

# Barriers and Opportunities for SMEs in EV Technologies: From Research to Innovations

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**Abstract** This report has been produced as part of the FP7-funded research project INTRASME (Innovative Transport SME Support Action) which aims to improve the capacity and capability of European SMEs to develop and implement products more rapidly in the low carbon transportation sectors. This report presents results of work on how SMEs acquire new technologies and develop new products and services and the value SMEs get from participating in EU R&D Transport programmes, focusing on the barriers SMEs face in exploiting their innovations and how these can be overcome. The report identifies strategies associated with the successful commercialisation of technology, and produces recommendations for the European Commission on support for SMEs.

**Keywords** Electric vehicles · Smart mobility · Low carbon transport · SMEs · Barriers · Commercialization · Productionisation

## 1 Introduction

According to the European Roadmap for Electrification of Road Transport [1], up to 5 million electric cars could be in use by 2020 in Europe, rising to 15 million electric cars in 2025. If one includes e-bikes, e-scooters and other e-mobility systems the

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figure will be far higher, with up to 30–40 million electrically powered mobility vehicles in use in 2020 [2]. These new systems offer new opportunities for SMEs as described in the ICT for the Fully Electric Vehicle Roadmap [3] based on changes to the supply chain and emerging business models. While the internal combustion engine (ICE) is an extremely complex system whose control depends on components and software packages in the hands of a few large organisations, the management of one or more electrical motors is much less demanding and is accessible to many new organisations including SMEs. Similarly the management of the production of battery packs may not be a monopoly of a few large companies. The investments for a full production plant of light and heavy quadricycles can be as much as 15–25 times lower than the investment needed for a small conventional M1 ICE city car. The introduction of these new forms of mobility could be driven by new players acting much faster than large OEMs are used to. As the 2011 EU Transport White Paper states “it is clear that SMEs will have a pivotal role to play in this sector, being quick to adapt to new and emerging technologies in the sector”.

There appears to be significant scope for SME innovation in this domain, but significant barriers remain. According to JRC analysis, innovators in the transport sector bear the risk that their up-front investments will not deliver a satisfactory return for reasons that include [4]:

- High capital intensiveness, reinforced by problems of financing;
- Uncertainty in market demand (which limits the incentive to innovate);
- Complex innovation systems that require coordinated innovation efforts and innovation speeds between all players (e.g. vehicle/fuel/infrastructure/consumer), including industry, academia and governments;
- Markets that are dominated by established enterprises and therefore make it difficult for newcomers to enter.

The transition of new technologies from research through to deployment in the market is a risky step that often fails: this transition is often called the ‘valley of death’. This paper looks at how SMEs acquire new technologies and how EU funded R&D projects could help SMEs in making this transition.

Although there appears, in principle, to be a good opportunity for SMEs in this domain, which EU funded R&D programmes could help them to address, it is important to look at the SME experience from their point of view to understand the relevance and benefits of such programmes to them and how they could be improved. Large organisations who work with SMEs in EU projects also develop a good understanding of the barriers they face and how such projects can help to address them, and their insights are also captured in this paper.

This paper has been produced as part of the FP7-funded project INTRASME (Innovative Transport SME Support Action) which aims to improve the capacity and capability of European SMEs to develop and implement products more rapidly in the low carbon transportation sectors.

## 2 Methodology

The focus of the INTRASME project is on electro-mobility (matching most of the activities in the European Green Vehicles Initiative apart from alternative fuels [3]) and smart/intelligent mobility. The topics addressed are:

- Low Carbon (Land) Vehicles (Hybrid and Full Electric)—Electric Vehicle (EV) Technologies and Fuel Cells for range extension.
- Light Aircraft—Electric Aircraft.
- Electric water vehicles.
- Smart Mobility: End to End Journey Management—Focus on systems needed to support electromobility, e.g. Intelligent Transport Systems, Smart Grid, rather than all co-modality projects which may have more limited economic impact for companies.
- Enabling Technologies that can be applied to the above low carbon transport/electromobility applications, e.g. Supercapacitors.

The INTRASME project has analysed how firms acquire and develop low carbon transport technology in different regions of Europe, by identifying the processes involved in developing a new technology/product application through to the early stages of commercialisation (i.e. pre-production/small volume sales), as follows:

- Data on SME technology development processes, practices and experiences has been gathered through an interview process of 57 SMEs from four target regions listed below and also from other EU countries to ensure that results from the survey can be generalised and applied to Europe as a whole:
  - UK, West Midlands
  - Poland, Warsaw
  - Italy, Piedmont
  - Bulgaria, Ruse
- These SMEs on occasion have participated in EU R&D programmes but more often have not participated in EU or national programmes or have participated in national programmes only. Comparing their views with SMEs that are involved in EU R&D projects has provided context for understanding the level and effectiveness of SME participation in EU R&D programmes.

