# STRENGTHENING EUROPEAN COMPETITIVENESS THROUGH A PAN-EUROPEAN NETWORK OF CLUSTERS OF EXCELLENCE ON AUTOMOTIVE COMPOSITES

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**Abstract**

Driven by the need for emissions reduction, the area of automotive composites has been attracting increasing research efforts around the world. In Europe, several R&D clusters have been set up, gathering experts from academia, industry and public administration. As these centres are dispersed around Europe, communication and coordination among them has been observed to be unstructured and limited.

Whereas the European composites ecosystem remains fragmented, large-scale coordinated initiatives in other continents have been aligning efforts among academia, state and industry to accelerate research results. At the same time in Europe, stakeholders of competing solutions have come together to provide the answer to the light-weighting issue.

This paper examines the potential of increasing Europe's competitiveness in the field of automotive composites by enhancing the communication, coordination, and knowledge exchange among the clusters. The paper looks into the research performed by ten clusters of excellence in six countries aiming to identify overlapping research efforts as well as explore potential synergies.

The results show that, should the communication and knowledge exchange between the clusters be enhanced, research efforts could be better aligned and focused on Europe's priorities, optimising resource allocation, thus accelerating automotive composites development, reinforcing the European position and increasing EU competitiveness.

## 1. Introduction

Lightweight materials and related technologies have seen rapid development in the last few years, receiving traction from multiple sectors, primarily transportation, construction and energy [1-3]. Stakeholders from the two main competing solutions to the lightweighting challenge – lightweight metals (high-strength steel, aluminium) and fibre reinforced polymer (FRP) composites – are aligning efforts to position their materials as the preferred solution for each sector. North America, Europe and

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Asia (Japan, Korea) are leading the composites race, with significant investments having being made in several aspects – from raw materials to recycling – by a number of actors, both private and public.

### 1.1. Developments in Metal Solutions

On a global scale, the WorldAutoSteel, the automotive arm of the World Steel Association, is a group comprising 21 steel producers around the world. Throughout the last 18 years, the group has facilitated investments of 60 million euros in R&D projects demonstrating the capabilities of high strength steel in automotive applications. The latest of a series of projects was the FutureSteelVehicle, demonstrating steel intensive designs for electric vehicles, providing significant weight reductions of 35% over reference vehicle, and total lifecycle emissions reduction.

In Europe, stakeholders of the metal industries combined forces in 2014 under the Metallurgy Europe EUREKA cluster, with ambitious goals revolving around developing high value metal solutions, establishment of companies and creation of jobs, and development of skills. The cluster gathers 270 organisations from 17 countries, and a total of 1 billion euros public-private commitment to be invested in the seven-year R&D&I programme. Within its first year of operations (2015-2016) the cluster intends to grant some 250 million euros through collaborative projects under 14 categories.

Several activities have been initiated in the private sector as well, such as ThyssenKrupp's InCar and InCar plus projects, aiming at reducing weight and manufacturing costs of steel automotive components.

### 1.2. Developments in Composites

In the USA, the IACMI (Institute for Advanced Composites Manufacturing Innovation) initiative was inaugurated in January 2015, as part of the National Network of Manufacturing Innovation. The initiative gathers seven institutes and a funding of 250 million dollars (70 million in federal funds, and 180 million private investments) in an effort to achieve its ten-year objectives of reducing Carbon Fibre Reinforced Polymer (CFRP) production cost by 50%, improving FRP recyclability to 95% , increasing CFRP embodied energy savings by 75%, increasing greenhouse gas avoidance by 75%, creating jobs, and increasing production capacity [4]. Less than three months after official launch, IACMI already announced its first call for collaborative project proposals.

In Asia, several investments between public and private actors have been initiated. In South Korea, Hyosung and the central government co-invested in late 2014 a sum of 1.39 trillion won (1 billion euros) in a carbon fibre hub, directed towards increasing production capacity, as well as the creation of an incubator and other supporting services aiming at nurturing the creation of small businesses [5]. In Japan, the National Composites Centre was established in 2013, to facilitate composites development among different actors. In addition, other partnerships have emerged, such as the collaboration between Mitsui & Co. and the Innovative Composite Materials R&D Centre (ICC) of the Kanazawa Institute of Technology (KIT) in 2015, with the end goal being the development of a composites supply chain under the coordination of the Japanese Ministry of Economy, Trade and Industry [6].

