Working Paper No. 369

Spark of Transformation: The Impact of Electricity Prices on Europe's Industrial Landscape – Introducing the Green Industrial Location Attractiveness Index (GILAI).

Jonas Grafström

RATIO
Näringslivets forskningsinstitut

Box 3203
103 34 Stockholm

Besöksadress:
Sveavägen 59, 4 tr

Spark of Transformation: The Impact of Electricity Prices on Europe's Industrial Landscape – Introducing the Green Industrial Location Attractiveness Index (GILAI).

JONAS GRAFSTRÖM*
The Ratio Institute
SE-113 59 Stockholm
Sweden

E-mail: jonas.grafstrom@ratio.se

Abstract

This paper examines the influence of volatile electricity prices on the industrial landscape of Europe. The record-breaking prices experienced in the European wholesale electricity market throughout 2022, along with contributing factors such as the surging gas prices, nuclear power limitations, and reduced hydroelectric output, present complexities and challenges to Europe at the same time as a new wave of green industrialization is forming. Drawing from European Commission- and Eurostat data a new tool, the Green Industrial Location Attractiveness Index (GILAI) is introduced that should be helpful for predicting future green industrial establishments. The top three countries for green industrial establishments in Europe are Sweden, Finland, and Austria. A North/South European split with northern countries achieving higher rankings, while southern countries grapple with several factors. Through this analysis, the aim is to contribute to a better understanding of the evolving industrial landscape in Europe and identify strategies to enhance industry competitiveness and sustainability in the face of fluctuating electricity prices.

Keywords: Electricity, Industry, Europe, Renewable, Transformation.
JEL classification: Q41, L94, Q42, Q54.

* Responsibility for any remaining errors, however, resides solely with the author. This paper was presented at the ETTE yearly meeting in Stockholm on June 13, 2023.

1. Introduction

Despite soaring electricity prices in 2022, the European Union (EU) saw a rise in industrial employment and output compared to 2021. However, electricity-intensive industries, such as basic metals, chemicals, non-metallic minerals, and paper, experienced a decline in output (Sgaravatti et al., 2023). The electricity price has a significant impact on the European industry, especially on energy-intensive sectors (Makridou et al., 2016). Electricity demand varies across different sectors, with industrial sectors typically exhibiting the highest demand (Zhao et al., 2014; Makridou et al., 2016). It is anticipated that energy prices will continue at historically high levels in the foreseeable future (Ari et al., 2022). The considerable fluctuations observed in the European electricity market underscore the inherent difficulties faced by several countries that aims to maintain or expand an industrial base.

The phenomenon of deindustrialization was seen as an inherent development in contemporary advanced economies, as suggested by scholars like Rodrik (2016) and Škuflić and Družić (2016). However, deindustrialization in Europe seems to be broken and Europe is currently undergoing a reindustrialization process, marked by the return of production and the emergence of a robust green industry (Capello and Cerisola, 2023). The green industrial sector relies heavily on electricity and has a pressing need for non-CO2 energy sources. As a result, countries with the capacity to meet this demand are positioned to become champions of employment. The research question then arises: Which countries possess the capacity to excel in the green re-industrialization of Europe?

The purpose of this paper is to analyze the influence of volatile electricity prices on the future industrial landscape of Europe and to introduce an analytical tool for predicting green industrial development in Europe. Understanding the impact of volatile electricity prices is crucial for making informed decisions, enhancing economic competitiveness, facilitating sustainable energy transitions, and ensuring energy security. The findings presented in this paper contribute to the expansion of the existing literature on electricity prices and their influence on industrial investment decisions, providing insights into the future of the European industry and the challenges and opportunities it may face. A significant contribution of this paper is the introduction of a Green Industrial Location Attractiveness Index (GILAI) designed to assist in predicting future green establishments.

The constructed GILAI scenarios provide valuable insights into the factors influencing the European industry's reindustrialization process. Electricity prices, energy intensity, and renewable energy play significant roles in determining the attractiveness of locations for green industrial establishments. The reindustrialization of Europe, as mentioned, is closely linked to the ability to provide competitive electricity prices, improve energy efficiency, and promote renewable energy sources in the industrial landscape. The GILAI index offers a structured approach to evaluating these factors and can assist policymakers and investors in making informed decisions regarding green industrial development in Europe. From a general policy perspective, the necessity of investigating the impact of fluctuating electricity prices on Europe's industrial landscape enables informed decision-making, promotes economic competitiveness, supports sustainable energy transitions, and enhances energy security.

Predicting the precise outcomes and effects of electricity prices on the industrial landscape is complex and contingent on numerous interrelated factors. The proposed GILAI serves as a foundational tool for analysis and continuous improvement, offering a perspective on the reindustrialization issue. It is not intended to be definitive, as the landscape evolves over time due to country-specific decisions, market dynamics, energy policies, technological advancements, and global economic conditions.

The remainder of the paper is structured as follows. In Section 2, you will find background information on recent developments in electricity and energy that impact industry competition and price trends. Section 3 outlines the data used and describes the approach for constructing the GILAI index. Section 4 presents the results of the GILAI ranking. Section 5 offers a discussion of the results. Finally, in Section 6, the paper concludes and discusses its policy implications.

2. Recent development

2.1 Electricity and energy affecting industry competition.

Energy intensity refers to the quantity of energy needed to produce one unit of economic output, commonly measured as energy consumption per unit of GDP. The energy intensity metric serves as a crucial indicator of a country's or region's energy efficiency, offering insights into their economic development, energy consumption patterns, and environmental sustainability. Notably, energy-intensive industries are highly responsive to fluctuations in electricity prices. Elevated energy expenses can significantly impact their production costs, profitability, and global competitiveness (Rokicki et al., 2022).

In Europe, there has been a consistent trend of decreasing industrial energy intensity over the past few decades (Lamb et al., 2021). The decline in energy intensity can be attributed to several factors, including improvements in energy efficiency, technological advancements, shifts in economic structure, and policy initiatives promoting sustainable development. The EU has set specific targets for member states to reduce their energy consumption and increase energy efficiency (Chlechowitz et al., 2022). One of the key targets was the Energy Efficiency Directive, which aimed to achieve a 20 percent improvement in energy efficiency by 2020 (European Commission, 2018).

As a result, energy intensity in Europe has generally been decreasing, indicating a higher economic output with relatively less energy consumption. Generally, countries with a more service-oriented economy tend to have lower energy intensity. On the other hand, countries with energy-intensive industries, such as manufacturing or heavy reliance on fossil fuels, may exhibit higher energy intensity levels. Energy plays a vital role in various sectors, including industry, transportation, agriculture, and residential areas. Not all countries have easy access to abundant or inexpensive energy sources. These efforts contribute to minimizing energy waste, reducing greenhouse gas emissions, and enhancing overall energy security. Reducing energy intensity can yield multiple benefits, including enhanced energy resilience, reduced dependence on external energy sources, lower energy costs, and the promotion of sustainable economic growth.

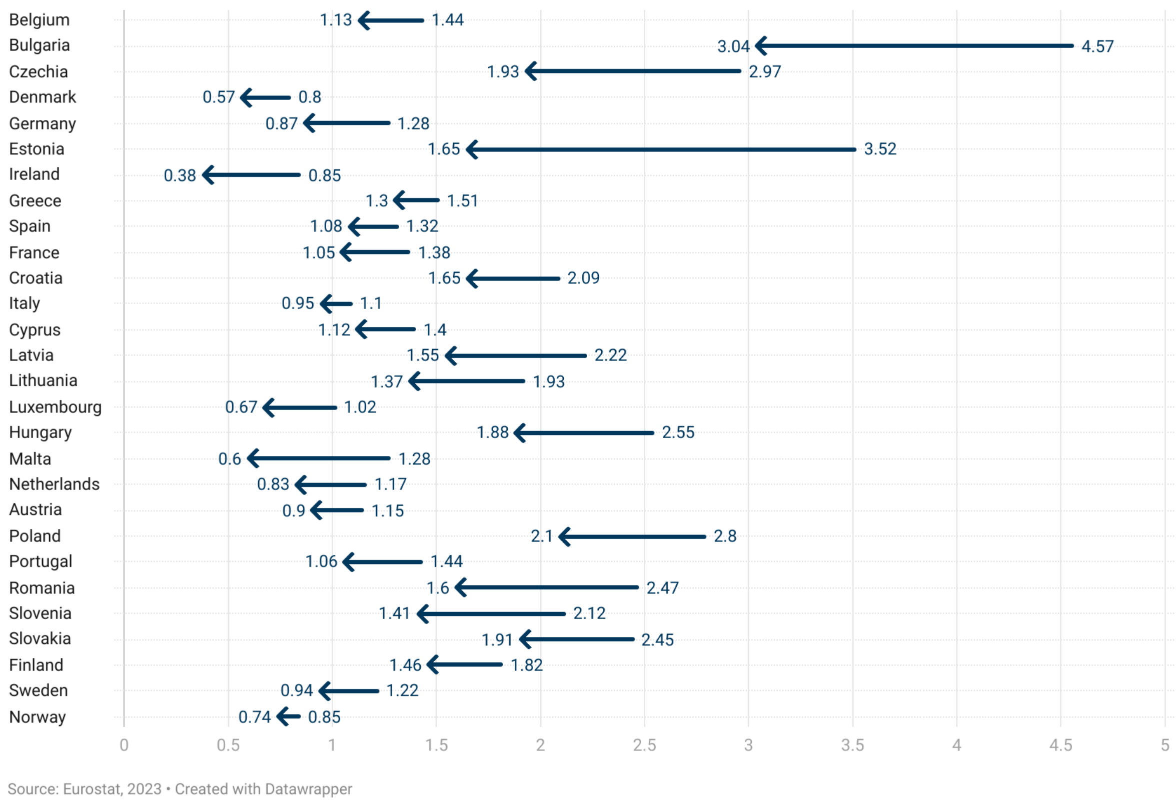

Figure 1 Energy intensity change 2013-2021 GWh/GDP (million). Source: Eurostat 2023.

