European Commission

Competitiveness of corporate sourcing of renewable energy

Annex A.3 to Part 2 *of the Study on the competitiveness of the renewable energy sector*

Case study: Google

ENER/C2/2016-501

28 June 2019

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Author: Ivo Georgiev (COWI)

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1 Introduction

Google is a **technology company** providing products and services "to organise the world's information and make it universally accessible and useful"[1]. Eight of Google's core products (Search, Android, Maps, Chrome, YouTube, Google Play, Gmail, and Drive) have more than 1 billion monthly active users.

The company offers a broad collection of cloud-based products and services, including G Suite business productivity apps like Docs, Drive, and Calendar and satellite mapping and analysis platforms like Google Earth and Google Earth Engine. In recent years, Google has expanded into consumer electronics with products including Google Pixel, Google Pixelbook, Google Home, and Chromecast

Google's headquarters are in Mountain View, California, in the United States, with the Dublin office (Ireland) serving as its EU headquarters. The company owns and leases office and building space, research and development labs, and sales and support offices across more than 160 cities, primarily in North America, Europe, South America, and Asia, and owns and operates 16 data centres on four continents. Google is a wholly owned subsidiary of Alphabet Inc., which also includes companies such as Access, Calico, CapitalG, GV, Verily, Waymo, and X. Google's revenues in 2018 totalled $136.8 billion and, as of December 31, 2018, Google had 98,771 full-time employees.[2]

Google has achieved a **leading position in various markets**, such as online advertising. The technology sector is notoriously competitive and dynamic with a large number of strong, diverse and mobile competitors. Thus, Google faces competition across its different operational branches. In search engine services, those include Yahoo and Bing. In cloud services, those include Microsoft, AWS (Amazon Web Services) and IBM. In online television and video/news, competitors include Apple and Facebook.

2 Company

Google is currently the **biggest corporate buyer of renewable energy** in the world. Through the end of 2018, the company has signed contracts to purchase 3.4 GW of wind and solar that have enabled over €4.2 billion investment in renewable energy projects across the globe. €1.2 billion of those are in Europe, where Google has signed contracts for 900 MW of renewable power capacity. In addition, Google has installed 3 MW of on-site self-generation solar power capacity at its Belgium data centre.

The company signed its first renewable energy power purchase agreement (PPA) with a 114 MW wind farm in Iowa in 2010. Seven years later, Google announced that it had reached its goal of matching **100% of its electricity consumption with renewable energy purchased** from over 30 wind and solar photovoltaic (PV) projects across the globe.

In Europe, Google is playing a leading role in accelerating the **clean energy transition** on the private sector side. The company's experience could encourage other European companies to benefit from purchasing renewable energy and support

[1] See: Google, *Our mission*, available online at: https://www.google.com/search/howsearchworks/mission/.
[2] Alphabet, 2018 Form-10k

the EU in reaching its 2030 target[3] while contributing to gross domestic product (GDP) growth and creating new jobs.

The clean energy transition in the technology sector is driven by **growing consumer demand for data related services and products**. Worldwide, the daily data generation per capita is set to increase significantly to 72 GB in 2025 (from approximately 4 GB in 2018). As a result of the increase in data generation (and communication), the outlook for the **global power capacity of data centres** is set to increase to above 80 GW for the same period (from approximately 52 GW in 2018). This corresponds to investments in data centres that can generate annual revenues in the range of €25-43 billion for the construction industry, contributing further to GDP growth and job creation during 2018-2025.[4]

In Europe, Google's four data centres account for the majority of the company's electricity consumption on the continent. As of 2018, Google operates data centres in Belgium, Finland, Ireland and the Netherlands, and it announced a new data centre in Denmark. Google could expand its data centre footprint to other EU countries as its business grows.[5]

3 EU countries of operation

In **Belgium**, Google's data centre is located in St. Ghislain, near the city of Mons in the southern part of the Walloon Region. The facility was the first investment of the company in Europe and has gradually expanded. Google spent a total of €775 million on construction and operation of the data centre over the period 2007-2014. It announced a further €250 million investment in 2018 to expand the data centre. The vast majority of the construction and operations have taken place in Belgium and with the use of Belgian workers and suppliers. This has generated new jobs, provided additional sources of income in Belgium, and created significant downstream benefits for the rest of the economy (multiplier effects). Such multiplier effects include the role of the data centre in supporting economic activity and employment in other industries such as retail trade, transport, accommodation, restaurants, housing and finance. Google has also constructed a 3 MW on-site solar PV facility on land adjacent to its data centre which became operational in 2017.

In **Finland**, Google's investment in the Hamina data centre has yielded an economic contribution of €660 million to the Finnish economy over the 2009-2015 period, equivalent to an annual average of €95 million, and has also supported 1,600 jobs per year over the same period. The jobs at a data centre facility include positions in management, mechanical and electrical maintenance and repair, IT and systems technicians, plumbing and water management, and hardware operations; these are experts who receive, set up, install and manage the physical hardware. Google has sourced significant quantities of wind power from Sweden for its operations in Finland. In 2018, it also announced 3 new PPAs for 190 MW of wind energy in Finland which will start delivering electricity to the grid in 2019 and 2020. Google's data centre in Finland is one of the cleanest in its portfolio with respect to carbon-free energy. According to a recent report by Google, in 2017 the data centre's electricity consumption was matched 97% on an hourly basis with regional carbon-free energy coming either from Google's PPAs or from the regional electricity grid.

