UPPGIFTER:	
Projektnamn	Scrap and grab: Should Sweden introduce a vehicle scrappage subsidy?
Projektspecifikation till FoI-portfölj	Transportekonomiprogrammet (portfölj Planera)
Hänvisning till avsnitt i Trafikverkets FoI-plan	Transportekonomiprogrammet – riktad utlysning
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Trafikverkets ärendenummer	TRV202x/XXXX Fylls i av Trafikverket
Sökandens ärendenummer	
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Instruktioner:

- Ansökan skickas som pdf till trafikverket@trafikverket.se med hänvisning ”FOI-Riktad utlysning Transportekonomi” i ämnesraden.
- Samtliga avsnitt i projektspecifikationen ska fyllas i men kan anpassas utifrån projektets omfattning och avsnittets relevans. I de fall avsnittet inte är relevant ange ”ej relevant”.
- All gulmarkerad hjälptext tas bort innan ansökan skickas till Trafikverket.
- CV bifogas till ansökan.

Innehåll

1 Sammanfattning, bakgrund, syfte och mål

1.1 Sammanfattande projektbeskrivning

Svensk och europeisk politik som syftar till att minska transportrelaterade koldioxidutsläpp är inriktade på nya fordon, och uppmuntrar särskilt införandet av nya noll- och lågemissionsfordon. Dessa policyer, t.ex. bonus-malus, kan påverka värdet av begagnade fordon samt skrotningen, och dessa fordon kommer framgent att stå för en mycket större andel av transportrelaterade utsläpp än nya fordon. Projektet syftar till att uppskatta elasticiteten för skrotning av passagerarfordon i förhållande till priserna på begagnade fordon, samt att utvärdera effekten av en mängd olika skrotningssubventioner på skrotningstakten och efterfrågan på nya bränslesnåla fordon, givet policyåtgärder som höjer priset för fossildrivna fordon (malus). En unik mikrodatauppsättning av priser på begagnade bilar kommer att utvecklas, som tillsammans med ett rigoröst empiriskt tillvägagångssätt kommer att användas för att länka samman marknaderna för begagnade och nya bilar under bonus-malus-policyn. Resultaten från projektet kan tjäna som en grund för att förstå de potentiella kostnaderna och fördelarna med att införa fordonsskrotningssubventioner. Det föreslagna projektet är därför direkt relevant för svensk transportpolitik, som är inriktad på att snabbt minska transportrelaterade koldioxidutsläpp.

English

Swedish and European policies aimed at reducing transport-related carbon dioxide emissions are focused on new vehicles, and in particular encourage the introduction of new zero- and low-emission vehicles. These policies, e.g. bonus-malus, can affect the value of used vehicles as well as scrappage, and these vehicles will in future account for a much larger share of transport-related emissions than new vehicles. The project aims to estimate the elasticity of scrappage of passenger vehicles in relation to the prices of used vehicles, as well as to evaluate the effect of a variety of scrappage subsidies on the scrappage rate and the demand for new fuel-efficient vehicles, given policy measures that increase the price of fossil-fueled vehicles (malus). A unique micro-dataset of used car prices will be developed, which together with a rigorous empirical approach will be used to link the used and new car markets under the bonus-malus policy. The results of the project can serve as a basis for understanding the potential costs and benefits of introducing vehicle scrapping subsidies. The proposed project is therefore directly relevant to Swedish transport policy, which is aimed at rapidly reducing transport-related carbon dioxide emissions.

1.2 Planerad tidsram

Startdatum: 2024-06-01	Slutdatum: 2026-11-20

1.3 Bakgrund

Sweden aims to reduce carbon emissions (“emissions”) from road transport by at least 70 percent in 2030 (relative to the 2010 level), and to achieve net zero by 2045. The focus of policy to achieve this so far has been to encourage the purchase of new zero and low-emission vehicles (ZLEVs), and discourage the purchase of fossil-powered cars, rather than the traditional fuel taxes which raise revenue and encourage efficiency. The focus on ZLEVs is perhaps natural given the long-run aim of zero net emissions – plus the unpopularity of fuel taxes among some groups of voters – however it may not be an effective way to reach medium-term goals since the purchase of new, clean vehicles does not automatically lead to a reduction in the use of older polluting vehicles. The focus of this project is on how a scrappage subsidy might work in tandem with policies encouraging the purchase of ZLEVs to

promote a socio-economically efficient and equitable transition to a low-emission vehicle fleet.

