

# CLIMATE CHANGE ADAPTATION IN THE CHAMPAGNE REGION

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COMITÉ  
CHAMPAGNE

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# THE CHALLENGE POSED BY CLIMATE CHANGE IN CHAMPAGNE

GLOBAL WARMING IS A FACT. THE GLOBAL AVERAGE TEMPERATURE HAS INCREASED BY 0.8°C SINCE PRE-INDUSTRIAL TIMES. THE IMPACT CAN ALREADY BE SEEN IN CHAMPAGNE.

## CLIMATE CHANGE A REALITY IN THE REGION

Over the **past 30 years**, the three key universal bioclimatic indexes used to monitor local winegrowing conditions have evolved as follows:

**HUGLIN INDEX**  
ROSE FROM 1,565 TO 1,800



**WATER BALANCE**  
SLIGHTLY DOWN



**COOL NIGHTS INDEX**  
ROSE FROM 9.8°C TO 10.4°C

Compared with the 30-year baseline average (1961-1990), the temperature has risen by **1.1°C ON AVERAGE**. Average rainfall is still 700mm/year. Damage caused by spring frosts has slightly increased despite a drop in the number of frosty nights due to earlier bud burst.

The consequences are already visible and are indeed positive for the quality of the musts:

Over the **past 30 years**:

