Recycling of End-of-Life Vehicles (ELVs) is a complex process: composition of vehicles changes constantly, waste treatment technology is steadily improving. Furthermore, the depletion of the Earths' resources and economic and legislative considerations are important and developing aspects.

In order to make sound decisions, it is important to be able to simulate scenarios and visualize the effect of changes in addition to having the necessary insight into the chain. Life Cycle Analysis (LCA) studies and similar tools are not adequate enough for this purpose. For this reason, the compliance organisation ARN, together with FFact and ARN Advisory, has performed the Ecotest for ELVs in 2010.

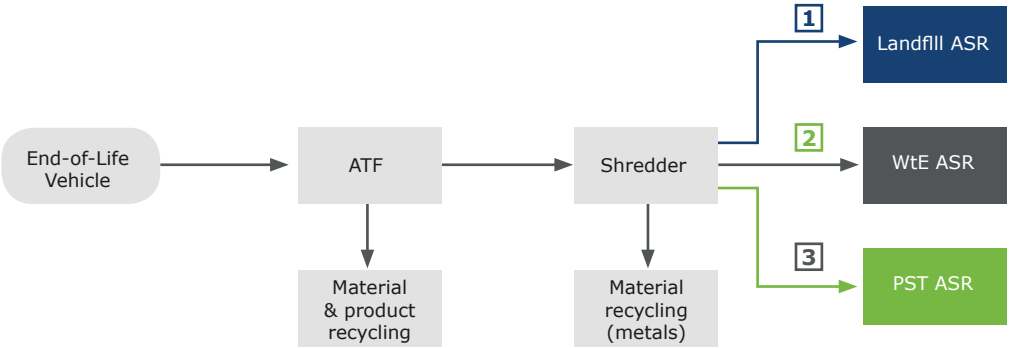
Ecotest for ELVs is a "decision support tool" managers who need to base sustainability decisions on facts about the production chain taken from actual practice. The tool enables the user to look at the chain from the following perspectives:

- **Ecology (CO_2 footprint)**
- **Recycling and recovery of raw materials**
- **Economy (cost)**

Using Ecotest for ELVs, it is possible to weigh three chain scenarios against each other while taking various options for the chains into account.

At present, the scenarios focus on the processing of Auto Shredder Residue (ASR).

ASR is the general description for the residual waste of the shredder after metal separation. Each scenario includes the depollution of the ELV and spare parts trading at the Authorised Treatment Facility (ATF) and the shredding of the hulk.



1. The Automotive Shredder Residu is sent to the landfill site*
2. The Automotive Shredder Residu is treated at a Waste to Energy (WtE) plant
3. The Automotive Shredder Residu is treated in the Post Shredder Technology (PST) plant from ARN

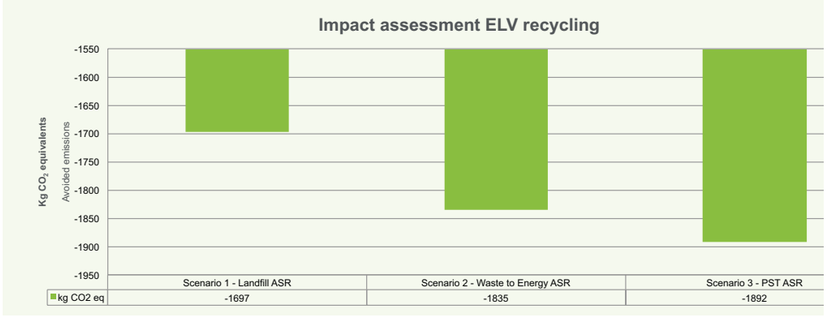
* The landfill scenario is forbidden by Dutch law. However, it is useful to have a full understanding of this scenario so that well-founded discussions with parties such as government authorities can be held.

Ecotest for ELVs helps users make decisions

Ecotest for ELVs: 3 chain scenarios

Ecotest for ELVs assesses three scenarios

Ecotest for ELVs provides an analysis of the most essential indicators to enable the ELV chain to be assessed in terms of actual practice. It starts as an impact assessment of the different scenarios, in which only the avoided greenhouse gas emissions are compared.

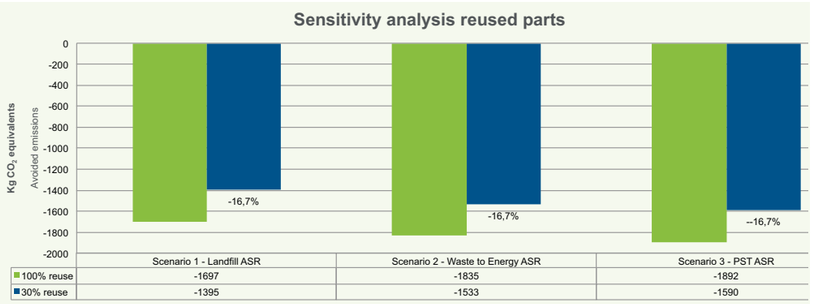


The Ecotest analysis is more than one indicator; the recycling and recovery percentages and the economics of each scenario are also considered. The analysis is presented as shown on the right.