Since INTRASME has been set up to help innovative SMEs enter supply chains, the following types of EU R&D projects were studied to identify SMEs involved in EU R&D projects to interview:

- Projects with high innovation potential with significant involvement of SMEs.
- Projects that are still on-going or recently completed where exploitation and dissemination support could still be helpful.
- Projects representative of different types of R&D Projects from different EC programmes, and of the different challenges faced by SMEs.

A short list of projects based on the above criteria was produced by searching through EC project data sources (primarily CORDIS and project websites). The projects were analysed to identify those with significant innovative SME involvement, either as an important partner supplying technology or in a few cases acting as project coordinator. The list was also filtered to ensure coverage of the low carbon transport technology categories identified above. 38 SMEs were identified and targeted for interviews, including 4 SMEs acting as coordinators of EU projects. The SMEs short-listed for interviews were contacted and a good response rate of about 55 % was achieved with good coverage of EU countries. These SMEs are/ have been involved in 31 EC R&D projects.

Coordinators and other participants also involved in the projects and in exploiting the results, e.g. Original Equipment Manufacturers (OEMs), Tier 1s, Research Institutes were also selected for interview to capture their views of SME involvement. 25 Coordinators/other organisations that were not SMEs but were involved in EU projects with SMEs were identified and targeted to approach for interviews, and 14 organisations involved in 21 EC R&D projects were interviewed.

Data on SME decisions, actions and experiences (and those of organisations working with SMEs in R&D projects) were captured during the course of the project in structured questionnaires. These data were logged and aggregated. By providing a structure that provides a degree of consistency of results over a larger sample it is possible to construct generalised observations about common experiences.

### **3 SME Acquisition and Development of New Technologies and Impact of EU R&D Projects**

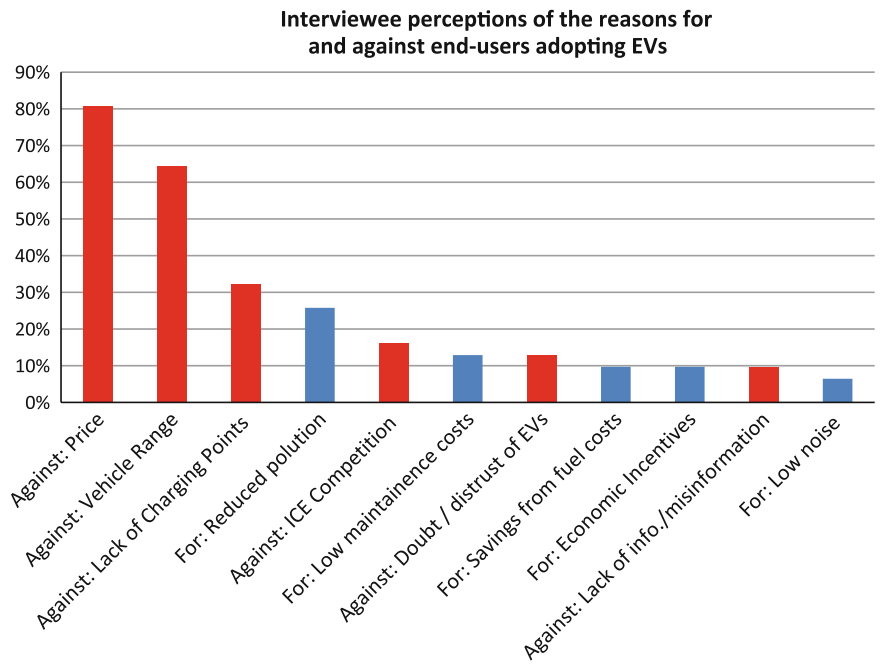
#### ***3.1 Perception of Market Opportunities***

Participants were asked why they saw an opportunity to enter the EV and Smart Mobility markets, in order to assess why they sought to acquire a particular technology. Most commonly cited reasons are listed below:

- Personal interest in the technology or application of the technology
- The intrinsic benefits of the technology (ecology, performance, safety)
- Opportunity to open a new market
- Future market growth trends
- An environmental philosophy

Prominent amongst the answers was a sense that the EV sector presents an opportunity to open a new market where there is opportunity for future growth.