**EARLIER HARVESTS**  
STARTING 18 DAYS EARLIER



**- 1,3 g H<sub>2</sub>SO<sub>4</sub>/L**  
TOTAL ACIDITY

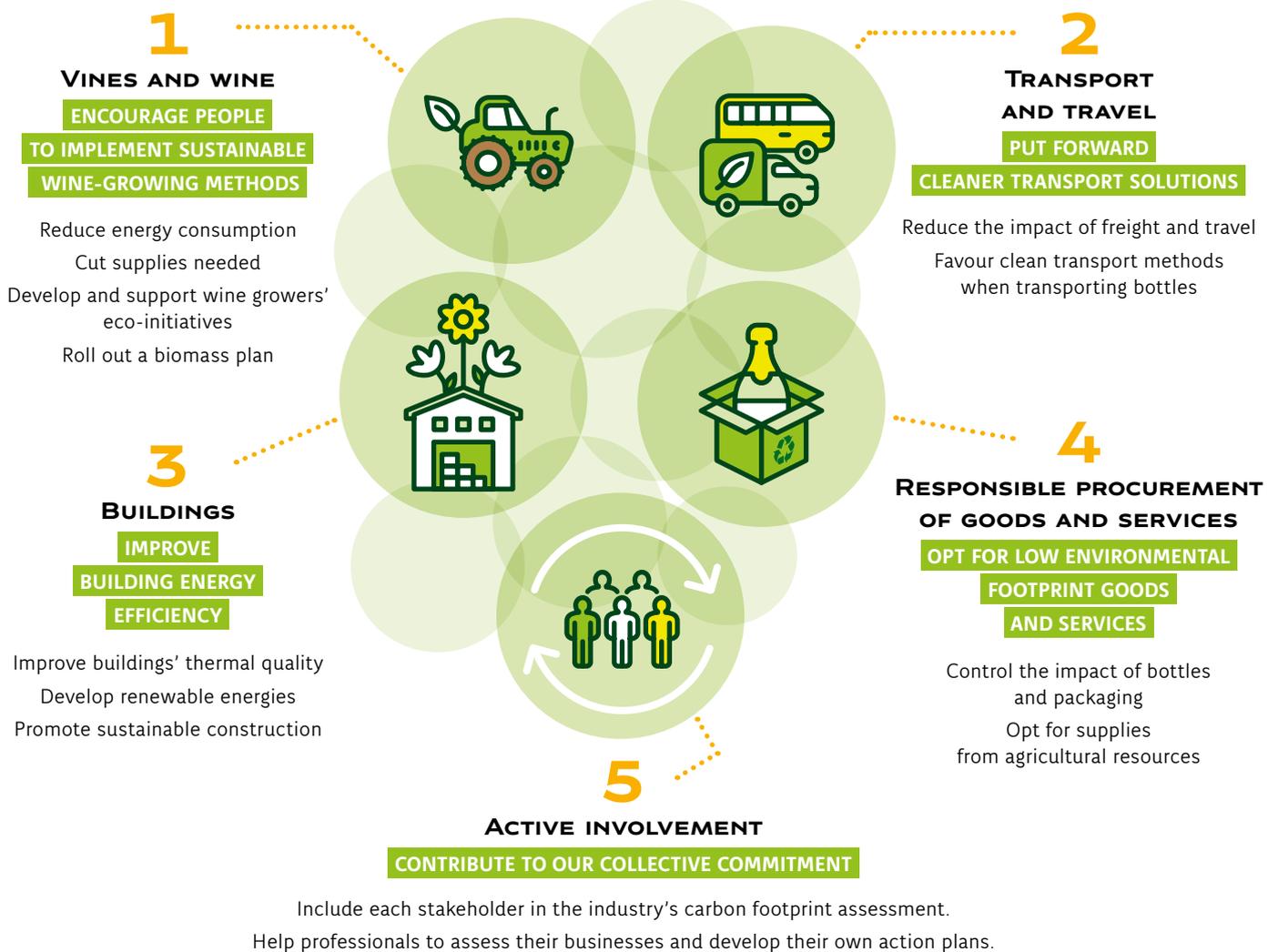


**+ 0,7 % VOL**  
NATURAL ALCOHOLIC  
STRENGTH BY VOLUME

These beneficial effects may well continue if global warming is limited to a 2°C rise. However, the Champagne Region is now exploring ideas that would enable the inherent characteristics of its wines to be preserved in less optimistic climate change scenarios.

# THE CHAMPAGNE'S CARBON FOOTPRINT

THE CHAMPAGNE REGION STARTED TO ACTIVELY FOCUS ON CLIMATE CHANGE IN 2003. CHAMPAGNE WAS THE FIRST WINE-GROWING REGION IN THE WORLD TO CARRY OUT A CARBON FOOTPRINT ASSESSMENT AND IDENTIFY THE MAIN SOURCES OF EMISSIONS.



In 2003, Champagne region equipped itself with an ambitious climate plan and is aiming to cut its emissions by 75% by 2050. The first results are clear to see: the CO<sub>2</sub> emissions generated by each bottle of Champagne have been cut by 20% in 15 years.



Reducing bottle weight, waste recycling and biomass conversion are among the most significant initiatives.

## LIGHTER BOTTLES

FOLLOWING FIVE YEARS OF EXPERIMENTATION, IN 2010 THE CHAMPAGNE REGION LIGHTENED EACH BOTTLE TO LIMIT THE IMPACT OF PACKAGING AND TRANSPORT-RELATED CO<sub>2</sub> EMISSIONS.

### BOTTLE WEIGHT



A REDUCTION OF  
**7%**  
OF BOTTLE WEIGHT

AN EMISSIONS REDUCTION OF  
8,000 TONNES OF CO<sub>2</sub> A YEAR

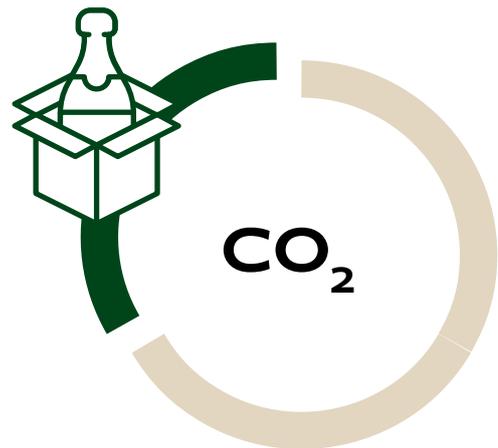
The equivalent of a fleet  
of 4,000 vehicles



PACKAGING'S SHARE  
in the Champagne production process  
is significant and accounts for

**1/3**

OF THE CHAMPAGNE'S  
CARBON EMISSIONS



A SUCCESSFULLY  
ACCOMPLISHED  
TECHNOLOGICAL CHALLENGE

The glassblowers rose to the challenge of striking a balance between reducing bottle weight as much as possible and preserving the bottle's mechanical characteristics.

## WASTE RECYCLING & BIOMASS CONVERSION

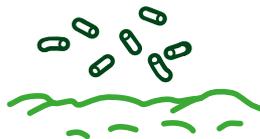
THE CHAMPAGNE REGION'S AMBITION IS TO DISCONNECT VALUE CREATION FROM THE FLOWS OF MATERIALS AND ENERGY WHICH ENABLE IT. THE INDUSTRY HAS THEREFORE WORKED WITH ITS REGIONAL PARTNERS TO SET UP AN INDUSTRIAL ECOLOGY PROGRAMME WHICH FUNCTIONS IN AN ALMOST CYCLICAL WAY.



