Smart Transportation Alliance

SAFE, GREEN AND CONNECTED ROADS FOR POST-COVID MOBILITY

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1. Background

The coronavirus outbreak has been one of the major shocks to the European and global economy in the past year. The COVID-19 pandemic has caused an economic crisis unique in its severity:

- Estimated unemployment rates of 21% by 2021.
- GDP reduction of 9.5-12.4% (estimated).
- Most affected sectors: hotels & restaurants, entertainment, tourism, commerce, etc.

In the European Union, Member States are taking measures to provide assistance to these particularly badly affected sectors. Within this current context of crisis, the Spanish Road Association (AEC – *Asociación Española de la Carretera*) has developed a Proposal Plan for "Safe, Green and Connected Roads" in Spain, which incorporates measures for urban and interurban roads. The initiatives included in such Plan are in line with Next Generation Europe requisites.

The “Safe, Green and Connected Roads Plan” for Spain is structured into twelve action programmes, six of these for rural roads and the other six linked to urban roads.

Based on the different references of European road construction and maintenance associations, AEC estimates that the application of this Plan will require the investment included in Table 1, where creation of employment is also included:

	Rural roads	Urban roads	Total
Investment (million €)	24,700	7,360	32,060
Creation of new jobs	345,000 (direct) 445,000 (indirect)	103,000 (direct) 132,00 (indirect)	1,0250,000

Table 1: Investment required and estimation of job creation (Source: AEC)

2. Objectives

The main objectives of the "Safe, Green & Connected Roads Plan", whose principles are aligned with the Spanish Strategy for Safe, Sustainable and Connected Mobility 2030, published in 2020 are:

- Propose initiatives for Next Generation Europe recovery and a resilience mechanism.

- Activate economy.
- Create new jobs.
- Adapt to mobility of the future (electromobility, micro-mobility, etc.).
- Support the implementation of the Agenda 2030, as the Plan integrates in a balanced manner the three dimensions of sustainable development – economic, social and environmental.

3. Safe, Green and Connected Roads: Action Programme for rural roads

The Safe, Green and Connected Roads Plan highlights the importance of improving rural roads for the fulfilment of sustainability objectives; six actions are proposed in order to increase the safety of highways, but also ensuring the proper implementation of clean energy and providing with an answer to current demography problems.

3.1. Safe roads.

This programme is divided into three lines of action. It is estimated that its implementation in Spain will require a total investment of 2,860 million euros and the generation of 40,000 new direct jobs.

Line of action 1: ROADS 2+1

The publication on single carriageways safety "*Seguridad en carreteras convencionales: un reto prioritario de cara al 2020*", carried out by AEC and Seopan (the Spanish Association of infrastructures construction and management companies), highlights the potential of 2+1 roads to reduce the number of frontal collisions on this road type. A '2+1 road' is a special road design based on the provision of two lanes in one direction and one lane in the other, alternating every few kilometres, with physical separation between traffic flows, allowing for safe overtaking.

The study, focusing on the Spanish road network, identifies 12 sections on 10 roads, with a total length of 114 kilometres, both on the national and regional road network. It represents an investment of **126 million euros** and the creation of **1,765 direct jobs**.

Image 1: Road 2+1 (Source: Generalitat de Catalunya)

Line of action 2: FORGIVING ROADS, SAFE SYSTEM APPROACH

The study brings forward changes in the infrastructure and its environment to reduce the number and consequences of run-off-road collisions, using a Safe System approach.
These roads create a safer environment for drivers by delimiting road sides or improving the road surface adherence, while they can reduce the consequences of accidents, providing a "safety zone" on road sides, smoothing the side slopes and removing obstacles from the side of the road; if these actions are not possible, installing the most appropriate vehicle restraint systems.

The analysis developed for the Spanish road network concludes that around 540 kilometres of roads should be improved to become significantly safer. This would require an investment of **326 million euros** and would generate **4,560 direct jobs**.

Line of action 3: HIGH RISK ROAD SECTIONS.

Finally, the study introduces the upgrading of high-risk road sections. These measures include low-cost actions, such as the installation of rumble stripe or directional panels, overtaking manoeuvre restrictions or using intelligent road signs on dangerous crossings, as well as other high-scale interventions.
Extrapolating existing data of the researched cases on the entirety of the Spain single carriageways road network, around 4,000 kilometres would be eligible for specific action, resulting in an investment of **2,400 million euros**, which would generate **33,700 direct jobs**.

