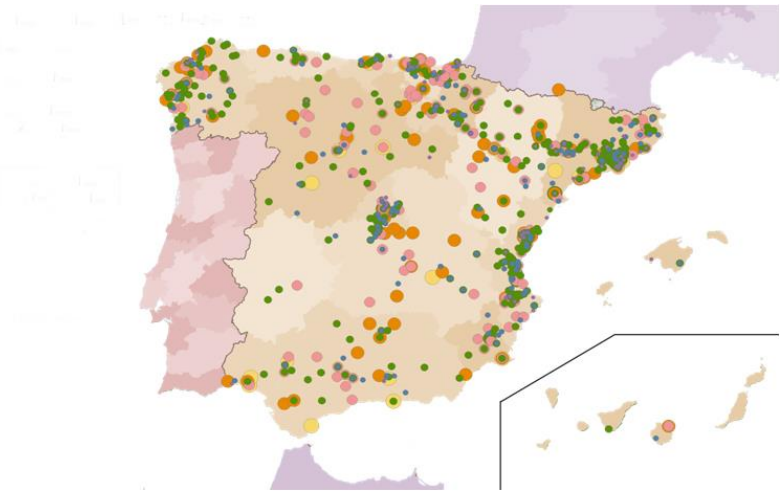
COGEN Europe Country Focus Webinar Series:

SPAIN



Rodrigo Álvarez (ASPAPEL)
Julio Artiñano (COGEN España)
Javier Rodríguez (ACOGEN)

27th of April 2022

INDEX

1. Importance of cogeneration SPAIN

Summary of CHP in SPAIN

- Spanish CHP: 5.600 MW_e installed power generating (28 TWh_e/year), 11% of the national electricity (50% self-consumption) at 600 industries
- CHP accounts for 20 % of national NG consumption (80 TWh). 10% of existing facilities running on HC liquid fuels
- 20% of national industrial GDP produced by CHP means at heat intensive industrial sectors

SPAIN HE CHP

11%

National **Electricity** generation

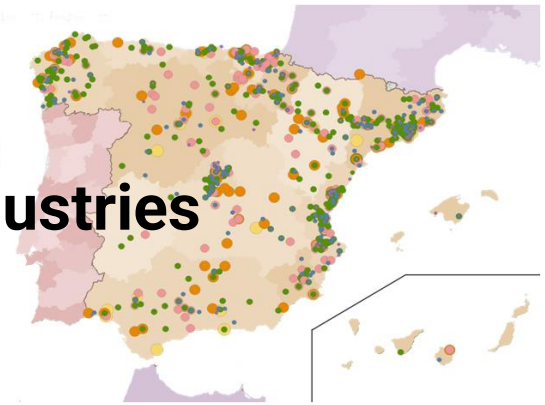
20%

National **GAS** consumption

20%

Industrial GDP

@ 600 **industries**



1. Importance of cogeneration SPAIN

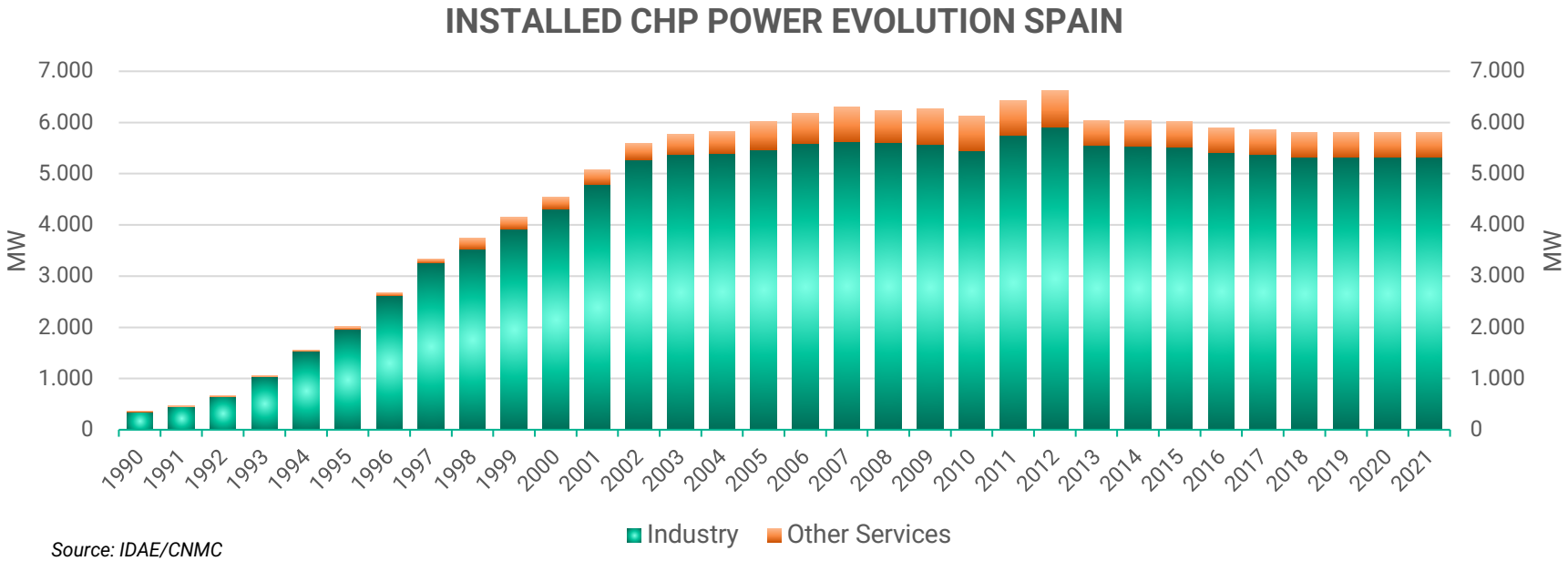
I. Relevance in the energy mix and industry:

