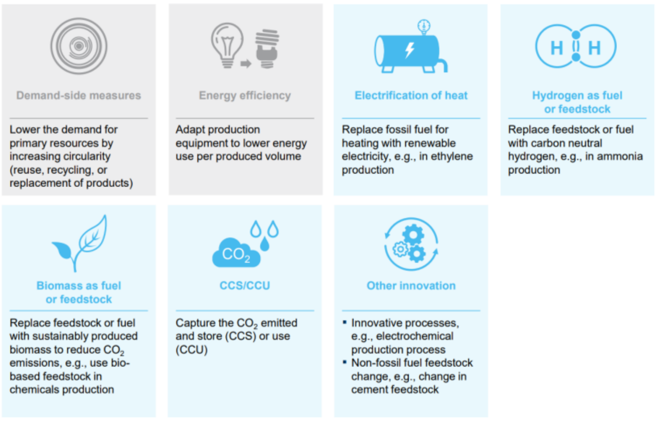
Industry

Figure 69: Differences in final energy consumption in industry compared to Baseline in 2050



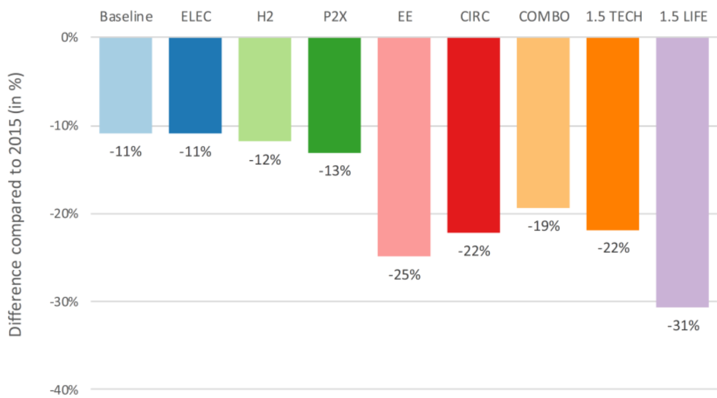
Source: PRIMES.

Figure 66: Menu of options to decarbonise industry



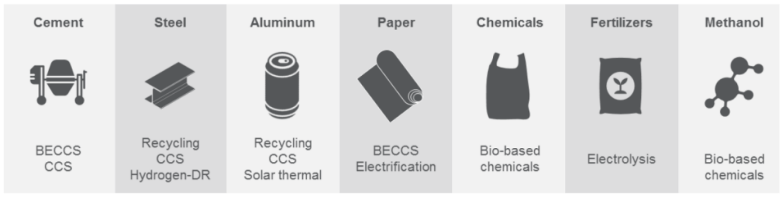
Source: McKinsey & Company.

Figure 68: Total final energy consumption in industry by scenario compared to 2015



Source: PRIMES.

Figure 67: Low carbon technologies used for each material in industry



Source: ECOFYS.

Agricultura y otros no CO_2

18% of the GHGs emitted in the European Union in 2015 were non-CO2 gases.

Table 2: Major sources of non-CO2 greenhouse gases in the EU in 2005

Sector	Major sources	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Contribution to current EU28 non-CO_2 emissions
Energy	Energy use (power, industry, residential)	x	x					3.9%
	Transport	x	x					1.3%
	Coal mining	x						2.9%
	Oil and gas production	x						1.5%
	Natural gas transmission & distrib.	x						2.5%
Industry	Nitric & adipic acid, caprolactam prod.		x					1.4%
	Primary aluminium production				x			0.1%
	Semiconductor industry				x		x	0.1%
Agriculture	Livestock: enteric fermentation	x						**21.7%**
	Livestock: manure handling	x	x					**8.7%**
	Agricultural soils		x					**22.3%**
	Rice cultivation	x						0.3%
	Agricultural waste burning	x						0.3%
Waste	Solid waste	x	x					**14.0%**
	Wastewater	x	x					4.2%
Other	AC & refrigeration			x				**11.3%**
	High and mid voltage switches					x		0.3%
	Aerosols			x				0.9%
	Foams			x				0.7%
	Other F-gas uses			x		x		1.4%
	Other N2O uses		x					0.9%

Figure 74: Example of technologies and mitigation potential in the agriculture sector

