TITAN CONTAINERS

Cold Storage for Winemakers

A Critical Safety Net in a Warming World

Exploring innovative new methods of grape preservation during the harvest window

Executive Summary

Everyone but the last few climate change deniers now agrees that the planet is getting hotter.

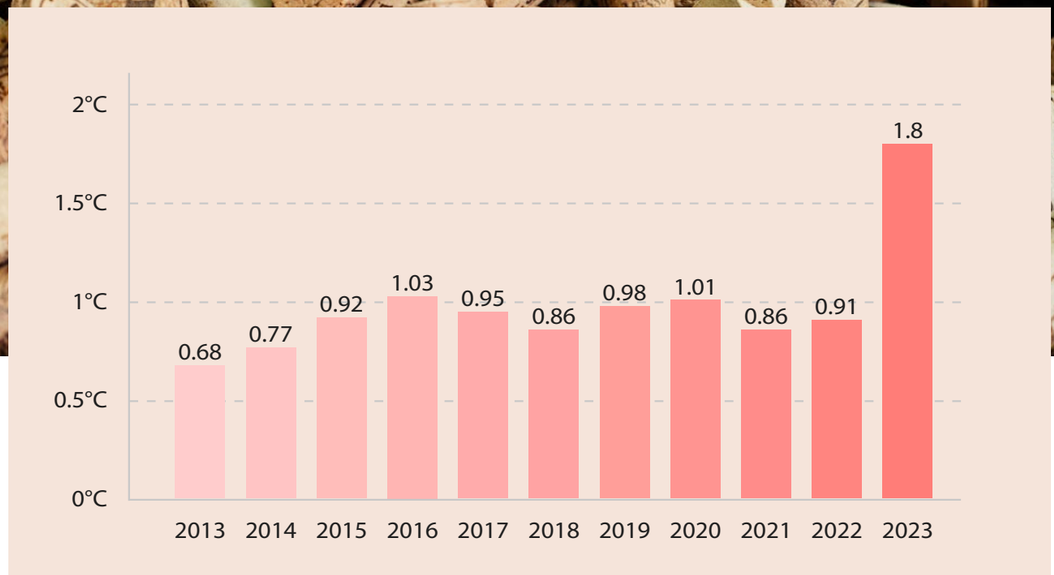
Global warming has prompted more than 190 countries to sign the 2015 COP 21 Paris Agreement and take all necessary steps to prevent temperatures rising more than 1.5°C above pre-industrial levels. To do that, scientists warned that green-house gas emissions must peak no later than 2025.

While some say this may already have happened,[1] the 1.5-degree ceiling that scientists said we must not pass is now expected by many experts to be breached within the next few years – regardless of the progress on emissions.[2]

For millions of people around the world who work in agriculture, the planet's changing climate is a serious concern. Farmers increasingly have to contend with droughts, floods, heatwaves, fluctuating harvest times and even shifts in tempera-ture zones.

One example can be seen in parts of the Mediterranean, where olive farming is gradually expanding north.[3] From 2010 to 2020, the largest number of new olive oil businesses registered in Italy was in Piedmont, where registrations tripled from 641 to 1,939. Piedmont, flanked by the Alps, has a famously temperate climate.

The fact is that 2023 was the hottest year since modern record-keeping began in 1880, and the past decade has been the warmest 10-year period ever.
For many of the world's winemakers, this poses a significant problem. Warmer, longer summers can disrupt the delicate balance of sugar, acid, and secondary compounds in a region's grapes, affecting their development – and, ultimately, the quality of the wine.



2023 was the hottest year since modern record-keeping began in 1880, and the past decade has been the warmest 10-year period ever. **– Climate.gov**

In this white paper, we will assess the impact of global warming on winemaking and explore how hotter summers are rewriting the rules of the grape harvest window.

We will also look at some of the emerging techniques and innovations in the winemaking industry that are helping to mitigate the effects of climate change.

And we will examine a case study of Austria's oldest wine estate using 20ft portable cold storage containers as a 'safety net' during the grape harvest.

The Impact of Climate Change on Winemaking

The global wine market is estimated at around $350bn a year.[4] Approximately one million people work in 100,000 wineries worldwide.[5]

Winegrowing regions are traditionally found at latitudes that are warm enough for grape ripening but are not subject to excessively hot conditions. Many are also found in dry climates, which helps minimise fungal diseases.

