IMPACT STUDY OF THE IMPLEMENTATION OF A BIONGV TER SECTOR IN FRANCE

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Introduction & Objectives

In recent years, the NGV sector has affected various areas : freight transport, passenger transport, urban cleaning, logistics, etc. It also appears that BioNGV can be an alternative energy in the railway world, particularly in passenger transport.

Currently, 930 TER railcars still run on diesel in France. They make it possible, in most cases, to serve the smallest service lines and isolated stations of the territory, where electrification would represent a significant cost.

These TER are divided into 6 different models, three built by Alstom in 100% diesel (X72500, X73500 and X73900) and three models built by Bombardier. Two models are two-modes diesel-catenary (B81500 and B82500) and the last model is 100% diesel (X76500).

On this TER fleet, a certain number are reaching mid-life, thus allowing extensive maintenance or engine replacement. This represents an opportunity to change engines to a cleaner technology.

Currently non-existent in French railways, BioNGV technology could easily be integrated into existing diesel train structures and thus create a new sector. This sector has ecological advantages, with a sharp reduction in CO_2 emissions, and economic advantages, by lowering the energy bill for the operation of TER. In addition, this technology is already industrialized in the road industry and benefits from a highly developed supply network with the presence of a natural gas transport and distribution network, and therefore of BioNGV, in France.

As employment is a strong argument in favor of new industrial sectors, the evaluation of the impact of the BioNGV TER sector in France by 2030 on employment is a good vector to support its development and demonstrate its qualities.

Thus, the study aims to determine the direct, indirect and induced jobs that this new sector could generate by administrative region:

- Direct, indirect and induced FTEs, current and future, as well as their progression until 2030.
- Co-jobs, ie identical jobs for diesel.
- Distribution of jobs by type of actor, by qualification and by location.
- Catalytic FTEs: jobs retained by maintaining rail links thanks to the gain in competitiveness provided by BioNGV. These jobs may be directly linked to the operation and maintenance of the line or may be dependent on the presence of a local station.
- The economic impacts of the turnover generated in France and in Europe as well as the tax impacts.

Executive summary

The BioNGV represents an alternative solution to the diesel TERs that circulate in France. This solution seems to meet TER uses for a large part of the diesel TERs present in France with scenarios, proposed by Sia Partners, estimating a potential between 33% and 70% of the fleet running on BioNGV in 2030.

The central scenario of this study targets a fleet of 563 BioNGV TER in 2030, or 61% of the TER fleet, representing an annual consumption of 560 GWh, which would lead to a reduction of 175,000 t / year in CO_2 emissions.

From a social point of view, the establishment of such a sector would represent, in 2030, 15,200 long-term jobs working on the operation and maintenance of TER but also on BioNGV refueling stations and biomethane production units. 2,100 non-sustainable jobs would also be generated over the year 2030 to finalize the implementation of the sector : transformation of TERs into BioNGV, construction of BioNGV refueling stations and construction of anaerobic digestion units. A total of 16,750 jobs would therefore be created by 2030.

Of these 16,750 jobs, 10% (nearly 1,600 jobs) would be specific to the BioNGV sector. They would concern the construction activities of refueling stations, the construction and operation of anaerobic digestion units, but also a non-negligible part of the jobs generated by the transformation of TER into BioNGV. Among the jobs generated by the transformation of TER into BioNGV, 41% would be direct jobs related to the R&D of BioNGV TERs and indirect jobs related to the manufacture of specific equipments for BioNGV TERs.

From an economic point of view, the BioNGV TER sector would generate an income of 1.5 billion euros, mainly from the operation and maintenance of TERs.
Of these revenues, 73% would be distributed in the French economy in the form of remuneration, gross operating surpluses, taxes and duties and 27% would be used to import equipments and products not manufactured in France. To compare, when French industry generates a resource in France (national production and imports, to meet French needs), it relies on 35% of imports. The BioNGV TER sector would therefore be less dependent than the average on imports.

Finally, BioNGV TERs demonstrate economic efficiency by consuming less fuel, which is itself less expensive. Thus, up to 55% of the costs related to fuel consumption can be avoided, which represents 65,000 euros per year for a TER traveling 100,000 km per year.

This increased profitability could support, indirectly, the maintenance of TER lines in rural communities in France and thus have several positive effects on the (re) location of jobs and the reduction of CO_2 emissions.

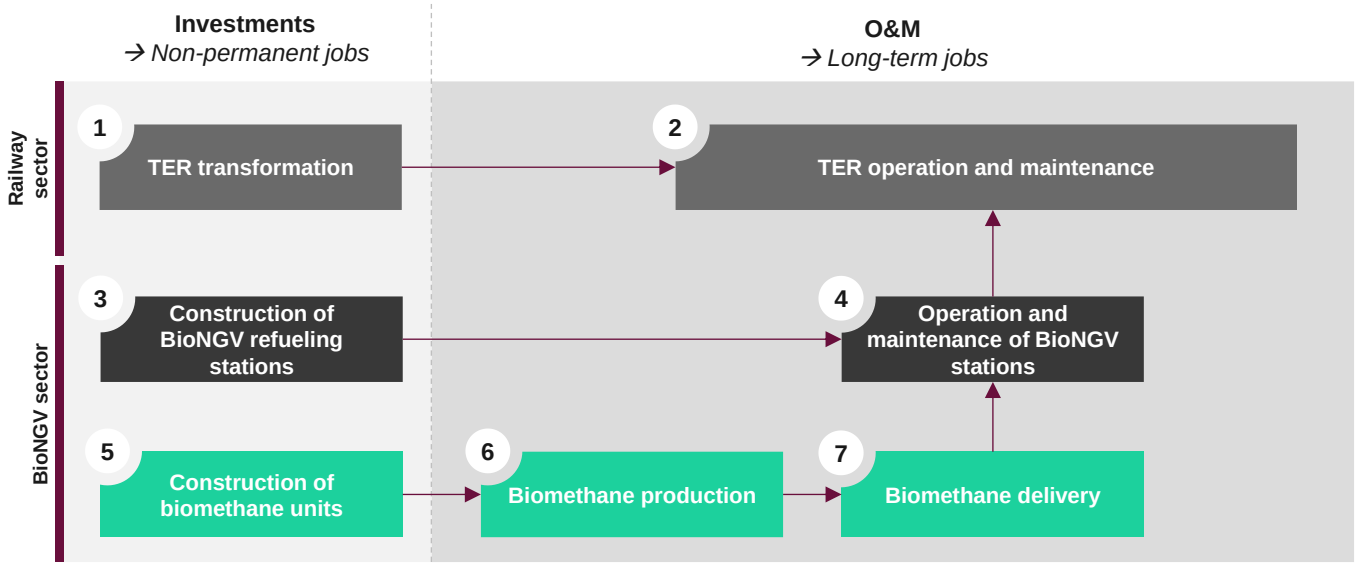
Indeed, it was estimated that the maintenance of these smaller service rail lines would lead to:

- The maintenance of 16,000 rail jobs linked to the operation and maintenance of rail infrastructure and TER,
- The maintenance of a territorial dynamic concerning approximately 113,000 rural jobs,
- The maintenance of rail transport for around 94,000 people to get to their place of work, preventing them taking the car and thus generating additional annual emissions of 91,000 tons of CO_2.

General methodology

The estimated number of jobs generated by the establishment of a sector includes jobs directly affected by the sector in question. The establishment of the BioNGV rail sector involves the business segments described in Figure 1.

FIGURE 1: BIONGV TER SECTOR DESCRIBED BY BUSINESS SEGMENTS



Other jobs are created, in particular those related to suppliers in these business segments. This is referred as indirect employment which is calculated for all suppliers, for suppliers of suppliers, and so on.

Finally, the estimated number of jobs also includes jobs that are created by spending on the wages of jobs created directly and indirectly. These jobs and economic impacts are called the induced impact.

The entire rail BioNGV activity also translates into environmental impact through the consumption of BioNGV rather than diesel. This environmental impact is expressed as a reduction in emissions of CO_2, NO_x and $PM_{2.5}$ and PM_{10}. The noise impact of the CNG hybrid engine is also taken into account without, however, being monetized.

In addition to these direct and indirect impacts, this study sought to quantify the number of jobs affected by rail links involving BioNGV TERs. These jobs represent the so-called catalytic impact of the BioNGV rail industry. These jobs relate to both the operation and maintenance of railway lines and the operation and maintenance of the TERs themselves. All the jobs affected by the presence of a station (counter, maintenance, relay, etc.) are also included in this catalytic impact. This impact would make it possible to underline the environmental impact of maintaining the rail link by avoiding the modal change of transport from train to car.

Participants

We would like to thank all the rail and NGV players who participated in this study:

- 2C-Consulting
- AS24/Total
- Bombardier
- GRDF
- Groupe Iming : Ingéole / SPMO
- Naturgy
- Proviridis

The results and analyzes of this study are the sole responsibility of Sia Partners. The vision given in this document results from the analysis of Sia Partners in total independence.

Summary

1. Geographical situation and projections

Estimating the impacts of the BioNGV TER sector in France begins with carrying out an inventory of the existing TER fleet and imagine its transformation into BioNGV.

This projection also makes it possible to calculate the forecast consumption of biomethane by the sector. The goal is to compare it with the potential for biomethane production by region and thus verify the correct correlation between production and local consumption.

A. Existing fleet of diesel TERs and its transformations into BioNGV to 2030

France has a fleet of TER of which 930 use diesel. This diesel TER fleet is made up of 6 models from two manufacturers: Bombardier and Alstom. Of these 6 models, 2 are dual-mode (called BGC), that is to say they can run under catenary when the line is electrified and can also run on non-electrified lines thanks to their diesel engine. The other 4 models are 100% diesel.

The TER fleet is spread over the entire territory according to the table below:

TABLE 1 : REGIONAL BREAKDOWN OF DIESEL TERS[1]

Region	B81500	B82500	X76500	X72500	X73500	X73900	Total
Auvergne Rhône-Alpes	40	28	26	16	82		**192**
Nouvelle Aquitaine	51	10		23	53		**137**
Hauts de France		46	34	6	12		**98**
Grand Est		15	59		21	17	**112**
Bourgogne Franche Comté	39		5		39		**83**
Occitanie	28			8	38		**74**
Normandie		9	14	14	25		**62**
PACA	26		9	17			**52**
Pays de la Loire			16	10	14		**40**
Centre-Val de Loire	1			16	16		**33**
Ile de France		24					**24**
Bretagne		8			15		**23**
France	**185**	**140**	**163**	**110**	**315**	**17**	**930**

The conversion operation to BioNGV consists of changing the existing diesel engine, partially or totally, in order to run on BioNGV. Several technical elements need to be installed: storage of BioNGV, engine control systems and injection of BioNGV ... In the model of BioNGV train studied, a battery is also added in order to optimize the consumption of the TER and switch off the TER engine when passing through a station, reducing pollutant emissions and noise at the station.

In this study, the transformation of trains to BioNGV as a replacement solution for diesel TERs is studied according to the identified uses. The regions, in view of the remaining years of life of the TER and the consequent investments, could prefer to renew the rolling stock at the end of its life rather than opt for a retrofit or a change of the engine between 2025 and 2030.

On this existing fleet, several fuel modification options are being considered: batteries, B100 and BioNGV. Electrification of lines is not considered as a possible solution in the short and medium term due to its high cost. The choice of energy used is made according to several environmental, economic, technical or operating criteria:

[1] Source : Le matériel roulant de la SNCF, Denis Redoutey

- Criterion 1: the BioNGV TER is only interesting on lines with non-electrified lines over a distance of 80 km. Below this distance, the battery-powered TER appears to be a more attractive solution both economically and environmentally. The batteries would make it possible to convert 50% of the fleet of dual-mode TERs and the rest could be converted to BioNGV. This constraint determines the part of two-mode TER transformed in the high scenario.
- Criterion 2: The frugal electrification of the line terminals would allow recharging of the batteries, thus increasing the battery uses that could be made on the dual-mode models. This assumption leads to reducing the share of two-mode TER convertible to BioNGV and to bring it down to 25% of the fleet. This assumption is used to determine the part of two-mode TER transformed in the low and intermediate scenario.
- Criterion 3: The retrofit of the TER X72500 model is not of much interest to the regions. The regions would therefore probably have to wait for the end of life of this model to carry out a total renewal (BioNGV or other), an operation which should be carried out after 2030. This constraint eliminates the X72500 model from the potential for transformation to BioNGV. It is applied for all scenarios.
- Criterion 4: A last alternative energy available in the short term and at low cost is the B100. The main regions producing rapeseed and agrogasoil would potentially prioritize this energy. Regions such as Hauts-de-France, Grand-Est, Normandy, Bourgogne-Franche-Comté, Occitanie and PACA have both developed rapeseed areas and sizeable agricultural production units. This assumption is used in the low scenario.