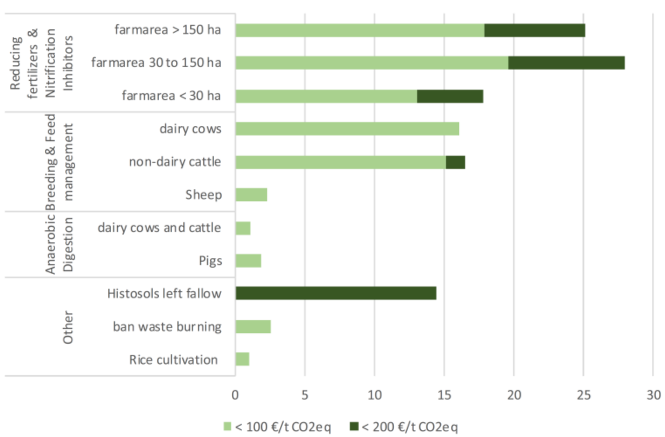
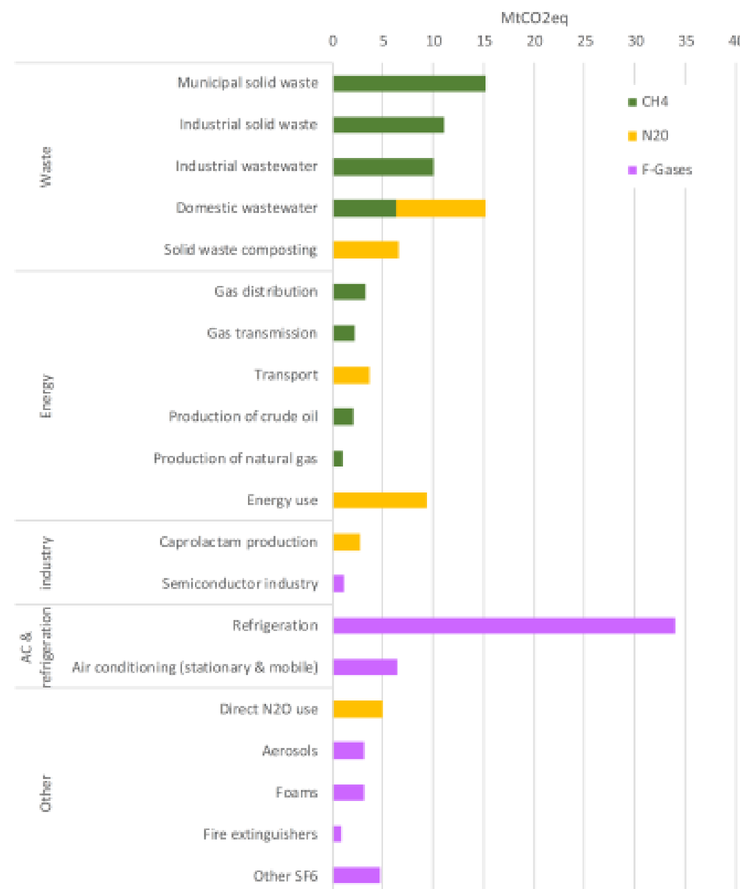


Figure 80: Additional non-CO_2 emissions reduction potential in 2050 compared to baseline in the EU in sectors other than agriculture



