GLOBAL CHP MARKET OVERVIEW

For COGEN World Coalition
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CHP MARKET OVERVIEW
Methodology and Sources

Methodology

- Desk research, including data collection; comparison and analysis of data from different sources
- Priority given to IEA data for consistency, as data from other sources do not cover the same period
- Analysis of CHP market development in the period 2011-2022, with focus on CHP fuel mix, CHP electricity and heat generation (when available), and electricity share in total electricity generation. The main report has more data on big markets in each region with additional information.
- Most of the slides are 2021 data as the 2022 IEA data was not complete enough to use. However for EU-27 2022 data were used.

Sources

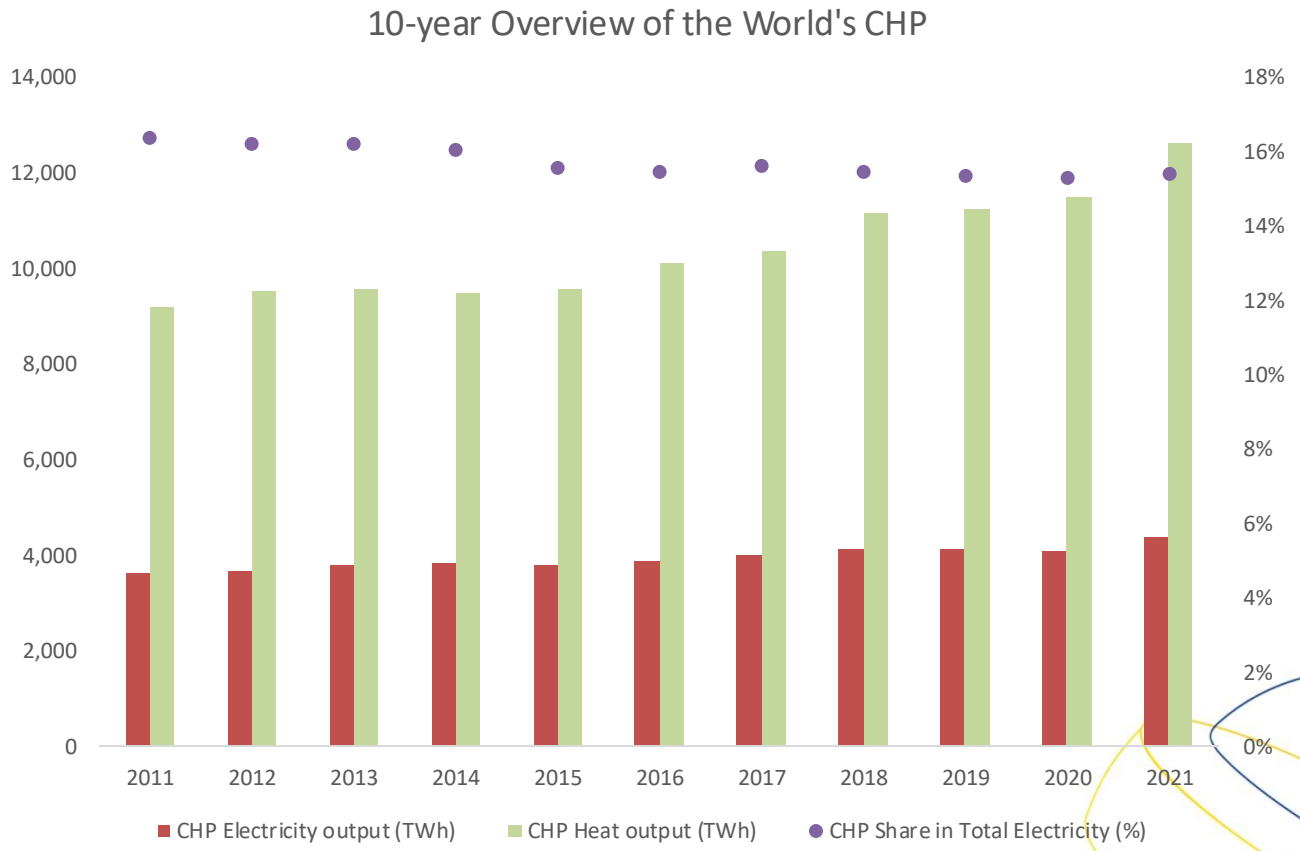
- IEA, Eurostat, National Statistics Offices
- Other sources (COGEN Europe, Global Energy Monitor, Digest of UK Energy Statistics (DUKES)…)

World

Electricity produced by CHP plants in 2021:

4,398TWh

- Electricity generation values from IEA database include condensing parts which may lead to overestimated values.
- We can observe an **increase of the CHP electricity output of 757TWh between 2011 and 2021.**
- During the given period, **CHP Heat output went up from 9193TWh to 12642TWh.**
- On the contrary, **the share of CHP in the total electricity generation has slightly decreased nearly 1%.**



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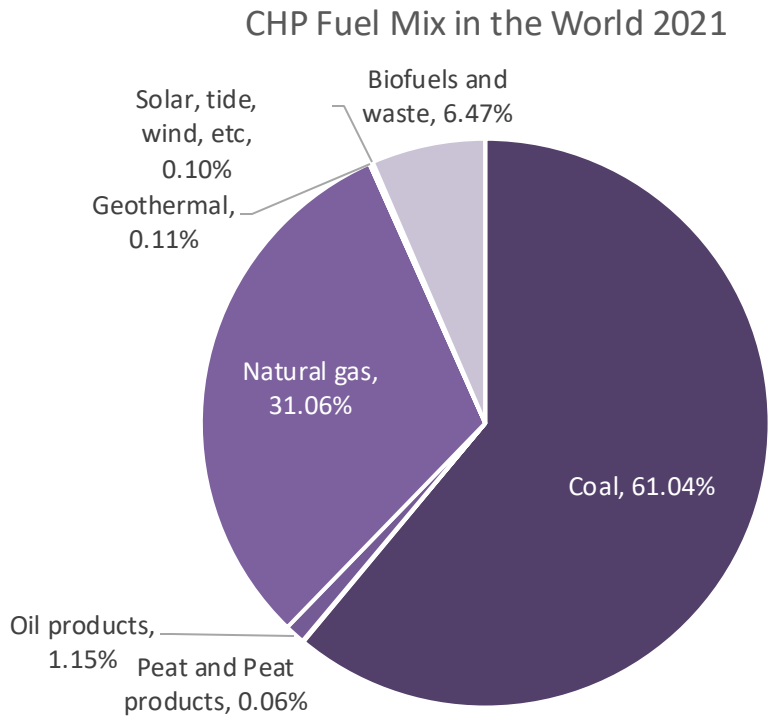
CHP Fuel Mix



Commentary:

- Fossil fuels continue to dominate with coal leading at 61%
- Biofuel is a growing share, now at 6.5%
- 98.6% of the fuel mix share is held by 3 fuels: coal, natural gas and biofuels and waste.

Future trends:

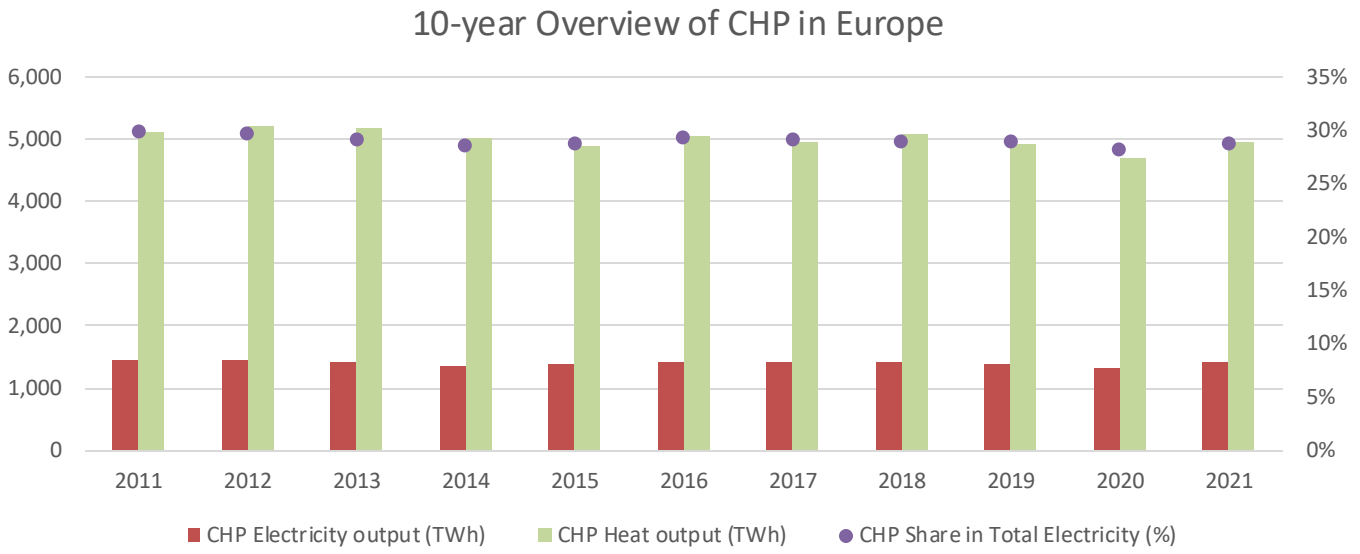
- **Decline of Coal and Oil**: Coal and oil are likely to see reduced shares due to environmental regulations and the shift towards cleaner energy.
- **Shift towards Renewables**: The share of renewable energy sources like biofuels, solar, and wind in CHP is expected to increase as countries pursue decarbonisation goals.

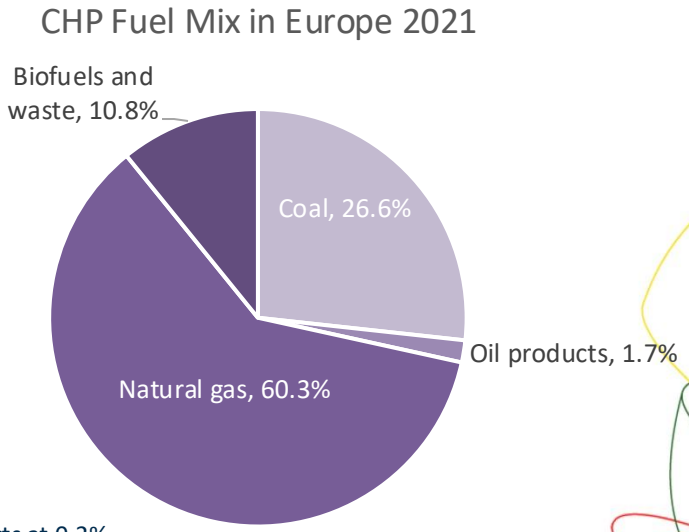
Europe

Electricity produced by CHP plants in 2021:

1,406TWh

- CHP represents **29%** of the electricity produced in Europe.
- Minor variations in CHP electricity generation during the last 10 years **(between 1450 and 1320 TWh)**.
- CHP's share of total electricity production stays stable at **~29%.**
- The main fuels are **natural gas and coal**, followed by biofuels and waste.