According to INRAE, France's National Research Institute for Agriculture, Food and the Environment, "If global warming exceeds 2°C, some 90% of all traditional wine-growing areas in the coastal and plains regions of Spain, Italy, Greece and southern California may become unable to produce high-quality wine in economically sustainable conditions by the end of the century due to risks of excessive drought and more frequent heatwaves." [6]

The flipside to such dramatic circumstances, of course, would be the suitability of previously cooler countries – such as Scotland and Sweden – for winemaking. However, transitioning to such a world would cause disruption to the industry on an unprecedented level.

While 2°C remains a doomsday scenario – for the time being at least – rising temperatures are irrefutably already causing chaos at vineyards around the world.

- Mild winters are bringing vines out of dormancy earlier – making them vulnerable to frost. In 2021, the French grape harvest was the smallest in decades because of sub-zero temperatures in April. Four years earlier, a biting frost wiped out 40% of the Bordeaux harvest.[7]
- Water shortages in countries such as Australia and South Africa are making some growers question the long-term viability of their vines.[8]
- Wildfires in the US, South Africa, Chile, Canada, Portugal and other countries have caused scorched vineyards or 'smoke taint', which can ruin the flavour of wine.
- Extreme heat is becoming a problem in many winegrowing regions worldwide, with longer, hotter summers forcing earlier harvests under the full glare of the sun.

Industry journal The World Of Fine Wine recently noted that **"in just 20 years, for wine, climate change has moved from being a theoretical problem to an actual one."** [9]

In 2021, the French grape harvest was the smallest for decades because of sub-zero temperatures in April.

The early ripening of grapes and the problems this causes

For centuries, many of the world's winemakers could predict the window for their grape harvest with a degree of accuracy. While this has always varied according to grape variety and region, it usually fell at the end of summer or in autumn.

But the planet is already 1.2°C hotter than it was before the industrial revolution, and harvest dates are getting earlier and earlier. Scientists have found that for each degree centigrade of warming, grape harvests need to take place six or seven days earlier.[10]

As previously mentioned, many of the past 10 years have seen exceptionally hot summers, nudging harvest dates earlier still.

In Jerez, Spain, high temperatures brought the start of the 2022 harvest date forward to July 28 – the earliest ever. At one vineyard in South Australia, the picking dates have moved forward a whole month over the past 50 years.[11]

Choosing to pick fully ripened grapes in sub-optimal conditions is not a decision that winemakers take lightly.

While grapes harvested in high summer may pass muster in terms of ripeness and acidity, they risk missing out on the all-important flavour compounds that their wines are famous for and which typically develop over time on the vine.

The risks of leaving grapes on the vine during a heatwave

Winemakers who play the waiting game subject themselves to a multitude of potential problems. Sugar content, for example, can rise when grapes are left on the vine – resulting in higher than desirable alcohol content during fermentation.

Acidity, meanwhile, can start to reduce – and with it, much of the wine's structure and freshness. The risk of rot and disease also has to be considered when grapes are left on the vine – as does damage caused by birds and insects.

Leaving ripe bunches hanging can stress young vines, too. Vineyard magazine notes it eats into "the carbohydrate reserves that would otherwise be laid down for the winter dormancy period, ready to be called upon for strong early growth next spring." [12]

Why many winemakers struggle to process large quantities of grapes quickly

Winemakers have built their processing capacity around a manageable and predictable harvest window. Traditionally, they have expected grapes to ripen at a relatively slow and predictable pace.

But when large volumes of grapes ripen faster – and under full summer sun – this presents several problems, including:

- **Limited equipment:** most wineries have a fixed capacity for crushing, pressing and fermenting. Expanding this is not easily or rapidly achieved and would require considerable investment.

- **Labour:** in blistering summer heat, grape pickers may need more breaks and work at a slower pace. This can cause issues when trying to gather the entire grape harvest quickly.

Most wineries are simply not set up to process their entire grape harvest within a very short timeframe.

At one vineyard in South Australia, picking dates have moved forward a whole month over the past 50 years.

Key Issues Faced by Winemakers as a Result of Hotter Summers

Faced with fast-ripening grapes and no let up in high ambient temperatures in sight, many winemakers feel they have little choice but to begin the harvest earlier than they would like.

This means potentially gathering hundreds of tonnes of grapes in a very short period of time.

Once grapes have been picked, the key issue for many winemakers today is capacity. What are they supposed to do with the fruit before it can be processed?

Bottlenecks can easily form. And with each tick of the clock's second hand, the potential for loss of valuable product increases.