Suelo

Figure 83: Use of bioenergy by sectors and by scenario in 2050

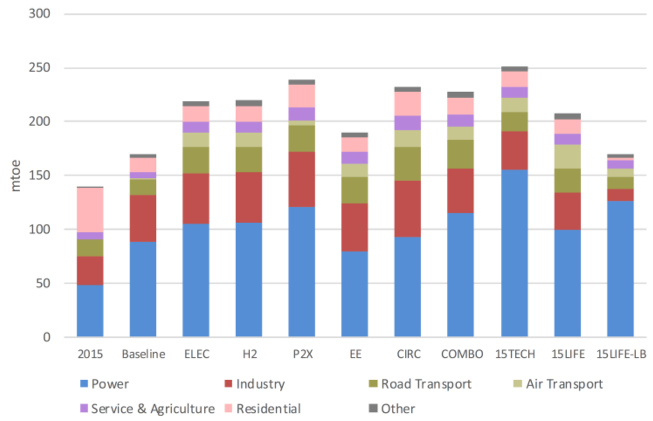


Figure 84: Break down of bioenergy feedstock in 2050

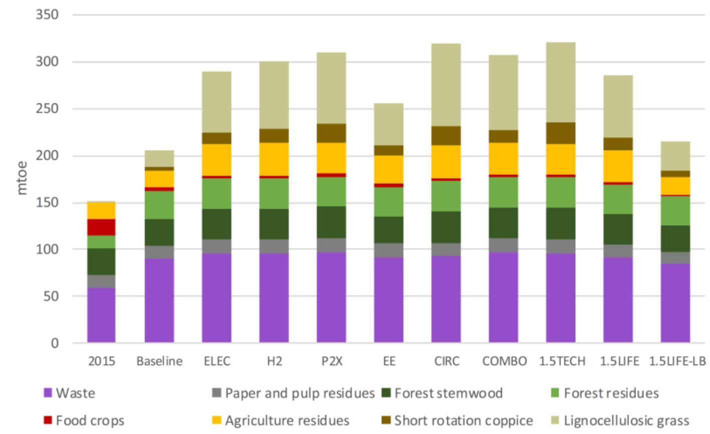


Figure 85: Use of natural land by 2050

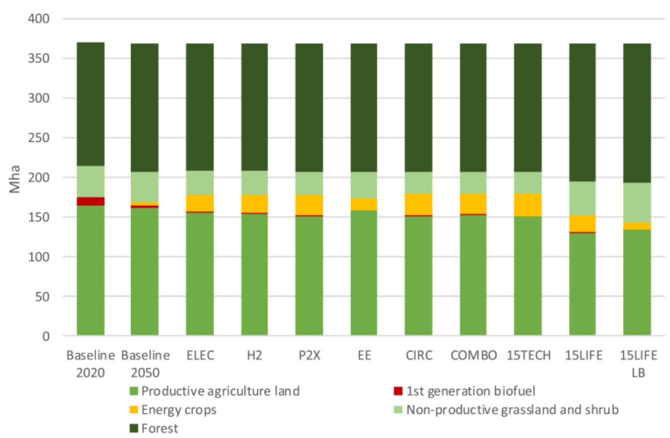
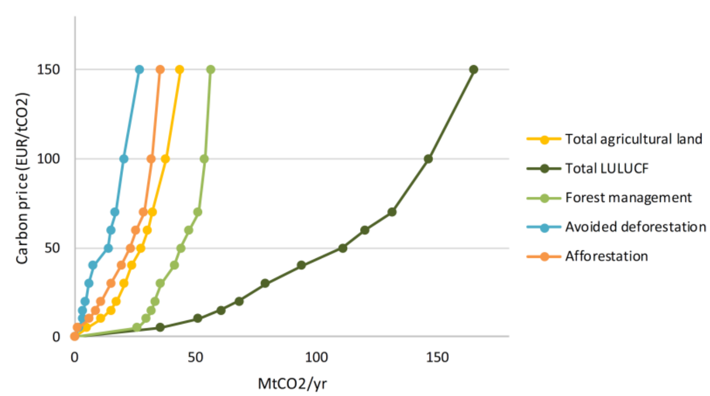
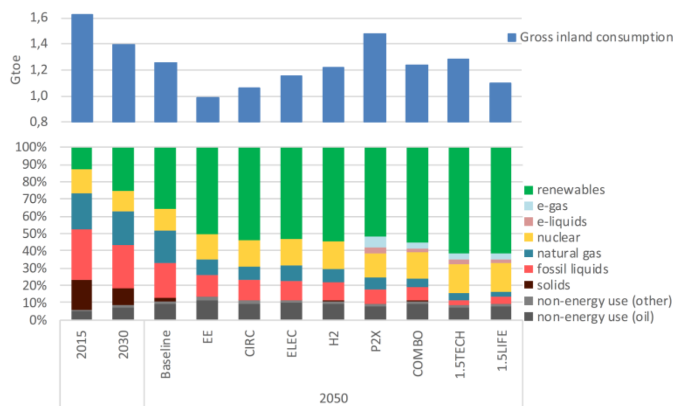


Figure 86: Potential for carbon sequestration and LULUCF sink enhancement at different carbon prices in 2050



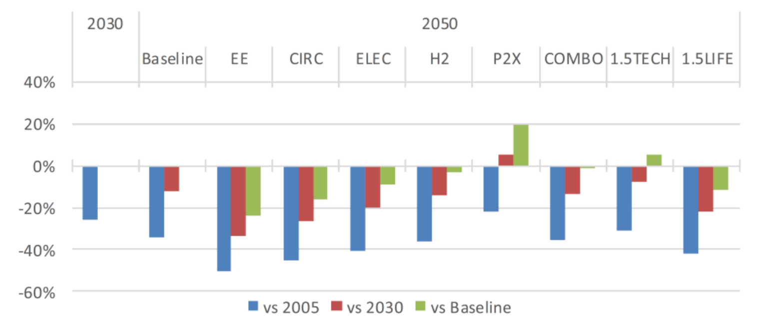
Consumo y renovables

Figure 18: Gross inland consumption



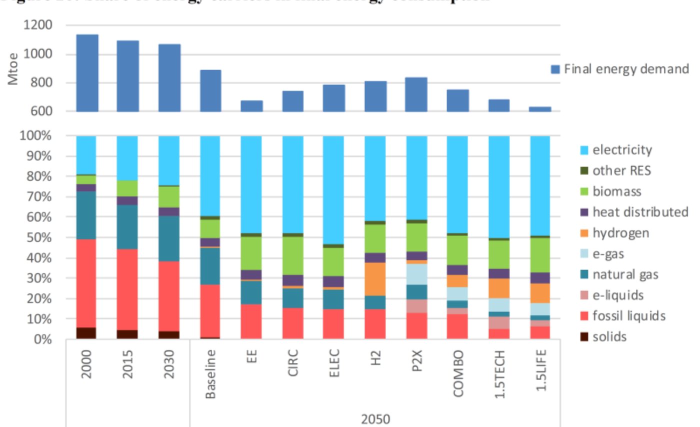
Source: Eurostat (2015), PRIMES.