I. *Cogeneration is one of the most efficient technologies due to the fact that it produces simultaneously electricity and heat*
II. *Cogeneration electricity production accounts for 10,6% of the total production of the Spanish generation mix*
III. *It has a strong presence in the industrial sector which represents more than 90 of the total cogeneration capacity (6000 MW)*
IV. *20% of industrial GDP is manufactured with cogeneration*
V. *The cogeneration activity is included as a lever to boost the energy efficiency dimension to meet the European climate objectives*

II. Regulated and remunerated activity

I. *Cogeneration is a regulated and remunerated activity It has been included in a stable economic regime since the 90 's*
II. *In 2014 it was introduced the specific remuneration regime for renewables, cogeneration and waste (under the regulatory framework of RD 413 2014 which developed what was stated in the new Law of Electric Sector, Law 24 2013*
III. *The specific economic regime is established by regulatory periods of 6 years The first one with the entry into force of RD 413 2014 (2014 2019 under the new regime*
IV. *Investment in cogeneration will play an important role in the period up to 2030 with an investment and renovation framework for more than 1 200 MW that will contribute to achieve a decarbonized industry through a foreseen auction process*

1. Importance of cogeneration SPAIN

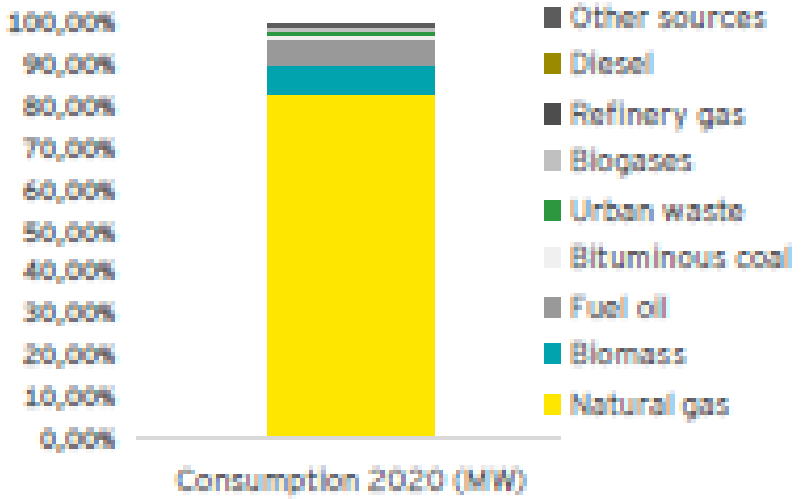


Source: IDAE/CNMC

CHP consumption fuels (GW) 2020

I. Natural gas is the primary energy used for the operation of cogeneration plants, which are powered by gas turbines or gas engines In 2020 natural gas accounted for 83 % of the total consumption, biomass represented 8% and the rest is divided among fuel oil, bituminous coal, urban waste, etc.

II. Cogeneration in Spain, consumes around 80 to 90 TWh



1. Importance of cogeneration SPAIN

The electricity generated by cogeneration technologies has an important role in the Spanish mix and the system efficiency to meet decarbonization targets