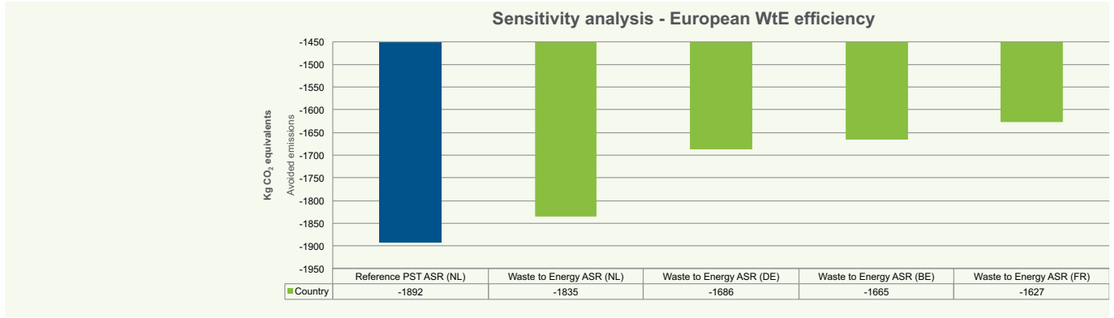
From the dashboard above, clear information can be presented about the different scenarios. Such information is crucial when making decisions based on evidence and quantifiable data. In the case of ELV recycling in the European Union, the recycling & recovery percentage is a crucial number for Member State compliance with European Commission Directives. While the 2015 95% target might be a reason to opt for the PST scenario, the environmental gain from PST compared to an efficient waste incinerator is actually not that big. If the recycling & recovery targets were any different, the choice might have been to go for more incineration with energy recovery. For now it is clear that the incineration route of ASR will exceed the maximum subquota of 10% energy recovery. Of course the validity all depends on the assumptions made and the sensitivity of the assumptions on the overall outcomes. Ecotest can make these sensitivities transparant.

Sensitivity analysis of assumptions

In order to give a certain validity to the numbers of the impact assessment, it is very important to perform sensitivity analyses on critical assumptions. In the following example, the assumption that a reused vehicle part (like an engine or alternator) would have the same life span as the 'adopting' car is critically assessed. This assumption is debatable; it highly depends on the age and quality of the car and of the part. In order to test the impact of this assumption, the life span of the reused part is reduced to 30% (e.g. the reused part has an extended life of 30%). This reduced extended life has a negative impact on the avoided emissions of the several scenarios.



The second sensitivity analysis is performed to compare the Dutch WtE plants to the neighbouring countries Germany, Belgium and France. The activities in the recycling chain, previous to the ASR treatment, can be considered equal to other European countries. It is therefore very insightful to use the PST plant of ARN as a reference and compare the different European WtE efficiencies. It is important to note that the differences between these countries have two reasons. In Germany, the overall efficiency is relatively lower which is caused by old WtE plants in the eastern part of Germany. New plants in Germany have a high efficiency. Furthermore, while all Dutch and German WtE plants are operated with energy recovery, this is not the case in Belgium and France. In these countries, it is estimated that between 70-80% of the WtE plants are operated with energy recovery.



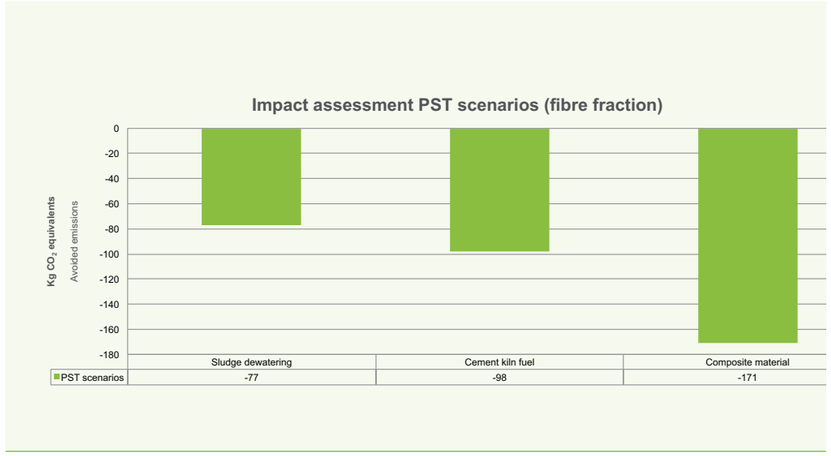
Ecotest for PST assesses three scenarios

The PST plant also uses the Ecotest in order to improve their environmental, economic and recycling performance. In this particular example, only one of the several outputs of the PST plant is examined. The fibre fraction contains mostly PUR foam and textile lining from the seats, this fraction can be used for different purposes.

- As a sludge dewatering agent and subsequent treatment in a WtE
- As a cement kiln fuel
- Or as a composite material

The first two purposes are considered as energy recovery, while the latter can be considered as material recycling.

The PST plant produces more than one output; Ecotest is a useful instrument to determine the policy of ARN. For instance, the mineral fraction is very promising for further improvement of the performance of the PST plant.



Ecotest quantifies the ELV chain and assists in making choices

Ecotest for ELVs is not an academic project, it is a practical tool based on actual data from the chain. Ecotest for ELVs uses only the most essential indicators to justify a decision. This is in contrast the enormous number of environmental indicators often used for an LCA study. Naturally, Ecotest for ELVs complies with the ISO standards applicable to this type of analysis. Ecotest uses the LCA software SIMAPRO 7 to carry out the necessary calculations.

Ecotest for ELVs differs from a static LCA analysis or a CO_2 calculation in that it uses a dynamic model. After the data for the product chain has been entered into the model, it is possible to make changes to the model allowing new scenarios to be analysed.

Testimonial Arie de Jong

Arie de Jong, CEO of ARN Holding, is very enthusiastic about the Ecotest product: 'We have built a recycling facility for processing shredder waste. Ecotest is helping us to optimise the chain. Once we have chartered the outlet channel, we test the sustainability performance in terms of CO_2 emissions, raw-material savings and costs. In addition, Ecotest can now be deployed in tendering procedures for processing dismantled ARN materials, thus allowing the comparison of recycling processes. ARN aims to remain critical and further optimise the overall chain performance for end-of-life vehicles in the years to come'.