Figure 17: Changes in primary energy consumption in 2050 (% change)



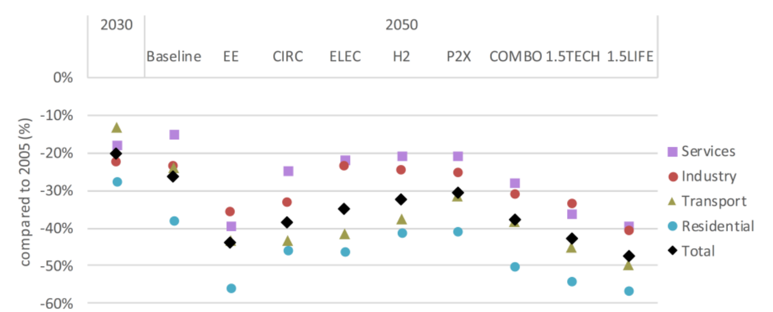
Source: Eurostat (2005), PRIMES.

Figure 20: Share of energy carriers in final energy consumption



Source: Eurostat (2000, 2015), PRIMES.

Figure 19: Changes in sectoral final energy consumption (% change vs 2005)



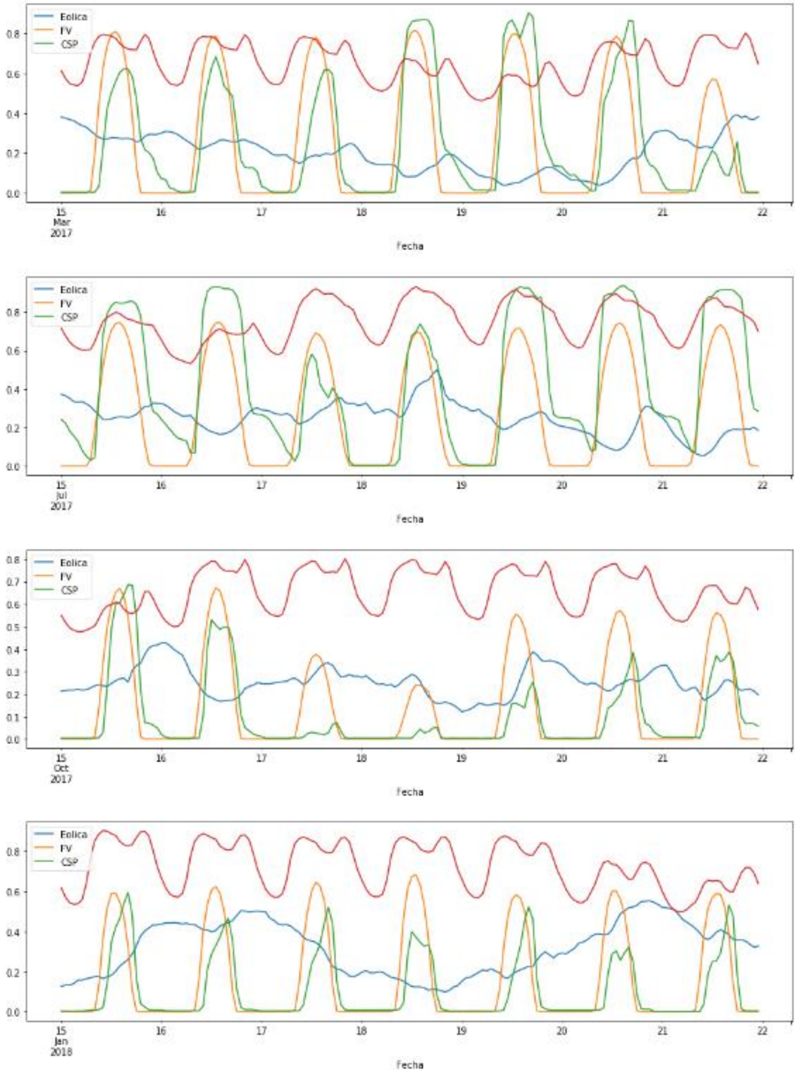
Note: "Services" includes here the agriculture sector.