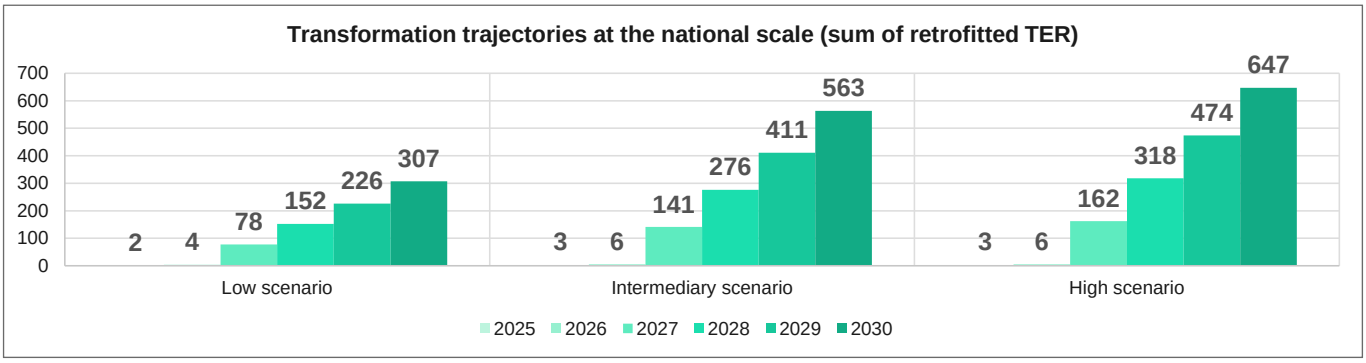
From these 4 criteria, 3 transformation scenarios were drawn:

- Low scenario: The rapeseed and agrogasoil producing regions prefer the deployment of TER B100 (100% rapeseed oil origin diesel) rather than BioNGV trains. In addition, frugal electrification, allowing the deployment of end-of-line recharging for BGC TERs, limits BioNGV uses to 25% on these models. The low scenario leads to a conversion rate of the TER diesel fleet of 33% to BioNGV.
- Intermediate scenario: All 100% diesel TERs are converted to BioNGV. For BGCs, frugal electrification makes it possible to consider the transformation or renewal of 25% of the existing fleet to BioNGV. The intermediate scenario, which will be the main scenario for the presentation of results leads to a transformation rate of the TER fleet of 61%.
- High scenario: 100% diesel TERs are converted or completely renewed to BioNGV. For BGCs, electrification is not taking into account, which makes it possible to consider 50% of these TERs circulating on BioNGV. The high scenario makes it possible to achieve a conversion rate of 70% of the existing TER fleet.

The period over which the transformation of TER is carried out is estimated between 2025 and 2030. The transformation would be done in 2 stages. The first would be to carry out a small number of transformations over the first two years, 2025 and 2026, in order to put in place the necessary organization to reach an industrial phase over the following three years.

All of these assumptions lead to the trajectories described in the graph below:

FIGURE 1 : EVOLUTION OF BIONGV ROLLING STOCK UNTIL 2030 (CUMULATIVE NUMBER OF TERS TRANSFORMED)[2]

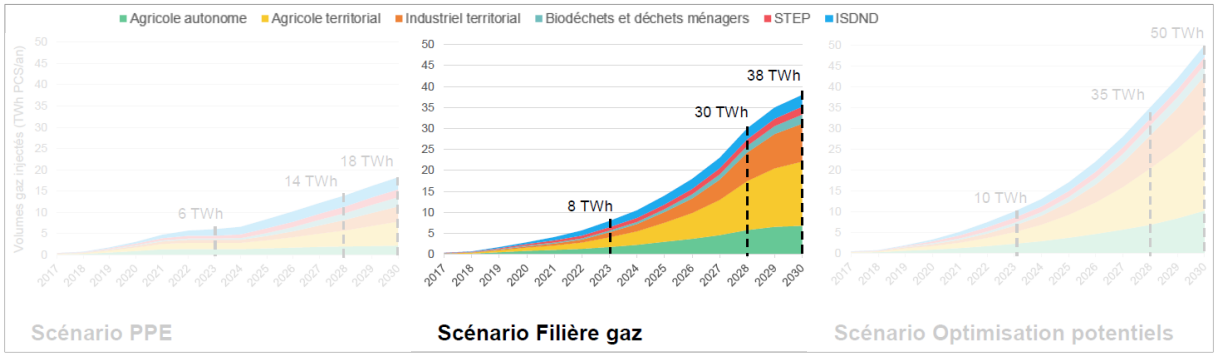


B. Biomethane production and demand scenario for BioNGV

As part of this study, jobs related to the construction and production of BioNGV are also estimated. In order to be able to account for these jobs, it is necessary to use a biomethane production scenario that has been defined by the French gas sector.

The biomethane production scenario adopted is that of the gas sector, which is described below:

FIGURE 2 : SELECTED BIOMETHANE PRODUCTION SCENARIO – THE GAS SECTOR SCENARIO[3]



Source : Etude emploi biogaz GRDF - 2019

The biomethane development scenario introduces an annual production volume as well as a structure of the production chain in terms of types of injection units. Knowing the typology of the anaerobic digestion units deployed is important to estimate the number of jobs in construction, operation and maintenance of injection units. For example, agricultural anaerobic digestion creates more jobs than units backed by WWTP or non-hazardous waste storage facilities.

Moreover, these scenarios give different regional development trajectories, which makes it possible to refine the regionalization of the impacts linked to biomethane production and to check regional production capacities in relation to the consumption of rail BioNGV.

In order to carry out this verification, regional consumption in 2030 was calculated for each region based on the fleet transformed by region and consumption data provided by the railway engineering offices.

[2] Source : Sia Partners from Le matériel roulant de la SNCF de Denis Redoutey
[3] Source : Etude d'impact emploi de la filière biogaz en France, Transition – GRDF, 2019

TABLE 2 : ANNUAL CONSUMPTION OF BIONGV BY REGION[4]

Region	Mean annual distance traveled per TER (km/year)	BioNGV consumption in 2030 (GWh)
Auvergne Rhône-Alpes	86 000	**126,0**
Nouvelle Aquitaine	93 000	**69,9**
Hauts de France	72 500	**47,7**
Grand Est	72 600	**85,8**
Bourgogne Franche Comté	96 000	**59,1**
Occitanie	107 000	**56,1**
Normandie	80 000	**38,0**
PACA	77 000	**12,5**
Pays de la Loire	78 000	**28,5**
Centre-Val de Loire	103 000	**20,1**
Ile de France	34 000	**1,8**
Bretagne	79 000	**14,4**

These consumptions are compared to the productions estimated by region in the gas sector scenario:

TABLE 3 : ESTIMATION OF BIOMETHANE INJECTION CAPACITIES BY REGION (GAS SECTOR SCENARIO)[5]

Region	Injection capacities in 2030 (GWh)
Auvergne Rhône-Alpes	**3 831**
Nouvelle Aquitaine	**4 407**
Hauts de France	**3 897**
Grand Est	**3 700**
Bourgogne Franche Comté	**2 269**
Occitanie	**2 845**
Normandie	**3 042**
PACA	**1 266**
Pays de la Loire	**3 585**
Centre-Val de Loire	**2 269**
Ile de France	**2 664**
Bretagne	**4 226**

Across France, the consumption of BioNGV in 2030 by the TER fleet would reach 560 GWh per year (the consumption of 2,240 buses) and would represent around 1.5% of biomethane production. The region with the highest consumption rate of biomethane produced would be the Auvergne - Rhône - Alpes region with 3.3% of its production consumed by BioNGV TER.

The establishment of the BioNGV TER sector by 2030 would therefore represent only a minimal share of biomethane production in France in 2030.

[4] Source : Sia Partners d'après ARAFER 2016, Bombardier, 2C-Consulting, GRDF
[5] Source : Etude d'impact emploi de la filière biogaz en France, Transition – GRDF, 2019

2. A redesigned railway system to integrate BioNGV

The development of the BioNGV TER sector in France would require the mobilization of industrial players in the railway sector and the establishment of a set of infrastructures to produce and transport the BioNGV to the TER supply.

Thus, railway design offices, manufacturers (Bombardier and Alstom), maintenance workshops and railway operators would be mobilized on the development of BioNGV TERs, from their transformation to their operation and maintenance.

As for the BioNGV sector, the biomethane delivery network is already well in place, but the production and fueling sectors need to be deployed more widely. Actors involved in the construction of anaerobic digestion units as well as the construction of TER refueling stations will be mobilized, as will those involved in the operation and maintenance of these units

The estimation of employment impacts on all these blocks is based on work units, described in the following sections. These work units are then associated with FTE ratios per work unit, which are collected during interviews with the sector.

A. Transformation of TER to BioNGV[6]

The transformation of trains to BioNGV is carried out in 3 stages. The unit of work associated with this activity is the TER.

The first step is to develop BioNGV TER models. This step includes research, engineering and prototyping of the systems developed. It would represent a cost that could vary from 15 to 20 M€ per TER model developed.

The second step is the approval of the BioNGV systems. It concerns the homologation of the BioNGV engine, the homologation of the engine system combined with the control electronics and a final homologation of the BioNGV storage system. These approvals are necessary in order to verify compliance with the safety and environmental standards defined by the European and French regulatory framework.

All research, development, prototyping and approval costs come to € 100,000 per TER under the intermediate scenario which sees 563 TERs transformed on 4 BioNGV models developed.

The last step is to carry out the transformation in the industrial workshops. For this step, the main cost items are the engine, gas storage system, control electronics, catalyst, hybridization system and assembly. The transformation is valued at around € 650,000 per TER, excluding research, development and approval costs.

The sum of these costs determines a total cost of the retrofit of around € 750,000 per TER.

Among these costs, research, development, prototyping and homologation are considered specific to BioNGV, ie 100,000 € per TER. In terms of equipment, € 120,000 related to storage of BioNGV and engine hybridization are specific to BioNGV hybrid models. Of the € 750,000 cost of retrofitting a TER, a total of € 220,000 would be specific to BioNGV, i.e. 29% of the cost of transforming the TER.

[6] The data on the transformation of TERs come from interviews with stakeholders in the sector.

B. The operation and maintenance of TER

The operation and maintenance of the TER is carried out in the region that owns the rolling stock. The unit of work associated with this block is the distance traveled by region by all the TERs transformed in this region, this unit is the TER.km.

According to the 2016 ARAFER[7] (now ART) study on the operation and maintenance of TER, the main cost items are as follows:

- Tolls for the use of rail infrastructure
- Driving
- Support
- Rolling stock load
- Distribution
- Other expenses

This ARAFER report also indicates that an average of 18 SNCF agents work in the TER operation and maintenance segment for 100,000 TER.km traveled in the region.

The interviews also revealed that there would be very little difference in the maintenance of BioNGV engines compared to diesel engines, involving no additional jobs or expenses. Thus, this ratio of 18 jobs per 100,000 TER.km is applied to the distances traveled by BioNGV TER.

C. Construction of BioNGV refueling stations and operation and maintenance[8]

Refueling with BioNGV involves the establishment of new infrastructures different from diesel refueling stations. This activity is specific to the BioNGV TER sector.

The main unit of work of this block is the amount of BioNGV consumed (in GWh) per region. It makes it possible to calculate the number of refueling stations needed but also to estimate all the operating and maintenance costs linked to the activity of the stations. The sizing of a rail refueling station was assumed to be similar to that of a private refueling station for a small fleet of buses (10 to 12 buses) requiring the refueling of 2 buses in parallel.

Regarding the construction part of the BioNGV stations, 3 major cost items make up its price:

- Engineering and studies: study and land prospecting, technical study of supply needs and equipment sizing, feasibility studies (connection and flow rate proposed by the gas network operator, electrical connection) and geotechnical study. This step represents around € 90,000 to € 100,000 per station.
- The works: Civil Engineering, Piloting and Conduct of works, VRD, electricity… This cost item is around € 300,000 which is lower than for a bus station due to a limited civil engineering cost (groundworks and electrical connection are already done).
- Equipment: Compressors, distributors, compressed gas storage tanks, video surveillance and control system. The compressors are of European origin but not French. The main compressor manufacturers are the German Bauer and the Italian Fornovo Gas and Safe. The total cost of this item is up to € 900,000.