In Europe, one of the main investors in composites and related technologies is the European Commission (EC). Until now, throughout the H2020 and FP7 programmes, the EC has funded some 50 composites related projects in the last nine years, giving out 260 million euros. Main areas of focus of the funded projects are related to manufacturing technologies, customisation to applications, and enabling technologies (e.g. modelling and simulation). The ongoing SEAM cluster projects (ENLIGHT, ALIVE, SafeEV, MATISSE) funded under the EC FP7 programme are an example of a large-scale innovation action gathering 49 partners from ten countries in a 19 million euro effort. Of the four projects, ENLIGHT focuses on composites, aiming to advance lightweight material technologies for application in structural vehicle parts of future volume produced Electric Vehicles (EVs) along four axes: performance, manufacturability, cost effectiveness and lifecycle footprint [7].

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As a result of EC, national and private investments, several clusters of excellence have been set up in a number of regions, bringing together experts from the triple helix of innovation (academia, industry and public administration), with the purpose of creating value for all stakeholders involved. These clusters perform state of the art R&D&I in the field, driven by the industrial needs of regional partners.

Even though clusters work on similar aspects of composites (industrial needs across Europe are similar), communication between them is often unstructured and sparse. Out of the ten clusters involved in the study, some were not fully aware other cluster activities, while limited collaborations had been established in Europe.

The paper looks into the research performed by ten clusters of excellence in six countries, to identify overlapping efforts, and point to synergies that can be leveraged, reinforcing the European position in the field and increasing EU competitiveness in end-user markets, such as transportation.

## 2. Methodology

As the purpose of the paper is to evaluate the potential of strengthening European competitiveness by means of cluster networking, it is key to gain a deep understanding of the most relevant clusters of excellence working on automotive composites in Europe. These are defined as entities bringing together leading regional actors from the automotive and chemical industries, both industrial and academic organisations, with the aim of performing challenge driven research based on industry needs that contributes to overcoming the current bottlenecks towards mass-adoption of automotive composites.

These ten most relevant European clusters were identified through dialogue with leading automotive and chemical organisations building on recent work [8]. Namely they were: AESICOM – Composites Industry Cluster (Valencia, Spain), AZL – Aachen Centre for Integrative Lightweight Production (Aachen, Germany), CCSWE – Composites Centre Sweden (Lulea, Sweden), CiC – Composites Innovation Cluster (Derbyshire, UK), IMAST – Technological District for Engineering of Polymer Composites and Structures (Naples, Italy), IRT Jules Verne – Research Centre for Advanced Production Technologies (Nantes, France), OHLF – Open Hybrid Lab Factory (Wolfsburg, Germany), MAI Carbon (Augsburg, Germany), MERGE – Technologies for Multifunctional Lightweight Structures (Chemnitz, Germany), LIGHTer Arena (Stockholm, Sweden). Cluster locations are illustrated in Fig. 1.

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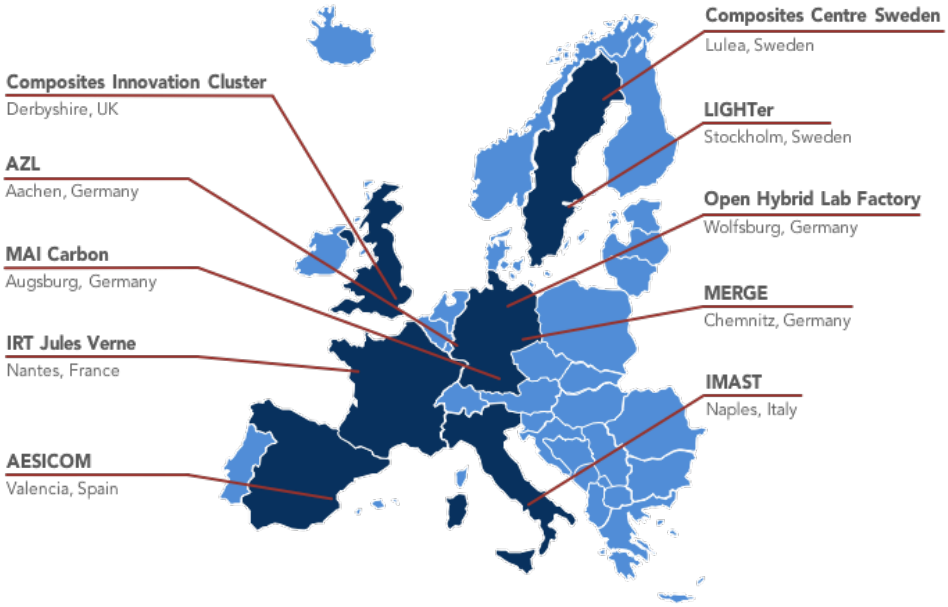


