A European Strategy on Clean and Energy-Efficient Vehicles

Renault-Nissan Comments

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1. Should the vision agreed in the CARS 21 mid-term review be adjusted? (i.e. 2020 perspective of improved combustion engine's market dominance combined with growing market penetration of electric and hydrogen vehicles and hybridisation conceived as the bridging technology and 2050 perspective of transport decarbonisation)

Yes, even if this approach remains globally relevant. This vision was adopted against the background of the early days of Europe's severe financial and economic crisis, which was pushed for accelerated evolution in the automotive sector. However, there have been some important developments since then:

- Since 2008, the socio-political momentum to support zero emissions breakthrough technologies has significantly increased. With increasing awareness of societies and governments for climate change and actions like the EU climate package, multi-stakeholder support for zero emission mobility strongly rose.

- The deep crisis which the car industry has had to go through since last quarter 2008 has forced the accelerated reorganisation and research for breakthrough to ensure future competitiveness of the car industry;

- Most recent technology developments and the clear interest of many European countries have strongly accelerated the mass market introduction of electric vehicle. **The Renault-Nissan Alliance estimates that around 10% of the world automotive market will be full electric by 2020** and even more in Europe (10 to 15%) if the necessary conditions are fulfilled (i.e. infrastructure, public incentives). Hybrid will be an interim solution bridging the way to pure electric cars. As regards hydrogen vehicles, the Alliance considers this technology as a medium to long term development.

- Taking into account the current market visibility, with additional improvements in terms of emissions, mainly for gasoline engines, by 2020 the internal combustion engines will remain the most common technology. Despite the lack of visibility of a possible market introduction of fuel cell vehicles it is important to consider this technology as a potential breakthrough for the next decades.

In conclusion, the vision agreed by CARS 21 stakeholders remains a good reference but would need to be adapted towards an accelerated introduction of zero emission mobility.

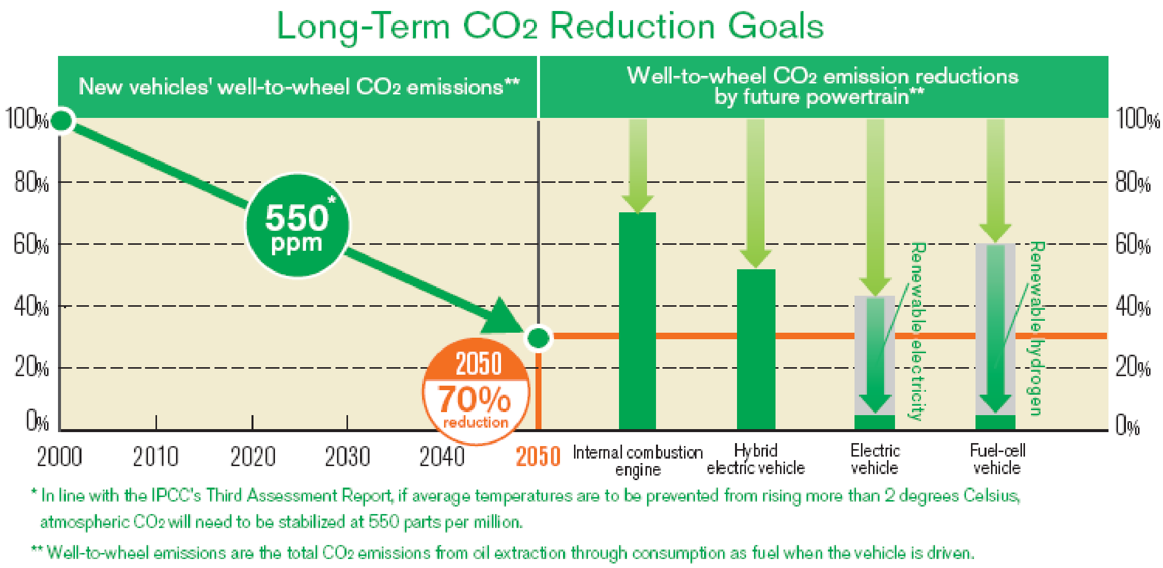
2. What is the potential of different clean automotive propulsion technologies (improved fuel efficiency, hybridisation and alternative powertrains) for contributing to decarbonisation objective in the short, medium and long term?

