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# Comparing Fiscal and Incentive-Based Climate Policies: Sweden's Carbon Tax Vs. Germany's Renewable Energy Act

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**Abstract**

This paper conducts a comparative analysis of two significant environmental policies — Sweden's 1991 Carbon Tax and Germany's 2000 Renewable Energy Sources Act (EEG). The study investigates their effectiveness in reducing $CO_2$ emissions, economic implications, and the policy mechanisms that shaped their outcomes. Sweden's carbon tax demonstrated long-term environmental benefits through gradual price adjustments and increased biofuel adoption, while Germany's EEG showcased the power of feed-in tariffs and subsidies in rapidly expanding renewable energy generation. However, both approaches faced challenges — Sweden in industrial exemptions and Germany in cost efficiency. By examining these cases, the paper highlights how fiscal and incentive-based frameworks can complement one another to balance emission reduction and economic growth.

**Keywords:** Carbon Tax, Renewable Energy, Environmental Policy, Sweden, Germany

## INTRODUCTION

Arjun Sabharwal is a dedicated International Baccalaureate (IB) student with a passion for Economics, demonstrated through his insightful research paper on comparative environmental policies with Luminere. His academic curiosity is complemented by practical experience, including a summer school program at the National University of Singapore (NUS) and an internship in the fintech sector. Combining rigorous analytical skills with a keen interest in sustainable finance, Arjun is an emerging young scholar eager to contribute to global economic and environmental discussions.

### Case Study: Sweden's Carbon Tax (1991)

The research question I am exploring is "Which policy was more effective in reducing carbon emissions; the carbon tax in Sweden 1992 or the subsidies program in Germany?". This question is integral as it dwells upon the relation between two very different carbon regulations, a fiscal disincentive and a financial incentive, and their influence on carbon dioxide emissions. Understanding the relationship between these factors is vital for policy makers, businessmen and citizens concerned about the environment. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

Efforts towards reducing Carbon emissions by the government had started during the 20th century. Sweden had introduced their C02 tax on January 1st,1991, which was part of a broader tax reform which addressed several environmental and fiscal issues of the economy. This policy is significant as it is an example of one of the earliest fiscal measures designed to reduce carbon emissions. Another such case is

The Germany's Renewable Sources Energy Act (EGG), which represents a different approach. The EGG was initiated on April 1st, 200. This act is aimed at expanding renewable energy usage in the country. The EGG was a critical step taken by the Germans for the Energiewende or 'Energy transition' which was a strategic move away from fossil fuels by relying more on sources such solar, wind and biomass. This act is integral as it has been instrumental in making Germany a global leader in the renewable energy sector, ranked 4th in the world, trailing only behind, China, The U.S, and Brazil. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

Swedish Carbon Tax (Bohlin, 1998; Lin & Li, 2011; Shmelev & Speck, 2018; Sterner, 2020).

The Carbon tax of Sweden, which was introduced in 1991, as part of a broader tax reform by Sweden, aimed to reduce the carbon emissions in the country. This tax was an attempt by Sweden to follow the Paris agreement, an international climate agreement, which had aimed to limit global warming and to prevent the temperature from increasing by more than 2 degree C of the preindustrial temperature.

Sweden first introduced a carbon tax at the rate of SEK 250(24.48 USD) per ton of CO2, gradually increasing the rate over time to SEK 1180 (115.56 USD) per ton by 2019. This phased approach allowed households and businesses to adjust to the higher cost of energy which helped in minimizing the economic disruptions. Along with the carbon dioxide tax, Sweden had also implemented a value added tax on transport fuel such as gasoline and diesel which was and remains one of the largest factors to the carbon emissions in Sweden.

"Carbon Taxes and CO2 Emissions: Sweden as a Case Study" by Julius J. Anderssonis an article which evaluates the effect of the carbon tax policy on carbon emissions emitted by the transport sector. The paper compares Sweden's carbon emissions to countries part of the OECD (Organization for Economic Co-operation and Development), that don't implement a carbon tax. The study also evaluates the elasticity of gasoline and other fuels to a change in carbon tax and compares it to their price elasticity.

chapter 5 - "The Carbon Tax in Sweden"- of "Standing Up for a Sustainable World" by Thomas Sterner introduces the carbon tax as a measure to fight the climate crisis. The source gives an analysis on the policy's role in reducing carbon emissions, especially in the heating and energy sectors, whereas other options such as biofuels have become prominent. The source also provides a short description on the tax's direct economic impact, such as its effect on the price of fossil fuels.