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[3] *European Parliament, Energy: new target of 32% from renewables by 2030 agreed by MEPs and ministers (2018)*

[4] Nordic Council of Ministers, COWI, Data Centre Opportunities in the Nordics – An Analysis of the Competitive Advantages of the Nordic vs FLAP-D markets.

[5] The company has acquired land for potential future data centre construction in Denmark, Sweden and Luxembourg.

In **Ireland**, Google bought an old warehouse on an industrial site and transformed it into the company's third data centre in Europe. This is the second data centre conversion of an old building (the first one being the data centre in Hamina, Finland). The facility is located not far from Google's European headquarters in Dublin, Ireland, and became operational in 2012. Since 2011, Google has invested around €350 million in the construction and operation of its Irish data centre.

In the **Netherlands**, Google's data centre in Eemshaven started operations in 2016. From day one, the facility's electric consumption was matched with renewable energy from the nearby 63-Megawatt Delfzijl wind farm, for which Google has a **10-year PPA** with Dutch power company Eneco. Google also signed **two additional Dutch wind PPAs** for Windpark Krammer and Bouwdokken in Zeeland (Western Netherlands). Windpark Krammer was developed by two community cooperatives with more than 4000 people members. For these two projects, Google joined forces with three Dutch companies (AkzoNobel, DSM and Philips) to source power from these two wind farms. In the summer of 2017, Google added a 31 MW solar PV PPA, also with Eneco.

Figure 1 Google's data center in Eemshaven, Netherlands

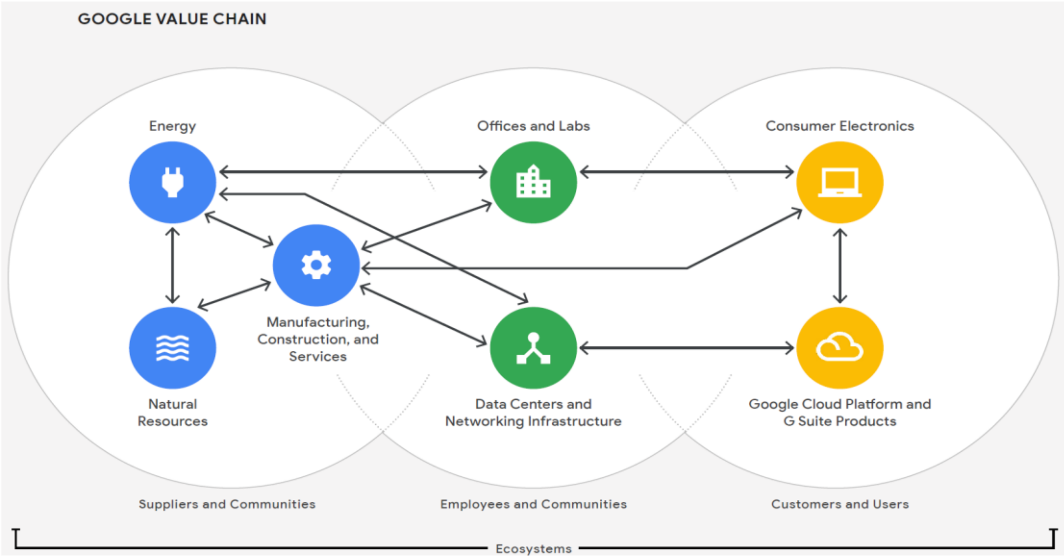
Source: Google

In November 2018, Google announced its first data centre in **Denmark**, in the town of Fredericia. The company is committed to matching its energy use with 100% carbon-free energy by pursuing new investment opportunities in Danish renewable energy projects like onshore wind, offshore wind and solar energy. Google has announced that the Fredericia data centre will be among the most energy-efficient data centres in Denmark to date, taking advantage of advanced machine learning. The forecasted impact of the construction of the data centre consists of 1,450 jobs per year during 2018-2021. Once operational, around 150-250 people are expected to be employed at the site in a range of roles—including computer technicians, electrical and mechanical engineers, catering and security staff.

4 Energy consumption

Energy plays an essential role in Google's businesses. From a **value chain perspective**, it powers the suppliers (providing manufacturing and construction services), the Google employees and communities (offices, labs, data centres and networking infrastructure), and the customers and users (consumer electronics, cloud platform and other products).

Figure 2 Google's value chain



Source: Google, Responsible supply chain report (2018)

Google's data centres are the largest individual consumers of energy in the value chain. Having a reliable and constant supply of electricity in the data centres ensures the delivery of products like Search, Gmail, YouTube, Maps, and Google Cloud whenever customers need them.