- **ICE**: In the coming years, the internal combustion engine using conventional fuels will remain the most common source of power. Accordingly there is still potential to improve fuel efficiency of conventional vehicles, mainly for gasoline engines (i.e. engine downsizing, variable valve timing, twin-turbocharging, cylinder deactivation, digital/camless valve actuation, homogeneous gasoline direct injection).
    - Under the Nissan Green Program 2010, the company is working to raise the efficiency of internal combustion engines to the ultimate level. The Renault-Nissan Alliance is developing technologies to cut engine emissions of CO2 by 30% from the current level by 2015.
    - The new generation of petrol engines developed by Renault (TCe family from 90 to 115hp), will permit the use of direct fuel injection and will enable even higher specific power outputs. CO2 emissions will be cut by between 30 and 40g/km compared with the engines they replace, and certain vehicles will be able to claim CO2 emissions of less than 100g/km. The first of these engines will be launched within the next two-and-a-half years.
    - Regarding the new generation of diesel engines, Renault-Nissan plans to develop in-depth modifications to the 1.5-litre (20g/km less CO2 from 2012) and the 1.6-litre (25g/km less from 2011).

- **Hybrids**: there are various degrees of hybridisation providing different results depending on the base being petrol or diesel engines. The potential of CO2 reduction could range from 25% to 35%. In the long term the CO2 reduction could reach 50%.

- **Pure electric vehicles** are clearly the technology offering the highest CO2 reduction potential. **Considering only CO2 from tank to wheel the emissions are zero. In addition, there will be no NOx, CO, HC or particulate matter emissions. In a well to wheel analysis the current estimation is that the CO2 reduction could reach 60% if taken into account current energy mix and close to 100% if the electricity is coming from renewable sources.**

- Given the current uncertainty about the hydrogen production, the overall CO2 reduction potential of **Fuel Cell vehicles** is difficult to estimate. With the current hydrogen generation process the well to wheel CO2 reduction might reach 40%. If a renewable source of hydrogen is developed in the future, the overall reduction may come close to 100%. The Renault-Nissan Alliance is heavily investing in FCV. The new FCV's (Renault Espace and Nissan X-Trail) hydrogen storage capacity has been raised by 30% compared with the 2003 model. Together with improvements of the FCV's power plant, this has given the vehicle a cruising range of over 500 km, or 1.4 times that of the previous model.



What is the decarbonisation potential of the complementary measures in the short, medium and long term (e.g. guidelines on eco-driving, application of Intelligent Transport Systems) and how reliable are these potentials?

The Renault Nissan Alliance is committed to reduce CO2 emissions. The integrated approach allows reducing CO2 emissions with the lowest costs to society.

- Eco-driving, infrastructure and traffic management are cost effective measures and can be applied on the whole car park.
- ITS will become more important in infrastructure measures and traffic management.

It is difficult to estimate with figures the contribution of such measures which are involving many different stakeholders.

3. What are the implications of new propulsion technologies in a lifecycle analysis perspective as regards vehicles, and in a well-to-wheel perspective as regards energy supply chains?

An integrated approach involving all stakeholders is necessary from a Life Cycle perspective: This implies material and energy suppliers (sustainable processing in mining and production), automotive industry and its suppliers, fuel and electricity providers.

Many well to wheel studies have been made recently by laboratories, universities and public bodies. On a full life cycle basis, taking account of emissions from power generation, and emissions relating to production and disposal, EVs have the potential to offer significant carbon dioxide and greenhouse gas emissions reductions over time compared to conventional petrol/diesel fuelled ICVs. These savings have the potential to become much greater with further decarbonisation of the European power mix. Some key results from recent studies about the subject include the following:

- According to the study made by the UK Department of Transport in 2008, **by 2030 CO2 equivalent emissions for an EV could be one third that of a petrol vehicle**.