Participants were also asked why they believed EV products were being adopted or not by end users. See Fig. 1.



**Fig. 1** SME views of reasons for and against end-users adopting EVs

Negative reasons greatly outweighed positive reasons. Amongst the reasons for non-adoption price, battery range and infrastructure featured highly, followed by competition from conventional vehicles and uncertainty on behalf of the consumers. Positive reasons included sustainability, reduced maintenance costs, savings from reduced fuel costs and economic incentives. These views reveal a perception that the technology and business case for EVs is still under-developed. This presents an opportunity for new entrants to benefit from technological improvements but also underlines the risk that unless these issues are resolved there may be insufficient demand to amortise costs.

Several of the reasons for and against adoption also point to the role of external regulations (policy drivers to reward use of less polluting vehicles), intervention (economic incentives and disincentives) or the influence of other actors (the availability of charging points, competition from ICE vehicle producers).

In summary, EV businesses perceived considerable scope for technological change to contribute to and benefit from growth in a new market. The inverse, however, is that unless technological challenges (as relates to price, weight and performance) and issues external to the market (such as the availability of charging points) are resolved, there are doubts in the supply chain about the viability of the value proposition to the consumer.

3.2 SME Acquisition of Technology

Figure 2 provides an overview of how SMEs source ideas

The most important sources of ideas, in order of responses, are from management and in-house R&D, followed by partners and regional clusters, market trends and commercial partners. This demonstrates the central role of entrepreneurs (management and founders) as the drivers and link between networks of practical know-how (partners and regional clusters) and networks of market knowledge (commercial partners). This balance of supply and demand (factor) shifts as companies grow in size.

- Micro businesses are most likely to draw on the know-how of partners and regional clusters, but are unlikely to be led by: market trends (4 %) or sales (0 %). Medium-sized companies by contrast are more likely to develop ideas in response to: market trends (57 %) and sales (14 %), and companies that have successfully commercialised a product are significantly more influenced by commercial customers (ranging from 16 to 47 %). This suggests that as organisations grow, demand factors play a greater role in creation of new ideas.
- Collaborative R&D features more highly as a source of new ideas for medium sized businesses (29 %) than for micro-businesses (0 %). This is likely to be associated with the greater access to EU R&D funds: where 33 % of medium-sized businesses have participated in projects against 12 % of micro-businesses.
- Sales and end-users do not feature as a major source of ideas for any size of company.

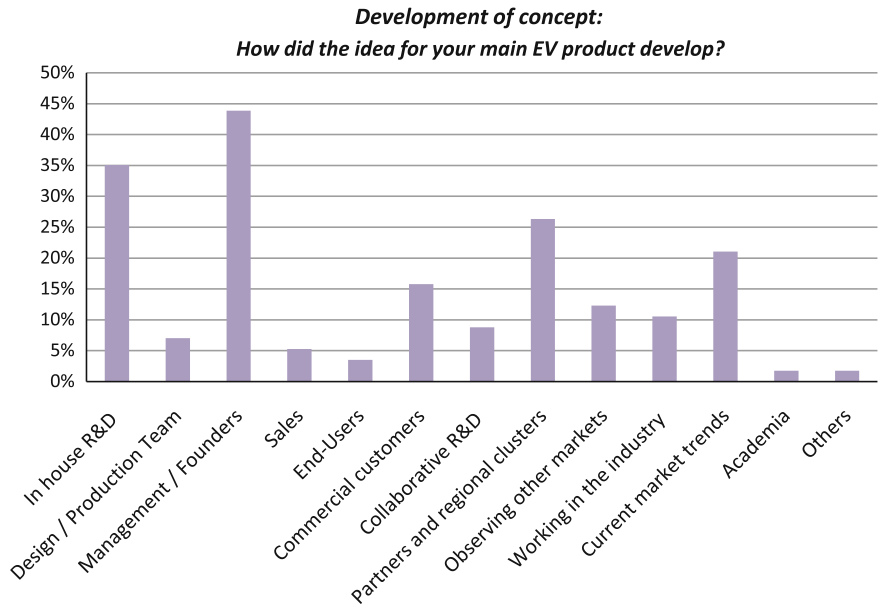


Fig. 2 Development of the concept

### 3.3 Impact of SME Involvement in EU R&D Projects

The SMEs involved in EU R&D projects, covering the full range of sizes from micro through to medium, gave their views on the effectiveness of collaboration in 26 EC collaborative projects in which they are involved, and the results are shown in Table 1.

