PROS AND CONS OF NUCLEAR ENERGY

Why nuclear energy is both useful and possibly dangerous

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WHY NUCLEAR ENERGY IS USEFUL

1. NUCLEAR ENERGY SAVES LIVES

It has prevented 1.8 million deaths which would have been caused by pollution

Nuclear energy doesn't produce the air and water pollution produced by fossil fuels

→ Deaths caused by nuclear power resonate more

2. NUCLEAR ENERGY REDUCES CO_2 EMISSIONS

It is harmless for the environment when referring to the production of energy

*There will be at least 100 years before switching off to renewable and clean energy

3. NEW TECHNOLOGIES

New technology can avoid the most negative aspects of nuclear power

Nuclear innovation stopped in the 1970s

Better elements can be used instead of uranium

https://www.youtube.com/watch?v=pVbLlnmxIbY&ab_channel=Kurzgesagt%E2%80%93InaNutshell

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WHY NUCLEAR ENERGY IS USEFUL

1. NUCLEAR WEAPONS PROLIFERATION

"Nuclear Non-Proliferation Treaty": to spread nuclear reactor technology and NOT to spread nuclear weapons

→ Not all countries have signed the treaty

2. NUCLEAR WASTE AND POLLUTION

Radioactive

Poisonous chemicals (plutonium)

Reprocessing: extraction of plutonium from spent nuclear fuel to create new fuel or weapons

1946-1993: countries dumped radioactive waste into oceans

Burying waste is not safe either

3. ACCIDENTS AND DISASTERS

60 years of nuclear power usage

7 major accidents (Chernobyl and Fukushima)

No factors in common

https://www.youtube.com/watch?v=HEYbgyL5n1g&ab_channel=Kurzgesagt%E2%80%93InaNutshell

Geothermal energy in Italy: where and how it is produced

Tuscany is leading the way with the historic Larderello plant: Italy has an installed capacity of 1,100 megawatts, producing 5% of the nation's green energy.

Italy has potential resources of extractable and exploitable **geothermal energy** estimated at between 500 million and 10 billion tonnes of oil equivalent. This means **between 5,800 and 116,000 *terawatt hours* of energy**, compared with annual energy requirements of just over 300 terawatt hours. In short, it would only be necessary to extract a small fraction of that energy to fully satisfy all **domestic demand**, especially since this data only concerns the surface layer, less than five kilometers in depth.
Renewable, clean and inexhaustible, the energy released in the form of terrestrial heat still plays a relatively marginal role in the Italian energy mix, contributing just a few percentage points. In spite of this, Italy is **one of the main producers of geothermal energy** in Europe and the world. The driving force behind this is the country's natural wealth of geothermal resources; there are numerous **natural hot springs** in various areas of the peninsula that are ready to be exploited as a key feature of the national energy transition towards green energy sources.

The long history (in short) of Italian geothermal energy

The advent of geothermal energy in Italy dates back to the beginning of the 1900s. In reality, however, in the area of present-day Tuscany, historical sources have revealed that people have been exploiting the heat from its natural springs since antiquity: **Etruscan populations** did so for at least the entire first millennium BC.
In fact, it was in Tuscany, at **Larderello** in the province of Pisa, that the **world's first geothermal power plant** was built. Since those pioneering technical experiments more than a century ago, the plant has played a central role in the innovation of geothermal energy, and more generally, in the ability to exploit geothermal sources. Initially, the steam released naturally from the ground was used as an alternative to coal-fired steam engines; later this activity became increasingly oriented to transforming heat into transportable **electric energy**.
Alongside this transformation, the structure of the plant has also undergone substantial changes. In the past, the heart of the plant was the so-called **lagone** (a natural reservoir resulting from the outflow of hot water from below ground), the direct source of hot water mixed with steam at temperatures of up to 150°C. Today, however, **injection and extraction wells** are drilled into the ground to depths of more than 4 km, where ***geothermal fluid*** is captured. The heat is directly exploited in the form of steam, powering turbines that generate electric energy.
In recent years the amount of geothermal energy produced and the installed capacity have been growing steadily, but at a rather slow pace. In the decade between 2007 and 2017, for example, the overall increase in installed capacity amounted to just 10%. All of which shows that geothermal energy has never become a leading form of renewable energy in Italy, despite its **huge potential**.

