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*Interest groups and the
failure of transformative
innovation policy
– Insights from the ethanol
car bubble in Sweden 2003–
2013*

Rickard Björnemalm & Christian Sandström

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- Insights from the ethanol car bubble in Sweden 2003-2013

Rickard Björnemalm
The Institute for Economic and Business History Research (EHFF)
Stockholm School of Economics
Box 6501
SE-113 83 Stockholm, Sweden
rickard.bjornemalm@gmail.com

Christian Sandström
The Ratio Institute
P.O. Box 3203, SE-103 64 Stockholm, Sweden
christian.sandstrom@ratio.se
Jönköping International Business School
Box 1026
551 11 Jönköping, Sweden
christian.sandstrom@ju.se

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Abstract

Literature on innovation policy has so far paid little attention to policy failure and the mechanisms leading to failure. We describe the Swedish bubble in ethanol cars 2003-2013 and explain why well intended policies may end up with unsatisfactory results. Directives from the European Union forced policymakers in Sweden to act swiftly and the Swedish government put in place The Pump law which forced gas stations to supply ethanol as a fuel from 2006 and onwards. In combination with targeted tax deductions for ethanol cars, a sharp increase in demand took place in 2006-2008. As these started to experience engine problems by 2009-2010, demand declined. Tax deductions were subsequently altered in order to also include cars with very low CO₂ emissions, a shift that contributed further to the downfall of ethanol cars. Our data suggests that domestic car manufacturers Volvo and Saab, along with Ford benefited from the ethanol policies as their combined market share for green cars surged from 12 to 75 percent 2005-2008. Ethanol was competitive in the political domain as the fuel was backed by the Centre Party and the associated farmers' lobby group, but lacked economic, technological and environmental competitiveness. Our findings suggest that innovation policies aimed at supporting new technologies against vested interests may instead end up extending established interests as policies are put in place under the influence of various stakeholders.

Keywords: Ethanol car, policy failure, innovation, technology, environment
JEL Codes: O25, O31, O38, O44, Q42

1. Introduction

Innovation policy has increasingly converged with industrial policy and environmental policy. Environmental policy used to be primarily concerned with imposing various controls upon the emission of harmful substances. Inspired by economists such as Mariana Mazzucato (2021), many governments, as well as the European Union, have taken industrial policies on a new, considerably more interventionist path, sometimes referred to as innovation policy 3.0.

Literature on innovation systems has emphasized the importance of niche experiments in order to accomplish transitions towards sustainability across different sectors (Geels, 2002). Scholars have emphasized the importance of government support in the nursing phase when a new technology is still immature.

While state support to infant industries and novel technologies have been highlighted by many scholars as critical, this policy recommendation is rarely questioned or scrutinized. Specifically, more knowledge is needed regarding the boundary conditions for such policies, i.e. under what conditions are these policies more or less likely to function as intended? A systematic review of innovation literature showed that scholars pay little attention to the mechanisms behind policy failure (Kärnä et al., 2022). While there are some notable exceptions that take a critical stance concerning innovation policy and regional development (Andersson and Andersson, 2020; Hannon et al., 2017; MacNeil, 2016) the prevailing bias is nevertheless towards studying success while paying little attention to failure.

In this paper, we explore how and why state innovation policies aimed to support sustainability transitions may fail. This is done through a historical case study of the Swedish bubble in ethanol cars. Ethanol cars gained traction in the early 2000s and peaked in 2008. By 2010, the bubble burst as car engines broke down and there was a public outcry among consumers.

As policymakers and key interest groups tend to be well integrated into established technological and economic paradigms, efforts to support technological niche experiments face the inherent risk of becoming extensions of current hegemony rather than contributing to its displacement and any real process of creative destruction.

Our case description shows that state support for transitions to sustainability face an inherent risk of being captivated by those actors who are better at political maneuvering rather than by the firms who develop the most promising technology. While previous research has argued that political support towards nascent industries is required, our findings suggest that such political support may instead strengthen incumbent interests. As policymakers and key interest groups tend to be well integrated into established technological and economic paradigms, efforts to support technological niche experiments may therefore become extensions of current hegemony rather than contributing to its upheaval.

The remainder of the paper is organized as follows. Next, we review some of the literature on

sustainability transitions and the role of innovation policy. We thereafter present our method, which is followed by an empirical description of our data. Last, we discuss these findings and related them to existing literature.

2. Theoretical background

Policymakers and scholars are increasingly in agreement regarding the importance of combining economic growth with sustainable development. Historically, these two goals have primarily been accomplished by imposing taxes, subsidies, and complete bans on certain emissions. The interplay between technology development and regulation has resulted in considerable advances (Porter and van der Linde, 1995).

The perceived urgency of environmental issues has nevertheless implied that scholars call for more active state efforts towards sustainability. While such policy recommendations have been developed for several decades, they have become more formalized under the umbrella term “Innovation policy 3.0”.

Innovation policy 3.0 marks a shift away from ideas of technology neutral policies and towards a more active state. The first generation stems from Vannevar Bush’s *Science The Endless Frontier* (1945), a classic call for government investments in basic science that would subsequently spill over resulting in technological progress and economic growth. The next generation is usually referred to as the chain linked model (Kline and Rosenberg, 1986), it posits that innovation policy also needs to facilitate some of this diffusion of knowledge, e.g. by creating science parks, incubators and improve the general conditions for new technology based firms. Below, we describe and situate innovation policy 3.0 in a broader theoretical context related to technological transitions and system failure.

2.1 Technological Transitions and system failure

Innovation policy 3.0 can be situated and understood in relation to the growing body of literature on Technological Transitions (TT’s). This stream of research has for several decades looked into the role of policy in accomplishing industrial renewal. Inspired by e.g. institutional theory, technology studies (Latour, 1991) and evolutionary economics (Nelson and Winter, 2004), Geels (2004) developed a multi-level perspective making a distinction between three different levels. According to Geels, experimentation takes place in technological niches, a niche can be defined as spaces sheltered from commercial competition and market forces. University research environments, corporate R&D and industrial research institutes are examples of such environments.

The *Socio-technical Regime* (ST) is the setting in which established industries, technologies and institutions are stable. The ST is therefore a form of meso level, usually characterized by stability, but also resistance to change.

The *Landscape* Level is the third level and contains macro trends and the broader external environment that is beyond the direct control of actors within the ST.

A key message in the TT literature is the conflict between experiments taking place within niches and the interests and agendas of the established actors in the ST. With access to superior relational and financial resources, incumbent firms are frequently able to block and prevent initiatives in the ST from taking place. The ST is usually subject to path dependence and technological lock-in as uncertainty is high (Dosi, 1982). Collective action problems may occur in the sense that no individual actor has enough incentives to adopt radically new innovations. Moreover, literature on political economy frequently tells a story about regulatory capture, i.e. how established actors are able to captivate the policymaking process in order to prevent renewal from taking place (Rotmans et al., 2001). Therefore, policymaking tends to result in “more evolution than revolution” (Rotmans et al., 2001) as a political process ends up being captivated by vested interest groups.

As a consequence of path dependence, technological lock-in, regulatory capture and collective action problems, scholars increasingly talk about not only market failure in its conventional sense (Arrow, 1962), but also of *system failure*, meaning that entire technological systems may fail to accomplish desired levels of renewal and change. The resulting outcome would then be an absence of desirable economic and environmental development. Similar arguments have been made throughout various strands of the innovation systems literature, e.g. national innovation systems (Freeman, 1987; Lundvall, 1992), sectoral innovation systems (Breschi and Malerba, 1997; Malerba, 2004), technological innovation systems (Carlsson and Stankiewicz, 1991) and regional innovation systems (Cooke, 2001).

2.2 Innovation Policy 3.0

What is the role of policy in addressing the dilemma of system failure? While some scholars have pointed at the general importance of creating sound conditions for private entrepreneurship (Eriksson et al., 2020) and specifically institutional entrepreneurs (Eriksson and Nykvist, 2022), prevailing policy recommendations derived in literature on innovation systems and technological systems have emphasized the importance of creating technological niches and nursing markets (Jacobsson and Bergek, 2004). In doing so, scholars have argued that technology neutrality is not ideal as implementing them is “an elusive quest” that is not even to be preferred (Azar and Sandén, 2011, p.135) and that

“the policies required to bring these more advanced technologies to the shelf are more complex and include increased public research and development, demonstration, niche market creation, support for networks within the new industries, standard settings and infrastructure policies (e.g., when it comes to hydrogen distribution) (Sandén and Azar, 2005, p. 1566).

The third generation marks a step towards more government involvement as the idea is that innovation policy should be instrumental in addressing grand challenges (Schot and Steinmueller, 2018) and transition entire sectors of the economy out of the system failure scenario identified by Geels (2004) and other colleagues.

These ideas have been popularized by scholars such as Mariana Mazzucato who have advocated that the state take on a more active role in advancing societal goals such as sustainability (Mazzucato 2021). The following quotes from Mazzucato's writings are used to illustrate the expanded role of governments in innovation:

Governments play a critical role in catalysing and coordinating both public and private investment around common goals, not least transitioning to a green economy (Mazzucato, 2022, p. 93)

Key here is to use the full range of levers available to governments — from supply-side interventions, with the state acting as an investor of first resort (rather than lender of last resort) and as a funder and regulator with clear direction, to demand-side interventions, with the use of dynamic procurement policy to incentivize innovative solutions in domains ranging from public transport to housing (Mazzucato, 2022, p. 93).

