Financing green mobility
Is it enough and where does it go?

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There has never been more finance available for innovative green mobility in the transport sector than there is today. But where is all the finance going? How is the funding of the energy transition being made available to the different actors in the transportation sector? How are the actors utilizing the funds?

On Dec 9-10, 2021, **the annual International Conference on Mobility Challenges** provided an outstanding opportunity to bring together researchers, industry experts and policy makers to discuss these issues. This note gives a summary of the debate.[1]

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On public and private financing

The transport sector represents a form of substitution economy. The value created is not immediately perceptible to individuals and only makes sense with collective choice. Public policies are essential to assist in the deployment of green transportation technologies. In the past, regulations and subsidies such as feed-in tariffs have allowed renewable energies to develop.

About half of the €45 billion invested in the plan for climate is dedicated to the transport sector: €8 billion for low-carbon vehicles based on battery, natural gas or hydrogen; €10.6 billion for infrastructure deployment such as charging stations, alternative fuels refueling stations and rail infrastructure; and €10 billion for soft mobility (such as bicycle paths). The bulk of the increase in investments from 2019 to 2020 comes from funding for electric and hybrid vehicles, which tripled between 2019 and 2020. This increase is due primarily to the European regulation that require vehicle manufacturers offer low-carbon alternatives.

To determine whether the investment is sufficient, they should be considered relative to the PPE (Programmations Pluriannuelles de l'Energie) and the SNBC (Stratégie Nationale Bas-Carbone) with the goal of reducing greenhouse gas emissions by roughly 40% by 2030. For the transport sector, the investment deficit is estimated at about €6.5 billion for the coming years.

In the entire transport sector (including rail), 60% of the investments are public (managed by local authorities or network managers), while 40% are private, such as companies and households investing in EVs and charging stations. Public and private investments are interlinked; public project leaders can mobilize private funds just as private project leaders can mobilize public funds. For example, the SNCF network (a public sector investor) borrows from the private markets while an individual (private investor) can apply for an ecological bonus for his new EV.

Most investments are financed on the financial markets. For example, the Grand Paris Express company issued green bonds and will rely on operating revenues to repay this debt in the very long term, up to around 2070. For private actors, investments can be made from their own funds, loan from commercial banks or subsidies. In addition, regional initiatives may combine

local (public) authorities and private companies with hybrid financing, as is the case with the ‘Zero Emission Valley’ in the Auvergne-Rhône Alpes region.

With respect to hydrogen mobility, there is a very ambitious European policy for the upstream production of green hydrogen, but the policy for the deployment of downstream infrastructures is not jointly defined (contrarily to the joint policy adopted in Switzerland for the deployment of heavy trucks). In absence of such coordinated actions, private investors cannot be expected to make important long-term investments. Indeed, As much as 50% of FiveT's funds could be invested in the downstream infrastructure: this represents €800 million over the next 6 years, and €3-5 billion with other investors and public supports. This amount will only be invested where the policy makers have proposed the right coordinated policies.

We need to look at the hydrogen mobility business in the same way we looked at renewable energy fifteen years ago. In the face of uncertainty, we must bet that the dynamics will scale up these assets. By choosing the right partners and the right investments, the underlying dynamics will make these assets extremely valuable. Today, for example, investors are reluctant to invest in (blue) hydrogen production from natural gas because there is a belief that regulation, public policy, and the market will align in favour of renewable (green) hydrogen.

The European Union Fuel Cells and Hydrogen Joint Undertaking (FCH JU) has funded most of the R&D and demonstration projects so far. These projects are key to enabling the development of the market. The first support schemes were designed to support complete hydrogen ecosystems. As the hydrogen industry matures, European funding bodies are adapting their support schemes, with a greater focus on production and HRS (Hydrogen Refueling Stations). Recently released European calls for projects suggest a greater focus on developing green hydrogen production and the infrastructure network.

Public support is required in the EU countries for the first vehicles in the ecosystem. France has one of the most ambitious strategies at the European level regarding the development of renewable hydrogen. Many projects have been supported by ADEME (the French national agency for ecological transition) through the Call for Proposals “Ecosystèmes territoriaux hydrogène”. ADEME supports the development of complete hydrogen ecosystem (production, distribution, dispensing and end-applications) and aims to connect the different projects for large scale deployment in the medium term.

The French national hydrogen strategy is based on three pillars: (1) Decarbonization of industry, (2) Development of professional and heavy-duty mobility, and (3) R&D and innovation. The government has allocated about €10 billion to develop hydrogen for the period

of 2020-2030. This should contribute to develop 6,500MW of electrolysers – to produce 680,000 tons of hydrogen and create between 50,000 and 150,000 jobs over the next ten years.