- Other fuel types include:
  - Peat and Peat Products at 0.2%
  - Geothermal at 0.3%
  - Solar, tide, wind, etc at 0.1%

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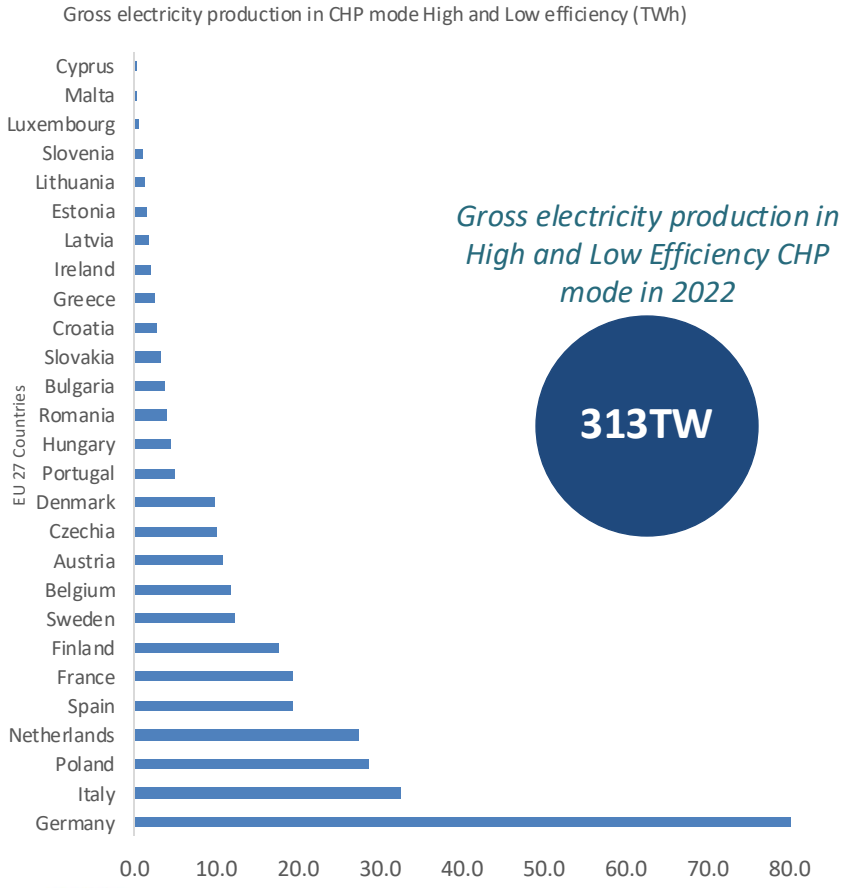
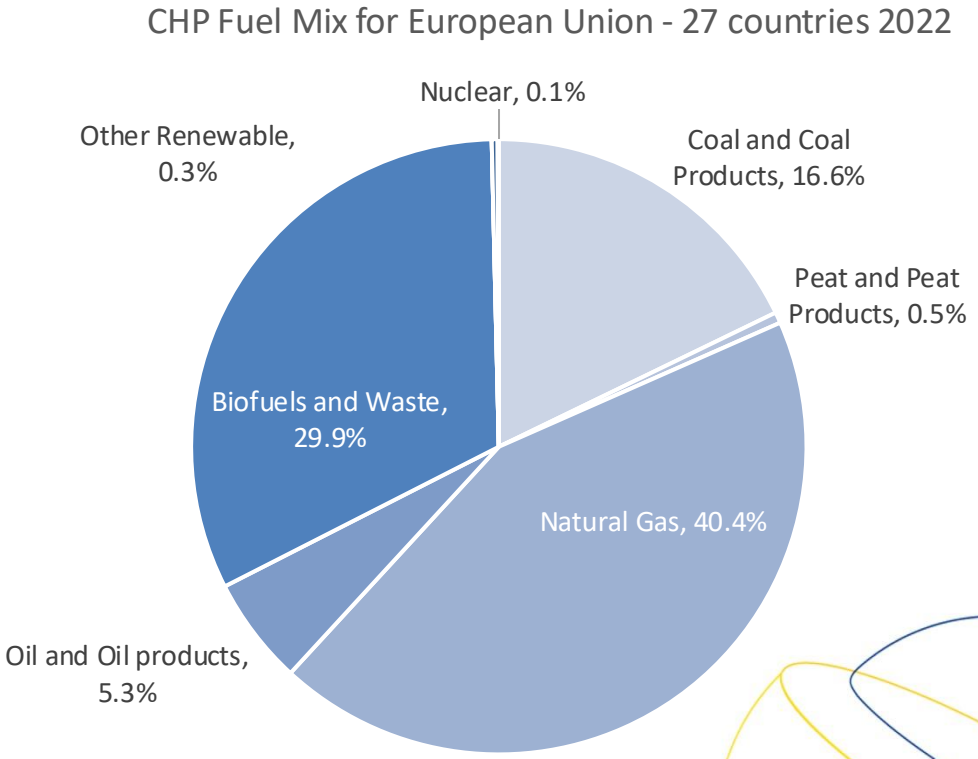
Additional details on EU27 (2022 Eurostat)

- Germany are still the leading producer of CHP in EU27, followed by Italy, Poland and the Netherlands.



Gross electricity production in High and Low Efficiency CHP mode in 2022

313TW



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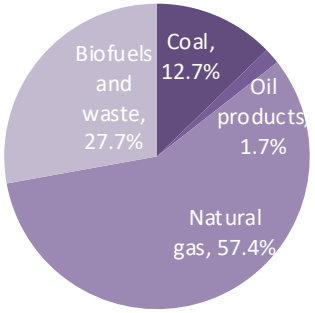
Specific Countries within Europe

Germany

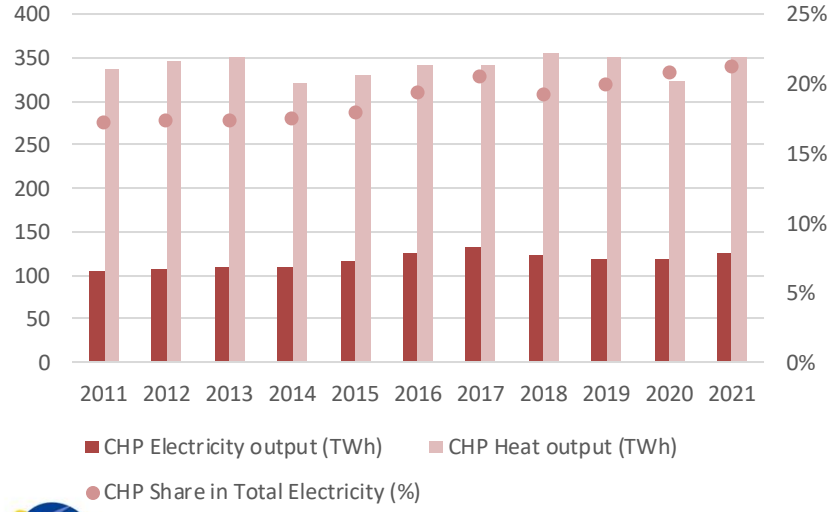
Electricity produced by German CHP plants in 2021:

125TWh

CHP Fuel Mix in Germany 2021

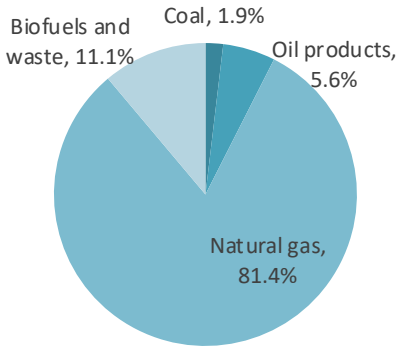


10-year Overview of CHP in Germany



Italy

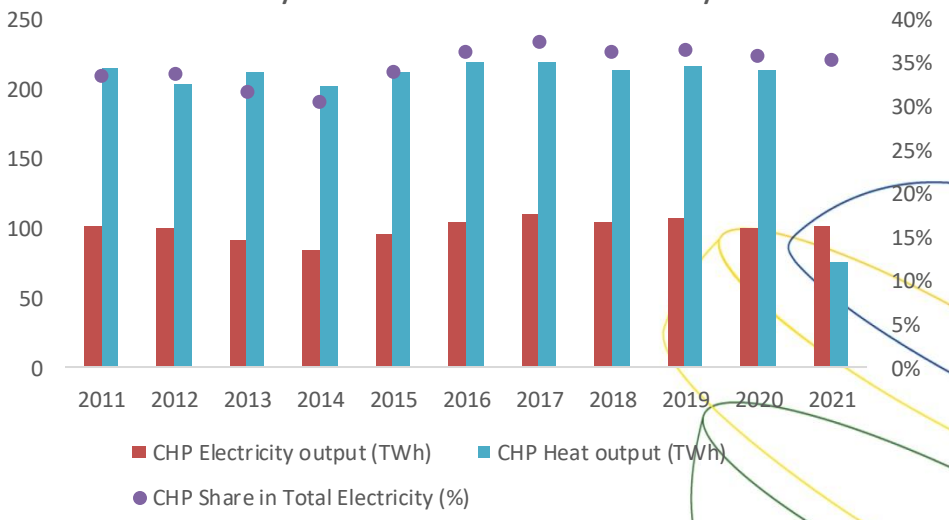
CHP Fuel Mix in Italy 2021



Electricity produced by Italian CHP plants in 2021:

102TWh

10-year Overview of CHP in Italy



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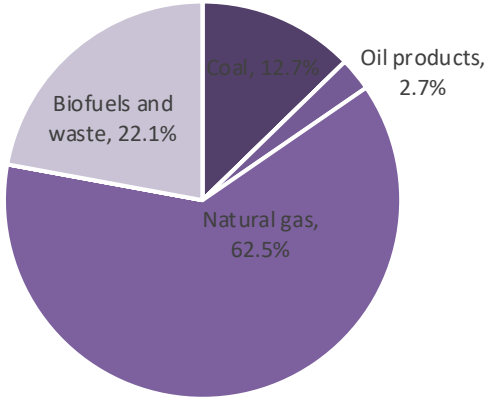
The Netherlands