“The case for radical change is thus overwhelming. But to drive this change, we have to see the problem through a particular lens – concentrating on rethinking government in order to stimulate improvements across the economy. Why? The reason is simple: only government has the capacity to steer the transformation of the scale needed – to recast the way in which economic organizations are governed, how their relationships are structured and how economic actors and civil society relate to each other.” (Mazzucato, 2021, p. 23)

2.3 Failure in Innovation policy research

While Jacobsson and Bergek (2004) acknowledge that “policymaking is a political process”, initiatives aimed at nursing technological niches are rarely questioned, neither in academia nor by policymakers. Broadly speaking, there is a lack of studies on failed innovation policy (Kärnä et al., 2022) and the trend towards Innovation Policy 3.0 and increased directionality has so far not been paralleled by a discussion regarding the boundary conditions of such policies.

There is a general lack of attention directed towards the study of failure within academic research on innovation policy. In a literature review spanning 7161 papers published 2010-2019 in major innovation journals such as *Research Policy*, *Technological Forecasting and Social Change*, *Industrial and Corporate Change*, *Technovation*, *Journal of Technology Transfer*, *Economics of Innovation & New Technology* and *EI&ST*, Kärnä et al. (2022) show that policy failure is scarcely talked about in the literature on innovation policy.

Kärnä et al. (2022) review these 7161 articles and search for the occurrence and frequency of terms that are associated with various aspects of policy failure, including Rent-seeking, Pork barrel, Median voter, Special interest groups, Regulatory capture, Lobbying, Budget maximizing, Political failure and Political Economy. Only 11 percent of the studied papers contained any mention of the terms related to failure and out of these 11 percent, less than fifty percent did so at any length beyond merely mentioning a term like e.g. rent seeking.

2.4 Synthesis: the role of policy in technological transitions

Summing up the above, we observe on the one hand that academic research has become increasingly optimistic regarding the possibilities for policymakers to intervene in the market economy and tilt it towards outcomes that are socially and environmentally desirable. On the other hand, echoing the results of Kärnä et al. (2022), little academic effort has been devoted studying how and why more interventionist innovation policies may fail.

In this paper, we are therefore specifically interested in how policies aimed to support technological niches may fail to result in industrial renewal. We therefore set out to answer the following research question:

What are the mechanisms behind failed transformative innovation policy?

3. Method

In order to study failed transformative innovation policy, it was necessary to identify a historical case where it is clear that policies did not end up as expected. Moreover, a fairly recent example would be more suitable as policy lessons are probably more applicable if this is the case.

The Swedish ethanol bubble constitutes an interesting case where these criteria are fulfilled. It began in the early 2000s, burst in 2008-2010 and we have not witnessed any recovery since then. To the contrary, out of the two (major) competing alternatives to combustion engines – ethanol and electricity – electric vehicles have gained momentum in the past decade and few people regard ethanol cars as a viable alternative today (see figure 2). By market share, it is also clear that ethanol cars have declined and that electric vehicles have gained the upper hand. Our results also show that the ethanol bubble was a product of innovation policies and support structures, and that it failed in both economic and environmental regards.

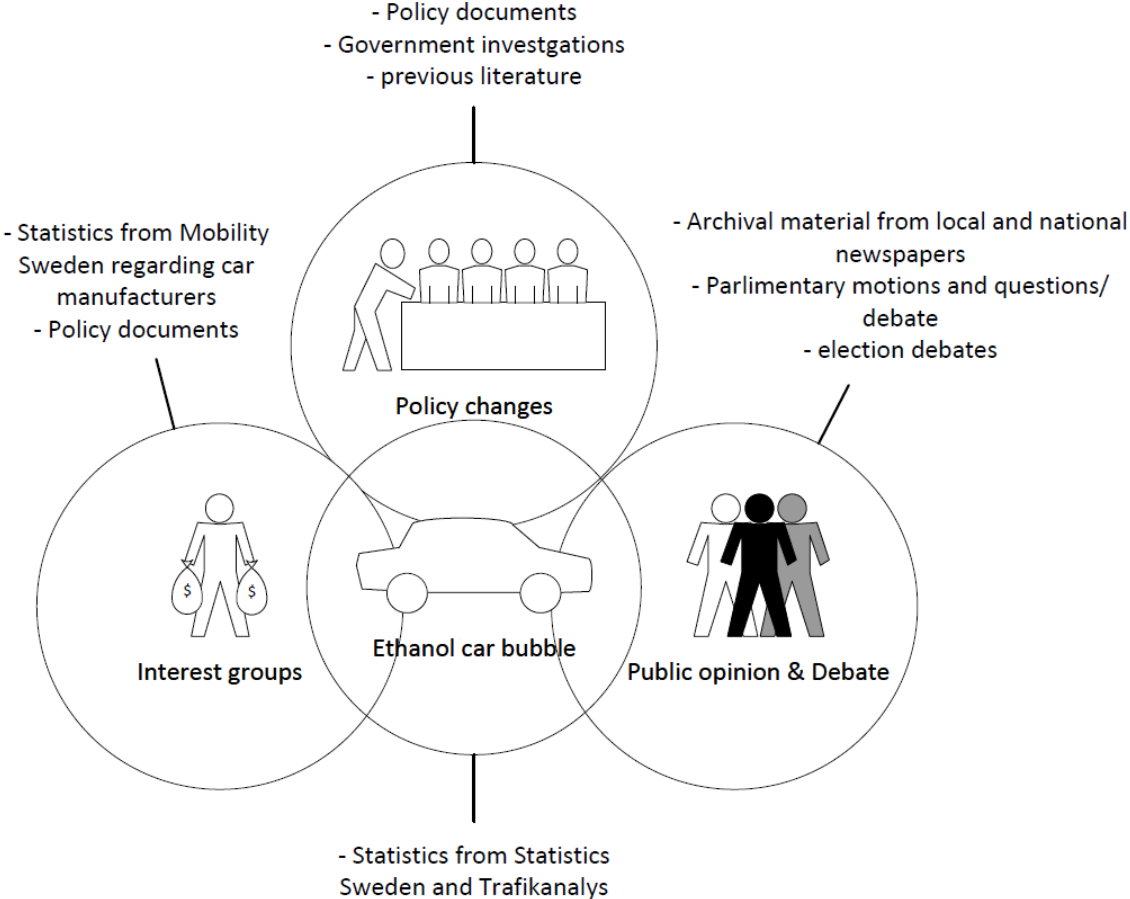
3.1 Data collection and analysis

Having chosen the Swedish ethanol bubble as our case, we initially gathered secondary data from multiple sources. We first identified and reviewed secondary literature in the form of newspaper articles, reports from government agencies and parliament, the Swedish revenue service and limited number of academic articles of relevance. These provided a baseline and helped us to identify key policy decisions and documents. Based on insights from these documents, we visualized the policy process by constructing an initial timeline of events.

Second, the timeline was complemented by statistical data from Statistics Sweden, Trafikanalys and Mobility Sweden, concerning market share, number of cars sold, new registrations and amount of vehicles being in operation. This data was used to descriptively illustrate the scale and scope of the ethanol car bubble. We used these descriptive statistics in tandem with the data from the initial timeline and other parliamentary documents to identify influential interest groups and their connection to the policy process.

Finally, we gathered data that reflected public opinion and public debate (as expressed in newspapers and by politicians), at the time. By utilizing an online archive (Mediearkivet) with multiple digitized newspapers, we were able to collect an illustrative sample of both national and local newspapers. In addition, we also reviewed parliamentary motions and questions as well as election debates. Our method allows us to cover three different dimensions in regard to our case as illustrated in Figure 1 below.

Figure 1: Dimensions of the Swedish ethanol car bubble and our related sources



As the figure shows, we can more holistically analyze the ethanol car bubble by highlighting three different dimensions using a variety of sources. This adds empirical and analytical depth to our case since we discuss not only the policy process in isolation but instead the confluence of these three dimensions which together created the ethanol car bubble.

3.2 Limitations

During this time, a bubble in domestic ethanol production also grew in Sweden, while ethanol cars and ethanol production are clearly interrelated processes, we have chosen to treat them as separate here and instead devote a unique paper to the Swedish ethanol production bubble. Hence, this paper is only concerned with the emergence, growth and rapid decline of ethanol cars 2003-2013.

4. Empirical part: the Swedish ethanol car bubble

While at times being subject to more popularity, ethanol has always been reliant on state support and hasn't taken off on its own (Eklöf et al 2012). The state's support of ethanol in Sweden has varied over time, most often gaining traction as a potential replacement for oil. As Eklöf et al (2012) highlights, decisions and arguments related to fuel independence were repurposed into a "green-identity" (p. 632), leading to the "greening" of ethanol in the Swedish public discourse. This, combined with ethanol lobbying organizations and networks (like Foundation for Swedish Ethanol Development (SSEU)¹ for instance) that were formed in the 1980s as well as long standing political allies in the Center party provided the necessary support for the Swedish ethanol bubble.

