



What are the prospects for the industrial storage of liquid energy products in France?

"Any resource is only as good as its availability to those who use it".

The Union des Stockistes Industriels (USI) brings together the main players in the storage of fossil and renewable liquid energy products and chemicals, as well as the national players in pipeline transport.

USI's 25 members operate 95 storage depots and 7,000 km of pipeline network, providing extensive coverage of the national territory. On a daily basis, they work to provide the population and businesses with the essential liquid energy products they need. These infrastructures, which are essential to security of supply, form a safe, tried and tested logistics network that complies with Seveso regulations and the Technological Risk Prevention Plan (PPRT).

The fight against global warming, through assertive policies to reduce greenhouse gas emissions, will reduce the consumption of liquid products of fossil origin, particularly in the transport sector. This development will lead to changes in storage and pipeline transport infrastructures. USI's members, key logistics players in the distribution of liquid energy products, wanted to benefit from a forward-looking vision in order to pursue their development. USI commissioned the study from E-

CUBE, a strategy consultancy dedicated to energy, mobility and climate issues.

Unlocking the future is the first step.

1- The USI E-CUBE study: Making the State's vision a reality

The French Strategy for Energy and Climate (SFEC) assesses energy consumption for the next three decades through the Multiannual Energy Plan (PPE). While the values announced by the government are open to discussion and interpretation, USI has chosen to base its study on the forecast figures set out in the official documents, without questioning them in any way. It is not the purpose of this study to discuss whether or not these targets have been achieved. Based on already-announced consumptions target for 2030 and 2040, this study reflects the sequential development of the phases of change and disruption involved in achieving the targets.

The fall in consumption has led us to include, among other parameters, assumptions about French refining and the need for strategic storage, given their impact on the logistics network. These scenarios and parameters have been determined on the basis of data, knowledge and expertise held by USI and E-CUBE.

2- What to expect from the USI E-CUBE study

The USI E-CUBE study simulates the consequences of the State's vision as presented in the SFEC and

the PPE on the logistics network for liquid energy products (petrol, diesel, jet fuel and fuel oil), in the seven defence zones, for the timeframes 2030 and 2040. This simulation is accompanied by five national scenarios that vary the parameters based on the degree to which objectives are met and the evolution of strategic stocks.

The USI E-CUBE study is first and foremost a tool for those involved in industrial storage and pipeline transport. It is unique in that it presents the results by Defence Zone, as close to the ground as possible. It translates into figures the possible future storage capacities based on consumption projections for the coming decades. Because of the way it was developed, this tool has the advantage of being open-ended and can be re-parameterised to take account of new circumstances, changes in national strategies or potential technological advances.

Conclusion

The USI E-CUBE study forms the basis of the forward-looking vision demanded by USI members.

It will serve three purposes: to assist USI members with their own strategic assessments, to initiate additional, more targeted studies at local level, for example, and finally to serve as a basis for strategic thinking on product availability at national level.

Over the next decade, the USI E-CUBE study predicts that territorial coverage will be significantly affected by the reduction in the number of depots and storage capacity as a result of falling consumption. This decline would have a significant impact on pipeline flows, depending on the region and the increase in road-tanker transport, which is more flexible but has an unfavourable environmental and social impact.

Eventually, it would be impossible to cover the entire country, potentially leading to logistic deserts that would be detrimental to economic development and mobility in certain areas. USI's members are determined to continue to provide the population and businesses with the liquid energy products that are essential for economic continuity throughout the country. One challenge for companies will be their ability to maintain their

assets and continue to train their staff, despite sharply reduced volumes. In this context, legislative, administrative and, where necessary, financial support measures will be required in order to make the structural transition to new products while retaining historical activities.

These include:

1. simplifying the process of obtaining operating permits to enable our companies to begin their transition,
2. putting in place an appropriate legal framework to enable companies to merge, incorporating a forward-looking vision, in mergers,
3. Increasing national strategic stock obligations,
4. Discussions with industry players on future products and their specifications.

On the basis of the USI E-CUBE study, USI will initiate a dialogue with the various industry partners in order to draw up joint proposals.


