Local Content Requirements and the Renewable Energy Sector: A Comparison of Canada and the UK

Tarampoulous, Zak

Student Name: Zak Tarampoulous

Student number: s3080684

Title of Seminar: International Cooperation and the Design of Global Economic Institutions

Thesis Supervisor: Dr. M. D. Sampson

Date: 21/05/2024

Embargo statement: Public

Word count: 7990

Local Content Requirements and the Renewable Energy Sector: A Comparison of Canada and the UK

Universiteit Leiden
The Netherlands

Table of Contents

1. Introduction

The development of the green economy has become a popular concern for policymakers around the world due to the recognition of the importance of sustainable economic growth and the protection of the environment (United Nations Conference on Trade and Development [UNCTAD], 2014, p. 19). To alleviate the potential costs of transitioning to a more environmentally friendly society and to appease domestic constituents, governments have sought to combine the development of the green economy with the reshoring of supply chains in strategic green industries, the nurturing of domestic firms and the expansion of employment opportunities domestically (p. 35). To that end, both developed and developing countries have implemented Local Content Requirements (LCRs) as a key component of their green industrial and trade policies (Scheifele, Bräuning & Probst, 2022, p. 1).

LCRs are imposed as a minimum share of locally sourced inputs in the manufacturing of a particular value chain and it is usually coupled with government subsidies or public tenders (Jha, 2013, p. 30). Throughout the 2000s and especially since the global financial crisis, about 140 LCRs have been employed in a number of sectors (Scheifele, Bräuning & Probst, 2022, p. 1). Not surprisingly, the renewable power industry, mainly in wind and solar, stands out, having been increasingly subjected to such a policy (p. 1). Inherently, LCR is a protectionist measure and it holds significant repercussions for trade, employment, investment and production in the industry that it is introduced (UNCTAD, 2013, p. 4)

In November 2023 the BASIC countries - Brazil, South Africa, India and China - proposed to the agenda of the COP28 climate talks the inclusion of the topic of unilateral trade measures in relation to climate change. In a joint statement they explained that trade protectionism and the lack of international cooperation threatens trust and effective climate action around the world and called for collaboration in producing and providing trade access for sustainable goods and services. Crooks (2023) indicated that the statement was a response to measures recently adopted by developed countries and especially the Inflation Reduction Act (IRA) in the United States. On the 26th of March 2024 China filed a complaint to the WTO regarding the Local Content Requirement (LCR) for electric vehicle subsidies of the IRA (The Associated Press, 2024). It was argued that the US used these green subsidies as a means to discriminate against battery components from other countries.

In 2013, Canada's sub-national government of Ontario had to revise its wind and solar Feed-In-Tariff (FIT) scheme, which mandated domestic content restrictions, to comply with a ruling of the WTO (International Energy Agency [IEA], 2015, p. 222). Similar cases were referred to the Dispute Settlement Body of the organization, concerning India's, Greece's and Italy's LCRs for subsidy programmes in the renewable energy sector (UNCTAD, 2014). WTO members are allowed to adopt trade-related measures associated with environmental goals as long as they do not produce barriers to trade (UNCTAD, 2013, pp. 1). Green subsidies with LCRs violate the principle of national treatment and are prohibited under the Agreement on Subsidies and Countervailing Measures of the WTO.

This research aims to address a research gap that exists in the literature on the topic. Namely, that no comparison has been made before between countries that use LCRs in the renewable energy sector as part of their industrial and trade policy and countries that do not employ LCRs for the development of a competitive renewable energy sector. Academics have had contrasting views concerning the efficiency of LCRs in strengthening domestic industries and developing export-competitiveness. The research question of this project is defined as:

"What is the effect of Local Content Requirements on the competitiveness of the renewable energy sector of countries?"

In the following sections the previous literature on the topic of green protectionism, LCRs and their impact on the renewable energy sector is discussed followed by the formulation of hypotheses and the conceptualization of the main variables of the research. Then, the methodology chosen and the cases and data to be analyzed are introduced. Finally, the results of the research are illustrated and discussed. The cases of Canada and the UK are compared and important inferences are made for the study of green protectionism, industrial policy and international trade. In summary, it is argued that LCRs have significant positive effects on the competitiveness of the renewable energy sector of countries but this is only felt as a short term effect.

2. Literature Review and Theoretical Framework

2.1 Green Protectionism

Trade restrictions have decreased considerably during the last five decades and yet protectionist policies are still emanating globally (Irwin, 2020, p. 87). Barriers to trade consist of tariffs, quotas and increasingly non-tariff barriers. Their effects are mainly studied in terms of their impact on imports, domestic prices, inefficiency and employment. When import barriers are imposed on a product, economists suggest that income is reallocated from domestic consumers to domestic producers. The product that is demanded is in more limited supply driving its price upwards (pp. 88-89). This benefits domestic producers while consumers are faced with higher costs. Because of the rise of the domestic price of a good, a discrepancy is created with the world market price which results in increased production at home while consumers can afford to buy less than before. This causes inefficiency and a deadweight loss to the economy (p. 89).

Irwin (2020, pp. 113-114) has pointed out two justifications for trade intervention. Firstly, he maintained that economic benefits may be produced if protectionism created favorable externalities. This would be the case if the positive impact of the industrial activity is ignored and the private costs of production are higher than the social costs of production (pp. 113-114). In such a situation, less of a good would be created than is socially advantageous. Renewable energy production for instance is a representative example of an industry that could be justifiably targeted by trade interventionist policies. Secondly, export competitiveness could prove worthwhile of trade intervention to gain rents from the international market or balance against trade related measures adopted by other countries (p. 116).

However, Irwin (2020, pp. 113-114) highlighted that a trade distortive measure would be a second best option for harnessing these two benefits in comparison to a less protectionist policy such as domestic subsidies, research and development (R&D) and learning by doing. This is because, theory has shown that although a trade barrier would potentially make right a market failure and increase the desirability of exports, significant side-effects could spring up, like prices going up (pp. 114-115).

Article XX of the 1994 GATT explains that environmental goals may be legitimate reasons for trade measures but this does not mean that they be applied in an arbitrary, or discriminatory manner or lead to a disguised restriction on international trade (Lottici & Galperín, 2014, p. 13). The term 'green protectionism' was first employed in a document written by the World Wildlife Fund in the 5th WTO Ministerial Conference in Cancún (WTO, 2003, p. 1). It was described as "the use of measures for narrow protectionist ends under the guise of addressing legitimate environmental goals".

Green protectionism uses compatible methods with traditional protectionism but the goal is not purely economic as it aims to protect the environment and promote sustainable practices too. It is said to assist new green industries to develop, reduce carbon emissions, increase employment, safeguard national interests and strengthen the autonomy of a country (Anderson, 2023). Despite the fact that it may be deemed as an important means to limit the consequences of the transition towards a greener economy, its effects, as is the case with traditional protectionism, can be devastating. This is because it may hinder economic efficiency, lead to increased tensions between countries, higher prices, less innovation and ultimately strained economic growth (Anderson, 2023). It may also jeopardize the clean energy transition both domestically and globally by promoting a race to the bottom in climate policies and leading to the obstruction of the fight against climate change (Revare, 2023).

2.2 Local Content Requirements

LCRs are defined as "policy measures that require foreign or domestic investors to source a certain percentage of intermediate goods from local manufacturers or producers." (UNCTAD, 2013, p. 5). Producers do not have to solely be domestic enterprises but also localized foreign owned firms can take advantage of the legislation too. The aim of LCRs is rarely expressed outright yet it usually constitutes the nurturing of competitive industries and the expansion of employment opportunities locally (p. 5). The policy is most frequently combined with other measures related to state aid or public tenders. To be eligible for public procurement or state support of some kind, for example a subsidy, a tariff rebate or a tax credit, governments condition stakeholder applications on fulfilling a LCR (p. 5).

The policy is effectively used as an instrument to attract investment into a particular supply chain of a country. By incentivizing firms to base their activities in the country, the reshoring of the value chain of a particular technology is promoted inducing learning spillovers and positive side-effects for the whole economy (Probst, Anatolitis, Kontoleon & Anadón, 2020, p. 842; Vadila & Christian, 2024, p. 174). Strategic sectors and mostly those that create large profits such as oil and gas or those that need various components for their manufacturing activities such as automobiles, have been the subject of numerous LCRs in the previous decades.

Despite this, as Deringer et al. (2018) maintained, LCRs can cause serious drawbacks to downstream firms, export-oriented firms and consumers. It is claimed that LCRs have similar effects to import quotas on goods and services (UNCTAD, 2014, p. 3). They create an artificial market demand for locally sourced products which drive prices up while cheaper imports are discouraged and replaced by more expensive inputs. This in turn leads to decreased production of and higher prices in domestic final goods (Vadila & Christian, 2024,

p. 176). In this way, the competitiveness of the industry is damaged both domestically and internationally (Deringer et al., 2018; Araújo & Flaig, 2017).

To illustrate this, Vadila and Christian (2024, p. 175), in their investigation of the impact of LCRs on Indonesia's trade, found that the policy caused a decrease in the amount and value of exports of the affected products. The impairment of the export-oriented sector of Indonesia was evident according to the authors. In terms of prices, Hufbauer (2013, p. 92) conducted a thought experiment on the case of China's automobile sector. According to the results automobiles suffered a 7 percent price hike because of the implementation of the policy compared to the counterfactual.