A refueling station costs around 1.3 million euros, a slightly lower budget than for roadside stations because the land development for the CNG station is less important (sites already served).

[7] ARAFER – Bilan annuel du marché français du transport ferroviaire de voyageurs, 2015-2016
[8] Données issues des entretiens avec les acteurs de la filière GNV

D. Construction of anaerobic digestion units and production of BioNGV[9]

The construction of anaerobic digestion units and the production of BioNGV are activities specific to the BioNGV sector and which therefore represent additional jobs compared to the diesel sector. As part of the diesel sector, the investment and operation of diesel production units are activities carried out outside of France, leading to the import of 100% of the diesel consumed by TER.

All the data and information on the construction of biomethane units and the production of BioNGV were extracted from the study of the employment impacts of the biogas sector carried out by Transition on behalf of GRDF in 2019.

These results were transcribed as a ratio per GWh and are divided into two segments:

- Construction of anaerobic digestion units: the employment per GWh ratios in the construction segment of anaerobic digestion units were multiplied by the quantity of BioNGV consumed by the newly transformed TER. The cost items for the construction of anaerobic digestion units were recovered in the study on the industrial roadmap for the biomethane sector carried out in 2018 by GRDF.
- The biomethane production segment also draws its data from the two studies mentioned above. These € / MWh or employment / GWh ratios are multiplied by the quantities of BioNGV consumed by the entire BioNGV TER fleet.

E. The delivery of biomethane to refueling stations

The delivery unit constitutes the activity of transporting biomethane from its place of injection to its place of consumption. Operators of natural gas transport and distribution networks are included in this scope, as are operators of natural gas storage sites. On the other hand, LNG terminal management companies are not considered because they do not act within the framework of the biomethane / BioNGV market.

This activity is considered to be similar to the activity of transporting diesel fuel, which implies that the jobs of this activity are recorded in the "co-employment" segment.

All the cost items were calculated on the basis of the CRE reports on the costs of the natural gas transmission, distribution and storage operators: GRTgaz, GRDF and Storengy.

The 2019 jobs were identified across all players in this segment to calculate the ratios number of jobs per TWh of natural gas consumed in France in 2019. The employment impact of this segment was calculated by combining these ratios with the annual quantities consumed by BioNGV TERs.

[9] GRDF / Transition – Etude d'impact de la filière biogaz sur l'emploi en France de 2018 à 2030, 2019

3. Social and economic impacts are distributed over the territory in favor of regions with a developed industrial fabric

The impacts of setting up a BioNGV TER sector are direct, indirect and induced[10]. These impacts are estimated for the three scenarios defined above. The details of the impacts are presented only for the intermediate scenario.

A. National impact on employment of the 3 scenarios studied

The employment impacts of the three scenarios are between 9,400 and 19,100 jobs in 2030. This large difference is the consequence of the number of TERs transformed into BioNGV in the three scenarios.

These estimated jobs are separated into two categories:

- Non-permanent jobs linked to the construction, in 2030, of anaerobic digestion units, BioNGV refueling stations and the transformation of the last TERs,
- Long-term jobs linked to the operation and maintenance, in 2030, of anaerobic digestion units, refueling stations, BioNGV TER and gas networks making it possible to transport the BioNGV from the anaerobic digestion unit to the refueling station.

In the low scenario, where BioNGV TERs are in direct competition with battery TERs and TERs running on B100 (agrogasoil produced in France), the number of jobs in 2030 would reach 9,400 FTE.

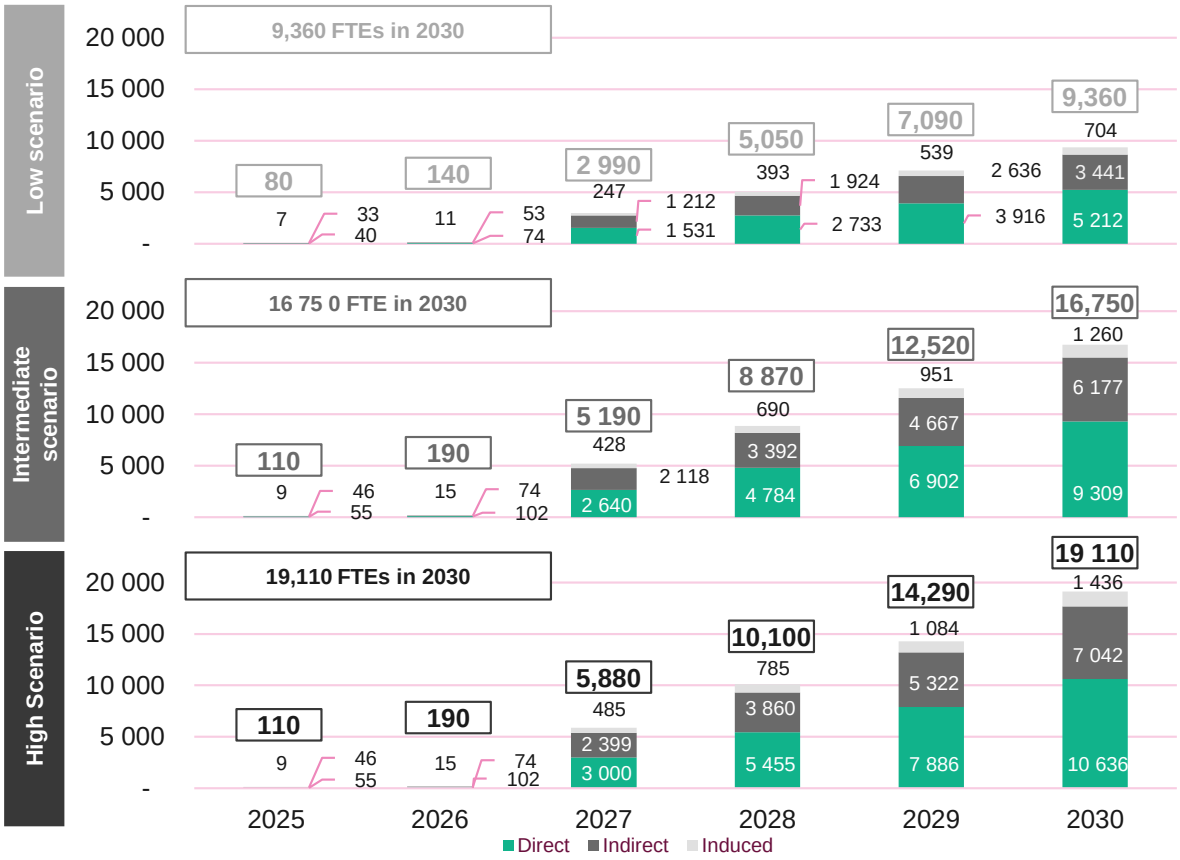
The high scenario, in which the BioNGV TERs compete with the battery TER but with more developed uses on the two-mode TERs, would make it possible to reach a number of jobs around 19,100 FTEs in 2030.

Finally, the intermediate scenario, on which the characteristics of the jobs will be detailed (sustainability, specificity to BioNGV, professional category of the job and geographical location) shows a potential of 16,750 FTEs in 2030.

On all of these scenarios, 56% of jobs are generated by direct activity, 36% by indirect activity of suppliers and 8% by activity induced by remuneration.

[10] The direct impact concerns the activities of biomethane unit construction, biomethane production, delivery of biomethane to BioNGV bunkering stations, construction of BioNGV bunkering stations, operation and maintenance of fueling stations, transformation of TER to BioNGV and operation and maintenance of BioNGV TER. The indirect impact concerns all the suppliers of these activities, for example, suppliers of equipment for TER (engines, BioNGV storage, hybridization modules, etc.) or even suppliers of compressors, distributors, etc. for refueling stations.
The induced impact is the consequence of the remuneration of the jobs created in the direct and indirect impacts. This remuneration will allow the generation of household expenditure and thus the creation of additional activity.

FIGURE 3: EVOLUTION OF SOCIAL IMPACT FOR THE 3 SCENARIOS FROM 2025 TO 2030



The dynamics displayed in these graphs are the result of a combination of accelerating factors:

- A first factor is the growth in the number of TER transformed per year between the experimental phase over the first two years (2025 and 2026), the industrialization phase in the following years, and the finalization phase of the transformations in the year 2030.
- The second acceleration factor is linked to the first and is based on the commissioning of the converted TERs (operation, maintenance and supply). Thus, the activity generated by operation and maintenance is increased tenfold by the annual installation of a growing number of TERs for operation, maintenance and refuelling with BioNGV.

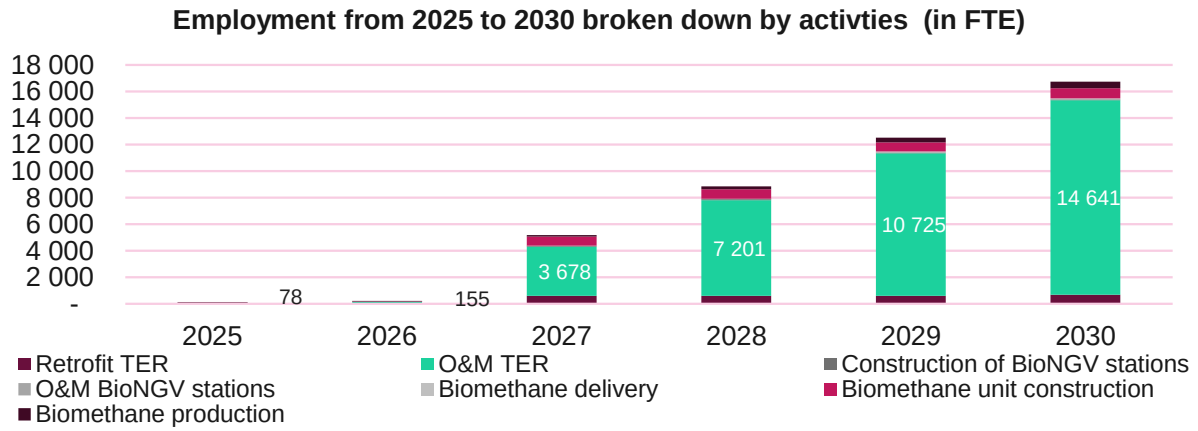
B. Characteristics of jobs in the intermediate scenario

Not all of these jobs are the same. Thus, several characteristics qualify these jobs, such as the activity segment in which the job is generated, the durability of this job over time, the professional category affected as well as the location in the different regions. Jobs are also defined as specific to the BioNGV sector or as co-employment. A job specific to the BioNGV sector is a job that would not have been generated by the retrofitting of TERs to diesel. Thus, jobs linked to the production of biomethane, the construction of anaerobic digestion units and the construction of refueling stations are considered specific. Likewise, BioNGV TER's research and development work is specific to the BioNGV sector.

The operation and maintenance of the BioNGV TERs would generate the majority of jobs in the BioNGV TER sector, reaching 14,600 jobs combined between direct, indirect and induced jobs (see figure 4).

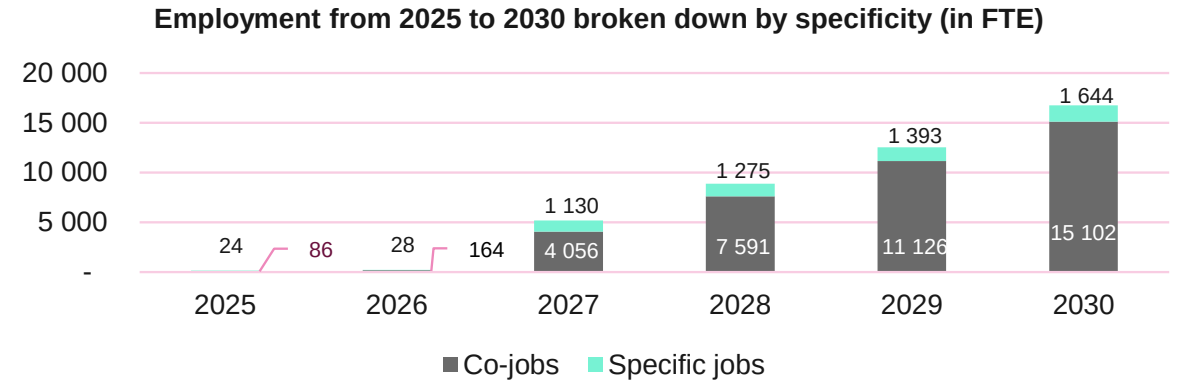
The second job-creating segment would be the construction of anaerobic digestion units with 770 FTEs created in 2030, followed by the transformation of TER into BioNGV approaching 700 FTE. These jobs, which are not permanent, would be created mainly by equipment suppliers, who account for almost 70% of the turnover of these segments.