**120,000**

**TONNES OF VINE  
WOOD PER YEAR**

(vine shoots, branches and stumps) and just as many winegrowing sub-products (pomaces, must deposits and lees).



**80%**

**OF VINE WOOD IS  
GROUND INTO THE  
SOILS**

It enriches the soil with humus and is a natural fertilizer.



**20%**

**IS BURNED**

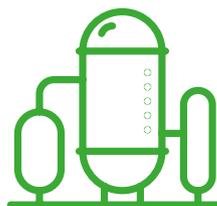
Recovering energy from the wood in this way equates to a potential of **0.5 tonnes of oil equivalent per hectare**.



**90%**

**OF WASTE**

is also sorted and recycled or used to recover energy.



**100%**

**OF WINEMAKING SUB-PRODUCTS**

are used by industry (fuel and industrial alcohol), cosmetics, healthcare and the agro-food sector.

Champagne region is also focusing on supplies and is seeking to replace fossil fuel based supplies with bio-sourced supplies coming from the agricultural resources produced in the region. All of these initiatives help to **reduce Champagne's environmental footprint and stimulate the local socio-economic fabric.**

# A PROGRAMME TO DEVELOP NEW GRAPES VARIETIES THE CHAMPAGNE REGION IS INVENTING THE GRAPE VARIETIES OF THE FUTURE

## FROM THE DOMESTICATION OF VINES... TO THE EMERGENCE OF OUR GRAPE VARIETIES

The *Vitis* genus dates back over 60 million years to the start of the Tertiary period.

At that time, the primitive grapevines were confined to the northern hemisphere. In Champagne, a fossilised vine leaf dating back to the Palaeocene epoch (60 million years ago) was found in the Sézanne region.

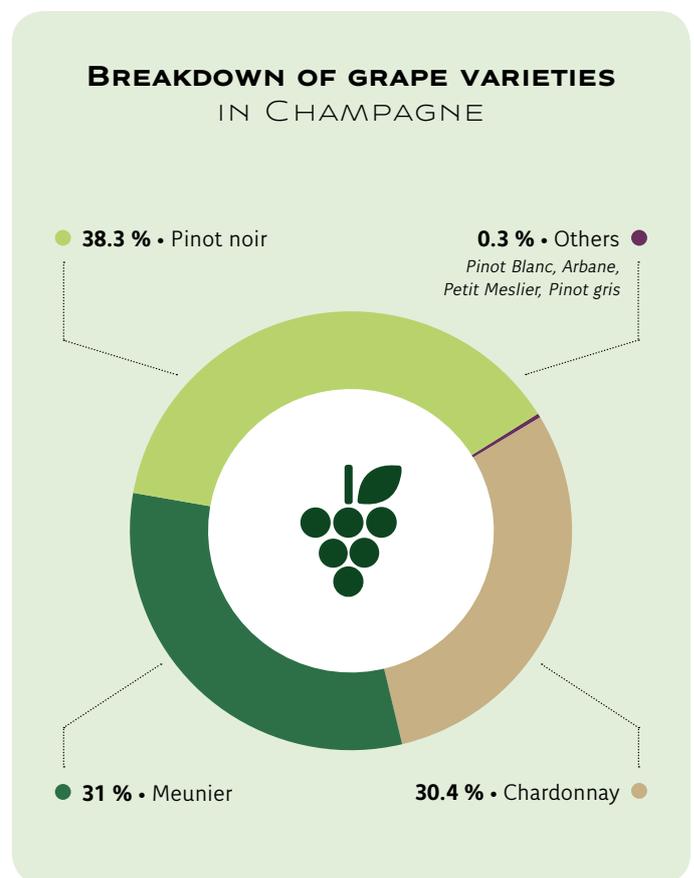
The Romans brought winegrowing to Champagne between 2AD and 3AD. The first ampelography documents referring to Champagne date back to the 16th century. *La Maison Rustique* quotes some of the best vines as being 'Morillon, Pinot Aigret, Fromenteau or Pinot gris and Gouais'.

