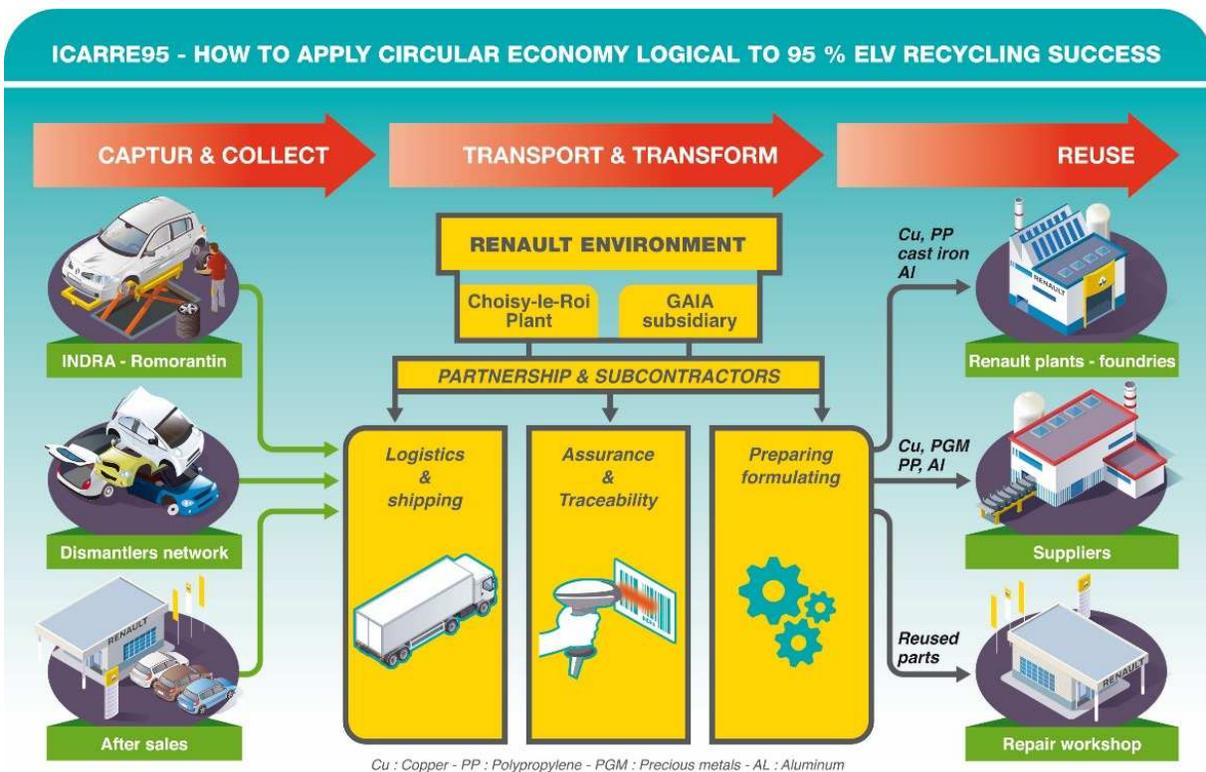




ICARRE95

The ELV (End of Live Vehicle) Directive forms the statutory framework for end-of-life related requirements. It stipulates increasing recycling and recovery targets of up to 85% (recycling) - 95% (valorization) in mass in 2015. These values are monitored by ADEME in France. In addition, the extended responsibility concept obliges the respective stakeholders to contribute actively to a reliable responsibility scheme. It's the reason why Renault has chosen, as a leading car manufacturer with a leading position in environmental strategy, to invest in recycling activities, even if these activities are out of core of a car manufacturer.



In such a framework, Renault has proposed ICARRE95 Life+ project, to demonstrate effectively the technical and economic sense of valorization up to 95 % of ELV cars. To demonstrate with a practical way such objective, Renault has put in place with his 3 partners: INDRA, SYNOVA and DUESMANN, short loops for reuse of automotive materials and parts (short means that materials and parts coming from ELV are reused in the automotive sector).

A video film: [ICARRE95](#) exemplifies the activities and the results.