FIGURE 4: ESTIMATION OF JOBS CREATED BY BUSINESS ACTIVITIES



Of all these jobs, a large proportion would be jobs common to the diesel TER diesel and BioNGV TER sectors. These common jobs represent 90% of the jobs generated (see figure 5). Specific jobs (10% of jobs generated) would be carried by segments such as the construction, operation and maintenance of anaerobic digestion units as well as the construction of BioNGV refueling stations and the specific BioNGV part of the transformation of the TER.

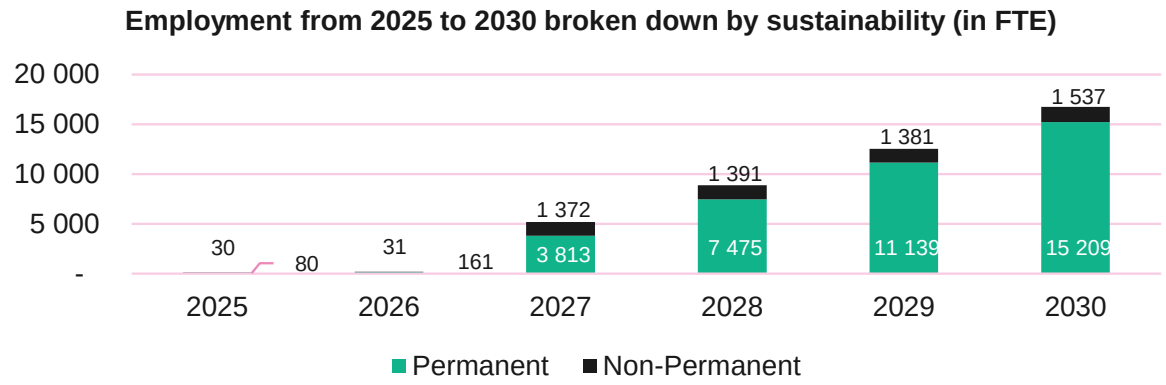
FIGURE 5: ESTIMATION OF BIONGV SPECIFIC JOBS



Regarding the sustainability of jobs, a very large part of these jobs would be sustainable, in particular because of the importance of the TER operation and maintenance segment, whether they have diesel or BioNGV engines. These permanent jobs represent 91% of jobs (see figure 6).

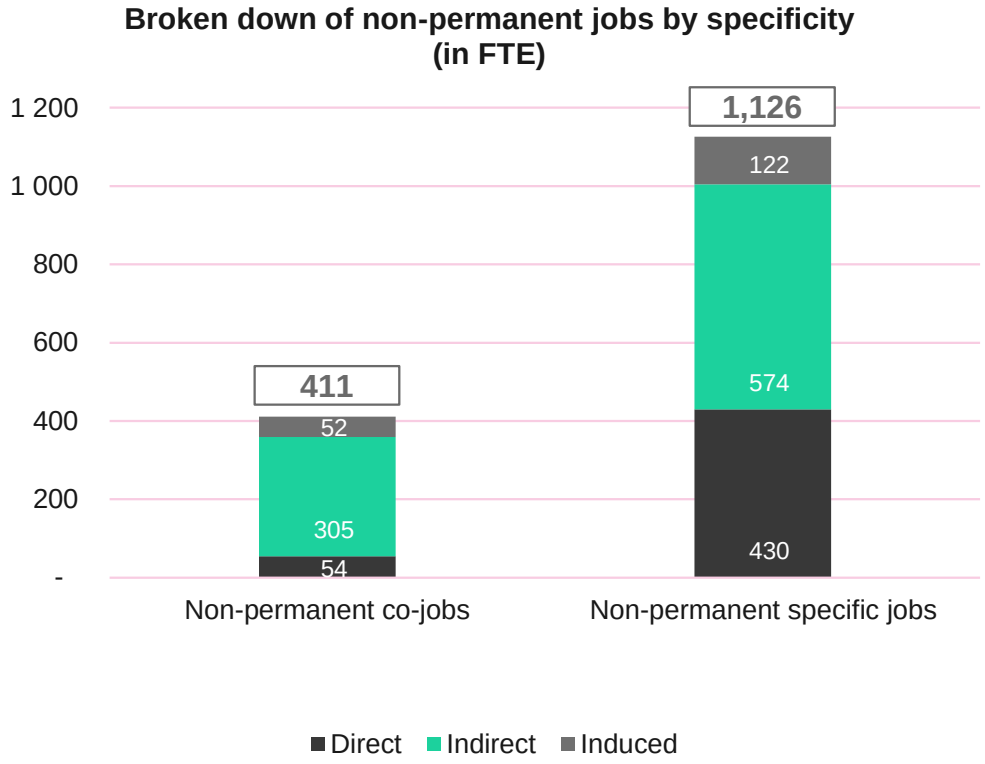
Non-permanent jobs would be generated by the TER conversion activities and the construction of the infrastructure necessary for the proper functioning of the BioNGV TERs. They would represent 9% of the jobs generated.

FIGURE 6: ESTIMATION OF PERMANENT AND NON-PERMANENT JOBS



Among these non-permanent jobs, a large part would come from the construction of anaerobic digestion units (50%) while the transformation of TER into BioNGV would represent 46% of the jobs (see Figure 7). The remaining 4% would be generated by the construction of the BioNGV refueling stations. The BioNGV specific activities would represent the most non-permanent jobs with 73% of the jobs generated against 10% for all activities.

FIGURE 7: DISTRIBUTION OF JOB SPECIFICITY FOR NON-PERMANENT ACTIVITIES

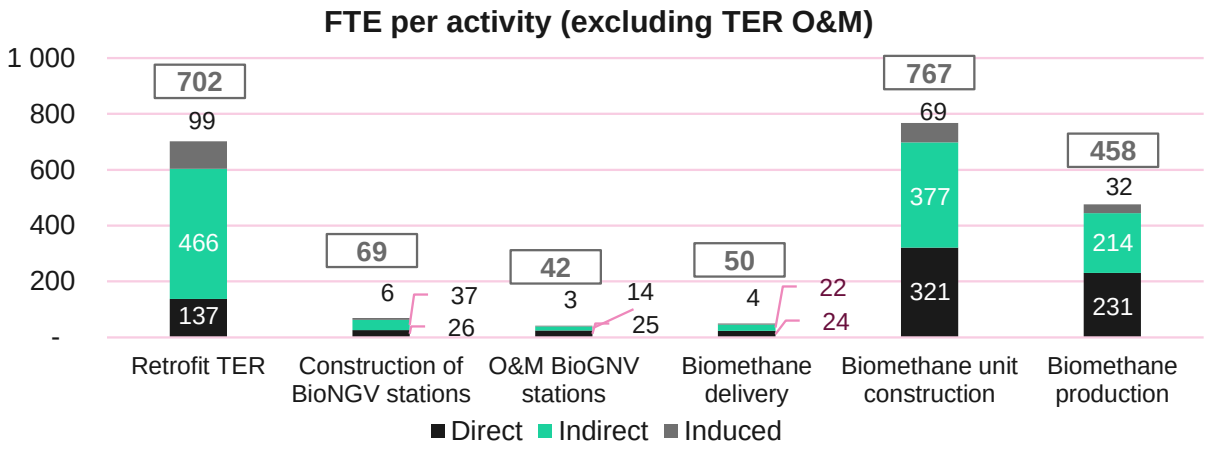


Non-permanent specific BioNGV jobs would be carried by three business segments, which are the construction of refueling stations, the construction of anaerobic digestion units and the specific BioNGV part of TER transformation:

- The construction of BioNGV refueling stations would represent 66 FTEs in 2030, or 6% of non-permanent jobs specific to BioNGV
- The construction of anaerobic digestion units would represent 767 FTEs, ie 68% of non-permanent jobs specific to BioNGV
- The BioNGV-specific part of the TER retrofit would represent 291 FTEs, or 26% of the BioNGV-specific non-sustainable jobs

In addition to TER operation and maintenance, which would account for 87% of the jobs generated by this sector, TER processing activities and the construction of anaerobic digestion units would increase employment to 1,400 jobs (see Figure 8). Total employment excluding TER O&M would reach 2,110 FTEs.

FIGURE 8: DISTRIBUTION OF JOBS BETWEEN BUSINESS ACTIVITIES (WITHOUT TER O&M)



Two types of activity stand out: transformation and construction activities and operation and maintenance activities.

The investments made in the construction of infrastructure and the transformation of rolling stock would generate a major part of the jobs (excluding O&M of TERs). Out of the 2,110 FTEs in total, these investments would lead to the creation of 1,540 FTEs, or 73% of jobs outside of TER operation and maintenance.

The remaining 570 FTEs would be the jobs generated by the operation and maintenance of these infrastructures.

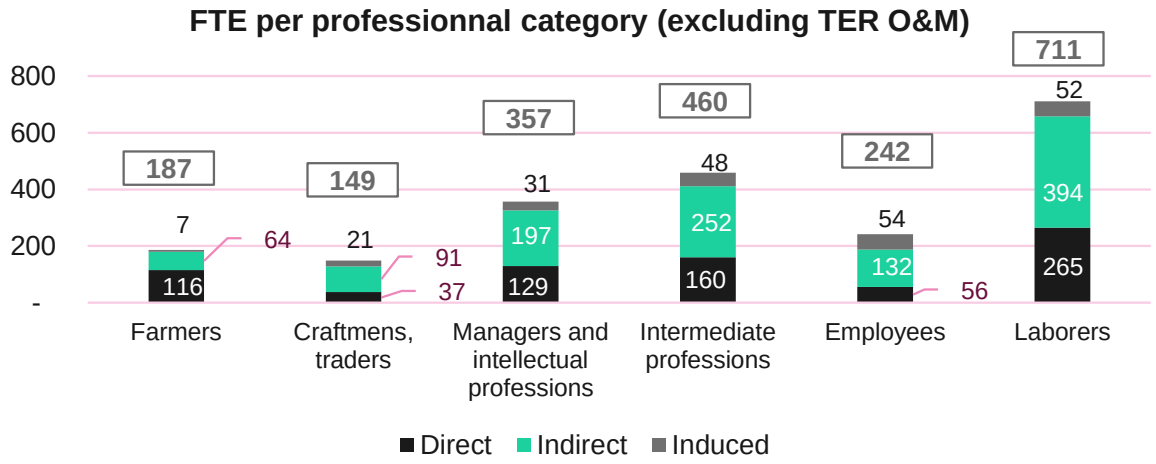
The 1,540 investment-related jobs would be generated mainly at suppliers, due to the size of the industrial equipment needed for these three segments (transformation of TERs, construction of fueling stations and construction of anaerobic digestion units).

All professional categories would be concerned, including farmer operators (see Figure 9). This professional category would find itself integrated into the economic activity thanks to the use of BioNGV produced mainly from raw materials from agricultural waste. Among other professional categories, workers represent a large part of employment due to the importance of the manufacturing part of the equipment for TERs (fueling stations, anaerobic digestion units, civil engineering for these two business segments). The intermediate professions category, in which technicians are included, would also be strongly represented. In particular,

they will be heavily involved in the equipment assembly phases as well as in the maintenance of fueling stations and anaerobic digestion units.

Executives and intellectual professions would also be strongly represented and supported by the significant need for studies and engineering for all segments of activity in the establishment of the BioNGV TER sector.