‘*Morillon, Pinot Aigret, Fromenteau, Pinot gris and Gouais*’

Meunier, Pinot gris and Pinot blanc emerged thanks to mutations of Pinot noir. Petit-Meslier is the result of Gouais and Savagnin being crossed. Finally, the origins of the Arbane variety remain a mystery to this day.

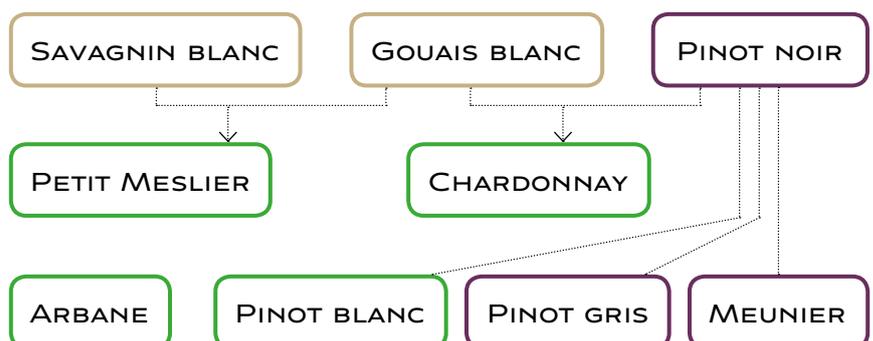
The majority of the local varieties are therefore ancient varieties to which Chardonnay has been added. Chardonnay is a more recent variety as it dates back less than 150 years.

Since 1927, seven grape varieties have been authorized in Champagne: Pinot noir, Meunier, Chardonnay, Arbane, Petit Meslier, Pinot blanc and Pinot gris.



### FAMILY TREE OF THE SEVEN VARIETIES AUTHORIZED IN CHAMPAGNE

RESEARCH UNDERTAKEN BY  
MONTPELLIER INRA, IFV AND  
MONTPELLIER SUPAGRO



## CROSS-BREEDING IN THE VINEYARD

### A LONGSTANDING TRADITION

Until the start of the 19th century, European vines were relatively isolated. With the advent of globalised trade and new methods of transporting goods, the region's grape varieties had to contend with new pests native to America. The arrival of powdery mildew in 1845, phylloxera in 1863 and downy mildew in 1875 devastated the European wine landscape, with grape varieties proving highly sensitive to these new pests.

It is against this dramatic context that the genius of the French hybrid teams will be measured. They plan to cross the European vine species (*Vitis vinifera*) with American species (*Vitis riparia*, *Vitis rupestris*, *Vitis berlandieri*, *Vitis labrusca* or *Muscadina rotundifolia*), some of which are resistant to powdery/downy mildew and phylloxera. The aim is to create new varieties combining these three types of resistance: this is the means by which direct producer hybrids (DPHs) are created. Famous hybrid breeders including Oberlin, Seyve-Villard, Seibel, Couderc and Baco all made their mark by giving their name to a wide range of hybrids. Though the quality of wine produced from these DPHs was subsequently found to be generally poor, they helped to ensure the sustainability of the French wine-growing tradition and around twenty hybrids are still registered in the official catalogue.

During the 20th century, chemistry came to the winegrowers' rescue with the rapid development of plant disease control products as the main strategy to protect vines against powdery and downy mildew. In the late 1990s, the consequences to public and environmental health resulting from systematic use of these disease control products led the French wine industry and public research sector to explore alternative solutions.

In the 2000s, INRA (French National Institute for Agricultural Research) set up an innovative plant breeding programme. The INRA-ResDur programme (sustainable resistance programme) aims to foster the development of sustainable winegrowing, which is also more environmentally-friendly. The programme aims to produce varieties with effective and sustainable resistance, giving good growing capability to the vine and making for wine with good sensory qualities. While the basic principle is age-old (cross-hybridization), the early sorting techniques used, such as MAS (marker-assisted selection), are innovative.

Since 2010, Champagne has been taking part in the INRA-ResDur programme by undertaking *in situ* evaluation of the candidate varieties which could be included in the French catalogue. For the first series of varieties planted in 2011-2012, evaluation resulted in four new varieties being included in the catalogue: Voltis, Floreal, Artaban and Vidoc. A second series is being evaluated and a third series has just been planted and will be observed from 2020 onwards. A number of criteria are used to evaluate the varieties: phenology, agronomic behaviour, yield components, and wine quality, although they have not been selected in order to create a specific type of wine.