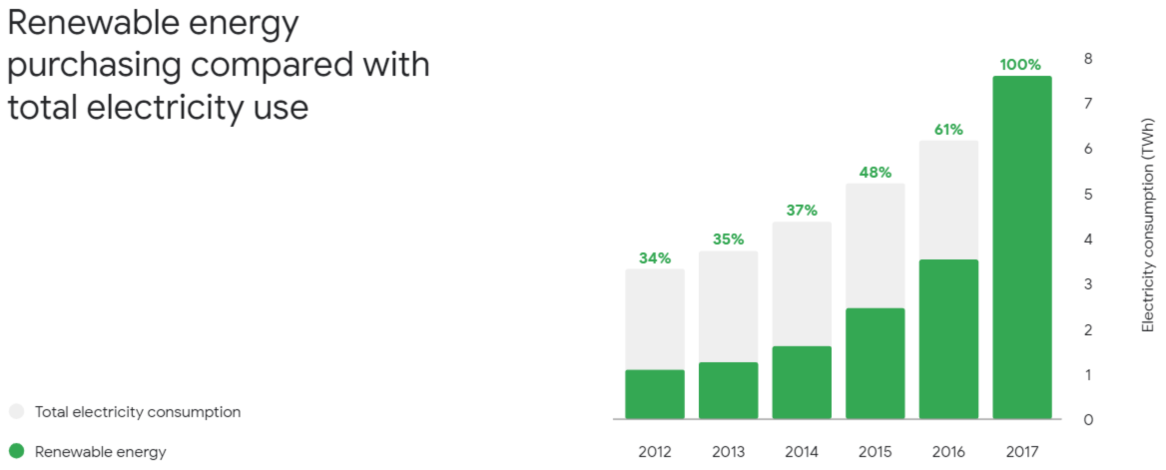
5 Renewable energy purchasing method

The levelized costs of wind and solar have decreased significantly since 2010, making renewables the cheapest source of energy available on the grid in some areas. These falling costs make it more attractive for companies such as Google to purchase power from renewable energy projects.

In 2017, Google reached its goal of matching **100% of its total electricity consumption with renewable energy purchases** on a global, annual basis. This means that for every MWh of electricity that Google consumes each year around the world, it purchases an equivalent amount of renewable energy in that same year. Google continues to consume electricity from the regional electricity grid, but by signing PPAs with wind and solar project developers they also enable additional renewable energy to be brought onto the grid system.

Depending on the geography where renewable energy is purchased, this is achieved either through direct purchases from renewable developers or through partnerships with utility providers. An overview of Google's global electricity consumption and its share obtained by renewables over the period 2012-2017 is illustrated below. Google's electricity consumption in 2017 was 7.6 TWh, an increase of 23% over its 2016 consumption.

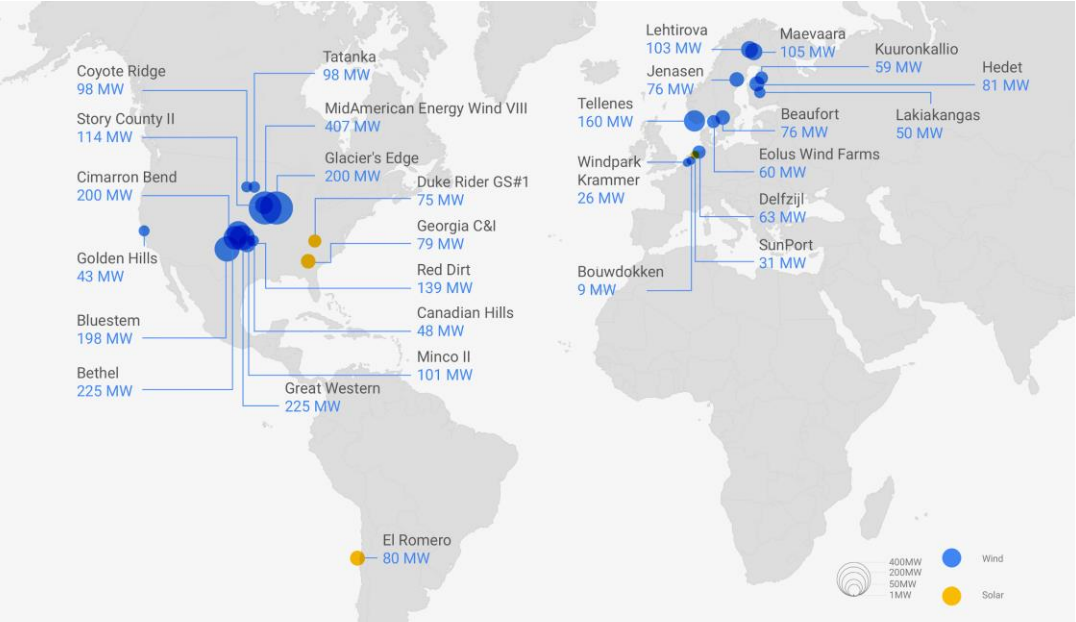
Figure 3 Google's electricity consumption and share matched by renewable energy, 2012-2017



Source: Google

The company has signed contracts for the **construction of new renewable energy projects in seven countries.**[6] In Europe, Google has signed agreements to purchase renewable energy produced by wind turbines located in the Nordics (770 MW) and West Europe (98 MW). Additionally, the company buys energy produced by solar PV (31 MW) in the Netherlands. A map of Google's global renewable energy PPAs as of 2018 is illustrated below.