Where are the geothermal plants in Italy?

As mentioned above, the region that represents Italian geothermal more than any other is Tuscany, for reasons that are both **historical** and **geological**. Beginning with Larderello - which today is home to Europe's largest *geothermal plant* - the number of regional geothermal plants has multiplied over the decades, and there are now **more than thirty**. Most of Tuscany's geothermal energy comes from the heat derived from the intrusion of a magmatic pluton beneath the **volcanic system of Mount Amiata**. More generally speaking, the main provinces where electric energy is produced through the exploitation of geothermal resources are **Pisa, Siena** and **Grosseto**.

In Italy there are many other areas with abundant geothermal resources, such as the **Veneto** region and the **Friuli-Venezia Giulia**. Then there is also **Campania**, in **Sicily** and finally **Emilia Romagna**.
All of these regions, however, when compared with Tuscany, have an almost negligible impact on the Italian *energy balance* in absolute terms, even though, at least on the map, Sicily and Campania (including some marine areas) have potential that is comparable with Tuscany.

How much geothermal energy is produced in Italy?

More or less, about **6 terawatt hours** of energy is generated each year in Italy, with an installed capacity in the order of **1.1 gigawatts** (or 1,100 megawatts). Of this, just over 900 megawatts correspond to the capacity of the plants that convert heat into electric energy, so-called geothermoelectric plants, while just under 200 megawatts derive from the direct use for **urban heating, thermal springs, therapeutic uses** and **cultivation in greenhouses**.

Interesting facts about geothermal energy

Among the features of Italian excellence in this field is a much higher than average respect for the **development goals** set for geothermoelectric. By the end of 2019, Italy had already comfortably surpassed the target of 80% to be achieved by the end of 2020, while almost all other European countries have not even achieved 20% of their targets.
Among the characteristics that make geothermal a particularly advantageous renewable source at the national level are the related advantages in terms of employment. In fact, the number of so-called green jobs generated by the sector far exceeds the energy capacity generated. According to an Italian study, each megawatt of installed and maintained geothermal capacity creates **34 jobs**, compared with 19 for wind power and 12 for photovoltaic.

Trends, innovations and observations

One of the most alluring prospects for geothermal energy, which is also shared with other renewable sources, is its growing **yield**. While until a few decades ago the upper limit was **just a few percentage points**, today geothermal plants can reach over 20% (heat pumps cab even reach 50%) and are capable of extracting more than four times more energy than is required to keep them running.
Among the most interesting technological advances today is the possibility or preventing **toxic** or climate-altering **gases** being released from underground, thereby preventing them from being emitted into the atmosphere. On this front, data from the Italian Geothermal Union shows that carbon dioxide emissions that have been avoided thanks to geothermal have passed from 3.7 million metric tonnes in 2010 to 4.0 million in 2015. This leap forward can be explained also by **technical improvements** at the plants. Furthermore, it is possible to create inverse geothermal, which works also with temperatures lower than 100°C and exploits the subsoil as if it were a **storage tank** for excess heat during the summer, which is then recovered during the colder months in the form of electric energy.
Looking to the future, it is believed that through the 2020s the production of geothermal energy in Italy will be limited to the exploitation of resources with a **temperature of at least 90°C**, while in the 2030s new technologies will also make it possible to benefit from sources at **lower temperatures**, with so-called non-conventional geothermal.

Adapted from: https://www.enelgreenpower.com/learning-hub/renewable-energies/geothermal-energy/italy