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APPLICATION OF NEODYMIUM MAGNETS IN A LOW-COST PARABOLIC CONCENTRATOR FOR SCHOOLS

Claudio Marinho de Pinho Pontes
PhD student in the Postgraduate Program in Local Development at Centro Universitário Augusto Motta (Unisuam), Rio de Janeiro-RJ

Lucio Fábio Cassiano Nascimento
Master in Mechanical Engineering and PhD in Materials Science. Permanent professor in the Postgraduate Program in Local Development at: ``Centro Universitário Augusto Motta`` (Unisuam), Rio de Janeiro-RJ

Patricia Maria Dusek
Master in Law by ``Universidade Cândido Mendes`` and PhD in Law by: ``Universidade Veiga de Almeida` (2014) / Gama Filho. Ad hoc reviewer for Scientific Journals. Researchers in the area of innovation and sustainability, with patents related to the topics researched. Professor of undergraduate courses in Administration and Law. Researcher in the stricto sensu Postgraduate Program in Local Development (PPGDL) of ``Centro Universitário Augusto Motta`` - UNISUAM, where she also teaches the subjects Environmental Corporate Governance, Socio-Spatial Inequalities, Entrepreneurship and Business Plan and Business Legislation

Abstract: The objective of this article is to contribute, through bibliographical research, on the application of parabolic concentrators with neodymium magnet motors for use in schools. This study presents the fundamentals of building a parabolic concentrator with permanent magnets, in order to serve the school population during cold climates during the academic year of educational institutions. An attempt was made to analyze the existing instruments to deal with energy savings as well as the issue of using energy in water heating. This theme was chosen, after its importance, due to the need to improve thermal comfort conditions in schools, as well as energy savings for the institution with the use of renewable energy, adapting to the UN 2030 agenda, in the end of the study verified the effectiveness of using parabolic concentrators with permanent magnets, with advantages compared to solar panels.
Keywords: Parabolic concentrator, Renewable Energy, Neodymium Magnets, schools.

INTRODUCTION

The use of solar energy on a large scale is attributed to Archimedes (282 to 212 BC); than the Roman fleet in Syracuse Bay (currently belonging to Italy), focusing the sun's rays until it heated up and caught fire. This event was cited by several authors in the period between 100 BC and 1100 AD.

It was reported that the equipment used by Archimedes, which contained a glass, with 24 mirrors that converged on a focal point. Other scholars defend the idea that Archimedes would have used soldiers' shields instead of mirrors, due to the manufacture of glass. Glassmaking was in its infancy at the time of Archimedes (c. 287-212 BC), and he was not directly involved in this process. However, Archimedes contributed to the knowledge of optics and the improvement of glass lenses, with experiments that influenced the later development of glassmaking and optical technologies. This situation arises from the fact that it is an ancient material, being among the oldest materials made by man. Therefore, it is a material whose history is confused with the history of civilization itself (VIEGAS, 2006, 17).

In the middle of the 18th century, the development of solar furnaces began in the Middle East and Europe, the purpose of which was the fusion of metals, especially iron and copper (Lodi, 2011). According to (KALOGIROU, 2009), the initial function was the development of the Lavoisier solar furnace in 1774, as shown in Figure 1. This project had a main lens of 1.32 m in length and a secondary lens of 0.2 m in length, capable of reaching temperatures of 1750 º C.

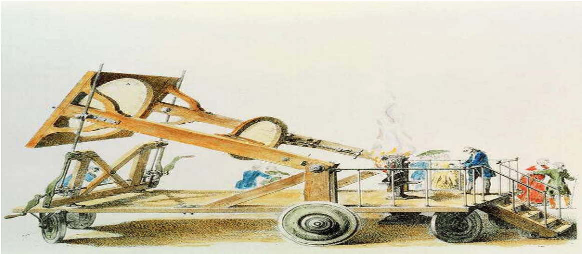


Figure 1: Lavoisier solar furnace (1774).

Source: Artwork of Antoine Lavoisier's Solar Furnace is a photograph by Science Photo Library which was uploaded on September 26th, 2018.

In the 19th century, the first attempts to generate steam (at low pressure) using solar radiation emerged. In 1866, Augustin created the first solar engine equipped with a parabolic reflector and a cylindrical glass boiler, which supported a steam engine, in Europe and North Africa (RAGHEB, 2011 apud LODI, 2011). In Figure 2, you can see the parabolic collector of a solar-powered printer from 1882.

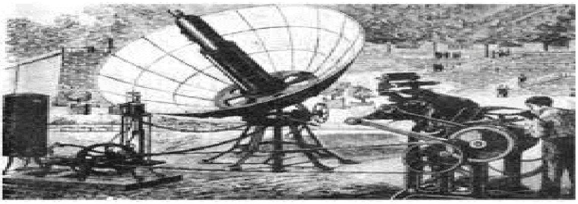


Figure 2: Parabolic collector of a solar-powered printer (Paris, 1882)

Source: KALOGIROU (2009).

Models that capture and concentrate solar rays through mirrors, with the aim of improving the effect caused by solar heating, have existed for a long time. In Figure 3, it is possible to analyze John Ericsson's Parabolic Concentrator, created in 1870.

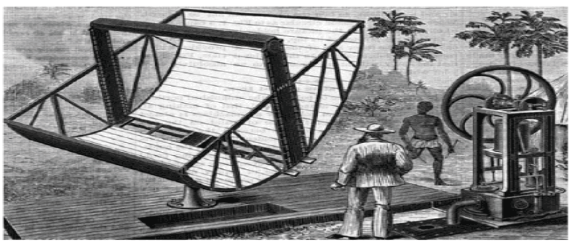
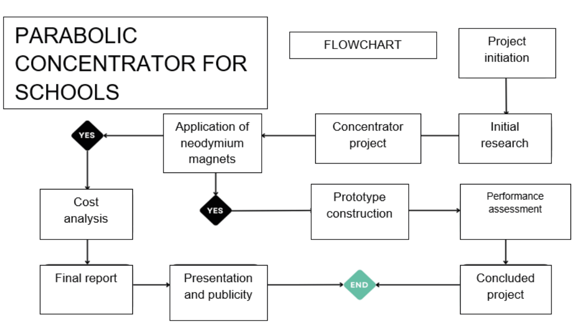


Figure 3 – Parabolic concentrator by John Ericsson (1870).