4.1 Historical and political background

While ethanol has been seen as a fuel of the future, it has always been reliant on state support and hasn't taken off on its own (Eklöf et al 2012). Despite this historical lack of competitiveness, ethanol cars gained traction in the early 2000s and peaked in 2008. By 2010, the bubble burst as car engines broke down and there was widespread discontent among the general public. Having been praised as part of a green transition, ethanol is not any longer part of the Swedish car market in any significant way.

Figure 2 below shows the number of ethanol cars in traffic in Sweden and Figure 3 shows the number of sold ethanol cars per year. Table 1 highlights the growth rate on an annual basis, from 2006 to 2007 sales of ethanol cars increased 36 percent and grew even faster the following year at a rate of 66 percent. Decline in the following years was equally steep, -32 percent 2008-2009, -11 percent 2009-2010, -57 percent 2010-2011, -61 percent 2011-2012 etc. The overarching objective of this paper is two describe and explain this rapid growth and subsequent decline.

¹ Later renamed BioAlcohol Fuel Foundation (BAFF)

Figure 2: number of ethanol cars in traffic in Sweden 1996-2019

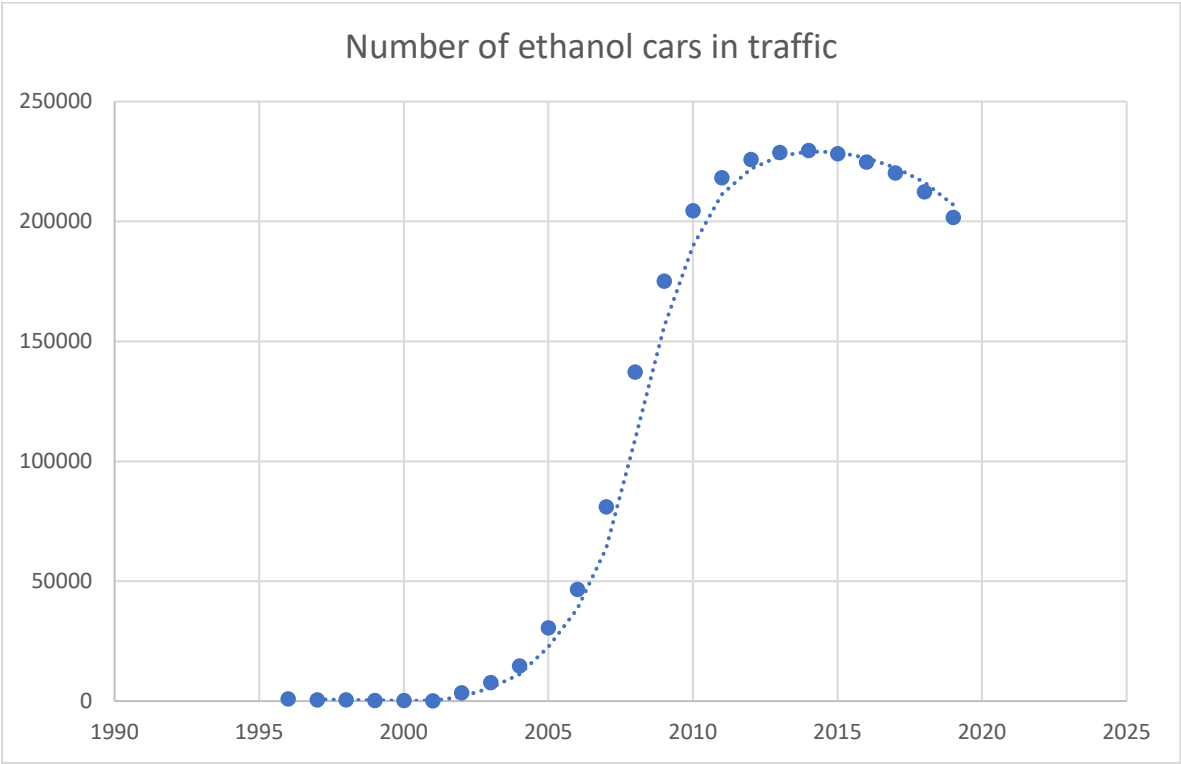
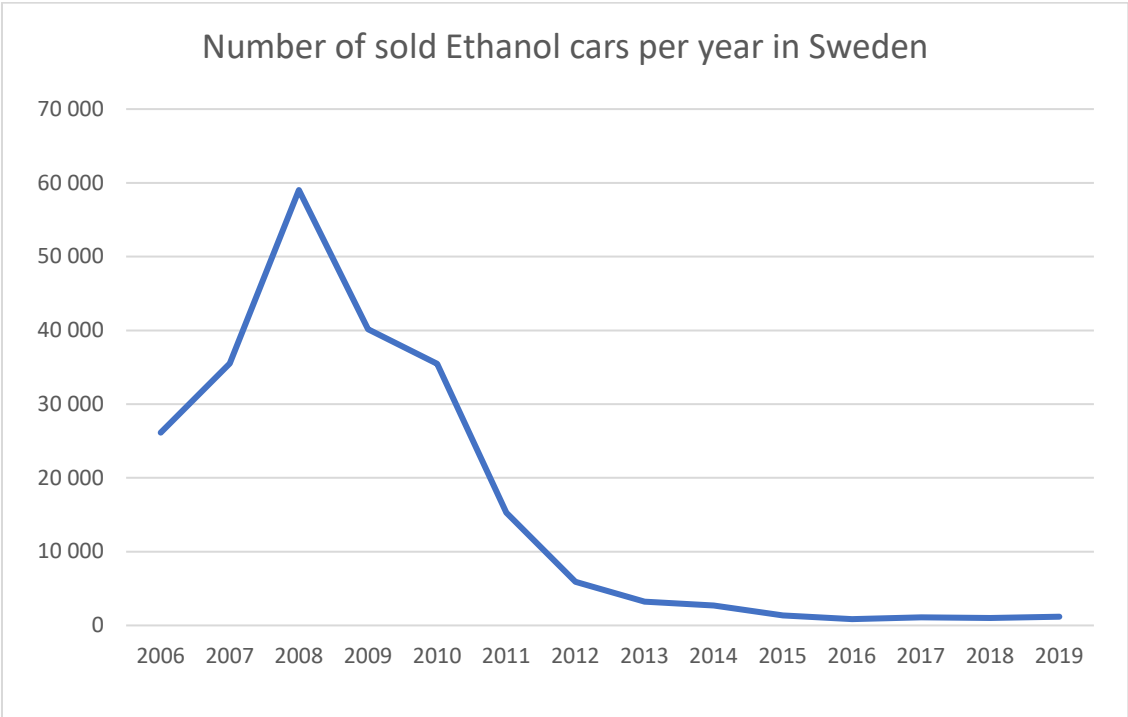


Figure 3: number of sold ethanol cars per year in Sweden 2006-2019



Year	Growth rate (%)
2007	36
2008	66
2009	-32
2010	-11
2011	-57
2012	-61
2013	-45
2014	-17
2015	-49
2016	-37

Table 1, growth rate of newly registered ethanol cars 2007-2016

In the 1990s, the Center Party was joined by the Social Democrats in supporting ethanol as Göran Persson, the prime minister at the time, declared a vision of the “Green People’s Home”² where biofuel production constituted an important part (Eklöf et al 2012). With this change in political conditions ethanol now enjoyed bipartisan support. This support enabled

² “Folkhem” is a Swedish vision of society dating back to the Social democratic Prime minister Per Albin Hansson, 1928-1945.

investments in domestic biofuel production and several reforms to incentivize the purchase and use of ethanol cars.

Over the years, ethanol received extensive support from the Centre Party. In fact, every party leader since Torbjörn Fälldin (in the early 1980s) have written motions in Swedish parliament arguing in favor of subsidies and various forms of support for ethanol (M 1982/83: 1101, M 1984/85:558, M 1985/86:Sk572, M 1989/90:Sk685, M 1991/92:Sk19, M 2004/05: MJ370, M 2018/19:2610). Table 2 below illustrates 7 parliamentary proposals, put forth by 6 different leaders of the Center Party, all promoting ethanol.