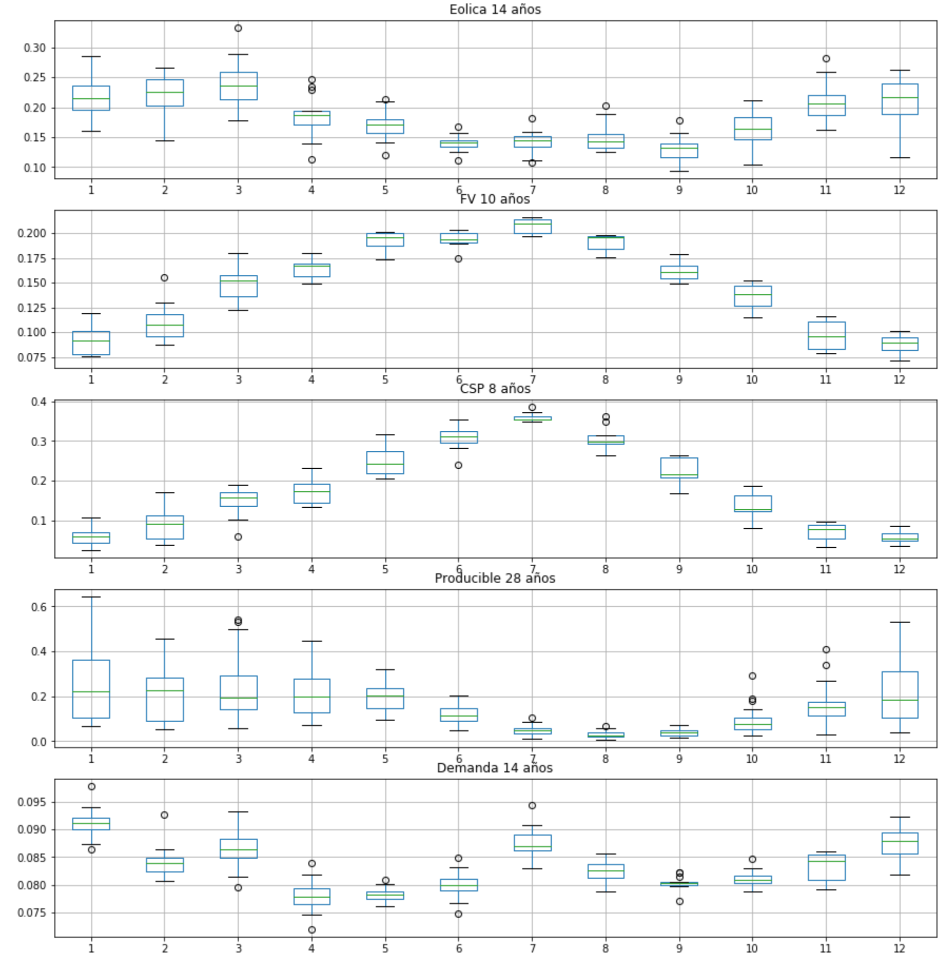
Source: Eurostat (2005), PRIMES.

02

Necesidades de electrificación.
Power-To-X.
Economía Circular.

Necesidad acumulación. CP y MP.