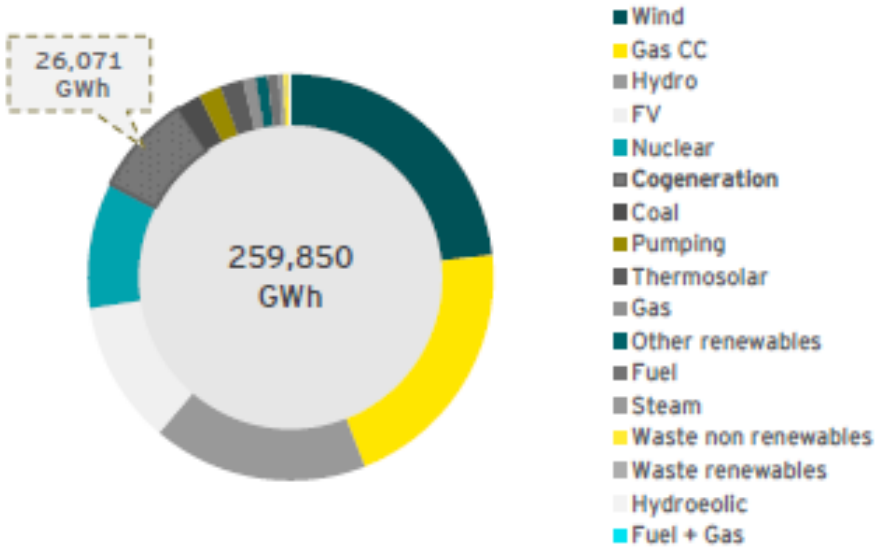
I. Cogeneration accounted for 5% of the total installed capacity in the country in 2021 with a total of 5.64 GW

II. The Electricity production through cogeneration in 2021 was 26 090 GWh, almost 11% of the total production of the Spanish generation mix in 2021 (259 850 GWh)

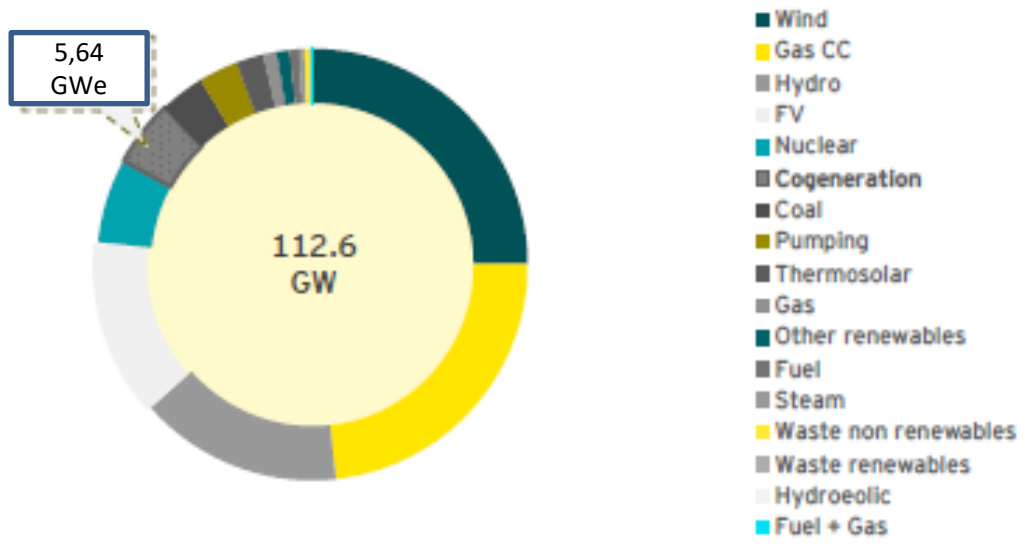
III. 50% of the electricity production from cogeneration is self consumed in the industries themselves and the surplus in nearby supply points

IV. The cogeneration activity is included as a lever to boost the energy efficiency dimension to meet the European climate objectives

CHP generation (GWh) 2021



CHP capacity by technology (GW) 2021



1. Importance of cogeneration SPAIN

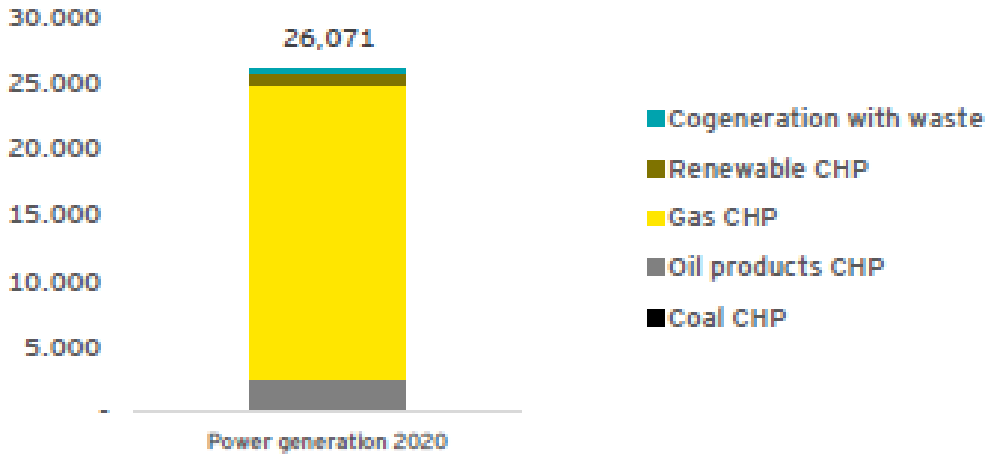
20% of Spanish industrial GDP is produced with cogeneration, which plays a key role in heat intensive sectors