New vehicle policies such as CO2 emission standards and purchase subsidies/fees represent “incomplete regulations”, since these do not directly apply to used vehicles, which are often the large majority of total vehicle stock. When governments impose purchase fees on new high(er)-emission vehicles, the supply of high-emission vehicles decreases in the resulting market equilibrium. Given the higher costs involved in the manufacture of low-emission vehicles and the skew towards those in new vehicle sales, the average price of new vehicles consequently increases. One result of this price rise of new vehicles is that more emission intensive used vehicles (that comprise the majority of the fleet) become more valuable, which may delay scrappage of older used vehicles (Bento et al., 2020). This effect would be minimized if appropriate policies for used vehicles are in place. In view of the rapid transition to new ZLEVs for Sweden, concerns related to emissions from the older vehicle stock become central to transport-related emission reductions.

In light of these dynamics, a key question to be answered is precisely how policies pertaining to new vehicles affect scrappage decisions. To the extent that tight emissions policies targeted exclusively at new vehicles reduce scrapping of higher emission used vehicles, there is a “leakage” of emissions via the delayed scrappage channel. Understanding the magnitude of this leakage is of vital importance in evaluating both the effectiveness (and welfare implications) of new car emission reduction policies and in specifically designing scrappage policies to counteract this leakage. The magnitude of this leakage is tied to the so-called scrappage elasticity. Scrappage elasticity is a key parameter that summarizes the sensitivity of scrappage rate to changes in used vehicle prices resulting from changes in new vehicle policies e.g. bonus-malus. Jacobsen & van Benthem (2015), in an influential paper, examined the effect of fuel prices on scrappage decisions by estimating scrappage elasticity in the context of fuel economy standards. The underlying mechanism by which fuel economy standards affect scrappage decisions is through variations in fuel costs that determine the values of used vehicles. Empirical evidence from the U.S. shows that vehicle scrappage decisions of consumers respond more strongly to vehicle prices than, for example, fuel prices (Bento et al., 2018). Apart from the fact that used vehicles may often be driven shorter distances, the reason for differences in scrappage response from vehicle and fuel price changes is consumers' failure to rationally capitalize future fuel costs into vehicle prices. These findings suggest that although new vehicle emission standards and purchase fees on high-emission vehicles are intended to change the emission-intensity composition of vehicles, the effect of such policies on used vehicle prices and related scrappage decisions can be difficult to predict ex-ante and crucial in understanding emissions of the vehicle fleet. The aim of this project is therefore to rigorously estimate, using micro-data on car scrappage and used car prices, the magnitude of leakage and to evaluate the effect of hypothetical scrappage policies on new passenger vehicle demand and on scrappage rates, in the context of the malus policy. More specifically the proposed project aims to examine the link between scrappage policy design and consumer welfare as well as emission reductions.

Available evidence from selected European countries (Grigolon et al., 2016) and the U.S. (Mian & Sufi, 2012) suggests that incentivizing consumers to scrap older, high emission vehicles stimulates demand for new and relatively more fuel efficient vehicles. A prominent example of a scrappage subsidy, the “Cash-for-Clunkers” program in the U.S., for example, has been shown to (temporarily) increase demand for relatively more fuel efficient vehicles (Li et al., 2013; Mian & Sufi, 2012). In the EU, Germany implemented Europe’s largest subsidy in 2009 (both in absolute and relative terms, with €5 billion set aside and sufficient financing for replacement of up

to 4.8% of the fleet) that resulted in a sizeable policy effect (defined as the fraction of total sales that are directly attributable to the policy) of up to 50% (Helm, Koch and Rolf, 2023). However, only a modest 7% reduction in NO2 concentrations at pollution monitors was observed immediately following the study. A broadly similar policy effect, of 48%, was observed for Italy, which had a program similar to (but not as generous as) the German one (Marin and Zoboli (2020)). For Spain, Laborda and Moral (2019) suggest that Spain's version, that was in force in different guises between 2012 and 2016, yielded a policy effect of up to 40%. Finland has had three different schemes at different time points, 2015, 2018, and 2020/2021. While no rigorous econometric evaluation is currently available for any of these policies, summaries of analyses by the Finnish Transport Agency, Traficom, suggest that there was some effect of the policy, although the exact magnitudes are unclear. For the latest version, eligibility included purchases of electric bicycles and public transit passes, which together accounted for the large majority (74%) of subsidy users, meaning that this program essentially turned into a vehicle retirement program, as opposed to a replacement program. While Traficom (Hyttil et. al (2023)) provides a moderate estimate of reduction of emissions (of 5000 tonnes of CO2) from the scrapped cars for the 2020/2021 version, it is not clear if the counterfactual used accounted for the potential future usage of the cars that were in fact scrapped. Finally, France has the largest and longest-running scrappage premium anywhere (in effect from 2015). Its newest version (from July 2021) provides the greatest subsidy amount (up to €5000), sizable annual outlay (€ 283 million for 2021), and distinguishes subsidies by household income and vehicle emissions. The latest version in fact allows electric bicycles to be purchased as well. In the absence of specific evaluation, the emission reductions and the specific effects of the policy on car purchases are unknown.