Parliamentary proposals	Quote	Persons	Reference
Motion 1982/83: 1101	” [...] that the Riksdag decides that ethanol and methanol based on domestic renewable raw materials must be tax-free” ³	Thorbjörn Fälldin, Karin Söder, Olof Johansson, Rune Gustavsson, Nils G. Åsling, Arne Fransson, Kjell A. Mattsson, Claes Elmstedt, Tage Sundkvist, Britta Hammarbacken, Karl Boo, Gunilla André, Anders Dahlgren, Gunnel Jonäng	Motion 1982/83: 1101 Thorbjörn Fälldin m. n. Beskattningen av etanol och metanol, p. 17
Motion 1984/85:558	"[...] request that the government - in consultation with The concerned in the market - takes the necessary initiatives to introduce Swedish ethanol as fuel [...]" ⁴	Thorbjörn Fälldin, Olof Johansson, Anders Dahlgren, Nils G. Åsling, Gunilla André, Karin Söder, Karl Boo, Gunnel Jonäng, Gunnar Björk, Rune Gustavsson, Tage Sundkvist, Arne Fransson, Bertil Fiskesjö, Bertil Jonasson, Einar Larsson, Kjell A. Mattsson, Britta Hammarbacken	Motion 1984/85: 558 Thorbjörn Fälldin m. n. Åtgärder för att introducera svensk etanol som drivmedel, p.18
Motion 1985/86:Sk572	[...] that the Riksdag decides that a tax exemption on domestically produced ethanol must be introduced.” ⁵	Karin Söder, Anders Dahlgren, Nils G. Åsling, Kjell A. Mattsson, Gunilla André, Karl Erik Olsson, Gunnar Björk, Olof Johansson, Gunnel Jonäng, Bertil Fiskesjö, P.-O. Eriksson, Britta Hammarbacken	Motion till riksdagen 1985/86:Sk572 Karin Söder m. fl. (c) skattefrihet på etanol, m. m. , p. 15
Motion 1989/90:Sk685	“that the Riksdag, as its opinion, informs the government of what is stated in the motion regarding tax exemptions for ethanol, methanol, biogas and other biofuels [...]" ⁶	Olof Johansson, Karl Erik Olsson, Bertil Fiskesjö, Gunnar Björk, Pär Granstedt, Karin Israelsson, Per-Ola Eriksson, Görel Thurdin, Karin Söder, Gunilla André, Börje Hörnlund, Agne Hansson, Larz Johansson	Motion till riksdagen 1989/90:Sk685 av Olof Johansson m. fl. (c) skattefrihet för etanol, m.m. , p. 1

³ "[...] att riksdagen beslutar att etanol och metanol baserade på inhemska förnybara råvaror skall vara skattefria"

⁴ "[...] begära att regeringen - i samråd med berörda på marknaden - tar erforderliga initiativ för att introducera svensk etanol som drivmedel [...]"

⁵ "[...] att riksdagen beslutar att skattefrihet på inhemskt producerad etanol skall införas."

⁶ "att riksdagen som sin mening ger regeringen till känna vad i motionen anförts om skattebefrielse på etanol, metanol, biogas och andra biobränslen [...]"

Motion 1991/92:Sk19	" Ethanol is an important alternative. From an environmental point of view, a more extensive use of ethanol as a fuel clearly justified." ⁷	Lennart Daléus, Elving Andersson	med anledning av prop. 1991/92:67 Skatten på etanol, m.m. Motion 1991/92:Sk19 av Lennart Daléus och Elving Andersson (c)
Motion 2004/05:MJ370	"The Riksdag announces to the government as its opinion what is stated in the motion that a revision of the customs regulations is required, so that our domestic ethanol production is not disadvantaged" ⁸	Maud Olofsson, Åsa Torstensson, Kenneth Johansson, Sofia Larsen, Roger Tiefensee, Margareta Andersson, Eskil Erlandsson	Fordonsbränsle Motion 2004/05:MJ370 av Maud Olofsson m.fl. (c)
Motion 2018/19:2610	"The government's proposal also does not give any advantage to cars that can run on ethanol, the most commercialized biofuel we have in the country." ⁹	Annie Lööf, Anders W Jonsson, Emil Källström, Alireza Akhondi, Daniel Bäckström, Jonny Cato Hansson, Fredrik Christensson, Magnus Ek, Eskil Erlandsson, Johan Hedin, Ulrika Heie, Peter Helander, Martina Johansson, Ola Johansson, Johanna Jönsson, Mikael Larsson, Helena Lindahl, Per Lodenius, Kerstin Lundgren, Sofia Nilsson, Rickard Nordin, Niels Paarup-Petersen, Annika Qarlsson, Lars Thomsson, Helena Vilhelmsson, Linda Ylivainio, Kristina Yngwe, Solveig Zander, Martin Ådahl, Anders Åkesson, Per Åsling	Motion till riksdagen 2018/19:2610 av Annie Lööf m.fl. (C) Centerpartiets budgetmotion 2019, p. 111

⁷ " Etanolen är ett viktigt alternativ.

Från miljösynpunkt är en mer omfattande användning av etanol som drivmedel klart motiverad."

⁸ "Riksdagen tillkännager för regeringen som sin mening vad i motionen anförs om att det krävs en översyn av tullbestämmelserna, så att inte vår inhemska etanolproduktion missgynnas"

⁹ "Regeringens förslag ger heller inte någon fördel till bilar som kan köras på etanol, det mest kommersialiserade biodrivmedlet vi har i landet."

Starting in the 1980s, ethanol had been lobbied to be used in buses. In the 2000s, focus shifted towards incentivizing consumers to purchase ethanol cars. Subsequently there was a massive surge in sales. With time however, consumers had to foot the bill when these cars ran into engine trouble. This, along with other factors such as altered political support, resulted in a lack of confidence in these cars and subsequently a rapid decline in sales to the point where today ethanol cars are not a substantive part of the Swedish car market.

4.2 The rise of ethanol cars in Sweden

In the following sub-sections, the Swedish ethanol bubble is described in further detail. Table 3 on the next page provides a summary of the main political measures that were taken.

The bubble had its origins in a directive from the EU (2003/30/EG) that set up guidelines for goals to increase the use of biofuels to a certain point for the year 2005 and a higher point for 2010. The Swedish government levied a state investigation into how these goals can be achieved. The investigation was published in two parts, one (SOU 2004:4) pertaining mainly to how a 2005 goal could be reached and what a law that mandated gas stations over a certain size to provide pumps with renewable fuels¹⁰ would look like. The other part focused on other ways to reach the 2010 goal as well as the design of “green certificates” for fuel (SOU 2004:133).

SOU 2004:4 finds that ethanol is the only real alternative to be able to reach the 2005 goal and that approximately 150 000–300 000 cars that use ethanol will need to be sold. Notably, it also states that the proposed law, while being technology-neutral on paper, would in practice lead to ethanol being almost exclusively used over other biofuels. The EU-directive and the subsequent government investigation marked the starting point of the ethanol bubble. The various laws and regulations imposed in the coming years (see table 3 below) are in many ways a product of the EU-directive and Sweden’s attempt to comply with it.

¹⁰ The definition used in the actual law is problematic for a variety of reasons that will be explained below.

Year	Action
1995-	Ethanol Tax relief (For production)
2000-2012	Benefits for Environmentally friendly occupational cars (Electric, Electric hybrids, Ethanol and gas)
2006-	Carbon dioxide differentiated vehicle tax (special rate for diesel cars with filter)
2006-	Pump law (Mandated renewable fuels pumps in stations)
2007-2009	Green Car Rebate (10 000 kr for buying a green car)
2007-	Congestion Tax relief (for green cars except 120 CO ₂ /km gasoline cars)
2009-2018	Vehicle Tax relief (Included many 120 CO ₂ /km diesel cars)
2012-	Benefits for Environmentally friendly occupational cars (Electric and gas)
2012-2018	Super-Green Car rebate
2018-2022	Bonus Malus

Table 3: a summary of the main actions taken by policymakers to support various alternative fuels and related cars.

4.2.1 The “Pump Law”

Taking effect in 2006 the “Pump Law ” as it would later become known to the general public is a law that mandated gas stations over a certain size to provide pumps with “renewable” fuels. Notably, the law contains an exception that specifically excludes green electricity from counting as a “renewable fuel” that gas stations could otherwise have provided in order to be compliant with the “Pump Law”. Thus, the law specifically refers to biofuels when talking about renewable fuels, not electricity.

The outline of the legislation was drafted in the first part of the government investigation (SOU 2004:4) as previously mentioned. The version presented in the investigation did not exclude electricity and interestingly, the bill proposed was heavily criticized by the people behind it. Among other things they warned that the bill would in practice favor ethanol cars despite being “technology neutral” on paper.

As a result the investigation’s proposal for a law that mandated renewable fuels in gas stations did not directly lead to a proposal in parliament. Instead, the center-left government tried other avenues, reaching out to the fuel industry to attempt to make them self-regulate and increase the use of biofuels on their own. These talks had the threat of legislation still looming

over the negotiations. Eventually negotiations broke down and the government revisited the legislation route, drafting a bill that was sent out for referral to key stakeholders.

During these discussions, the draft bill did not contain the previously mentioned exception of green electricity. It was now brought to the government's attention by special interest groups representing competitors to green electricity¹¹ that the current bill would include green electricity as a renewable fuel.