Hufbauer (2013, p. 37) contended that LCRs inherently distort trade. Challengers of LCRs cite that the measure ignores the advantages of Ricardo's principle of comparative advantage (UNCTAD, 2013, p. 7). By misallocating resources and incentivizing firms to specialize in sectors that they are not competitive in, they artificially inflate their attractiveness and decrease the desirability of foreign goods which are of greater quality or more cost-effective than domestic ones (p. 7). LCR is innately a protectionist measure which can result in inefficient import substitution and trade restrictiveness (pp. 7-8).

2.3 Local Content Requirements and the renewable energy sector

Countries have been implementing policies in the past decades and especially after the global financial crisis of 2008 to decarbonize their economies. A key step towards this goal is the development of a greener electricity sector through the expansion of renewable energy production (Probst, Anatolitis, Kontoleon & Anadón, 2020, p. 142). To strengthen the competitiveness of the domestic renewable energy sector, create local green jobs, garner support for green industrial programmes and achieve energy security, governments have often employed LCRs as a prerequisite for state funding or public procurement of green power projects (Hufbauer, 2013, p. 10; UNCTAD, 2014, p. 19; Kuntze & Moerenhout, 2014).

There are opposing views on LCRs' influence. A common concern that has been stated in the literature and mentioned in the previous sub-section, is the likelihood that higher prices will have to be paid by producers of renewable energy as a result of the increased costs of their inputs (UNCTAD, 2014, p. 28). This would then mean that consumers and firms would also face rising costs and would have to appropriate a larger proportion of their income on electricity. Indeed, Probst, Anatolitis and Kontoleon (2020, p. 847) concluded that a LCR imposed on Indian solar PV projects caused an approximately 6% increase in the cost of solar PV power generation. From 2014 to 2018 Indian solar panels were roughly 14% more expensive than international ones and export growth did not follow either (p. 847). The first hypothesis is defined as:

H1: *LCRs cause an increase in the costs of the renewable energy generation of countries.*

Regarding investment, there are scholars who believe that higher input prices and diminished consumption as a result of LCRs may discourage investors from putting funds in the sector (UNCTAD, 2013, p. 9). Despite this, most of the literature and evidence on the topic agrees with the view that LCRs do have a positive effect on investment. According to the UNCTAD (2014, p. 27) LCRs have in quite a few cases achieved their main objectives, namely creating green employment and enticing green investments in the host market.

H2: *LCRs have a positive effect on investment in the renewable energy industry of countries.*

As far as export competitiveness is concerned, Scheifele, Bräuning and Probst (2022, p. 13) contended that developing global competitive industries should be taken into serious acknowledgement given that a main criticism towards industrial policies, like LCRs, relates to the duration that the domestic protection lasts (p. 13). An LCR is no longer necessary when the sector is attractive in the international market. It is natural that through state protection the renewable energy industry has the opportunity to mature and subsequently form a competitive advantage in the international market. Export competitiveness could therefore be the result of such intervention and significant gains from trade may be enjoyed (UNCTAD, 2013, p. 6). In fact, Scheifele, Bräuning and Probst (2022, p. 3) have found that countries have set important export objectives in their industrial policies when it comes to renewable energy and especially wind and solar production. However, the authors claimed that, with the exceptions of China and Spain, LCRs have not provoked a noteworthy increase in solar and wind energy component exports (p. 1). Based on this a third hypothesis is formulated:

H3: *LCRs do not have an effect on the export-competitiveness of the domestic renewable energy industry of countries.*

2.4 Conceptualization

The dependent variable of the research is the *competitiveness of the renewable energy sector of countries*. This corresponds to the attractiveness of the industry in terms of the costs of renewable energy generation, the investment drawn to the industry and the export competitiveness of renewable energy related products.

3. Methodology

3.1 Research design and case selection

For the purposes of this research and to test the hypotheses that were formulated, a small-N comparative study and most specifically, the Most Similar Systems Design is employed. This is because it enables a detailed analysis of the cases that are chosen and a thorough comparison of their distinctiveness. By identifying a significant difference in the independent variable and vast similarities, which act as control variables, in regards to other factors that influence the relationship between the independent and dependent variable, MSSD can determine the effect of the former on the latter (Halperin & Heath, 2017). In this research, two cases and in particular, two countries are contrasted based on characteristics and variables that are relevant to the topic. The entities to be selected have to be alike in relevant qualities and resemble each other in terms of other factors influencing the effectiveness of the policy that is evaluated. In this way, the impact of LCRs on the renewable energy sector can be demonstrated.

The countries of Canada and the UK are chosen to be the subject of the analysis that will follow. Both countries have been developed economies with similar GDP per capita rates throughout the years and are well-integrated into the global economy (Central Intelligence Agency [CIA], 2022). They have been members to the UN, the OECD, the World Bank, the IMF, the WTO and other organizations which have been strong proponents of free trade and the transition to a greener economy. The two countries have also established similarly strong commitments to phasing out their carbon emmissions and have adopted strong measures to support renewable energy generation.

Theoretical accounts support that the economic complexity of a country is considered an important variable that can affect the success of a LCR policy in promoting export activity (Scheifele, Bräuning & Probst, 2022, p. 5). Countries with high economic complexity in their industrial base find it easier to differentiate their production and are more capable of developing intricate technologies. Renewable power technologies are deemed as highly complex and capability gaps may explain why LCR policies have not led to their expected results in terms of exports in the past (p. 13). Both countries have exhibited similarly high economic complexity rates although the UK's level has been slightly better than Canada's (Harvard University, 2022).

Moreover, the stability of the market and policy framework under which a LCR is introduced plays a significant role. In an uncertain host environment, Lewis and Wiser (2007) posited that businesses would be hesitant to invest in the renewable energy industry and export-competitiveness would be less likely to be fulfilled. The size of the host country's market is also essential to gain from economies of scale and build cost-competitiveness (Scheifele, Bräuning & Probst, 2022, p. 4). Both Canada and the UK have in general enjoyed sizable and competitive markets, stable policy environments and high levels of government effectiveness ('Worldwide Governance Indicators', n.d.).

Lastly, countries which implement LCRs in industries that they are not really familiar with or that they do not boast the appropriate manufacturing structures to produce in scale and inexpensively are less likely to succeed in developing export competitiveness (Scheifele, Bräuning & Probst, 2022, p. 1). Instead, countries that have had export capabilities in similar industries before the adoption of the policy, for instance in electronics for solar PVs and primary metals for wind turbines, have achieved export competitiveness in renewable energy goods according to Scheifele, Bräuning and Probst (2022, p. 1). Both Canada and the UK have been active in industries relevant to the renewable energy sector like steel production ('World steel in figures 2009', 2009).

Most importantly however, in contrast to the UK, Canada's provinces of Quebec and Ontario used LCRs in their green industrial policies. These mainly targeted on-shore wind energy generation and therefore the analysis concentrates just on this type of renewable energy.

Quebec employed LCRs in its on-shore wind energy tenders for the first time in 2003 as part of its "Energy Strategy 2006-2015". Their main goal was to build a local supply chain and provide employment opportunities in regions that were struggling economically (UNCTAD, 2014, pp. 22-23). The first tender of 1000 MW, issued in 2003, required the initial 200 MW of installed wind energy capacity to have 40% local content, the following 100 MW 50% and the remaining 700 MW 60% (pp 22-23). The second tender of 2 GW, which occurred in 2006, mandated a 60% regional LCR while the third issued in 2010 kept the structure of the second. In 2014 another tender was released with a 60% LCR including 30% in specific regions.

In Ontario a LCR was initiated in 2009 and coupled with a FIT under its Green Energy and Green Economy Act. The policy aimed at promoting renewable energy and increasing green jobs (UNCTAD, 2014, pp. 21-22). If the required threshold of LCR was not followed, renewable energy developers were not eligible for a higher FIT. Turbine towers made in Ontario, steel used for the manufacturing of the towers, consulting services and on-site construction inputs and labor were specifically targeted as key aspects of the policy (pp. 21-22). Because of the trade restrictiveness of the measure and an investment deal signed between Ontario and Samsung, Japan was prompted to file a complaint against Ontario's FIT while other countries also criticized it (pp. 21-22). In 2014 the sub-national government had to abolish the LCR as part of its green industrial policy to comply with a WTO ruling that prohibited it. The Green Energy Act was repealed in 2018 (Government of Ontario, 2018).

Despite the fact that LCRs have not been universal for the whole of Canada and were adopted by sub-national governments, important conclusions can still be inferred from this case. Ontario and Quebec constitute the largest provinces of Canada in terms of size and population and thus the impact of policies adopted regionally are felt throughout the country. Electricity is also not only consumed inside the provinces that it is produced and it is usually traded throughout Canada (Canada Energy Regulator, 2024).

On the other hand, in the UK, the Renewables Obligation (RO) scheme, which was a quantity-driven quota system for renewable energy, was introduced in 2002 (World Wind Energy Association [WWEA], 2018, p. 5). It mainly mandated the purchase of a specific portion of energy from renewable sources and instituted a penalty, in the form of a buy-out payment, for energy suppliers that did not meet the requirements (p. 5). The revenue from these payments was reallocated to energy suppliers according to the extent that they had met their obligation (p. 5).

In 2010 a FIT was adopted to work in tandem to the RO policy. FIT contracts are in force for 20 years. Under the scheme, electricity generators were given a tariff depending on the kWh of electricity produced, while an export tariff to incentivize electricity exports was also included (WWEA, 2018, pp. 6-7). FIT rates were curtailed in 2012 and 2016 as a response to the massive upsurge in demand that was caused by the policy. Due to the steepness of the cuts to the program, some have warned that investor confidence in the renewable energy sector of the UK could diminish (p. 7).