On the EV market

Light vehicles

EVs are increasingly gaining competitive edge in the light-duty mobility segment. By 2025, EVs are expected to have a lower Total Cost of Ownership (TCO) compared to diesel fuelled vehicles. There seems to be a consensus among different stakeholders that LPG technology may no longer be needed in this segment. Vehicle Original Equipment Manufacturers (OEMs) have committed €300 billion worth of investments for electrification by 2030, many of them no longer propose new vehicle models powered by LPG technology.

The bottlenecks in the transition to electric vehicles are the availability of raw materials, production of green electricity, the deployment of public charging infrastructure in dense urban areas and highways, and securing rural connections. We believe that France is out of the chicken and egg dilemma with the ongoing massive investment in the charging infrastructure. The year 2020 witnessed a turning point for the electric mobility market in France. In 2020, about 200,000 EVs were sold in France, representing more than 10% of the light vehicle sales. Moreover, the sales have been increasing in the first 10 months of 2021. A previous forecast estimated that 15 million EVs would be sold in France by 2035. A revised forecast is now up to 17 million EVs after the announcement of the ban on the sale of new petrol and diesel vehicles in 2035 by the EU.

Heavy-duty Vehicles

Today, biogas is the only low-carbon alternative available for the heavy-duty vehicles (truck mobility) sector. There will be no 44-ton BEV or FCEV available for sale before 2024 and there is a significant lack of infrastructure for these technologies. In the long term, there is no one-size-fits-all solution in this segment.

Conventional fuels are omnipresent in this ‘hard-to-decarbonize’ segment, and it is likely that different low-carbon technology solutions will coexist and complement one another in this segment. Each low-carbon technology has its strengths and weaknesses. Biogas, battery electric and green hydrogen have limited resources. Biogas vehicles are the only mature low-carbon technology with low TCO, but the technologies suffers from the emission of local

pollutants. Electric and green-hydrogen vehicles do not emit local pollutants but have a significant TCO challenge that still needs to be resolved. In addition, operational constraints such as the charging time and travel range play against electric mobility in this segment. It is necessary to consider the complementarity among these technologies to rapidly decarbonize the heavy-duty vehicles sector.

Segmentation of the recharging market for EV

Connecting shared houses/buildings to charging points: Home charging is the cheapest and requires the least infrastructure investment. Therefore, the most economical solution is to maximize home vehicle charging, though this approach is challenging given that 44% of people live in collective buildings. A pending law aims to ease the installation of charging points in collective/shared buildings and it is expected that the decree will be finalized rapidly.

Access to public charging infrastructure: Additional expertise is needed to help the public authorities design the master plan. Development of the master plan will require working with the local authorities to provide network capacity and EV market penetration forecasts.

Fast charging on highways: There is a plan underway to equip highways with fast charging options before the end of next year (2022). Network studies to assess the power demand and fast charging requirements are needed.

By 2025, according to the French Mobility Orientation Law ('LOM Law'), all non-residential car parks with more than 20 spaces will be required to equip 5% of their space with charging stations for EVs, forcing medium and large-scale retail outlets to adapt. In addition, motorway concession companies will have to equip their service areas with charging stations by 2023. The 'LOM Law' also provides for the installation of charging stations in condominium parking lots. Despite these obligations, the work to connect the electric network to the charging stations takes an average of nine months and is holding back the development of electric mobility in France.

For retailers who own parking lots, most operators are ready to finance the infrastructure on their parking and share the generated revenue with them and retailers are willing to install charging stations in their parking lots. Moreover, France's 2022 target of 100,000 charging stations is not necessarily a satisfactory indicator to measure the deployment of charging stations, given the difference between slow and fast charging stations. It may be more relevant to observe the deployment in terms of the installed capacity per parking lot. It is also necessary

to strike a balance between charging time and customer needs (e.g. thirty-minute parking at a food chain parking lot versus two-hour parking at a cinema parking lot).

Simulation results show that 35-50 kWh BEV with 22-50 kW chargers are the most cost-efficient solution for urban needs, and 55 kWh BEV with 50 kW chargers are optimal for rural needs.

Business models and profitability for EV rechargers

Operators typically buy electricity from suppliers and sell this electricity with charges on stations that start at 200 kWh up to 2000 kWh. They let the installation to landowners on a long-term basis.

The fast-charging business model should be distinguished from the classic charging, which differs in terms of roadways and urban landscape. Despite the existence of a traffic risk, the existence of a business model around fast charging is becoming feasible. First, the user is aware that they are paying for a different service, and is willing to pay a premium for speed (between 0.45-0.70 €/kWh compared to 0.15 €/kWh at home). This leaves the opportunity to make a significant margin. For slower charging on the street, the user is less willing to pay more per kWh. Secondly, fast charging stations have a relatively high turnover (2 charges per hour), so the business can be profitable.