The greatest impact of the taxes in Sweden has been the reduction of the carbon dioxide emissions. Carbon dioxide emissions had shown a sharp drop of 8% between 1990 and 2010. The environmental impacts were especially visible in the transport sector. Between 1905 and 2005, carbon emissions in the transport sector had dropped by 10.9%, which was equal to a drop of 2.5 million metric tons of CO2 emissions annually. This was a exceptional achievement given the fact that the Transport sector's emissions accounted for nearly 40 % of the country's CO2 emissions during the period.

While being a massive success in curbing the growth of Carbon dioxide emissions in Sweden, the tax policy has also been strong economically. While there were initial worries about the economic impacts of the carbon tax, Sweden's economy has continued to grow steadily. Between the years 1990 and 2005, as Sweden's carbon emissions fell by 8%, the economy grew by 51%, dispelling the concerns about the policy's economic repercussions.

The Carbon tax has also caused an impact on how consumers behave, especially in the transport sector. The fuel usage has noticeably gone down as there is an increase in the number of diesel-powered vehicles. In 1991, only 2.7% of the passenger cars in Sweden ran on diesel, however by 2015, the share had increased to 29.6% of passenger cars being diesel powered. This has shown a shift in the mentality of the

consumer as they are increasingly opting for a more environmentally better option. This shift has also been reflected throughout Europe, where imposition of fuel taxes has incentivized adoption of more fuel-efficient vehicles.

Sweden's carbon tax policy like this paper had previously mentioned before had faced many concerns of its impact on the country's competitiveness, especially in case of more energy heavy industries. However, due to the government's gradual increase in taxes for sectors such as agriculture and manufacturing the country was able to adapt to the changes. However, many still debate about the tax's long-term effects on the economy, consumers and the producers.

**Case Study: Germany's Renewable Energy Sources Act (2000)**

The Renewable Sources Energy Act or the Erneuerbare-Energien-Gesetz(EGG) were a series of German laws that were designed to improve previous renewable energy legislation, like the Electricity feed in Act or the Stromeinspeisungsgesetz of 1991. The primary function of the EGG was to offer fixed feed-in tariffs for renewable energy producers, including solar energy, wind energy and biomass. The policy helped provide financial security to investors investing in the renewable energy sector, since the tariffs were higher than the market rates and they were guaranteed for up to 20 years. His policy required utilities who are responsible for the distribution of electricity to buy all renewable energy generated by independent producers, which helped the market grow faster. This policy significantly boosted Germany's renewable energy capacity and reduced its reliance on fossil fuels. By 2002, renewable energy accounted for 9% of the electricity. Germany became a world leader in installed wind capacity, with 13,512 MW by October 2003, representing nearly 40% of global capacity. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

"Impacts of the German Support for Renewable Energy on Electricity Prices, Emissions and Profits," by Traber, Thure; Kemfert, Claudia discusses Germany's support for the renewable energy sector, especially about the feed-in tariff, impacts of the prices of electricity, effect on the atmospheric carbon emissions and the profit of firms in the energy market. In this paper they use the electricity market model EMELIE and "decompose (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

the impact of the feed-in of renewable energy in Germany into two effects: a substitution effect triggered by the displacement of conventional sources and a permit price effect induced via the ETS." (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

"Economic Impacts from the Promotion of Renewable Energy Technologies: The German Experience" by Manuel Frondel , Nolan Ritter, Christoph M. Schmidt, Colin Vance also examines the expansion of Germany's renewable energy sector. Thus, sources, however, assess the policy's impact on job creation, climate protection and innovation technology. This paper argues that the EGG and in particular the feed-in tariff, has failed due to its unsustainable cost. The paper states that the governments support mechanisms towards the Renewable Energy Act "massive expenditures that show little long-term promise for stimulating the economy, protecting the environment, or increasing energy security." (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

"Renewable Energy Policy in Germany: Pioneering and Exemplary Regulations" by Mischa Bechberger and Danyel Reiche is a paper that discusses Germany's achievement of helping in the growth and development of renewable energy sources. It focuses on Germany's leadership in wind energy, solar energy, and other renewable sources of energy, The paper also attributes the success of the renewable

energy sector to the Renewable Energy Sources Act, for helping the country and enabling the growth of wind, solar and biomass energy. This paper however also points out the difficulties and obstacles to further renewable source development such as the powerful coal lobby and long-term natural gas contracts, which may obstruct the development of renewables. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

The EGG has led to huge investments in renewable energy infrastructure, especially increased investments in wind and solar power. For example, the 100,000 Roofs Programme for photovoltaics, introduced alongside the EEG, provided significant subsidies and loans to promote solar installations. This along with the feed-in tariffs, set off a rapid expansion of the solar industry in Germany. By 2008, Germany accounted for 42% of the global solar panel market. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