Sweden also had a long-running scrappage premium between 1976 and 2007. The early versions were variants of a deposit refund system (300 SEK, and then 500 SEK in 1988) with a goal of ensuring appropriate disposal of end-of-life-vehicles (ELVs). This was later (beginning 1994) differentiated between cars that were recently inspected (a premium of 1500 SEK) and not (14 months, altered to 9 months in 1994), which was then abolished in 1998. For cars manufactured post-1998, an extended producer responsibility-based policy was introduced, with non-differentiated base payments, again revised in 2001, following the EUs ELV Directive (700 SEK premium), and again differentiated in 2003 by car age (1700 SEK for cars older than 16 years, 1200 SEK for cars aged 7 to 16). The only study explicitly evaluating this policy, Forslind (2008), suggested that an increase in the (2001) premium by 10% leads to an increase of 2.3% in the number of de-registered vehicles. Overall, there is little rigorous evidence regarding the effect of the previous and long-running scrappage premium for Sweden (see also Sändström (2003) for a theory-based analysis of the scrappage premium).

We note that a recent report (Larsson et al (2023)) investigates a complementary question for Sweden, the implications for emissions (carbon and nitrogen oxides, particulate matter) and traffic-related accidents (and the use of raw materials) of different life spans for a passenger car. This report considered life cycle emissions, unlike tailpipe emissions most commonly considered (including in our proposed approach) and, using a combination of a car exchange and a car fleet model, compared alternative scenarios with different car types replaced earlier than average (using an average life span of 19 years). This report side-steps the question of the key aspect that drives the modelled replacement scenarios, changes in the relative prices of cars of different vintage/age, as well as other relevant aspects, including: the diverse designs of policies that drive the modelled replacement (e.g. income/car age differentiated subsidies, as in France and Finland); the welfare implications of different design of policies that promote accelerated replacement; and the effect

upon the market for new vehicles, including changes in the supply side. Using a rich data set of actual emissions (our proposal uses certified emissions), this report suggests that accelerated replacement of petrol cars, under the criterion considered, can lead to emission-related benefits, but replacement of diesel cars yields lower benefits. Overall, this report suggests mixed benefits resulting from an accelerated replacement program for Sweden in light of current EU policies regarding transport-related carbon emission policies.

We hypothesize that in the presence of fuel taxes, which are significantly higher in Sweden than the US, scrappage subsidies reduce the stock of scrapped vehicles that would have otherwise been sold in the used vehicle market. In particular, linking scrappage subsidy with purchase of ZLEVs enhances consumer welfare by not only stimulating demand for new vehicles but also increases environmental quality by reducing the life of older high emissions vehicles.

We note that a one-time limited period scrappage subsidy might reduce the supply (increase the price) of used vehicles, in turn reducing scrappage rates in the future. This rebound in the scrappage rate leads to emission leakage, and is known in the literature as the "Gruenspecht effect" (Gruenspecht, 1982). We expect this effect to not substantially offset the benefits accruing from a scrappage subsidy since maintenance and fuel costs for such vehicles are usually high, particularly for Sweden with high carbon-related fuel taxes. In any case, the degree to which a scrappage subsidy is effective and efficient is an empirical question, and will be explored in detail in the project.

This project seeks answers to the following questions.

- What is the scrappage elasticity of used vehicle prices?
- Does scrappage subsidy affect new vehicle demand and used vehicle scrappage rates? And if so, to what extent?
- What are the welfare and carbon emission implications of different scrappage subsidy schemes?

1.4 Syfte

The main purpose of this project is to provide rigorous empirical evidence on: (i) the effect of new vehicle purchase policies on vehicle scrappage rates; and (ii) vehicle scrappage subsidies on the demand for new fuel-efficient vehicles, scrappage rates and welfare.