The Contracts for Difference (CfD) program replaced the RO which was abolished in 2017 (WWEA, 2018, p 7). Its purpose is to boost 'low carbon' energy sources. A CfD has a 'strike price' which if exceeded by electricity prices the difference goes to consumers while if they fall below it, the producer is subsidized to balance the discrepancy (p. 7). CfD operates in auction rounds which determine the most efficient, in terms of cost and energy generation capacity, technologies to be adopted for an energy project (p. 7). Maximum guaranteed prices are decided by the government based on which the attractiveness of bids is evaluated. The CfD program is still in force today.

3.2 Data and operationalization

The analysis is focused on the time frame between 2009 and 2019. This is because LCRs were most prevalent and their impact was most felt on the renewable energy industrial base and the economy of Canada mainly during this period. From 2009 to 2014 both Ontario and Quebec were using a LCR as a measure of their green industrial policies. Scholars have maintained that a post-LCR period is important to be taken into account too as the effects of the policy may take some time to be felt (Scheifele, Bräuning & Probst, 2022, p. 2). It has been shown that investments into wind energy projects take up to 2 to 5 years to be translated into fully operational energy generators while a sector also needs some years to mature before it is able to become competitive in the international market ('Wind turbine fundamentals', n.d.).

Because the last utilization of a LCR in Canada occurred in 2014 in Quebec it is reasonable to include data at least up to 2019. It is also important to take into account though that data drawn from the years when the Covid-19 pandemic was ripe, namely from 2020 to 2022, could have resulted in peculiar and potentially biased findings given the impact that it had on trade, manufacturing activities, the global economy and the energy sector overall (IEA, 2020). Availability of data constraints for 2022 and 2023 was also an issue and hence evidence that has been collected since 2020 is not included in the analysis.

The data used for the research are derived from countries' and international organizations' statistical bases as well as government, non-governmental and international organizations' reports. The main sources constitute the UNCTAD, the International Renewable Energy Agency (IRENA), the Canadian Energy Regulator (CER), Wind Europe, the UK's Department of Energy Security & Net Zero and the UN Comtrade database of the

Department of Economics and Social Affairs (UN DESA). Therefore, primary but also secondary sources are employed.

The dependent variable is assessed based on the three factors identified in the conceptualization of the variable, namely the costs of renewable energy generation, the investment drawn to the industry and the export-competitiveness of renewable energy related products. The focus though, as mentioned before, is only on on-shore wind energy.

The costs of on-shore wind energy generation are operationalized as the Levelized Cost of Energy (LCOE) of utility-scale onshore wind power projects. The LCOE describes the cost of generating energy comprising all the costs over its lifetime, such as initial investment, operations, maintenance and cost of capital. It is basically the minimum price that energy must be sold for an energy project to cover its expenses (Berrada & Loudiyi, 2019).

The investment drawn to the industry is operationalized based on the amount of money invested or merely the occurrence of investment on on-shore wind related facilities as well as the annual on-shore wind energy capacity installed. Scheifele, Bräuning and Probst (2022, p. 4) also used data on installed capacities to capture the investment levels on renewable energy.

Export-competitiveness is operationalized as the value in USD of on-shore wind power related products exported as well as the net weight of the exports in kilos. In order to find information on the value and weight of exports of wind turbines and wind turbine components in the UN Comtrade database and the trade database of the government of Canada, the Harmonized System (HS) Codes of onshore wind turbine components are utilized. These are found in Izaak Wind's (n.d., pp. 25-29) paper which comprises the HS Codes of the renewable energy sector. The codes 730820, 841290, 848340, 850161, 850162, 850163, 850164 and 850231 are selected. Data for the net weight of the Canadian exports of onshore wind turbine components are not available for 2015 and 2016.

4. Analysis

First, an analysis of the three key factors influencing the competitiveness of an industry is assessed for each country. Then, the impact of Canada's LCRs on the competitiveness of the country's wind power sector is evaluated through the comparison to the counterfactual of the absence of LCRs in the UK's renewable energy policies.

4.1 Canada

4.1.1 Cost of onshore wind energy

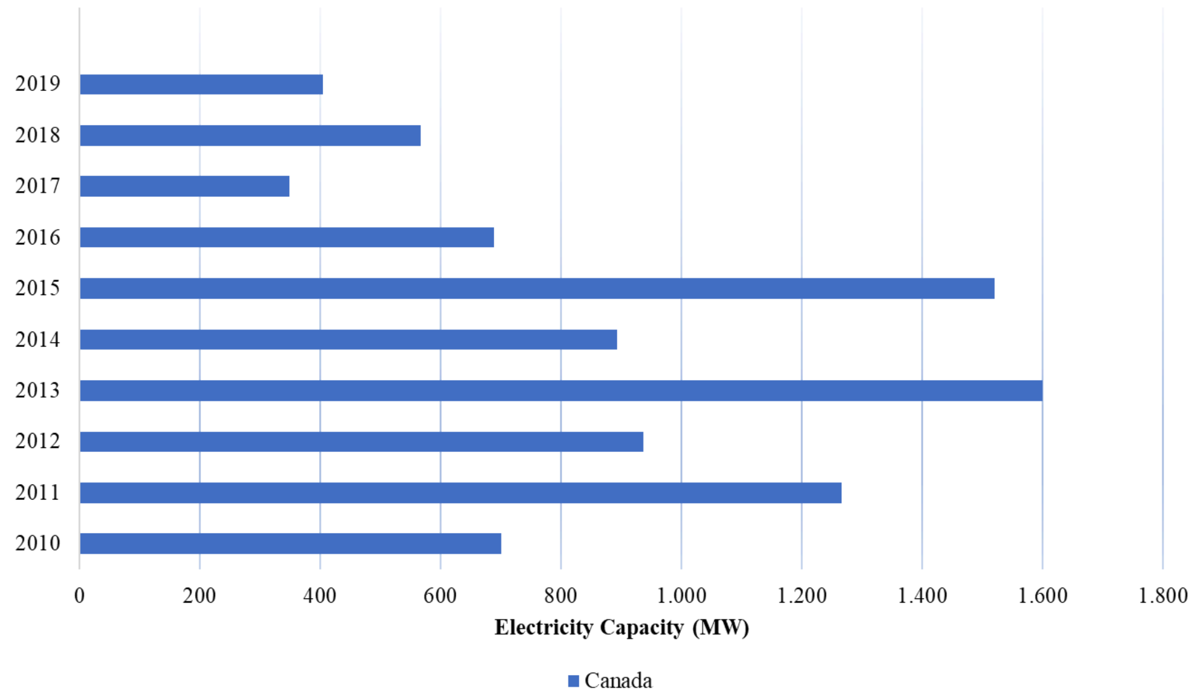
The LCOE of utility-scale, meaning of 50 megawatts (MW) or more, onshore wind projects in Canada was 0.1048 USD/kWh in 2009 while in 2010 this value significantly increased to 0.1174 USD/kWh (IRENA, 2023). The LCOE of 2011 decreased to the 2009 level but rose again in 2012 reaching a value that was slightly lower than that of 2010. From 2013 until 2018 the LCOE of onshore wind energy projects declined steadily ending the period with a value that was about 0.05 USD/kWh lower than that at the beginning of the period (IRENA, 2023). A small ascent followed in 2019 leading to a LCOE of 0.0602 USD/kWh.

Overall, although no progress was made in the costs of onshore wind power generation from 2009 to 2012 in Canada, the LCOE declined considerably between 2009 and 2019. Therefore the LCRs imposed by Ontario and Quebec may have led to a loss of competitiveness of onshore wind energy projects in Canada during the initial years after their large-scale implementation but they do not seem to have limited its attractiveness, in terms of generation costs, overall.

4.1.2 Investment in the onshore wind energy sector

Regarding investment, installed wind electricity capacity in Canada was approximately 3,300 MW and 4,000 MW in 2009 and 2010 respectively (Canada Energy Regulator [CER], 2015). In 2011 a sharp increase occurred reaching about 5,265 MW while this staggering upward trend continued until 2015 with annual additions approaching or exceeding 1000 MW (IRENA, 2024). In 2016, installed wind electricity capacity amounted to 11,902 MW, 702 MW more than 2015 (National Energy Board, 2017). In the following year only about 300 MW were incorporated (IRENA, 2024). Canada had an installed wind power capacity of 12,816 MW in 2018 while in 2019 this figure increased by 400 MW reaching 13,220 MW (IRENA, 2024).

Figure 1: Onshore wind power annual capacity additions in Canada from 2010 to 2019 (Source: IRENA, 2024)



The UNCTAD (2013, pp. 21-23) argued that while major companies in the wind energy sector had expressed their frustration with Quebec's and Ontario's LCRs they still invested in the provinces. General Electric, Enercon, REpower opened manufacturing facilities in Quebec and competed for wind turbine projects throughout the country (UNCTAD, 2013, pp. 21-23). In Ontario, Siemens announced the construction of a wind blade manufacturing facility in Tillsonburg which resulted in an investment that exceeded $20-million in 2010 (CTVNews, 2010). The same year, the provincial government of Ontario announced the launch of wind tower manufacturing plants in the cities of Windsor, London and Toronto as part of a $7-billion green energy deal between the province and Samsung (CTVNews, 2010). In the agreement it was stipulated that the facility in Windsor would solely use steel from Ontario.