Main results from ICARRE95 can be summarized as follow:

- A physical demonstrator of 95 % valorization has been put in place at Romorantin INDRA's location
- Development of new routes for material recycling : three families of materials have been studied and experimented: plastics, foams & textiles, metals, from collection of wastes until reuse in new products,
- Development of an offer for spare parts on a national basis with warranty on price, quality and traceability for customer's satisfaction,
- Increase and sharing of knowledge on recycling, by exchange with and between waste companies, industrial companies, recycling companies, chemistry companies, schools, end users ...
- And also evaluation of environmental impacts: decrease of CO² emission/ carbon footprint, savings in raw materials and waste reduction. This is in particular, the result of building optimized logistics routes for flow massification (with additional effect of cost reduction for economical balance).

To achieve these objectives, ICARRE95 project has been organized through 7 actions (fig1):

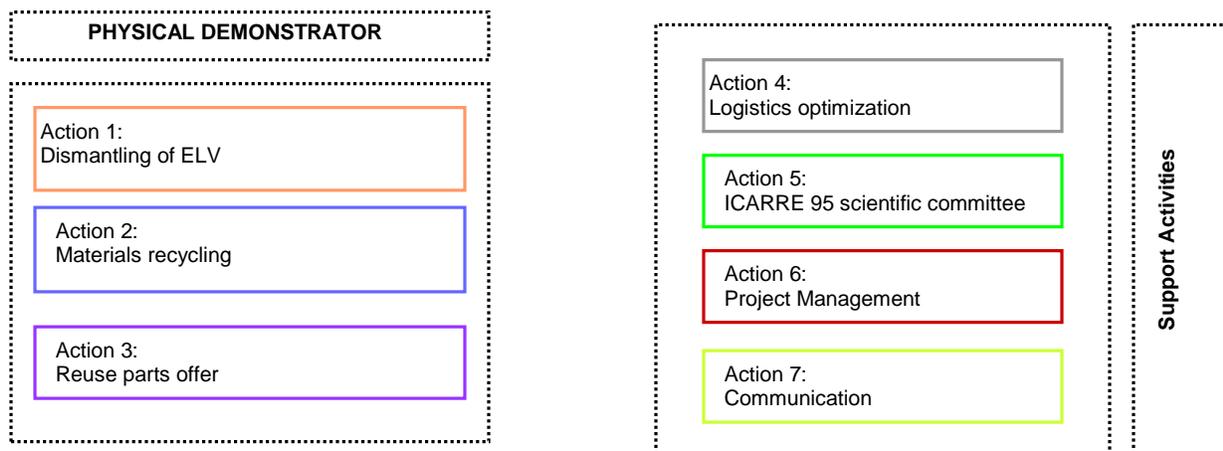


Figure 1: ICARRE95 project organization

Before starting the description of ICARRE95 activities and results, it must be noted that dismantling and valorization of ELV already exist before ICARRE95 starts (see fig 2), with some efficient routes for some materials. So the project has focused its actions and resources on materials and parts where lack of valorization has been stated in order to reach and robustify the 85/95 % ratios required by regulation.