1.5 Mål

This project proposes to develop a unique dataset of used vehicle prices at different life years of vehicles. The dataset will be at a detailed vehicle model level to allow analysis beyond the stated purpose of this project, and itself represents an important resource for future research. Using this dataset, along with vehicle registration data for Sweden (on SCB's system MONA, to which dataset the project team already has access), the project proposes estimating the elasticity of vehicle scrappage in Sweden, which can be used as an input in the evaluation of several policies such as vehicle registration taxes, emission (or fuel economy) standards and scrappage subsidies. The models and tools developed for the project can also be used by Swedish governmental agencies, among others, for ex-ante evaluation of specific scrappage policies, enabling a rapid and efficient de-carbonisation of transportation. In fact, the models and approaches developed for this project may be used with the approaches developed/used in the report by Larsson et al

(2023) to obtain complementary perspectives on accelerated retirement programs. Our estimate of scrappage elasticities, for instance, can be used to inform the optimal lifetime question addressed in that report (by combining the elasticity estimate with a car fleet price estimate). An alternative approach may be to enrich the models we propose to develop by using the actual emission from driving (especially non-carbon emissions) instead of certified.

1.6 Metoder, modeller och data

Methods and models

The project employs several methods to construct the used vehicle prices data, estimate scrappage elasticities and conduct policy experiments for scrappage subsidies. To develop the used vehicle prices dataset we rely on web scraping from used vehicle listing sites and build a vehicle price prediction algorithm based on vehicle characteristics including vehicle usage (i.e., mileage) and age. We consult used car auction sites to access their sites and datasets and build the price prediction algorithm.

Our estimation of scrappage elasticity and scrappage subsidy policy analysis is performed as follows. We propose to use a two-step approach, which we outline next, with a few additional technical details provided in an Appendix. In the first stage, we estimate a scrappage elasticity empirically, based upon registration data and vehicle characteristics. In the second stage, we use the estimated elasticity in a market equilibrium model, consisting of households who purchase new and used vehicles and provide used cars to the market, and firms who supply new vehicles, to simulate the effects of different scrappage policies.

In the first step, we begin by computing the scrappage rates of different age and model vehicles as the fraction of vehicles of a given model and age scrapped between consecutive observation years. Vehicle age is calculated as the difference between observation year, and vehicle vintage year. In determining the scrappage rate, we exclude exported and unregistered-but-not-scrapped vehicles. Following Jacobsen & van Benthem (2015), we estimate a *scrappage elasticity* based on a panel instrumental variable regression of the annual scrappage rate on annual vehicle prices. More specifically, we use the cost of driving a certain distance (e.g., cost of driving 100 km), which depends on fuel prices and the fuel efficiency of the model, as an instrument for vehicle prices. The motivation for using the cost of driving as an instrument for vehicle prices is that higher fuel prices make more fuel-efficient vehicles more valuable relative to vehicles with lower fuel efficiency, and that the mechanism by which fuel prices affect scrappage rate is only through vehicle prices. Predicted vehicle price obtained from a first-stage regression of vehicle price on cost of driving is then used to explain variations in scrappage rate in a second-stage regression. We interpret the coefficient corresponding to predicted prices in the regression of the logarithm of scrappage rate on the logarithm of predicted vehicle prices as the *scrappage elasticity*, the sensitivity of scrappage rate to changes in vehicle prices. To allow variations in prices (in the first-stage regression) and scrappage rates (in the second-stage regression) of vehicles of a given age across model and over time, we include age-year and age-model fixed effects.

In the second step, we analyse different variants of scrappage subsidy based on a simulation model suggested in Goulder et al. (2012) and applied by Jacobsen & van Benthem (2015) in the context of fuel economy standards. The model consists of the three economic agents, namely new vehicle manufacturers, used vehicle suppliers and households. Vehicles are defined by age and several other vehicle characteristics. We model the demand for a vehicle as derived from the utility of a representative household (with a fixed income) given by a CES utility function of vehicles and consumption goods. New vehicle manufacturers set prices for the different vehicle variants they supply to

maximise profit in a market environment characterised by Bertrand competition. The supply of used vehicles by households in a given period is given by supply of both used and new vehicles in the previous period minus scrapped vehicles. The number of scrapped vehicles in a given period is determined by the scrappage probability and the previous period vehicle stock. The scrappage probability is in turn linked to the vehicle's resale value and the estimated scrappage elasticity. Vehicle resale value, that determines scrappage probability, is related to scrappage subsidy which reduces the supply of used vehicles (that become more attractive as demand for and hence price of new vehicles increases). Vehicle resale value is the sum of discounted future rental prices that are adjusted to scrappage. We note that the rental cost of old (and new) cars is influenced by the costs involved in keeping a used car legal and road worthy (i.e. maintenance, vehicle insurance, and registration-related costs) and thus, the probability of scrapping.
The model solves (equilibrium) prices that equate demand and supply for new and used car markets. First, the model solves used vehicle equilibrium prices given new vehicle prices. Then the model solves new vehicle equilibrium prices. This is done for every year during a considered simulation period. This model is then used to evaluate several counter-factual scenarios for scrappage policies e.g. evaluating several scrappage premia tied to vehicle age and new vehicle purchase (possibly differentiated by household income).