At the same time, in 2014 the Champagne Committee launched a regional programme involving cross-breeding with Pinot noir, Gouais, Chardonnay, Meunier, Arbane and Petit-Meslier.

## DEVELOPING INNOVATIVE VARIETIES

### THE MAIN STAGES

The flowers from a flagship variety, such as Chardonnay, are manually castrated.



The flowers are then fertilised using pollen from a resistant vine variety and the future bunch is protected until harvest time.



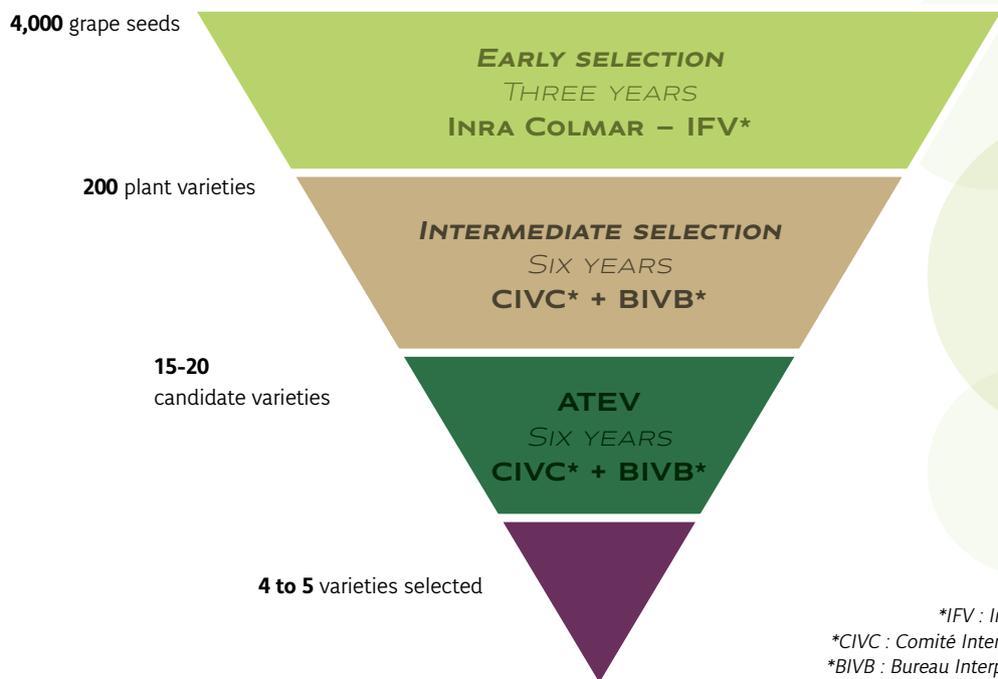
Seedlings from the grape seeds are sorted using marker-assisted selection tools to retain only those that have acquired the desired genes.



# THE SELECTION PROCESS

## RESISTANT TYPICALLY REGIONAL VARIETIES

### NEW GRAPE VARIETIES - A 15-YEAR SELECTION PROCESS



\*IFV : Institut Français de la Vigne et du Vin  
\*CIVC : Comité Interprofessionnel du Vin de Champagne  
\*BIVB : Bureau Interprofessionnel des Vins de Bourgogne

## STAGE 1

Early selection (3 years) helps retain only those seedlings containing the desired resistance genes.

So that four to five varieties can be obtained at the end of the process, 4,000 grape seeds are sown for germination. Once the seedlings develop, they are sorted by genotyping (marker-assisted selection) using DNA from one of their leaves. Only seedlings with the required resistance genes are retained.

## STAGE 2

Intermediate selection (6 years) *in situ* in the Comité Champagne's experimental vineyard and in Burgundy.

200 plants – evaluation based on 5 vines of each variety.

This stage helps verify resistance effectiveness, behaviour when exposed to other pathogens, degree of precocity and the main growing and oenological features.

## STAGE 3

Agronomic, Technological and Environmental Value tests (ATEV) (6 years).

15 to 20 varieties – evaluation based on a minimum of 90 vines of each variety, grafted on at least 2 sites and 2 rootstocks.

A crucial stage intended to study resistance durability and precisely establish the cultivation and technological capacities of each variety, compared with control varieties.