Figure 4 Google's renewable energy PPAs across the world



Source: Google

[6] The seven countries are currently the US, Chile, Norway, Sweden, Finland, the Netherlands, and Taiwan.

To ensure that these energy purchases have a meaningful environmental impact, Google applies strict standards of **"additionality"**. This ensures that all renewable energy purchases bring new renewable energy capacity on to the grids where they operate. Whenever Google purchases renewable energy, the following three fundamental principles apply:

1. **Additionality**: Google signs agreements with greenfield projects that are pre-construction, which ensures that Google's purchases lead to carbon reductions by displacing carbon-emitting generation on the same grids where they operate.[7]
2. **Bundled physical energy**: Google purchases both the physical renewable energy and the corresponding renewable energy certificates (RECs), or Guarantees of Origin (GOs) in Europe. This ensures that Google provides all or nearly all of the project's cash flow over time, as opposed to purchasing only the REC or GO which provides a small portion of the project's cash flow.
3. **Proximity:** Where possible, Google purchases renewable energy from projects that will operate on the same grids as its data centres, which creates a stronger link between the renewable power that Google purchases and its data centre consumption.

Following those fundamental principles, Google applies **four methods** (primary tactics) to purchase renewable energy:

1. **Direct renewable purchasing** - In most of Europe, deregulated wholesale and retail power markets make it possible for the company to directly purchase renewable energy and have it contractually delivered to data centres consuming electricity on the same regional grid. Under this structure, Google signs a physical PPA[8] with a project developer on a grid where Google has an operating data centre, as well as a separate "balancing agreement" with a third party company (utility or energy trading firm) that helps deliver the PPA across the grid and can also "firm and shape" the energy into blocks.[9] Google typically has a separate electricity supply agreement in place to supply any electricity needed above and beyond the energy contracted through PPAs.

For example, electricity generated through Google's wind and solar PPAs in the Netherlands is contractually delivered to its data centre in Eemshaven, where it becomes part of the facility's retail electricity bill.

Another approach for direct renewable sourcing is to **build onsite self-generation**. In 2017, Google completed construction on its first renewable energy generation at a data centre site – a solar farm in Belgium, which is delivering electricity to the data centre. The €3 million project offers a reasonable return on investment and generates enough electricity annually to power the data centre's water treatment facility. The site's 10,665 ground-mounted photovoltaic solar panels are expected to generate 2.9 GWh of renewable energy each year.

[7] In most cases, the PPA also allows developers to obtain the financing needed to realize the project, since it provides them with a stable source of revenue for the power generated by the project.

[8] Physical PPAs involve contractual delivery of the produced renewable energy to the data centre (the consumer - buyer) on the relevant grid. The off-taker (Google) takes ownership of the power and will often work with a third party to balance the delivered energy over the course of the contract.

[9] "Firming and shaping" is the process of combining the output of a non-dispatchable, intermittent resource (like a wind or solar farm) with the output of a dispatchable, non-intermittent resource (like a traditional gas-fired facility) over time to create a flat, constant electricity supply profile for a consumer. Retail electricity providers do this by purchasing enough firming energy on a wholesale market in a given hour to "balance out" whatever energy is being produced by a renewable resource, thereby ensuring that their customer is receiving a flat supply of electricity.

2. **Fixed-floating swaps** - In geographies where it is not possible for renewable energy to be contractually delivered to the data centre facility, the company can still sign a PPA known as a fixed-floating swap. Under this structure, Google signs a PPA for renewable electricity and the RECs or GOs[10] with the project developer and then sells renewable electricity from the project into the wholesale market. This happens through the following steps:

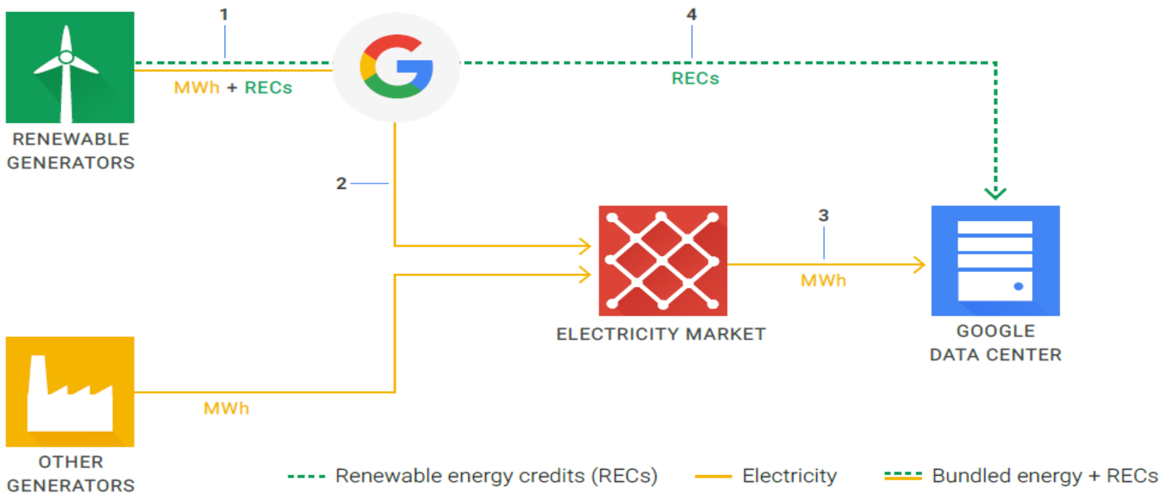
Step 1: Google purchases bundled physical renewable energy and RECs/GOs directly from a wind or solar farm using a negotiated, long-term, fixed-price structure via a PPA contract.