Bruno Hayem,
President of the Union des Stockistes Industriels



E-CUBE

STRATEGY
CONSULTANTS

Outlook for downstream oil logistics in France

Executive Summary

Study carried out for the *Union des Stockistes Industriels (USI)*



E-CUBE STRATEGY CONSULTANTS

May 2024

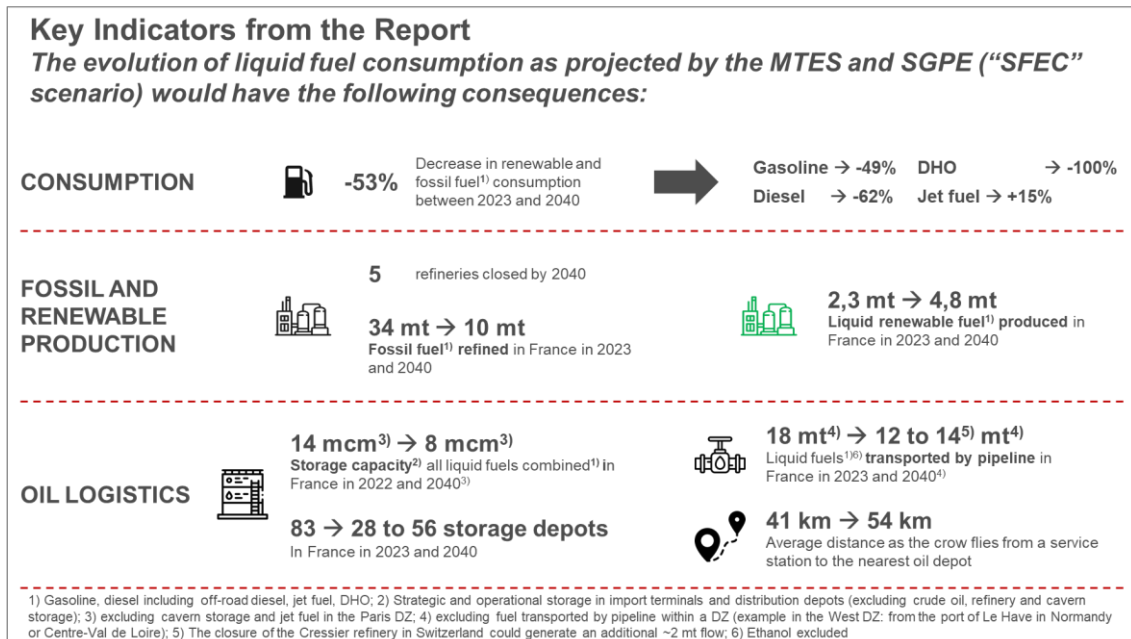
Contact:

E-CUBE Strategy Consultants SAS

8 rue Royale | 75008 Paris | France

philippe.abiven@e-cube.com

1 Key results



2 Objectives

USI is a trade association of the leading oil pipeline stockists and operators in France.

This study aims to enlighten the members of the USI, at the level of each Defence Zone, on the consequences of the following phenomena on oil pipeline infrastructure and storage (capacities and use):

- By 2030: expected growth in gasoline consumption and decrease in diesel and domestic heating oil (DFO) consumption;
- By 2040: reduction in overall consumption (excluding jet fuel).

3 Background

At the French and European levels, ambitious decarbonisation objectives aim for carbon neutrality by 2050. These objectives are reflected in measures that will significantly reduce the consumption of most petroleum products (excluding jet fuel) by

the end of the 2020s or early 2030s (e.g. ban on the sale of light-duty vehicles with combustion engines from 2035).

This marked decrease in consumption will necessitate a profound change in France's oil logistics infrastructure (particularly in storage capacity) and in its operational usage including the size, frequency, and content of batches on pipelines; turnover rate and nature of products – increasing renewable blending rates – in storage sites).