Data

We propose combining three datasets; a detailed vehicle registration data from the Swedish vehicle register; fuel prices data from external sources such as Drivkraft Sverige (https://drivkraftsverige.se/); and a used vehicle price dataset that we will construct.

The project team already has access to the vehicle registration data from the Swedish vehicle register for years 2011-2020 (to be extended soon to 2021), for use in a current transport-related project funded by the Naturvårdsverket related to estimating the effects of the bonus-malus policy on the new car market. This dataset contains detailed vehicle characteristics and history including vehicle (de)registration as well as scrappage status. The vehicle registration data is our main basis for the calculation of scrappage rate of vehicles at the level of vehicle model and age. Similarly, for the same project, a dataset of fuel prices has also been assembled. We supplement these data with a used vehicle price dataset that we intend to construct, based upon data from several car auction sites in Sweden. The latter data will be very detailed to match vehicles in the vehicle register by model name and vehicle age for an appropriate sample period e.g. 2016-2021.

1.7 Projektgenomförande kopplat till projektaktivitet

The project consists of three work packages (WPs). In the first work package, we aim to construct a used vehicle price dataset. The second work package focuses on estimating scrappage elasticities, while scrappage subsidy policy analysis is undertaken in work package three.

Work package one (WP1): Data construction

June - December 2024

WP1 entirely focuses on building a dataset of used vehicle prices. This is the most difficult task in the project with a potentially huge pay-off. We are communicating with companies that sell used vehicles on an auction basis for collaboration in building a used vehicle price dataset. Such companies are ideal partners to construct used vehicle price data: they use vehicle register data from the Swedish vehicle register and know the price at which used vehicles listed for sale on their sites have been sold. Since listings are at a

detailed model–year level, it is possible for such companies to have average prices of a vehicle model at different ages.

As an alternative, we plan to do extensive web scraping of used vehicle listing sites to obtain suggestive prices of used vehicles. Since such sites often use standard vehicle model description formats, it is possible to capture details of listed vehicle characteristics including prices. In any case, this part of the project is likely very laborious, and we expect it to take us up to seven months to complete.

Work package two (WP2): Estimation of vehicle scrappage elasticity

January - November 2025

In this work package, we combine the used vehicle price dataset from WP1 with the vehicle register data from the Swedish vehicle register to estimate scrappage elasticity for different vehicle age categories. The task requires computing actual scrappage rates of each vehicle model at the different life years of the vehicle. In addition to scrappage rates, WP2 requires data on cost of driving for each vehicle model which depends on fuel prices and vehicle fuel efficiency. We expect to spend up to four months preparing the data for analysis. Additional eight months are needed to run regressions, and complete a draft manuscript and present it to both the reference group and international conference(s).

Work package three (WP3): Scrappage subsidy policy analysis

December 2025 - November 2026

We plan to conduct scrappage subsidy policy experiments in WP3. WP3 relies on used vehicle price data from WP1 and estimates of scrappage elasticity from WP2 along with vehicle registration data. The focus in this work package is investigating the effect of different scrappage subsidy designs to identify criterion for participation in a vehicle scrappage program. For this purpose, we consult the extant literature on scrappage program design and examine promising experiences from other countries in the context of Sweden. We expect that reviewing literature and building a quantitative model to take up to three months while writing and improving the research report takes additional nine months.

1.8 Kopplingar till andra projekt

The project team has been working together on an ongoing project, “Bonus-Malus-policyn för privata fordon: hur stor är koldioxidutsläppsminskningen?” The ongoing project is funded by Naturvårdsverket and runs from April 2021 to March 2024. Using micro-data from the Swedish vehicle register, the existing project evaluates the market and environmental effects of the bonus-malus program for new passenger vehicles. By focusing on the used car market and scrappage, the proposed project perfectly complements the existing project, which is focused exclusively on the market for new cars. The proposed project will also build on the significant expertise related to dealing with Swedish vehicle-related micro-data acquired by the (unchanged) team from the ongoing project.

2 Förväntat resultat

The project is expected to produce the following results which are useful for researchers, policy advisors and decision-makers in the transport domain for Sweden.

- First, the anticipated development of a novel dataset of used vehicle prices at the model name-model age-calendar year level for some time period e.g. 2016-2021.

Availability of such a dataset creates a unique opportunity for researchers to study the interplay between used and new vehicle markets, which is of significant policy interest.