I. Industrial cogeneration fits and is especially suitable for heat intensive industries, that is, those that require large amounts of heat and electricity in their production processes and where energy costs are essential to be competitive

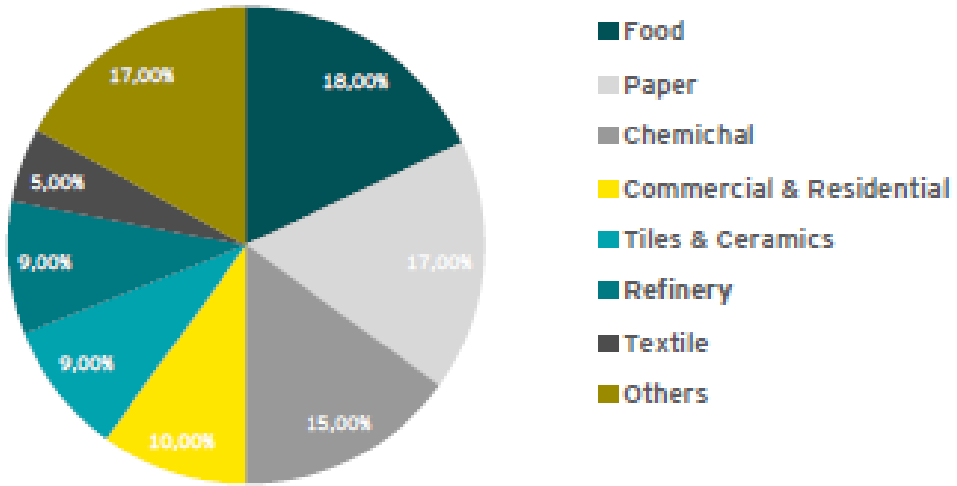
II. The cogeneration in Spain has a strong presence in the industrial sector, which represents more than 90% of the total cogeneration capacity (6 000 MW) Within the industrial sector, the food, paper and chemical industries have a great weight in this mix, accounting for approximately 50% of the total installed capacity

III. In Spain, 20% of the country's industrial GDP is manufactured with CHP and its production is associated to economic sectors (paper, chemical, refining, ceramic, automotive, textile, etc. and it employs approximately 200 000 direct jobs

IV. Heat intensive processes in which cogeneration is used cannot be electrified yet. The use of renewable gases will be key to decarbonize this sector, replacing other more carbon intensive primary energy