Source: RAGHEB (2011) apud LODI (2011)

Next, the search for clean and affordable energy will be explored, including research on the parabolic concentrator.

METHODOLOGY



Flowchart 01 – Parabolic concentrator for schools.

Source: Author himself, 2023.

Initially, an analysis was carried out to explore the themes involved in issues related to SDG 7 of the 2030 agenda, proposed by the United Nations (UN, 2015), whose purpose is to guarantee reliable, sustainable and modern access to clean and affordable energy for all.

The main searched words related to the research topic are linked to institutions with credibility in the area of sustainability and energy. These contribute to the elaboration of processes for developing strategies and actions in order to achieve long-term objectives in the Brazilian and global energy sector. This refers to the industry and infrastructure involved in the production, distribution and consumption of energy.

In the Brazilian context, this is the set of activities related to the generation of electricity, oil, natural gas and other energy sources used in the country. Globally, the energy sector covers the diverse energy systems of different countries, including renewable, non-renewable and alternative energy sources. The energy sector plays a fundamental role in economic development, environmental sustainability and geopolitical issues, as well as being an important focus for innovation and investment.

An exploratory methodological approach was adopted, combining quantitative and qualitative techniques. To carry out the study, a bibliographical search was carried out in specialized sources, energy sector institutions and Brazilian websites. Data collection took place on January 15, 2023, covering the period from 2018 to 2022. The keywords selected as a basis were: Parabolic concentrators, Renewable Energy, Neodymium Magnets and schools.

DEVELOPMENT

RENEWABLE ENERGY

Renewable energies are those obtained from natural sources that are naturally replenished and do not run out. They are considered sustainable forms of energy, as they do not emit or emit minimal amounts of greenhouse gases and other pollutants during their generation or use.

There are several renewable energy sources, including:

i. Solar energy: Solar energy is obtained from solar radiation and can be converted into electricity through photovoltaic solar panels or used directly for water and space heating, as shown in Figure 4.

Figure 4 – Solar Grid

Source: https://rede.solar/energia-solar/,2021.

ii. Wind energy: Wind energy is generated by the force of winds, which move the blades of wind turbines as shown in Figure 5, converting kinetic energy into electrical energy.

Figure 5: Wind energy.

Source: http://www.brainmarket.com.br/2020/06/10/eolica-offshore-em-ascensao,2021.

iii. Hydroelectric energy: Hydroelectric energy is produced by harnessing the flow of water in rivers, dams or waterfalls, which drives turbines that generate electricity, as shown in Figure 6.

Figure 6: Itaipu Hydroelectric Plant.

Source: https://clickpetroleoegas.com.br/usina-hidreletrica-de-itaipu, 2021.

Hydroelectric energy faces problems such as environmental impact, displacement of communities and changes in the aquatic ecosystem. The construction of dams can lead to the depletion of water resources and pose safety risks. Furthermore, it affects aquatic fauna and can emit greenhouse gases. Dependence on water availability makes hydropower vulnerable to climate change and prolonged droughts.

Solutions must be found to mitigate these impacts and find a balance between energy generation and environmental conservation.

iv. Tidal energy: Tidal energy is obtained by taking advantage of the movement of tides and sea currents to generate electricity. Figure 7 shows a plant operated by the use of tides.

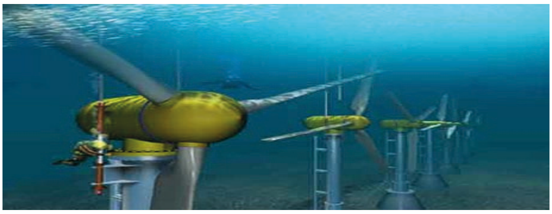


Figure 7: Largest Tidal Power Plant in the world in Scotland.

Source: marsemfim.com.br, 2019.

v. Geothermal energy: Geothermal energy comes from the Earth's internal heat. It can be used through geothermal plants, which use steam or hot water from the ground to generate electricity or for direct heating, as shown in Figure 8.

Figure 8: Geothermal Power Plant.

Source: energias3bvirgendevico.home.blog,2021.

vi. Biomass: Biomass consists of organic materials, such as agricultural waste, wood waste and energy crops, which can be burned or converted into biogas to generate electricity, heat or fuels. Figure 9 shows a Biomass plant.

Figure 9 – Biomass Plant

Source: Biomass imagem de stock. Imagem de agricultura, macro - 72402677 (dreamstime.com),2021.

These renewable energy sources offer a more sustainable alternative compared to non-renewable energy sources, such as oil, coal and natural gas, which are finite and release large amounts of greenhouse gases and pollutants when burned. The use of renewable energy plays a fundamental role in reducing greenhouse gas emissions, diversifying the energy matrix and transitioning to a cleaner and more sustainable energy system.

The main forms of non-renewable energy include:

NON-RENEWABLE ENERGIES

Non-renewable energies are obtained from Sources that deplete over time and cannot be easily replaced or quickly regenerated. They have limited availability and are consumed more quickly than they are produced naturally.

I. Fossil fuels: products obtained from the remains of organisms

ancients that went through a long process of pressure and heat over millions of years. Oil, coal and natural gas are the main examples of fossil fuels. These resources are used for various purposes, such as electricity generation, heating, transportation and as raw materials in the chemical industry. In Figure 10, you can see an oil extraction platform, which represents a model for extracting fossil fuels. These resources are used for various purposes, such as generating electricity, heating, and transporting raw materials in the chemical industry. In Figure 10, you can see an oil extraction platform, which represents a model for extracting fossil fuels.