The danger of grape spoilage due to high ambient temperatures

Where once freshly picked grapes could await their turn to be processed in cool September or October air, they now risk spoiling when put to one side in conditions that may not drop below 25°C even at night.

There is no firm consensus on the perfect temperature to store grapes, though most experts concur that it is somewhere between 1 and 5°C. However, there is a general agreement that leaving grapes at high temperatures before crushing and pressing should be avoided at all costs.

Among the key concerns are:

- Mould and mildew growth
- Oxidation
- Premature fermentation
- Bacterial growth

Wineries from California to Austria and Australia are now seeking ways to keep grapes safe, secure and cool until they can be processed.

Mitigating the Effects of Global Warming on Winemaking

Farmers of all kinds want to play as small a part in the global food waste story as they can. Winemakers are no exception.

According to the UN's Food and Agriculture Organization, 1.6 billion tons of food – worth $1 trillion – is spoiled or wasted every year.[13]

To avoid grapes getting damaged, winemakers are turning to a range of innovative solutions to protect their crop as they come to terms with global warming.

Adapting to rising temperatures

Winemakers are employing everything from shade nets to climate-resistant grape varieties to help them fight back against climate change. Even the old-school winemakers of Bordeaux are experimenting with grapes that are better suited to warmer climates.

The Times reported in June 2024 that "traditional Bordeaux grape varieties such as merlot, cabernet sauvignon and cabernet franc are ill-suited to heat and humidity," and went on to explain how one winery, Château La Tour Carnet, has been planting new vines since 2013.[14]

On January 26, 2021, France's Institut National de l'Origine et de la Qualité (INAO) officially approved four new red and two new white grape varieties in the Bordeaux region.[15]

Around the world, several high-tech solutions are also being explored.

Innovative vineyard management for fast-changing climates

Winemakers are lifelong students of terroir, weather, fermentation and blending techniques. The most forward-thinking combine their experience and an understanding of the long history and growing conditions of their vineyard with new possibilities.

Recent technological developments include:

- Smart sensors and remote sensing to monitor soil, temperature and other factors.
- Advanced weather forecasting to help make informed decisions about vineyard management.
- Machine learning and AI to help predict grape ripeness and optimal harvest times.[16]
- Sprays made from marine microbes that can help vines become more resilient.[17]
- Next-generation cold storage solutions to protect freshly-picked grapes that are awaiting their turn to be processed. In South Africa, portable solar-powered storage bins are being employed to keep grapes chilled entirely off-grid.[18]

Also in South Africa, a company that counts more than 20 wine estates as cold storage clients says some of the benefits of using refrigerated containers during the harvest include:

- Affordability vs. in-built solutions
- Speed of installation
- Precision temperature control
- Mobility

In the US, meanwhile, a Connecticut-based company has on-site refrigerated trucks for wineries that give vineyard managers the opportunity to "buy yourself time if the grapes are ready to be picked but not processed."

The largest family-owned container brand in the world is TITAN Containers. Its Arctic-Store brand of refrigerated containers currently serves winemaking clients in France, Greece and Austria, where demand spiked during the 2024 harvest.

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Cold Storage Containers for Winemakers: A Critical Safety Net in a Warming World

As global temperatures continue to rise, so do demands on wine processing facilities. When freshly picked grapes can’t be crushed and pressed immediately, cold storage gives estate managers some time to breathe.

Scientists at the Laimburg Research Center in Italy have been looking into how cooling grapes can help during the winemaking process. “In a preliminary test,” reports Andreas Putti from Laimburg’s Food Microbiology Laboratory, “we examined the total number of germs, yeasts and acetic acid bacteria on ruländer and merlot grapes at different storage temperatures (4°C and 20°C).”

At the higher temperature, Putti’s report states that the natural microflora on the grapes is at risk of multiplying during storage. This happens especially with unhealthy grape material when juice from the partially crushed grapes has already started to leak into the lower layers of the grape tubs.

“A high initial bacterial count of undesirable yeasts or bacteria could both disrupt the fermentation process and lead directly to the formation of off-flavours,” Putti notes.[19]

Initial tests showed that the total bacterial count was higher after 72 hours when the grapes were stored at 20°C than at 4°C. The Center’s research is ongoing.

Technical specifications of cold storage containers for wine

Modern cold storage containers are energy-efficient and capable of rapidly achieving low ambient temperatures that are well-suited for storing grapes.

Some models, such as TITAN’s latest-generation ArcticStore cold storage containers, feature superior levels of insulation and industry-leading chilling technology. As a result, they can cut energy use by as much as 20% compared to standard models from two or three years ago.