**Figure 1.** Cluster locations.

In order to gain a deep understanding of each cluster, qualitative and quantitative information was collected, via telephone interviews with cluster managers and academic experts representing the clusters, and later contrasted and aggregated with public information sources such as websites, press releases, and relevant publications by reference authors and entities, such as Plastics Europe, SAMPE Journal, Composites World, Lucintel, and Reinforced Plastics, among others. The information gathering was conducted between May-June 2015, hence information exhibited here represent the state of clusters during the same period.

The study gathered data on the total yearly budgets from all clusters, taking into account all different funding sources, in order to estimate the order of magnitude of a joint European network, aiming at comparing it with similar large-scale initiatives. In order to identify preliminary opportunites for synergies, main competences and challenges were mapped per cluster, based on assessment by interviewees. These preliminary ideas were later contrasted with the portfolio of projects each cluster had decided to set up, hence confirming their priority research topics. Projects taken into account where ones that were ongoing or had recently finished (within 3 months) by May 2015.

The information was compiled, aggregated and finally validated by interviewees. Communication was followed-up where needed by telephone, and a live meeting was organised in July 2015 with eight cluster representatives to present preliminary results.

## 3. Results

Most of the clusters involved have a strong industrial 'cornerstone member' in their region, and an academic institution with expertise in at least one of the fields related to composites, presented in Table 1. The way the clusters operate differs significantly; whereas some have a core partnership group with which they have ongoing activities, others have a project-based approach, with different partners joining each project.

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**Table 1.** Cluster main industrial and academic partners.

| Cluster | Main Industrial Partner(s) | Main Academic Partner |
|---|---|---|
| AESICOM | - | AIMPLAS |
| AZL | - | RWTH Aachen |
| CCSWE | - | Luleå University of Technology |
| CiC | CYTEC | - |
| IMAST | Adler Plastic, FCA, CYTEC | - |
| IRT JV | Faurecia, Renault, Solvay, PSA, PlasticOmnium | - |
| LIGHTer | Volvo | Swerea |
| MAI Carbon | Audi, BMW, Airbus, SGL | TU München, University of Augsburg |
| MERGE | Volkswagen, Krauss Maffei | TU Chemnitz |
| OHLF | Volkswagen, BASF, DowAksa, Engel, IAV, Magna, Siempelkamp, ThyssenKrupp | TU Braunschweig |

The ten clusters combined represenet a large R&D&I community of some 3,000 researchers, 1,200 industrial partners, and a combined annual budget of 100 million euros. The size of industrial partners is well represented, with 34% of the 1,200 partners being large corporates, and the rest 66% being SMEs.

Fig. 2 illustrates the combined annual budget and partners of all clusters next to the two most comparable initiatives, IACMI and Metallurgy Europe. Annual budget for the comparable initiatives is taken as their funding, divided by the timeline planned until their objectives have been reached – in years (according to their roadmap); seven and ten years for Metallurgy Europe and IACMI respectively. As one can see, combined network of industrial partners is much larger than any of the other two initiatives, showing that a cluster network would have the potential of a broader impact. Combined annual budget is also higher than IACMI, but lower than Metallurgy Europe, demonstrating that a network would be comparable to other initiatives.