Therefore, despite widespread opposition to LCRs, major players in the industry did not abandon Quebec's and Ontario's markets and did not stop funding the wind power grid of the provinces (UNCTAD, 2013, pp. 21-23). From the $21.1 billion of cumulative investment in the wind energy sector in Canada, between 2010 and 2017, $8 billion took place in Ontario and $7.6 billion in Quebec. The two provinces were responsible for almost three quarters of wind energy investment in Canada during this period (Clean Energy Canada, 2019, p. 25). However, after the government of Ontario abandoned its LCRs the manufacturing plant in

Tillsonburg closed in 2017 while all operations were halted at the Windsor facility in 2019 (Reevely 2017 ;"No", 2019)

4.1.3 Export-competitiveness of the wind energy sector

In terms of the export-competitiveness of the Canadian wind power sector, from about USD 420,579,000 in 2009, USD 624,963,000 of onshore wind related products were exported in 2019 (Government of Canada, 2024). The value of exports associated with onshore wind products peaked at around USD 745,284,000 in 2012 but then it fluctuated recording roughly USD 491,704,000 of exports in 2016 bouncing back again in the following three years (Government of Canada, 2024). This represents a substantial increase in the annual value of exports of the Canadian onshore wind industry during this period. A similar upward trend was followed by the net weight of Canada's wind industry exports of goods, amounting to about 25,289,000 kilos in 2009 and weighing approximately 79,696,000 and 71.546,000 kilos in 2012 and 2019 respectively (UN DESA, 2024).

Figure 2: Value of Canada's wind industry exports of goods, from 2009-2019 (Source: Government of Canada, 2024)

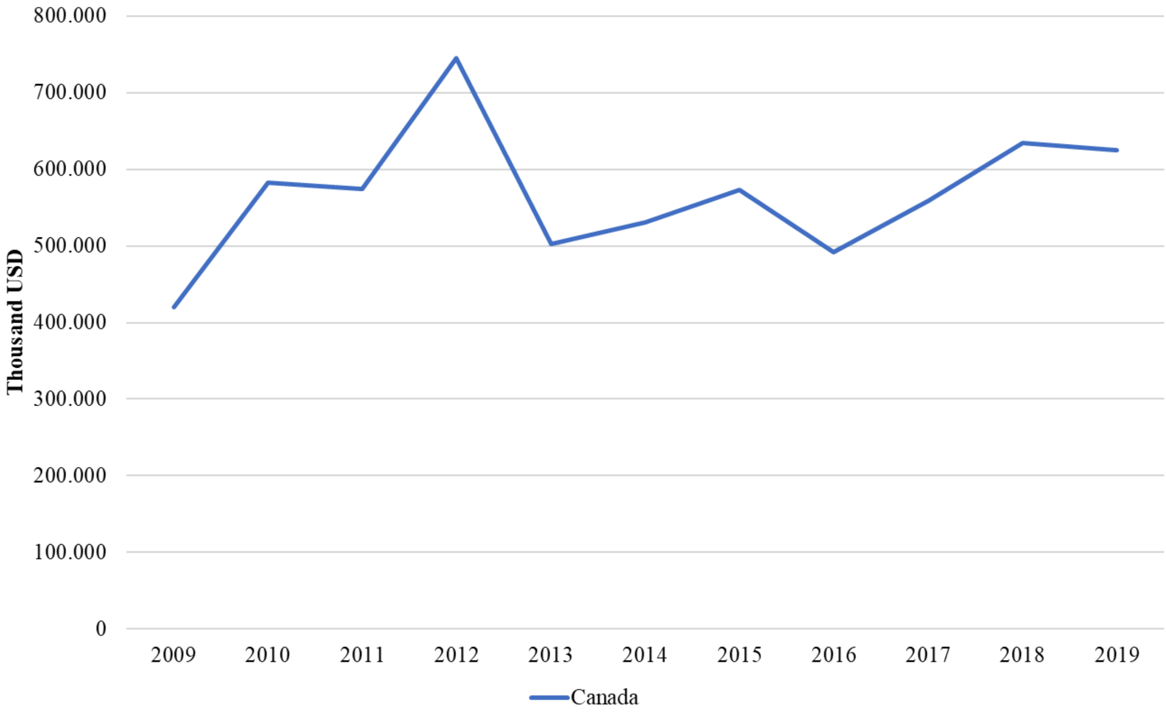
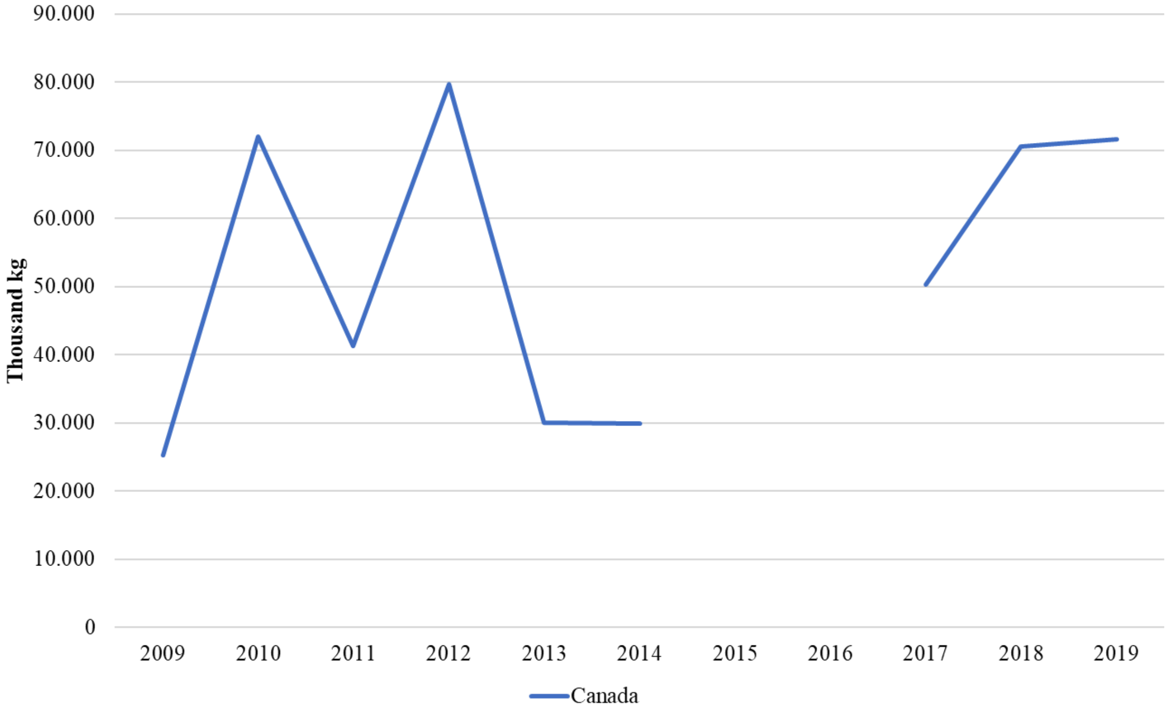


Figure 3: Net weight of Canada's wind industry exports of goods, from 2009-2019 (Source: UN DESA, 2024)



4.2 The United Kingdom

4.2.1. Cost of onshore wind energy

The cost of on-shore wind energy in the UK, as expressed by the weighted average LCOE of newly commissioned utility-scale onshore wind projects, has declined significantly from 0.0805 USD/kWh in 2009 to 0.0487/kWh in 2018 (IRENA, 2023). The LCOE increased both in 2010 and 2011 reaching 0.1079 USD/kWh and 0.1108 USD/kWh respectively. From 2012 to 2017, gradual decreases occurred ending the period at 0.0696 USD/kWh (IRENA, 2023). A considerable decline was experienced in 2018 when the LCOE recorded a 0.02 USD/kWh reduction but in 2019 the LCOE of newly commissioned onshore wind projects rose again averaging 0.0595 USD/kWh (IRENA, 2023).

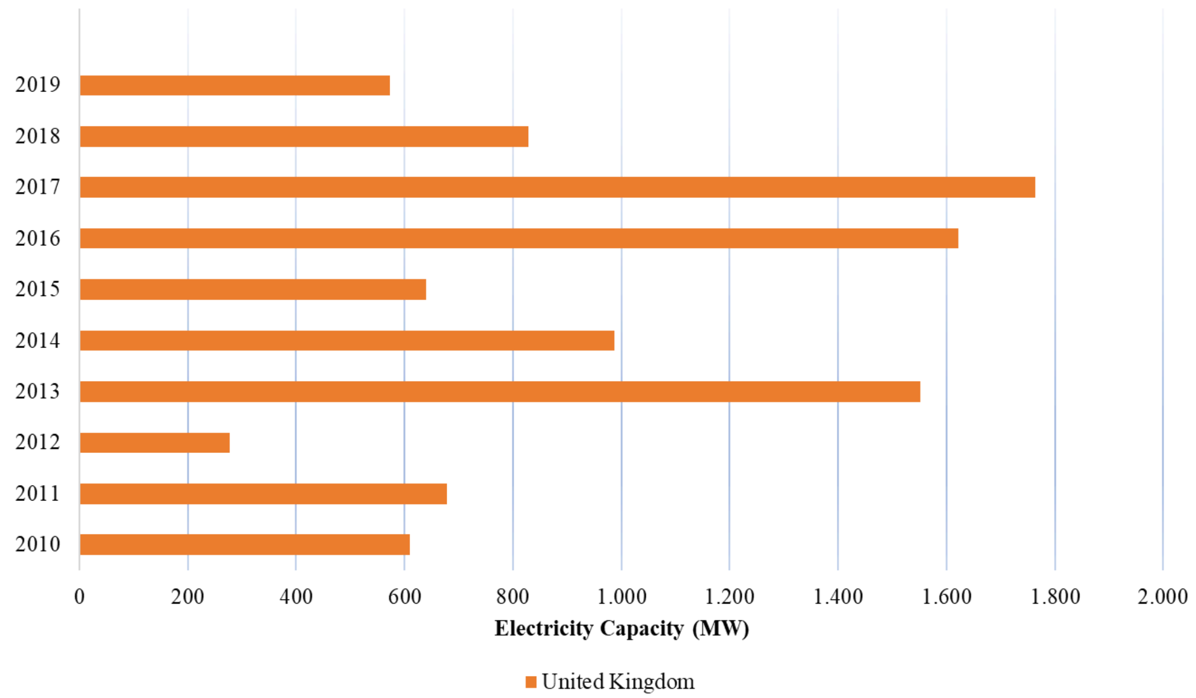
4.2.2 Investment in the onshore wind energy sector