In half of the projects the SMEs felt that the collaboration was highly effective while in just over a quarter of cases the collaboration was viewed as moderately effective, for reasons discussed below. The effectiveness of collaboration was only rated as low in one case (4 % of projects).

Concerns raised by several SMEs included:

- Fewer participants would be more effective—the more participants, the more project time goes to information gathering and communication.
- Cases of OEMs doing in-house solution development and less integrated into projects than other participants.
- Slow OEM decision-making.

Once SMEs are in EC projects they are generally happy with the level of collaboration. They need help to get into projects if they are not already familiar with them, and once in a project they value the help provided by coordinators who support them in carrying out the required administration tasks. Collaboration increases in effectiveness as partners get to know each other. Benefits provided to SMEs that they highlighted in the interviews included:

- Higher profile and increased credibility from the moment a project is awarded and publicised (in one case an SME was saved from bankruptcy by orders that followed the publicising of an EC project award).
- Acquiring new knowledge and skills.
- Broader market view.
- Strengthening collaboration with large industries and research institutes.
- FP7 works well as the researchers/engineers interact at the working level, which is a key benefit, enabling SMEs with new concepts to learn what OEMs look for in terms of production-ready technology, e.g. need to carry out formalised failure analysis, production tolerances, etc.
- Possibility of developing future products/services and working with project partners who can help them.

**Table 1** SME views of the effectiveness of collaboration in EC R&D projects

Effectiveness of collaboration—SME view	Highly effective	Moderately effective	Low effectiveness	Too early to judge
Number of projects	13	7	1	5
Percentage of projects (%)	50	27	4	19

- Provides funding allowing SMEs to risk employing people to develop new solutions.
- Supporting SME participation in research projects through a higher funding rate than for large companies (as it is at present) helps a lot.

The interviews with SMEs were also used to establish common problems and barriers SMEs face and to give them the opportunity, based on their experience in the EU projects, to suggest improvements. In addition, interviews with non-SME Coordinators or other key participants were carried out including similar questions to be answered from their perspective of the SME involvement in their projects. These other participants generally had wide experience of EU projects and working with SMEs. The main barriers identified by SMEs involved in EC R&D projects to developing and exploiting their innovations, validated by coordinators and other non-SME organisations in such projects, are listed below in Table 2, together with the frequency with which they were raised by SMEs.

The impact assessment report that looked at SME participation in Framework 5 and 6 in March 2010 [5] found that SMEs, while reporting positive impacts from participation in the project, were generally not optimistic about exploitation. Similarly for the SMEs in this study the issue of linking to larger partners and getting effective exploitation of their ideas is their dominant concern.

Finance and making the business case for investment is another major concern of innovative SMEs participating in EC R&D projects. Accessing finance is particularly difficult at present, and with uncertain demand from customers, is exacerbated by existing electric vehicles being seen as too expensive for general adoption and hybrid technology as already available and adequate to meet the demand. Hence investors often see no commercial reason to support new EV technologies.

SMEs are felt to be a good source of innovative ideas by other project partners, but SMEs felt that they could benefit much more from links to Universities/Research Institutes. SMEs sometimes feel disconnected from research in academia, recognise the need to develop collaborative relationships, but often lack the time to do so.

**Table 2** Main barriers cited by SMEs to developing and exploiting their innovations

Barriers in order of importance	Number of SMEs	Proportion of SMEs (%)
Linking to exploitation partners—OEMs, Tier 1s/Tier 2s ETC	12	57
Finance and business case (including market need)	10	48
Innovation and links to universities/research institutes	8	38
Productionisation	6	29
Need to join clusters for critical mass	6	29
Need to understand EC programmes and bid processes and for guidance and support	4	19



Taking working prototypes through to production is seen as a major challenge: bringing new technologies into production is too expensive for many SMEs.

SMEs value being part of a larger community or network, especially micro-SMEs, which gives them access to tools and knowledge they need, and sometimes need access to such networks to understand and exploit new low carbon transport opportunities. There are interesting examples such as the Torino e-District in Italy where SMEs are joining together (and with manufacturing partners) to aggregate capability to achieve critical mass and jointly pursue new opportunities in electric vehicles.