Figure 10 – Oil platform

Source: pt.solar -energia.net, 2021.

II. Nuclear energy: is produced through the process of nuclear fission, in which heavy atoms, such as uranium-235, are fragmented into smaller atoms, resulting in the release of a large amount of energy. Nuclear energy is mainly used to generate electricity in nuclear power plants. In Figure 11, you can see a representation of a schematic drawing of the operation of a nuclear power plant.

Figure 11 – Nuclear plant.

Source: celerosft.com, 2021.

WORLDWIDE ENERGY MATRIX

In 2018, global energy demand reached 14,282 Mtoe, according to the International Energy Agency. The following year, this demand increased to 14,486 Mtoe, representing an increase of 1.4%. However, due to the COVID-19 pandemic, the estimate for 2020 was 13,963 Mtoe, a 3.8% drop compared to 2019.

Forecasts for 2021 indicate a recovery in global energy demand, with an increase of 5.2% (14,689.0 Mtoe), exceeding the 2019 value by 1.2%. In the last 48 years, both Brazil and other countries have undergone significant structural changes to their energy sources. In Brazil, there was a considerable increase in the share of hydroelectric energy, liquid bioenergy and natural gas.

In several countries, there is an increase in the use of natural gas and nuclear energy. An example of this is solid biomass, which grew in the Organization for Economic Cooperation and Development (OECD) between 1973 and 2020, in contrast to what happened in Brazil and other countries. In fact, in the OECD, there is no longer any substitution of firewood for fuel. In several countries, there is an increase in the use of natural gas and nuclear energy. An example of this is solid biomass, which grew in the Organization for Economic Cooperation and Development (OECD) between 1973 and 2020, in contrast to what happened in Brazil and other countries. In fact, in the OECD, there is no longer any substitution of firewood for fossil fuels, which is still common in other parts of the world. In the OECD, there is an increase in the use of firewood in the pulp and paper industry and in environmental heating systems. In table 1, you can check the internal energy supply in Brazil and the world.

Source	Brazil		OCDE		Others		World	
	1973	2020	1973	2020	1973	2020	1973	2020
Oil derivates	45,6	33,1	52,6	33,0	29,9	23,8	46,1	29,4
Natural gas	0,4	11,8	18,9	30,2	12,9	22,0	16,0	24,1
Mineral coal	3,2	4,9	22,6	13,8	31,1	35,7	24,6	26,2
Uranium	0	1,3	1,3	10,3	0,2	2,4	0,9	5,2
Hydro	6,1	12,6	2,1	2,4	1,2	2,6	1,8	2,7
Other non-renewable	0	0,6	0	0,5	0	0,1	0	0,3
Other renewables	44,8	35,8	2,5	9,7	24,7	13,5	10,6	12,2
Solid biomass	*44,3*	*26,0*	*2,4*	*5,2*	*24,7*	*11,3*	*10,5*	*9,1*
Liquid biomass	*0,5*	*7,7*	*0*	*1,02*	*0*	*0,15*	*0*	*0,61*
Wind	*0*	*1,71*	*0*	*1,70*	*0*	*0,67*	*0*	*1,04*
Solar	*0*	*0,321*	*0*	*0,93*	*0*	*0,72*	*0*	*0,77*
Geothermal	*0*	*0*	*0,16*	*0,81*	*0*	*0,64*	*0,1*	*0,67*
Total:	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Of which, they are renewable	*50,8*	*48,4*	*4,6*	*12,1*	*26,0*	*16,1*	*12,5*	*14,9*
Total - Mtep	**82,2**	**287,6**	**3.741**	**4.949**	**2.105**	**8.281**	**6.109**	**13.915**
% of the world	*1,3*	*2,1*	*61,2*	*35,6*	*34,5*	*59,5*		

Table: 1 – Domestic Energy Supply in Brazil and the World (% and toe).

Source: Brazilian Energy Review 2020 — Ministry of Mines and Energy (www.gov.br)

Between 1973 and 2020, the OECD reduced the share of oil and its derivatives in its energy matrix by 19.4 percentage points. This occurred due to the effort to replace these products, mainly due to the shocks in oil prices that occurred in 1973 (from US$3 per barrel to US$12), in 1979 (from US$12 to US$40) and from 1998, when a new cycle of increases began, (Brazilian Energy Review 2020 — Ministry of Mines and Energy (www.gov.br)).

The COVID-19 pandemic significantly affected the consumption of petroleum derivatives, especially in the transport sector, with a forecast drop of 9.3% in 2020. In the case of coal, the forecast is for a reduction of 4.3% in 2020. 6%. OECD countries, despite representing only 17% of the world's population, have a 42% share in the global economy (in terms of GDP at purchasing power parity) and 36% in energy consumption. This indicates that these countries have a higher per capita energy consumption and a lower energy intensity compared to the rest of the world (Brazilian Energy Review 2020 — Ministry of Mines and Energy (www.gov.br)).

In the Global Energy Matrix, it is important to highlight the importance of the composition of energy sources. The energy matrix of a country or the world is a representation of the origin of the energy sources used to meet energy demands. In your described scenario, the global energy matrix is strongly dominated by non-renewable Sources, such as coal, oil and natural gas, which are finite Sources and generally associated with significant emissions of greenhouse gases and pollution ("Source: ENERGY MATRIX (epe.gov.br), 2021").