Europe has been actively promoting interconnection between national power grids to enable cross-border electricity trade (Hawker et al., 2017). This allows countries to optimize their electricity generation mix, access renewable resources from neighboring countries, and improve grid stability. Interconnection also facilitates the integration of intermittent RES into the grid.

The integration of energy markets across Europe can influence electricity prices (González and Alonso, 2021). Cross-border electricity trading and interconnections allow for better resource allocation and price convergence, potentially leading to more stable electricity prices for industries (Ovaere et al., 2023). High electricity prices can reduce the competitiveness of European industries, particularly those that rely heavily on energy consumption (Astrov et al., 2015). Moreover, the relationship between electricity prices and employment in the industrial sector is a multifaceted one, influenced not only by price levels but also by various sector-specific factors and international market dynamics.

Deschênes (2011) suggests a weak negative relationship between state-level electricity prices and employment rates. Cox et al. (2014) similarly find a weak substitutability between electricity and labor, indicating that higher electricity prices can lead to lower employment due to output contractions. Marin (2017) found that a 10 percent increase in energy prices had a modestly negative impact on employment in French manufacturing establishments, with the negative effects concentrated in energy-intensive and trade-exposed sectors. Bijnes et al., (2022) found that a negative elasticity for employment in Europe's most energy intensive industries. Li et al. (2022) showed that rising electricity prices reduced labor demand in Chinese manufacturing enterprises, with the impact being greater in high-GDP cities, labor-intensive industries, and in enterprises with foreign private ownership.

Several studies have explored the intricate relationship between energy prices and various economic factors. Hille and Möbius (2019) reveal positive net employment effects, highlighting the transition from energy-intensive to energy-saving sectors. Similarly, Marin and Vona (2019) focus on the labor market, showing how energy price increases impact technician and manual worker demands. Building on this, Marin and Vona (2021) delve into the effects on French manufacturing establishments, noting partial offsets through job reallocation. Meanwhile, Saussay and Sato (2018) shift the focus to international investment, observing shifts from higher- to lower-priced countries due to relative price increases. In contrast, Barteková and Ziesemer (2019) find that increasing electricity prices can deter foreign direct investment. Lastly, Li and Leung (2021) broaden the scope, linking economic growth to the expansion of renewable energy across seven European countries. These studies collectively provide a nuanced understanding of how energy price fluctuations influence various facets of the economy.

2.2 Recent price development and the energy transition

Throughout 2022, the European wholesale electricity market witnessed numerous instances of record-breaking high prices, culminating in a peak in August (European Commission, 2023). The surge in gas prices, coupled with the limited availability of nuclear power and the conflict in Ukraine, as well as reduced hydroelectric output caused by drought, collectively exacerbated the strain on an electricity market that was already operating under tight conditions (IEA, 2022). Drought conditions led to a substantial year-on-year decline of 19 percent in hydroelectric output across Europe between January and September 2022. In France, for example, maintenance work led to the offline status of most of the country's 56 reactors in September (Horowitz, 2022). Over the course of the year, the European Power Benchmark maintained an average of 230 €/MWh, signifying a significant increase of 121 percent when compared to 2021. Among European nations, Italy recorded the highest average baseload electricity prices at 304 €/MWh, followed closely by Malta (294 €/MWh), Greece (279 €/MWh), with France also ranking high at 275 €/MWh (Ari et al., 2022).

Network prices in Europe followed a steady upward trajectory until 2012, ultimately peaking at €0.0943 per kWh. Subsequently, prices experienced a decline leading up to 2020, with rates reaching €0.0781 per kWh in the second half of 2019 and €0.0820 per kWh in the second half of 2020. While there was an increase compared to 2020, the prices remained lower than the peak observed in the first half of 2008. However, in the second half of 2022, a significant surge occurred (as depicted in Figure 1), with prices soaring to €0.1986 per kWh, marking the highest point recorded since the commencement of data collection (Eurostat, 2023a).

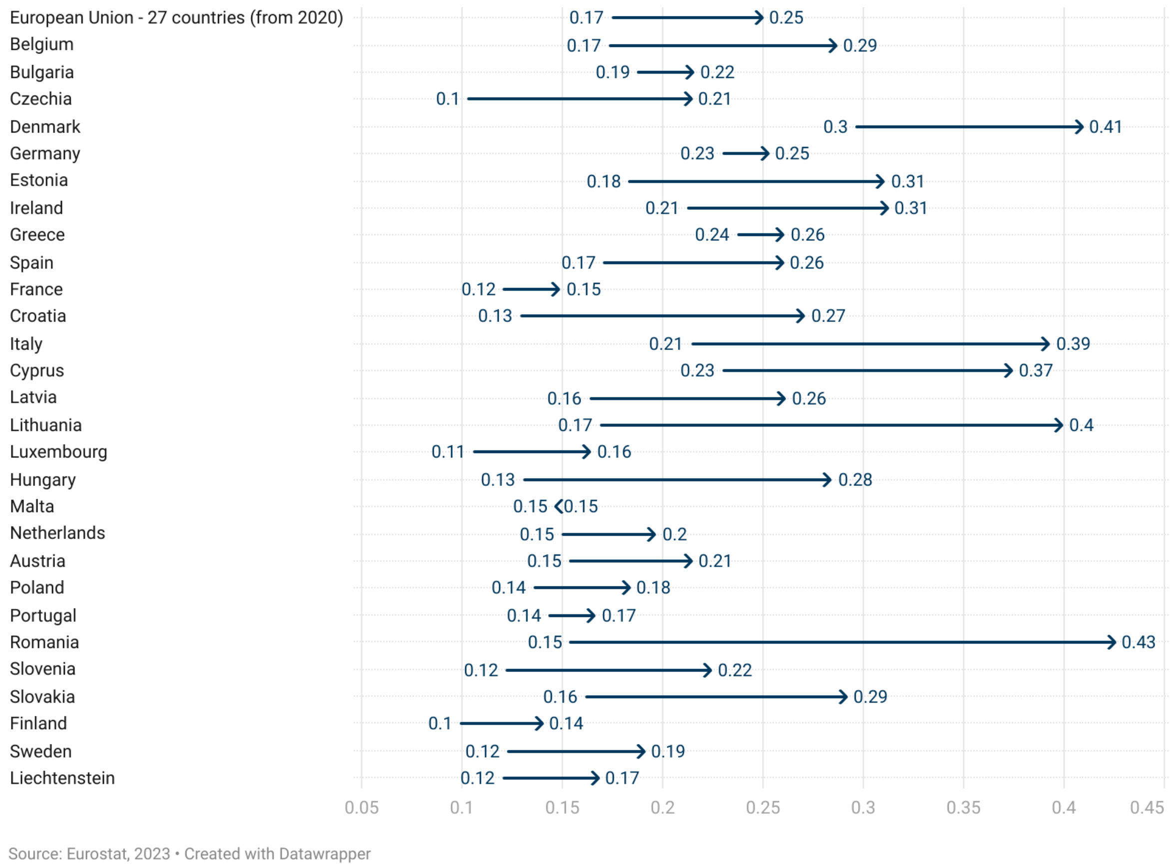

Figure 2 Change in Electricity prices 2021-2022. Source: Eurostat, 2023.

When adjusted for inflation, the total price for non-household consumers, inclusive of taxes, stood at €0.1244 per kWh in the second half of 2022. This figure was lower than the actual price, which included taxes during the same period. Conversely, the total price for non-household consumers, excluding taxes, amounted to €0.1986 per kWh in the second half of 2022. This was higher than the actual price without taxes in the first half of 2008 (Eurostat, 2023a).