FIGURE 9: DISTRIBUTION OF JOBS BETWEEN PROFESSIONAL CATEGORIES

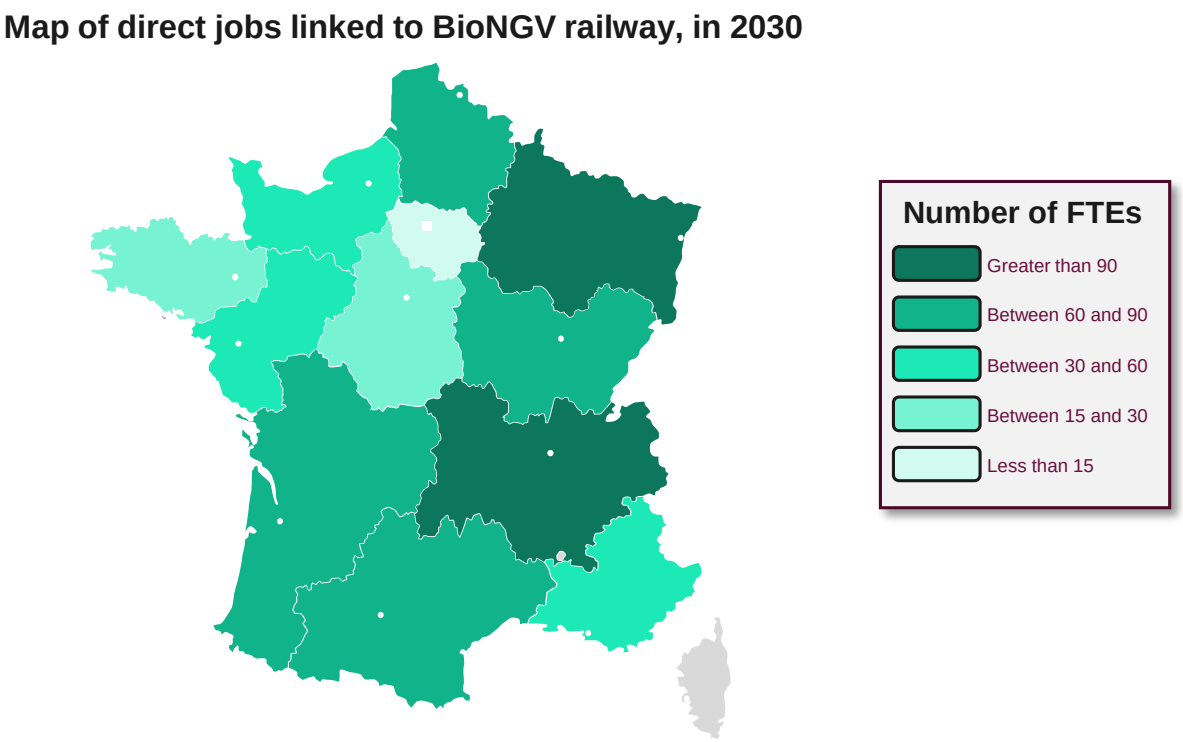


The territorial distribution of job creation is not uniform (see Figure 10). As for the direct impact, the disparity in the distribution of jobs would be the consequence of a centralized location of SNCF's industrial technical centers equipped for the transformation of TER. This geographical disparity can also be explained by the inequality of BioNGV uses between different regions.

For example, the Auvergne-Rhône-Alpes region benefits from both a large TER park and an industrial technicenter. It therefore combines the jobs linked to the BioNGV sector (high local consumption with a larger number of methanisation plants) and the jobs generated by the presence of the technical center on its territory. Although having a smaller potential for BioNGV

TERs, regions such as Grand-Est and Nouvelle-Aquitaine have a significant potential for job creation due to the presence of two industrial technical centres each.

FIGURE 40: DISTRIBUTION OF THE DIRECT IMPACT BETWEEN REGIONS

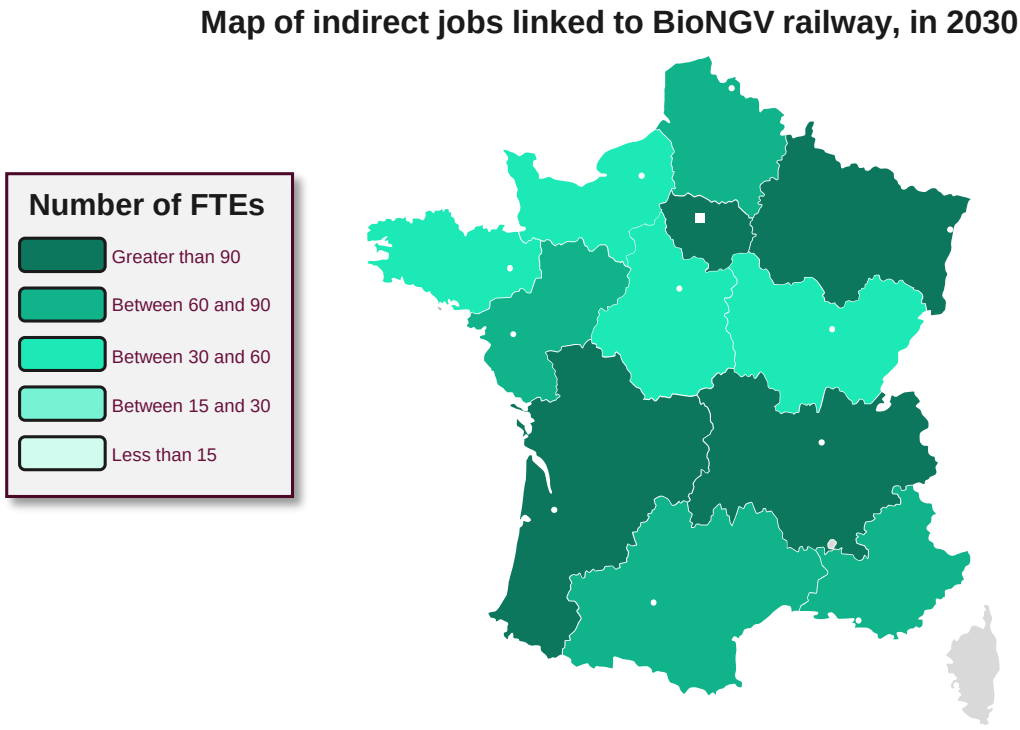


Conversely, regions such as Ile-de-France or Provence-Alpes-Côte d'Azur would not benefit from the direct impact of the implementation of the BioNGV TER sector because of the small number of TERs that could be converted to BioNGV.

However, the structure of French industry allows for a diffusion of these impacts at the indirect level with the supply of materials and equipment coming from all the territories (correction made for imports). Thus, the Ile-de-France region would see the number of jobs generated on the indirect impact increase due to the importance of the digital industry and design offices

enabling the research, development and engineering necessary for the implementation of the BioNGV TER sector (see figure 11).

FIGURE 11: DISTRIBUTION OF THE INDIRECT IMPACT BETWEEN REGIONS



Beyond the Ile-de-France region, the Occitanie, Hauts-de-France, Grand-Est and Auvergne-Rhône-Alpes regions have important railway industrial sites allowing them to capture part of the indirect activity. For its part, the PACA region would benefit from a highly developed digital industry, particularly in Sophia-Antipolis or in the Pays d'Aix en Provence, to recover the activity linked to the implementation of the BioNGV TER sector in this area.

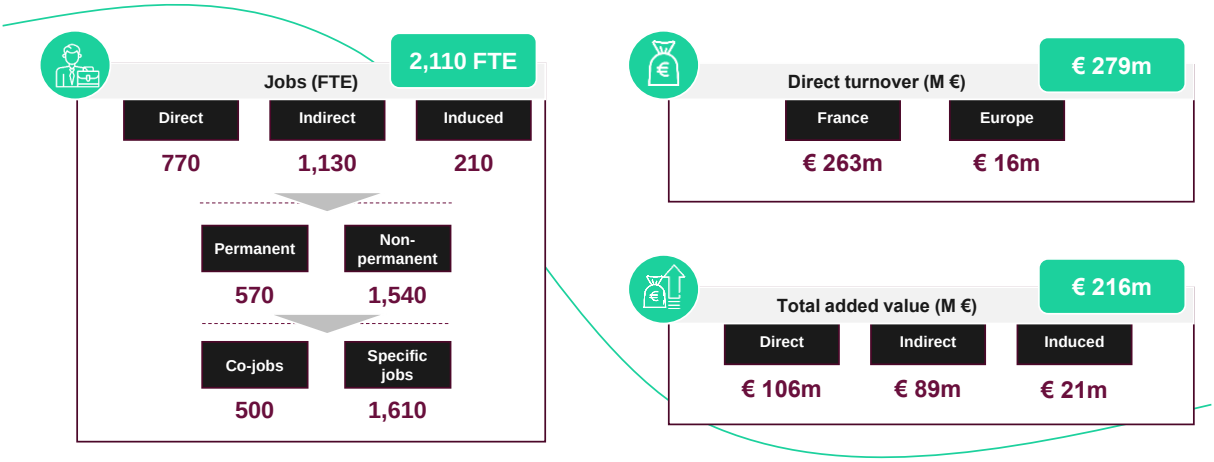
C. Economic and fiscal impacts

In terms of economic impact, the BioNGV TER sector would generate a revenue of 1.5 billion euros, of which €1.2 billion for TER operation and maintenance, i.e. 82% of the revenue.

Of the remaining 279 million euros, 16 million would be imported from Europe. This import concerns equipment that cannot be produced in France because of a too large industrial lead of the players concerned in other European countries. For example, the BioNGV engines that can be integrated into TERs would be produced exclusively by the manufacturer MAN in Germany. For refueling stations, compressors are said to have a high share of imports from German (Bauer) or Italian (Fornovo Gas or Safe) players.

Finally, 263 million euros would come from activity aimed at French players. They break down into 106 million euros of added value on direct activities, 89 million euros of added value on indirect activities and 21 million euros of added value on induced activities (see figure 12).

FIGURE 12: BREAKING DOWN OF ECONOMIC AND SOCIAL IMPACTS (EXCLUDING TER O&M)

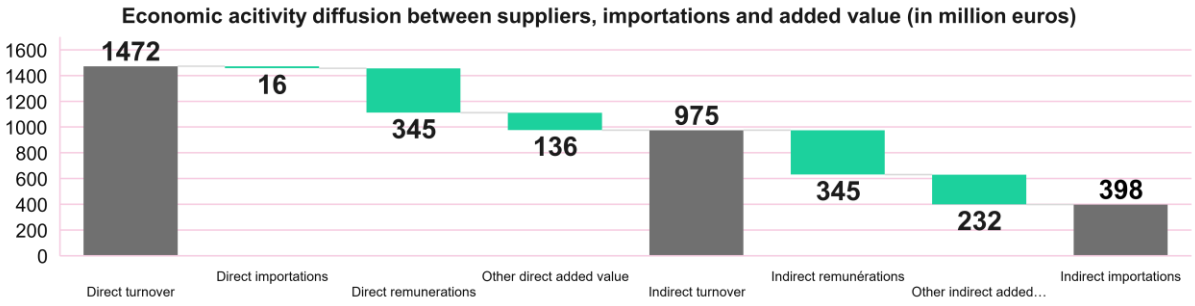


Sources: Sia Partners ISEE model according to SNCF Open Data, NGV sector, GRDF, 2C-Consulting, Bombardier, INSEE

Including the operation and maintenance activity of BioNGV TER, the added value of the direct impact would be 481 million euros broken down into 345 million euros in remuneration and 136 million euros in EBITDA, taxes and duties. The remaining 975 million euros would represent the direct intermediate consumption which represents the turnover of all indirect activities. On this indirect activity, the added value would reach 577 million euros broken down into 345 million euros of remuneration and 232 million euros of EBITDA, taxes and duties.

The remaining sum, 398 million euros, would represent all the imports made to produce the indirect impact (see figure 13).

FIGURE 13: BREAKING DOWN OF THE TURNOVER OF THE BIONGV TER SECTOR IN 2030



Thus, the BioNGV TER sector in 2030 would allow 73% of its turnover to be distributed in the economy and only 27% used to import products and equipment that France does not have on its territory. By way of comparison, the share of French industrial resources (production and imports) is based at 35% on imports.

On all of the activities studied, the tax benefits for the French state are broken down into taxes on energy consumption (TICGN or TICPE), taxes on production (excluding TICGN or TICPE and VAT), taxes on companies and VAT.

A total of 241 million euros in taxes would be generated thanks to this activity broken down as follows:

- TICGN: 2.9 million euros,
- Taxes on production and companies: 196 million euros,

- VAT on TER ticketing and household consumption: 43 million euros.