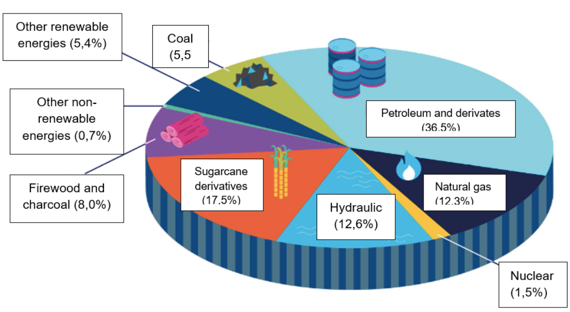


Figure 12 – World Energy Matrix

Source: Energy Matrix (epe.gov.br), 2021.

Renewable sources, such as solar, wind, geothermal, hydropower and biomass, are considered more sustainable in the long term, as they are naturally available resources that regenerate and have a lower environmental impact compared to non-renewable sources. However, as you mentioned, these renewable sources still represent a relatively small portion of the global energy matrix, (Source: as the International Energy Agency (IEA), 2021).

The inclusion of hydropower and biomass in the Renewable Sources category is appropriate, as these Sources are generally considered part of the renewable energy mix due to their renewable nature.

However, the share of these renewable Sources is slightly greater than the portion grouped under "Others", reaching around 15% of the global energy mix, (Source: The International Renewable Energy Agency (IRENA), 2022).

The transition to cleaner, renewable energy sources is critical to mitigating climate change and reducing dependence on non-renewable energy sources. In recent years, there has been an increase in efforts to promote the use of renewable energy sources and reduce dependence on fossil fuels, which is an important step toward global energy sustainability, (Source: the United States Energy Information Administration United States (EIA) and Brazilian National Electric Energy Agency (ANEEL), 2021.

WORLDWIDE ELECTRICAL MATRIX

Over the last 50 years, there has been a common trend towards a reduction in oil, derivatives and hydraulic energy, and an increase in other energy sources, except coal in the energy matrices of Brazil, OECD and other countries.

The drop in the share of mineral coal in Brazil was reversed due to the lack of rain, which had a direct impact on the cost of hydraulic energy. As a result of the lack of rain, there was an increase in the use of thermoelectric plants, many of which run on mineral coal. This explains why reducing the use of mineral coal is not always desirable in the Brazilian context. In contrast, in the

OECD, there was a decrease of 17.8 percentage points in the share of mineral coal between 1973 and 2020.

Electricity is necessary for many everyday activities, such as watching television, listening to music on the radio, lighting environments, turning on refrigerators, charging cell phones and many other things, as shown in Figure 13 below.

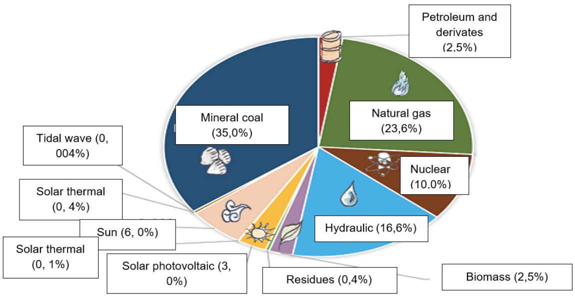


Figure 13 – World Electrical Matrix.

Source: ENERGY MATRIX (epe.gov.br), 2021.

BRAZILIAN ENERGY MATRIX

Over the last 50 years, there has been a common trend towards a reduction in oil, derivatives and hydraulic energy, and an increase in other energy sources, except coal in the energy matrices of Brazil, OECD and other countries. In Brazil, the drop in the share of mineral coal was reversed due to the lack of rain, while in the OECD there was a decrease of 17.8 percentage points between 1973 and 2020.

The lack of rain has an impact on the direct cost of hydraulic energy, since it is generated from water, which moves turbines in a hydroelectric plant. When there is a shortage of rain, water levels in the plant's reservoirs can decrease, which reduces the capacity to generate hydraulic energy. This leads to an increase in energy production costs, as the supply of electricity from that Source is compromised.

Table 2 presents the structure of the OIE (International Energy Organization) in 2019 and 2020.

Specification	mil tep		20/19 %	Structure (%)	
	2019	2020		2019	2020
NON-RENEWABLE	**158.316**	**148.518**	**-6,2**	**53,9**	**51,6**
Oil and derivatives	100.898	95.247	-5,6	34,3	33,1
Natural gas	35.909	33.824	-5,8	12,2	11,8
Mineral coal and derivatives	15.435	14.027	-9,1	5,3	4,9
Uranium (U308) and derivatives	4.292	3.727	-13,2	1,5	1,3
Other non-renewable energies	1.780	1.693	-4,9	0,6	0,6
RENEWABLE	**135.642**	**139.094**	**2,5**	**46,1**	**48,4**
Hydraulics and electricity	36.364	36.210	-0,4	12,4	12,6
Firewood and charcoal	25.725	25.710	-0,1	8,8	8,9
Sugar cane derivatives	52.841	54.933	4,0	18,0	19,1
Other renewable energies	20.712	22.241	7,4	7,0	7,7
TOTAL	**293.957**	**287.612**	**-2,2**	**100,0**	**100,0**
Of which. thev are fossil	154.023	144.791	-6,0	52,4	50,3

(a) Gas and blast furnace, steelworks and sulfur; (b) leachate, biodiesel, wind, solar, rice husk, biogas, wood waste, charcoal gas and elephant grass

Table 2 – Internal Energy Supply (OIE)

Source: RBrazilian Energy Review 2021 — Ministry of Mines and Energy (www.gov.br)

The composition of the Brazilian energy matrix is significantly different from the global average. In Brazil, we have a higher proportion of renewable energy sources compared to the rest of the world.

If we consider the sum of contributions from firewood and charcoal, hydroelectric energy, sugar cane derivatives and other renewable sources, renewable energies make up 44.8% of our energy mix, almost half of the total. Figure 14 shows the composition of the Brazilian energy matrix.