Following the energy crisis experienced in August and September, the final quarter of 2022 witnessed a return to normalcy (Eurostat, 2023a). Although gas prices decreased from their all-time highs, they remained elevated throughout November and December, with a brief dip in October. Prices reached a peak of approximately 150 €/MWh in early December before gradually declining to around 70 €/MWh by month-end. To compensate for the reduced supply of Russian pipeline gas, caused by the Nord Stream supply cut in the third quarter, the European market heavily relied on liquefied natural gas (LNG) imports, which increased by 13 billion cubic meters (bcm), marking a 70 percent rise compared to the previous year. Additional pipeline imports primarily originated from Norway and the UK. Monthly imports of Russian pipeline gas stabilized at around 3-4 bcm, significantly lower than the 11-12 bcm per month recorded in Q4 2021. Consequently, the share of Russian pipeline gas imports decreased by approximately 15 percent in Q4 2022, representing a decline of more than 25 percentage points compared to the same quarter in 2021 (Eurostat, 2023a).

The price premium, when compared to Asian markets, gradually diminished and dropped to approximately 10 €/MWh by late December, following its peak above 100 €/MWh during the crisis in August (Eurostat, 2023). This reduction in price premium was influenced by the abundance of LNG in southwestern Europe and improved grid congestion in northwestern Europe, contributing to a normalization of the discount in LNG import prices compared to the Title Transfer Facility (TTF) and other continental benchmarks.

In Q4 2022, the United States emerged as the largest supplier of LNG to the EU, accounting for 13.2 bcm (36.9 percent of total EU LNG imports), followed by Qatar with 6 bcm (16 percent of EU imports), and Russia with 5.6 bcm (15 percent). During the same period, the EU surpassed Japan and China to become the world's leading LNG importer. In Q4 2022, EU gas consumption witnessed a year-on-year decline of 21 percent, amounting to 95.4 bcm (25 bcm less). However, gas usage in power generation remained robust, with an increase of 1.7 percent, reaching 133 TWh.

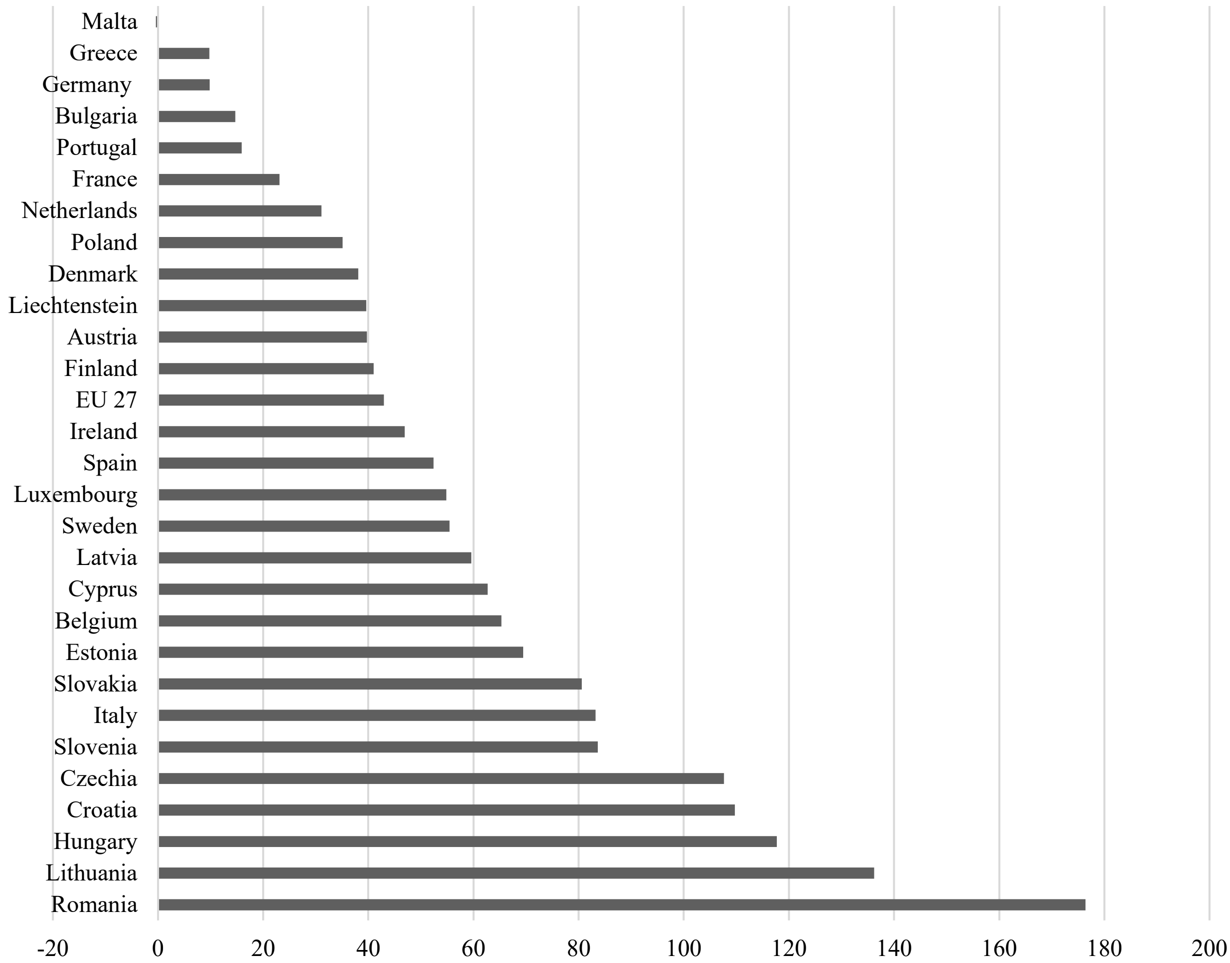

Figure 3 Change in electricity prices for non-household consumers compared with previous year's same semester, second half 2022. Source: Eurostat, 2023.

Taxes wield significant influence in determining the ultimate energy prices for consumers across the EU, thereby exerting a substantial impact on consumption and investment behaviors (European Commission, 2023b). Notably, taxes on electricity witnessed a considerable upsurge, escalating by 37.3 percentage points, surging from 16.1 percent in the first half of 2008 to a peak of 53.4 percent in the first half of 2020 (Eurostat, 2023). In the latter half of 2022, taxes constituted the smallest share observed since data collection commenced, standing at a mere 5.6 percent. This decline reflects measures implemented to alleviate the burden of electricity costs. When considering the total price for non-household consumers, encompassing non-recoverable taxes, it more than doubled (138.1 percent) compared to the first half of 2008, moving from €0.0834 per kWh to €0.1986 per kWh in the second half of 2022.

The EU has a long-term goal of reducing greenhouse gas emissions by 80-95 percent compared to 1990 levels by 2050 (European Commission, 2023). Achieving the EU goal requires a significant increase in the share of renewable energy sources (RES) in the overall electricity mix. RES have variable generation patterns, depending on factors like weather conditions and time of day. This intermittency requires the integration of energy storage technologies and grid flexibility measures, which can add additional costs to the electricity system.

While investing in RES brings environmental and health benefits, it can also result in higher electricity prices for both businesses and consumers (Bijnens et al., 2022), but some studies have found a negligible effect (Sisodia et al., 2015). In 2016, Wang et al., (2016) discovered that the implementation of Renewable Portfolio Standards (RPS) in the United States led to an initial rise in electricity prices. Similarly, Río et al (2018) revealed that the promotion costs associated with renewable energy in the EU had a positive and statistically significant impact on retail electricity prices, albeit a minor one. Contrarily, Dillig et al., (2016) indicated that the increase in electricity prices in Germany was not primarily attributed to renewables but rather to the liberalization of the European energy market since the liberalization introduced investment risks that impeded necessary investments well before the rise of renewable energy sources.

The transition to renewable energy sources, such as wind and solar power, has implications for electricity prices (Wang et al., 2016; Dillig et al., 2016; Río et al., 2018). While renewable energy can contribute to decarbonization and sustainability, the initial investments and infrastructure costs can sometimes result in higher electricity prices in the short term. Energy taxes and environmental taxes has a negative impact on renewable energy deployment (Dogan et al., 2022).

While the specific mix of energy sources varies among European countries, notable trends and shifts have occurred on a broader scale. In 2021, most of the electricity generated in the EU came from non-combustible primary sources, constituting 58.1 percent of the total (Eurostat, 2023c). In contrast, combustible fuels such as natural gas, coal, and oil accounted for less than half of net electricity generation, representing 41.9 percent. Nuclear power stations supplied a quarter of the electricity, totaling 25 percent. Among renewable energy sources, wind turbines held the highest share of net electricity generation in 2021 at 13.7 percent, followed closely by hydropower plants at 13.3 percent, while solar power contributed 5.8 percent to the EU's net electricity generation. Wind generation increased by 33 TWh (+8.6).

Historically, fossil fuels, including coal, natural gas, and oil, have dominated electricity generation in Europe. However, there is a noticeable downward trend in their usage, as many European countries have been phasing out coal-fired power plants or implementing stricter emission regulations. In 2022, fossil fuels produced 1.11 million Gigawatt-hours (GWh) of electricity, marking a 3.3 percent increase compared to 2021, whereas renewables generated 1.08 million GWh, reflecting only a marginal 0.1 percent rise. The most significant increases in electricity generation occurred in the solar photovoltaic sector, which saw a remarkable increase of 29.3 percent, as well as in wind energy, which experienced an 8.9 percent growth. Conversely, electricity production from hydro sources declined by 17.7 percent, and solid biofuels showed a decrease of 7.4 percent during the same reference period (Eurostat, 2023d).