## STAGE 4

Once the varieties have been chosen (4 or 5 probably), administrative measures will be taken to register them in the French catalogue of vine varieties, and finally in the Champagne protection denomination of origin specifications.

The regional programme started its intermediate selection phase in 2018. The first varieties (called «genotypes» at this juncture) crossed in 2015 have been planted out. Evaluation will get underway in 2020. Other varieties were planted in 2019 and planting will continue until 2022-2023.

# VINE TRAINING



## SOIL MANAGEMENT

Working the soil (ploughing, cover planting, fertilisation etc) makes for good water management, facilitates the mineralisation of organic matter, and increases nitrogen absorption by the plant.

Soil management can partially mitigate the impact of the climate on vines. It provides an overall reserve of acidity and lower pHs and therefore has an impact on grape composition and the balance of the musts.



## GROWING PRACTICES

Managing foliage height and density are other ways of adapting to climate change.

Experiments are aiming to determine the effect of the intensity of pinching back at different stages of the grapevine's growth on the malic acid content of grapes. A first relatively short topping during the fruit setting phase helps the young leaves, the main sources of malic acid for the future berries. Conversely, subsequent less severe trimming will leave more foliage in place, which will limit the detrimental effect of the sun on the malic acid during the ripening phase.



## WIDER-SPACED VINES

With a view to rising to environmental and climatic challenges, i.e. to cutting the quantity of inputs and encouraging cover planting, an experiment changing planting density, and above all the space between the rows of vines, has been undertaken.

In 2005, INAO (regulatory body for French Protected Denomination of Origin (PDO) products) authorized the planting of a dozen hectares of more widely-spaced vines on an experimental basis (PDO for a limited time period). The experiment stretched across 17 plots located around the Champagne area.

The spacing between the rows varied between 1.8m and 2.2m and the space between the vine stocks, on the row, between 0.9m and 1.2m. Density varied between 4,000 and 5,500 vines per hectare compared with the traditional figure of 8,000 vines per hectare. This meant that tailored growing techniques needed to be developed.

A first evaluation showed that wider-spaced vines are slightly less susceptible to spring frosts, that grassy strips are easier to maintain with mechanisation being simpler, and that they have an improved resistance to water shortages. They also enable acidity to be maintained in the grapes.

Evaluation is underway to determine the consequences of such a change: the agronomic, oenological, environmental and economic impact, and the repercussions on work ergonomics, and the impact on the landscape itself.



## GRAPE RIPENING

The Matu Network was created in 1956 and now operates on close to 600 plots. The network takes samples of grapes as soon as ripening starts and aims to accurately identify the dates and potential quality of the harvest in order to harvest ripe and 100% healthy grapes.

In the face of climate change, this enables the grape harvest to be effectively adapted in order to preserve the balance of the musts (dates, circuit and conditions in which grapes are picked).

# OENOLOGICAL PRACTICES

IN 2018, THE CHAMPAGNE REGION RECORDED ITS FIFTH GRAPE HARVEST STARTING IN AUGUST IN THE PAST 15 YEARS. TRIALS HAVE BEEN CONDUCTED TO SEE HOW BEST TO PROTECT GRAPES AND MUSTS AGAINST THE HEAT.

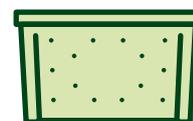
**THE FIRST MEASURES ARE TAKEN IN THE VINEYARD WHERE IT IS ALL ABOUT TAKING COMMONSENSE STEPS TO STOP THE GRAPES FROM GETTING HOT**



Switch picking to the coolest times of day



Do not leave grape harvest bins in the full sun but instead make use of the shade found along the rows of vines



Use light harvest bins (up to 5°C difference between a white bin and a red bin after six hours of exposure to the sun)

Grapes need to be pressed as quickly as possible once they reach the pressing facility. Containers need to be filled to the brim to minimise juice oxidation.

**IN THE FERMENTING ROOM, STEPS TO CUT THE TIME TAKEN SHOULD BE ENCOURAGED**



Enzymatic treatment makes for clear musts after 10 hours



Early addition of yeast prevents fermentation delays



Strict hygiene rules prevent undesirable micro-organisms from developing

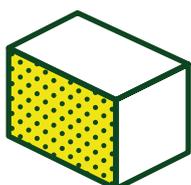


Keep musts at 18/20°C whenever possible

## ADAPTING TO CHANGES IN GRAPE MUST COMPOSITION

WITH THE IMPACT OF CLIMATE CHANGE AND CHANGES TO VINE TRAINING METHODS TO MEET ENVIRONMENTAL REQUIREMENTS, GRAPE MUST COMPOSITION CONSTANTLY EVOLVES AND OENOLOGY NEEDS TO BE ABLE TO ADAPT IN ORDER TO GUARANTEE THE EXCELLENCE AND INHERENT CHARACTERISTICS OF THE WINES.