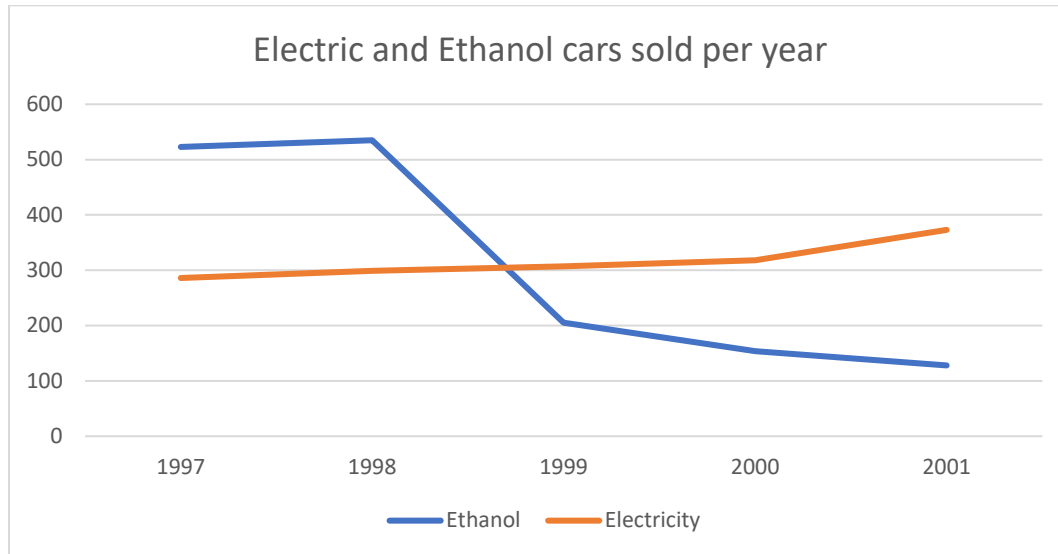
The government therefore created an exception to the version of the bill that was brought before parliament and later voted for after being heavily criticized in the traffic committee. The main concern raised was that the law wasn't going to be technology neutral and that it would hurt owners of gas stations. The Swedish legal council also criticized the bill for lacking analysis of its consequences. Seemingly absent from the criticism was the added exclusion of green electricity. This decision to add the exception was motivated in part with the idea that including green electricity would defeat the purpose of the bill as gas station owners would just add a couple of charging stations or power outlets and thereby comply without making much efforts. The market for electric cars was referred to as "negligible" at this point in time so the exclusion of electricity from the Pump law was not deemed to be a major problem.

Arguably this was somewhat accurate at the time as the market for alternative fuels for cars was clearly still in its infancy. It should also be mentioned that this exception of "green electricity" still exists today despite that the electric car market has grown in significance over the past two decades.

As can be seen in Figure 4 below, both electric cars and ethanol cars were in fact negligible in the late 1990s and early 2000s. Interestingly, the graph also shows that it was far from evident in these years that ethanol would gain the upper hand. To the contrary, it is clear that both technologies were still in their infancy and still evolving.

¹¹ These were the actors mentioned: The Swedish Petroleum Institute(Svenska Petroleuminstitutet), The Consumer Agency(Konsumentverket),The National Federation of Motor men (Motormännens riksförbund), Swedish Gasoline trade (Svensk Bensinhandel) and (Swedish) Swedish Association of Gases (Svenska Gasföreningen)

Figure 4: sales of electric cars and ethanol cars in Sweden 1997-2001.



As mentioned above, the “Pump Law ” came to disproportionately benefit ethanol over other alternative fuels despite supposedly being technology neutral. The law had other unsavory effects as some individual gas station owners struggled economically after having invested in new and expensive biofuel pumps. Investigations into this matter have not been able to conclude that the Pump Law resulted in closures of gas stations though it is clear that they incurred considerable costs.

Another problem with the law was uneven access as the availability of Ethanol varied greatly across the country. In conclusion the law either implicitly or explicitly benefited ethanol at the expense of other alternative fuels.

4.2.3 The Green Car Rebate

In 2006 a new center-right government was elected in Sweden replacing the previous center-left one. One of the new government's priorities was to pass a rebate that would incentivize people to buy new environmentally friendly cars. This rebate contributed to the further expansion of the ethanol bubble. An in-depth look at the effects of the reform was provided in Huse and Lucinda (2014). The green car rebate consisted of 10 000 Swedish kronor and was directed towards individuals who bought a new green car.

The rebate started to be actively used in April 2007, meaning that it was not synchronized with the car manufacturer's production cycle as an adjustment to production could not be made until 2008 (Huse and Lucinda (2014)). The definition of a “green car” under the rebate looked at what fuel the car ran on and how much CO₂ the car released. In fact, the Swedish green car rebate was quite unique in its focus on alternative fuels, the need to get the Green Party's support for the reform has been identified as the main reason for this (Huse and Lucinda 2014). However, under the definition of a green car at the time cars that ran on fossil fuels could be counted as “green” if they released less than 120g of Co₂/Km. Notably, cars

that ran on alternative fuels like ethanol were allowed to release 220g Co₂/Km (Huse and Lucinda 2014).

The most common type of green car was flexi fuel cars that ran on both ethanol and gasoline. These cars could run exclusively on gasoline if the price of ethanol was higher than the price of gas. While the green car rebate would over a lifetime lower emissions with approximately 493 200 ton CO₂ (Huse and Lucinda 2014) the cost for this would per ton CO₂ depend on how often consumers switched between ethanol and gasoline.

In practice, the green car rebate functioned as a subsidy for ethanol cars. Both the number of ethanol cars and their relative market share increased when the rebate was introduced. There was also a drop off in market share when the rebate ended. Huse and Lucinda (2014) state that the rebate was unnecessary as the lower operating costs should have been enough to stimulate demand. Regardless, the green car rebate was another reform that helped to convince the public to buy ethanol cars, contributing to the continued expansion of the ethanol bubble.

4.2.4 Freedom from Congestion taxes

The Stockholm congestion tax, instituted as a trial in 2006 and then implemented permanently in 2007, refers to time-relative tolls that were levied against drivers that travel across the city during high traffic volume hours. The main purpose of the congestion tax is reflected in the name: to reduce congestion. Other indirect effects may include positive effect on the climate due to lowered emissions (SOU 2013:84).

In line with this thinking, “green cars” were granted an exception from the congestion tax. Hultkrantz and Liu (2012) have analysed how this exception affected the overall effectiveness of the congestion tax by simulating the effects of such minor modifications of the congestion tax. They found that adding exceptions for green cars greatly reduced the overall effectiveness of the tax. As a result, the main purpose of the tax was undermined as this exception acted as another incentive for consumers to purchase a green car.

At the time, the legal definition of a green car actually included low-emission gasoline cars yet these were not part of the exception from the congestion tax. This specifically steered consumers towards new alternative-fuel cars of which ethanol was the most popular. Thus, the reliefs from congestion tax also contributed, to the further growth of the ethanol bubble.

4.2.5 Additional Political support

Another aspect that helped to amplify the ethanol bubble was the political support ethanol gathered. As with any reform, convincing the public of its merits is essential. Ethanol enjoyed bipartisan support as both the center-left governments and center-right governments did their part with the aforementioned pump law, green car rebate and freedom from congestion taxes. There were some politicians that went further in their support for ethanol, highlighting it as a potential savior of the deindustrialized rural north in Sweden. Similar more successful

attempts at creating political coalitions between politicians and rural voters using ethanol have been made in countries like the US and Brazil.

Some Centre Party politicians like Maud Olofsson, the minister of industry and enterprise from 2006 and on stood out in her support for ethanol. Driving her ethanol-ford as early as 2001 and saying the following in a parliamentary debate from 2005:

“But within a few years it will be commercially viable to extract ethanol from cellulose, i.e from forest raw materials and waste from the forest industry. This will mean lower production prices and higher competitiveness for Swedish-produced ethanol (2005/06:N482, p.3)

Ethanol is also mentioned in the 2006 election as Swedish Prime Minister Göran Persson also expressed support for ethanol:

“...Therefore, we should not try to attract people with lower gas prices, but instead get something else to pour into the tank on which the cars can be driven” (Persson, Election debate, 2006)¹²

Göran Persson would also tour ethanol factories and inaugurate the municipally owned company Sekab which was supposed to do research on future generations of ethanol that used cellulose. The large-scale innovations in ethanol research that were promised did not come to fruition. There was political support for alternative fuels across the board but in practice ethanol would be the alternative fuel that benefited.

In figure 1 we can see the ethanol bubble clearly develop. With bipartisan political support, the “pump law”, the green car rebate and other reforms such as exemptions to congestion taxes for green cars, the bubble grew rapidly and reached its peak in 2008. This is then followed by a steep decline which will be described below.