Nuclear energy has been an important part of Europe's electricity generation mix. Some countries, including France, Sweden, and Finland, have a significant reliance on nuclear power. The future of nuclear energy in Europe is subject to debate, as some countries have opted for phase-outs or reduced dependence on nuclear power due to safety concerns and long-term waste management issues. Some projects have been announced or are ongoing. In 2024, France is planning to add an EPR reactor at the Flamanville 3 Nuclear Power Plant with a capacity of 1650 MWe. Slovakia is set to construct the Mochovce 4 reactor in 2024. This reactor is a VVER-440 type with a capacity of 471 MWe. The United Kingdom is embarking on a major nuclear energy project with Hinkley Point C1 and C2. Both reactors are EPR models with a substantial capacity of 1720 MWe each.

According to the World Nuclear Association (2023) there has been some upgrades of European nuclear power. All operating reactors in Switzerland have undergone upgrades, resulting in an increase in capacity by 13.4 percent. Spain has implemented a program to increase its nuclear capacity by 810 MWe (11 percent) through upgrades to its nine reactors. Most of the increase has already been completed. For example, the Almarez nuclear plant was boosted by 7.4 percent at a cost of $50 million. The original Olkiluoto nuclear plant in Finland has increased its capacity by 29 percent to 1700 MWe. This plant initially had two 660 MWe Swedish BWRs commissioned in 1978 and 1980. Additionally, the Loviisa plant, which operates with two VVER-440 reactors, has been uprated by 90 MWe (18 percent). Swedish utilities have conducted upgrades on three plants. The Ringhals plant underwent an upgrade of approximately 305 MWe between 2006 and 2014. Oskarshamn 3 was uprated by 21 percent to 1450 MWe, costing €313 million. Forsmark 2 experienced a 120 MWe uprate (12 percent) until 2013.

Renewable Energy: The share of RES in electricity generation has been steadily increasing in Europe (Tutak and Brodny, 2022; Dogan et al., 2023). The declining costs of renewable energy technologies, supportive policies, and commitments to decarbonization have contributed to the growth of renewable electricity generation.

In 2022, Europe witnessed a surge in new wind installations, reaching a total of 19.1 GW, despite facing economic challenges and supply chain difficulties. Out of this, 16.7 GW were installed onshore, while 2.5 GW were installed offshore (Wind Europe, 2023). In 2022 wind power output grew 33 TWh (+8.6). In 2022, wind power accounted for 15 percent (equivalent to 420 TWh) of the total electricity generation in the EU. Among the EU countries, Germany emerged as the largest wind power generator, producing 126 TWh, which made up 22 percent of its overall electricity mix. Spain followed closely with 62 TWh, also accounting for 22 percent. Denmark had the highest proportionate contribution, with wind power making up 55 percent, corresponding to 19 TWh. Other countries with notable shares of wind power include Ireland (34 percent), and Portugal (26 percent).

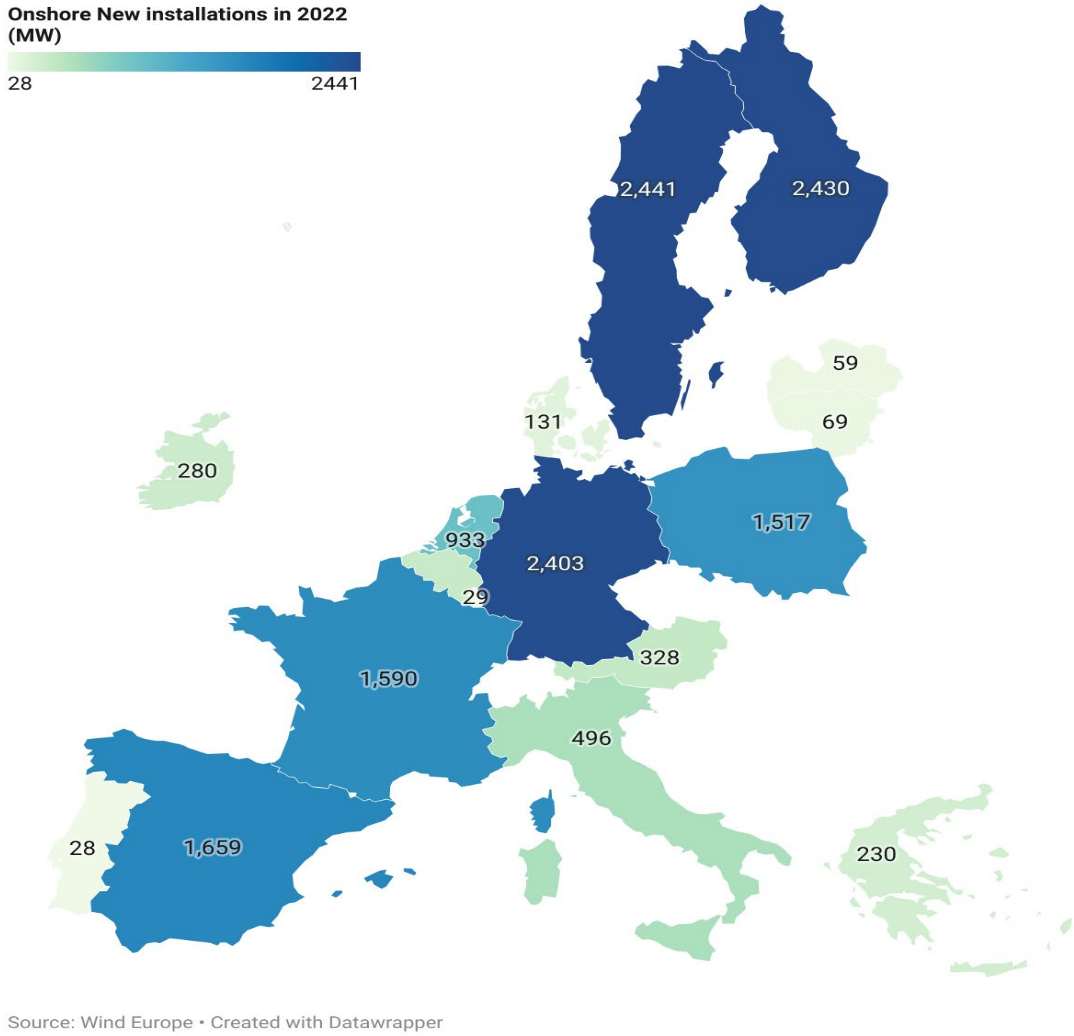

Figure 4 Onshore New Installation in 2022 (MW). Source Wind Europe.

To achieve the EU's target of 45 percent renewable energy by 2030, wind energy installations must average 31 GW per year between 2023 and 2030 (Wind Europe, 2023). This calculation is based on a target installed wind power capacity of 440 GW. Among European countries, Germany led the way in wind farm installations during 2022, with nearly 90 percent of the installed capacity being onshore. Additionally, Germany connected the Kaskasi offshore wind farm (342 MW) to the grid, contributing to a total installations figure of 2.7 GW. Sweden and Finland each installed 2.4 GW of capacity, while France achieved 2.1 GW, including the notable addition of its first large-scale offshore wind farm, Saint Nazaire, with a capacity of 480 MW.