- Second, the project will produce estimates of vehicle scrappage elasticity, a key parameter that summarizes the sensitivity of scrappage rate to changes in used vehicle prices due to changes in vehicle policies. Such a parameter is likely very useful for determining, e.g., annual vehicle registration taxes.
- Third, the project is expected to produce results pertaining to the effect of scrappage subsidy on new vehicle demand and scrappage rate. These can yield important insights that link specifics of alternative policies to welfare and emissions. These results can support government agencies in the transport domain such as Transport Analysis in providing more reliable and relevant policy advice to transport decision makers.

2.1 Immateriella rättigheter

The dataset on used vehicle prices this project develops will remain the property of the organization that funds the project.

3 Projektets omfattning och avgränsning

The proposed project, while focused and specific, is rather ambitious from a research and policy perspective. In view of the project leader's experience in leading such projects, the competences of the other two team members, and the project team's access to a national and international network of experts in the relevant areas (accrued through previous activities and research exchanges), the time taken and budgeted amounts are very reasonable.

The project focuses on estimation of scrappage elasticity, and evaluation of a scrappage subsidy on new vehicle demand and scrappage rates. It is based on the theory that purchase fees on high-emission new vehicles affect the value and road life of used vehicles by increasing the cost of owning a vehicle. While the project intends to produce results on the sensitivity of vehicle scrappage rates to changes in used vehicle prices driven by new vehicle related policies, it will not attempt to estimate potential health costs or benefits due to changes in traffic safety and emission levels.

4 Rapportering och betalningsplan

A status update, either in written form and/or through oral presentations, can be made with representative(s) of Trafikverket at least once a year. An invoice is planned to be sent three times per year, together with, if appropriate, a summary of the project's financial status. There will also be a half time report to Trafikverket before the end of the second year.

5 Tidplan

The time schedule for the three Work Packages are as follows:

WP1:

- Construction of the Data set, June-December 2024
- Consultation with reference group: September 2024

WP2:

- Estimation of vehicle scrappage elasticity, January-November 2025

- Presentation of findings and refining estimations: May-August 2025
- Completion of a manuscript based on findings, September-November 2025

WP3:

- Scrappage subsidy policy analysis, January-December 2026
- Identify specific policies, together with reference group: January 2026
- Present simulation-based findings at scientific conferences, to reference group, June-August 2026

Complete scientific manuscript, report for Trafikverket, November 2026

5.1 Milstolpar

The project intends to achieve the following milestones at its different stages.

June 2024: Official project kick-off

November 2025: Used vehicle price dataset ready for WP2 and WP3

May 2025: Literature and data preparation for WP2 completed.

November 2026: Working paper for WP2 available.

March 2026: Literature and data preparation work for WP3 completed.

September 2026: Working paper for WP3 becomes available.

November 2026: Project ends with submission of a final project report.

6 Budget

All team members are based at SLU, and all work will be carried out at SLU. Most of the applied-for funds are intended to cover salary, which, in view of the laboriousness of many tasks, are appropriate: (i) 75% of Aemiro Melkamu's position for 24 months. Aemiro will work intensively on all aspects of the project, including the challenging task of construction of the data set. (ii) 30% of Chandra Kiran's salary for the full period. He will also be involved in all aspects of the project, with a greater emphasis on the econometric and simulation aspects. (iii) Finally, Rob Hart, who will direct the overall project will have about 8% of his salary covered.

The only other significant part of the project cost is the collection of used car-related data, specifically prices. We anticipate working with car auction sites (such as Wayke, bilweb, possibly vroom). Since these are commercial organisations, we anticipate having to purchase some of the data. While inquiries regarding these data have begun, there is no specific cost estimate, which can only be known once discussions are complete. Consequently, we have tentatively budgeted upto 300 000 SEK, but the final amount may well be lower. The final cost component is travel cost, related to participation in major national and international conferences, of which we anticipate at least three in total. In addition, we anticipate organizing a small workshop/conference in connection with the conclusion of the project, focused on not only presentation of findings but also discussion with all national agencies and researchers interested in transportation-related economic aspects. All costs in relation to these activities are anticipated to be covered by the project financing.

