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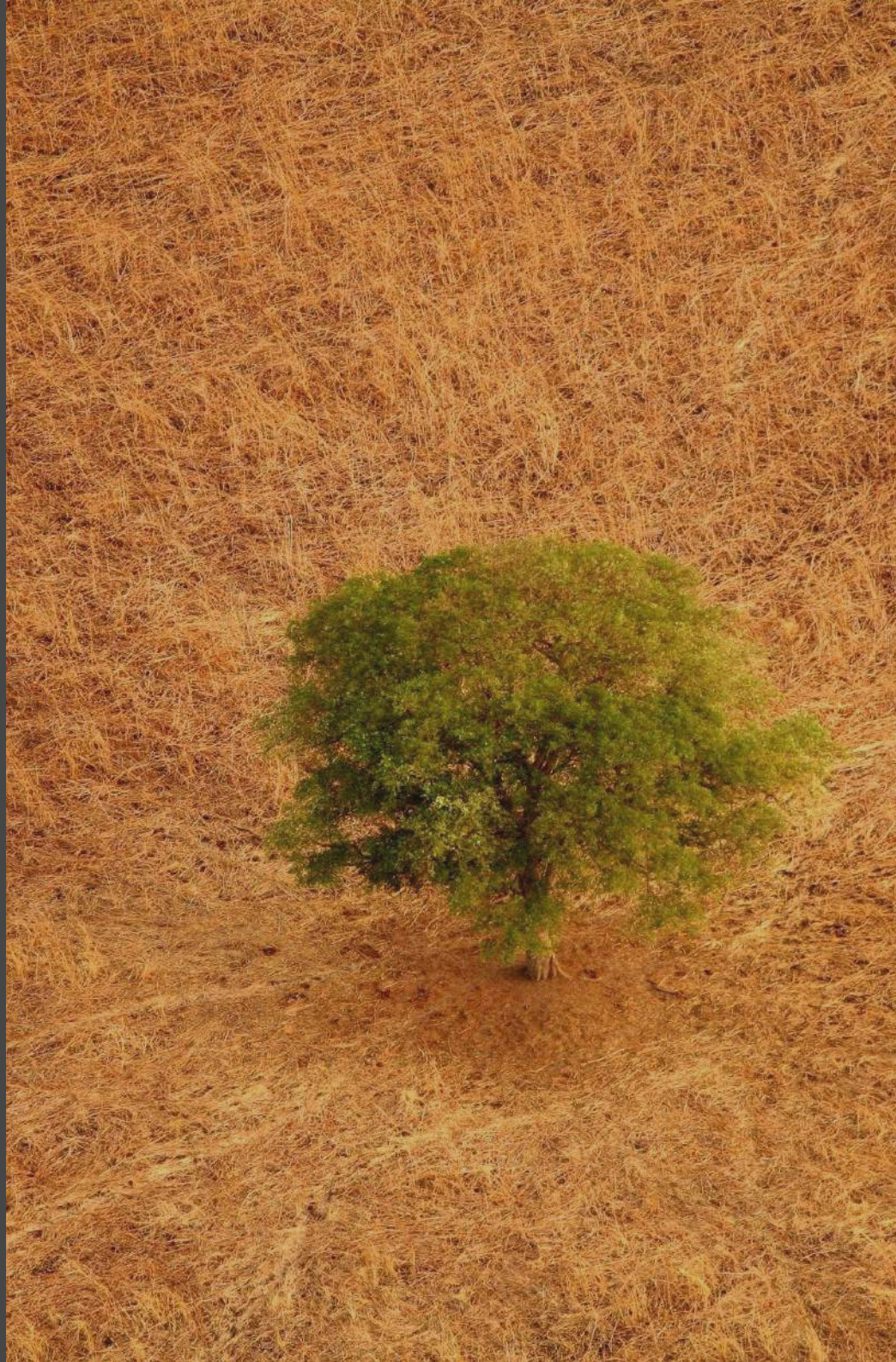
Climate change risk assessment

Final report
March 2022





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Climate risk in the context of Vinmonopolet’s materiality assessment

Strong sustainability management is guided by a materiality assessment, or a detailed overview of which sustainability-related topics are considered to be the most important to any given organization.