This evolution needs to be differentiated:

- By geography: consumption and supply logistics will not evolve at the same pace across all regions (current logistics already vary significantly by geography)
- By product:
 - The reduction in diesel and domestic heating oil consumption is already underway, whereas gasoline consumption is expected to increase until the end of the 2020s or early 2030s. Jet fuel consumption could continue to rise in the long term, with an eventually predominant renewable portion.
 - The growing share of renewable fuels will increase logistical complexity including the need for segregated storage (often smaller in size) and stricter contamination constraints (especially for B100).
- By type of infrastructure: the geographic location, product mix (including regarding non-fuels like chemicals), and asset size will influence the utilization of various players' infrastructures and thus the sustainability of their operations.

4 Scope of work and simplifications

- Geographical granularity:
 - The information is aggregated at the level of the Defence Zones (as defined below);
 - Only mainland France is concerned (excluding Corsica, other metropolitan islands and overseas territories).
- Product granularity:
 - Consumption and storage needs are analysed according to the following categories:
 - Gasoline;
 - Diesel;
 - Domestic heating oil (DFO);
 - Jet fuel (A-1 jet specifications).
 - The logistics of crude oil and other products (e.g. bitumen, aviation gasoline) are only addressed insofar as they affect the logistics of the products mentioned above

- The renewable portion of fuels is not considered separately (unless otherwise stated). The analyses are therefore conducted "as if" fossil and non-fossil products were a single product although:
 - Renewable and fossil portions can be blended in distribution depots (in particular for gasoline/ethanol). Handling a multiplicity of products mixed in varying proportions will thus require more storage and tanks of various sizes;
 - The transport of certain renewable products requires specific logistics (in particular ethanol).
- Deliveries and consumption: deliveries and consumption are assumed equal. In reality, there are discrepancies between these two quantities because product consumed in a geographical area (country or defence zone) may be delivered from a different geographical area.

5 Consumption

The reference scenario for the evolution of consumption by product is based on:

- For gasoline, diesel, and jet fuel: publications from the Ministry of Ecological Transition and Territorial Cohesion as well as the General Secretariat for Ecological Planning, such as the new French strategy for energy and climate (SFEC), the Multi-annual Energy Programming (PPE), and the 3rd National Low-Carbon Strategy (SNBC3).
- For domestic heating oil and off-road diesel (NRD): E-CUBE projections, as public projections for these products are currently unavailable.

The reference scenario projects a significant decrease in the consumption of diesel (-62%), gasoline (-48%), and domestic heating oil (-100%), alongside a gradual increase in renewable fuels by 2040.

The total volume of products consumed decreases by more than 50% between 2022 and 2040, reaching 31 Mcm in 2040. At that date, diesel remains predominant in the fuel mix, accounting for 48%, while jet fuel grows in importance, reaching 29%. From 2022 to 2030, gasoline consumption increases by about 10% and then decreases. The Paris region's share of consumption increases, as it accounts for over 80% of jet fuel consumption, which is product whose consumption is the most stable over time.

In reality, consumption may evolve differently from what is depicted in the reference scenario, which is directly derived from public policy objectives. In addition, energy infrastructure must be resilient to a certain level of variation compared to the most likely scenario. For this reason, we consider alternative scenarios and sensitise results based on them.

6 Fossil fuel refining capacity

The future production of refined fossil products in each Defence Zone (annual quantities by product) is determined based on assumptions regarding the dates of permanent shutdown or capacity reductions at existing refineries (e.g. closure of desulphurisation units).

Assumed closure dates are based on:

- The evolution of the supply-demand balance in its catchment area;
- Its competitiveness compared to other refineries in the catchment area, if applicable.

As a general rule, the year of closure for each refinery is selected from the possible dates of major turnarounds, which occur every 6 to 7 years on average.

The ratio of the quantity of product refined in France to French consumption remains between 50% and 80% with up to 4 French refineries closing by 2040 and some others experiencing a reduction in their activity (including closure of desulphurisation units or distillation towers). Only 2 refineries are expected to remain in operation after 2040: one refinery in the Northern half of France, and one in the Southern half. If the location of the remaining refining capacity were different, this would impact the location of crude oil vs refined fuel storage. All else being equal, the closure of a refinery increases the volume of fuel passing through the region's import terminals and distribution depots, thereby increasing the required storage capacity at these facilities.