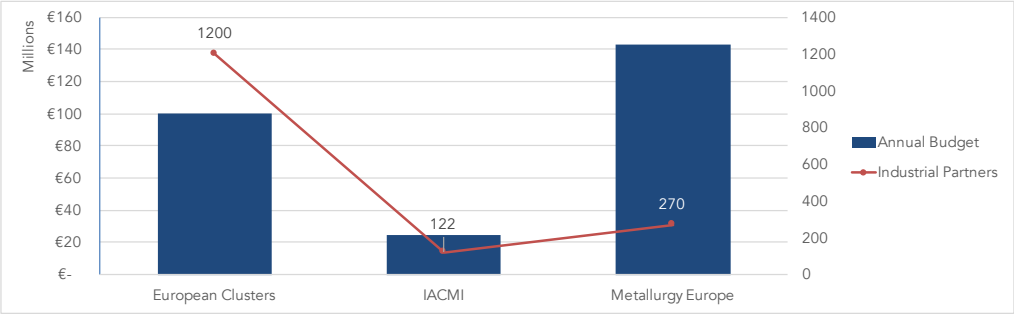


**Figure 2.** Combined annual budget and partners compared to other initiatives.

Clusters were funded by national, European and private sources. National funding was in most cases granted to clusters for the establishment and development of cluster activities, within a predefined timeframe. European funding was granted through projects the clusters had initiated or participated in, that were funded by the EC. Private funding was contributed by industrial partners, depending on the cluster structure, either as membership fees directly to the cluster, or as contribution to projects. National funding was the main source of funding (coming from national or regional governments), accounting for 60% of total funding for all clusters. Private funding accounted for 33%, while the

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other 7% came from the EC. It is worth mentioning though, that although the final benefactor was the national government, the funds could have indirectly come from EC sources.

Fig. 3 illustrates the project structure for the ten different clusters. Despite most of them being multisectorial, the majority of projects are focused on the automotive sector, as expected, accounting for 38% of total cluster cluster activities. The second largest sector is that of aerospace, accounting for 16% of total activities. This figure also reflects the cross-sectorial potential of composites, with the clusters being able to replicate benefits of this technology across several end-user markets, even within their own member organisations.

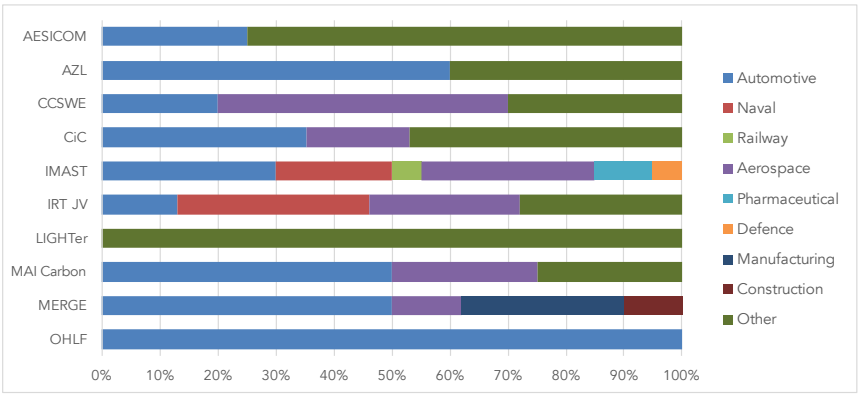


**Figure 3.** Project structure per sector, per cluster.

The combined strengths and challenges of all clusters are presented in Fig. 4. The bubble size shows the amount of clusters that are considered strong/very strong or challenged/very challenged in each category. In order to provide a better picture of how cluster competences relate with the European vision, the EC priorities in the field of composites [8] are marked with a star. One can see that all competence areas are well covered by the total of the clusters.