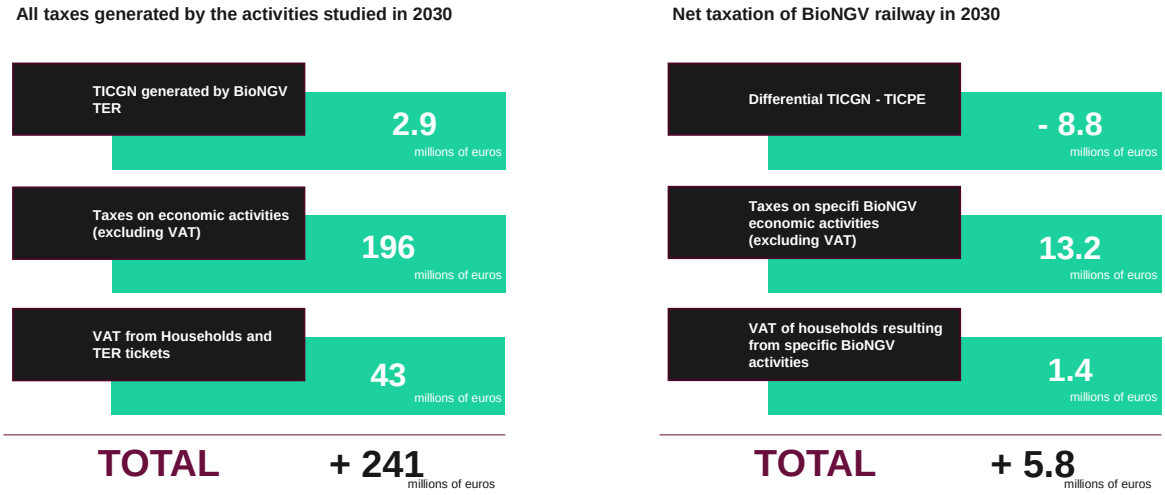
On the taxation of energy consumption, it was assumed that the consumption of BioNGV by TERs would be taxed at € 5.23 / MWh. This tariff was assumed to be stable until 2030. In order to calculate the losses linked to the change of TICPE regime to TICGN, the TICPE tariff taken into account was € 18.82 / MWh, assumed to be stable until 2030 due to application of the TICPE reduced tariff for the rail sector on the National Rail Network.

Thus, the state would experience a loss of 8.8 million euros on the taxation of BioNGV at the TICGN tariff compared to the taxation of diesel at the TICPE tariff, in 2030.

This loss would however be offset by taxes on production generated by activities specific to BioNGV, representing 13.2 million euros as well as the VAT generated by the expenditure of households remunerated by activities specific to BioNGV, 1.4 million d 'euros.

Thus, the difference in taxation between TICGN and TICPE would be offset by the income generated by activities specific to BioNGV for the state (see figure 14).

FIGURE 14: TAX BALANCE OF ACTIVITIES RELATED TO THE BIONGV TER SECTOR

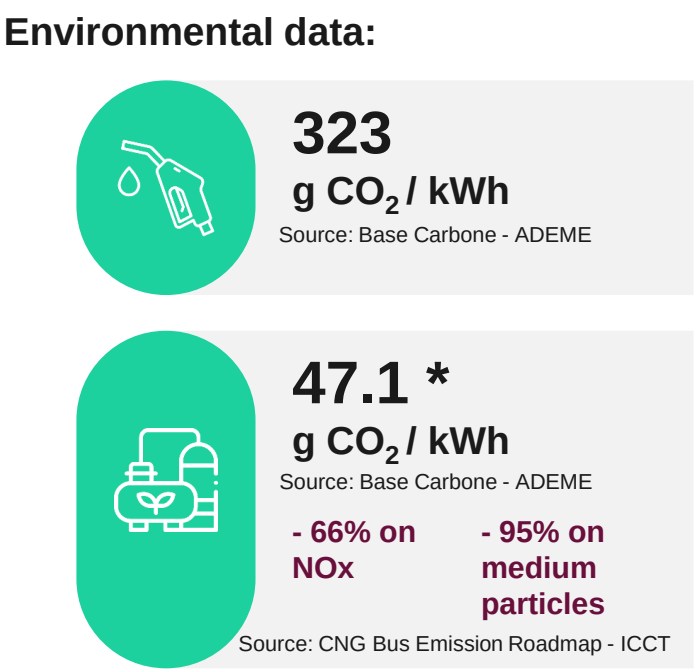


D. Environmental impacts

In addition to the social and economic impacts of the BioNGV TER sector, the most sought-after impact in the implementation of such a sector is the environmental impact, i.e. the reduction in carbon dioxide emissions but also of NOx and medium particles emissions.

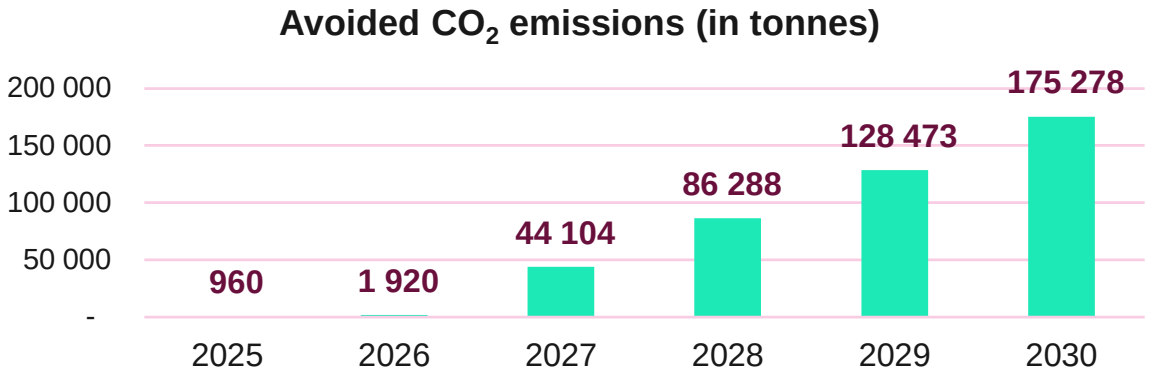
As regards CO_2 emissions, the values used correspond to the emission values linked to the combustion of diesel fuel or BioNGV present in the ADEME carbon base and calculated according to the life cycle analysis rules for fuel. The values used are shown in figure 15.

FIGURE 15: ENVIRONMENTAL DATA OF DIESEL AND BIONGV COMBUSTION[11]



Combined with the fuel consumption calculated in the intermediate scenario, the reduction in CO_2 emissions would reach **175,000 tons / year of CO_2 in 2030** (see figure 16), or the equivalent of **69,000 passenger cars**.

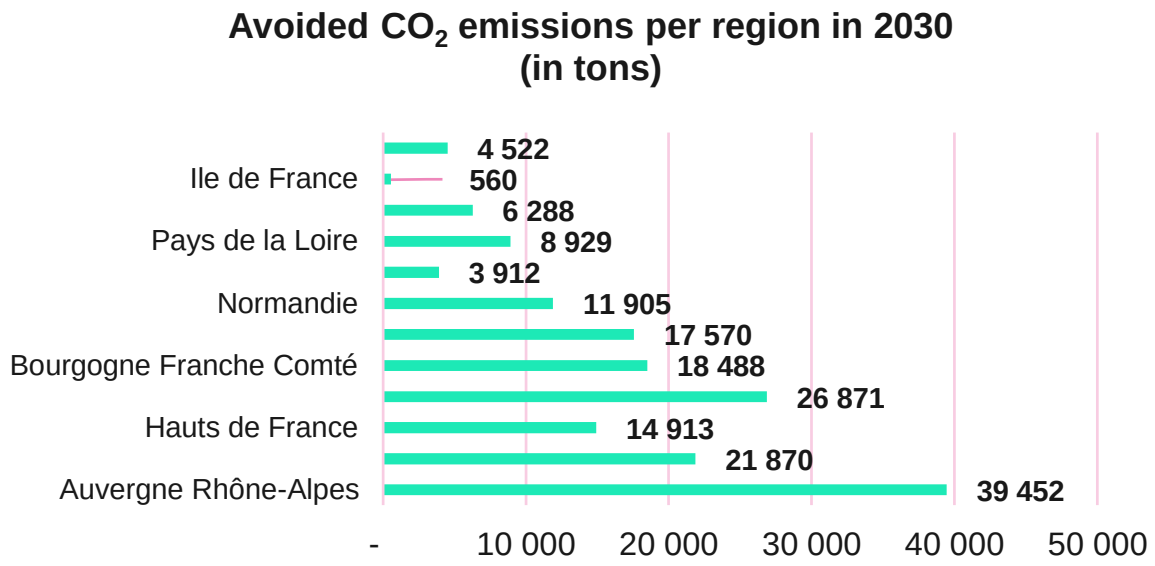
FIGURE 16: TRAJECTORY OF THE REDUCTION OF CO_2 EMISSIONS FOR THE INTERMEDIATE SCENARIO



The Auvergne-Rhône-Alpes region is the region where the switch to BioNGV allows for the greatest reduction, with a reduction in emissions of around 39,000 tons of CO_2 in 2030 (see figure 17).

[11] The value of 47.1 gCO_2 / kWh corresponds to the production of biomethane (44.1 gCO_2 / kWh) to which is added the compression to refuel the TER (3 gCO_2 / kWh). However, this value does not include the positive externalities of biomethane and which would be deducted and give a net emission value of 26.4 gCO_2 / kWh (23.4 + 3 gCO_2 / kWh) according to the biomethane sector.

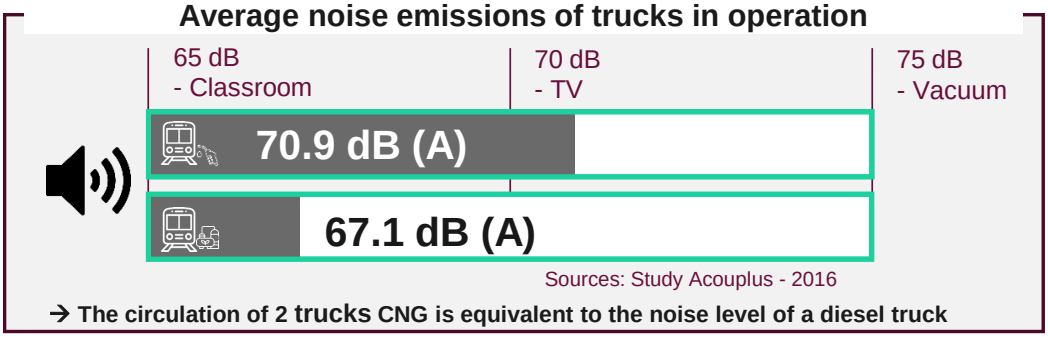
FIGURE 57: DISTRIBUTION OF THE REDUCTION OF CO_2 EMISSIONS PER REGION IN 2030



With regard to the reductions in NOx and average particle emissions, a quantitative assessment cannot be carried out due to a lack of technical study on this subject for railways and the dependence of the results on the type of engine, the standards that it must meet as well as the engine operating speed. Thus, only the results for a bus can be shown in this study without being able to make a technically accurate estimate for a train, for the reasons mentioned. Thus, for a bus, NOx can be reduced by 66% and average particles by up to 95%, which makes the CNG engine a considerable asset for reducing local pollution, especially in stations. A study published in January 2021 by AirParif on its fleet of 2,000 buses showed that the reduction of NOx between a Euro VI diesel engine and a Euro VI CNG engine could reach a potential reduction of 86%.

Switching to the BioNGV engine would allow a last environmental gain: noise reduction. Again, the results relate to the noise level of a truck engine and only a comparison between a diesel truck engine and a BioNGV engine can be made. A diesel engine would reach 70.9 decibels against 67.1 decibels for a BioNGV engine. This difference, on the decibel scale, would lead to say that the noise level of a diesel truck is equivalent to the noise generated by the simultaneous circulation of two BioNGV trucks (see figure 18).

FIGURE 6: COMPARISON OF NOISE LEVELS OF DIESEL AND BIONGV TRUCKS



4. A sector with side effects due to its competitiveness on fuel costs

A last type of impact can be linked to the establishment of a TER sector using BioNGV, the catalytic impact. It represents all the side effects of this sector.

In the context of this study, the catalytic impact takes into account the effects related to economic gains on the operation of TERs due to lower fuel expenditure compared to diesel TERs. A study by 2C-Consullting shows that, for a TER traveling 100,000 km per year, the reduction in fuel costs is 65,000 € per year, i.e. a reduction of 55% of this cost item.