Installed onshore wind power capacity in the UK was 3,471 MW and 4,080 MW in 2009 and 2010 respectively (Department for Energy Security & Net Zero, 2024). In 2011 about 700 MW more were added, reaching 4,758 MW according to the Department for Energy Security & Net Zero (2024). This value increased to 6,035 MW in 2012 while in 2013, after a remarkable growth in installed wind energy capacity in the country, around

1,500 MW were implemented (Department for Energy Security & Net Zero, 2024). In 2014, the UK had an onshore wind energy capacity of approximately 8,573 MW, up by about 1000 MW from the previous year, but in 2015 only 639 MW were installed. Investment on the onshore wind power sector equalled 7.9 billion pounds between 2010 and 2014 according to the Department of Energy and Climate Change (2015) of the UK.

In 2016 an even larger increase was recorded compared to 2013 amounting to 10,833 MW (Department for Energy Security & Net Zero, 2024). As a result of the fact that developers strived to exploit government subsidies before they phased out, in 2017 more than 1,000 onshore wind turbines were implemented adding to the grid about 1,700 MW (LSE, 2020; Department for Energy Security & Net Zero, 2024). This sharp increase was followed by roughly 900 MW of newly installed onshore wind power capacity in 2018 representing an investment of just 0.5 billion euros (Wind Europe, 2019; Department for Energy Security & Net Zero, 2024). From 13,425 MW in 2018, onshore wind electricity capacity rose by only 573 MW reaching 13,998 MW in 2019. Overall, significant growth occurred in the UK between 2009 and 2019.

Figure 4: Onshore wind power annual capacity additions in the United Kingdom from 2010 to 2019 (Source: Department for Energy Security & Net Zero, 2024)

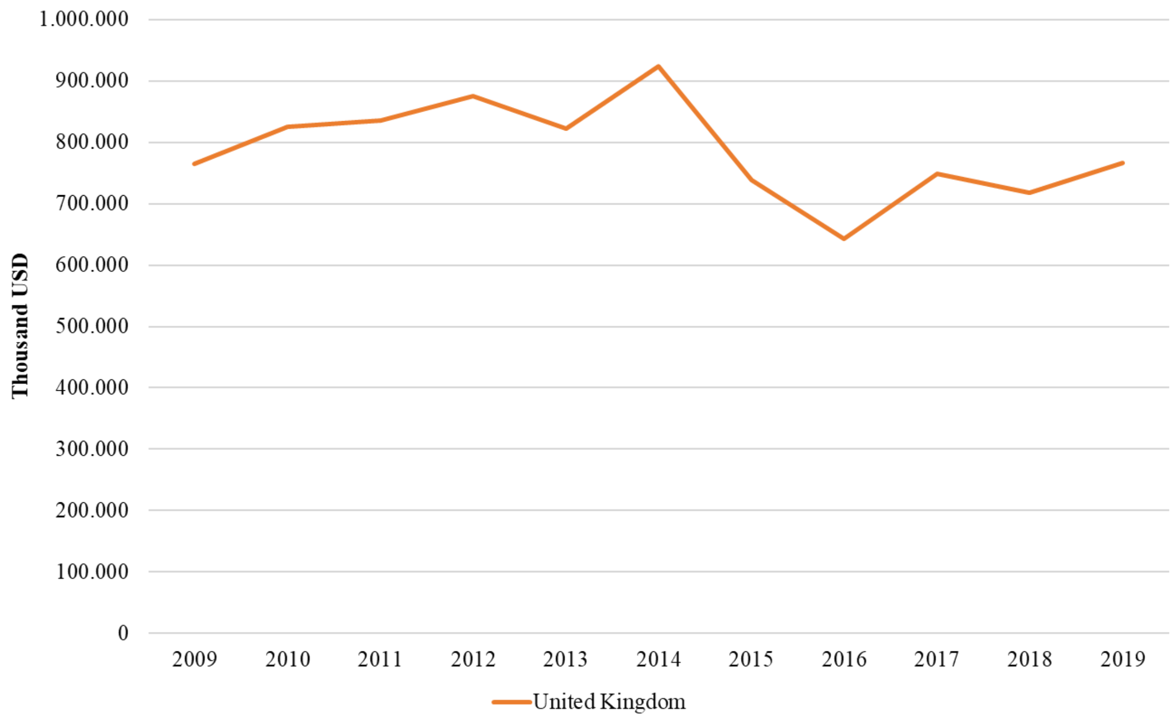


In comparison to other countries in Europe the UK has not had a noteworthy industrial capacity in the onshore wind sector and most of the turbines and technology used have been imported from abroad (WWEA, 2018, pp. 22-23). Despite some development in the 1990s, because of foreign competition, design problems and an uncertain policy environment domestically, onshore wind turbine manufacturing in the UK has not progressed in the past two decades (WWEA, 2018, pp. 22-23)

4.2.3. Export competitiveness of the wind energy sector

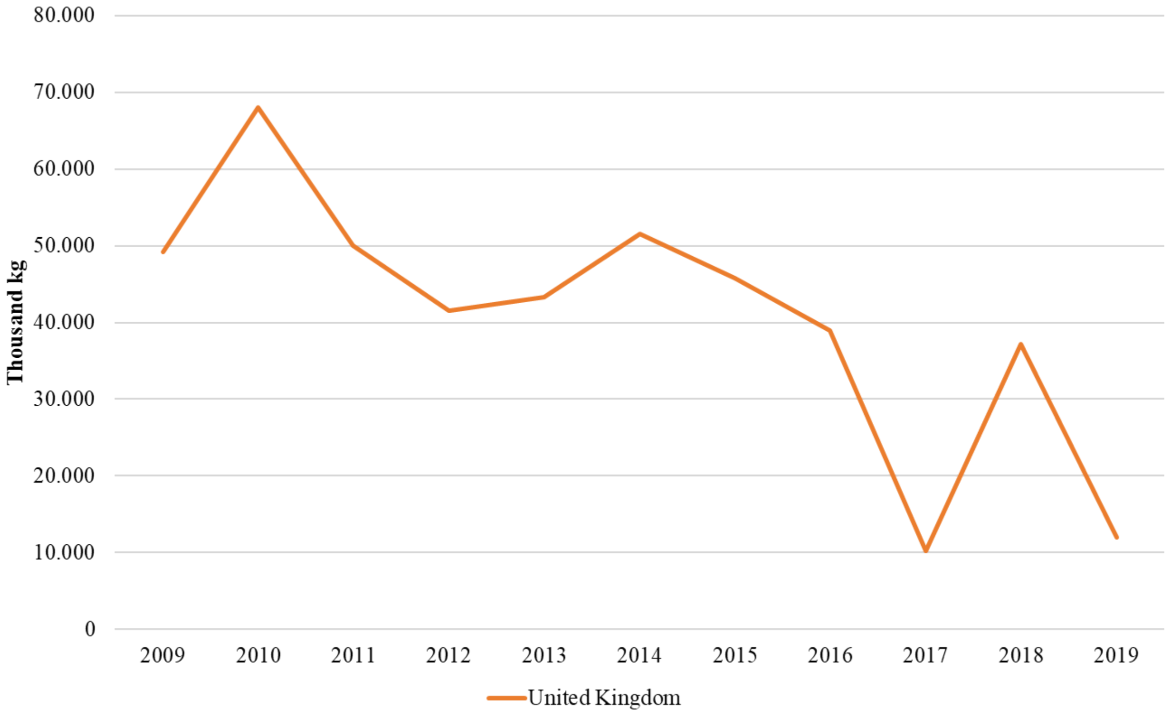
RenewableUK (2019) stated that despite the adoption of governmental policies that obstructed the advancement of onshore wind since 2015, the UK has exported onshore wind products and services to 23 countries. Overall, according to evidence from the UN Comtrade Database, exports of onshore wind related products amounted to USD 764,717,872 in 2009 (UN DESA, 2024). This figure peaked at US$ 923,380,578 in 2014 after a sharp increase but after significant decreases in the next two years the value of exports fell to US$ 642,094,014 in 2016 (UN DESA, 2024). In 2019, the export value of onshore wind related products rose to USD 765,781,084 recording approximately the same sum as 2009 (UN DESA, 2024).

Figure 5: Value of the United Kingdom's wind industry exports of goods, from 2009-2019 (Source: UN DESA, 2024)



The figure concerning the United Kingdom's net weight of wind industry exports illustrates a slightly different picture and a graver situation for the export competitiveness of the sector in the country. In 2009 around 49,166,000 kilos of onshore wind related goods were exported (UN DESA, 2024). The net weight of wind industry exports peaked at 67,964,000 kilos in 2010 but then it fluctuated reaching 41,564,000 kilos in 2012 and rising to 51,572,000 kilos in 2014 (UN DESA, 2024). In 2017 the lowest value was recorded, amounting to about 10,233,000 kilos (UN DESA, 2024). After a considerable increase in 2018, British onshore wind related exports of goods weighed only 11,964,000 kilos in 2019.