3.2. Significant CO2 savings following a proper maintenance condition of roads

In 2020, the AEC released a study that estimated about 53% of the country's road network exhibits significant damage of the surface and structure on pavements. A new surfacing of these roads would reduce CO_2 emissions up to 6% for heavy vehicles and 9% for light vehicles. The study identified that specific works are necessary for almost 90,000 kilometres of roads, in some cases surface treatments suffice, and in other cases major structural renovations are necessary.

Carrying out surfacing work on part of the road network would mean an investment of **8,200 million euros**, and a total of **147,000 new direct jobs**.

Image 2: Resurfacing works (Source: AEC).

3.3. Adaptation of roads to connected and autonomous mobility

Connected and autonomous mobility is one of the greatest challenges today and the future of mobility. Optimising connected and autonomous mobility may require the adaptation of the existing infrastructure and its equipment to different automation levels of vehicles. Not only an optimal maintenance condition is required for roads, but also a consistent alignment, quality weather information, proper equipment (traffic sings, road markings, etc.),

communication technologies, traffic monitoring, emergency stop zones, 5G coverage, etc. (Source: CTAG – Automotive Technology Centre of Galicia).

The proposed programme for the progressive adaptation of the road network to connected and autonomous mobility is divided in two stages, one wide-ranging and a second one with a narrower scope, as described below:

- Stage 1: covering the entire Spanish motorways network (17,228 km), which concentrates 60% of national mobility.
- Stage 2: covering the main road network (not only motorways, but also primary highways from the national and regional road network) (50,028 km), which concentrates 75% of national traffic volumes.

According to European Union data, the unit cost to adapt a high-capacity road to connected and autonomous mobility lies at 230,000 euro/km; assuming a significantly lower cost on highways network (50% less), the following investments and direct employment perspective may be established:

	DESCRIPTION	INVESTMENT	DIRECT EMPLOYMENT
STAGE 1	Motorway network (17.228 km)	3,962,440,000 €	55,474
STAGE 2	Main road network (50.028 km)	7,734,440,000 €	108,282

Table 1: Investment and employment generation for the strategy for progressive road network adaptation to a future connected mobility

3.4. Charging stations for electric vehicles along roads

To solve the challenges of mobility electrification, besides the support to electric vehicle purchasing, it is also essential to build adequate infrastructures to allow vehicle charging in non-urban environments. In addition, solar energy recharging systems are to be considered along the entire road network.

The proposed Plan consists of two stages:

- Stage 1: equip all fuel stations with one solar-powered electric charging station (consisting of two charging spots). In Spain, 11,600 units would be required.
- Stage 2: in addition to stage 1, equip rural roads with a similar charging station every 50 km. The Spanish road network would need 3,300 units more.

The impact on investment and direct employment that the previous stages represent is shown below:

	DESCRIPTION	INVESTMENT	DIRECT EMPLOYMENT
STAGE 1	Fuel stations	928,720,000 €	13,002
STAGE 2	Stage 1 + every 50 km	1,192,720,000 €	16,698

Table 1: Investment and employment generation stages of the alternative energy charging infrastructure deployment Plan

3.5. Priority itineraries for freight transport in rural areas.

The aim of this programme is to ensure the safe and secure delivery of freight in rural areas, which could be affected by problems concerning the accessibility of these areas. This programme proposes the improvement of the overall accessibility and the creation of mini-logistics centres for the storage and distribution activities of goods.

This option is proposed for towns with 5,000 - 20,000 inhabitants (889 municipalities in Spain). It is estimated a total investment of **622 million euros** and the creation of **8,700 direct jobs** (an average of 10 jobs per municipality).

3.6. Roads for safe tourism mobility in depopulated areas

In order to recover tourism activity in Spain, this Plan considers the improvement of the road network in rural areas to allow safe, comfortable and efficient mobility. To that end it proposes to adapt access roads to small villages, especially for those with less than 5,000 inhabitants (6,827 villages in Spain, where 5.7 million people live).

For each one of these villages, the plan considers improvements on road sections 20 km long (average value), both rural and urban areas. In Spain, this would mean a total investment of **4,100 million euros** and the creation of **57,300 direct jobs**.