7 Liquid renewable fuel production capacity

Liquid renewable fuels can be produced in two main ways:

- By renewable production units located on the sites of current fossil fuel refineries: in this case, their commissioning occurs a few years after the closure of fossil fuel production (assumption: 4 years).
- On existing or new independent sites.

In the reference scenario, France is projected to produce about 80% of its consumption of renewable fuels by 2040, primarily due to the conversion of 3 refineries to biorefineries (mainly for producing renewable jet fuel).

This conversion is expected to result in the production of nearly 5 million tonnes of renewable fuels (biofuels and synthetic fuels) in France in 2040. This growth will largely come from jet fuel, owing to its relatively stable consumption, coupled with renewable fuel blending objectives of 37% by 2040, in line with the European "RefuelEU Aviation" regulation.

The current production capacity of bioethanol and biodiesel is expected to remain stable.

8 Liquid fuel flows

The evolution of the logistics landscape differs between geographies:

- In some regions (e.g. Paris), the nature and direction of logistics flows change little compared to the current situation: most of the supply comes from pipelines. The increasing blending of renewable fuels leads to a slight increase in logistical complexity due to the increased truck deliveries from renewable production facilities for products that are not currently pipeline-compatible (e.g. ethanol).
- In other regions, the closure of refineries and the change in the gasoline/diesel consumption ratio alter oil logistics more profoundly. For instance:
 - Increase in maritime shipments (including coastal navigation), particularly for diesel and domestic heating oil, due to the higher share of gasoline in the consumption mix
 - Increase in imports and replacement of "crude oil" logistics with "refined product" logistics.

Oil pipelines are the most resilient mode of transport under these changes: the evolution of the refining landscape and the maintenance of jet fuel consumption support their activity in the long run.

9 Strategic storage capacity

Assuming that the strategic storage parameters remain unchanged (number of days of stock per product, share of crude oil, refining and cavern stocks), strategic stocks of refined products in depots evolve in line with consumption and decrease by more than half between 2022 and 2040, from 6.4 to 3.0 Mcm.

However, all the aforementioned parameters can greatly impact the future storage landscape in France. Indeed, strategic storage is estimated to account for ~45% of refined product capacity in depots today although two-thirds of strategic stocks are either in the form of crude oil or in refineries and caverns.

10 Operational Storage Capacity

10.1 Description of the phenomena at play

The decline in liquid fuel flows will impact import terminals and distribution depots in several ways:

- Drop in depot deliveries
- Decrease in shipment size and/or delivery frequency
- Closures of tanks and/or depots
- Increase in unit cost of downstream liquid fuel logistics

In a context of reduced consumption, storage sites will have to make a combination of the following decisions:

- Increase unit prices (capacity, throughput, ancillary services such as additivition, etc.);
- Reduce costs;
- Accept a decline in the profitability of assets.

Foreseeable consequences are:

- Closures of unused storage tanks (which reduce operation & maintenance expenses);
- Mergers of neighbouring depots (which can keep the most profitable tanks in operation – e.g. gasoline tanks – while reducing the total operating costs of the depots);
- Closures of depots (if they are not economically viable);

The "order" in which storage capacity will close is difficult to anticipate because it depends on:

- Shareholding of depots
- Local competitive dynamics
- Local administrative or political decisions.

Downstream oil logistics will have to spread fixed costs over lower consumption:

- Fixed operating expenses (e.g. fixed personnel expenses of oil pipelines and distribution depots);
- Taxes and fees which are not proportional to throughput (e.g. certain types of port fees);
- Capital expenditures (e.g. depot upgrades to address the growth in gasoline consumption in the coming decade).

Thus, despite the gradual decrease in storage capacity, unit storage prices are expected to increase in the long term:

- Depots that remain in operation will aim to maintain their profitability by increasing prices;
- The "last" site operating in a certain geographical area will gradually increase its unit tariffs to cover its costs, until its economic catchment area (i.e. the geographical area where it supplies consumption because products are cheaper to transport through its logistics than through alternative logistics such as trucking from import terminals) becomes too small.