Step 2: Google takes title to and liquidates the physical renewable energy into the competitive wholesale electricity market at the floating market price, where it is pooled with other local energy sources.

Step 3: Google's data centre buys electricity from the utility or retail electricity provider, which is supplying the same grid into which Google sold the physical renewable energy (in step 2). The utility uses the grid to balance out intermittency and deliver a smooth electricity supply, 24/7.

Step 4: Google separates the newly created RECs/GOs from the physical energy produced (in step 1) and retains them to match them to the retail electricity purchased at the data centre. Over a year, the total number of RECs/GOs that Google acquires and retires each year equals its total annual electricity consumption on a global basis.

Figure 5 Fixed-floating swap diagram



Source: Google

3. **Utility renewable energy tariffs** - In areas where retail markets are not open to competitive suppliers and particularly where there is no auction-based wholesale market, Google works with utility providers to create a new class of rates called a "renewable energy tariff," also known as a "sleeved PPA" structure, in which the utility procures renewable energy (either through a PPA or asset ownership) for sale and delivery to Google's data centre. This model is not prevalent in Europe due to the deregulated nature of electricity markets.

[10] One REC/GO corresponds to 1 MWh of renewable energy generated.

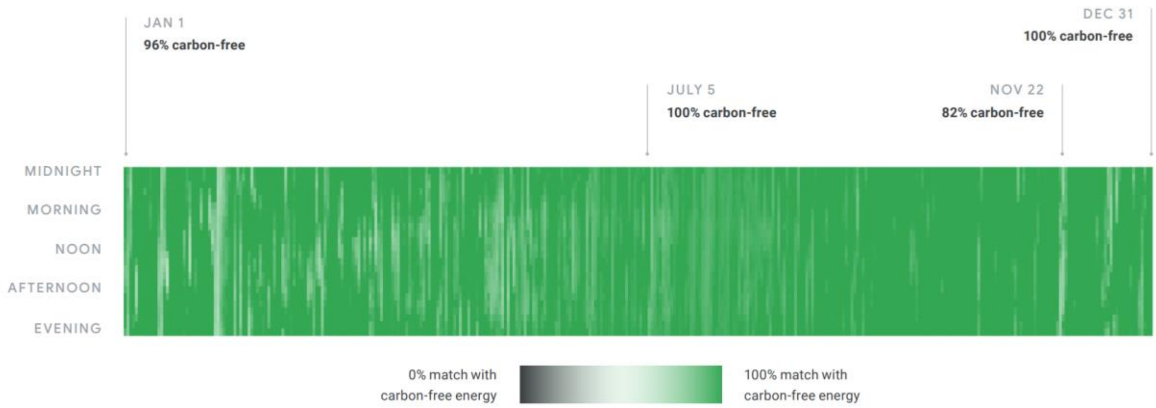
4. **Grid-mix renewable content** - The utility's grid mix contains energy from renewable resources that is not otherwise being purchased by specific consumers and is part of the "residual" mix. For each MWh of retail electricity consumed by a Google data centre, the company counts the portion that comes from residual renewables on the grid.

Google will continue to purchase renewable energy to match 100% of its electricity consumption on an annual basis as it grows around the world. Google has also outlined a longer-term, more ambitious goal to eventually match its consumption with carbon-free energy in every hour of the day in every region where it operates a data centre.

Carbon-free energy is any type of electricity generation that does not directly emit carbon dioxide. This includes renewables like solar, wind, geothermal, hydropower, and biomass, and other carbon-free technologies, such as carbon capture and storage, and nuclear energy.

In a recent discussion paper, Google showed the progress of a number of its data centres toward this long-term goal. At Google's Hamina data centre in Finland, they found that in 2017 its electricity was matched 97% with carbon-free energy on an hourly basis, either through Google's PPAs or the grid mix. Overall, in every data centre region where Google has signed a renewable energy PPA, its electricity consumption was matched at least 65% with carbon-free energy on a 24/7 basis.

Figure 6 24/7 carbon-free energy profile of Google's Finland Data Center



Source: Google

The company will make progress towards its 24/7 carbon-free energy goal by continuing to purchase renewable energy in regions where the company operates, considering a broader scope of energy technologies or services that enable 24/7 delivery of zero-carbon energy, and by promoting policies to empower consumers to choose their energy supply.

