Total: Leading the charge in renewable energy through machine learning and data science

Total developed the Solar Mapper tool to make solar potential estimation faster and easier, driving the adoption of solar power globally by using machine learning to model estimates in low-data areas.

- Supports the development of a global solar estimation tool by providing data from Google Project Sunroof
- Speeds up training with Cloud TPUs, enabling complex machine learning models to be developed in six months
- Encourages uptake of solar power in France by increasing territory covered for solar estimation from 30% to 90%

From individuals in their homes to large corporations, change is needed on every level to reduce emissions and reach climate goals initiatives such as making the EU climate-neutral by 2050. Customers are also increasingly keen to see what action companies are taking to play their part. Total is addressing this challenge by committing to decarbonization and aiming to become carbon neutral by 2050. It has already shifted to a multi-energy strategy that includes renewable energies, low-carbon electricity, and carbon neutrality solutions as integrated parts of its business.

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—Philippe Cordier, Research Program Director, Scientific Computing, Data Science and AI, Total

The Total group's offering is extremely wide, spanning the entire energy production and supply chain, with an aim of bringing clean, affordable, and reliable energy to both private and corporate customers. Through Total Direct Energie, it's France's largest supplier of electricity to people's homes, serving 4 million customers (2019), and through its Marketing and Services division, it runs service stations all over the world. This makes it well placed to have a wide-reaching impact by investing in and developing innovative technology to help drive forward change in the sector.

One of these initiatives is to "'solarize" all of its service stations by equipping them with solar panels so they generate their own energy. This way, they're more independent of the grid, reducing each retail outlet's carbon emissions. The project launched in 2016, and three years later Total inaugurated its 1,000th solar-powered station, located in Marrakech, Morocco. With an aim to reach 5,000 solarized stations across 57 countries, it needed a way to easily estimate the solar potential of sites around the world. But while tools existed that covered individual cities or certain regions, they didn't cover the many global locations that Total requires, as it has service stations across every continent, and notably in 30 African countries from Burkina Faso to Zimbabwe. Total also plans to solarize all of its business-critical facilities, and this initiative will impact all the corporations that it works with, directly and indirectly, around the world.

– Fabrice Ongenae, Directeur de la technologie, Algoan

The team that focuses on scientific computing, data science, and AI in Total's Corporate R&D division decided to try and solve this issue, developing a solar potential estimation tool to work out how much power could be produced by solar panels on a service station site. It quickly realized that the tool could be used for many different applications, including for estimating the potential output of solar panels on private houses, or on commercial and industrial sites, and could encourage the use of solar panels worldwide.

Working with data from Google Earth Engine together with Google machine learning experts and using Google Cloud, it developed an innovative new tool: Solar Mapper.

"Our team's goal is to leverage machine learning and data science to deploy better and faster renewable energies" explains Philippe Cordier, Research Program Director of the Scientific Computing, Data Science, and AI Research Program at Total. "For this project, we quickly realized that with Project Sunroof, Google had the best expertise in artificial intelligence relating to solar energy, and that only Google was capable of providing the data we needed."

Solar panels are a key part of the move toward renewables, and that's why they need to be economically viable. Tools such as Project Sunroof by Google can help make the economic case for solar panels by helping individuals to create a personalized solar plan. Using Google Earth Engine imagery, it analyzes factors such as the roof size and shape, shaded roof areas, and local weather conditions to calculate an estimated yield.

But Sunroof only covers certain regions such as the US, the UK, and Germany, and in locations where high-quality satellite images aren't available, there is insufficient data to power the analysis. Even in France, where Total's headquarters are located, coverage using Project Sunroof tools was previously only 20%.

It was Gilles Poulain, Project Manager of Satellite Imagery & AI for Responsible Energy at Total, who came up with the idea to solve the problem using machine learning. "Total has many service stations on the African continent, and the solutions that exist don't cover those regions," explains Gilles. "My plan was to use generative models to enhance the 3D data we use to model shade and calculate solar potential where high-quality images were not available. By doing this, we can estimate the solar output for positioning solar panels on service stations in any location."

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—Gilles Poulain, Project Manager, AI for Responsible Energy, Total

From model to launch in six months with powerful Google Cloud TPUs

Using data from satellite images provided by Google Earth via Google Project Sunroof API, the team leveraged AI Platform with Cloud Storage to create the models for the proof of concept stage but soon faced another challenge. "The issue was how to access processors powerful enough to train the models," says Gilles. Working together with data scientists at Google Cloud, the team found a way to speed up its processing by switching from GPUs to Cloud TPUs to train and run its machine learning models.

The team is now able to leverage several TPUs at the same time, running six separate training regimens across six TPUs, in order to test out ideas and tune the models in parallel. "Being able to leverage several Google Cloud TPUs has definitely been instrumental to successfully developing the tool in six months," says Gilles. "When we switched from GPUs to TPUs, the short test runs that were taking six days to complete were ready in six hours."

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—Philippe Cordier, Research Program Director, Scientific Computing, Data Science and AI, Total

Supporting customers worldwide to adopt solar power

Using the work undertaken by the R&D team, supported by the machine learning team at Google Cloud, Total Direct Energie is now planning to launch a solar estimation tool that will enable individual customers in France to estimate the solar potential of their homes. "Before, if you lived in rural France, you'd need to have a specialist visit your house to view the site and an estimate of solar potential would have taken days or weeks to calculate, depending on the complexity of the factors," says Gilles. "With this tool, an estimate is available in seconds, and 90% of the country is covered."

Now that the team has demonstrated it's possible to successfully train models to enhance the data, the tool for global coverage has passed the proof of concept stage, and is now ready to be scaled up by Total for its service stations project. "Beyond its application for service stations, the Solar Mapper tool will eventually accelerate the deployment of solar energy globally," Gilles explains. "It's a mass solution that creates estimates in minutes, not days, and we believe that quick estimates will encourage individuals and companies to take the next step with solar power."

Total sees many other potential applications for Solar Mapper, such as within its SunPower division, which sells solar panels to individuals and commercial clients for industrial uses. With extended coverage, clients in many more locations will be able to easily estimate the potential yield available to them by installing solar panels. But most importantly, it will help Total achieve its carbon-neutral ambition.

"As a partner in this project, Google Cloud is supporting us to achieve our strategic goal of reaching net-zero emissions by 2050," says Philippe. "Solar Mapper is one of several initiatives that will help us to supply the world while reducing our carbon footprint, providing clean energy at scale."