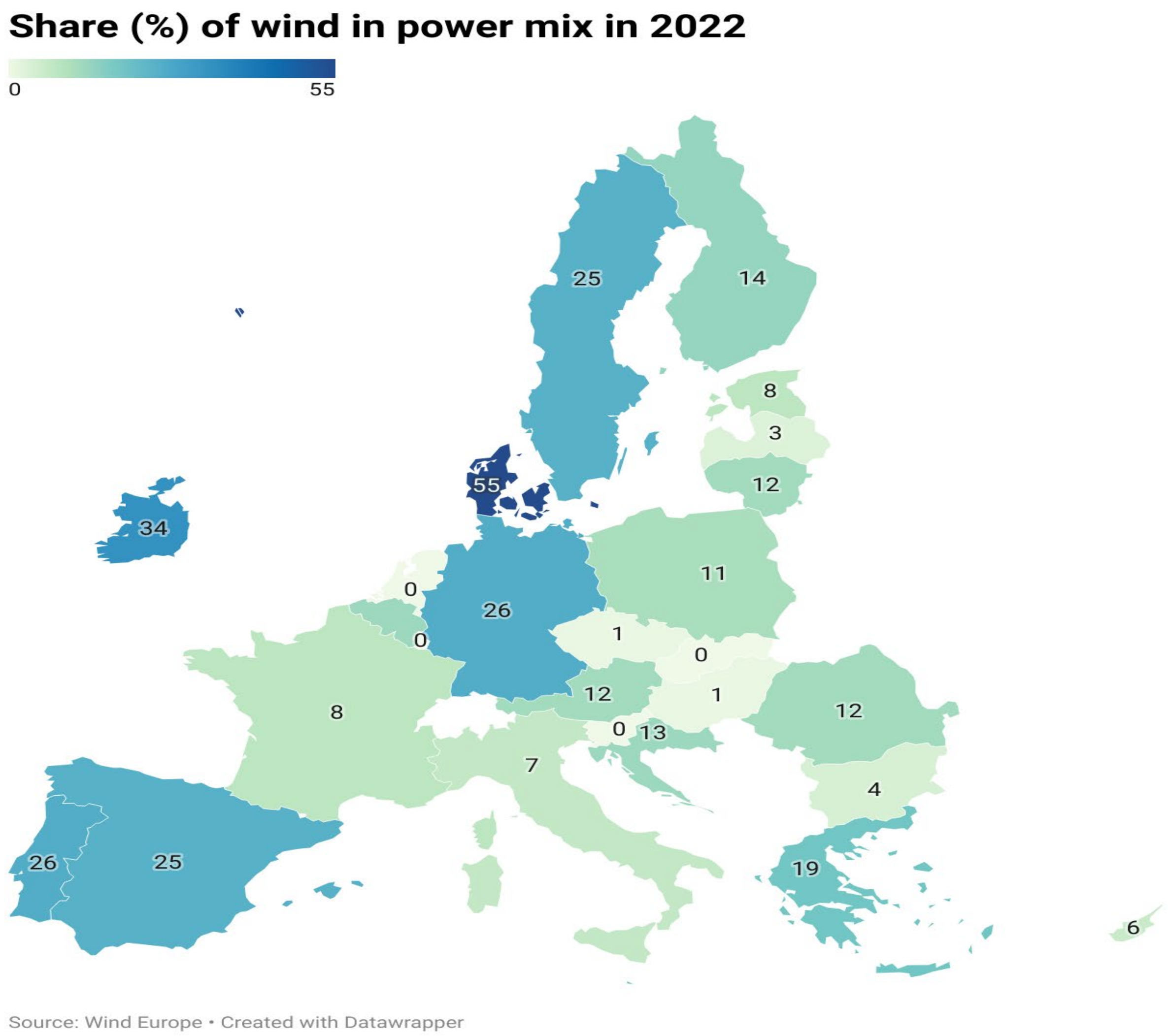

Figure 5 Share (percent) of Wind in power mix 2022. Source: Wind Europe.

Solar energy has witnessed considerable growth, driven by falling costs and technological advancements (Grafström and Poudineh, 2023). Countries with favorable solar conditions, such as Spain, Italy, and Germany, have seen significant installations of solar photovoltaic (PV) systems. The amount of electricity generated from solar power experienced an increase of 39 terawatt-hours (TWh) or 24 percent in 2022. The share of solar power in the electricity mix rose to 7.3 percent, marking an increase of 1.6 percentage points compared to the previous year's figure of 5.7 percent. The expanding solar generation was primarily driven by Germany, which witnessed a rise of 9.6 TWh (a 20 percent increase). Additionally, countries such as Spain added 5.7 TWh (a 21 percent increase), the Netherlands added 5.8 TWh (a 51 percent increase), France saw an increase of 4.3 TWh (a 27 percent increase), and Poland added 4.1 TWh (a 104 percent increase).

Biomass, derived from organic materials such as agricultural waste, wood pellets, and energy crops, has long been used for electricity generation in Europe. It provides a renewable and carbon-neutral energy source, though concerns related to sustainability and emissions associated with biomass utilization remain. It constitutes around 60 percent of EU´s renewable energy and is mostly concentrated to the heating sector (European Commission, 2021).

Many European countries, such as Norway, Sweden, and Switzerland, have a long history of utilizing hydroelectric power. This renewable energy source continues to contribute significantly to electricity generation, especially in regions with ample water resources. The expansion possibility is however limited due to protection of existing unused rivers.

The energy mix and the pace of developments vary across European countries due to factors such as resource availability, policy priorities, and market dynamics. Nonetheless, the overall trend in Europe has been a shift towards cleaner and more sustainable sources of electricity generation, with a growing share of renewable energy contributing to the continent's power supply.

3. Data and approach

The factors influencing the location of green industrial investments are unquestionably complex. Recent noteworthy investments in green sectors, such as the establishment of battery factories, have been motivated by a dual aim: ensuring energy security and making a significant commitment to green energy. Notably, after four decades, new steel mills are now being planned, constructed, and opened. The process of green re-industrialization in Europe is likely just beginning, but the precise locations where this transformation will unfold across the continent remain uncertain.

To facilitate analytical assessments of potential locations for new industrial establishments, an index has been developed based on the previously presented data. This comprehensive system takes into account several critical factors, including Electricity Prices, Energy Intensity, Wind Installations, Price Change, and Renewable Energy Share, each assigned specific values for every region or location under consideration. Countries are ranked on a scale from 1 to 27, with the highest-scoring location receiving 27 points and the lowest scoring 1 point. These individual scores are then amalgamated to form an overall ranking, resulting in the creation of a Green Industrial Location Attractiveness Index (GILAI). A higher GILAI score indicates a more appealing destination for establishing a green industry:

*Green Industrial Location Attractiveness Index (GILAI) = (w1 * Electricity Prices) + (w2 * Energy Intensity) + (w3 * Wind Installations) + (w4 * Price Change) + (w5 * Renewable Energy Share).*

The resulting GILAI value provides a quantitative measure of the country's attractiveness for industrial establishments. Countries with higher GILAI values are more attractive, while those with lower values are less so. The Data was collected from Eurostat, The European Commission and Wind Europe. A few of the indicators was not found for Lichtenstein. The countries capability to host major industrial establishments should be limited.

Determining factors for the location of industrial establishments can be complex, and multiple variables can play a role. Firms might have specific needs and take other factors into account, such as institutional stability, ease of doing business or labor cost or availability. The index is open for development, and it should be used as an indicator and is presented as an illustration. When two countries are very close to each other such as the case for Austria (92 points and France (90 points) then the score might not with certainty say that one country have an edge, rather that they are both close to each other.

The chosen factors are presented below. Each of these factors are likely relevant and contribute to a formula for assessing their impact on industrial establishments' location decisions.

1. **Electricity Prices for Non-Household Consumers**: Industrial establishments often consume significant amounts of electricity. High electricity prices can increase operational costs, which may make a country less attractive for industrial development. Conversely, lower electricity prices can be an incentive for businesses to establish themselves in a particular area. Prices is a function of the existing generation infrastructure and will in the short run be fixed.
2. **Energy Intensity of the Economy**: Energy intensity measures the amount of energy required to produce one unit of GDP. Countries with a high energy intensity may be less attractive to energy-intensive industries since they would incur higher costs. The already existing industries could have a grandfathered position on the market or access to the power grid in such a manner that it is hard to be given capacity for new establishments.
3. **New Wind Installations in 2022 (MW)**: The availability of renewable energy sources, such as wind power, can be a crucial factor for industries that aim to reduce their carbon footprint and energy costs. Countries with a higher capacity for wind energy may attract industries seeking clean and cost-effective energy sources. The installation of wind serves as a proxy for the ability to expand the generation capacity in an industrial manner. Solar is a factor, but due to data availability for all countries wind was chosen.
4. **2021-2022 Price Change**: Price stability is essential for businesses to plan their operations effectively. A significant and unexpected price change in electricity costs could deter industrial establishments from a country. This factor reflects the stability of the energy market. This variable captures the extreme variance that was introduced due to the Russian invasion of Ukraine. Other exogeneous shocks will likely occur over time and the 2021-2022 should serve as a proxy for further reactions.
5. **Renewable Energy Share in 2021**: Industries committed to sustainability and environmental responsibility may prefer countries with a higher share of renewable energy in their energy mix. Carbon intensive energy will be faced out in the EU and will see its price go up due to changes in the EUETS system, hence carbon-based energy is not a reliable energy source in the long run. The variable also is important for firms that wants to have a green production.

In the context of this formula, denoted as follows: w1, w2, w3, w4, and w5, representing weights assigned to each respective factor based on their perceived importance. These weights can be determined through empirical analysis or expert opinions. In the initial results presented in this paper, all factors have been assigned equal weight. This approach is adopted due to the inherent challenge of assigning rankings, as it is, to some extent, subjective and contingent upon firms' preferences dictated by their specific needs.

To assess the attractiveness of different countries for establishing industrial facilities, one can customize this formula by adjusting the weights and input values. It serves as a valuable starting point for a preliminary analysis, but it also warrants further refinement and customization to align with specific contexts and objectives.

The equation employed for calculating the Green Industrial Location Attractiveness Index (GILAI) demonstrates a notable degree of flexibility, allowing for the incorporation of supplementary variables for predictive purposes and the consideration of a diverse range of factors. Although the GILAI serves as a valuable instrument for evaluating the appeal of industrial locations, there exists room for further refinement and expansion, aimed at providing a more comprehensive assessment of the multitude of factors influencing industrial site selection.

In this context, there is the potential to introduce a broader array of variables beyond the initial set. These variables could encompass various dimensions, including economic, environmental, and social aspects, contributing to a more holistic evaluation of industrial location attractiveness. However, for the scope of the present paper, the primary focus remains on energy-related variables. This focus aligns with the research objectives and the specific context under investigation, acknowledging the significant impact of energy factors on the green industrial landscape.