Despite the success that the EEG had in the implementation of renewable Energy in the country, the act has faced a lot of criticism regarding its cost effectiveness. Manuel Frondel , Nolan Ritter, Christoph M. Schmidt, Colin Vance argue that the high cost of the subsidies, in particular the cost of solar panels, was not proportional to the benefit they had provided. By 2009, he feed in tariffs for solar energy were 8 times higher than electricity prices at the power exchange, which had led to an overallocation of subsidies toward less efficient renewable technologies. The high investments towards solar energy despite Germany's unsatisfactory geographic conditions for solar, raised questions about the long-term feasibility of using this policy. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

The EGG has had a major effect in decreasing the carbon emissions is the atmosphere, which was Germany's primary objective in passing these laws, by shifting from using conventional fuel-based electricity generation to a more sustainable and environmentally friendly method. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

A paper by Traber, Thure; Kemfert, and Claudia (2007) suggests that the EGG had resulted in reduced emissions from the generation of electricity by 32 million tons in Germany. However, this wasn't the case when we view this subject in a European context. The reason why the reduction in carbon emissions was less significant in the rest of Europe was the European Emissions Trading Scheme (ETS). Due to this scheme, the amount of carbon emissions a country can emit is capped across the continent, and hence, a reduction in one country's carbon emissions can result in increased carbon emissions in another country due to the tradable nature of the carbon permits. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

As mentioned earlier, the implementation of the EGG was elemental in the Enegiewende, which was a policy formally adopted by Germany in the 2000s to shift the country towards renewable energy and away from not only fossil-fuel based energy, but also nuclear based energy, as an attempt to decarbonize their country. The policy's support for renewable energy caused a decrease in nuclear power, which had dropped from 30.2% of all electricity production in 2000 to 23.3% by 2008. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

As mentioned before, Germany's EGG had to face much worry and criticism over its cost-effectiveness, especially due to the high costs of using renewables. For example, the feed-in tariffs of solar energy were roughly eight times more than what the market price was. Therefore, Germany was over allocating resources towards a technology which was less efficient, leading to inefficient allocation of resources. However, this isn't the only concern. Germany is not a region which receives a lot of sunlight, therefore

many raised concerns over the long-term feasibility of implementing a policy which would invest heavily in solar power. In addition to the environmental impacts, the EGG has also resulted in a few economic issues. The implementation of these policies has made the price of electricity more expensive and therefore increased the burden on consumers and has therefore also sparked some public discontent. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

However, in terms of environmental impact, Germany's EGG played a more significant and crucial role in expanding both the domestic and global market for renewables. This Act has helped paved the path for Germany to become a leader in both Solar and Wind energy production hence reducing its reliance on fossil fuels. Despite the high cost to bear because of the ETS, this Act had laid a groundwork for Germany's Energiewende. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

**Comparative Analysis**

Comparing both of these policies provides many challenges due to various differences in the policies' objectives and design. The EGG on promoting use of renewable energy by using subsidies and other market incentives. Sweden's carbon tax on the other hand is a fiscal measure aims to reduce the carbon emissions in the country by making Carbon related activities more expensive.

The policies were both implemented during very different time periods, during which both the global conditions and regional conditions were very different. Sweden's carbon tax (1991) was initiated at a time when Carbon pricing and other environmental policies were relatively new concepts. The EGG (2000) on the other hand was part of a broader shift in European agendas towards more environmental protection and promotion of renewables.

As a smaller economy Sweden is less reliant on heavy industry and can therefore be more resilient towards the impacts of implementing a carbon tax, whereas Germany, having an extremely energy intensive Industry will be unable to deal will the impacts that the introduction of a carbon tax would result in. The EGG was also implemented in a time where the world was making rapid advancements in renewable energy technology, which could have been one of the factors heavily influencing the success if the policy. (Bechberger & Reiche, 2004; Frondel et al., 2010; Traber & Kemfert, 2007; Nicolini & Tavoni, 2017).

In terms of the economic impact and efficiency of the policy itself, Sweden's carbon tax was more effective. Th implementation of this tax had not only led to a substantial decrease in Sweden's carbon emissions while still allowing the economy to have a stable economic growth rate. By gradually increasing tax rates and promoting the use of cleaner and more efficient fuels, the tax has managed to both minimize the possible economic disruptions because of the tax and fulfil their environmental objectives.

In conclusion, both policies were extremely effective in different ways. Sweden's carbon tax had proved to be a more economically cost-effective method of dealing with carbon emissions while continuing to foster the economic growth of Sweden. The EGG on the other hand, despite its high costs, has achieved significant growth in the production of renewable energy. Whether expanding the renewable energy sector or reducing carbon emissions, both policies can be considered extremely effective. however, in terms of overall economic stability and Carbon emissions reduction, Sweden's carbon tax holds an edge

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