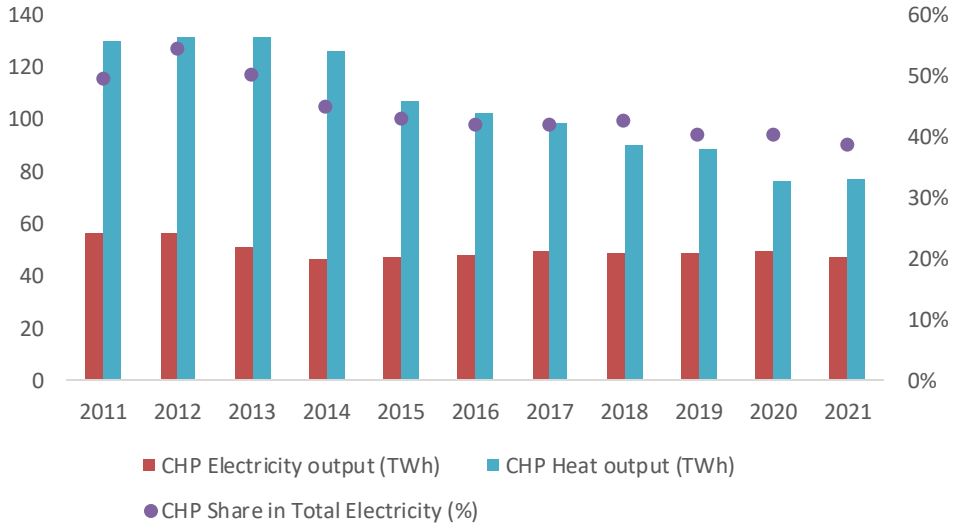
CHP Fuel Mix in the Netherlands 2021

Electricity produced by Dutch CHP plants in 2021:

48 TWh



10-year Overview of CHP in the Netherlands

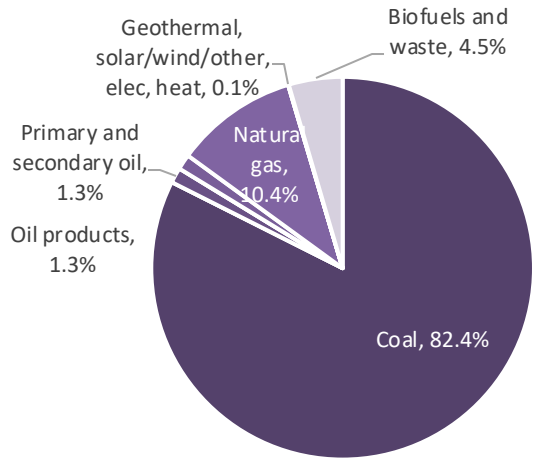


Poland

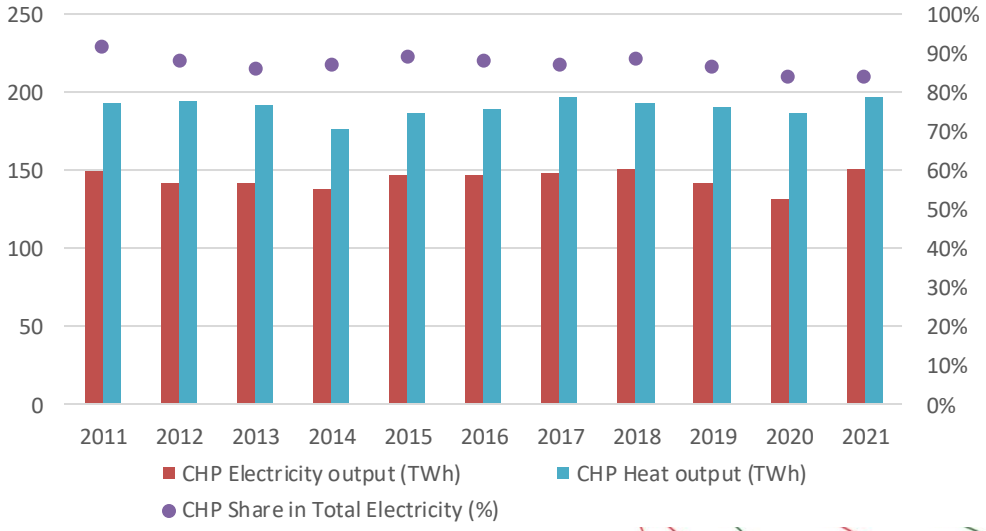
CHP Fuel Mix in Poland 2021

Electricity produced by Polish CHP plants in 2021:

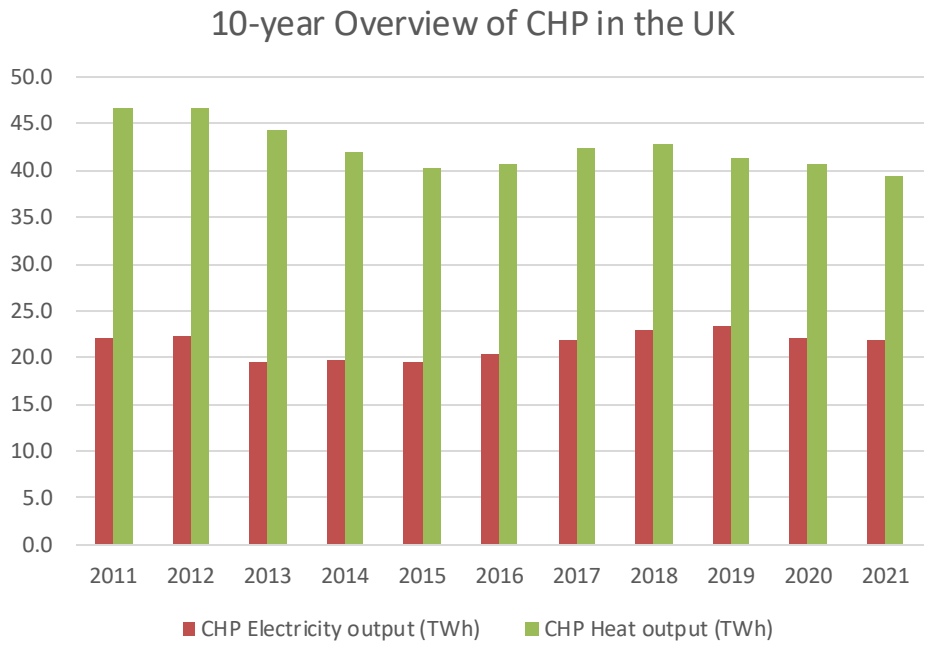
150 TWh

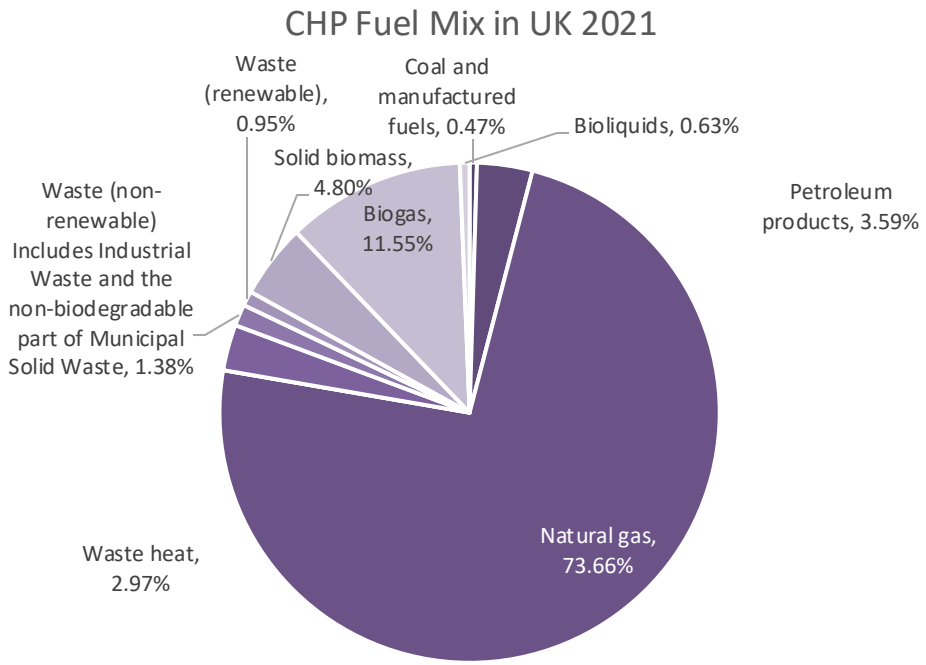


10-year Overview of CHP in Poland



United Kingdom





- CHP electricity production has slightly **decreased** over the period **between 2011-2021, from 22 TWh to 21.8 TWh,** with small variations throughout.
- **Natural Gas makes up 74% of the CHP fuel,** coal only a small 0.5%.
- **CHP Heat output has decreased from 46 to 39 TWh** over the same period.

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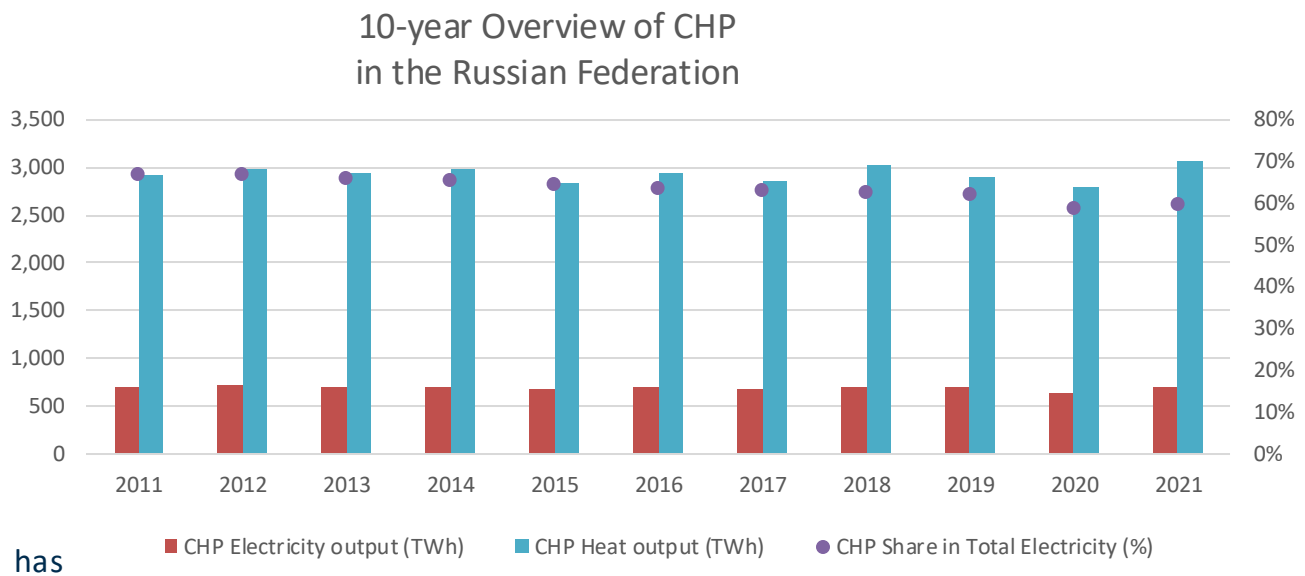
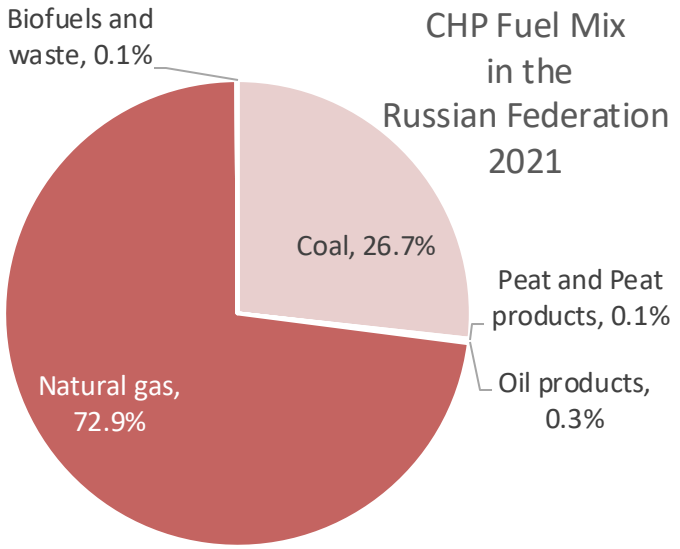
Russian Federation