6 Drivers

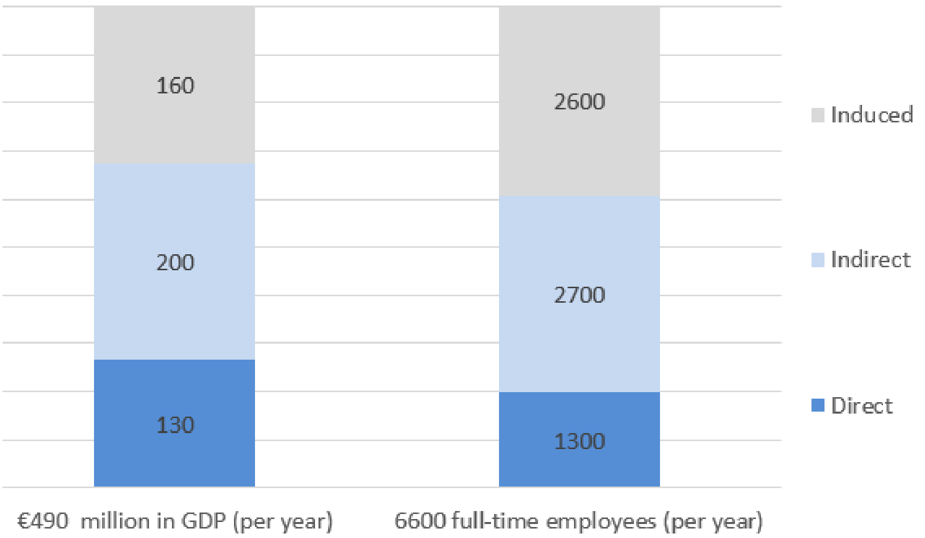
Corporate sourcing of renewable energy is a win-win both for Europe's economy and energy transition, and for Google's business.

6.1 Benefits to the EU economy

Google's construction of the four data centres in the EU and investments in fibre and renewable energy contribute to the EU's energy transition. Since 2007, Google has made a €4.3 billion data centre related investment (€3.2 billion on construction and operation, and an additional €1.1 billion on European fibre networks). The investments have supported economic activity in Europe with an average of €490 million per year in GDP in the period 2007-2017, or €5.4 billion in total over the period. Google's data centre investments have supported 6,600 jobs in total per year on average (in full-time equivalents).

The supported economic contribution to the EU includes a **direct economic effect** (first-order impact of the data centres' expenditure), as well as the **jobs and economic contributions** across the data centre suppliers' industries up the value chain (indirect economic effect). Moreover, when workers at data centres and suppliers' industries spend their wages on consumer products and services, this supports local enterprises and leads to a broader economic contribution (induced economic effect).

Figure 7 Economic impact of Google's data centre investments, GDP and employment



Source: Copenhagen Economics, Eurostat, World Input-Output Database and Google

Google's data centres deliver **benefits to local communities** across the EU as:

- They create jobs in remote areas that include IT technicians, electrical and mechanical engineers, catering, facilities and security staff.
- They influence others to invest in the region, as Google's presence is used actively by regional development entities to promote further investments in the regions.
- They bring technical, operational and managerial knowledge that can improve the productivity of local suppliers through knowledge spill overs and market-size effects, which can increase the local suppliers' productivity and competitiveness.
- They support the local data centre community. Almost €3 million in grants have been provided across Europe over the past few years via teaching collaborations in local colleges.

In addition to its data centre investments, Google's PPAs for 900 MW of renewable power capacity in Europe have enabled €1.2 billion of investment in wind and solar projects across the continent. Additionally, Google's data centres help digital users consume energy in a more efficient[11] and environmentally friendly way. If all data centres in Europe were as efficient as Google, electricity consumption could drop every year by around 26 TWh[12].

6.2 Benefits to Google

Besides all the benefits to the European economy and supporting the clean energy transition (including for renewable energy project developers), Google purchases renewable energy because it makes business sense and improves competitiveness. It is an effective way to lock in electricity costs at competitive prices and hedge against increases in wholesale power market prices.

As renewable energy is the cheapest form of electricity in many places in Europe, the company purchases it not only because they take seriously the importance of environmental sustainability, but also because it makes business sense from a cost optimization perspective. Data centres use a significant amount of electricity, and while the cost of natural gas and coal fluctuates over time, the cost of solar and wind can be locked into a long-term contract and give predictability in financial planning.

From a strategic perspective, Google's decision to purchase renewable energy has a positive impact on two main competitiveness dimensions:

1. **Cost competitiveness**, as stable and low renewable energy prices reduce electricity expenses and operating costs in the long-term.

2. **Differentiation**, as renewable energy contributes to environmental sustainability, which brings a competitive advantage.

Additionally, the decision to purchase renewable energy has a positive impact on Google's value chain. Renewable energy is needed to meet green requirements requested by customers. Regulatory compliance and resilience also appear as positive impacts.

Google's decision to procure renewable energy via PPAs has a positive impact on the company's competitiveness because it:

1. **Provides stability to electricity prices (price hedging)**, which reduces the risk exposure to fuel-price volatility and allows for smoother financial planning over the long term.