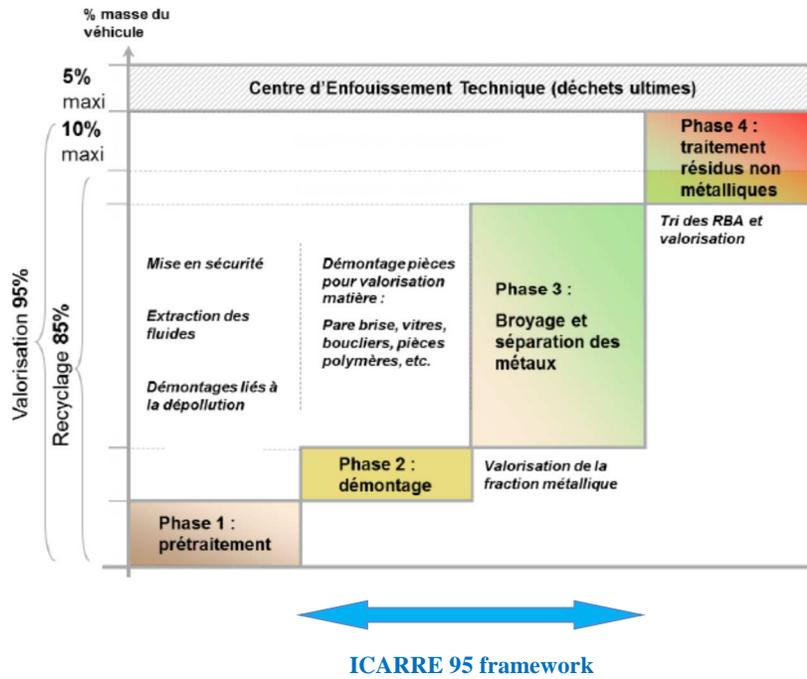


Figure 2 :
How to achieve « 95% »

First phase of pretreatment is normalized: operations are mandatory, recycling routes and paths are well known and corresponding recycling ratio are fixed by regulation. So phase 2 and phase 3 but at a lower level, have focused ICARRE95 actions.



ICARRE95 first action is dedicated to dismantling. Without paths for valorization, dismantling of parts for material reuse is very low in dismantlers' community as such operation is not cost effective. Labour cost for part extraction plus storage cost must be covered by waste value, which depends on its usage. Situation is different for spare parts, as such market exists for a long time as it's the main revenue for dismantlers.

The main objective is to imagine solutions for a better and cheaper dismantling, develop and experiment them before disseminating across ELV centers.

A better dismantling means wastes that are better sorted and so whose value is higher. It means also spare parts that are not damaged during dismantling, so can be reused. Dismantling sheets have been produced during the project for such purpose.

Cheaper dismantling asks for identification of improved productivity paths. For such purpose, two ways have been explored by INDRA, as pilot of this activity:

- (i) efficiency at work post through its design,
- (ii) development of a destructive tool for automation of dismantling.

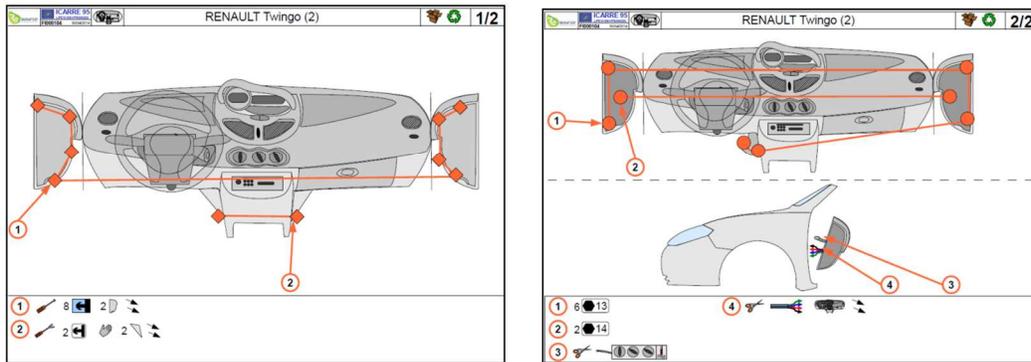


Figure 3 : exemple of dismantling sheets (Twingo II dashboard)



Figure 4 : dismantling tool in action

The 95% demonstrator is based on these improvement (plus shredder performance as the ratio is evaluated on the whole chain). This demonstration is running on real flows at INDRA Romoratin facilities: 4000 and 5000 ELV/year, with a good representativeness of the ELV stock in France.

Dissemination of this “best practice” has been done, through the development and use of a simulation tool, customized for each ELV center. This tool uses ELV centers data such as number of ELV/year, labour cost, dismantling time database, storage capacity, level of professionalism and training ... to provide each dismantler with a practical solution well adapted to their capacity and their associated shredder’s performance. If regulation ratio of 85/95% are not achieved, the tool allows to compute a dedicated plan to each dismantler taken into account their investment capacity.

This tool and practices are disseminated through regular meeting between INDRA’s dismantlers network and their INDRA technical and commercial counterpart.