Nonetheless, the adaptable nature of the GILAI underscores its potential for future research endeavors seeking to explore and incorporate additional determinants of industrial attractiveness. For instance, the index could be enriched by introducing variables such as ease of doing business indexes, economic freedom indexes, labor costs, and other pertinent factors. This approach would make the index a more comprehensive and nuanced tool for assessing the desirability of industrial locations.*GILAI = f(Energy Variables, Ease of Doing Business, Economic Freedom Indexes, Labor Costs).*

4. Results

Based on the calculations sowed in Table 1, we can see the relative attractiveness of each country for industrial establishments. Higher total GILAI values suggest greater attractiveness, while lower values suggest lower attractiveness.

Table 1 Green Industrial Location Attractiveness Index (GILAI).

	Electricity prices non household	Energy intensity of the economy	New Wind installations in 2022 (MW)	2021-2022 price change	Renewable energy shares 2021	Total
Sweden	21	20	26	15	27	109
Finland	27	12	25	11	26	101
Austria	18	22	19	10	23	92
France	25	21	24	6	14	90
Spain	14	19	23	13	15	84
Germany	15	23	27	3	13	81
Italy	4	24	20	21	12	81
Luxembourg	24	25	12	14	1	76
Portugal	23	16	11	5	21	76
Latvia	12	9	13	16	25	75
Denmark	2	26	15	9	22	74
Netherlands	20	18	21	7	4	70
Slovenia	16	13	1	22	18	70
Lithuania	3	7	14	26	19	69
Croatia	11	11	1	24	20	67
Ireland	6	27	17	12	3	65
Belgium	9	14	18	18	5	64
Poland	22	5	22	8	7	64
Greece	13	15	16	2	16	62
Czechia	19	4	1	23	10	57
Romania	1	10	1	27	17	56
Estonia	7	3	1	19	24	54
Cyprus	5	17	1	17	11	51
Hungary	10	6	1	25	6	48
Slovakia	8	8	1	20	9	46
Malta	26	2	1	1	2	32
Bulgaria	17	1	1	4	8	31

1. Sweden (109): Sweden stands out as the most attractive destination for green industrial establishments. Sweden offers competitive electricity prices for non-household consumers, which can significantly reduce operational costs. Sweden demonstrates a robust focus on renewable energy, with substantial wind installations in 2022 and a high share of renewable energy in its energy mix. The stability in electricity prices from 2021 to 2022 adds to the predictability and attractiveness of the industrial landscape in Sweden.

2. Finland (101): Finland closely follows Sweden in terms of attractiveness for green industrial establishments. Finland offers competitive electricity prices, making it cost-effective for industries to operate. The country maintains a good level of energy efficiency, indicating efficient energy usage and the potential for cost savings. Additionally, Finland has a solid presence of wind installations in 2022 and a significant share of renewable energy.

3. Austria (92): Austria secures the third position as an attractive destination for green industrial development. Austria provides competitive electricity prices. The country also demonstrates strong energy efficiency. Furthermore, Austria experiences relatively stable electricity prices from 2021 to 2022, adding to the reliability of the industrial landscape. While its wind installations are moderate compared to some other countries, Austria's renewable energy supply contributes to its overall appeal.

These top three countries offer a combination of competitive electricity prices, energy efficiency, a focus on renewable energy, and stable price environments. However, the choice among them would ultimately depend on the specific needs and priorities of industrial establishments, as well as industry-specific considerations. When it comes to the bottom countries, they all have some decent factors but overall, they are consistently ranked low on most of the factors in the index.

However, keep in mind that this analysis assumes equal weights for each factor, robustness checks was performed to see the effects of smaller weights given to different variables. For example, the variable new wind installation was given a lower weight since many countries did not construct any wind power that year. The results, especially the top countries remained. In the appendix the calculations with both wind and energy intensity are set to zero. The top countries remain while Germany loses out somewhat. The bottom countries also remain stable. Here are some alternatives with different weightings of the variables:

Table 2 Alternative weightings for the index.

2: Emphasis on Renewable Energy (40 percent for Renewable Energy Share 2021, 15 percent for each of the other factors)	3: Focus on Energy Prices (40 percent for Electricity Prices Non-Household, 15 percent for each of the other factors)	4: Balancing Energy Efficiency and Renewable Energy (30 percent for Energy Intensity, 30 percent for Renewable Energy Share 2021, 10 percent for each of the other factors)	5: Emphasis on Change in Electricity Price (40 percent for 2021-2022 Price Change, 15 percent for each of the other factors)
1. Sweden	1. Finland	1. Sweden	1. Sweden
2. Finland	2. Sweden	2. Finland	2. Austria
3. Austria	3. Austria	3. Austria	3. Italy
4. France	4. Latvia	4. Latvia	4. Latvia
5. Spain	5. Lithuania	5. Lithuania	5. Portugal
6. Italy	6. Spain	6. Spain	6. Spain
7. Latvia	7. Portugal	7. Portugal	7. France
8. Portugal	8. Italy	8. Italy	8. Lithuania
9. Germany	9. Luxembourg	9. Luxembourg	9. Luxembourg
10. Lithuania	10. France	10. France	10. Finland

The rankings in Table 2 exhibit relatively stable patterns despite variations in weighting. The extent of change depends on the specific weighting scheme applied. For instance, when renewable energy share is assigned the highest weight (40 percent), Sweden consistently secures the top position. Conversely, Finland's ranking experiences a substantial drop from 2nd to 10th place in this scenario. When energy prices are heavily weighted (40 percent), Finland emerges as the leading choice, while it may hold lower positions in other weighting scenarios. Sweden, typically ranked first in other scenarios, experiences a notable decline to 7th place. In the scenario that equally values both energy intensity and renewable energy share (30 percent each), Sweden maintains its top-ranking status. However, there are slight shifts in the rankings of Finland and Austria, with Finland dropping from 2nd to 10th place and Austria ascending from 3rd to 2nd place. In the case where "Emphasis on Change in Electricity Price" is emphasized, Sweden remains at the pinnacle. However, Italy rises to the 3rd position, surpassing its rankings in other scenarios.

The weighting of factors introduces some variability in rankings, but the overarching trends remain relatively consistent. Sweden consistently emerges as a top-performing country across various dimensions of green industrial location attractiveness. In contrast, the rankings of other countries may shift depending on the specific emphasis placed on different factors. The results remain similar, there are some changes but roughly the same countries remain in the top 10.

5. Discussion

Industries in regions with lower electricity costs have a long run advantage, potentially affecting trade balances and investments in energy-intensive sectors. The ability of industries to adjust and effectives their energy- and especially electricity consumption based on price signals can help mitigate the impact of high electricity prices, thereby reducing costs and enhancing competitiveness. Demand response programs and flexible production processes can enable industries to optimize their energy usage during periods of high prices (Strbac, 2008). Electricity prices will impact the industrial landscape in Europe. Fluctuations in electricity prices can influence the competitiveness and profitability of industries, especially those that are energy intensive. Higher electricity prices will increase production costs, reduced profitability, and potentially impact investment decisions. Conversely, lower electricity prices could make industries more competitive and attractive for investment.

The index presented in Table 1 suggest a North/South European split in terms of electricity prices, energy intensity, and renewable energy. Northern European countries tend to have higher rankings, reflecting good performance in these areas, indicating a stronger emphasis on sustainability and lower energy intensity. Southern European countries generally have lower rankings, suggesting some challenges related to electricity prices, energy intensity, and renewable energy adoption. These differences likely result from varying energy policies, resources, and historical energy infrastructure development across the countries.

Table 2 suggests that the stability of the model is relatively robust, as the rankings exhibit a degree of consistency across different weighting scenarios. This stability is particularly evident in the case of

Sweden, which consistently secures a top position regardless of the specific factors emphasized or the weights assigned to those factors. Conversely, the rankings of other countries may vary to some extent when different factors are given higher or lower weights. For example, Finland's ranking can change significantly based on the emphasis placed on specific factors. While there is some variability in rankings due to the weighting of factors, the overall trends and the continued prominence of certain countries, like Sweden, suggest that the model is generally reliable and stable in assessing green industrial location attractiveness.

The EU has implemented various initiatives to promote RES and reduce greenhouse gas emissions (Grafström, 2018a, Grafström, 2018b). This transition towards clean energy can also affect electricity prices and potentially reshape the industrial landscape by incentivizing or mandating the adoption of sustainable practices. In 2022, wind and solar power achieved a historic milestone by generating a record-breaking one-fifth (22 percent) of the EU's electricity. This marked the first time that RES surpassed fossil gas (20 percent) and remained higher than coal power (16 percent) in terms of their contribution to the electricity mix (Eurostat, 2023c). Europe's reaction to Russia's incursion into Ukraine in 2022 was to expedite its transition towards a more sustainable electricity system. As a result, there has been a concerted effort to swiftly reduce gas consumption while simultaneously phasing out coal. This shift could lead to a significant expansion of clean energy sources across the continent.