The internal rate of return (IRR) on investment for fast charging projects remains very uncertain, depending on hypothesis it can be between 10-30%. Despite the uncertainties, many investors are positioning themselves to take advantage of this market, including BlackRock, which has invested $500 million in Ionity, a company that builds high-power charging network for electric vehicles along major highways in Europe. Today, there seems to be no lack of investors for projects. The calls for tender for motorway concessions has apparently been successful even though a charging station on a freeway costs about €1 million.

Given the considerable uncertainty around the profitability of some investments, some banks have adopted a diversified approach by setting up funds not only dedicated to transport and mobility, but also offering a broader investment on energy transition. Today, the expected IRR over 10 years is 8-9% in new mobility projects, as there is always a risk premium. Once the projects are more mature and de-risked, the IRR will tend towards 4-5%, like other renewable energy projects.

On hydrogen deployment

The hydrogen projects in France and around the world

The deployment of hydrogen in France will be mainly concentrated within some large industrial clusters (basins) for industry and mobility. Two scenarios have been considered: (1) A reference Scenario (based on the national goals) - 6.5 GW of electrolysis, 1,000 hydrogen refueling stations; and (2) a more ambitious scenario – 10 GW of electrolysis, 1,700 hydrogen refueling stations.

Currently, France has only 25 hydrogen buses with 63 buses under construction. An additional 360-400 buses are also planned for deployment in the near future. There is only one in France hydrogen truck in France today; however, many more trucks are going to be deployed. The Occitanie regional project ('Hydrogen Corridor' project) targets two production units of renewable hydrogen, eight refueling stations, forty hydrogen trucks, forty refrigerated trailers, and fifteen hydrogen retrofitted coaches.

There are now many international projects with at least a partial focus on hydrogen for mobility. More than 85% of the announced projects have mobility end-uses (buses, trucks, and cars) and more than 95% of the projects will rely on green hydrogen production.

The three common types of projects, and their associated challenges, are outlined below:

- Local, small-scale, and mobility-focused projects that are mostly led by Public-Private Partnership (PPP) initiatives, often with long-term experience and mostly located in Europe. The challenge here is the accessibility of public funds and not the availability.
- Local, medium-scale, and industry-focused projects that are centered around one or two large industrial players (refinery or fertilizer manufacturers) with mobility off-takers as a potential add-on. These projects are mostly led by the private sector. The primary challenge for these projects is compliance with regulatory requirements.
- Large-scale, international and export focused projects that aim to connect global supply and demand. The projects develop in phases to mitigate investment risks and can be led by the private sector or large sovereign investors. The challenge here is putting long-term commercial off-take arrangements in place to reduce investment risk.

Hydrogen retailing stations

Hydrogen mobility requires fewer charging points compared to electric mobility. Hydrogen refining stations are an essential part of regional clusters. It is an easy and profitable model to

deploy in an area like Paris in which Hype (outlined below) already provides a substantial demand for hydrogen. For a complete deployment between regional clusters along major traffic roads in Europe, the European directive indicates that about 900 stations would be necessary, with roughly 100 located in France. For the coming years, it is especially important to build stations where a fleet need has been clearly identified.

The Zefer project and Hype

One of the flagship projects supported by EU policy for light-duty vehicles is 'ZEFER' (Zero Emission Fleet Vehicles for European Roll-out) which targets the deployment of a 180-vehicle fleet in Paris, London, and Copenhagen. The project has been successful, with over 99% availability of the vehicles, and has inspired subsequent projects. Nonetheless, despite decreasing vehicle costs, national and regional grants are still needed to further reduce the cost premium of FCEVs (Fuel Cell Electric Vehicles) and accelerate the market. In the year 2021, the TCO (Total Cost of Ownership) is still high.

The 'Hype Project' in France is part of the Zefer project. It has successfully mobilized European and national funding to accelerate the deployment of the largest FCEVs taxi fleet in Paris. Also, similar large scale projects are emerging across Europe in taxi applications (for instance in Madrid).

The need for cost reduction: A challenge for French hydrogen mobility

Cost reduction of hydrogen technology is possible by scaling up of production, developing infrastructure for hydrogen transportation (pipes) and distribution (refueling stations), and developing downstream sectors (mobility, industry, and energy) demand. To reduce costs, building territorial ecosystems and scaling up the production are critical. A key factor in scaling up hydrogen technology comes from the European hydrogen backbone project, spanning 21 countries and 23 Transmission System Operators (TSOs) it aims to develop 40,000 km of hydrogen pipelines. Fostering innovation and R&D efforts should also be maintained.

The International Conference on Mobility Challenges December 9-10, 2021

Sponsors

Armand Peugeot Chair (CentraleSupélec & ESSEC Business school),

Chair Energy & Prosperity (Fondation du Risque)

Climate Economics Chair (Université Dauphine - PSL).

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List of invited speakers

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