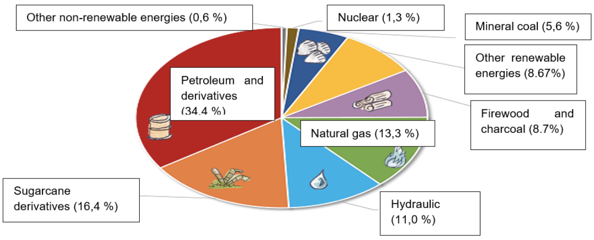


Figure 14 – Brazilian Energy Matrix.

Source: Matriz Energética (epe.gov.br),2021.

Brazil stands out in the share of hydraulic energy and solid bioenergy, with 65.2% and 9.1% respectively, compared to other countries, ("Source: MATRIZ ENERGÉTICA (epe.gov.br), 2021"). Wind and solar energy are rapidly expanding in all regions.

BRAZILIAN ELECTRICAL MATRIX

In 2020, the amount of Internally Offered Electricity (OIEE) reached 645.9 TWh, which represents a decrease of 0.8% compared to 2019 (an estimated drop of 1.2% globally, to 26,670 TWh). Solar energy generation showed the biggest growth, with a rate of 61.5% in 2020, and distributed generation has already contributed 45% of the total generated. ("Source: ENERGY MATRIX (epe.gov.br), 2021".

As solar energy increases its share in the OIEE, annual expansion rates will gradually decrease, from 876% in 2017, to 316% in 2018 and 92.2% in 2019. Table 3 shows the domestic energy supply electricity (OIEE), ("Source: MATRIZ ENERGÉTICA (epe.gov.br), 2021".

Specification	GWh 2019	GWh 2020	20/19 %	Structure (%) 2019	Structure (%) 2020
Hydraulics	397.877	396.327	-0,4	61,1	61,4
Sugarcane bagasse	36.827	38.776	5,3	5,7	6,0
Wind	55.986	57.051	1,9	8,6	8,8
Solar	6.655	10.750	61,5	1,0	1,7
Other renewable energies	18.094	19.966	10,3	2,8	3,1
Oil	6.926	7.745	11,8	1,1	1,2
Natural gas	60.448	53.464	-11,6	9,3	8,3
Coal	15.327	11.946	-22,1	2,4	1,8
Nuclear	16.129	14.053	-12,9	2,5	2,2
Other non-renewable energies	12.060	11.121	-7,8	1,9	1,7
Import	24.957	24.718	-1,0	3,8	3,8
TOTAL (c)	**651.285**	**645.915**	**-0,8**	**100,0**	**100,0**
Of which, they are renewable products	*540.395*	*547.587*	*1,3*	*83,0*	*84,8*

(a) Leachate, biogas, rice husk, elephant grass, wood waste and charcoal gas. (b) blast furnace, steelworks, coke oven, refinery and sulfur gas, and tar (c) Includes captive self-producer (which does not use the electricity grid)

Table 3 – Internal Electricity Supply (OIEE)

Source: Brazilian Energy Review 2021 — Ministry of Mines and Energy (www.gov.br)

Figure 15 represents the OIEE (Internal Electricity Supply) matrix. The graph ´´a`` presents non-renewable energies, the central graph ´´b`` highlights the comparative advantages of renewable Sources, which represent 78.1 % of the Brazilian electrical matrix, compared to the world average of just 28.1% and the OECD bloc with 30.1%, graph ´´c`` presents renewable energies.

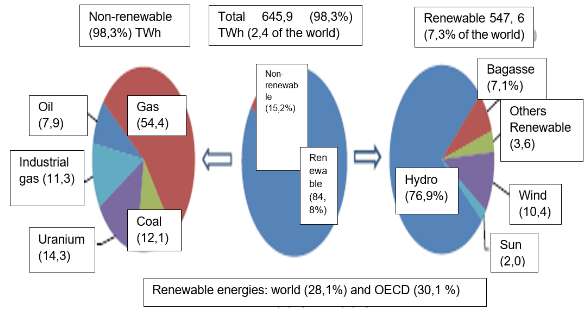


Figure 15 – Domestic Energy Supply in Brazil - 2020.

Source: RBrazilian Energy Review 2020 — Ministry of Mines and Energy (www.gov.br)

Brazil's electrical matrix is predominantly made up of renewable sources, this is due to the fact that a significant portion of the electrical energy generated in the country comes from hydroelectric plants. Furthermore, wind energy has shown significant growth, which contributes to keeping the Brazilian electricity matrix mostly renewable. Figure 16 shows the composition of Brazil's electrical matrix.

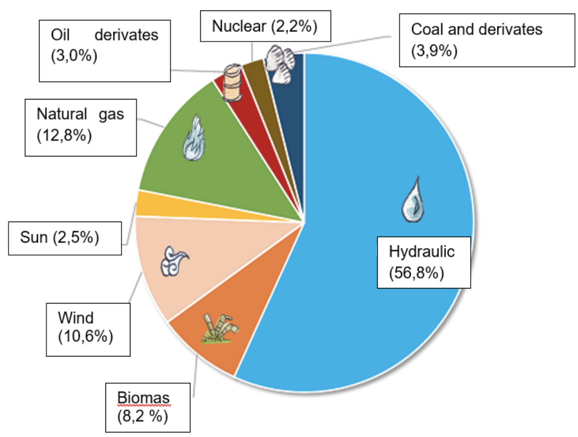


Figure 16 – Brazilian electrical matrix - 2021.

Source: ENERGY MATRIX (epe.gov.br), 2021.

ADVANCES IN ENERGY

The objective of the theme "Advances in Energy: Parabolic Concentrators, Muammer Yildiz's Turkish Engine and Improvement with Neodymium Magnets for Electric Bicycle Motors" is to explore innovations and technological advances in the areas of energy generation and use. It seeks to analyze how parabolic concentrators, Muammer Yildiz's Turkish engine and the use of neodymium magnets can be combined and applied to improve the efficiency and sustainability of energy sources. This involves investigating the possibilities of power generation, engine improvement and how these technologies can contribute to a cleaner and more energy efficient future.