¹² “... Därför ska vi inte locka folk med lägre bensinpriser utan vi ska få annat att hälla i tanken som bilarna kan drivas på

Headlines in regional newspapers	Date	Source
Environmentally friendly cars may get unfair advantage	2004-11-05	Helsingborgs Dagblad
Ethanol champion to win Örnsköldsvik citizen of the year award	2004-11-12	Örnsköldsviks Allehanda
Increased interest in ethanol cars	2004-12-28	Norra Västerbotten
Municipal council chairman inaugurated ethanol pump at Statoil gas station in Vara	2005-01-11	Hällekiskuriren
Premiere for ethanol pumping station - good alternative to gasoline	2005-05-17	Östran/Nyheterna
More ethanol cars on the Swedish market	2005-05-25	Upsala Nya Tidning
Billion dollar investment when a new ethanol factory is to be built	2006-04-21	Norrköpings Tidningar
Sekab wants to expand	2006-05-27	Örnsköldsviks Allehanda
Enviromental car bubble?	2006-07-13	Dalademokraten
Is there a risk for a enviromental car bubble?	2006-07-17	Hallands Nyheter
Ethanol production in Sweden is increasing greatly	2006-08-12	Metro
More booze for the cars	2006-08-12	Örnsköldsviks Allehanda
Bioethanol is more popular than biogas among car companies	2006-10-28	Norrköpings Tidningar
Ethanolpumps are popping up like mushrooms	2007-01-05	Gefle Dagblad
Biofuels- a dead end?	2007-10-25	Hallands Nyheter
Etahnol hysterial is a political blunder	2007-12-01	Nya Wermlands-Tidningen
The EU provides climate bonus for ethanol cars	2008-11-18	Motala & Vadstena Tidning
Electric cars more effective than ethanol cars	2009-05-08	Södermanlands Nyheter
Booze and cars don't mix	2010-01-21	Helagotland
Decreased interest in ethanol cars	2010-02-05	Norrköpings Tidningar
Gasoline in every other ethanol car	2010-05-27	Metro
Issues with ethanol cars "Feels like a big fraud"	2010-07-02	Norrköpings Tidningar
Ethanol car owners should avoid ethanol	2010-07-16	Smålandsposten

Table 4: a selection of headlines concerning ethanol in local newspapers

4.3 The Decline of ethanol

A collection of factors jointly contributed to the downfall of ethanol from 2008 and onwards. This decline is outlined in the coming sub-sections.

4.3.1 Mounting environmental concerns

While ethanol had never been a viable alternative to gasoline, the fuel became progressively more scrutinized from 2009 and onwards. Here, Sweden is also part of an international trend where environmental concerns regarding ethanol were gaining momentum. Research by David Pimentel at Cornell University showed that if all resource consumption is included, ethanol takes 29 percent more resources into use as input than the actual output. Put differently, making use of ethanol as a fuel is not sustainable as more energy is used to make it than is left to make use of (Pimentel, 2010).

Related concerns were also expressed at this point by Lister Brown of the Earth Policy Institute in the United States, who regarded US efforts to cease energy dependence by using corn and grain for fuel as a tragedy since it increases food shortages globally.

An important aspect of ethanol production concerns all the inputs required for growing the crops. Fertilizers require nitrogen, which emits 2 tons CO₂ per hectare. Put differently, already when growing the crops, ethanol would have a worse net CO₂ impact compared to other alternatives already at the point when crops are grown. Upon inclusion of costs for processing, logistics and distribution ethanol as a fuel becomes an obvious loser for the environment.

An expert group within the ministry of finance in Sweden published an investigation in 2010 which showed that CO₂ emissions would have been lowered by 20 million tons if the same transportation would instead have been done using gasoline. Sören Wibe, professor of forest economics, made some comments to the media about the report:

“Ethanol from agricultural products is the worst alternative as it results in both higher food prices, expansion of farmland in developing countries and CO₂ emissions.”

Wibe also ranked ethanol made from wheat and other grains in Europe as the least environmentally friendly option. In an interview with Dagens Nyheter, Wibe is asked why so few voices in academia had spoken out against the ethanol policies that had been put in place:

“Many individual scholars in Sweden are very critical of ethanol. The problem is that they are not heard in the public debate where ethanol has become synonymous with being environmentally friendly. Several government agencies are wholeheartedly and uncritically supporting ethanol. Several political parties and interest groups also seem to be stuck with the idea that ethanol is “the ethical alternative”. Research results pointing in an opposite direction are met with skepticism, silence and mistrust.”

While the quote from Wibe above indicates a consensus culture where it is difficult to express a dissenting opinion, a brief review of national news coverage on ethanol indicates that media became increasingly critical already from 2006 and onwards. Table 5 below contains some of the headings.

Headlines in national newspapers	Date	Source
More people choose green cars	2004-03-20	Dagens Nyheter
Go for ethanol as fuel	2004-09-28	Göteborgs-Posten
Volvo invests in ethanol	2004-11-09	Dagens Nyheter
Volvo's new green car runs on ethanol	2004-11-09	Ny teknik
Volvo invests in ethanol	2004-11-10	Dagens Nyheter
Ethanol cars can park for free in Östersund	2004-11-11	Sveriges Radio
New ethanol car launched in Örnsköldsvik	2004-11-23	Sveriges Radio
Here comes the alcohol car	2004-11-27	Sydsvenska Dagbladet
Ethanol fuel of the future	2004-11-27	Sydsvenskan
Volvo builds ethanol cars	2004-12-09	Aftonbladet
Volvo invests in ethanol	2004-12-09	SVT Västnytt
Ethanol cars new threat to health and environment	2005-11-24	Dagens Nyheter
Ethanol is a bubble	2006-03-24	Veckans Affärer
Ethanol is a gigantic mistake	2006-11-25	Dagens Industri
Ethanol is not sustainable	2007-01-27	Dagens Nyheter
Ethanol - fad or savior?	2007-02-07	SVT Nyheter
Ethanol cars lose in value	2007-11-20	Dagens Industri
Owners of ethanol cars are fooled	2008-01-25	Aftonbladet
We fool ourselves when filling up on ethanol	2008-02-03	Dagens Nyheter
Ethanol children work until they die	2008-04-13	Aftonbladet
Pollution from ethanol cars are dangerous	2008-04-20	SVT Nyheter
Ethanol - from savior to hangover	2008-06-14	Dagens Nyheter
Taxis that run on ethanol consume a lot of fuel	2010-02-06	Dagens Nyheter
The tide is changing for ethanol	2010-03-25	Aftonbladet
Owners of ethanol cars encouraged to use gasoline	2010-04-13	Sveriges Radio Ekot
Ethanol cars now run on gasoline	2010-05-27	Sydsvenskan
Industry admits problems with ethanol	2010-06-19	Dagens Nyheter
The fuel causes ethanol cars to collapse	2010-06-25	Dagens Nyheter
Ford encourages ethanol car owners to use gasoline	2010-07-17	Expressen
No one wants to pay for damaged ethanol cars	2010-07-22	SVT Nyheter
2000 car owners affected by ethanol problems	2010-06-24	Dagens Nyheter

Table 5: a selection of headlines concerning ethanol in national newspapers

4.2 Engine breakdowns and negative public opinion

During this time some ethanol contained high levels of sulfur which caused engines to clog and brake. While not necessarily the ethanol car's fault the people who owned these cars were outraged as they had to pay for reparations. Table 5 shows that media coverage of ethanol became increasingly concerned with this damage in 2010.

The negative reputation surrounding the fuel persists to this day in Sweden. According to a poll conducted by Ford when they were aiming to reintroduce ethanol cars in Sweden 1 in 4 swedes still harbor negative feelings towards ethanol and 54,8 % answered yes on either one of the statements: ethanol is damaging to the engine or that it is more expensive than gasoline.¹³ Despite attempts from the Green party to reintroduce ethanol cars¹⁴ swedes have remained hesitant as many remember the problems that occurred in 2008-2010.

4.3.2 Declining oil prices

To start with, by early 2009, oil prices decline sharply, the price of gasoline now dropped below the price of ethanol resulting in ethanol car owners refueling with gasoline. From an environmental standpoint this was bad news as flexi fuel vehicles that could run on both gasoline and ethanol were less efficient in terms of fuel consumption so when driven on gasoline exclusively they released more CO₂ than a normal gasoline car. This dented the car's "green" reputation as many people had bought the car with the idea that it was a more environmentally friendly alternative.

4.3.3 Changed financial incentives and diesel cars

As described previously, financial incentives to buy ethanol cars had contributed significantly to fueling demand. These incentives were now reverted. In 2012, the government decided to make other environmentally friendly cars tax deductible, but excluded ethanol cars from this new law.

When a tax was introduced in 2015 in order to be in line with EU-rules, whatever reminisce of support ethanol had put to an end. The tax was an attempt to prevent overcompensation of biofuels at the expense of other alternatives, something the Swedish Energy agency said probably didn't occur in 2015 rendering the tax unnecessary.

¹³ [En av fyra svenskar är negativa till E85 \(nyteknik.se\)](http://www.nyteknik.se)

¹⁴ <https://www.svt.se/nyheter/inrikes/miljopartiet-satsar-pa-etanol-vill-ge-bonus-till-de-som-bygger-om-bilen>

Figure 5: shows growth of various non-gasoline cars 2006-2022.