Electricity produced by Russian CHP plants in 2021

694TW



- CHP electricity production has **slightly decreased** over the period **between 2011-2021.**
- **CHP's share in total electricity output also decreased around 7%** in that same period
- **Natural Gas and Coal** make up **99.6%** of Russian CHP's fuel mix



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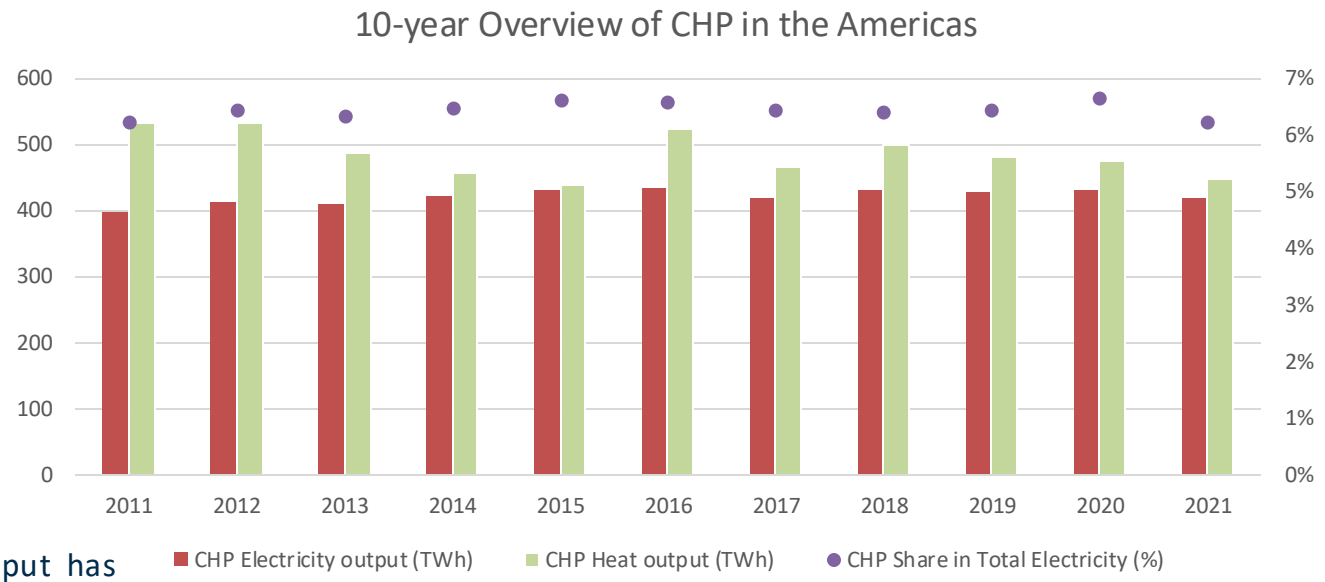
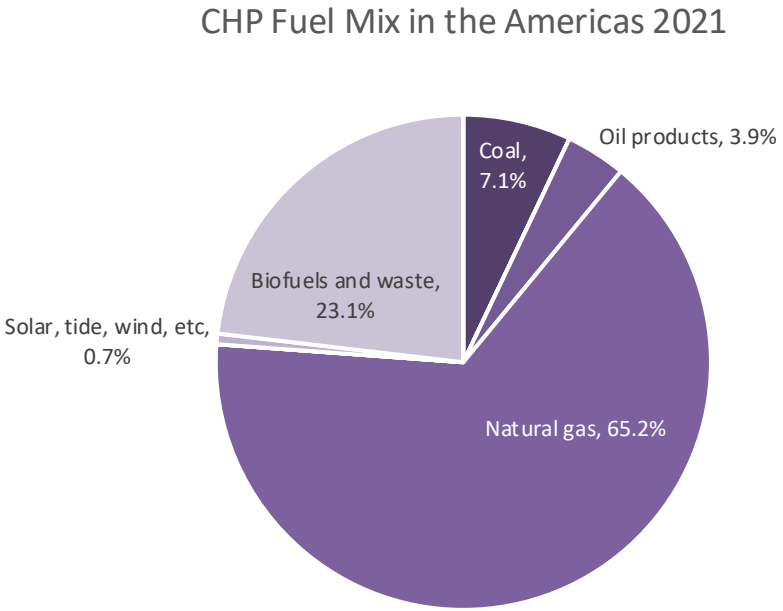
The Americas

Electricity produced by the Americas' CHP plants in 2021:

418TWh



- CHP's share in total electricity output has stayed constant between **6-7% between 2011 and 2021** with **very little variation.**
- The two largest CHP fuel are **Natural gas** which dominates at **65%** and **Biofuels and waste** at just **over 23%.**
- The share of **coal** used as CHP plant fuel has **reduced from 14% in 2011 to 7% in 2021.**
- **CHP heat output** has **decreased from 531TWh to 449TWh in the same period.**



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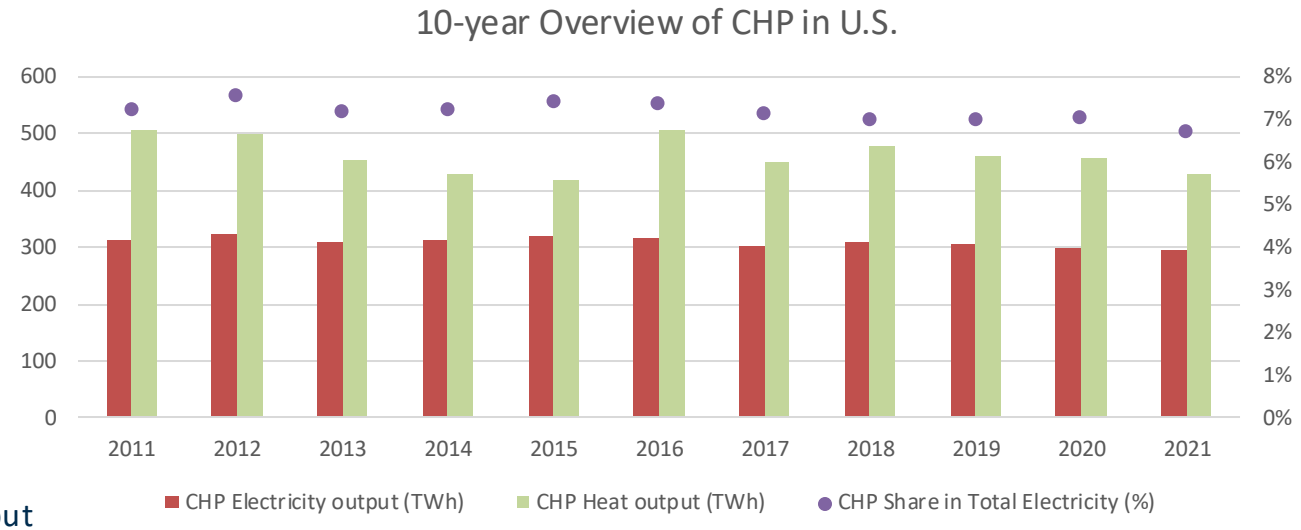
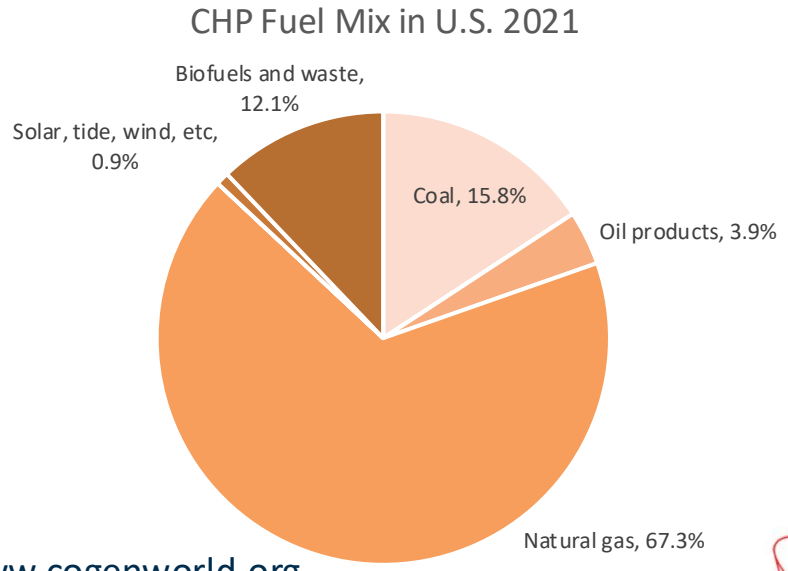
United States

Electricity produced by United States' CHP plants in 2021:

294TWh



- Little variation of the electricity output **(between 294 and 325TWh).**
- CHP electricity output reached its **lowest** level in 2021 over the past ten years.
- Stable evolution of the CHP electricity share **(~7%).**
- As the U.S. is the main producer of electricity by CHP in North America, its fuel mix is almost the same as the North American one. **Natural gas** is the main fuel.