PARABOLIC CONCENTRATORS

Parabolic concentrators, also known as parabolic mirrors, are devices that use solar energy to heat a thermal fluid in a high-pressure tube located at the focal point. This generates steam at high temperatures, which reaches around 1000°C, which is used to drive turbines and generate electricity. However, these systems depend on sunlight, which requires additional technologies to ensure steam generation at night and maintain a continuous supply of electricity 24 hours a day. To follow the solar movement throughout the day, synchronous motors are essential, although this configuration does not allow for seasonal adjustments in solar inclination.

Figure 17 - Parabolic Trough Concentrator

Source: cienciamx.com,2018.

TURKISH ENGINE BY MUAMMER YILDIZ

On the other hand, Muammer Yildiz's Turkish Engine, developed in 2013, innovates by using neodymium magnets to create an oscillating magnetic field within a static magnetic field. This motor is composed of a rotor and a stator located on the same axis and in relative movement.

The rotor contains permanent magnets distributed in several magnetic phases, while the stator has a second sequence of permanent magnets.

Permanent magnet motors operate within the principles established by physics, including the laws of thermodynamics and energy conservation. However, the claim of permanent magnet motors that supposedly produce infinite energy or perform work without consuming energy contradicts fundamental laws of physics, such as the principle of conservation of energy, which makes such claims inconsistent with established scientific principles.

However, there is a gradual evolution in the perception of the engine, and it is a matter of time before it is recognized as an important research and development initiative by renowned universities around the world, despite its incompatibility with the established principles of current physics. Figure 18 shows the magnetic motor developed by Muammer Yildiz.

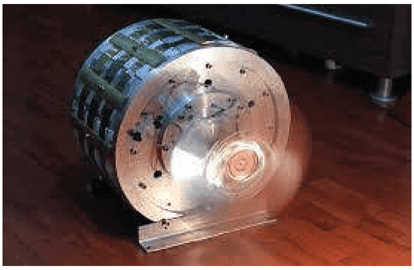


Figure 18 - Turkish Magnetic Motor Muammer Yildiz

Source: revolution-green.com/yilditz-magnetic-motor-update 2015

MOTOR IMPROVEMENT WITH NEODYMIUM MAGNET

On the other hand, according to the study by Pontes (2018), it was suggested the development of research that combined generative functions to compose the magnetic field element. The polarization of the neodymium magnets does not consume any electrical energy to form the magnetic field and generate clean energy used to rotate the holder with the magnetic chuck in order to loosen or tighten the screws through the rotor, the flashlight and the LED lighting as well such as the battery level indicator, which is rechargeable, as illustrated in Figure 19.

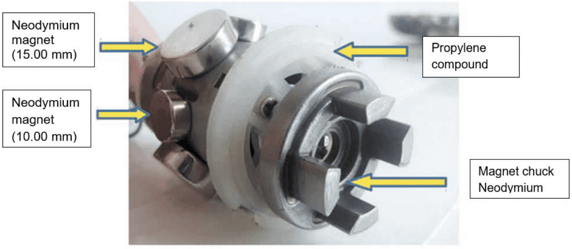


Figure 19 – Magnetic screwdriver rotor with Neodymium magnets

Source: https://www.atenaeditora.com.br/catalogo/ebook/aplicacao-de-energia-renovavel-aprimoramento-do-motor-com-ima-neodimio,2023.

Figure 20 below shows the right-side view of the screwdriver prototype with permanent magnets, whose operation was successfully tested. The rotor movements with neodymium magnets and all the prototype's functionalities met operational expectations. The test also approved the flashlight's LED lamp, with the electrical and mechanical circuits.

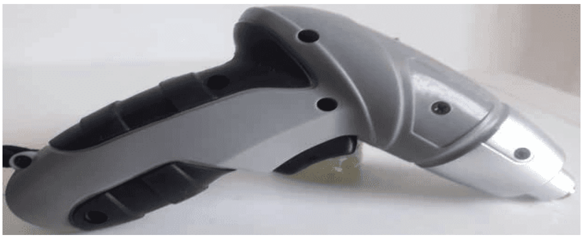


Figure 20 – Right side view of the Magnetic Screwdriver prototype

Source: https://www.atenaeditora.com.br,2023.

ELECTRIC BICYCLE MOTOR WITH NEODYMIUM MAGNETS

Regarding the electric bicycle motor with Neodymium magnets (5.4), Flávio, Leislye and Duarte (2022) proposed the creation of an electric bicycle prototype that used common and accessible components on the market, maintaining gears to guarantee greater autonomy in comparison with commercial electric bicycles.

During the production of the generator, they noticed the efficiency of neodymium magnets in creating a magnetic field, which, combined with the rotor and stator made up of coils, generated alternating current. To do this, they adapted an automatic alternator donated by a used car parts dealer. The first step was to remove the copper from the rotor, eliminating the need for external power for magnetization and energy generation during rotation.

Then, the 12-pin rotor underwent manual machining to create a cavity capable of accommodating an N35 neodymium magnet. Round-shaped magnets were used, composed of Nd2Feb, Class N35, magnetic load of 6.5 kg in silver color, play a crucial role for several reasons:

1. Energy Efficiency: Manual machining of the rotor allowed the creation of a cavity that would accommodate an N35 neodymium magnet. This type of magnet is known for its high magnetic flux

density, which results in greater efficiency in generating electrical current. This means that the system can produce more electrical energy with less effort, making it more efficient and economical in terms of energy consumption.

2. Power Generation: When inserting the N35 neodymium magnet into the cavity, the magnetic field generated is stronger and more stable, allowing the effective production of electric current. This is essential for the generator to function, as the current generated is used to power the electric bicycle, offering sufficient autonomy to meet users' needs.