Figure 6: Net weight of the United Kingdom's wind industry exports of goods, from 2009-2019 (Source: UN DESA, 2024)

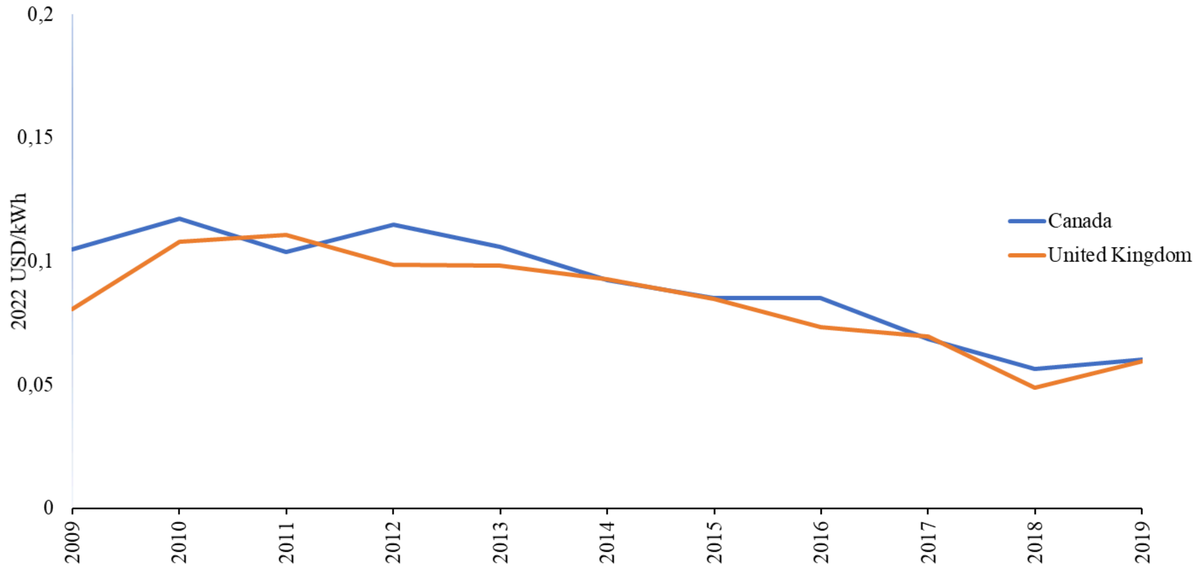


4.3 Comparative Analysis

Canada's LCOE consistently ranked higher or at the same level as the UK's except for 2011. Between 2012 and 2015 the minimum cost of onshore wind power generation decreased considerably in both countries. However, in 2016, progress in Canada stalled causing an approximately 0.012 USD/kWh difference between Canada's and the UK's LCOE (IRENA, 2024). Although the countries' LCOE converged in 2017, the UK recorded a lower value than Canada again in 2018.

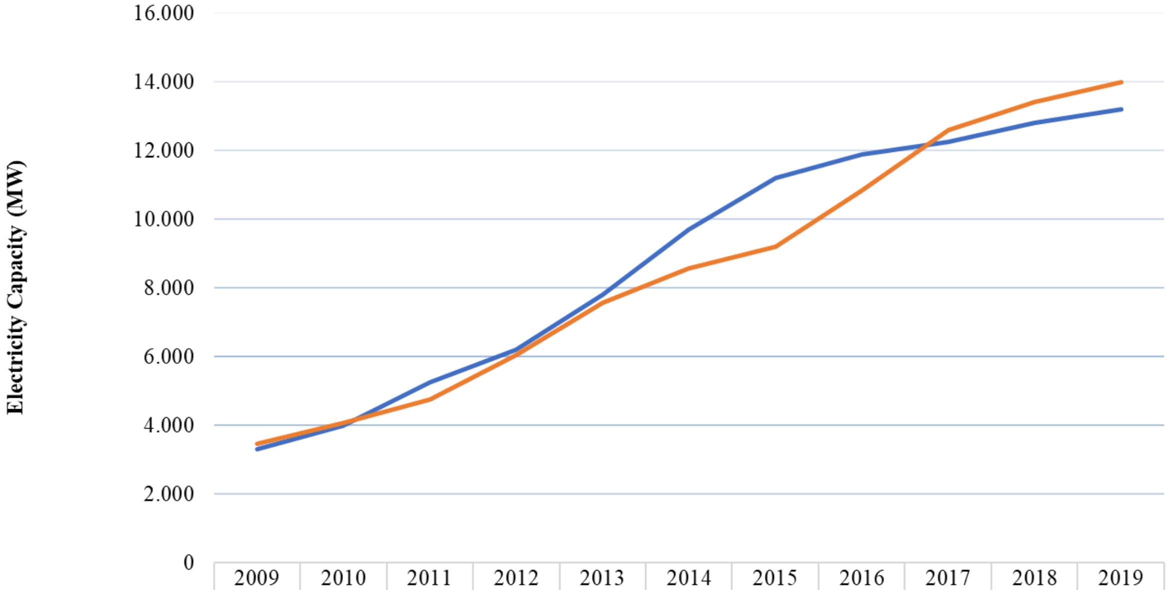
In spite of this, Canada experienced a more significant decline in its LCOE of newly commissioned utility-scale onshore wind projects than the UK between 2009 and 2019. This is evident when considering that in 2009 Canada's LCOE was higher than the UK's whereas in 2019 the two countries had roughly the same value. Based on these, the first hypothesis, that LCRs cause an increase in the costs of renewable energy generation of countries, is rejected. Overall, LCRs imposed in Canada did not harm the competitiveness of the onshore wind industry, in terms of electricity generation costs, significantly in comparison to the UK.

Figure 7: Weighted average LCOE of newly commissioned utility-scale onshore wind projects in Canada and the United Kingdom, 2009-2019 (Source: IRENA, 2023)



As far as investment is concerned, in 2009 and 2010 wind energy capacity in Canada and the UK was almost identical. From 2011 to 2016, Canada’s wind energy capacity was considerably higher than the United Kingdom’s but since 2017 this was not the case. Despite significant wind power capacity additions in Canada up to 2015, growth happened at a slower pace in the years after. The United Kingdom stepped up its onshore wind energy installations in 2016 and in 2017 it managed to surpass Canada’s capacity after consistently ranking behind it. Overall both countries experienced remarkable growth in their onshore wind power grids during this period.

Figure 8: Onshore wind power capacity in Canada and the United Kingdom from 2009 to 2019
(Sources: IRENA,2024; Department for Energy Security & Net Zero, 2024)



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canada	3.300	4.000	5.265	6.201	7.801	9.694	11.214	11.902	12.250	12.816	13.220
United Kingdom	3.471	4.080	4.758	6.035	7.586	8.573	9.212	10.833	12.597	13.425	13.998

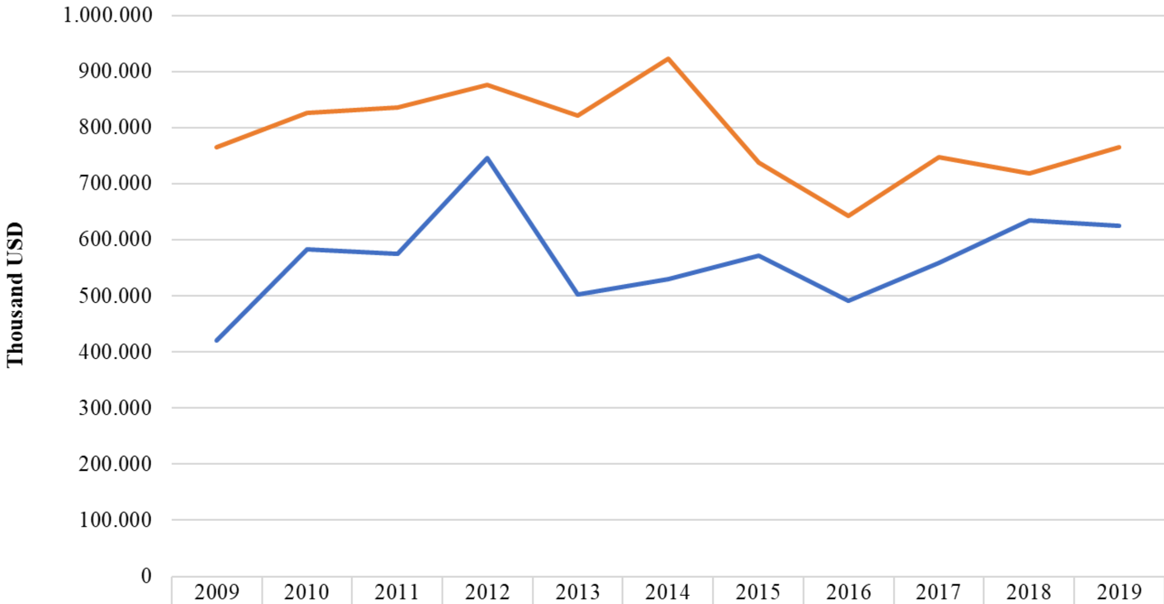
Notably, as explained in the previous sections, investment in facilities manufacturing wind turbines or wind turbine components was prominent in Canada after the LCRs were imposed while in the UK most of the resources used in wind power projects came from abroad. It is worth noting though that the development of the Canadian wind power sector stalled after the LCR policy was abolished in Ontario and factories supplying wind turbine components closed a few years later.