6.1 Sammanställning av totala projektkostnader och finansiering

Tabell 6.1
Sammanställning av totala projektkostnader och finansiering

Kostnadsslag, tkr	2023	2024	2025	2026	2027	Summa	
Personalkostnader	0	696	892	537		2125	
Antal timmar	0	1433	1865	1000		4298	
Utrustning, mark och byggnader	0	0	0	0		0	
Konsultkostnader	0	200	150	0		350	
Övriga direkta kostnader, resor	0	0	60	50		110	
Indirekta kostnader	0	294	374	230		898	
Totala kostnader	**0**	**1190**	**1476**	**817**	**0**	**3483**	
Projektets finansiering, tkr							**%**
Varav sökt bidrag från Trafikverket	0	1190	1476	817		3483	100%
Varav annan statlig finansiär						0	0%
Varav annan privat finansiär						0	0%
varav egen finansiering						0	0%
Total finansiering	**0**	**1190**	**1476**	**817**	**0**	**3483**	

6.2 Sammanställning av projektkostnader och finansiering Koordinerade projektpart

Tabell 6.2
Sammanställning av projektkostnader och finansering koordinerande projektpart
Om ekonomisk verksamhet ange litet, mellan eller stort företag:
Ange typ av forskning i projektet:

Kostnadsslag, tkr	År 1	År 2	År 3	År 4	År 5	Summa	
Personalkostnader	696	892	537			2125	
Antal timmar	1433	1865	1000			4298	
Utrustning, mark och byggnader	0	0	0			0	
Konsultkostnader	200	150	0			350	
Övriga direkta kostnader, resor	0	60	50			110	
Indirekta kostnader	294	374	230			898	
Totala kostnader	**1190**	**1476**	**817**	**0**	**0**	**3483**	
Projektets finansiering, tkr							**%**
Varav sökt bidrag från Trafikverket	**1190**	1476	817			3483	100%
Varav annan statlig finansiär						0	0%
Varav annan privat finansiär						0	0%
varav egen finansiering						0	0%
Total finansiering	**1190**	**1476**	**817**	**0**	**0**	**3483**	

6.3 Projektpart

Finansiering sökes ej för projektpart.

6.4 Kostnadsslag, den del som finansierarnas av Trafikverket

Tabell 6.4
Kostnadsslag, den del som finansieras av trafikverket

Kostnadsslag, tkr	2023	2024	2025	2026	2027	Summa
Personalkostnader		696	892	537		2125
Antal timmar		1433	1865	1000		4298
Utrustning, mark och byggnader		0	0	0		0
Konsultkostnader		200	150	0		350
Övriga direkta kostnader, resor		0	60	50		110
Indirekta kostnader		294	374	230		898
Totala kostnader	**0**	**1190**	**1476**	**817**	**0**	**3483**

6.5 Trafikverkets interna kostnader

Tabell 6.5
Trafikverkets interna kostnader (fylls i av Trafikverket)

Kostnadsslag, tkr	2023	2024	2025	2026	2027	Summa
Sökt bidrag från Trafikverket						
Trafikverkets interna kostnader för projektet ifylls av Trafikverket innan beslut (TG2) och ska ingå i projektets totala beslutade budget						
Summa underlag för total budget i Trafikverket	**0**	**0**	**0**	**0**	**0**	**0**

6.6 Projektets totala budget och timmar per aktivet/etappindelning

Tabell 6.6
Projektets totala budget och timmar per aktivitet/etappindelning

Aktivitet/etappindelning	Tid/datum/	Beskrivning	Budget fördelat per aktivitet/etapp	Timmar
WP 1: Data construction	1/6/2024-31/12/2024	Construction of used vehicles price data set	1190	1 433
WP 2: Estimation of vehicle scrappage elasticity	1/1/2025-31/11/2025	Using used vehicle price data at model name-age-calendar year data set, estimate scrappage elasticity	1416	1865
	1/05/2025-30/09/2025	Presentation at conferences/workshops	60	
WP 3: Scrappage subsidy policy analysis	1/12/2025-31/11/2026	Identify specific policies of interest (together with reference group)	767	1000
	1/08/2026-31/11/2026	Article submissions/revisions		
	1/09/2026-31/11/2026	Writing and submission of report to trafikverket		
	1/05/2026-30/09/2026	Presentation at conferences/workshops	50	

7 Organisation och parter

The project is hosted at the SLU, with all members of the research team, Rob Hart, Chandra Krishnamurthy and Aemiro Melkamu Daniel, being employed there.

Rob Hart is a Prof. of Economics with a long and successful record of research on markets related to the use of natural resources and emission of pollution. He has been the leader for two transportation-related Naturvårdsverket projects, one completed in 2021 and one ongoing (completion 2024 March). His focus is on understanding market evolution at large scales and over long time periods, and drawing policy conclusions.

Role/responsibility: As project leader, he will manage the overall project, and be responsible for tasks including coordinating both within the team and with the reference group, ensuring that timelines are met and for providing the overall direction to the project. He will also be involved in writing some of the resulting manuscripts and the final report.