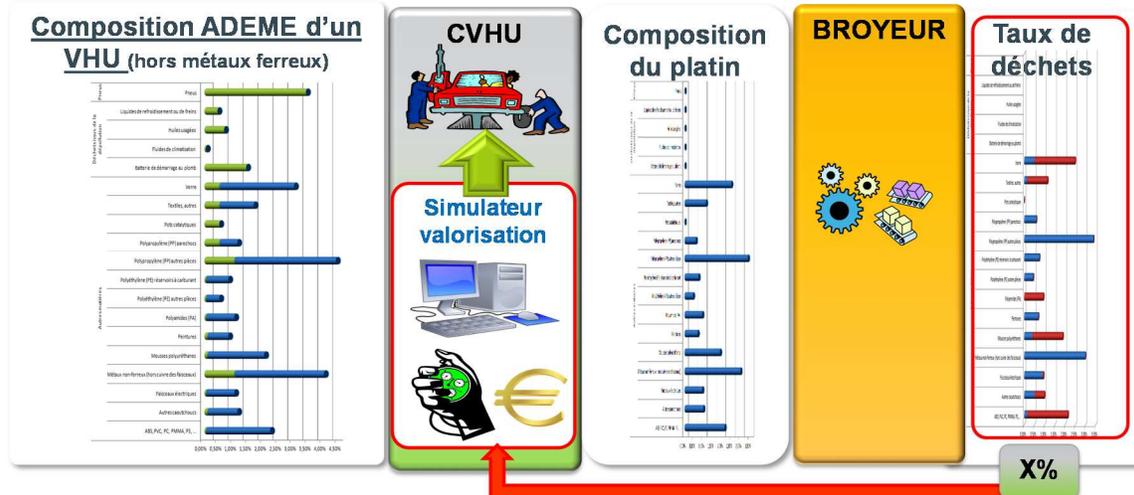


Figure 5 : joint analysis of the ELV center/shredder performance

Recycling of materials (**action 2 of ICARRE95 project**) is the second main technical pillar of the project. Main innovation consists in the building and management of short loops for ELV materials that will allow to avoid downcycling.

After analysis of the potential scope, three families have been selected on the basis of their weight ratio, recyclability potential and economic value. These families are:

- (i) plastics polymer, especially Noryl® et polypropylene (PP used for bumpers, interiors parts ...)
- (ii) foams & textiles (seats, carpets)
- (iii) metals (harness copper, PGM from catalytic converters, cast iron, magnesium alloy from steering wheel, aluminum allow wheels)

First activity has been the increase of collection, taking into account ELV centers storage constraints (they have limited place) and setting up quality rules for collected parts and materials to avoid pollution between different material grades (logistics aspect is also first order and is discussed in action 4). For example, PP is polluted by other plastics like PU or ABS when recycled. Situation is the same for aluminum wheel, as two incompatible grades (first one uses strontium and the second one antimony) are used by car manufacturers.

After collection ICARRE95 project has experimented recycling process, for example with SYNOVA partner for PP. Having SYNOVA (which is an automotive supplier for recycled PP) as project partner, has allowed to define quality of sourcing with respect to automotive specification, Finally two materials from ICARRE95 project have been elected in the “Panel Matière Renault”. A new process: NOVAFORM, has also be evaluated and optimized for recycled PP material, and has been chosen for some parts of future vehicle projects.

Concerning copper, existing process has been optimized for vehicle harness. It is now used for cast iron melting, which required some specific copper grade. For the other materials, ICARRE95 has conducted many feasibility studies (foam & textile) or has optimized existing routes (PGM).

In parallel of materials, ICARRE95 project address **reused parts** that requires a clean dismantling (action 3). Sale of reused parts is key as it impacts both 85/95 % objectives and ELV centers profitability.

Such market isn't new but remains very local and limited. So ICARRE95 project focus on extension of this offer to new customers at a national/international level through:

- choice and traceability thanks to a computerized stock,
- quality thanks to development of rules for dismantling, storage and transport (ELV centers have to agree to be authorized dealers)
- transparent price, reviewed on real time, based on national politics and related to new parts costs

Such an offer, is really new in Europe for an automotive manufacturer. It has started on body parts, as they are easily dismantled, quality is easily checked and a large demand exists because of road accident.

In order to give access to this offer to new customers, ICARRE95 has put in place following actions:

- creation of a stock for existing parts, development of its data base and of its management tool « **PRÉCIS** » (Pièces de Réemploi Circuit Indra Sidexa)
- development of **SVA** « Seconde Vie pour votre Automobile », interface for customers to create and manage a repair file.