- The CE-Delft report 2009 clearly mentioned that **EVs are currently almost twice as efficient as internal combustion engine vehicles** from a well to wheel perspective (from 12 to 17% for ICE and from 25 to 30% for EVs).

- The report on Electrification of Road Transport made by ERTRAC, EPoSS and the Smart Grids platform in 2009 shows that the estimated **well to wheel CO2 emissions of EVs**, using the EU-27 energy mix in 2010, **will range from 85 to 105 g eCO2**. On the other hand, the overall CO2 emissions of a conventional internal combustion engine vehicle will be inside the window 145 to 215 gCO2.

Renault Nissan internal studies are in line with the above objective findings.

What are the resource implications in introducing innovative propulsion technologies?

The automotive industry needs access to raw materials outside the EU. This implies free market access to third countries with level playing fields. In the long run, the EU should therefore enable a free trade policy to that effect.

4. What are the state of play and the future scenarios of technological developments in alternative powertrains (electric and hydrogen) and their market penetration?
The strategy and vision of the zero emissions electric vehicle timeline is not shared by all automotive manufacturers because not all of them have made the same strategic choices. The Renault-Nissan Alliance believes that the future of sustainable mobility will depend on the simultaneous development of many technologies. However, not all of them will be ready for the market introduction at the same time.

1. The first **Electric Vehicles** will **arrive late 2010 and early 2011.** Several European car manufacturers have highly invested to make electric mobility a reality in Europe. The Renault-Nissan Alliance believes that the market share of this technology will be at least 10% by 2020.
    - The current Li-ion battery technology allows today to commercialise safe, affordable and competitive fully electric vehicles. The first generation of segment C models of the Alliance will be able to have an autonomy range of 160 km. In the coming years, the second generation of batteries will allow the same kind of vehicles to almost double the autonomy.
    - The Alliance has heavily invested to develop a complete model range and have a worldwide manufacturing capacity of 550,000 electric vehicles per year by 2013. Of the total production, at least 200,000 vehicles will be manufactured in Europe.
2. The Alliance has been developing **Fuel Cells** since 1996 and has provided vehicles to demonstration fleets in California and Japan. Despite the short term priority given to pure electric vehicles the Alliance continues developing hybrids and hydrogen vehicles. We are balancing short- and long-term objectives in order to remain viable and prepare for the major evolutions that are occurring in our industry.
    - Currently the Alliance is working on a fuel cell stacks 25 percent smaller than the stack in its current hydrogen vehicles. It recently opened a fuel cell lab at the Nissan Technical Center in Farmington Hills, Michigan. There still are many challenges to successfully develop a mass market fuel cell vehicle.
    - We are moving forward with our zero-emission leadership strategy, which involves the development of electric vehicles and fuel cell vehicles. Electric vehicles will be launched first, and our production plans are on track. The first fuel cell vehicles with market potential could appear after 2015 and mass market is only expected in the long term.

What are major risks and opportunities associated for different stakeholders? What will be the economic, societal, employment and environmental impacts brought by these developments?

The **major risks** associated with the introduction of zero emissions vehicles are the following:

- The charging infrastructure is not fully standardised and implemented. This situation could delay the introduction of electric vehicles at European level while only a few advanced countries will have the market ready.

- The CO2 reduction potential will not be fully exploited if the share of renewable electricity generation targeted by Europe is not reached.

- The market will not reach significant volumes rapidly to allow economies of scale. If Member States do not decide on early purchasing incentives for customers.

The **major opportunities and benefits** in terms of economy, employment and environment are:

- Zero emissions technologies will bring a significant reduction of the overall vehicle emissions, not only CO2 but also NOx, CO, HC and particulate matters. They are a major step towards sustainable mobility.