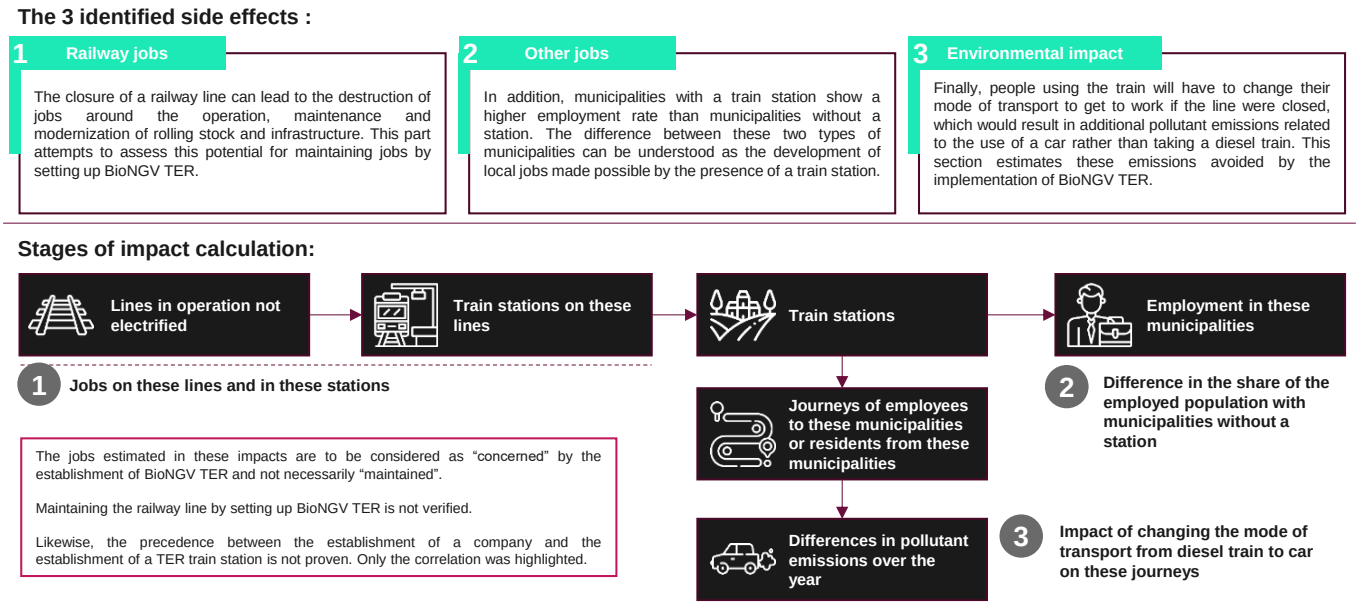
This economic gain can affect the profitability of a TER line and tip policy decisions towards maintaining the line. Beyond the economic aspect, maintaining rail transport is a way to avoid congestion in cities with disastrous environmental impacts. Rail links are also drivers of the rural economic dynamic, linking municipalities together.

Maintaining the TER line would have two impacts in terms of jobs and environmental impact:

- Maintaining jobs on the TER line[12]. The following activities are concerned: operation and maintenance of TER, operation and maintenance of railway infrastructure but also jobs linked to investments for the modernization of railway infrastructure.
- Local jobs preservation. It is proposed to study the impact of a station on maintaining an economic fabric that promotes employment. The presence of a station thus allows certain businesses and activities to remain in the area. A TER line closure could entail additional costs for employees or companies who could no longer carry out their activity in these localities and would therefore be forced to change their location. This impact does not measure a potential loss of jobs but rather a loss of dynamics in a territory.
- The suppression of TERs would lead to a shift from TER to car for people going to work by public transport from, and to, municipalities served only by diesel TERs. Maintaining these lines with BioNGV TERs would avoid these emissions[13].

[12] The direct - indirect - induced impacts should not be added together with the catalytic impacts, otherwise there is a risk of double counting the jobs linked to the operation and maintenance of TER.
[13] Sub-national relocation of jobs is not compatible with the "change in mode of transport" impact. There is a choice: the company / job relocates to a better served municipality or the employee changes mode of transport if the company remains.

FIGURE 7: METHODOLOGY FOR THE CATALYTIC IMPACT CALCULATION



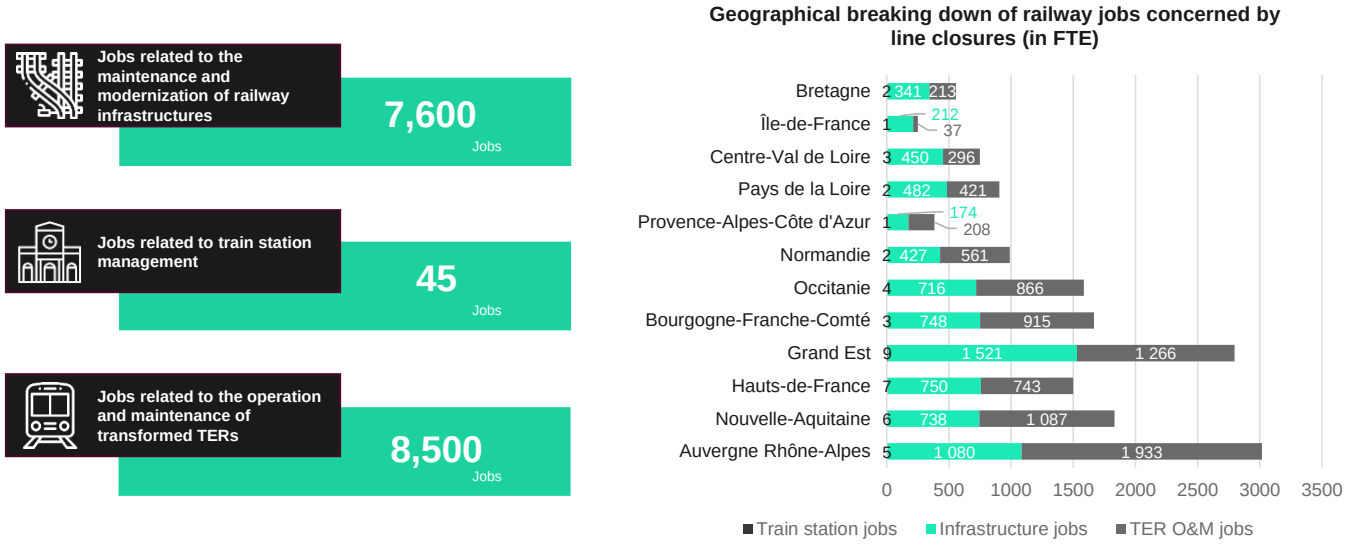
In the context of the BioNGV TER sector, these impacts are estimated but not certain because of the non-economic arguments for maintaining TER links on small isolated lines. The gain in competitiveness, although demonstrated, does not make it possible to define whether the TER link will be maintained because it depends on the political force in place or on the gain in relation to the operation of the whole line (number of passengers and cost infrastructures). For these reasons, the catalytic impact is calculated but separated from the direct, indirect and induced impacts.

A. Rail jobs on BioNGV TER lines

The catalytic impact on railway jobs concerns three different types of jobs, namely jobs linked to the operation, maintenance and modernization of the rail network, jobs linked to station management and finally jobs linked to the operation and maintenance of BioNGV TER. Due to the resumption of jobs related to the operation and maintenance of TER, the addition of the impacts of jobs in the direct, indirect and induced perimeters with the catalytic impacts would be false and would generate a double count.

For the intermediate scenario, these jobs would represent in 2030 nearly 16,000 jobs (see figure 20).

FIGURE 20: IMPACTS ON RAILWAY JOBS AND REGIONALIZATION



The impact on station management only includes the SNCF “Gares et Connexions” workforce involved in their management. All jobs related to operation and maintenance could not be estimated.

The number of jobs linked to infrastructure management represents a strong pool of jobs which could be boosted by the profitability of the operation of the BioNGV TERs, making it possible to free up an additional budget for the maintenance of the lines. This maintenance would make it possible to improve the lines, potentially leading to a reduction in the maintenance costs of the TER.

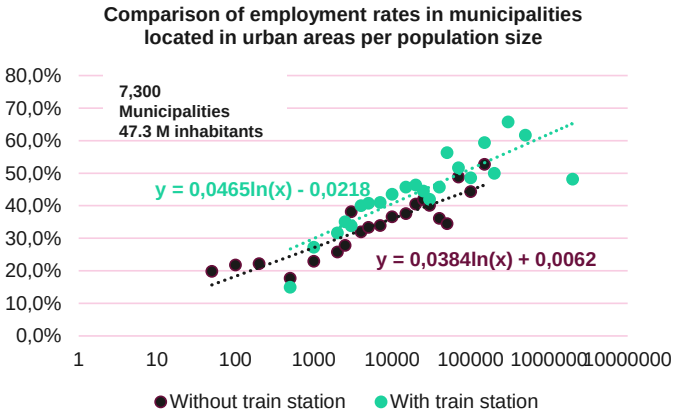
B. The impacts on the dynamics of municipalities of the presence of a TER station

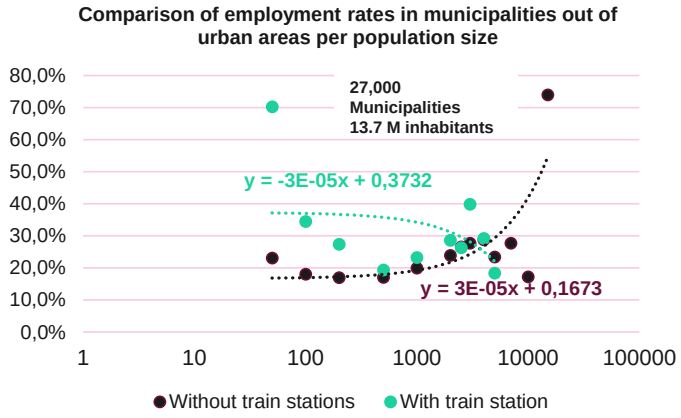
The presence of a station in a municipality implies a higher employment rate. This correlation exists for cities belonging to an urban area, that is to say a geographical area where the municipalities of the same area have urban continuity (see figure 21). Very often, these urban areas are areas of employment and dynamism. This correlation is also verified for "isolated" municipalities, that is to say not belonging to an urban area. On the other hand, this correlation is not verified for the largest "isolated" municipalities either because of the presence of a station in a neighboring municipality or because a large "isolated" municipality itself generates its activity.

FIGURE 21: CALCULATION AND COMPARISON OF THE EMPLOYMENT RATE BETWEEN DIFFERENT TYPOLOGY OF MUNICIPALITIES

In urban areas, the more the size increases, the more the municipalities show a significant gap in terms of job location. For towns of more than 70,000 inhabitants, the smaller difference between employment rate is due to the fact that these towns are in large urban units served by other means of rail public transport than the TER (Boulogne-Billancourt, Montrouge, Neuilly-sur-Seine, Villeurbanne, etc.)

For municipalities outside of an urban area, the presence of a train station will have an impact on employment for the smaller municipalities more strongly than for the larger ones.