Even the SMEs interviewed in this study, who are already involved in EC R&D projects, still felt they lacked understanding of EC programmes and how to get into new projects of value to them and their customers. The biggest barrier to SME involvement on EC R&D projects is the perception of the difficulties and problems both in bidding and participating in such projects, some but not all of which are justified. Once SMEs are in EC projects they are generally happy with the level of collaboration, and value the help provided by coordinators who support them in carrying out the required administration tasks.

### ***3.4 Strategies Deployed by Small Companies that Have Successfully Overcome Barriers to Commercialise Their Products***

68 % of the SME firms sampled stated they had commercialised their product(s) and, of this number, one third supplied outside their home region/nation. In all cases companies identified product performance (which often included innovative features) and price as essential elements in commercialisation. However a number of other key factors were identified:

- The importance of establishing an early lead in a niche market. Examples include: material handling vehicles, mobility vehicles, EV scooters, EV conversion kits etc.
- A strong emphasis on flexibility, customisation and responding to customer needs. Successful firms were often able to offer a wide range of services or adaption either through a diversity of internal competencies or leveraging the benefits of local supply clusters. The importance of responding quickly to customer needs was seen as essential in winning contracts; in one case the principle product was entirely redesigned and applied to an entirely separate sector.
- Exploiting comparative advantages of low labour costs and the competitive advantages of being the first in the field. Both of these factors were considered beneficial in Bulgaria and Poland, and a competitive advantage was identified in Italy, the UK and Finland where the absence of local competition in a sector enables the company to establish a dominant position.

- An open approach with large customers and an emphasis on protecting IP through superior know-how and delivery is important.

For firms that are at a pre-commercialisation or low volume production stage the key challenges are:

- Financing the R&D phase and the production and commercialisation phase: the first relates to funding R&D and prototyping stages, where firms are usually reliant on their own capital; the second relates to marketing low volume/high unit cost capital products to potential suppliers, where the costs of development need to be offset before investments can be made in mass production.
- Managing through uncertainty and promoting a convincing value proposition where all stages of the supply chain are unsure about the degree of market demand for EV products and likelihood that demand will offset the development costs of improving technology.
- Expanding beyond a local region where supply and demand factors are favourable.

These observations have two significant implications for understanding the product development process in the electric vehicle market:

- The product development process most frequently described by SMEs is strongly orientated around the technical development of the product. In firms where a product has been successfully commercialised, a focus on technical performance is combined with the ability to quickly customise these competencies to the needs of the market. This is reflected by the need expressed by companies for more marketing/brokerage support.
- An understanding of a firm's position within the surrounding industrial structure is essential. Almost all of the companies that had commercialised a product supplied B2B (business to business) and half of the original product ideas came from commercial partners. Clusters of similar companies can enable SMEs to share know-how and market knowledge as well as draw on a diverse range of competencies and quickly customise an offer. The presence of sympathetic regional support can help offset development and promote confidence in the region about the technology's future. The presence of a developed and localised supply chain enables SMEs to diversify their product range and reduce risk (examples include supplying to the commercial and higher education sectors or to the EV and ICE sectors) where SMEs are able to establish continuing relationships.

The manufacturing of Micro EVs does not necessarily require the expertise of the classical OEMs and in Europe there are groups of organisations (clusters), some represented by INTRASME partners, e.g. Torino e-District, that are developing the capability to develop supply chains capable of quickly responding to market demands. National and regional Government policy-maker support is required for such clusters to launch initiatives in local production or parts assembly, but Governments and funding agencies need help to recognise the potential for Micro

EVs that can be produced with much lower investments than are necessary for conventional vehicles.

- The INTRASME project has already stimulated initial work to develop formal Low Carbon Transport clusters in the Midlands (UK) and Ruse (Bulgaria) and also work to broaden existing initiatives around Warsaw (Poland) and Torino (Italy).
- The INTRASME project has also started the formation of an EU Super-Cluster, acting to promote the role of SMEs and regional clusters in the emerging market of Electromobility, at the Smart Mobility World conference in Torino in September 2013.

The overall SME view of the current EV/ITS market is as follows:

- The market is immature with some well-developed niches of activity e.g. Electric Golf Buggies, but low market penetration in areas such as automotive and aircraft
- Collaborative R&D, e.g. with Universities, is important in early product development stages
- Two ‘valleys of death’ exist in the development of products:
  - Feasibility stage: funding is usually accessible for early stage R&D (from own funds, public support).
  - Production stage: funding gap and a greater challenge for SMEs.