Without an adequate and reliable electricity supply, these sectors may face constraints in their production capacities, leading to decreased productivity and potential job losses. Insufficient electricity supply can deter businesses from expanding their operations or setting up new ventures. This lack of investment can restrict job creation and limit the opportunities available in the labor market.

Research has yielded mixed effects of rising energy prices on employment in various sectors and countries. Higher electricity prices can result in reduced employment due to output contractions, but they may also lead to increased demand for technicians while decreasing the demand for manual workers. The impact of rising energy prices on manufacturing sector employment depends on multiple factors, including energy intensity, trade exposure, and intra-firm job reallocation.

The transition to renewable energy sources, while beneficial for decarbonization and sustainability, can initially drive-up electricity prices due to upfront infrastructure investments and associated costs. Integrating energy storage technologies and grid flexibility measures to manage renewable source intermittency further contributes to electricity system expenses.

The service sector, including areas such as information technology, telecommunications, and hospitality, also heavily relies on electricity to function smoothly. Interruptions or inadequate supply of electricity can disrupt their operations. Certain industries, like mining, heavy manufacturing, and data centers, have particularly high energy demands. Without a sufficient electricity supply, these energy-intensive sectors may struggle to meet their operational requirements. The impact of electricity prices on the industrial landscape is just one of several factors that influence economic activity and industrial development. Other factors such as labor costs, regulatory environment, market demand, technological advancements, and government policies also play significant roles.

6. Concluding Remarks and Directions for Future Research

The European wholesale electricity market witnessed record-breaking high prices in 2022, driven by several factors, including surging gas prices, limited nuclear power availability, the Ukraine war, and reduced hydroelectric output due to drought. These challenges exacerbated strain on the electricity market, resulting in a substantial price hike compared to the previous year. The industrial sector, particularly energy-intensive industries, bore the brunt of the soaring energy costs. While the EU experienced increased industrial employment and output compared to the previous year, energy-intensive sectors like basic metals, chemicals, non-metallic minerals, and paper suffered output declines.

As indicated by the introduced Green Industrial Location Attractiveness Index (GILAI), the top three countries for green industrial establishments in Europe are Sweden, Finland, and Austria. Sweden leads as the most attractive destination due to its competitive electricity prices, emphasis on renewable energy, and price stability. Finland closely follows with competitive electricity prices, energy efficiency, and renewable energy goals. Austria secures the third position with competitive electricity prices, strong energy efficiency, and price stability. Conversely, lower-ranked countries face challenges in factors such as electricity prices, energy intensity, and renewable energy adoption, suggesting a North/South European split with northern countries prioritizing sustainability and achieving higher rankings, while southern countries grapple with these issues.

The index presented in Table 1 and the robustness check in Table 2 provides valuable insights into the attractiveness of different European countries for green industrial investments based on specific criteria. However, it's important to note that this index alone may not definitively predict where green industries will be allocated in Europe. The index primarily focuses on a specific set of factors related to energy and green industrial location attractiveness. While these factors are important, they represent only a portion of the considerations that businesses and investors may consider when deciding where to allocate green industries. The attractiveness of a location for green industries can change over time due to evolving policies, market dynamics, technological advancements, and global economic conditions. The index may not capture these dynamic changes. Green industry allocation decisions often depend on more granular and location-specific factors, such as infrastructure availability, workforce skills, supply chain considerations, and access to markets. These factors may not be fully reflected in the index. Government policies and regulations play a significant role in shaping the attractiveness of a location for green industries. These aspects may not be fully captured in the index but can have a profound impact on investment decisions.

To accurately predict where green industries will be allocated in Europe, it's essential to consider a broader range of factors and conduct detailed market and feasibility studies. While the index can serve as a valuable starting point and provide a general overview, it should be complemented with in-depth analysis and an understanding of the specific goals and preferences of investors and businesses in the green industry sector.

Efforts to reduce energy intensity and promote energy efficiency are essential goals in Europe, aimed at optimizing energy resources, enhancing energy security, and mitigating environmental impacts. Strategies to reduce energy intensity encompass measures like improving energy efficiency in industries, buildings, and transportation, adopting cleaner energy sources, and implementing energy conservation practices.

References

Ari, M. A., Arregui, M. N., Black, M. S., Celasun, O., Iakova, M. D. M., Mineshima, M. A., ... & Zhunussova, K. (2022). Surging energy prices in europe in the aftermath of the war: How to support the vulnerable and speed up the transition away from fossil fuels. International Monetary Fund.

Astrov, V., Hanzl-Weiss, D., Leitner, S. M., Pindyuk, O., Pöschl, J., & Stehrer, R. (2015). Energy efficiency and EU industrial competitiveness: Energy costs and their impact on manufacturing activity (No. 405). wiiw Research Report.

Barteková, E., & Ziesemer, T. H. W. (2019). The impact of electricity prices on foreign direct investment: evidence from the European Union. *Applied Economics*, 51(11), 1183-1198.

Bijnens, G., Konings, J., & Vanormelingen, S. (2022). The impact of electricity prices on European manufacturing jobs. *Applied Economics*, 54(1), 38-56.

Capello, R., & Cerisola, S. (2023). Regional reindustrialization patterns and productivity growth in Europe. Regional Studies, 57(1), 1-12.

Chlechowitz, M., Reuter, M., & Eichhammer, W. (2022). How first comes energy efficiency? Assessing the energy efficiency first principle in the EU using a comprehensive indicator-based approach. Energy Efficiency, 15(8), 59.

Cox, M., Peichl, A., Pestel, N., & Siegloch, S. (2014). Labor demand effects of rising electricity prices: Evidence for Germany. *Energy Policy*, 75, 266-277.

Deschenes, O. (2011). *Climate policy and labor markets. In The design and implementation of US climate polic*y (pp. 37-49). University of Chicago Press.

Dillig, M., Jung, M., & Karl, J. (2016). The impact of renewables on electricity prices in Germany–An estimation based on historic spot prices in the years 2011–2013. *Renewable and Sustainable Energy Reviews*, 57, 7-15.

Dogan, E., Hodžić, S., & Šikić, T. F. (2023). Do energy and environmental taxes stimulate or inhibit renewable energy deployment in the European Union?. Renewable Energy, 202, 1138-1145.

Dogan, E., Hodžić, S., & Šikić, T. F. (2023). Do energy and environmental taxes stimulate or inhibit renewable energy deployment in the European Union?. *Renewable Energy*, 202, 1138-1145.

European Commission, (2023). 2050 long-term strategy. https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en

European Commission, 2018. Energy efficiency directive. https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

European Commission, Joint Research Centre, Camia, A., Giuntoli, J., Jonsson, R. et al., The use of woody biomass for energy production in the EU, Publications Office, 2021, https://data.europa.eu/doi/10.2760/831621

European Commission, 2023. The Commission produces quarterly reports on EU gas and electricity markets. https://energy.ec.europa.eu/data-and-analysis/market-analysis_en#electricity-market---recent-developments

European Commission, 2023b. Energy taxation. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-taxation_en

Eurostat, 2023a. Electricity price statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics#Electricity_prices_for_non-household_consumers

Eurostat, 2023c. Electricity production, consumption and market overview https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_production,_consumption_and_market_overview#Market_shares

Eurostat, 2023d. Preliminary 2022 data for energy show mixed trends. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20230705-2. Accessed 2023-10-06.

González, J. S., & Alonso, C. Á. (2021). Industrial electricity prices in Spain: A discussion in the context of the European internal energy market. Energy Policy, 148, 111930.

Grafström, J. (2018a). International knowledge spillovers in the wind power industry: evidence from the European Union. *Economics of Innovation and New Technology*, 27(3), 205-224.

Grafström, J. (2018b). Divergence of renewable energy invention efforts in Europe: an econometric analysis based on patent counts. Environmental Economics and Policy Studies, 20, 829-859.

Grafström, J., & Poudineh, R. (2023). No evidence of counteracting policy effects on European solar power invention and diffusion. *Energy Policy*, 172, 113319.

Hawker, G., Bell, K., & Gill, S. (2017). Electricity security in the European Union—The conflict between national Capacity Mechanisms and the Single Market. Energy Research & Social Science, 24, 51-58.

Horowitz, J. (2022). Europe's Scorching Summer Puts Unexpected Strain on Energy Supply. New York Times. https://www.nytimes.com/2022/08/18/world/europe/drought-heat-energy.html

IEA (2022), Hydroelectricity, IEA, Paris https://www.iea.org/reports/hydroelectricity, License: CC BY 4.0

Lamb, W. F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J. G., ... & Minx, J. (2021). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental research letters*, 16(7), 073005.

Li, J., Jiang, Q., Dong, K., & Dong, X. (2022). Does the local electricity price affect labor demand? Evidence from China's industrial enterprises. *Environment, Development and Sustainability*, 1-25.

Li, R., & Leung, G. C. (2021). The relationship between energy prices, economic growth and renewable energy consumption: Evidence from Europe. *Energy Reports*, 7, 1712-1719.