3. Durability: The choice of the N35 neodymium magnet, together with its Nd2FeB composition, is important for the durability of the system. Neodymium magnets are known for maintaining their magnetism for long periods, making them ideal for long-lasting applications such as electric motors in bicycles. The Nd2FeB composition is corrosion resistant and offers greater magnetic stability.

4. Reduction of External Power: The ability of the N35 neodymium magnet to maintain its magnetism without the need for external power means that the system can function autonomously, without relying on additional power sources to magnetize the rotor. This is beneficial as it reduces system complexity and costs.

5. Overall Performance: The detailed specifications of the magnets, such as class N35 and magnetic load of 6.5 kg, are indicative of their ability to provide the performance required for the project. These features contribute to the overall effectiveness of the motor/generator, ensuring that it is capable of generating the electrical energy needed to efficiently propel the electric bike.

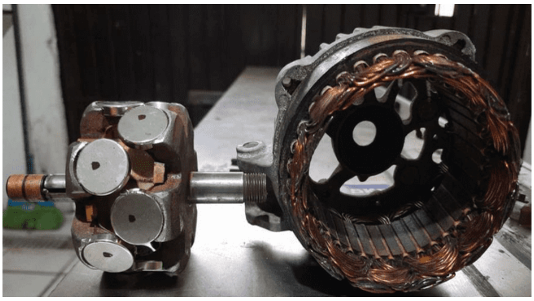


Figure 21 – Brazilian Bicycle Engine perfected by: Flávio, S Leislye, RS Duarte.

Source: https://repositorio.animaeducacao.com.br/handle/ANIMA/24194, 2022.

PARABOLIC CONCENTRATOR AND NEODYMIUM MAGNET

Water heating is an important need in several sectors, and the development of sustainable solutions to meet this demand has been a priority.

A promising technology is water heating using a parabolic concentrator and neodymium magnet motors. The parabolic concentrator uses curved mirrors to concentrate sunlight at a focal point, increasing the intensity of the solar energy received. When directed into a water heating system, the parabolic concentrator can generate high temperatures and provide a renewable energy source.

The integration of neodymium magnet motors in this system brings several advantages, as these motors have a high magnetic strength and are efficient in energy conversion. They can be used to drive water pumps, allowing hot water to circulate continuously through the heating system.

By combining the parabolic concentrator and neodymium magnet motors, it is possible to generate hot water and clean energy simultaneously. Concentrated solar energy heats water, which can be stored for later use in heating systems or converted into electricity to power other devices. This system has environmental and economic advantages, such as reducing greenhouse gas emissions by replacing fossil fuels, in addition to using a free and inexhaustible source of energy.

Neodymium magnet motors are efficient and durable, reducing the need for frequent maintenance and replacement. However, implementing this system requires significant initial investments and efficiency may vary according to geographic location and climatic conditions. It is important to carry out detailed studies to assess technical and economic feasibility before large-scale implementation.

In summary, water heating with a parabolic concentrator and neodymium magnet motors is a promising solution for generating hot water and clean energy, contributing to a more sustainable future and less dependent on fossil fuels.

FINAL CONSIDERATIONS

The Brazilian energy matrix and the world energy matrix present significant divergences in their composition and characteristics. The global energy matrix is predominantly based on non-renewable sources, such as oil, coal and natural gas, with a notable share of nuclear energy. In contrast, the Brazilian energy matrix is notable for its high dependence on renewable sources, mainly hydropower and biomass, with a growing role for wind and solar energy.

BRAZIL'S ENERGY POTENTIAL

Brazil holds a vast energy potential due to its abundance of natural resources. Its main source of energy is hydroelectricity, fed by numerous rivers and river basins. Furthermore, the country has vast areas suitable for generating wind and solar energy, expanding its energy potential, as well as a considerable reserve of biomass from its agroindustry.

EXPANSION OF NEW RENEWABLE ENERGY SOURCES

Brazil has actively promoted the expansion of renewable energy sources, with policies to encourage wind and solar energy, resulting in a constant increase in installed capacity. This contributes to the diversification of the energy matrix, reduction of greenhouse gas emissions and greater resilience of the energy system.

POTENTIAL OF USING PARABOLIC CONCENTRATORS WITH NEODYMIUM MAGNETS

Parabolic concentrators with neodymium magnets present an innovative method for producing thermal and electrical energy, taking advantage of the concentration of solar energy. Its advantages include high efficiency in capturing solar energy, low carbon footprint and flexibility in electricity and heat production. However, they also present challenges, such as high initial cost, dependence on scarce resources such as neodymium, and the need for storage to provide continuous power.

ADVANTAGES

1. Energy Efficiency: Parabolic concentrators with neodymium magnets have high efficiency in converting solar radiation into thermal energy, making them effective in generating electricity and heat;

2. Emissions Reduction: This technology contributes to reducing greenhouse gas emissions, aligning with sustainability and climate change mitigation goals.

DISADVANTAGES

1. High initial cost: the implementation of parabolic concentrators with neodymium magnets requires significant investments.

2. Neodymium shortage: reliance on rare materials such as neodymium can present availability challenges;

3. Energy storage: intermittent solar energy generation requires storage systems to provide constant energy, increasing complexity and costs.

in summary, the brazilian energy matrix is notably more dependent on renewable sources compared to the global matrix, and the country has great potential for the expansion of renewable energy, including parabolic concentrators with neodymium magnets. while this technology offers notable advantages, issues such as costs, resource availability and energy storage must be carefully considered in the search for sustainable energy solutions.

REFERENCES

A, A. Fernández-García; ZARZA, E.; VALENZUELA, L.; PÉREZ, M. Renewable and Sustainable Energy Reviews: parabolic trough solar collectors and their applications. **Elsevier**, Departamento de Fÿsica Aplicada, Universidad de Almerÿ, Spain, v. 04200, n. 04120, p. 1696-1717, 05 mar. 2010. Mensal.