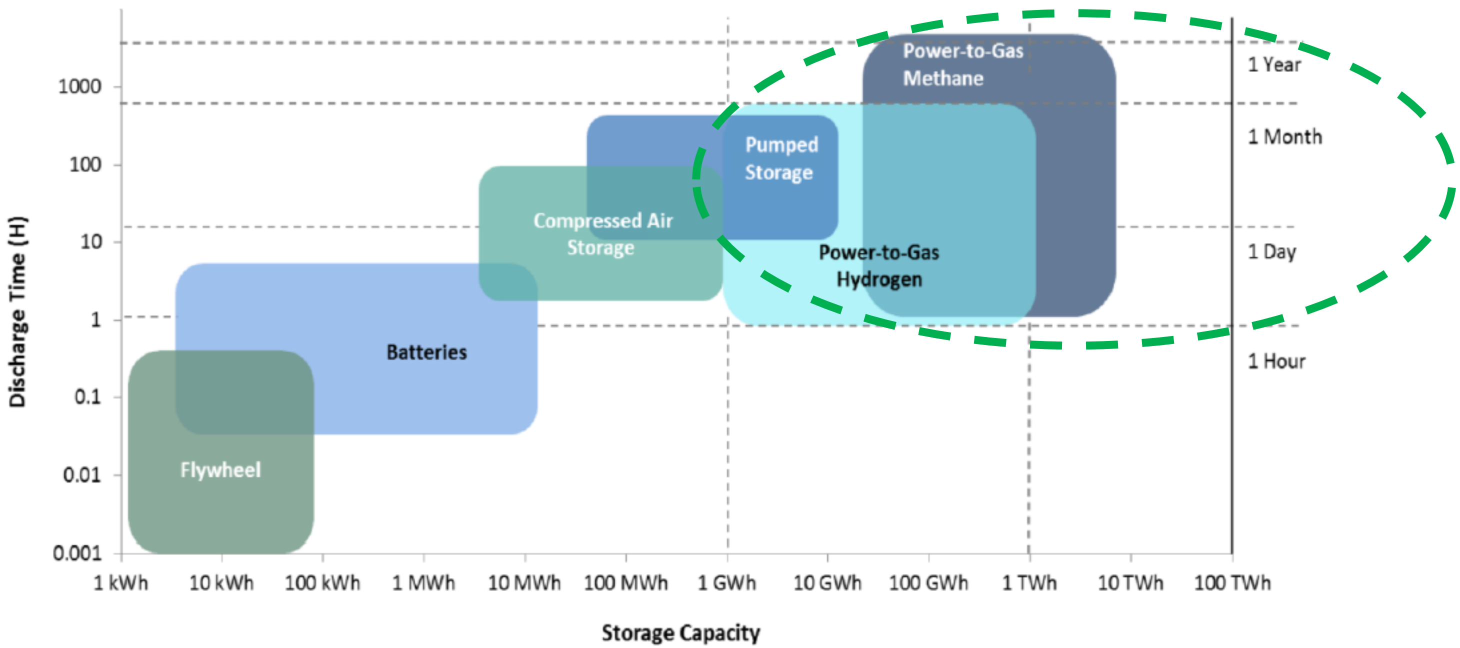




Acumulación Interestacional

- El **almacenamiento de energía** a medio-largo plazo (semanas-meses) será clave

Figure 15: Overview of different electricity storage technologies

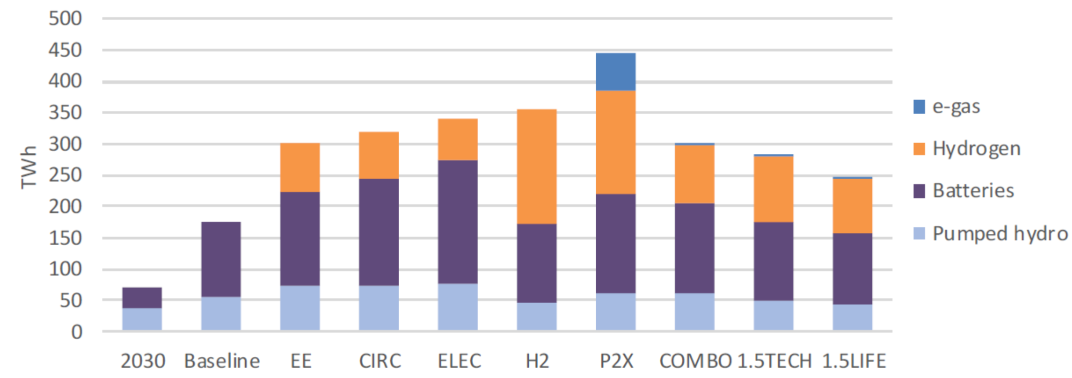


Source: European Commission (2017), Energy storage – the role of electricity[178].

P2X – El papel del H2 renovable

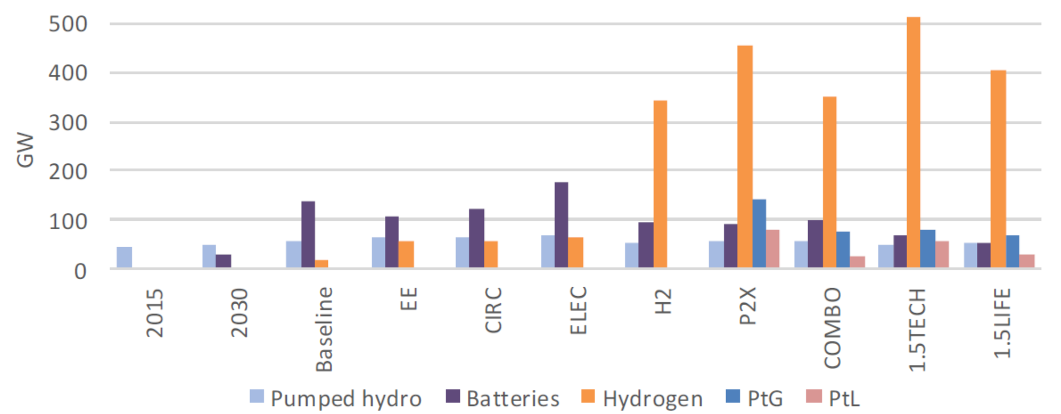
- La **capacidad de almacenamiento se multiplica** varios órdenes de magnitud
- El **almacenamiento de químico de electricidad** en 2050 oscila entre **65 y 220 TWh** en función de escenarios.
- El **P2X** es un actor relevante:
  - Power to gas
  - Power to liquids
  - Power to H2