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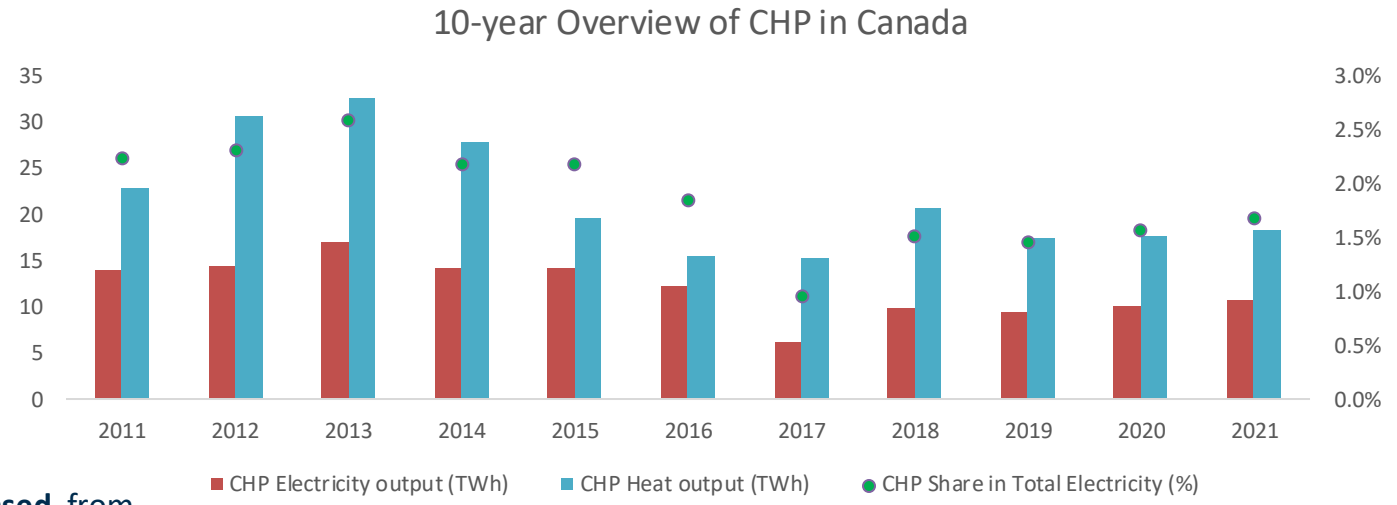
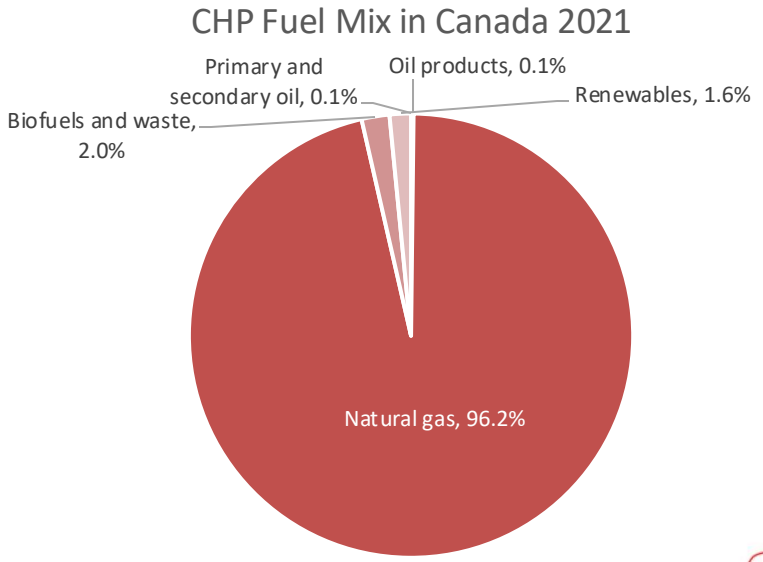
Canada

Electricity produced by Canadian CHP plants in 2021:

11TWh



- CHP electricity output has **decreased** from **14 TWh to 11 TWh** over the 10-year period.
- CHP electricity output reached its **lowest** level in **2017 at just 6 TWh**.
- CHP electricity share has varied **between 2.6% and 1%** but is **now at 1.7%.**
- **Natural Gas** in the main fuel source for CHP plants in Canada at **over 96%**



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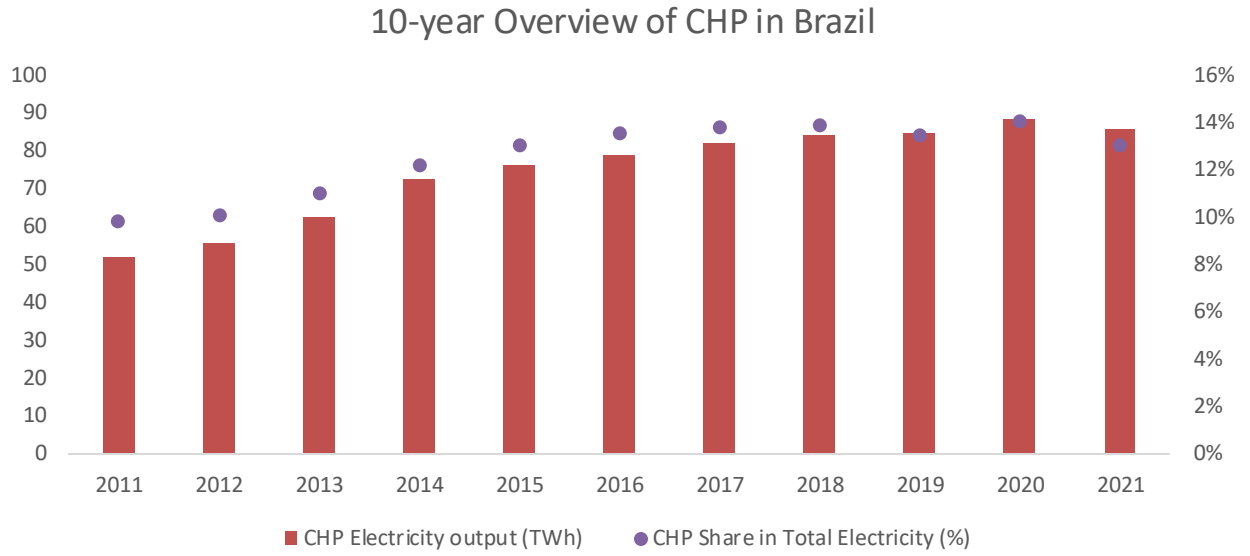
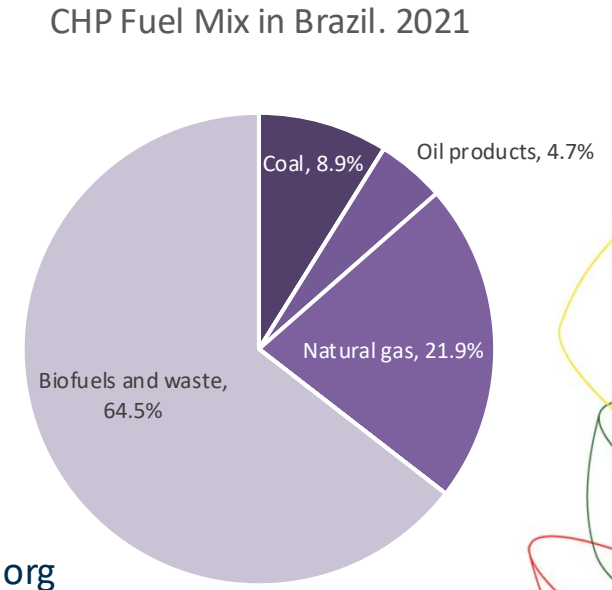
Brazil

Electricity produced by Brazil's CHP plants in 2021:

86TWh



- CHP electricity output over 10 years increased **from 52TWh to 86TWh**, an annual growth rate of 5.2%.
- CHP's share of electricity was almost **13%** in 2021, slight decrease from 2020.
- The main fuel used to power CHP is **biofuels and waste** at over **64%**.



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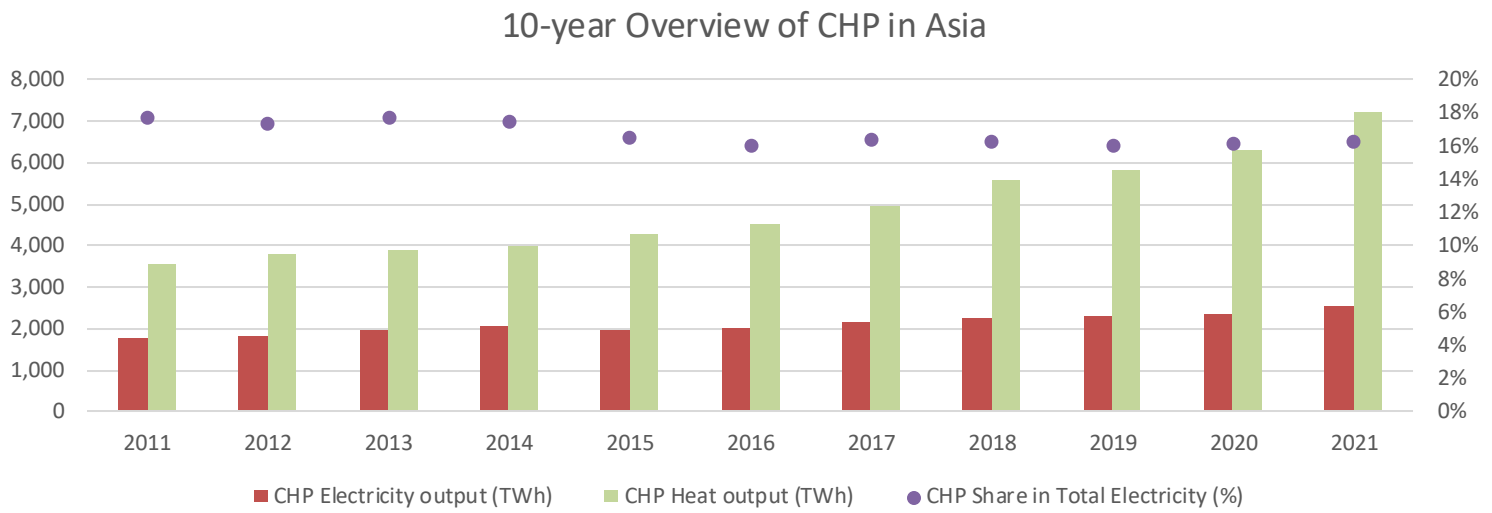
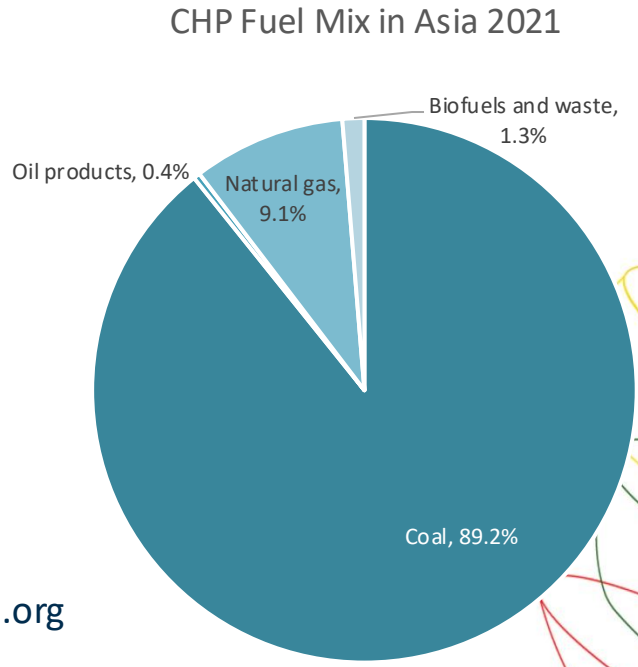
Asia