- A significant number of new direct jobs will be created for the manufacturing of batteries and electric vehicles. In Europe the Alliance will have three battery manufacturing plants (France, UK and Portugal) and four new electric vehicles assembly lines (France and Spain). New European zero emissions training centres are under construction in the UK and in France. In times of economic crisis the mass production of electric vehicles will bring significant job creation and development of economic activities in Europe.

- The electric mobility is a technology revolution for the automotive industry. New R&D activities for future generations, new skills to develop in Europe (i.e. engineers, business).

5. How can a trade-off situation be avoided where electrifying the power train would reduce or reverse improvements made in conventional technologies in the framework of existing and upcoming legislation on the CO2 emissions of road vehicles?

Shifting the focus to measures supporting accelerated introduction of zero emission mobility does not mean to neglect other CO2 reduction technologies. Moreover, improvements in conventional technologies will ensure the continuous progress of average emissions of the fleets, as those conventional technologies will remain a major part of the market for longtime.

- To reduce our global CO2 emissions, we believe it is important to not only promote the spread of zero-emission vehicles like electric vehicles but at the same time still to significantly improve the fuel efficiency of the internal-combustion engines used in most cars today. Accordingly Renault Nissan is continuously developing technologies to reduce CO2 emissions from gasoline engines to the level of diesel engines and hybrid systems.
- Regarding the investment in hybrid technologies, Nissan launched the Altima Hybrid in North America in 2007. In fiscal year 2010, it aims to launch new HEVs with Nissan's original hybrid technologies in North America and Japan.
- European citizens are more and more conscious about the need to protect the environment, therefore the market is requesting more fuel efficient cars. Electric vehicles will be part of the solution but investment in internal combustion engines improvement remains very important and critical to satisfy the 90% of the market by 2020.

6. What actions should be best taken at regional/ national /European or international level to promote technology development and market uptake of alternative powertrains (electric and hydrogen)?

It is important to understand that mass production of electric vehicles will start in 2011, public support being a key factor of success. In order to prepare the market for the mass arrival of electric vehicles, the Alliance has already established more than 40 partnerships worldwide with governments, utilities, large fleet owners, IT suppliers, etc. The public support given in areas like the USA, Japan or China is significant. In order to guarantee the competitiveness of the European market a coordinated approach is needed. The challenge is to turn the current national and regional strategy into a European vision.

There are three major aspects that need to be supported by national governments to successfully introduce the zero emissions mobility in Europe:

- **Financial and non-financial incentives for customers.** The total cost of ownership needs to be comparable to the current cost of having a vehicle with internal combustion engine. During the **introduction phase** of these new technologies the production volume is not large enough to fully exploit the economies of scale. **Therefore, during the first years of "ramp-up" a clear package of incentives needs to be implemented by European regions and countries.** A key part of this package is the mobility policies, mainly in urban areas to favour EV deployment (i.e. free parking, easy access to city centre). Clear and timely guidelines given at European level are needed to strongly harmonise the Member States approach.
- **Implementation of the charging infrastructure and technical standardisation.** In the particular case of electric vehicles, several types of charging infrastructure are available today. The most advanced European countries have already planned the deployment of such infrastructure for the first electric vehicles arriving to the market in 2011. A European initiative to quickly define the most important standards will strongly facilitate mass introduction at European level.
- **Management of electricity invoicing.** Access to the electricity in the public infrastructure needs to be easy and open. Monopoly situations should be avoided.

At European level, a road map should be established to give guidelines before the serial production in 2011 with the following elements:

- technical standardisation;
- how to incentivise the market introduction;
- how to put the infrastructure in place;
- European research funds for future battery technologies.

Regarding the industrial and R&D support, a technology neutral strategy is needed but always taking into account that all zero emissions technologies are not at the same level of development (i.e. electric vehicles are close to the mass market introduction, while fuel cell vehicles need further technology improvements). It is important to use European support schemes (i.e. FP7) to encourage the development of the key technologies like further improvements of combustion engines, new generation of batteries and the development of advanced electric powertrains.

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