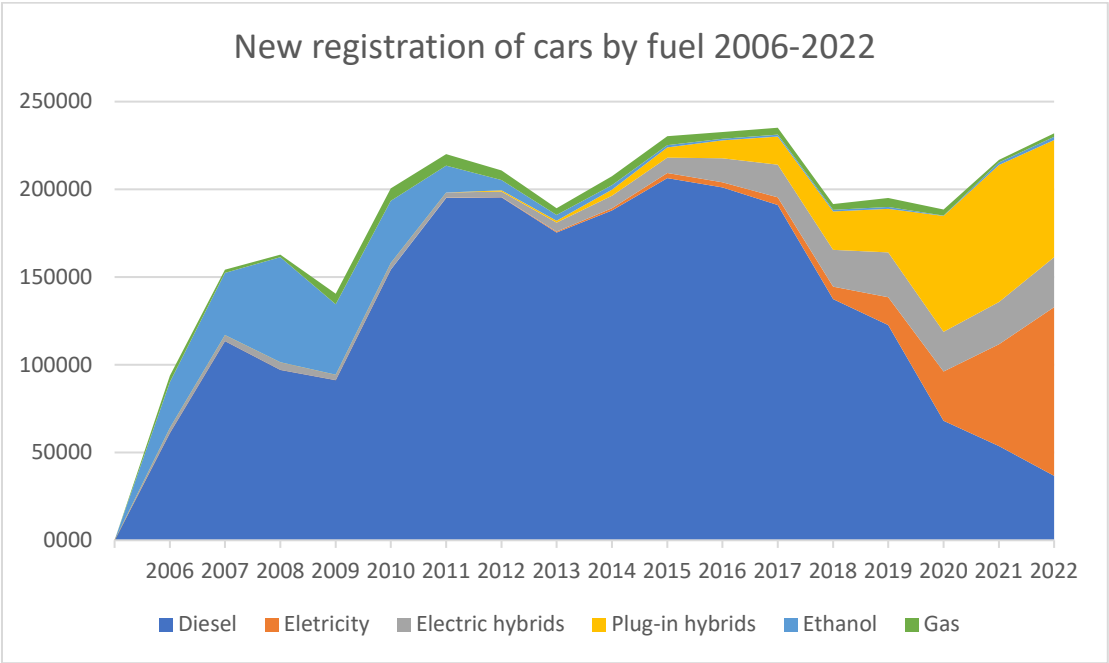
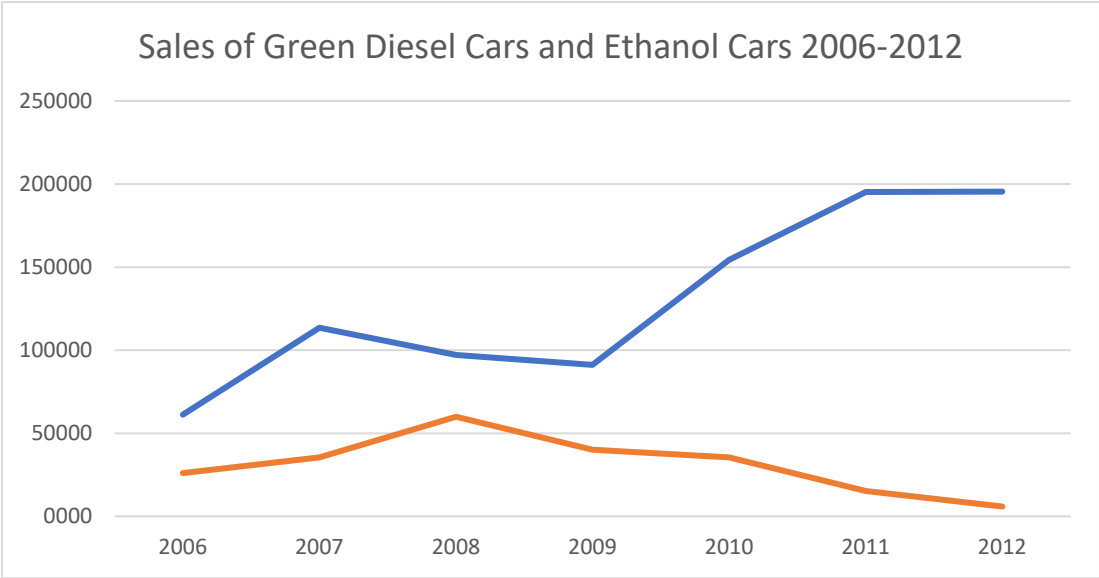


Figure 6: shows sales of green diesel cars and ethanol cars 2006-2012.



4.4 Effects of the Ethanol Bubble

Below, some of the effects of the ethanol car bubble are described.

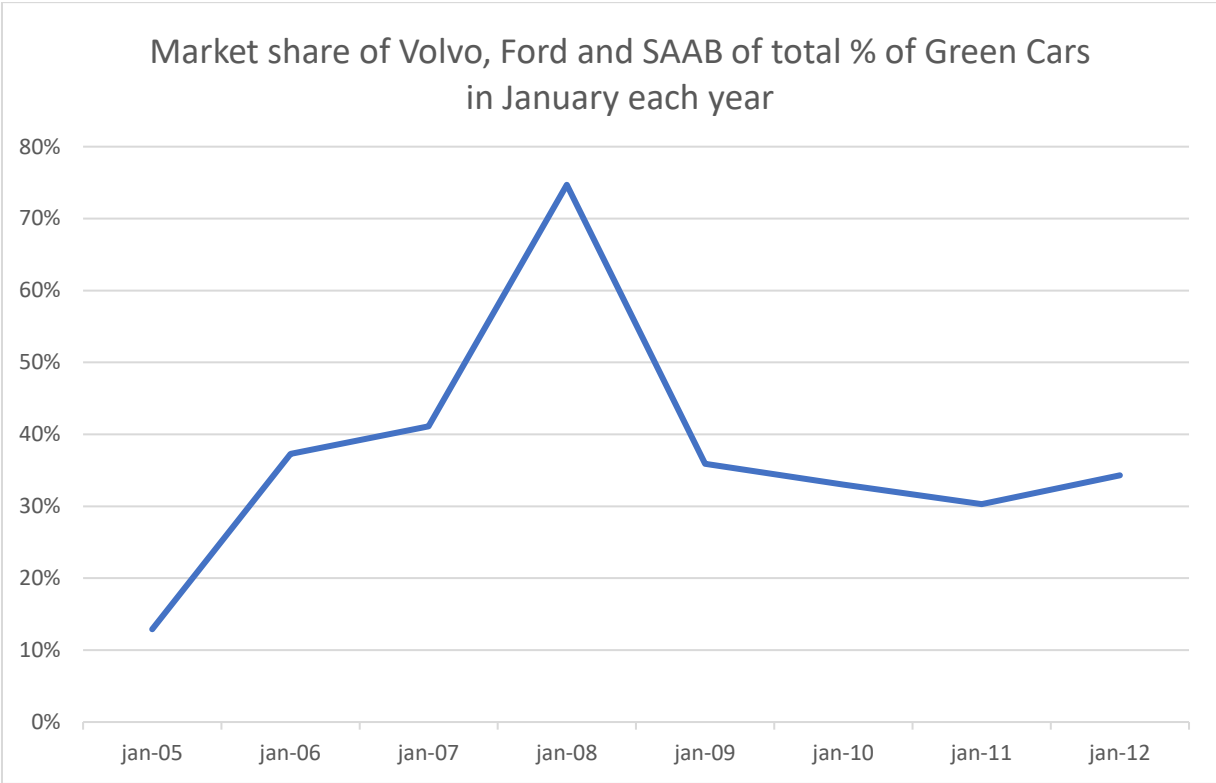
4.4.1 Car manufacturers

Statistics Sweden reports sales figures for all cars classified as alternative fuels. This segment of the market has been subject to considerable growth in the 2000s. When looking at the ethanol car bubble, it is clear that three car manufacturers benefited disproportionately from it: Volvo, Saab and Ford. As Volvo was owned by Ford in these years, they are in effect the same actor on the Swedish market.

As can be seen in Figure 6 below, Volvo, Saab and Ford jointly controlled slightly more than ten percent of the market for green cars in 2005. One year later, these three companies together made up almost 40 percent of all sales of “green cars” and at the height of the ethanol bubble in January 2008, they had grabbed 75 percent of the market for “green cars”. With the shift to low emission diesel cars also being included as environmental cars, competition increased in the coming years.

The data clearly shows that Saab, Volvo and Ford benefitted disproportionately from the ethanol policies put in place. As can be seen in table 5 above, press coverage in 2004 indicated that Volvo invested in the development of ethanol cars back in 2004. Were these firms anticipating the emergence of the Pump law as well as the tax exempts and various benefits targeted towards ethanol cars in the coming years? While it is hard to prove that they did so or that they proactively influenced the Pump law and policies to their favor, we can at least conclude that they benefitted extensively and that domestic car manufacturers gained the upper hand. It seems plausible that these firms were better in tune with shifts in policy than foreign car manufacturers would have been.