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### SUGAR

The trend is towards increasing ripeness, causing sugar levels in the must to be slightly higher (+0.7% volume in 30 years). Nothing alarming; and the practices based on adding less sugar and drawing at a lower pressure suffice in order not to increase alcohol content.



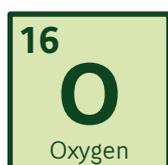
### ACIDITY

As a result of grapes being very ripe, malic acid has decreased in grape must over the past decade. However, the most representative indicator of a wine's acidity is its pH. Over 20 years, pH has barely altered, even if it is sometimes affected by annual variations. In practice, every possible effort is made from the vines to the press to reduce potassium levels in grape must (reducing the pH): cutting fertilisation, cover planting, selecting less productive rootstock, gentle and gradual pressing. However, the issue of acidity is still at the heart of discussions in the region. The trend seems to be to preserve malic acid in some of the wines, preventing malolactic fermentation; then the magic of blending takes care of the rest.



### NUTRIENTS

The third parameter affected by climate change is the nutritional content needed for winemaking. For many years, an increase in the amount of nitrogen-deficient must has been observed. This requires careful monitoring in order to prevent issues occurring during alcoholic and malolactic fermentation.



### SENSITIVITY TO OXYGEN

Finally, phenolic ripeness follows the same pattern as physiological ripeness and grape must is naturally enriched by polyphenols. Methods used to add sulphite need to be adapted, in order to protect grape must from oxidation, while limiting this input in order to meet growing consumer demands in this area.

# AN INDUSTRY COMMITTED TO SUSTAINABLE DEVELOPMENT

## RESULTS

OVER THE PAST 15 YEARS

2003 - 2018



**-20 %**

**CARBON FOOTPRINT**  
per bottle



**-50 %**

**OF PHYTOSANITARY PRODUCTS  
AND NITROGEN FERTILISERS**



**90 %**

**OF INDUSTRIAL WASTE**  
treated and recycled



**100 %**

**OF WINE-PRODUCTION  
EFFLUENTS**

and by-products treated and recycled



**20 %**

**OF AREA**

with an environmental certification

## OBJECTIVES

FOR THE FUTURE

**-75 %**

**CARBON FOOTPRINT**  
by 2050

**0**

**HERBICIDE**  
by 2025

Further rollout of  
**the circular economy**  
concept in  
the champagne region

**100 %**

**OF AREA**

with an environmental certification by 2030

**100% OF THE VINEYARD COMMITTED  
TO CONTINUOUS IMPROVEMENT**

# SUSTAINABLE VITICULTURE CERTIFICATION IN CHAMPAGNE

‘An official recognition of Champagne winemakers’ environmental performance.’



It represents **the day-to-day commitment of Champagne winemakers** to reduce their ecological footprint in **3 areas** :



**BIODIVERSITY**



**CARBON  
FOOTPRINT**



**WATER  
FOOTPRINT**

**Over 120 points are covered** by the Sustainable Viticulture in Champagne frame of reference introduced by the Comité Champagne and **recognized by the Ministry of Agriculture**.

Auditing and certification awards are the responsibility of an **independent certifying body**.

Holders of Sustainable Viticulture in Champagne certification can hold upon request the High Environmental Value (HEV) certification.



**OVER 20%**

**OF THE CHAMPAGNE VINEYARD**  
has environmental certification

*of which*



**15 %**

**HAS SUSTAINABLE VITICULTURE  
IN CHAMPAGNE** certification

The Comité Champagne was founded in 1941 and is an umbrella organisation for Champagne winegrowers and houses. The organisation runs economic, technical, environmental, quality improvement, industry management, communications and Champagne promotional and legal protection initiatives worldwide in order to promote the Protected Denomination of Origin Champagne.



COMITÉ INTERPROFESSIONNEL  
DU VIN DE CHAMPAGNE

[www.champagne.com](http://www.champagne.com)