Chandra Krishnamurthy is Associate Professor (Universitetslektor) in environmental and resource economics. He is an empirical environmental and resource economist with a strong background in economics of electricity markets and transportation, and has experience in working with large datasets in both research areas. His research focuses on ex-post project evaluation and demand systems as well as choice model estimation. He has worked, in the recent past, on ex-post evaluation of a transportation-related public policy project for San Francisco and on an ex-post evaluation of the effects of the entry of Uber on congestion and pollution (for California), both published in top field journals. He is also working on ongoing research related to understanding the effects of the Stockholm and Gothenburg congestion charge on property prices. For an ongoing transportation-related project, he has worked on the Swedish vehicle registration and vehicle testing (bilprovning data) on MONA, and on detailed Swedish property transaction price (Svenskmäklarstatisk) and congestion data in other ongoing research related to transportation.

Role/responsibility: He will be jointly responsible for assembling the used vehicle price dataset (WP1) and developing the econometric choice and simulation models (WP2 and WP3), writing the resulting manuscripts and the final report.

Aemiro Melkamu Daniel is a postdoc with research experience in consumer choice behaviour related to energy, environmental and transport issues. He has published several papers, and he is working on vehicle demand and travel behaviour in Sweden together with Hart and Krishnamurthy. He is familiar with the Swedish vehicle register data and the extant literature on environmental policies related to passenger vehicle transport around the world. He has training and skills in demand analysis and good knowledge of applied microeconomics as well as econometrics.

Role/responsibility: His role in the project includes assembling the used vehicle price dataset (WP1) and developing the econometric choice and simulation models (WP2 and WP3), writing the resulting manuscripts and the final report.

Reference Group

In order to help refine the research questions, and to provide feedback related to applicability and relevance of specific questions, a reference group will be created. The group will be composed of both academics and potential users of the research findings, and at least one representative from Trafikverket. We will be keen to invite members of the reference group of our current project funded by the Swedish EPA.

The following is the composition of the reference group so far:

1. Staffan Algers (algers@kth.se), *TP mod AB*.

2. Maria Bratt Börjesson (maria.bratt.borjesson@vti.se), *Professor, LiU and VTI*.

3. Helena Leander (helena.leander@energimyndigheten.se), *The Swedish Energy Agency*.

4. Marita Laukkanen (marita.laukkanen@vatt.fi) , *Research Professor, VATT Institute for Economic Research, Helsinki.*

8 Jämställdhet-, genus- och mångfaldsaspekter

The project team consists of researchers from diverse backgrounds. We are all male, however we will ensure that there is a good gender balance in the reference group, as there is in our current EPA project.

The topic of this project, scrappage of older used vehicles, is directly connected to notions of equity, and different distributional aspects. These issues will be specifically examined from a welfare perspective in our simulations of a hypothetical scrappage policy, as detailed in WP2 and 3. Transport policy is directly linked to important questions regarding distribution between different socioeconomic groups, and different regions (especially rural/urban). The desire to treat rural households fairly is an important reason for holding back on further rises in fossil-fuel taxation, which in turn leads to a focus on affecting vehicle purchase decisions, and hence also the need for scrappage subsidies. Analysis of these aspects will be an important part of the project.

9 Riskhantering

We believe that overall the risks related to the projects are modest, with two main risks in our view: an inability to obtain high quality used car price data, which is the most significant risk. However, we have outlined an alternative approach involving web scraping of used car websites for the transaction price dataset which, we believe, will provide usable data for our analysis. Another smaller risk involves one of the key personnel, Aemiro Melkamu, exiting the project, which can be managed with recruiting a researcher, either for a complete or a partial replacement.

10 Kommunikation och spridning av forskningsresultat

The results of the project will be made available by working papers published in the SLU, Uppsala or Umeå (CERE working papers series), see https://swopec.hhs.se/slucer/, and a final report will be published on a separate Project Web page that will be set up (see Bonus-malus evaluation (ekoninternt.se) for a previous project webpage). Material for journalists and the media, such as press releases, may be produced when necessary by SLU's communications department with the support of the project group.

Team members will present the findings at international and National research conferences, including but not limited to the EAERE, the European Economic Association, the Swedish Economics Association, Urban Economics Association etc. Given the significance of the proposed work and its complexity, the main outlet for international peer-reviewed scientific journals are in the area of environmental and general economics journals. In our view, the findings would be of relevance to the top field journals (e.g. JEEM/JAERE) and also possibly to top economics journals.

11 Överlämning

By the end of the project, a final report written in English (with a summary in Swedish) or (if possible) in Swedish (with a summary in English) will be prepared and submitted to the Swedish Transport Administration (Trafikverket). Working papers will be made

freely available on public repositories. Acknowledgements to Trafikverket for funding will also be highlighted in manuscripts submitted for publication in scientific journals.

12 Övrigt

Not relevant.

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