2. **Lowers electricity prices compared to grid electricity**, which ensures cost-competitive, predictably priced electricity supply (which is the largest operating expense of data centres) and reduces operating costs.

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[11] Google data centre PUE performance has dropped significantly. The TTM energy-weighted average PUE for all Google data centres is 1.12, making Google's data centres among the most efficient in the world.

[12] Copenhagen Economics, *European data centres: How Google's digital infrastructure investment is supporting sustainable growth in Europe.* *Country case: The Netherlands, Ireland, Belgium, Finland (2018)*

3. **Supports the deployment of additional renewable capacity** and thus climate change mitigation as a direct result of Google's decision to procure renewable energy, which drives a higher demand for products and services

Google also benefits from generating electricity through on-site renewable energy, such as its 3 MW solar PV project next to its data centre in St. Ghislain, Belgium. Furthermore, Google's business benefits from:

1. Revenues/tax credits linked to support schemes for solar PV.

2. Offsetting some of Google's electricity consumption through competitively priced renewable energy.

3. Positive impacts on value chain stakeholders and environmental sustainability, as there is a visible physical link between the company and renewable energy infrastructure.

While Google benefits from on-site renewables, it typically purchases renewable energy from off-site installations since on-site projects are not large enough to generate an amount of renewable electricity sufficient to match the data centre's consumption and may also not be the optimal site for a renewable energy facility with respect to resource availability.

7 Constraints

While Google is the **largest corporate buyer of renewable energy** on the planet, there are often challenges in the process of procuring renewable energy. Policies and regulations in some countries do not allow Google to purchase renewable energy in all markets where the company consumes electricity. Thus, Google purchases excess renewables from some grids to offset the inability to purchase renewables on others.

One constraint to renewable energy purchasing is **uncompetitive prices for renewable energy in some markets** where the company operates. While in some European regions, renewable energy is cheaper than the average prices in electricity markets, it is more expensive in others. One reason for price differences lies in support schemes, such as feed-in-tariffs (FITs), which fix renewable electricity prices at non-competitive rates. Under such structures, developers do not have an incentive to sign a PPA with a corporate off-taker like Google at a competitive market rate if they can sell the electricity to the government at the higher fixed tariff. FITs were an important tool for helping renewable energy achieve scale in Europe when the technologies were still nascent but are no longer needed to drive deployment. The end (or re-design) of feed-in tariffs is already ongoing in multiple EU countries and could open opportunities for Google and other companies to sign PPAs in more countries across Europe.

Additionally, in some countries such as France and Germany, if a renewable energy project benefits from a government support scheme, the government will either not issue GOs for the electricity or not allow the GOs to be transferred to another entity, even if the power is purchased through a corporate PPA. **GOs are central to the business case for renewable energy purchasing** as they allow corporate buyers to trace the renewable electricity they purchase and validate the claim that it is renewable. This is a key barrier and one reason why there are few corporate PPAs in these markets.

The **fragmented registration of GOs and lack of harmonisation across countries** also creates an administrative burden, particularly when retiring a large number of GOs as countries have different systems for tracking and retiring GOs.

A final constraint is that some markets lack **long-term hedging products** (such as firming and shaping services) that would enable corporate buyers of renewable energy to de-risk long-term exposure to volatility in electricity prices. PPA contracts carry particular risks for corporate buyers that stem from the variability of renewable energy production against a more constant consumption profile. New financial products and tools could help mitigate these risks, but they are not available in some markets.

8 Policy recommendations

The recast of the EU Renewable Energy Directive[13] features ambitious provisions for the uptake of corporate renewable energy sourcing in Europe, better long-term planning for public support, a simplified permit granting process, and an enabling framework for self-consumption in Europe including through corporate renewable PPAs. The agreed text strengthens for the role of GOs in tracking renewable electricity by making it the sole system for renewable energy tracking and claims. However, Member States are still provided **discretion regarding the issuance of GOs** for renewable energy that receives subsidies from support schemes, and the way that this will interact with corporate PPAs is unclear.

In this context, European countries will be required under this legislation to **identify and remove existing administrative and regulatory barriers** to the development of corporate renewable PPAs and direct investments in renewable energy generation.

Based on the findings from this case study, **policy recommendations** emerge in the following **three themes**:

1. **Support schemes** - National renewable energy support schemes should be reformed to take advantage of the declining cost of renewable energy technologies and to further encourage these cost declines. The ultimate goal of such support schemes should be to reduce the cost of renewable energy to the point where it can compete without government support. The introduction of competitive, market-based auction mechanisms for renewable energy procurement and support schemes is an encouraging development in this regard, and all countries should move toward this model. Competitive renewable electricity prices that reflect the fundamentals of the technology costs and performance are key to expanding corporate PPAs throughout Europe.
2. **GOs -** Guarantees of Origin are central to the business case for corporate renewable energy sourcing. Governments should ensure that GOs are issued and can be delivered to all buyers of renewable electricity through a corporate PPA. Policymakers should also ensure that GO systems are harmonized across countries, which will help reduce administrative burdens of managing, transferring, and retiring GOs.
3. **Cross-border PPAs** - Encouraging cross-border PPAs is an important element for expanding the contribution of corporate renewable energy PPAs to Europe's energy transition. This would allow renewable energy to be purchased from where it is cheapest and delivered to centres of consumption. While cross-

[13] European Council of the European Union Proposal for a Directive on the promotion of the use of energy from renewable sources (recast) (2018)

border PPAs are legally possible in Europe's electricity market, in practice there are a number of barriers. These include underdevelopment of physical transmission infrastructure across countries, under-allocation of cross-border transmission capacity between countries, an inability to reserve transmission capacity for extended time periods to match the length of renewable energy PPAs, and the public perception that cross-border PPAs are not as environmentally beneficial as in-country or locally-produced renewable energy.