CHP generation based on primary energy (GWh) 2020



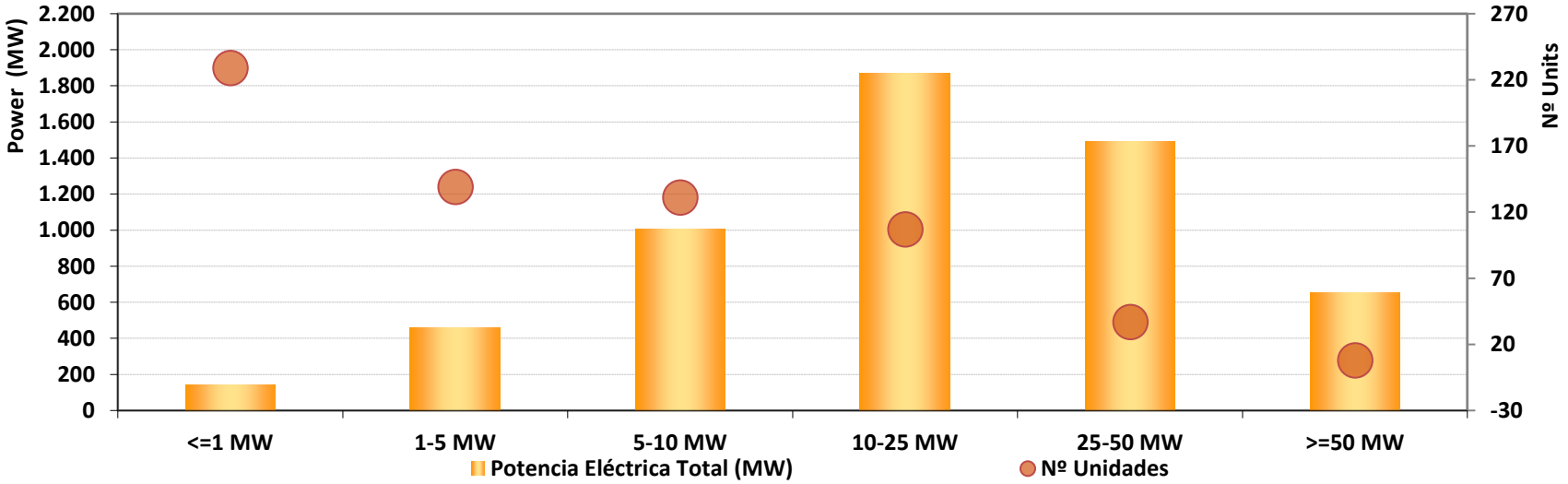
CHP capacity by Sector (%) 2020

1. Importance of cogeneration SPAIN

Spanish CHP Technologies

4.1._Según Tecnología	Nº de Unidades	Potencia Eléctrica Total (MW)	Producción Eléctrica Bruta (GWh)
Ciclo Combinado	47,0	1.543,0	9.853,0
Motor de Combustión Interna	478,0	2.318,0	9.522,0
Turbina de Gas con Recuperación de Calor	97,0	1.439,0	8.811,0
Vapor: Turbina a Contrapresión	11,0	193,0	794,0
Vapor: Turbina de Condensación	4,0	34,0	190,0
Varios [2]	14,0	91,0	534,0
TOTAL	**651,0**	**5.618,0**	**29.704,0**

Fuente: MITECO/IDAE. Datos Provisionales

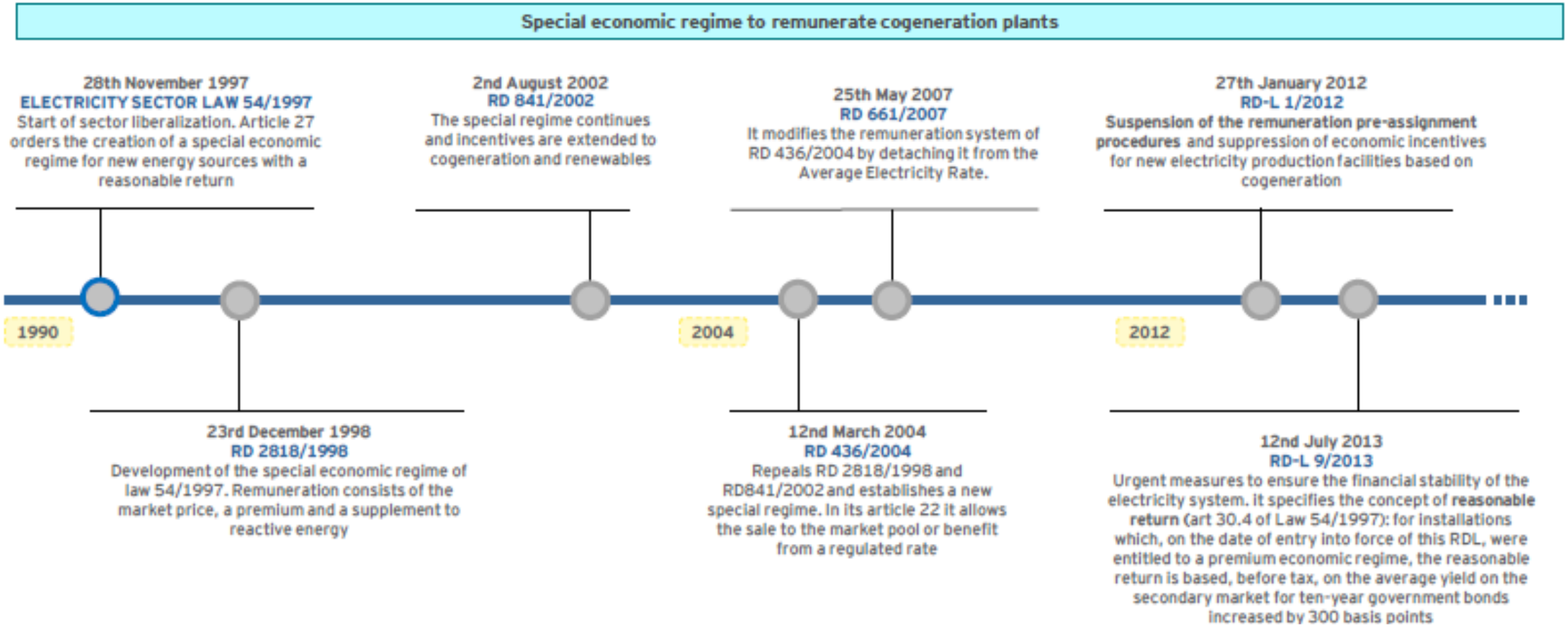


Spanish CHP number of units/ Power ranges

2. CHP Remuneration Regime - Spain

The CHP activity has been included under the special economic regime since the 90's