4. Safe, Green and Connected Roads: Action Programme for urban roads

The Plan also considers the importance of urban mobility, considering six specific actions which are described below. Vulnerable road users and reduction of congestion and emissions are in the centre of the actions in this context.

4.1. Improvement of sidewalks and pedestrian areas

The Plan proposes the creation of pedestrian areas and the enlargement of sidewalks in towns of more than 50,000 inhabitants. This would allow safe mobility of vulnerable users, while supporting sustainable mobility goals.

In Spain, our estimations cover the creation of pedestrian areas on 15% of urban road network and the enlargement of sidewalks along 40% of the urban road network. This would mean an investment of **190 million euros** and the creation of **2,700 direct jobs**.

4.2. Design and construction of specific lanes for bicycles, scooters and other personal mobility devices.

The plan includes the further construction of road lanes which are physically separated from motorized traffic, reserved for cyclists and scooter users.

In terms of geographic coverage in Spain the Plan involves the construction of 100 km of these specific lanes in Madrid, Barcelona and Valencia, 50 km in Seville, Zaragoza and Malaga, 20 km in another 57 towns between 100,000 and 500,000 inhabitants and in 86 municipalities between 50,000 and 100,000 inhabitants.

This means the construction of more than 3,300 km of lanes in total, resulting in a needed investment of more than **165 million euros** and the creation of **2,320 direct jobs**.

Image 3: cycle path (Source: web)

4.3. Redistribution of parking areas

The plan includes the construction of large parking areas in big cities (over 100,000 inhabitants), located underground in most cases. These parking areas can be labelled as 'park and ride' and they shall be linked to multimodal stations to facilitate commuting.

In Spain, this programme is estimated to cost **1,605 million euros** of investment and it will create **22,500 direct jobs**.

4.4. Low-emissions zones

Spain´s Integrated National Energy and Climate Plan 2021-2030 states that, from 2023 onwards, all cities with more than 50,000 inhabitants should establish low emission zones, with access restrictions for the most polluting vehicles. The plan will request an estimated public investment of 3,140 million euros.

This plan proposes to start, in the short term, with a third of the actions, which involve an investment of **1,036 million euros** and the creation of **14,500 direct jobs**.

4.5. Massive deployment of charging stations for electric vehicles

The Spanish Government's objective is to increase the number of electric vehicles up to 5,000,000 by the year 2030; currently, according to *Red Eléctrica de España* Spain's pool of electric vehicles reaches 81,000 units.

This plan aims to provide charging coverage for electric vehicles in cities, ensuring at least one charging post for every 10 electric vehicles. If the average cost of each public charging post is 6,000 euros, in order to support future cars fleet growth in the coming 3 years (it is considered that they would reach 1.5 million, to maintain sustained growth to be close to the rate of 5 million vehicles in 2030), 150,000 charging post will be need. This requires an investment of **900 million euros** and the generation of **12,600 direct jobs**.

4.6. Priority dedicated lanes for high-occupancy vehicles

This plan considers dedicated lanes based in the use of road equipment and intelligent transportation systems, thus reducing the investment needed for a large intervention work to create a physically separated lane in an already urbanized area. There is an example of this work in the access road A2 in Madrid, which is planned to be extended to other cities.

Image 4: A-2 in Madrid (Source: web)

In Spain, that means a total of 10 large cities (more than 500,000 inhabitants) and another 3 middle sizes cities between 100,000 and 500,000 inhabitants. Each action includes works on sections of 30 km of road (15 km each road side) with an average cost of 500,000 euros/km. In major cities the plan implies works over 1,800 km of roads and in cities between 100,000 and 500,000 inhabitants the improvement of 5,130 km of roads. The investment would reach **3,465 million euros** and the creation of **48,500 direct jobs**.

5. Conclusions

The coronavirus outbreak has been one of the major shocks to the European and global economy in the past year. The “Safe, Green and Connected Roads Plan” could be an opportunity to improve European mobility and economy sustainably. In Spain alone it is estimated that with a **32,000 million euro** investment it will be needed to carry out a total of 12 measures to soften the crisis which will generate 1 million of new jobs (direct & indirect) focused on the most vulnerable workforces.

This plan has been developed in accordance to the Next Generation Europe principles for ecological and digital transition of economies, while revitalizing the economy of Member States.