Electricity produced by Asian CHP plants in 2021:

2552TWh



- Increase of the electricity output **from 1,773TWh to 2,552TWh.**
- Despite an increase in output, CHP's share of electricity has decreased steadily since 2013 **from 18% to 17%.**
- Asian electricity markets are prioritising other technologies for development.
- Asia's main fuel remains **coal, and this is due to China's very high consumption of coal to power CHP**. The rest of the fuel used in Asia is almost exclusively natural gas.
- Leading countries: China, Japan, India



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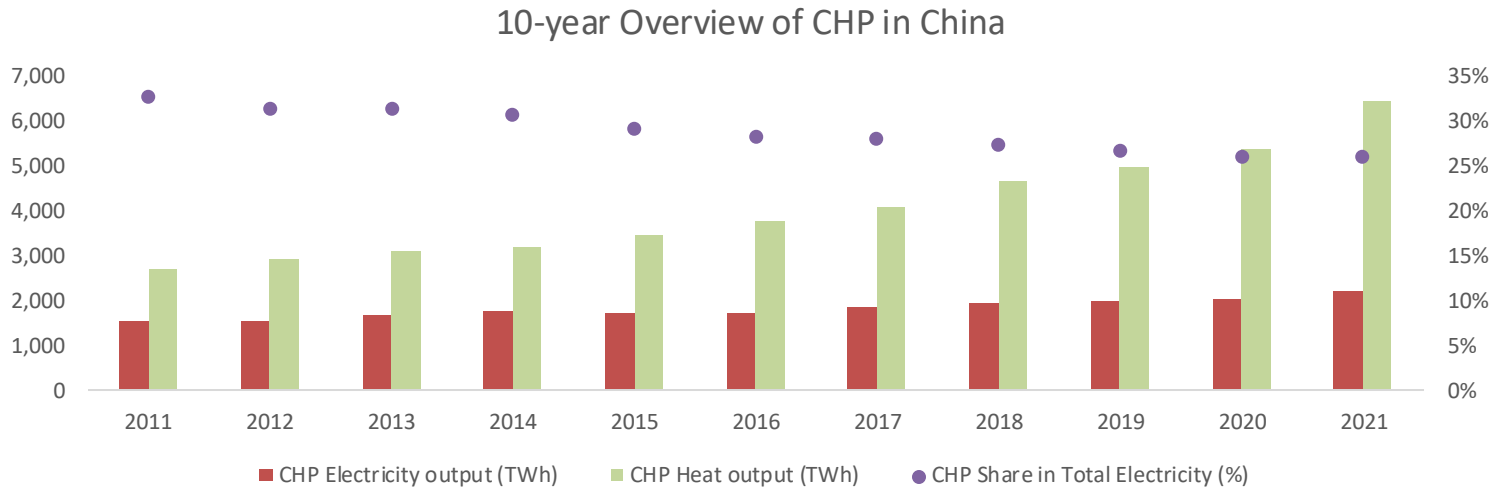
China

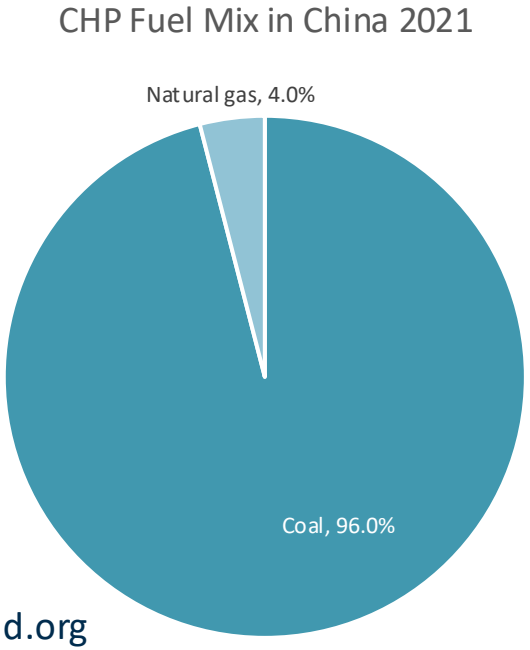
Electricity produced by CHP plants in 2021:

2,238TWh

China represents **68%** of all CHP electricity produced in Asia.



- Increase of the electricity output **from 1,548TWh to 2,200TWh.**
- Decrease of the CHP electricity share in the total electricity generation **(from 33% to 26%).**
- China does not seem to develop its CHP capacity at the same rate as its electricity demand. This suggests that China prioritises other technologies.
- **Coal** largely dominates the CHP fuel market in China. Natural gas has only a share of 4%.



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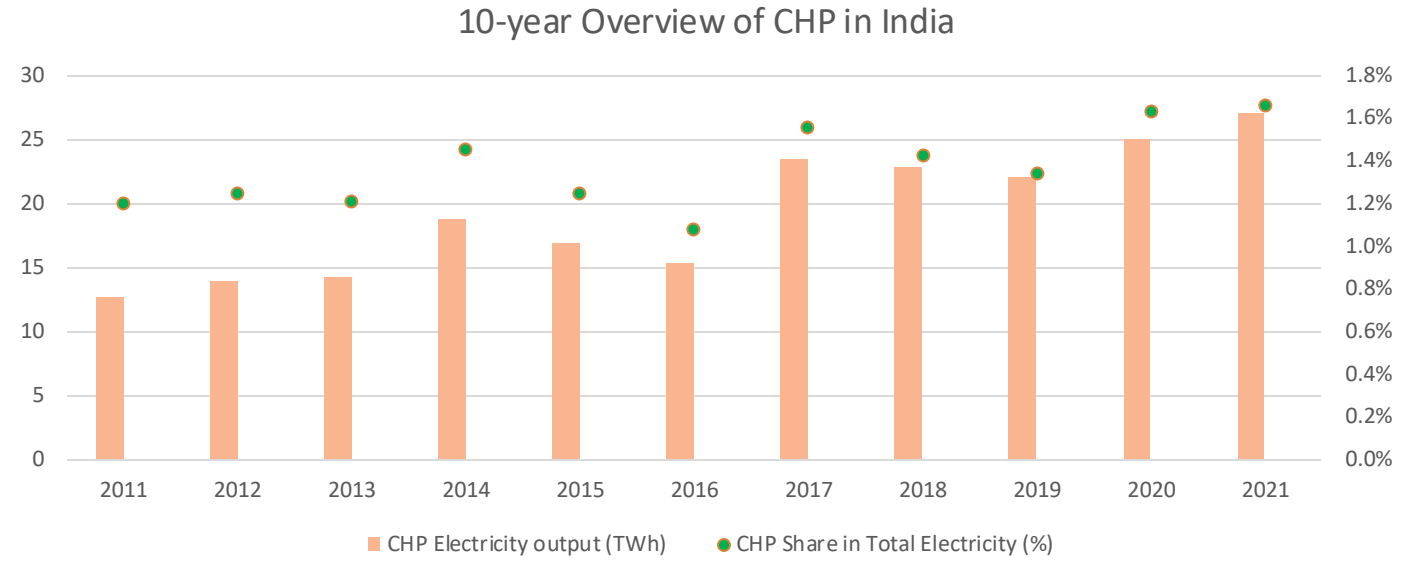
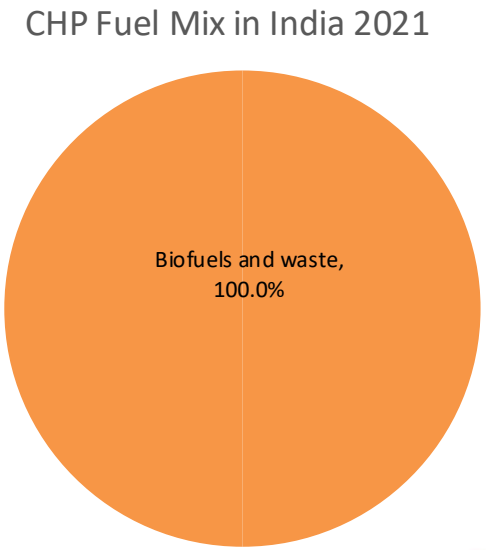
India

Electricity produced by Indian CHP plants in 2021:

27TWh



- Increase of the electricity output **from 13 TWh to 27 TWh** over the 10-year period.
- Small increase of the CHP electricity share in the total electricity generation **(from 1.2% to 1.7%).**
- **Biofuels and waste** dominates the CHP fuel market in India, making up 100% of the fuel.