Makridou, G., Andriosopoulos, K., Doumpos, M., & Zopounidis, C. (2016). Measuring the efficiency of energy-intensive industries across European countries. *Energy Policy*, 88, 573-583.

Marin, G., & Vona, F. (2017). The impact of energy prices on employment and environmental performance: Evidence from French manufacturing establishments.

Marin, G., & Vona, F. (2019). Climate policies and skill-biased employment dynamics: Evidence from EU countries. *Journal of Environmental Economics and Management*, 98, 102253.

Marin, G., & Vona, F. (2021). The impact of energy prices on socioeconomic and environmental performance: Evidence from French manufacturing establishments, 1997–2015. *European Economic Review*, 135, 103739.

Ovaere, M., Kenis, M., Van den Bergh, K., Bruninx, K., & Delarue, E. (2023). The effect of flow-based market coupling on cross-border exchange volumes and price convergence in Central Western European electricity markets. Energy Economics, 118, 106519.

Rodrik, D. (2016). Premature deindustrialization. Journal of economic growth, 21, 1-33.

Rokicki, T., Jadczak, R., Kucharski, A., Bórawski, P., Bełdycka-Bórawska, A., Szeberényi, A., & Perkowska, A. (2022). Changes in Energy Consumption and Energy Intensity in EU Countries as a Result of the COVID-19 Pandemic by Sector and Area Economy. *Energies*, 15(17), 6243.

Sgaravatti, G., S. Tagliapietra and Zachmann G. (2023). Adjusting to the energy shock: the right policies for European industry. Brugele. https://www.bruegel.org/policy-brief/adjusting-energy-shock-right-policies-european-industry

Sisodia, G. S., Soares, I., Ferreira, P., Banerji, S., Van den Poel, D., & Kumar, M. (2015). Does the use of solar and wind energy increase retail prices in Europe? Evidence from EU-27. *Energy Procedia*, 79, 506-512.

Škuflić, L., & Družić, M. (2016). Deindustrialisation and productivity in the EU. Economic research-Ekonomska istraživanja, 29(1), 991-1002.

Solar Europe, 2023. https://api.solarpowereurope.org/uploads/5222_SPE_EMO_2022_full_report_ver_03_1_319d70ca42.pdf

Strbac, G. (2008). Demand side management: Benefits and challenges. Energy policy, 36(12), 4419-4426.

Trujillo-Baute, E., del Río, P., & Mir-Artigues, P. (2018). Analysing the impact of renewable energy regulation on retail electricity prices. *Energy Policy*, 114, 153-164.

Tutak, M., & Brodny, J. (2022). Renewable energy consumption in economic sectors in the EU-27. The impact on economics, environment and conventional energy sources. A 20-year perspective. Journal of Cleaner Production, 345, 131076.

Wang, H. (2016). Do mandatory US state renewable portfolio standards increase electricity prices?. *Growth and Change*, 47(2), 157-174.

Wind Europe, 2023. Wind energy in Europe. https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2022-statistics-and-the-outlook-for-2023-2027/

World Nuclear organization. (2023). Plans For New Reactors Worldwide. https://world-nuclear.org/information-library/current-and-future-generation/plans-for-new-reactors-worldwide.aspx

Zhao, Y., Ke, J., Ni, C. C., McNeil, M., Khanna, N. Z., Zhou, N., ... & Li, Q. (2014). A comparative study of energy consumption and efficiency of Japanese and Chinese manufacturing industry. *Energy Policy*, 70, 45-56.

Appendix:

Here we calculate the Total (GILAI) scores for all countries in the table when "Energy Intensity of the Economy" and "New Wind Installations in 2022 (MW)" are weighted as zero:

GILAI = (w1 * Electricity Prices) + (0 * Energy Intensity) + (0 * Wind Installations) + (w4 * Price Change) + (w5 * Renewable Energy Share). GILAI for each country based on the remaining factors:

- Sweden: GILAI = (1 * 21) + (0 * 20) + (0 * 26) + (1 * 15) + (1 * 27) = 21 + 0 + 0 + 15 + 27 = 63
- Finland: GILAI = (1 * 27) + (0 * 12) + (0 * 25) + (1 * 11) + (1 * 26) = 27 + 0 + 0 + 11 + 26 = 64
- Austria: GILAI = (1 * 18) + (0 * 22) + (0 * 19) + (1 * 10) + (1 * 23) = 18 + 0 + 0 + 10 + 23 = 51
- France: GILAI = (1 * 25) + (0 * 21) + (0 * 24) + (1 * 6) + (1 * 14) = 25 + 0 + 0 + 6 + 14 = 45
- Spain: GILAI = (1 * 14) + (0 * 19) + (0 * 23) + (1 * 13) + (1 * 15) = 14 + 0 + 0 + 13 + 15 = 42
- Germany: GILAI = (1 * 15) + (0 * 23) + (0 * 27) + (1 * 3) + (1 * 13) = 15 + 0 + 0 + 3 + 13 = 31
- Italy: GILAI = (1 * 4) + (0 * 24) + (0 * 20) + (1 * 21) + (1 * 12) = 4 + 0 + 0 + 21 + 12 = 37
- Luxembourg: GILAI = (1 * 24) + (0 * 25) + (0 * 12) + (1 * 14) + (1 * 1) = 24 + 0 + 0 + 14 + 1 = 39
- Portugal: GILAI = (1 * 23) + (0 * 16) + (0 * 11) + (1 * 5) + (1 * 21) = 23 + 0 + 0 + 5 + 21 = 49

- Latvia: GILAI = (1 * 12) + (0 * 9) + (0 * 13) + (1 * 16) + (1 * 25) = 12 + 0 + 0 + 16 + 25 = 53
- Denmark: GILAI = (1 * 2) + (0 * 26) + (0 * 15) + (1 * 9) + (1 * 22) = 2 + 0 + 0 + 9 + 22 = 33
- Netherlands: GILAI = (1 * 20) + (0 * 18) + (0 * 21) + (1 * 7) + (1 * 4) = 20 + 0 + 0 + 7 + 4 = 31
- Slovenia: GILAI = (1 * 16) + (0 * 13) + (0 * 1) + (1 * 22) + (1 * 18) = 16 + 0 + 0 + 22 + 18 = 56
- Lithuania: GILAI = (1 * 3) + (0 * 7) + (0 * 14) + (1 * 26) + (1 * 19) = 3 + 0 + 0 + 26 + 19 = 48
- Croatia: GILAI = (1 * 11) + (0 * 11) + (0 * 1) + (1 * 24) + (1 * 20) = 11 + 0 + 0 + 24 + 20 = 55
- Ireland: GILAI = (1 * 6) + (0 * 27) + (0 * 17) + (1 * 12) + (1 * 3) = 6 + 0 + 0 + 12 + 3 = 21
- Belgium: GILAI = (1 * 9) + (0 * 14) + (0 * 18) + (1 * 18) + (1 * 5) = 9 + 0 + 0 + 18 + 5 = 32
- Poland: GILAI = (1 * 22) + (0 * 5) + (0 * 22) + (1 * 8) + (1 * 7) = 22 + 0 + 0 + 8 + 7 = 37
- Greece: GILAI = (1 * 13) + (0 * 15) + (0 * 16) + (1 * 2) + (1 * 16) = 13 + 0 + 0 + 2 + 16 = 31
- Czechia: GILAI = (1 * 19) + (0 * 4) + (0 * 1) + (1 * 23) + (1 * 10) = 19 + 0 + 0 + 23 + 10 = 52
- Romania: GILAI = (1 * 1) + (0 * 10) + (0 * 1) + (1 * 27) + (1 * 17) = 1 + 0 + 0 + 27 + 17 = 45
- Estonia: GILAI = (1 * 7) + (0 * 3) + (0 * 1) + (1 * 19) + (1 * 24) = 7 + 0 + 0 + 19 + 24 = 50
- Cyprus: GILAI = (1 * 5) + (0 * 17) + (0 * 1) + (1 * 17) + (1 * 11) = 5 + 0 + 0 + 17 + 11 = 33
- Hungary: GILAI = (1 * 10) + (0 * 6) + (0 * 1) + (1 * 25) + (1 * 6) = 10 + 0 + 0 + 25 + 6 = 41
- Slovakia: GILAI = (1 * 8) + (0 * 8) + (0 * 1) + (1 * 20) + (1 * 9) = 8 + 0 + 0 + 20 + 9 = 37
- Malta: GILAI = (1 * 26) + (0 * 2) + (0 * 1) + (1 * 1) + (1 * 2) = 26 + 0 + 0 + 1 + 2 = 29
- Bulgaria: GILAI = (1 * 17) + (0 * 1) + (0 * 1) + (1 * 4) + (1 * 8) = 17 + 0 + 0 + 4 + 8 = 29

These are the Total (GILAI) scores for all countries in the table when "Energy Intensity of the Economy" and "New Wind Installations in 2022 (MW)" are weighted as zero. The scores are based on the remaining factors: Electricity Prices, Price Change, and Renewable Energy Share.