Figure 8 : PRECIS, connection ELV Center/repair shop

SVA is connected to Renault commercial network intranet and so is directly accessible by all the repair workshops. Its connection with PréCIS allows for each repair file, a quick answer on the full or partial availability of needed parts as reused ones. Cost estimation and saving with respect

to use of new parts is computed, and the repair workshop can select which parts will be reused ones until finalization of the transaction. At mid-2015, stock corresponds to almost 30000 parts.

Same offer for powertrain parts is under study, but requires more time to be finalized as warranty aspects must be taken into account. A specific offer for particulate filter has also be initiated.

Action 4 is dedicated to **logistics** and its optimization. Logistics is a fixed cost item that must be mastered as it impacts directly profitability of the project. Both aspects: logistics for spare parts and logistics for materials have been studied, with a split tween two kinds of collection for materials. First one is “capillary” collection from ELV centers to grouping platform and second one is “approach” transport from these platform to recycling or use centers. Optimization of the logistics flow, with definition of which grouping platforms are required, has allow to cover almost all of the territory when drastically reducing the cost of logistics by 30 % from the beginning of the project to its end.

For reused parts, the project has decided to use the same company (CAT) used by Renault for spare parts, as it was cost effective. Action has focused on preparation of reused parts by ELV centers (packaging and shipping time).

Concerning material, the situation was quite new without existing solutions. ICARRE95 project actions have been:

- find partners for collection
- define “capillary” collections for different areas (urban, rural ...) with different densities
- make partners working together, define process and get return of experience
- adapt to first feedbacks and optimize costs

All things considered, during the project duration, more than 135000 catalytic converters, 480 tons of electrical harness and 2200 tons of PP have been collected and processed, given the project a “real life” experience in the solutions that have been developed.