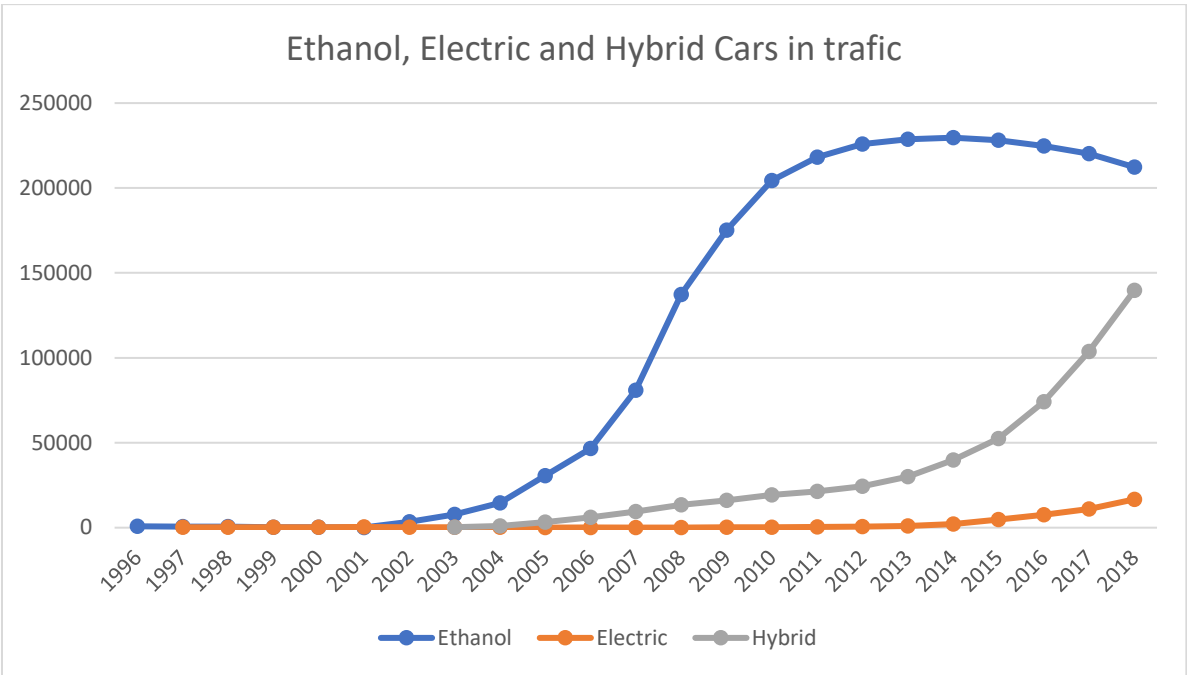
Figure 7: shows Volvo's, Ford's and SAAB's share of green cars 2005-2012.



4.4.2 Effects on technologies

As can be seen in figure 8 below as well as Figure 4 above, ethanol cars grew at the expense of other alternative fuels. Figure 4 showed that both ethanol cars and electric vehicles were in their infancy in the early 2000s. Support that was explicitly targeted towards ethanol seem to have postponed the emergence of electric vehicles. According to Tesla, Norway is five or six years ahead of Sweden when it comes to adoption of electric vehicles. The ethanol bubble seems to have been one factor that delayed the emergence of both low emission diesel cars and electric cars.

Figure 8: shows Volvo’s, Ford’s and SAAB’s share of green cars 2005-2012.



4.4.3 Effects on gas stations

The “Pump law” had a considerable impact on gas station availability. In the eight years from 2006 to 2014, the number of gas stations in Sweden declined from 3700 to 2700, a decrease of 27 percent, that had a disproportional effect on rural areas of the country. According to the interest group Svensk Bensinhandel, a couple of hundred gas stations were shut down immediately because of the pump law. In many other instances, the pump law had these effects in combination with other macro trends such as urbanization. According to Bertil Moldén, CEO at Bil Sweden, the inclusion of E85 at gas stations cost approximately one billion SEK (Svenska Dagbladet, 2014).

5. Discussion

The Swedish ethanol bubble presents an interesting opportunity to study how and why innovation policies may fail. As few other countries experienced a similar bubble in ethanol cars in this time period, the Swedish case may contain valuable insights.

5.1 A case of policy failure

As can be seen from the case description, ethanol did not turn out to be a viable alternative to fossil fuels. In this sense it is a failure as the government measures to support ethanol effectively lead the industry towards a dead end.

The technology was prematurely launched into the market which subsequently resulted in a backlash among consumers. Its environmental benefits were limited or non-existent and ethanol grew largely because generous, targeted support policies were put in place to favor ethanol. The Pump Law, tax deductions for green cars and several other measures were implemented in 2005-2008, resulting in the rapid growth of sold ethanol cars. Sales peaked in 2008 and declined sharply in the coming years.

The various policies put in place to support ethanol also had negative effects for the economy in a broader sense. Congestion taxes in the Stockholm area were stripped of their positive effects for the economy (Hultkrantz and Liu, 2012), gas stations were negatively affected and especially so in rural parts of the country and all efforts guided towards ethanol cars seem to have prevented the diffusion of electric cars.

5.2 Explaining the failure of innovation policy

How can we explain that the innovation policies and efforts towards transformative change turned out as a failure? Policymakers took many of the measures stipulated by innovation system scholars. They successfully identified a technological niche experiment and provided extensive supportive measures paving way for its diffusion into the Socio-Technical (ST) Regime (Geels, 2002).

While e.g. Jacobsson and Bergek (2004) acknowledge that policy-making is fundamentally a political process and many scholars in innovation studies draw upon both institutional theory, economics and sociology to argue that the ST Regime tends to have the upper hand and often tends to captivate established institutions and political processes, these domains of research fail to acknowledge that any political support to various technological niche experiments face the same risk of being captivated by resourceful interest groups.

Political attempts to support niche experiments may be intended at supporting institutional entrepreneurs and put in place with the intention of dismantling an established Socio-Technical regime, but upon implementation, these policies are pushed in different directions as they are influenced by various interest groups.

The case description above shows that political support directed towards a certain niche are indeed inherently political, and in hindsight, the economic and technological viability seems to have been secondary. As interest groups exert pressure on the political process we may end up with counter-productive support measures.

The Pump law was originally supposed to have been technology neutral. In reality it wasn't and as it in fact excluded the most attractive competing solution (electricity) it is clear that the pump law became an extended support for established vehicles rather than supporting future solutions. Historical documents concerning the design of the Pump Law show that several interest groups, including the Swedish Petroleum institute, were behind the decision to not include electricity into sustainable fuels. Hence, the ability of vested interests to capture the regulatory process implied that in reality, what was supposed to function as an incubation of new technologies, became an extension and entrenchment of existing solutions and firms. Ethanol cars were also referred to as flexifuel cars as they ran on both petrol and ethanol. In effect, ethanol cars therefore became an extension of existing automotive technology, albeit with a few modifications.

In conclusion, innovation policies aimed at supporting various novel technologies seem to have been justified by arguing that the established technology is entrenched and subjected to laws of path dependence, but suffered from the logical inconsistency of ignoring the risk that the supportive policies are also implemented under the influence of political and economic pressure.

As interventionist innovation policies often contain elements of grant applications, we would also expect such policies to end up supporting those firms that are good at applying for grants, i.e. subsidy entrepreneurs. Large firms are more able to mobilize resources to apply for grants and we therefore expect support policies to end up favoring today's incumbent firms and the ones that are well connected with policymakers. Again, broader reforms aimed to create better conditions for entrepreneurship are likely to be more productive (Eriksson et al., 2019).

7. Conclusion, limitations and future research

In this paper, we have uncovered some of the mechanisms behind the failure of innovation policies. Policy failure is a subject hitherto understudied by innovation scholars (Kärnä et al., 2022).

The article has described and explained the emergence, rapid growth and downfall of ethanol cars in Sweden. Support for ethanol was firmly rooted in the Centre Party for many decades, as the Social Democrats became progressively more in favor of ethanol considerable political support had been mobilized by the early 2000s. Directives from the EU Commission urged policymakers to take immediate action, the Pump law was put in place in 2006 and came to provide disproportional benefit to ethanol over other alternative fuels. Ethanol cars gained in popularity in the coming years and its adoption was further accelerated with other tax deductions. At its peak, ethanol cars amounted to more than 20 percent of all new cars sold in Sweden in 2008.

Demand decline rapidly in the coming years. Engines ran poorly on ethanol and broke down. New research concerning the negative environmental effects of ethanol was diffused from 2008 and onwards. As a consequence of these changes, tax deductions were altered to favor other alternative fuels at the expense of ethanol. In hindsight, it is clear that domestic car manufacturers Saab and Volvo benefited from ethanol policies, along with Ford, who owned Volvo in these years.

The Swedish ethanol bubble constitutes an illustrative example of how political connections and political capabilities determine the outcomes of policy support for innovation rather than technological and economic competitiveness. Having described the Swedish ethanol bubble, we conclude that support efforts directed towards technological niche experiments face the inherent risk of being captivated by interest groups. Choices regarding what technology to support and the design of these support structures do not take place in a vacuum. To the contrary, they are subject to influence from vested interests, both firms and political parties who are backed by various interest groups. Over the past 100 years, ethanol had always been associated interest groups within agriculture and the Centre Party which has historically represented farmers political interests.

We welcome further research on other aspects of ethanol policies in Sweden. This paper is largely based upon secondary data such as news media articles, aggregated statistics, official government documents and investigations. We would welcome further studies based upon interviews with policymakers but acknowledge the difficulty in obtaining access to former ministers who would candidly talk about a case of policy failure.

This paper has been explicitly concerned with ethanol cars. Related to ethanol cars, considerable efforts were also made in Sweden both to develop domestic ethanol production and to develop ethanol from cellulose (Sandström and Alm, 2022; Sandström and Björnemalm, 2022). Research focused on these aspects of ethanol in Sweden would make a

valuable contribution to deepened insight into the rapid rise and downfall of ethanol. We would also welcome more studies into the failure of innovation policies. To what extent the ongoing revival of interventionist industrial policies has been inspired by a stream of research that has scarcely been concerned with failure is also a question that merits further research.

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