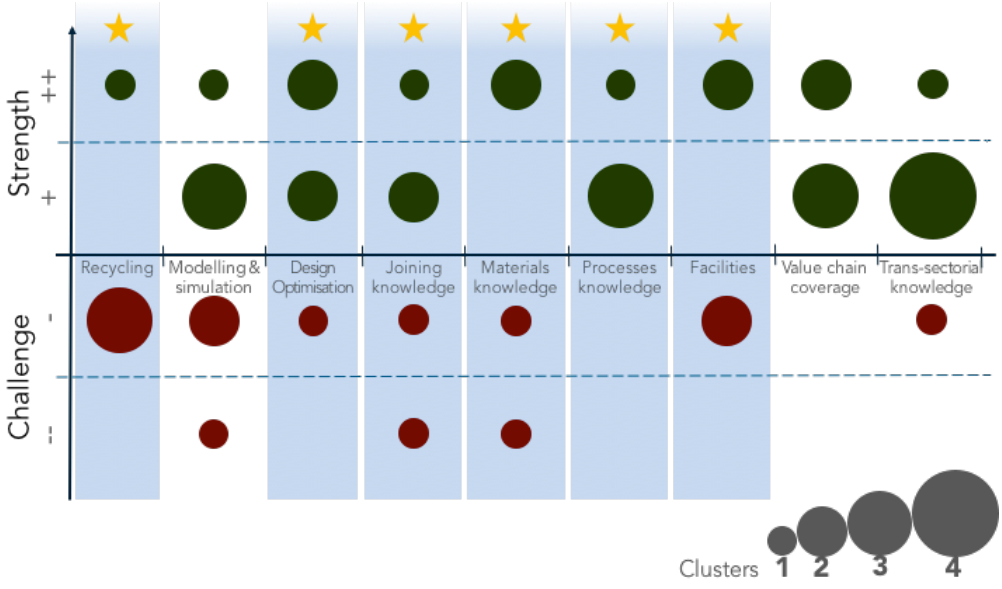


**Figure 4.** Cluster competences, and EC priorities.

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Fig. 5 illustrates an example of potential synergetic collaborations that such network would allow to establish, aiming to enhance the knowledge transfer between clusters, and enable them to learn from each other, thus reinforcing European competitiveness in this field. As the results are based on mainly quantitative data, cluster names have been removed.

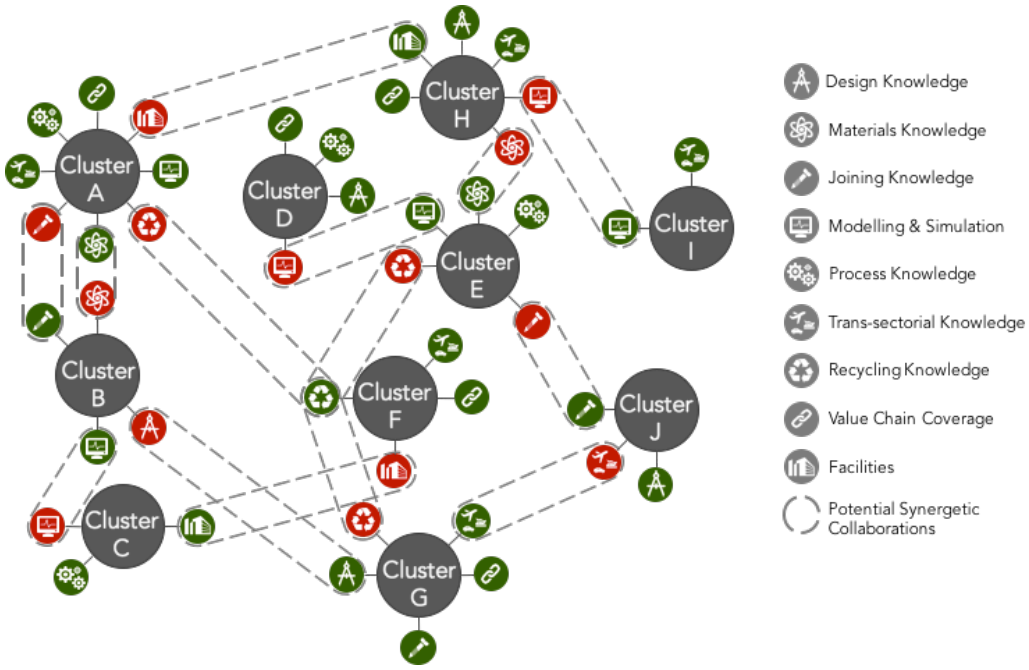


**Figure 5.** Potential synergetic collaborations between clusters.

## 4. Discussion and Conclusions

The combined cluster figures project a reality which is comparable to similar large-scale initiatives, comprising 1,200 entities and 162 projects. The total annual budget of a potential network, summing to 100 million euros is significantly higher than that of IACMI, WorldAutoSteel and comparable to that of Metallurgy Europe. Furthermore, a coordinated effort would position the network with the capacity and relevance to leverage substantial investments from public and private actors such as the European Investment Bank, EUREKA and others, hence potentially surpassing funds coupled by other initiatives worldwide.