Like many modern cold storage units, ArcticStores are available in 10ft, 20ft and 40ft sizes. They are also equipped with remote temperature monitoring and control so winemakers can be sure their grapes are being stored correctly.

A key consideration is managing CO2 levels. The Thermo King refrigeration units in ArcticStore containers have a fresh air management system named AFAM+, which helps protect fresh produce from detrimental conditions.

Many cold storage solutions, such as the ones in the ArcticStore collection, can be rented on demand.

Hiring for a period of 4-6 weeks during the anticipated harvest window gives estate managers a security blanket that requires no capital expenditure or construction disruption.

Cold Storage In The Wine Sector

— Maximising the harvest

How cold storage containers can save losses in the winemaking sector

Time is of the essence once grapes have been picked and they are waiting to be processed. Chilling them in portable cold storage can reduce waste and the resultant losses that winemakers would incur.

Cold storage can help with:

- Protection from spoilage – creating a temperature-controlled environment can reduce the risk of mould, mildew and bacterial contamination.
- Delaying spontaneous fermentation – yeast on the grapes can initiate fermentation that is beyond the winemaker's control, resulting in batches of wine that need to be rejected.
- Preserving flavour and aromas – cold storage helps maintain wine quality and flavours that are synonymous with the brand.

Winemakers can place cold storage containers wherever they are needed to provide maximum convenience and flexibility during the harvest.

Secure locking systems are typically fitted as standard to keep out pests and protect grapes against theft.

Case Study – Stift Klosterneuburg

How cold storage provides a critical ‘safety net’ for Austria’s oldest winery

The Stift Klosterneuburg wine estate is Austria’s oldest winery, founded in 1114. Like many vineyards in the country, it is feeling the effects of climate change on a regular basis.

Stift Klosterneuburg has been using portable cold storage containers as a ‘buffer’ during the grape harvest for several years. In 2024, they rented two 20ft ArcticStores from TITAN Containers’ Austrian team.

These, they said, would give their winemakers extra flexibility during the harvest.

The estate managers also knew that cold storage containers could be used as a holding area for small tanks of freshly pressed white wine grape juice. This would help provide some degree of control during the all-important fermentation process.

TITAN’s delivery teams placed the winery’s rented containers at optimal positions in two Stift Klosterneuburg vineyards. One was positioned outside a wine processing area, and the other in a parking lot.

While the grapes in storage were only kept overnight as they awaited their turn to be processed, the winery believes keeping them at an ambient temperature of 5°C will have a positive impact on this year’s vintage.

Peter Philipp, Head of Production at Stift Klosterneuburg, said: “Chilling is a really good way to preserve the grapes’ aromas. It’s also a non-invasive strategy for microbiological protection and lowers the risk of spontaneous fermentation, which we don’t want.

“We want fermentation to begin after the grapes have been through the crushing process. Cold storage buys us some time.”

TITAN Austria saw more than a 100% increase in orders from vineyard clients in 2024 – a direct result of climate change.

A total of 19 winegrowing clients rented 20ft or 40ft containers for a short period (4-6 weeks) and stated that the ‘safety net’ these provided during their busy harvest period was invaluable.

Conclusion

As well as empirical data about how climate change is affecting the global wine sector, there is anecdotal evidence from within the winemaking community about grapes withering or scorching on the vine during recent summers.

National Geographic reported that towns in southwestern France saw grape leaves burn on the vine in 2019, and the fruit they were shading started to wither.[20]

“Warmer weather is our new future,” says Peter Philipp at the Stift Klosterneuburg wine estate. “Of course, there will be years where vintages are more like we were used to, but something like this year (2024) will come more often. We need to find strategies to help us deal with it.”

Cold storage containers, he asserts, are part of the solution. Their role in mitigating bottlenecks during processing is becoming increasingly important.

“If I were starting again from scratch,” says Philipp, “everything would be different – bigger crushers, bigger presses, bigger tanks, air conditioning in the fermentation cellars and storage areas, plus, of course, a dedicated cooling room where you can store freshly picked grapes overnight. But that’s not something most wineries can do.”

As climate change continues to affect global weather patterns, estate managers are facing unprecedented challenges. As uprooting – literally – is unthinkable in almost every case, the only sensible solution is to investigate new methods that help winemakers make the most of things.

INNOVATION IN THE WINE SECTOR IS NO LONGER OPTIONAL. IT’S ESSENTIAL.

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