Against this background, SMEs that successfully commercialise their products use the following strategies:

- Acquire a strategic partner to exploit or invest in the technology.
- Offer to serve different markets with their product/competency.
- Develop services to cross-subsidise their main product.
- Focus on highly customised products/systems for customers.

## **4 Recommendations to the European Commission**

The INTRASME project has made a number of recommendations to the European Commission that will assist SMEs in taking their innovations to market. Space only permits a brief description of some of the recommendations but more details are available in the INTRASME reports ([www.intrasme.eu](http://www.intrasme.eu)). Key recommendations include:

### **(1) Mid-way Review of Exploitation Plans.**

Make review of exploitation plans a more important part of each project, carrying out a strict review of exploitation plans halfway through EC projects that are aimed at taking new technologies to market.

(2) **Productionisation Projects.**

The EC should consider supporting projects to show that novel ideas are production ready, and help manufacture successful prototypes. This would not require more EC R&D investment, but a re-balancing of investment towards larger productionisation projects at higher technology readiness levels away from smaller Specific Targeted Research Projects (STREPs) within the same overall budget. These projects will need to be a different type of project to STREPs and may involve different types of EC partners, e.g. banks, business angels, business development companies and could even offer the opportunity for the EC to play a role, e.g. to take equity. Any support should be conditional on future manufacturing in the EU, which will also benefit EU SMEs.

(3) **Shape EU EV policy around regional policy.**

EU EV policy must be shaped around regional policy and coordinated with national governments. The production of electric passenger vehicles is by necessity the culmination of inputs from a wide range of supply chain actors and other interested actors. For emerging EV producers the vitality of local clusters is important for sharing knowledge and resources and finding launch customers. Large OEMs, Tier 1 suppliers, or large fleet operators may act as primary customers for a range of EV suppliers, but are likely to be influenced only by policy directions made at an EU or national level.

## 5 Conclusions

This paper describes how SMEs acquire technology and develop new products and services across the EU, and the effectiveness of EU R&D projects in helping SMEs exploit their innovations. Key points are:

- Companies view the current EV market as immature with some well-developed niches of activity, but with a low level of market penetration in areas such as aircraft and the automotive market.
- Interest in entering the EV market is motivated by factors including personal interest in the technology and the perception of the market as at an early stage development, where there are opportunities for new entrants.
- Collaborative R&D, the exchange of knowledge between partners and the involvement of universities is important in the early product development stages.
- SMEs involved in EU R&D Projects and partners working with these SMEs identified barriers to exploitation of SME innovations, of which the most significant was the difficulty of linking to exploitation partners, and the INTRASME project has made recommendations to the EC on how they can be addressed.
- There are two ‘valley of death’ stages in the development of EV products: at the development stage and at the production stage. SMEs typically find the second stage to be the greater challenge as funding exists for early stage R&D but

finding a route to market is more challenging where an existing supply chain may not exist.

- Firms that have been successful in commercialising products employ the following strategies:
  - acquire a strategic partner to exploit or invest in the technology;
  - offer to serve different markets with their product/competency;
  - develop services to cross-subsidise their main product;
  - focus on highly customised products/systems for customers.

Overall the development of a lead market for EV production requires the coordination of a number of regional actors in the supply chain system. A focus on collaborative R&D is extremely important, but without a defined customer and structured set of subsidies or incentives, R&D support may benefit other industries or regions, or simply not reach production. It is by the identification of a route to market (often through the support of a number of existing key companies) that this ‘valley of death’ stage can be overcome.

To maximise their impact, further support for the exploitation of SME innovations is required from the European Commission (as well as national agencies). This paper makes a number of recommendations to the European Commission in relation to the exploitation of EU R&D Project results, EU R&D project mechanisms, and policy. More details of the work of the INTRASME project are available at <http://www.intrasme.eu/>.

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## References

1. European roadmap: electrification of road transport—EPRTRAC, EPOSS, SMARTGRIDS—June 2012
2. ICT4FEV D3.2—roadmap ICT for the Fully Electric Vehicle—30 Oct 2012
3. Multiannual roadmap for the contractual PPP “European Green Vehicles Initiative” draft version 1.0 (26 July 2012) for stakeholders consultation
4. Mapping innovation in the European transport sector—JRC—EUR 24771 EN 2011
5. SMEpact—impact assessment of the participation of SMEs in the thematic programmes of the fifth and sixth framework programmes for RTD—final report, March 2010

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Reports of the PPP European Green Vehicles Initiative  
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