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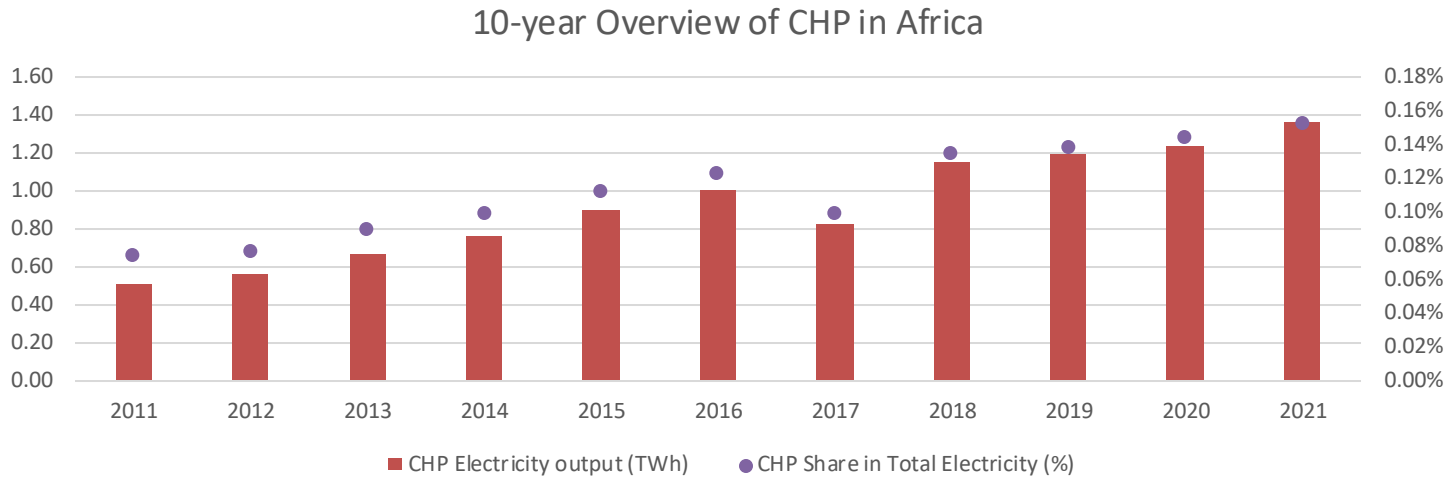
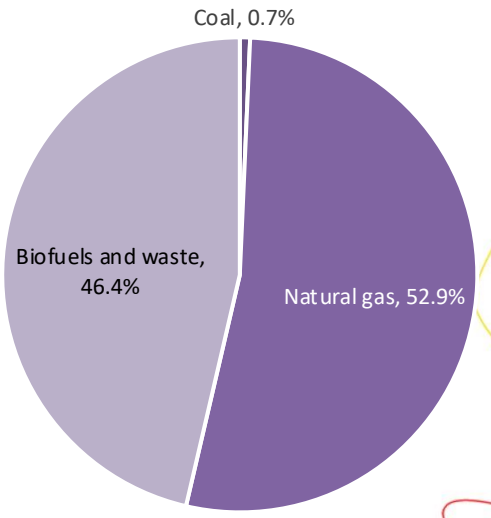
Africa

Electricity produced by African CHP plants in 2021

1.36TWh



- Increase of the CHP electricity output **from 0.51TWh to 1.36GWh.**
- The share of CHP electricity output in the African electricity generation is insignificant. In 2021 it was **0.15%.**
- According to the Energy balance table of Africa (IEA), CHP is powered with **biofuels and waste and natural gas**.
- No complete data from the IEA to do analysis by African countries.



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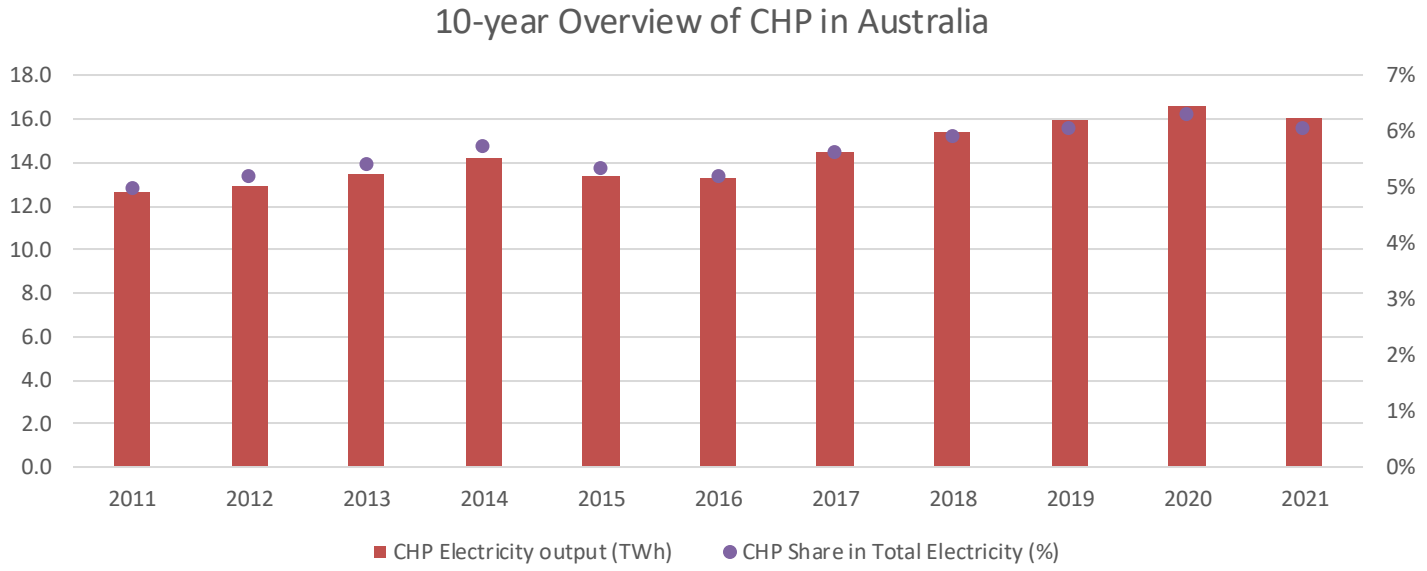
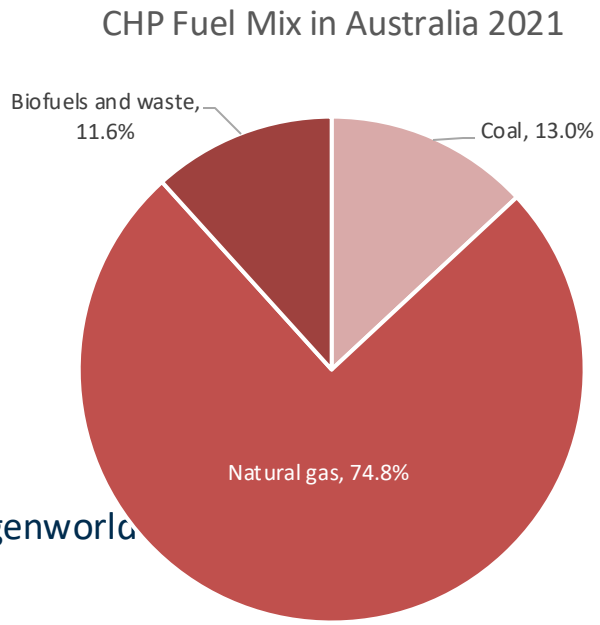
Australia

Electricity produced by CHP plants in 2021:

16.7TWh



- Small variations of CHP electricity output **(between 12.6 and 16TWh).**
- CHP's share of electricity remains constant **(5-6%).**
- High share of **natural gas** in CHP fuel mix. Coal, biofuels and waste are used in the similar proportions.



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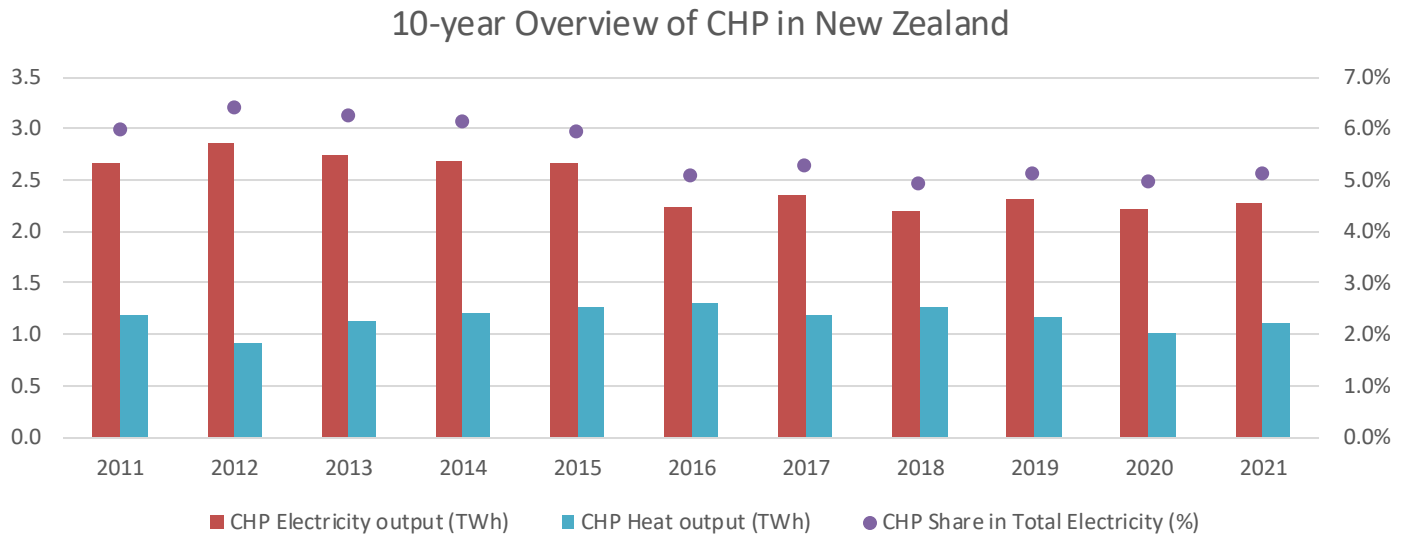
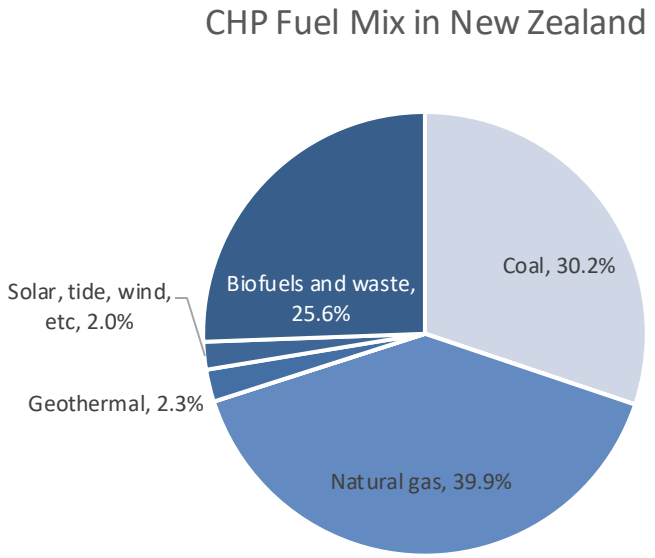
New Zealand

Electricity produced by New Zealand's CHP plants in 2021:

2.3 TWh



- Small variations of CHP electricity output **(between 2.2 TWh and 2.9 TWh). Decrease of 0.4 TWh since 2011.**
- CHP's share of electricity remains constant **(5-6%).** But has **decreased since 2011.**
- **Natural gas, coal and renewables in near equal shares of 1/3. High percentage** of Geothermal and solar, tide and wind **compared to rest of the world**