CARDOSO, M, **Motor Magnético V – Gate,** 2017. Disponíel em: < https://www.imablog.com.br/tag/gerar/,último acesso em 17 de Abril de 2023.

COSTA, I. P.et al. **Sistema de transformação de energia cinética em energia elétrica por meio de uma bicicleta ergométrica com aquisição de sinais e dados**. 2014. Disponível em: https://www.inovarse.org/sites/default/files/T14_0397_8.pdf Acesso em: 16 de Abril de 2023.

PONTES, Cláudio Marinho de Pinho, 2023, **Aplicação de energia renovável: aprimoramento do motor com imã neodímio, 2018.** Disponível em: https://www.atenaeditora.com.br/catalogo/ebook/aplicacao-de-energia-renovavel aprimoramento-do-motor-com-ima-neodimio,2023, Acesso em 20 de abril de 2023.

FINKLER, A. L. et al. A necessidade de regulamento de interconexão para microgeração por máquinas síncronas e assíncronas. **Revista de Ciência e Inovação**, v. 6, n. 1, 2021.

PEREIRA, J. A. S. **Estudo e implementação de técnicas de controlo para um motor BLDC de uma bicicleta elétrica**. 2017. Tese de Doutorado.

YILDIZ, M.(2013)**, Desenho esquemático do Motor Yildiz**, Disponível em: rexresearch.com/yildiz,Acesso em: 15 de abril de 2023.

JEBASINGH, Vk; HERBERT, Gm Joselin. Renewable and Sustainable Energy Reviews: a review of the solar parabolic trough collector. **Elsevier**, Departamento de Engenharia Mecânica, Noorul Islam University, Kumaracoil, Thuckalay 629180, Índia, v. 02, n. 01, p. 1085-1090, 21 out. 2015. Mensal.

ABDULHAMEDA, Ali Jaber; ADAMA, Nem Mariah; AB-KADIRA, Mohd Zainal Abidin; HAIRUDDINA, Abdul Aziz. Renewable and Sustainable Energy Reviews: review of geometric and thermal analysis of parabolic solar collectors, performance and applications.**Elsevier**, Adepartamento de Engenharia Mecânica e de Fabricação, Faculdade de Engenharia, Universidade Putra Malaysia, 43400 Upm Serdang, Selangor, Malásia Bdepartamento Automotivo, Faculdade de Engenharia/Al-Musaib, Universidade de Babilônia, Hilla, Babilônia, Iraque, v. 02, n. 01, p. 823-831, 14 abr. 2018. Mensal.

BRASIL. Lei n° 14.182 de 12 de julho de 2021. Dispõe sobre a desestatização da empresa Centrais Elétricas Brasileiras S.A. (Eletrobras). Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2021/Lei/L14182.htm. Acesso em: 15 de agosto. 2023

COMISSÃO ECONÔMICA PARA A AMÉRICA LATINA E O CARIBE/CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS (CEPAL/CGEE), **"Panorama dos investimentos em inovação em energia no Brasil: dados para um grande impulso energético"**, Documentos de Projetos (LC/TS.2020/62; LC/BRS/TS.2020/4), Santiago, 2020.

ELGAMAL, G. N. G., DEMAJOROVIC, J. As barreiras e perspectivas para geração de energia elétrica por painéis solares fotovoltaicos na matriz energética brasileira. **Rev. Gest. Ambient. e Sust.** - GeAS, São Paulo, SP, v. 1, p. 1-28, 2020.

EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Anuário Estátistico de Energia**, 2021. Disponível em: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-160/topico-168/Anu%C3%A1rio_2021.pdf. Acesso em: 15 de setembro. 2023.

EMPRESA DE PESQUISA ENERGÉTICA (EPE). **BEN Relatório síntese 2021 (base 2020)**, 2021. Disponível em: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-601/topico-588/BEN_S%C3%ADntese_2021_PT.pdf. Acesso em: 15 de setembro. 2023.

EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Emissão de Gases de Efeito Estufa em Reservatórios Hidrelétricos (nota técnica EPE/DEA/SMA 012/2022)**, 2022. Disponível em:https://www.epe.gov.br/sites-pt/publicacoes-dados abertos/publicacoes/PublicacoesArquivos/publicacao-673/NT%20EPE-SMA-DEA_012-2022.pdf. Acesso em: 11 de setembro. 2023.0 de jul. 2022.

EMPRESA DE PESQUISA ENERGÉTICA (EPE). BEN - **Séries Históricas e Matrizes (base 2020)**, 2020. Disponível em https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/BEN-Series-Historicas-Completas. Acesso em: 15 de setembro. 2023.

FERREIRA, H. G. R. et al. Resíduos sólidos urbanos (rsu): uma análise do setor energético em ascensão com base no impacto ambiental e na qualidade de vida. **Form. (Online)**, v. 27, n. 51, p. 65-83, 2020.

GASPARIN, F. B. et al. A Influência de Políticas Públicas para o Progresso da Geração Solar Fotovoltaica e Diversificação da Matriz Energética Brasileira. Palotina, PR: **UFP**, 2021.

INTERNATIONAL ENERGY AGENCY (IEA). **Net Zero até 2050: Um roteiro para o sistema energético global**, 2021. Disponível em: https://www.iea.org/reports/net-zero-by-2050. Acesso em: 15 de jan. 2023

INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA). **Perspectiva de transições energéticas mundiais: 1,5°C caminho**, 2021. Disponível em: https://www.irena.org/publications. Acesso em: 15 de agosto. 2023

TEIXEIRA, W. DE P. Energia solar fotovoltaica: uma revisão sistemática sob a perspectiva da sustentabilidade. **Rev. Cient. Sem. Acad.**, Fortaleza, CE, n. 180, 2019.