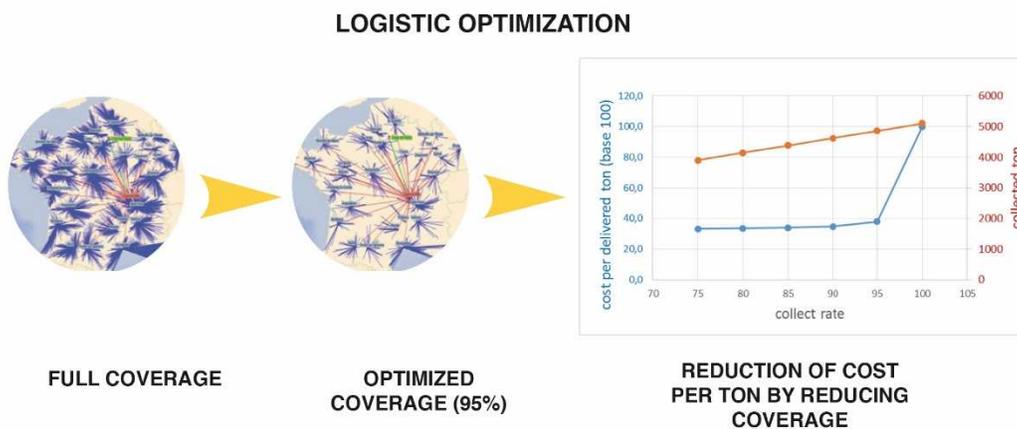


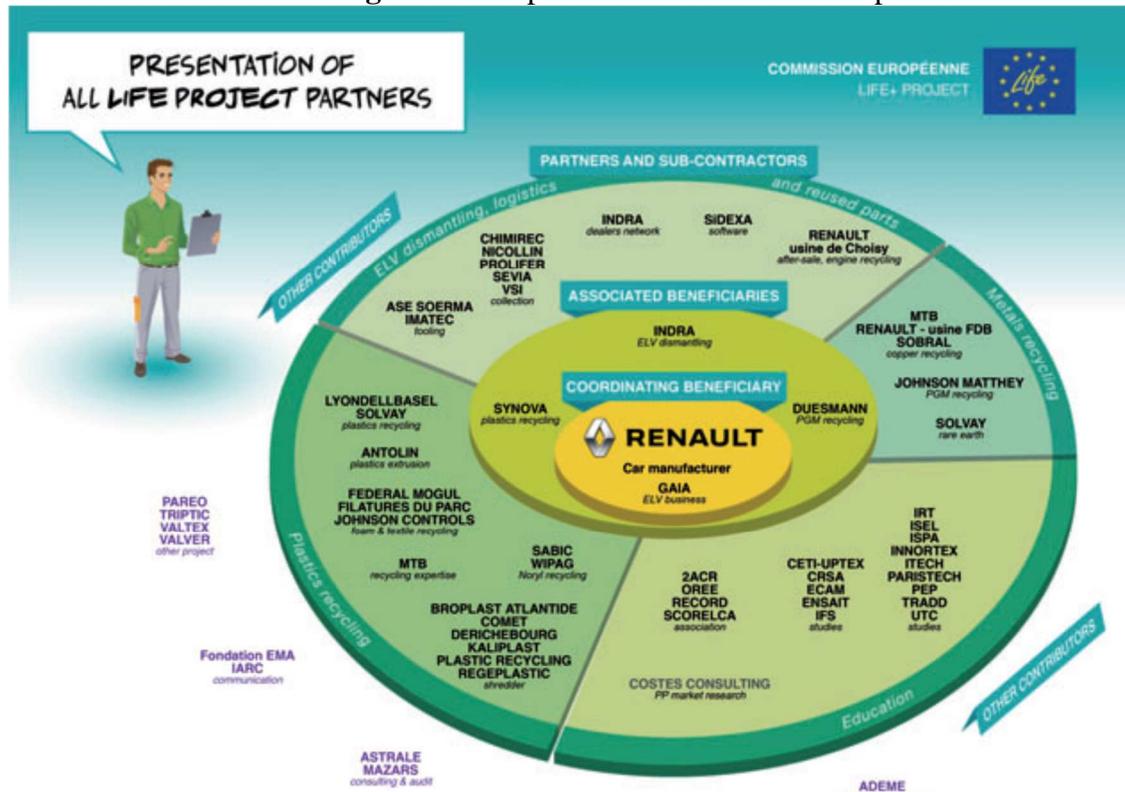
Figure 9: Optimization of logistics costs during the project

Action 5 was dedicated to set up of a **scientific committee**, in charge of collecting main research issues, proposing and following actions plan and capitalization of experience and knowledge. Also, coordination of exchanges with other stakeholders like universities, research centers, associations (IRT, RECORD) ... was one main responsibility of the committee.

A number of issues have been explored, a lot of projects have been initiated. For example, concerning plastics, many engineering schools have been approached and funded to explore some research questions. ISPA has proposed some formulation for AS7 grade which is a PP grade reinforced with fiber glass. ITECH has worked on aesthetic aspect as well on adhesion aspect for recycled PP containing paint residues. UTC, an engineering school in Compiègne, has performed a study on how to control the density of floating baths for PP sorting. Other studies have been performed on metallic materials like: rare earth in permanent magnet of electric motors, aluminum wheels, foams from ELV rear seats.

Output for some studies have been very positive (foam, PP with fiber glass ...) and some experimentation on real case have been performed with partners. We hope that some routes, experimented during ICARRE95 project, will be industrialized in the near future thanks to the positive experimentation.

Action 6 was dedicated to **management**. No particular issue has to be reported.



Just to be noted the large numbering of stakeholders that has been involved in the project from waste management companies to research Lab, professional organization, education, SME ...



Finally, **action 7** covers **communication** aspect. In addition to usual actions like development of a dedicated Internet Web site [ICARRE95](#) or production of a Layman's report, more than 100 communication activities have been performed addressing all the different stakeholders: ELV centers, automotive manufacturers, material developers ... in order to share experience with communities. A mass appeal video [ICARRE95](#) has been produced.

Among these numerous actions, let's highlight following ones:

- recycling day at INDRA Romorantin, (more than 150 dismantlers) with demonstration of the destructive dismantling tool, and conference dedicated to the 95 %,
- conference and booth at IARC (International Automotive Recycling Conference) conference,
- video available on youtube: <http://www.youtube.com/watch?v=JHneaWT4CkE>