The following table summarises the main aspects of the application of the Safe, Green and Connected Road Plan in Spain.

	ACTIONS	ROADS: SAFE - S GREEN - G CONNECTED - C	PLAN IMPLEMENTATION IN SPAIN	
			Investment (million €)	Jobs created
Rural roads	**Safe roads**	S	2,852	- TOTAL: 91,429 - Direct jobs: 40,000 - Indirect jobs: 51,429
	CO_2 savings from a proper maintenance condition of roads	G	8,200	- TOTAL: 261,486 - Direct jobs: 114,400 - Indirect jobs: 147,086
	Adaptation of roads to connected and autonomous mobility	S & C	7,734	- TOTAL: 247,543 - Direct jobs: 108,300 - Indirect jobs: 139,243
	Charging stations for electric vehicles along roads	G	1,190	- TOTAL: 38,171 - Direct jobs: 16,700 - Indirect jobs: 21,471
	Priority itineraries for freight transport in rural areas	S & G	622	- TOTAL: 19,886 - Direct jobs: 8,700 - Indirect jobs: 11,186
	Roads for safe tourism mobility in depopulated areas	S & G	4,100	- TOTAL: 130,971 - Direct jobs: 57,300 - Indirect jobs: 73,671
Urban roads	**Improvement of sidewalks and pedestrian areas**	S & G	190	- TOTAL: 6,171 - Direct jobs: 2,700 - Indirect jobs: 3,471
	Design and construction of specific lanes for bicycles, scooters and other personal mobility devices	S & G	165	- TOTAL: 5,303 - Direct jobs: 2,320 - Indirect jobs: 2,983
	Redistribution of parking areas	G & C	1,605	- TOTAL: 51,429 - Direct jobs: 22,500 - Indirect jobs: 28,929
	Low-emissions zones	G	1,036	- TOTAL: 33,143 - Direct jobs: 14,500 - Indirect jobs: 18,643
	Massive deployment of changing stations for electric car	G	900	- TOTAL: 28,800 - Direct jobs: 12,600 - Indirect jobs: 16,200
	Priority dedicated lanes for high-occupancy vehicles	S & G & C	3,465	- TOTAL: 110,857 - Direct jobs: 48,500 - Indirect jobs: 62,357

6. References

i. Ministerio de Transportes, Movilidad y Agenda Urbana. Gobierno de España. (2021). *Estrategia de Movilidad Segura, Sostenible y Conectada 2030.* Retrieved from https://esmovilidad.mitma.es/

ii. Asociación Española de la Carretera. (2020). *Press release "¿Hay relación entre el estado del pavimento y las emisiones?".* Retrieved from https://www.aecarretera.com/sala-de-prensa/comunicados/comunicados-2020/3043-hay-relacion-entre-el-estado-del-pavimento-y-las-emisiones

iii. Asociación Española de la Carretera. (2020). *Press release "El sector viario presenta un Plan de Carreteras Seguras, Verdes y Conectadas que puede generar más de un millón de empleos".* Retrieved from https://www.aecarretera.com/sala-de-prensa/comunicados/comunicados-2020/3051-el-sector-viario-presenta-un-plan-de-carreteras-seguras-verdes-y-conectadas-que-puede-generar-mas-de-un-millon-de-empleos

iv. Asociación Española de la Carretera y SEOPAN. (2017). *Seguridad en carreteras convencionales: un reto prioritario de cara al 2020.*

v. Foro Español de Smart Roads. (2020). *Aportaciones de la infraestructura en distintos niveles de movilidad autónoma.* Retrieved from https://smartroads.aecarretera.com/wp-content/uploads/2020/12/POSICIONAMIENTO-CONDUCCION-AUTONOMA-Y-CONECTADA_V4.pdf

vi. Gobierno de España. (2020). *Plan Nacional Integrado de Energía y Clima 2021-2030.*

vii. Ministerio de Transportes, Movilidad y Agenda Urbana. Gobierno de España. (2020). *Press release "Mitma aprueba definitivamente los proyectos para la implantación del carril Bus-VAO en la autovía A-2 en Madrid"*. Retrieved from https://www.mitma.gob.es/el-ministerio/sala-de-prensa/noticias/mar-28072020-1454

viii. *Red Eléctrica de España*. (2020). Retrieved from https://www.ree.es/es