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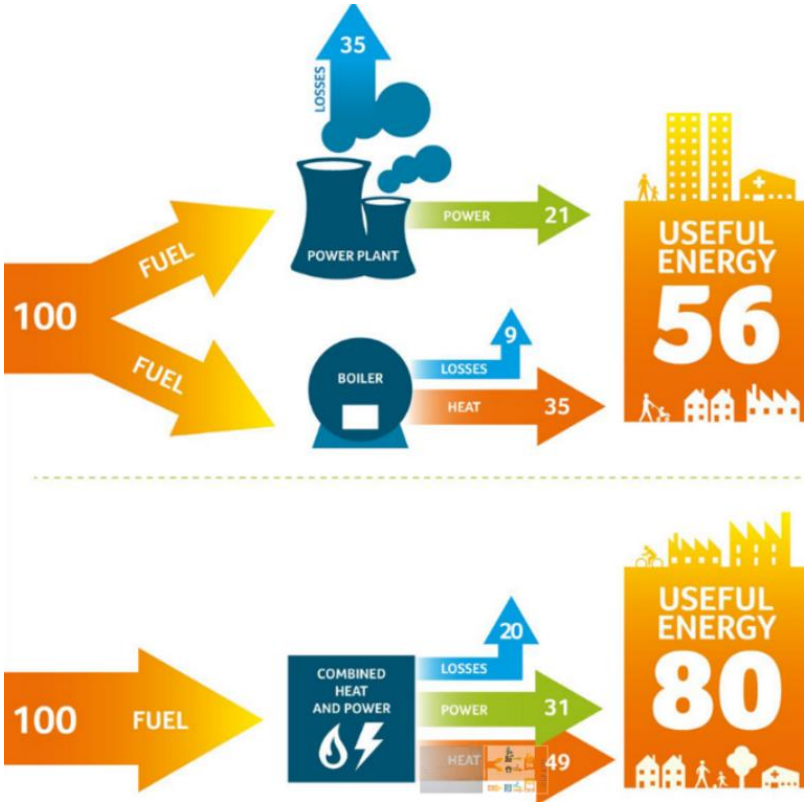
Current and future trends of CHP Market

	Geography	Technology	Fuel	Size	End-Users
Current situation	Asia Pacific is the largest and the fastest growing market in the world. Europe and North America have a developed, but stagnating CHP market.	Gas and steam turbines are the two main technologies on the market.	Coal and natural gas are currently the most used fuels in the world. Biofuels & waste are still marginal.	Large capacity units still dominate the market because of their extensive use in industrial sector (refineries, chemical plants etc…)	Industries such as refineries, chemicals, pulp and paper, food and beverages are currently the main end-users of cogeneration. Commercial and residential facilities (hospitals, universities, district heating) in lesser measure.
Forecast	Growth will come mostly from Asia (India, China) due to the industrial expansion. Growth in South America is also expected to continue. On the contrary, Europe and North America will see CHP role diminish, at best stagnate, due to current oil/gas prices and tighter GHG emissions norms.	Fuel cells are expected to be increasingly used in the next years, as it is a technology with clean by-products (water and heat). Micro-CHP fuel cell have already emerged on the market. Larger CHP fuel cells begin to be installed in the US, Japan and South Korea.	Transition from coal-based generation to cleaner sources is assumed, but low. Gas should still have an important part to play because of its relatively low greenhouse emissions compared to coal and oil. However, due to current geopolitical situation, unstable and unpredictable oil and gas prices, the share of new CHP running on fossil gas will eventually drop. More stringent GHG emission standards will also penalise gas fired CHP, worsening the business case. While it is expected to observe an increase in use of renewable sources, this will be marginal and cannot fully replace coal and gas as CHP fuels. Hydrogen should experience a rapid growth linked to the fuel cell emergence in the CHP sector. However, in short and medium term the business case will not be strong.	High demand for smaller size units (up to 10MW) from residential and commercial end-users. Use of Micro-CHP to replace domestic boilers.	Increase in the commercial and residential CHP installations: CHP as a key technology for city and district level utilities. Power and heat produced by utilities can be used on-site, distributed to the local facilities or transmitted to the grid/district heating. Data Centres are driving demand for gas turbines and gas engines. Mostly non-CHP at present, we expect that to change

Assessment of Waste Heat from the Power Sector

- **Waste Heat Potential**: Up to 50% of fuel energy in power plants is lost as waste heat.
- **CHP Efficiency**: CHP systems can capture this waste heat, boosting efficiency to 60-80%.
- **Applications**: Recovered waste heat can be used for:
  - District heating
  - Industrial processes
  - Absorption cooling
  - Additional electricity generation
- **Challenges**:
  - **Infrastructure Needs**: Retrofitting plants for heat recovery is costly.
  - **Geographical & Seasonal Constraints**: Heat demand varies by location and season.
  - **Opportunities**: Policies support waste heat recovery for energy efficiency and carbon reduction.

Assessment of Waste Heat from the Power Sector



- Transforms more than 80% of the energy into useful heat and electricity for factories, offices, public buildings and homes.
- Saves up to 40% energy compared to the separate supply of electricity and heat from conventional power stations and boilers.

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CHP Prospects for each Continent

Europe also has a well-established CHP market with strong policy support:

- The region has ambitious carbon reduction goals and energy security policies stimulating CHP investment.
- Natural gas is currently the primary fuel for CHP in Europe.

Asia-Pacific is positioned for significant CHP market growth:

- Rapid industrialisation, urbanisation, and economic growth are driving new CHP installations.
- China and India are leading the growth in power generation and consumption.
- China is the world's largest CHP market and expected to maintain its leadership position.
- The region is currently transitioning from coal-based to gas-fired power generation, creating opportunities for CHP

North America has a stable and expanding CHP market:

- The U.S. and Canada have established CHP infrastructure with government incentives supporting efficiency improvements.
- Natural gas is the dominant CHP fuel, with the region's abundant supply contributing to its attractiveness.

South America shows moderate CHP market growth potential:

- Brazil led the region with policies encouraging energy efficiency and industrial cogeneration.
- CHP has potential in mining, creating CHP opportunities.
- Challenges include regulatory barriers and economic instability in some areas, which can impact investment in new CHP projects.

Africa has emerging potential for CHP deployment:

- Industrial growth and urban expansion are increasing energy demand across the continent.
- Limited grid reliability and high electricity costs are driving interest in decentralised CHP solutions.

Summary

- North America, Europe, and Asia-Pacific are the regions with the most developed and fastest-growing CHP markets, while South America, Africa, and the Middle East present emerging opportunities with varying fuel mixes and growth rates.

EU Global Gateway: Boosting Clean Energy and Infrastructure in Africa and South America

EU Energy Projects Plan Boosts Africa and South America

The EU's Global Gateway initiative aims to unlock investment and enhance trade with developing nations, offering up to €300 billion between 2021 and 2027. Africa and South America are key beneficiaries, with several flagship projects focused on clean energy and infrastructure development.

Key Projects:

- **Southern Hydrogen Corridor** (Tunisia-Algeria)
- **Large-scale Green Hydrogen Production** in Argentina, Morocco, and Namibia
- **Electrical Interconnectivity** in Central and South America
- **Solar Panel Production** in The Gambia

These projects aim to strengthen EU strategic partnerships, with tangible milestones expected by 2025. The funding could support clean hydrogen development, improving energy access for sectors like CHP in both regions.

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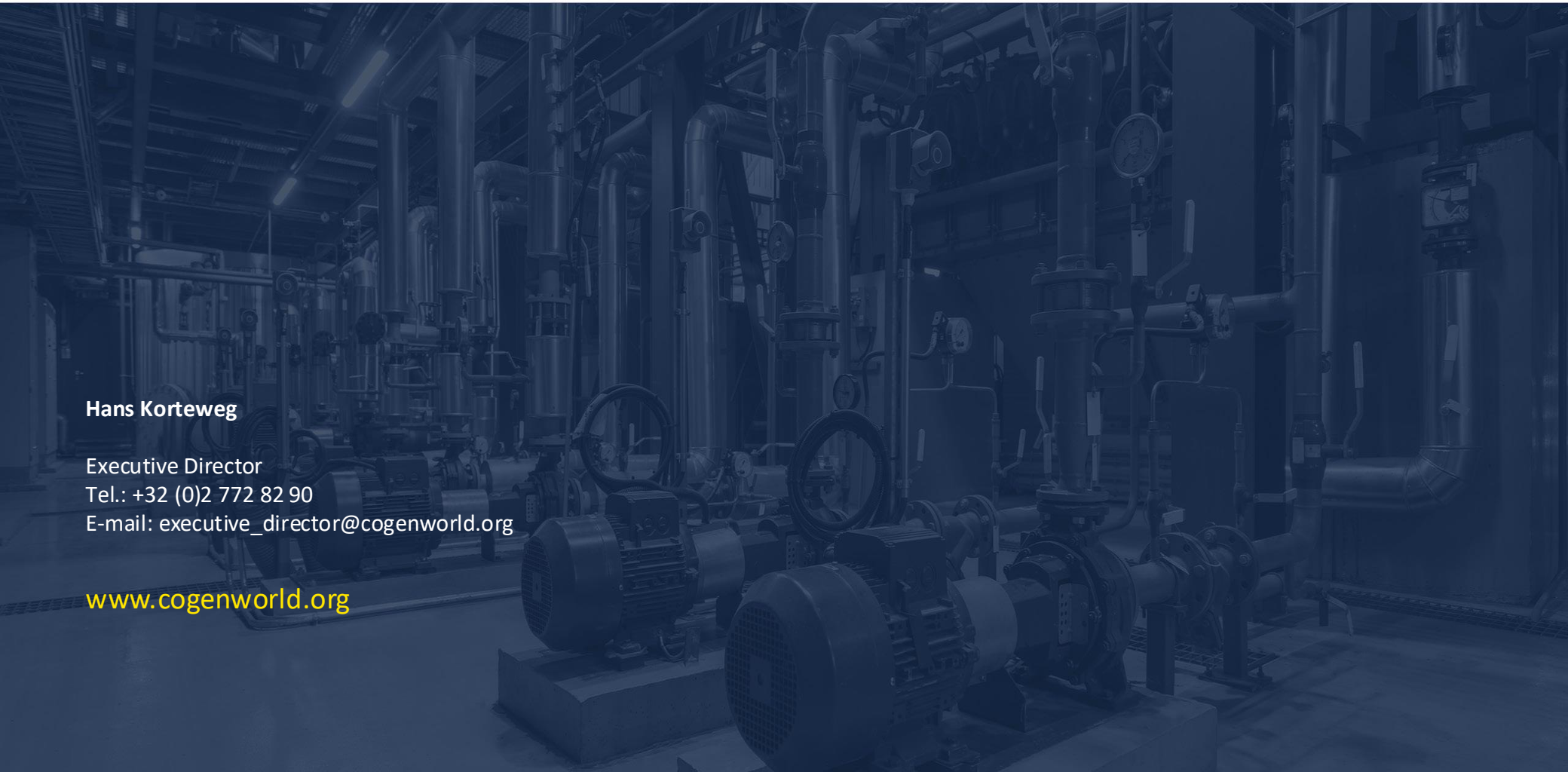

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