Policymakers should work to coordinate the development of **cross-border transmission infrastructure** and open up existing networks to increased transmission capacity allocation. This will ensure that renewable energy can be sited in the most economically optimal regions and delivered to areas where it is demanded, which will help Europe build out renewable energy at the lowest cost and allow for competitively-priced, cross-border PPAs.[14]

[14] For further details on Google's corporate sourcing of renewable energy, please see:
1.Google, Achieving Our 100% Renewable Energy Purchasing Goal and Going Beyond (2016)
2.Google, Breaking ground for Google's first data centre in Denmark (2018)
3.Google, Efficiency: How we do it (2018)
4.Google, Environmental Report (2018)
5.Google, Expanding Renewable Energy Options for Companies Through Utility-Offered "Renewable Energy Tariffs" (2013)
7.Google, Google's European data centres: the Cloud supporting communities & economies (2018)
8.Google, Green PPAs: What, How, and Why (2011)
9.Google, Moving toward 24x7 Carbon-Free Energy at Google Data Centres: Progress and Insights (2018)

CASE STUDY

Google

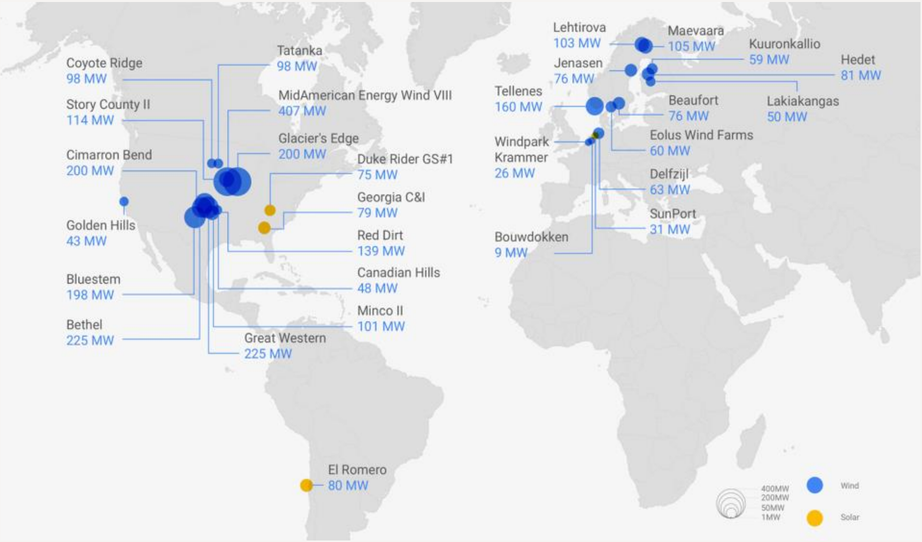
Source: Google

Google

Overview

Company

- Biggest corporate buyer of renewable energy in the world
- 100% of its electricity consumption matched with renewable energy purchased from over 30 wind and solar photovoltaic (PV) projects across the globe
- Signed contracts to purchase energy from new renewable energy projects in seven countries



Source: Google

Energy use

- Electricity consumption in 2017 was 7.6 TWh, an increase of 23% over its 2016 consumption

Procurement method

- Direct renewable energy purchasing
- Fixed-floating swaps
- Utility renewable energy tariffs
- Grid-mix renewable content

CEPS COWI

Google

Overview

Principles for purchasing renewable energy

- Additionality
- Bundled physical energy
- Proximity

Benefits to the EU and Google

- 6,600 jobs in total per year on average (in full-time equivalents) from 2007-2017, including both data centers and renewable energy PPAs
- Economic activity in Europe with an average of €490 million per year in GDP in the period 2007-2017, or €5.4 billion in total over the period
- Stability to electricity prices (price hedging), lower electricity prices compared to grid electricity, deployment of additional renewable capacity

Policy Recommendations

- National renewable energy support schemes should be reformed to take advantage of the declining cost of renewable energy technologies and to further encourage these cost declines
- Guarantees of Origin are central to the business case for corporate renewable energy sourcing and governments should ensure that GOs are issued for all renewable electricity and can be delivered to all buyers through corporate PPAs
- Encouraging cross-border PPAs is an important element for expanding the contribution of corporate renewable energy PPAs to Europe's energy transition
- Policymakers should work to coordinate the development of cross-border transmission infrastructure and open up existing networks to increased transmission capacity allocation