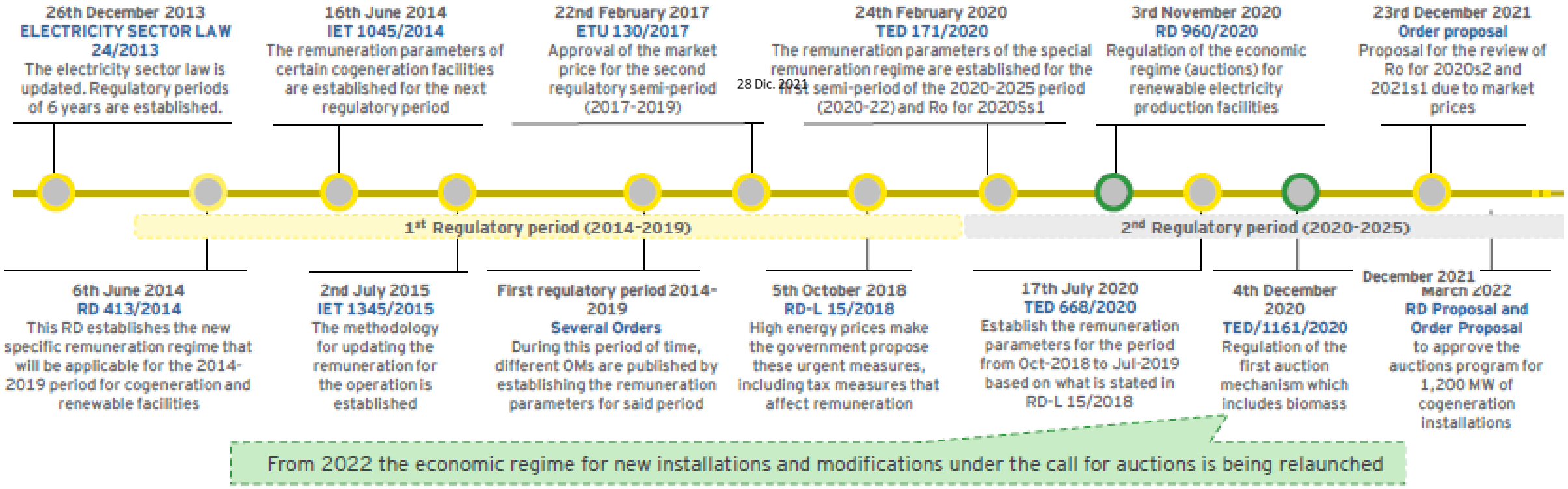
Cogeneration has been included in a stable economic regime since 1994 in RD 2366/1994 that includes cogeneration plants in the special regime. However, the publication of Law 54/1997 sets out the beginning of a special economic regime to remunerate cogeneration plants. This calendar serves to mark the most relevant milestones in terms of the remuneration framework, from the electricity sector law of 1997 to the present day.



2. CHP Remuneration Regime - Spain

The most relevant sector reform was the new Law 24/2013 for the electricity sector and RD 413/2014

Since the sector was liberalized, there was a period from 2012 to 2020, where no new installations were remunerated. RD 413/2014 establishes the specific remuneration regime with a remuneration framework for those installations that had recognized premium remuneration at the date of entry into force of RDL 9/2013.



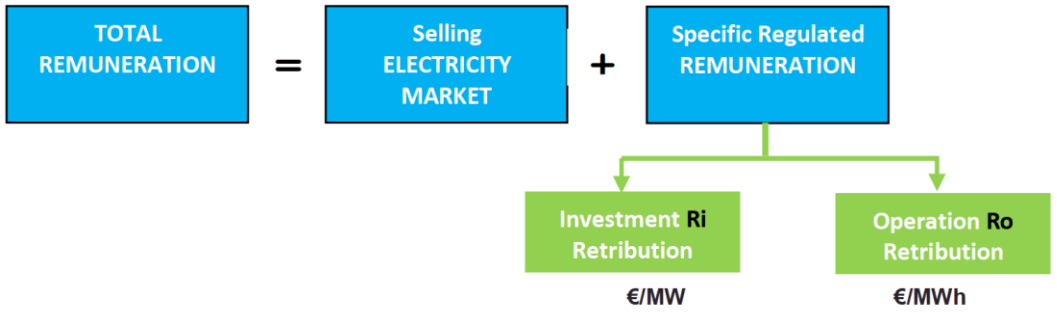
2. CHP Remuneration Regime - Spain

I. Today´s cogeneration retributive principles:

I. *CHP retributive model is based on a series of principles, the main one being that remuneration is based on the principle of* ***reasonable profitability.***
II. *In addition to the remuneration for the sale of energy valued at market prices, CHP facilities receive a specific remuneration during their regulatory useful life (Ro + Ri)*
III. *The regulatory remuneration periods have a duration 6 years, with two semi periods of 3 years*