Acknowledging these, the second hypothesis, maintaining that LCRs have a positive effect on investment in the renewable energy industry of countries is not rejected. It is indeed evident that Canada's wind power sector benefited significantly from the policy in terms of attracting investment. Even so, this played out only as a short-term effect given that after the policy was abandoned, the industry appeared to suffer a major blow in Canada.

In regards to export competitiveness, the United Kingdom's exports of onshore wind related goods surpassed Canada's by a quite big margin in 2009, both in terms of value and net weight. Contrastingly, in 2012, 2017, 2018 and 2019 the net weight of Canadian onshore wind industry exports of goods far exceeded the United Kingdom's. Despite some setbacks, Canada's value of exports of products associated with the onshore wind power industry increased considerably between 2009 and 2019. Conversely, the UK's rose up to 2014 but then suffered major declines in 2015 and 2016 eventually climbing up to a similar level as 2009 in 2019.

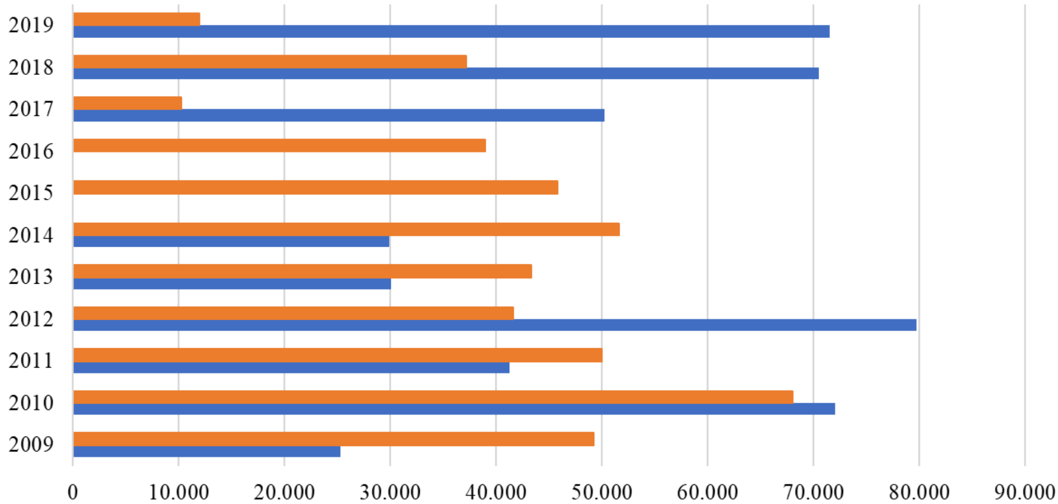
In general the value of exports of the United Kingdom was higher than Canada's between 2009 and 2019. This however might be because of differences in the currencies and the exchange rates of the two countries. The net weight of onshore wind related products can be used more clearly and less ambiguously as a measure of export-competitiveness to compare the two countries. Overall, the net weight of Canadian onshore wind industry exports grew significantly from 2009 to 2019 whereas the United Kingdom's net weight of exports of goods linked to the onshore wind energy sector decreased significantly during this period. Taking into account the previously mentioned, the third hypothesis, namely that LCRs do not have an effect on the export-competitiveness of the domestic renewable energy industry of countries, is rejected. Canada's wind power sector is shown to have made important gains in the international market while the United Kingdom, which did not use LCRs, did not really progress in that domain.

Figure 9: Value of Canada's and the United Kingdom's wind industry exports of goods, from 2009-2019 (Sources: UN DESA, 2024; Government of Canada, 2024)



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canada	420.579	582.409	574.257	745.284	502.081	530.476	572.507	491.704	558.682	634.358	624.963
United Kingdom	764.715	825.501	835.187	875.501	821.776	923.380	737.571	642.094	747.888	717.606	765.781

Figure 10: Net weight of Canada's and the United Kingdom's wind industry exports of goods, from 2009-2019 (Source: UN DESA, 2024)



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
United Kingdom	49.166	67.964	49.994	41.564	43.339	51.572	45.824	38.968	10.223	37.128	11.964
Canada	25.289	72.005	41.257	79.696	30.092	29.856			50.252	70.502	71.546

Thousand kg

United Kingdom Canada

At large, the use of LCRs as an industrial policy measure did not lead to a loss of competitiveness in the onshore wind power sector of Canada compared to the UK's. In comparison to the UK, LCRs did not significantly impact the Canadian industry in terms of costs, the policy had a positive effect on investment and strengthened the exports of onshore wind related goods. However, it can be argued that the effect of the policy did not last long and after the policy was abolished, serious drawbacks were manifested into the Canadian wind power industry concerning investment. In that sense, LCRs led to an artificial boost in the competitiveness of the Canadian wind energy sector which faded in just a few years after its implementation.

Discussion and Conclusion

The analysis that was conducted enlightens the discussion on the effects of LCRs on the competitiveness of the industries on which it is imposed and especially the renewable energy sector. The contemporary relevance of the results is evident when considering the reemergence of LCRs as a prerequisite for green projects and renewable energy. In particular, the introduction of the Inflation Reduction Act of 2022 by the US government is an unprecedented case of a country's employment of LCRs in the renewable energy sector with significant repercussions for international trade, the rules of the WTO and the American industry.

The research that was carried out could shed some light on the potential impact of the policy on the competitiveness of the American green automotive sector. Based on the findings presented in the previous section it can be stipulated that the LCR targeting the American automaker industry could encourage the domestic production of electric batteries and electric battery components, attract significant investments and lead to the development of an export competitive sector in the future. Kia, for example, not long after the legislation was adopted, pledged to expand its operations in North America to take advantage of the IRA's tax credits for EVs (Center for Strategic & International Studies [CSIS], 2022).

However, as it was the case with investments in Canada's wind electricity grid and the Ontarian wind turbine component manufacturing scene after the discontinuation of the LCR policy in the province, the US government could suffer a major blow in the likely event that the WTO rules that the provisions of the Inflation Reduction Act are unlawful under international trade rules. As was mentioned in the introduction, China has already sent a complaint to the organization. Nonetheless, given that the Appellate Body of the WTO has been paralyzed since 2019 due to the US's veto over the appointment of new judges, the institution would be unable to enforce a rule on the US (CSIS, n.d.).

Despite a rigorous and robust research design and an illustrative analysis, the study has some important limitations. The conclusions made should be applied to other cases carefully and critically. Firstly, the inferences made are mostly relevant to developed countries' experience with LCRs. Developing countries usually have characteristics that influence and potentially constrain the effectiveness of LCRs such as unstable markets and political landscapes and relatively low economic complexity. This was not the case for Canada and the United Kingdom for example which have been defined as attractive investment destinations with stable and strong policy environments throughout the years.

Secondly, offshore wind energy is not included in the analysis as Canada did not have offshore wind energy capacity due to implementation costs and regulatory constraints during the period that was studied (Choi, 2023). This leads to the underrepresentation of the British wind electricity capacity and investment in the offshore wind power sector in the country. The UK has been a global leader in the development and employment of offshore wind energy technology, has heavily funded research and development programmes and has taken measures to create an export competitive offshore wind industry (WWEA, 2018, p. 23). Contrary to what was the case with onshore wind, the incentives that the UK government has provided have resulted in the creation of a domestic supply chain of offshore wind energy components (WWEA, 2018, pp. 22-23).

Concluding, although scholars have disagreed on its effectiveness in the past, this study maintains that LCRs coupled with government incentives is an important industrial policy measure which can have positive effects on the competitiveness of the domestic renewable energy sector of countries. Based on the comparison between the Canadian and the British onshore wind power sector, it could be also argued that, in the short term, government incentives without LCRs would not be as effective as with LCRs in strengthening the competitiveness of the domestic renewable energy sector.

Despite this, as was demonstrated before, LCRs' duration plays a vital role. Industries take time to mature and create economies of scale. Investors are likely to be disincentivized to keep an otherwise unprofitable local supply chain without sustained state support. In Canada, as with other cases in the past, LCRs did not prove to be a sustainable solution to developing a competitive wind power industry. It is doubtful whether it was worth violating the rules of the WTO and resort to trade protectionism in order to align green with industrial and economic objectives. The measure should be carefully thought, designed properly and be critically assessed taking into account the domestic political, economic and social conditions as well as the external legal environment, before it is implemented.

Lastly, it is suggested that further research be done on the topic. Garnering public support for the green energy transition is an essential advantage of green protectionist policies that should not be ignored. Future research on the impact of LCRs on public perception of green projects could be of essence. The cases of Canada and the United Kingdom could be illustrative in drawing conclusions on the topic. Moreover, exploring the effect of developed countries' LCRs on developing countries' economies is an issue that should be studied further. Evaluating the effectiveness of the policy after the dysfunction of the WTO's Dispute Settlement Mechanism would also be of importance. As was proposed by Hufbauer (2013, p. 153), the WTO and regional free trade agreement secretariats should conduct reports on old and new LCRs alongside with other protective measures.