As concluded in the preliminary results illustrated in Fig. 4, one can see that there is a broad overlap in research focus of clusters, with deep knowledge in key widely demanded areas (e.g. recycling) isolated in limited clusters, whereas some others still lagging behind in expertise of specific domains that many others already master (e.g. materials knowlegde). A common research roadmap aligned at European level, building on preliminary work [8], and the establishment of a communication office that ensures constant dialogue among clusters would allow for an optimized prioritasation of investments and allocation of resources for research activities by each cluser, according to their capabilities. In the case that similar research projects would still be running in parallel (e.g. in competitive fields), certain tools and instruments could be set up, enabling the sharing and exchange of information and data (e.g. common materials database, common educational events, etc.), thus increasing efficiency and research outcomes of all clusters, from a global European perspective.

Capabilities of clusters' differ significantly, covering a wide spectrum. Increasing the collaboration among them would enable clusters to learn from each other, potentially overcoming current challenges

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of the sector together, and improve the collective capacities, infrastructure and offering of the network as a larger entity. Moreover, apart from the technical related issues, clusters could learn from each other on operational issues. The structure, financing and operational procedures of the identified clusters significantly varies, with several upsides and downsides for each approach (e.g. according to the funding sources structure, multisectorial activity, management of infrastructure or motivation and drivers of the core partners). Strengthening the communication between the clusters would enable them to share best practices, and improve their operations, communication and strategy procedures.

Finally, a network could aid in the definition and implementation of European-wide policies and regulations. Comprising of industrial and academic experts, it could be the contact point for the EC, advising on research topics to be prioritised and subsequently relevant research funding calls to be set up (e.g. Horizon 2020), as well as provide input on related regulations, such as emmissions reductions [9, 10].

Having identified the aforementioned advantages, the authors have already taken the first steps for the realisation of a cluster network. A first meeting with cluster representatives was held in July 2015 to present preliminary results of this study, and initiate discussions regading the set up of the network. Following discussions, seven clusters (AZL, ADVM-XC, IMAST, IRT JV, LIGHTer, MERGE, OHLF) expressed interest in participating.

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## References

[1] I. Verpoest et al. Advanced Materials Enabling High-Volume Road Transport Applications of Lightweight Structural Composite Parts. *SAMPE Journal*, 50 (3): 30-37, May/June 2014.
[2] G. Sims and G. Bishop. UK Polymer Composites Sector: Foresight Study and Competitive Analysis. National Physical Laboratory, 2001.
[3] C. Kazmierski. Growth Opportunities in Global Composites Industry, 2012-2017. Lucintel, 2012
[4] C. A. Blue. IACMI Overview. IACMI, November 2015.
[5] V. Huh. North Jeolla Province to Become Center for Carbon Fiber Industry. Korea Bizwire, November 2014.
[6] H. Caliendo. Mitsui, ICC to collaborate on carbon fiber composite production. CompositesWorld, April 2015.
[7] L Zanchi, M. Delogu, M. Ierides, H. Vasiliadis. Life Cycle Assesment and Life Cycle Costing as Supporting Tools for EVs Lightweight Design. *Sustainable Design and Manufacturing 2016*, 52: 335-348, 2016.
[8] J. Komornicki, L. H. Bax, H. Vasiliadis, I. Magallón, K. Ong. Polymer Composites for Automotive Sustainability. SusChem, 2016.
[9] European Commission, Regulation (EU) No 333/2014 Of The European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new passenger cars, *Official Journal of the European Union*, April 2014.
[10] Commission of the European Communities, Results of the Review of the Community Strategy to reduce $CO_2$ Emissions from Passenger Cars and Light-commercial Vehicles, February 2007.

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