II. Retributive parameters

I. *Based on RD 413/2014, during their regulatory useful life, in addition to the remuneration for the sale of energy, valued at the market captured price, CHP installations receive a retribution based on two main components: investment retribution (Rinv) and operation retribution (RO):*



- *Rinv Amount (CAPEX - €/MW), estimated per unit of installed capacity, which covers, for a standard plant, investment costs and guarantees reasonable profitability. Rebalances the relevant differences between the expected wholesale electricity price and the observed prices*
- *Ro (OPEX - €/MWh), It is aimed at covering the differential between the operating costs of a standard power plant and the income from the wholesale price of electricity and its aiming coefficient. Art 20 of RD 413/2014 establishes that these parameters will be reviewed, at least once a year and subsequently Art 3 of Order 1345/2015 specifies that they must be reviewed every six months*

II. *The Ministerial Order 1045/2014 approved the remuneration parameters for standard installations (IT) for the first regulatory semi period 2014-2016 and, since then, the remuneration parameters are being updated periodically.*
III. *The updating methodology for the RECORE operation for technologies whose costs depend essentially on fuel was set in the Ministerial Order 1345/2015.*

2. CHP Remuneration Regime - Spain

III. Near Future "in progress" 2022:

A. RDL 6/2022

I. This 30th of march published RDL, splits the 2020-2022 semi-period in two sub periods, 2020-2021 & 2022.

II. 2022 retribution parameters will be recalculated in two months according existing methodology

III. In addition, a new methodology for next period 2023-2025 has been announced, expected to be published in two months (end of May 2022).

B. LEGISLATIVE PROPOSAL OF THE PRODUCTION COST ADJUSTMENT MECHANISM FOR THE REDUCTION OF THE PRICE OF ELECTRICITY IN THE WHOLESALE MARKET – Pending EU decision

I. The aim of this proposal is to avoid the "contagion effect" of the electricity market by natural gas prices spikes, establishing a "market adjustment scheme" that will be internalized by marginal technologies when presenting their offering bids to the electricity wholesale market.

*II. This will result in lower bids and, thus, lower marginal electricity prices, all while maintaining the economic dispatch merit order at European level and current cross-border electricity flows between Spain and France. It will address part of the large gap between price and average cost linked to the **distortion in natural gas prices that is translating into hefty cost increases for firms and shrinking disposable income for households.***

3. Spanish CHP Auction 2022-2025

Proposal Auction Scheme issued dec 2021. Expected final regulation to be published end of 1S2022

1. Competitive bidding process by auctioning of **1,200 MW* of CHP** under support scheme distributed in three yearly tenders. First auction event by end of 2022.

2. CAPEX descendant marginal auction. CHP installations will compete **bidding CAPEX to be** awarded with a regulated remuneration (CAPEX and OPEX regulated incomes above electricity wholesale market price according to Royal Decree 413/2014) for a period of 10 years to be established. The yearly amount of power to be tendered will be established according to competitive pressure criteria. In case auctioned power remains not awarded, it will be reassigned for next auction tenders. **

3. Remuneration and execution period: 10 years awarded remuneration period following start-up of installation. Construction/execution period time for CHP installation to be determined (up to 24-30 months from awarding).

4. 13 different IT's * (Type of installations or installations standards/tendered products)** for auctioning purposes to be granted with regulated remuneration (**OPEX and CAPEX**), as follows:

- Three groups by sort of action:
    1) New plants
    2) modifications/renewal from NG to NG (from group a.1.1 natural gas Royal Decree 413/2014 to a.1.1 (gas))
    3) Fuel Change from liquid/solid HC to NG (form a.1.2 -liquid fuels -fuel and diesel- and coal) to a.1.1 (gas))
- Four power ranges, for each of the three previous sort of action: 0 to 1 MW | 1 to 10 MW |10 to 25 MW | 25 to 50 MW. No standard IT distinction between technologies (gas turbines/CCGT, & combustion engines)
- One IT for new plants of biomass CHP (biomass groups b.6 and b.8 RD 413/2014)

** Possible increasing Under discussion*

*** In example, a CHP plant would bid a % discount off investment/CAPEX initially stablished standard rates according to a portfolio of installations standards. (i.e. 20% off from 1 M€/MW for a 3 MW plant that would be awarded with a CAPEX return 7,35% interest rate and an OPEX of X€/MWhe above electricity pool market price. OPEX is periodically updated considering fuel prices, maintenance, etc..).*