Bibliography

Anderson, K. (2023). *Green protectionism: principles, examples and concerns*. Retrieved from https://greenly.earth/en-us/blog/ecology-news/green-protectionism-principles-examples-and-concerns?ps_partner_key=c292cm5jb21tZXJjZWRlbWFuZHRlYW01Mjc4&sid=lubdiiobod03p3x00sdre&ps_xid=xiiHR08veckP3Y&gsxid=xiiHR08veckP3Y&gspk=c292cm5jb21tZXJjZWRlbWFuZHRlYW01Mjc4

Araújo, S., & Flaig, D. (2017). Trade restrictions in Brazil : Who pays the price? *Journal of Economic Integration*, *32*(2), 283–323. https://doi.org/10.11130/jei.2017.32.2.283

Berrada, A., & Loudiyi, K. (2019). Economic evaluation and risk analysis of gravity energy storage. In *Gravity Energy Storage* (pp. 51–74). https://doi.org/10.1016/B978-0-12-816717-5.00003-7

Canada Energy Regulator. (2024). *Provincial and territorial energy profiles - Ontario.* Retrieved from https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html

Canada Energy Regulator. (2015, February 26). *Market Snapshot: Wind continues to Gain Power in Ontario, Quebec and Alberta in 2014.* Retrieved from https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2015/market-snapshot-wind-continues-gain-power-in-ontario-quebec-alberta-in-2014.html

CSIS. (2022, October 12). *An electric debate: Local Content Requirements and trade considerations*. Retrieved from https://www.csis.org/analysis/electric-debate-local-content-requirements-and-trade-considerations

CSIS. (n.d.). *The World Trade Organization: The Appellate Body crisis.* Retrieved from https://www.csis.org/programs/scholl-chair-international-business/world-trade-organization-appellate-body-crisis

China to challenge Biden’s electric vehicle plans at the WTO. (2024, March 26). *The Associated Press.* Retrieved from https://apnews.com/article/china-us-wto-electric-vehicle-subsidies-5048c991624f7be5e4800490e3b1273d

Choi, T. (2019, July 21) Offshore wind can help Canada reach net-zero goal: report. *Sustainable Biz Canada.* Retrieved from https://sustainablebiz.ca/offshore-wind-can-help-reach-net-zero-in-canada-report

CIA. (2022, December 21). *The world factbook.* Retrieved from https://www.cia.gov/the-world-factbook/about/archives/2022/

Clean Energy Canada. (2019, March 13). *Quantifying Canada's clean energy economy: An assessment of clean energy investment , value-added jobs.* Retrieved from https://cleanenergycanada.org/wp-content/uploads/2019/05/2019-03-13-Clean-Energy-Economy-FINAL-REPORT.pdf

Crooks, E. (2023). *Tensions over "green protectionism" emerge at COP28.* Retrieved from https://www.woodmac.com/news/opinion/tensions-over-green-protectionism-emerge-cop28/

Deringer, H., Erixon, F., Lamprecht, P., & Van der Marel, E. (2018). *The economic impact of local content requirements: A case study of heavy vehicles*. Retrieved from https://www.econstor.eu/bitstream/10419/202458/1/1013259750.pdf

Department of Energy and Climate Change. (2014). *Energy trends.* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/295362/ET_March_2014.PDF

Department of Energy and Climate Change. (2015). *Energy investment: Low carbon energy.* Retrieved from https://assets.publishing.service.gov.uk/media/5a80dcd9ed915d74e6230df9/DECC_LowCarbonEnergyReport.pdf

Government of Canada. (2024). *Trade data online.* Retrieved from https://www.ic.gc.ca/app/scr/tdst/tdo/crtr.html?grouped=GROUPED&searchType=KS_CS&naArea=9999&countryList=ALL&toFromCountry=CDN&reportType=TE&timePeriod=10%7CComplete+Years&currency=CDN&productType=HS6&hSelectedCodes=%7C850231&runReport=true

Gov't says wind turbine plant to create 700 jobs. (2010, December 1). *CTV News.* Retrieved from https://toronto.ctvnews.ca/gov-t-says-wind-turbine-plant-to-create-700-jobs-1.581255

Harvard University. (2022). *Country and product complexity ratings*. Retrieved from https://atlas.cid.harvard.edu/rankings

Halperin, S., & Heath, O. (2017). Political research: Methods and practical skills (Second ed.).

Hufbauer, G. C. (2013). *Local content requirements : A global problem* (1st ed.). Peterson Institute for International Economics.

International Energy Agency. (2020, May 20). The Covid-19 crisis is hurting but not halting global growth in renewable power capacity. Retrieved from https://www.iea.org/news/the-covid-19-crisis-is-hurting-but-not-halting-global-growth-in-renewable-power-capacity

Irwin, D. (2020). Protectionism: Economic costs, political benefits?. In *Free trade under fire: Fifth Edition* (pp. 84-118). Princeton, United States: Princeton University Press. https://doi-org.ezproxy.leidenuniv.nl/10.1515/9780691203362

IRENA. (2024). *Wind energy.* Retrieved from https://www.irena.org/Energy-Transition/Technology/Wind-energy

IRENA. (2023). *Wind costs*. Retrieved from https://www.irena.org/Data/View-data-by-topic/Costs/Wind-Costs

Izaak Wind. (n.d.). *HS Codes and the Renewable Energy Sector.* Retrieved from https://energyinformation.ir/images/Energy_Equipment_Market/Energy_Equipment_Info/Equipment_Code/hs-codes-and-the-renewable-energy-sector.pdf

International Centre for Trade and Sustainable Development (2013). *Removing trade barriers on selected renewable energy products in the context of energy sector reforms: Modeling the environmental and economic impacts in a general equilibrium framework.* Retrieved from https://seors.unfccc.int/applications/seors/attachments/get_attachment?code=CY4M3EURGJTMO3AXBQS4QVT9A8JGJ8XF

Kuntze, J.-C., & Moerenhout, T. (2014). Are Feed-in Tariff schemes with Local Content Requirements consistent with WTO law? In *Frontiers of international economic law* (pp. 151–180). https://doi.org/10.1163/9789004270190_009

Lewis, J. I., & Wiser, R. H. (2007). Fostering a renewable energy technology industry: An international comparison of wind industry policy support mechanisms. *Energy Policy*, *35*(3), 1844–1857. https://doi.org/10.1016/j.enpol.2006.06.005

Lottici, M. V., Galperín, C., & Hoppstock, J. (2014). "Green trade protectionism": An analysis of three new issues that affect developing countries. *Chinese Journal of Urban and Environmental Studies*, *2*(2), https://doi.org/10.1142/S234574811450016X

National Energy Board. (2017). *Canada's renewable power landscape: Energy market analysis 2017.* Retrieved from https://publications.gc.ca/collections/collection_2018/one-neb/NE2-17-3-2017-eng.pdf

No activity at Windsor's wind turbine plant, workers laid off. (2019, March 15). *CBC News*. Retrieved from https://www.cbc.ca/news/canada/windsor/cs-wind-quiet-1.5058216

Probst, B., Anatolitis, V., Kontoleon, A., & Anadón, L. (2020). *The short-term costs of local content requirements in the Indian solar auctions*. https://doi.org/10.17863/CAM.55321

Reevely, D. (2017, July 19). Windmill plant closes, as Ontario's Green Energy Act dies a painful, costly death. *Ottawa Citizen.* Retrieved from https://ottawacitizen.com/news/local-news/reevely-windmill-plant-closes-as-ontarios-green-energy-act-dies-a-painful-costly-death

Revare, G. (2023). *Green protectionism: A dangerous consensus.* Retrieved from https://uscnpm.org/2023/08/23/green-protectionism-a-dangerous-consensus/

RenewableUK. (2019, November 18). *New report reveals UK exporting wind and marine energy to 37 countries.* Retrieved from https://www.renewableuk.com/news/478158/New-report-reveals-UK-exporting-wind-and-marine-energy-to-37-countries.htm

Scheifele, F., Bräuning, M., & Probst, B. (2022). The impact of local content requirements on the development of export competitiveness in solar and wind technologies. *Renewable & Sustainable Energy Reviews*, *168*, 112831-. https://doi.org/10.1016/j.rser.2022.112831

Siemens selects Tillsonburg for turbine blade plant. (2010, December 2). *CTV News.* Retrieved from https://kitchener.ctvnews.ca/siemens-selects-tillsonburg-for-turbine-blade-plant-1.581588

The London School of Economics and Political Science. (2020, February 3). How important is onshore wind energy to the UK?. Retrieved from https://www.lse.ac.uk/granthaminstitute/explainers/how-important-is-onshore-wind-power-to-the-uk/

UN Department of Economic and Social Affairs. (2024). *UN Comtrade database.* Retrieved from https://comtradeplus.un.org/TradeFlow?Frequency=A&Flows=X&CommodityCodes=TOTAL&Partners=0&Reporters=124&period=2009&AggregateBy=none&BreakdownMode=plus

UNCTAD. (2014). *Local content requirements and the green economy*. Retrieved from https://unctad.org/system/files/official-document/ditcted2013d7_en.pdf

Vadila, Y. & Christian, D. (2024).The effects of local content requirements on trade: The case of Indonesia. In *Local Content Requirements: Promises and pitfalls* (1st ed., pp. 174–211). Routledge. https://doi.org/10.4324/9781003415794-7

WTO. (2003). *Green protectionism.* Retrieved from https://www.wto.org/english/forums_e/ngo_e/wwf_greenprotec_e.pdf

World Bank (2022). *Worldwide governance indicators.* Retrieved from https://www.worldbank.org/en/publication/worldwide-governance-indicators/interactive-data-access

WWEA. (2018). *United Kingdom.* Retrieved from https://www.wwindea.org/wp-content/uploads/2018/06/UK_full.pdf

Wind turbine fundamentals. (n.d.) Retrieved from https://renewablesfirst.co.uk/renewable-energy-technologies/windpower/windpower-learning-centre/wind-turbine-fundamentals/

World Steel Association. (2009). *World steel in figures 2009.* Retrieved from https://worldsteel.org/wp-content/uploads/2009-World-Steel-in-Figures.pdf

Wind Europe. (2019). *Wind energy in Europe in 2018: Trends and statistics.* Retrieved from https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2018.pdf