Figure 26: Electricity storage in 2050



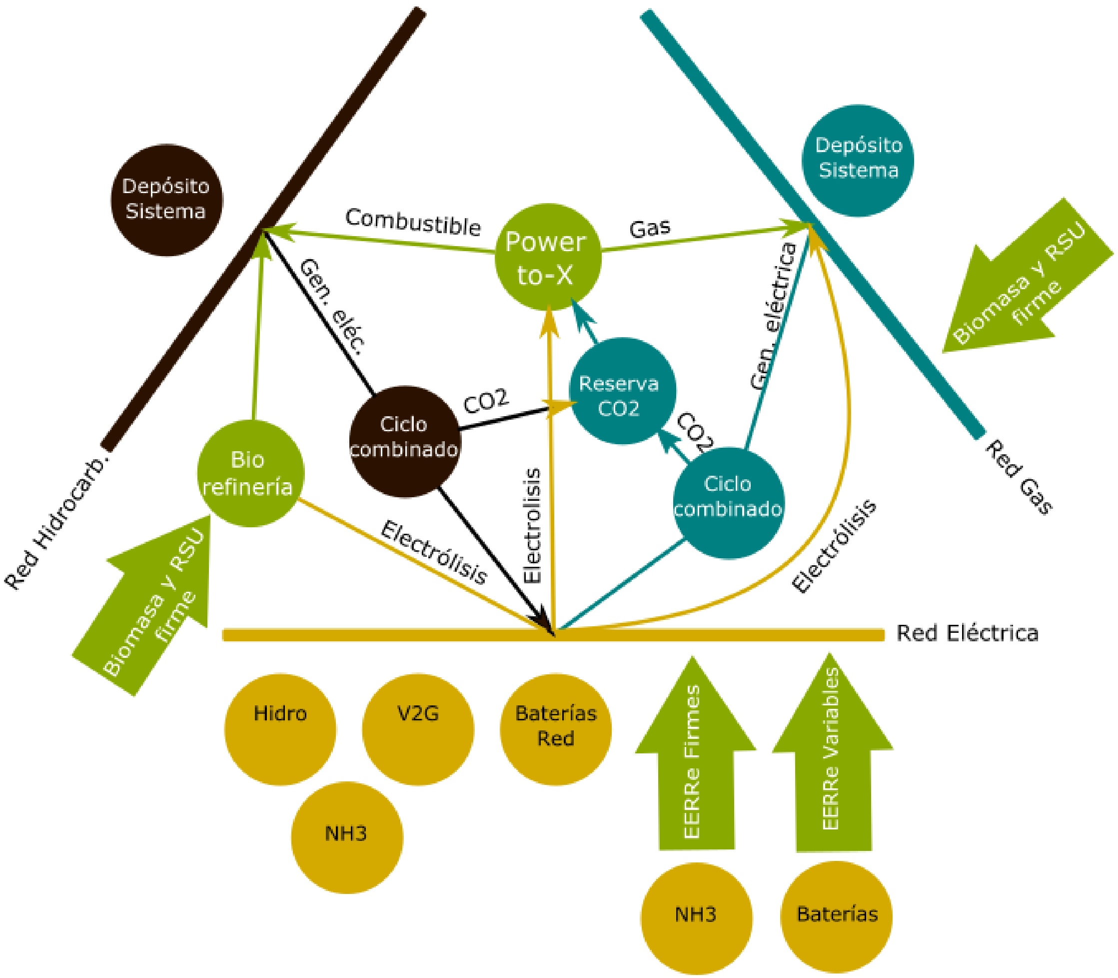
Source: PRIMES.

Figure 27: Electricity storage and new fuel production capacities (2050)



Source: Eurostat (2015), PRIMES.

Unificación de sistemas de gas-electricidad-combustibles.



- Raíz energética son las renovables.
- Fósil desaparece conforme puede ser sustituido.
- El H2 renovable, sólo o recombinado, es un vector de energía y de almacenamiento.
- Las redes de suministro se apoyan entre sí.
- Las redes de suministro actúan como depósitos de acumulación regulando en sistema.
- Otras sinergias se pueden crear en Power-To-Heat.

Bioeconomia circular

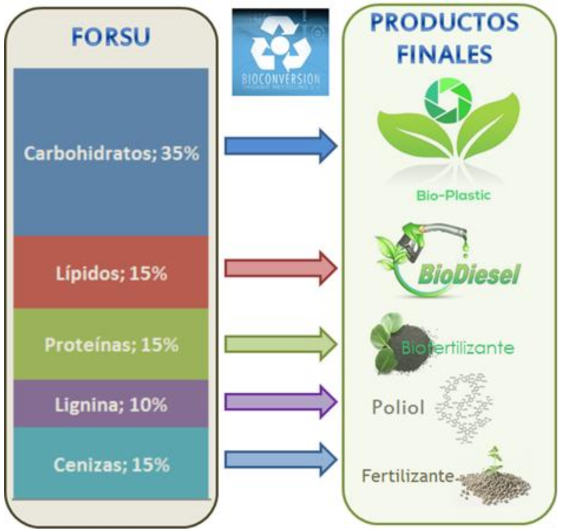
El potencial de los Bioresiduos Urbanos:

- Potencial en España: **2,7 Mt secas/año** (PNIR (2008-2015),
- **Generación constante, distribuida y con una logística establecida:**
  - Recogida selectiva bioresiduos obligatoria en 2023. Objetivo vertido <10% en 2035. Directiva (EU) 2018/851
  - **Coste** de la materia prima **negativo** Tasa aprox 100 €/t seca.
- Composición con **alto potencial de valorización**:

	% base seca	
Carbohidratos	41	(24-57)
Proteínas	15	(11-18)
Lípidos	13	(4-23)
Lignina	9	(4-10)
Inorgánicos	16	(11-24)

Muestra de fracción orgánica de residuos sólidos urbanos
Sample of organic fraction of municipal solid waste

Bioeconomia circular



Biorefineria Urbana Circular:

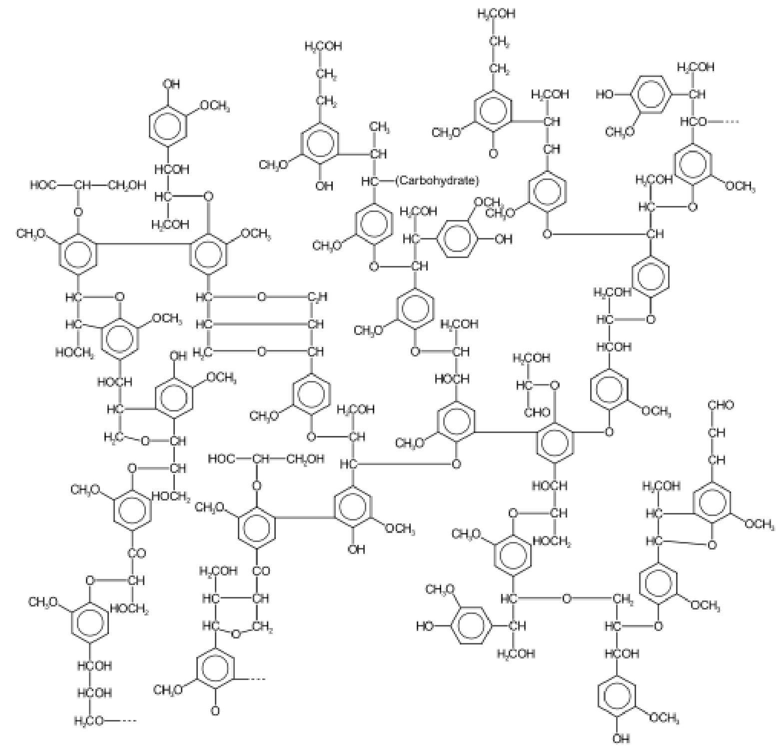
- aplicando el concepto de **biorefineria** para maximizar la **valorización integral** de todas las fracciones presentes en los **bioresiduos urbanos** (carbohidratos, lípidos, proteinas, lignina y minerales) con el objetivo de **residuos cero**
- aplicando el principio de la EU de **valorización en cascada** priorizando por los **bioproductos de alto valor añadido**:

- Bioplásticos biodegradables
- Productos químicos biobasados
- Bioestimulantes agrícolas
- Biopesticidas
- Biosurfactantes
- Biocombustibles avanzados
- Biofertilizantes
- ………….

Bioeconomia circular

El potencial de la lignina residual:

- La lignina es el principal subproducto de la industria del papel (57 Mt/año;) **o**. También es un subproduto de la producción de etanol avanzado.
- Se considera la **principal fuente renovable de aromáticos para el futuro.**
- El **40% de los producto químicos son aromáticos** con una producción anual superior a 23 Mt (25% en Europa). Fenol 8 Mt.



Bioeconomia circular

Valorización de lignina residual:

– Potenciales productos :

- Aromatizante (Vainilla)
- Polifenoles/poliuretanos
- Antioxidantes
- Estabilizantes UV
- Biosurfactantes
- Resinas fenólicas
- Retardantes de llama
- Floculantes
- Dispersantes
- Composites
- Biofertilizante
- …………

03

Conclusiones

- Las renovables van a ser la fuente raíz principal.
- El protagonismo de cada tecnología dependerá de su LCOE y su adaptación al sistema.
- El sistema y el sector industrial tiene que evolucionar mucho.
  - Gestión y procesos.
  - Almacenamiento.
  - Interconexión y modelo de negocio.
- La economía circular ‘industrial’ es una pieza clave del esfuerzo por la transición.

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