**** 3 sorts x 4 power ranges + 1 biomass IT (groups b.6 and b.8) = 13 IT or standards of installations to be auctioned with corresponding quotas*

3. Spanish CHP Auction 2022-2025

5. **Definition of new plants or modifications/renewals:**
   - New: Installation that has not been previously inscribed in the register of electricity production facilities (greenfield or brownfield location).
   - Modification/renewals: Investments in an existing plant that requires the withdrawal from the economic regime register of an exiting installation. The modification may include adjusting existing power either increasing/reduction/ equal.
6. **Self-consumption of electricity / 5 years term PPA´s options**: a minimum self-consumption CHP electricity value could be required – i.e. 30% in annual terms -, including near-by/proximity electricity consumption that does not receive regulated OPEX. Possibilities to accomplish self-consumptions requirements through 5 years PPA´s agreements.
7. **Hydrogen Ready**: CHP equipment will be prepared to consume 10%(v) of H_2.
8. **Primary energy savings (PES)**: Further requirements to Directive 2012/27/EC regarding >10% PES for "high efficiency"HE qualification will be placed in auctioning conditions in order to achieve **"very high efficiency" conditions (>15% PES).** Failure to comply with the "very high efficiency" condition will imply economical yearly adjustments.

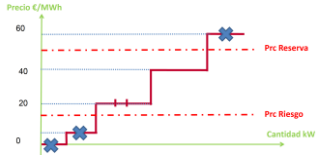
   Efficiency Requirements:

   High Efficiency (HE nowadays):
   P <1 MW ⇒ PES 0
   P ≥ 1 MW ⇒ PES ≥ 10%

   Very High Efficiency (VHE) auctioning requirements
   P <1 MW ⇒ PES ≥ 5%
   P ≥ 1 MW ⇒ PES ≥ 15%
9. **Auction tie-breaks**: In the event of a tie awarded bidding matching, the bid with highest % PES will be awarded first. The awarded set-up % PES will apply throughout the entire regulatory life of the facility. Further random tie-breaks criteria in place.
10. **Legislative texts**: an auction royal decree, order, and resolution. (Package in public consultation December 2021, final adoption and entry into force expected before July 2022 so the 1st auction could take place by the end of year 2022)

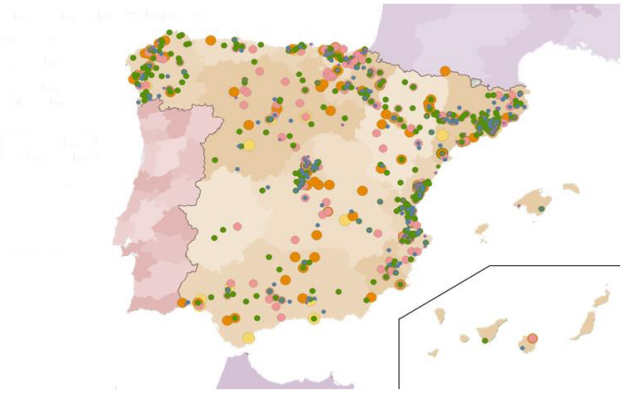
3. Spanish CHP Auction 2022-2025

Some Key Auction Package Perspectives



- **Very High Demand for new/renewals plants** *(expected demand > 2.000 MW vs. 1.200 MW offer): high effective competition.*
- **Large investment requirements** *(≅≥ 600 k€/MW) to accomplish VHE PES & decarbonization to tailored fit industrial needs*
- Some **regulation details pending** on final promulgation of legislative auction package *(power slots, number of products, final economical parameters, 5 years PPA possibilities and others). Long term updated scheme in place in 1S2022 for next 10 years period.*
- **CHP auction as the pillar to undertake integral multi-assets management and energy transformation at industrial sites:**
  - High potential for **hybridization electrical RES (photovoltaic, eolic, etc.)** self consumption at industrial sites under existing industry grid access capacities (> 1.800 MWe PV) with effective regulation already in place**.**
  - Synergies with **H2 generation projects** linked to industrial sites/CHP.
  - Promotion of other **energy related valorization** assets (biogas WWTP, residues, biomass/solar/electrical boilers etc.) oriented to flexible & **CHP integrated operation**.
- **Proximity selling/Local electricity markets** potential under progress development.
- **Boost of digitalization and energy (electricity|gas|CO2) market management** (day-ahead, continuous intra-day, operation markets, md-long term forward energy and risk management): **flexibility** of CHP operations/**management optimization**.
- **Very High industries interest/tendence for outsourcing/ESCO´s/ 3rd part long term agreements.**

THANKS FOR YOUR ATTENTION!



CONTACT US AT:

www.cogenspain.org

www.acogen.es

Main sources: Acogen, Cogen España, REE, CNMC, MITERD, OMIE, E&Y, NTT Data and others