Municipalities with a freight train station and without a passenger train station are excluded from the analysis: 420 municipalities representing 3.6 million hab

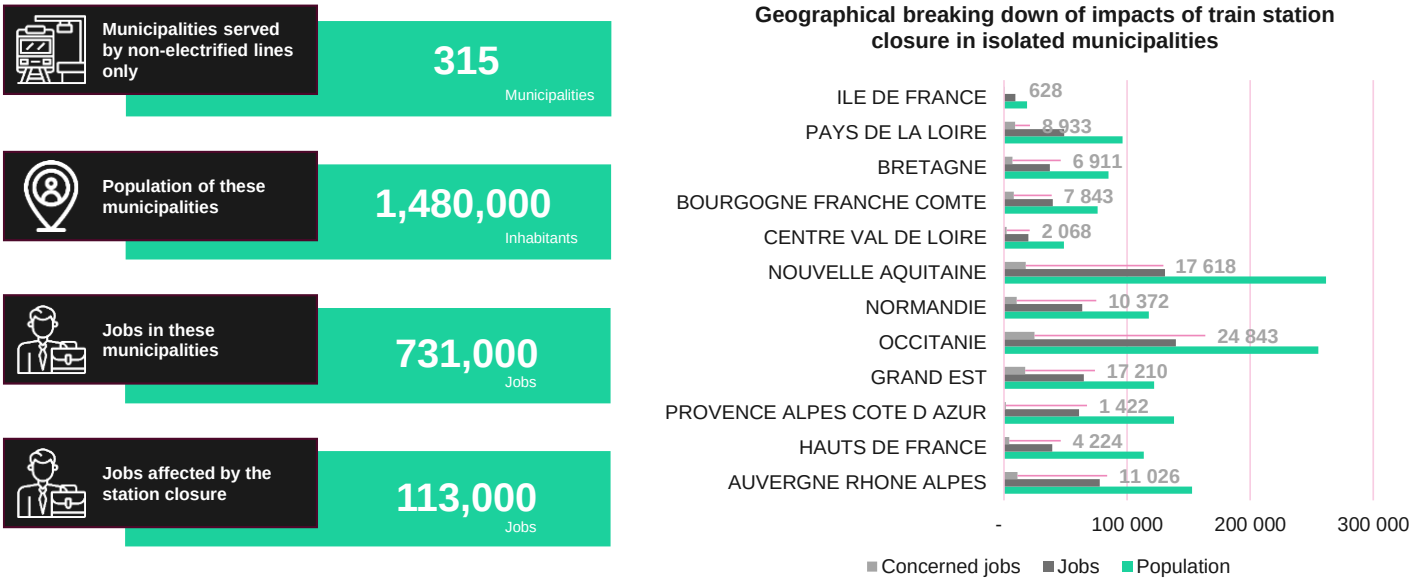
Sources: ISEE Sia model Partners according to SNCF Open data and INSEE

This correlation, demonstrated, makes it possible to estimate an employment rate according to the characteristics of the municipality.

Thus, for each municipality with a passenger station connected to the rail network by a non-electrified line, and therefore requiring the installation of a passenger train running on diesel, the employment rate of this municipality was estimated if the station did not exist. The difference between the effective rate of the municipality and the rate of similar municipalities without a station makes it possible to calculate the number of jobs maintained locally by the presence of a station. This calculation is carried out for all the municipalities meeting the criteria mentioned above. The sum of the uses thus calculated is corrected at the level of a region by the share of TER transformed with BioNGV.

This result gives the number of jobs maintained locally by the implementation of a solution improving the profitability of the railway line and allowing its operation to be maintained (see figure 22).

FIGURE 82: NATIONAL AND REGIONAL RESULTS ON JOBS CONCERNED BY MAINTAINING RAILWAY LINES



These results represent a reduction of the impacts because the jobs concerned are only calculated on the municipalities having access only to trains on non-electrified lines. People traveling on a non-electrified line between two municipalities served by electrified lines are not considered.

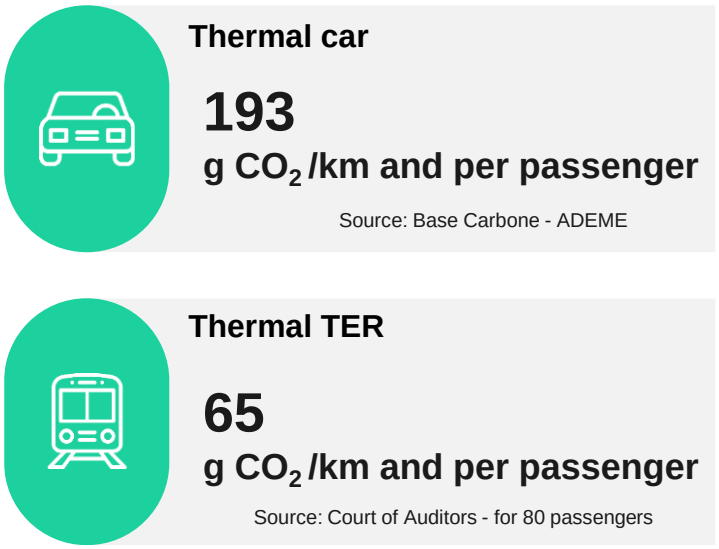
Regions like Occitanie and Nouvelle-Aquitaine show a strong dependence on the rail network. In these regions, the length of non-electrified lines is important, especially in Nouvelle-Aquitaine. For its part, Occitanie has three significant cities in terms of population and jobs: Colomiers, Rodez and Auch, whose lines are not electrified. In these three cities, the elimination of rail lines would impact 17,000 jobs.

In total, nearly 113,000 jobs would be locally protected because of the maintenance of these lines, made possible, in part, by the establishment of a BioNGV TER sector and the desire to maintain an environmentally responsible railway fabric (see figure 22).

C. The impacts of changing the mode of transport by closing a TER line

Closing a TER line would also change the means of transport for a person to get to their place of work. Thus, it is proposed in this study to quantify the number of people who would change their mode of transport, thus switching from low-emitting TER transport, even if the latter runs on diesel, to transport by private car (see figure 23).

FIGURE 23: COMPARISON OF KILOMETRIC CO_2 EMISSION FACTOR OF A PASSENGER BETWEEN THE CAR AND THE TRAIN



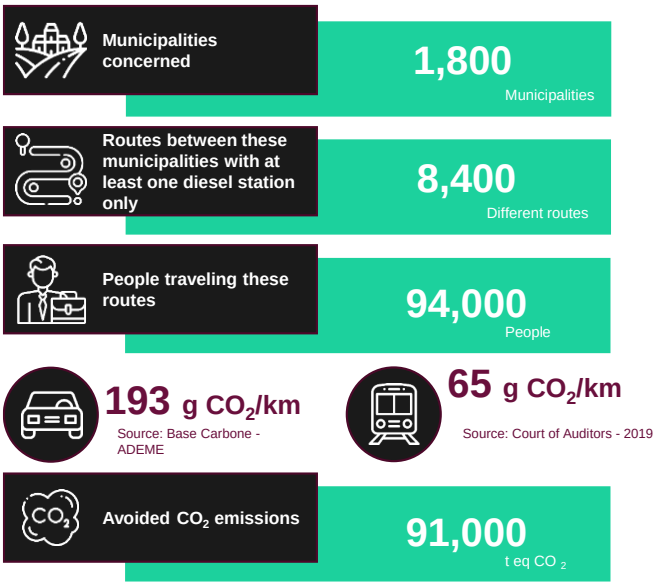
From a methodological point of view, this impact is measured by identifying the number of people[14] residing or working in a municipality whose station allows passenger transport[15] and is located on a non-electrified line[16]. In addition, only people who have declared that they use public transport to get to their place of work are considered.

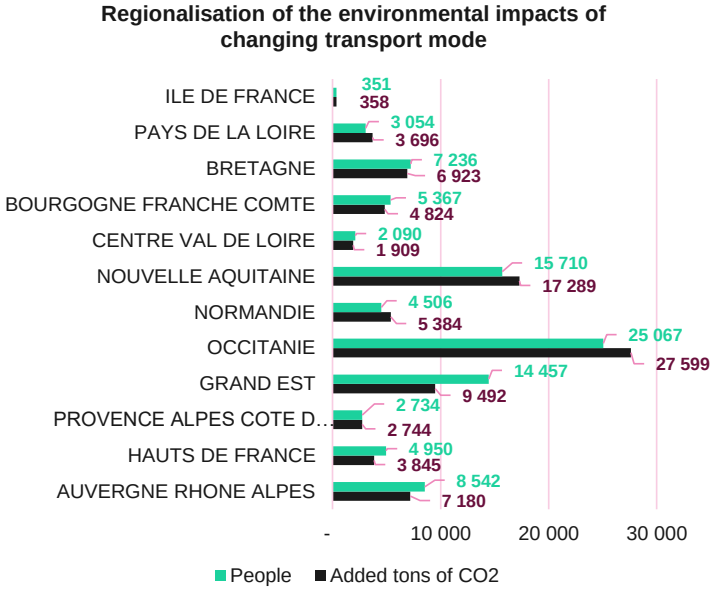
The environmental impact thus calculated is corrected by a coefficient representing the share of TER running on BioNGV in the region in order to estimate the emissions of pollutants avoided by the establishment of a BioNGV TER sector in the region.

Thus, 94,000 people would be affected by the change in mode of transport, which would represent an additional CO_2 emission of around 91,000 tons annually (see figure 24).

[14] INSEE 2017 – Recensement de la population : Mobilité professionnelle
[15] SNCF 2020 – Open data : Gares en exploitations en France
[16] SNCF 2020 – Open data : Lignes non-électrifiées

FIGURE 94: ENVIRONMENTAL IMPACTS OF CHANGING THE MODE OF TRANSPORTATION OF PEOPLE LIVING OR WORKING IN MUNICIPALITIES SERVED BY DIESEL TER.





In this impact, only the difference between the diesel TER and the thermal car is estimated due to the estimate already made in the direct part of the reductions in CO_2 emissions between the diesel TER and the BioNGV TER.

Conclusion

Reaching the CO_2 emissions reduction targets set by SNCF involves replacing diesel engines in TERs, whether by converting these engines or renewing the fleet. The establishment of a BioNGV sector appears to be a relevant short-term and low-cost solution to meet these objectives. The BioNGV demonstrates the following strengths:

- Mature technology ready to be implemented on TER in the short to medium term
- 86% reduction in CO_2 emissions compared to diesel TERs but also in NOx and medium particle emissions
- Achievement of a 55% saving on the fuel costs of a TER (65,000 euros per year) exceeding the additional costs of setting up the sector (220,000 euros per TER)
- Valorization of agricultural residues and other waste (household, industrial, agri-food ...) in a circular economy logic
- Production of natural organic fertilizer (digestate), a by-product of anaerobic digestion which can be spread on agricultural land and thus replace chemical fertilizers
- Net job creation linked to the consumption of energy produced in France for engines very similar to diesel requiring little training for technicians
- Offers additional outlets to the anaerobic digestion sector which could create up to 50,000 jobs by 2030

Glossaire

- **BioNGV** : Renewable natural gas vehicle (produced from annually renewed biological raw materials or waste)
- **dB - décibel** : Noise measurement unit used to compare the noise produced by a diesel engine and a BioNGV engine
- **Economy – Other taxes on production**: The other taxes on production mainly cover the tax on salaries, compensatory payments linked to transport, the territorial economic contribution (which replaced the professional tax since 2010), property taxes and the social solidarity contribution of companies (def. INSEE).
- **Economy – Intermediate consumption:** Value of goods and services transformed or entirely consumed during the production process. The wear and tear of the fixed assets used is not taken into account; it is recorded in consumption of fixed capital. (def. INSEE)
- **Economy – EBITDA**: Gross operating surplus, accounting aggregate integrated into the added value of a company
- **Economy – Product taxes:** The taxes on the products consist mainly of the value added tax, the internal tax on petroleum products, transfer duties for payment, duties on alcohol and tobacco (def. INSEE).
- **Economy – Remuneration:** All remunerations in cash and in kind that employers pay to their employees in payment for the work done by the latter: gross wages and salaries in cash and in kind, actual social contributions charged to employers (def. INSEE).
- **Economy – Added value:** Balance of the production account. It is equal to the value of production less intermediate consumption (def. INSEE).
- **eq:** equivalent
- **FTE**: Full-time equivalent
- **NGV:** Natural Gaz Véhicule
- **GRDF:** Gaz Réseau Distribution France
- **GRTgaz** : Gaz Réseau Transport
- **NAF** : Nomenclature d'Activité Française (French Nomenclature of Activity)
- **NOx:** Nitrogen Oxydes - Pollution emitted during the combustion of fossil fuels by engines
- **O&M** : Operations & Maintenance
- **PACA:** Provence-Alpes-Côte d'Azur
- **PM** : Particules Moyennes (Average particles) - Particles emitted during the combustion of fossil fuels by engines
- **Retrofit of TER:** Action of transforming an existing motorization of a TER
- **SNCF** : Société Nationale des Chemins de Fer Français
- **TER:** Train Express Régional
- **TICGN** : Taxe sur la Consommation de Gaz Naturel (Natural Gas Consumption Tax)
- **TICPE** : Taxe sur la Consommation de Produits Energétiques (Tax on the consumption of energy products)
- **VAT** : Value Added Taxe
- **Unit of work**: Unit used for impact modeling: Number of TER transformed, Distance traveled by TER, Consumption by TER, Number of methanization units, etc.
- **VRD** : Voirie et réseau divers (Roads and various networks)
- **Wh** : Wattheure - Unit of measure for energy consumed
- **WWTP** : Waste Water Treatment Plant

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