In addition, the share of distance covered by truck (as a % of oil logistics tonnes.km in France, all modes of transport combined) is expected to increase because:

- As the network of depots gets more sparse, the distance between distribution depots and service stations will increase;
- The closure of some depots will increase the proportion of direct deliveries from import terminals or refineries to service stations.

This phenomenon should lead to:

- An increase in logistics costs (since it can be assumed that deliveries currently not made by truck would be more expensive to make by truck, as each service station seeks to minimize its costs);
- An increase in geographical disparities in logistics costs (since logistics costs will increase for service stations that switch from truck deliveries from a depot supplied by mass logistics to truck deliveries from an import terminal or a distant refinery) – which could also accelerate the closure of service stations furthest from the remaining depots and refineries;
- Greater vulnerability of supply to strikes;
- An increase in CO₂ emissions per unit of fuel consumed (since transport by truck generates ~2 to 25-30 times the GHG emissions of trains and pipelines);

10.2 Reference scenario

It is likely that the size of shipments delivered by pipeline and rail will not change in proportion to consumption, and that this differentiated evolution will be result in a lower turnover rate (as the storage capacity needed to receive the shipments decreases less quickly than the throughput). Indeed, pipeline operators must arbitrate between maintaining the frequency of delivery and limiting transmix.

Under these assumptions, the projected total storage capacity (strategic and operational) decreases by 20% between 2022 (14.0 million m³) and 2030 (11.2 million m³), which is slightly less than the decline in consumption (28% between 2023 and 2030). Operational capacity at import terminals decreases by 17%, which is less than strategic capacity, primarily because the closure of fossil fuel production in the

Southeast requires additional operational storage of refined products. Distribution depot capacity is also more resilient: it declines by only 15% (because 50% of these depots are supplied by pipeline so their turnover rate decreases).

The decline in capacity accelerates between 2030 and 2040: it decreases by 30% from 11.2 million m³ to 7.8 million m³, in line with the decrease in consumption (46% between 2030 and 2040). The decrease at import terminals (31%) is partly mitigated there by the increased share of imports in the country's supply mix. Distribution depots remain more resilient, with an 18% decrease.

This evolution results in a reduction in the number of depots with more than 10,000 m³ capacity: from 83 in 2022, their number falls to between 49 and 73 in 2030, and then to between 28 and 56 in 2040. These intervals represent uncertainty regarding:

- The order in which depots close, depending on whether the "smallest" ones close first or not
- The way depots close: either partial (i.e. some tanks within each depot) or full.

In the reference scenario, it is estimated that the average distance "as the crow flies" between service stations and supply depots increases by approximately 15% every 10 years, from around 41 km in 2023 to 54 km in 2040.

10.3 Alternative scenarios

In the "alternative" consumption scenarios, where there is approximately a 3 to 6-year delay in the decrease of consumption compared to the reference scenario, operational storage capacity decreases more slowly. This is particularly notable for depots at import terminals: by 2030, their capacity reaches 3.6 million m³ (compared to 3.2 million in the reference scenario) due to increased deliveries of gasoline and jet fuel compared to the reference scenario.

11 Gasoline storage

Gasoline consumption in France has been steadily increasing since the mid-2010s, driven by the rising share of gasoline engines in the light-duty vehicle market.

This trend is expected to continue, leading to further increases in consumption until 2030:

- In the reference scenario: 14.4 Mm³ i.e. 5% increase vs 2023;
- In the "alternative" scenario: 17.3 Mm³ i.e. 32% increase vs 2023.

This growth could result in the following

- Increase in rates;
- Changes in location of strategic stocks;

- Increase in operational storage capacity in import terminals and distribution depots.

12 Logistics of renewable fuels

The physicochemical characteristics of some renewable products are different from those of the fossil fuels they replace, which requires special logistics considerations.

In particular, the growth in ethanol consumption raises questions regarding the adaptation of pipelines to ethanol and the increase in storage capacity. The same way as for gasoline storage, these investments are difficult to assess due to the uncertainty about the evolution of the ethanol blending rates in gasoline.