Vinmonopolet’s materiality assessment was recently updated in 2021 in accordance with the new GRI guidelines. Interviews with internal and external stakeholders were used to identify which topics were considered the most material according to the new GRI methodology, which focuses largely on likelihood and impact.

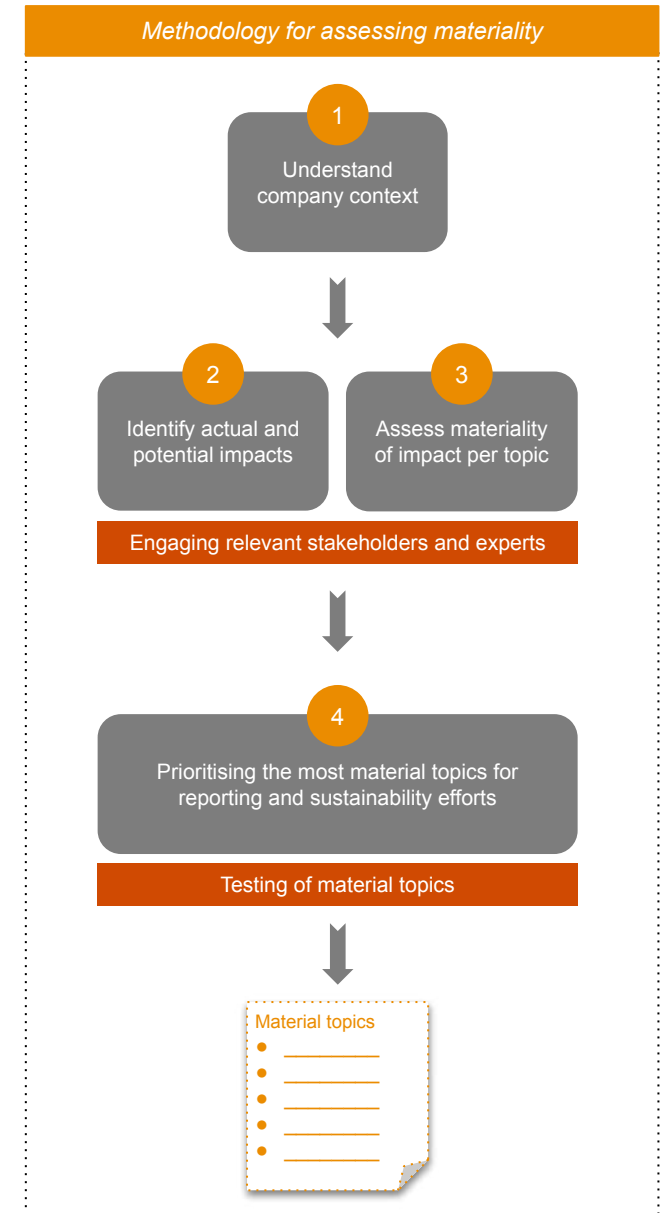
In order to appropriately prioritise sustainability efforts, Vinmonopolet uses its materiality assessment and the identified topics. The areas “Sustainable consumer behaviour” and “Smart Climate & environment solutions” are particularly important for Vinmonopolet, and have therefore created a desire to understand climate change risks and opportunities to a larger degree.

In order for Vinmonopolet to succeed, in turn, a thorough assessment and evaluation of climate change risk and opportunities was needed. This prompts the background and context for the analysis presented in this final report.

The new materiality assessment determined the following topics to be material for Vinmonopolet:

Governance	Environmental	Social
Ethical business conduct	Sustainable consumer behaviour	Alcohol and society
Corruption	Smart climate & environment solutions	Product safety
Fair economic competition	Climate change and GHGs	Limiting negative impacts of alcohol
	Environmental supplier follow-up	Value chain working conditions
	Material consumption	Forced labour
	Water consumption and runoff	Collective bargaining and action freedoms
		Attractive and inclusive workplace

Topics in **bold** are focus areas, or clustered topics that include those below it



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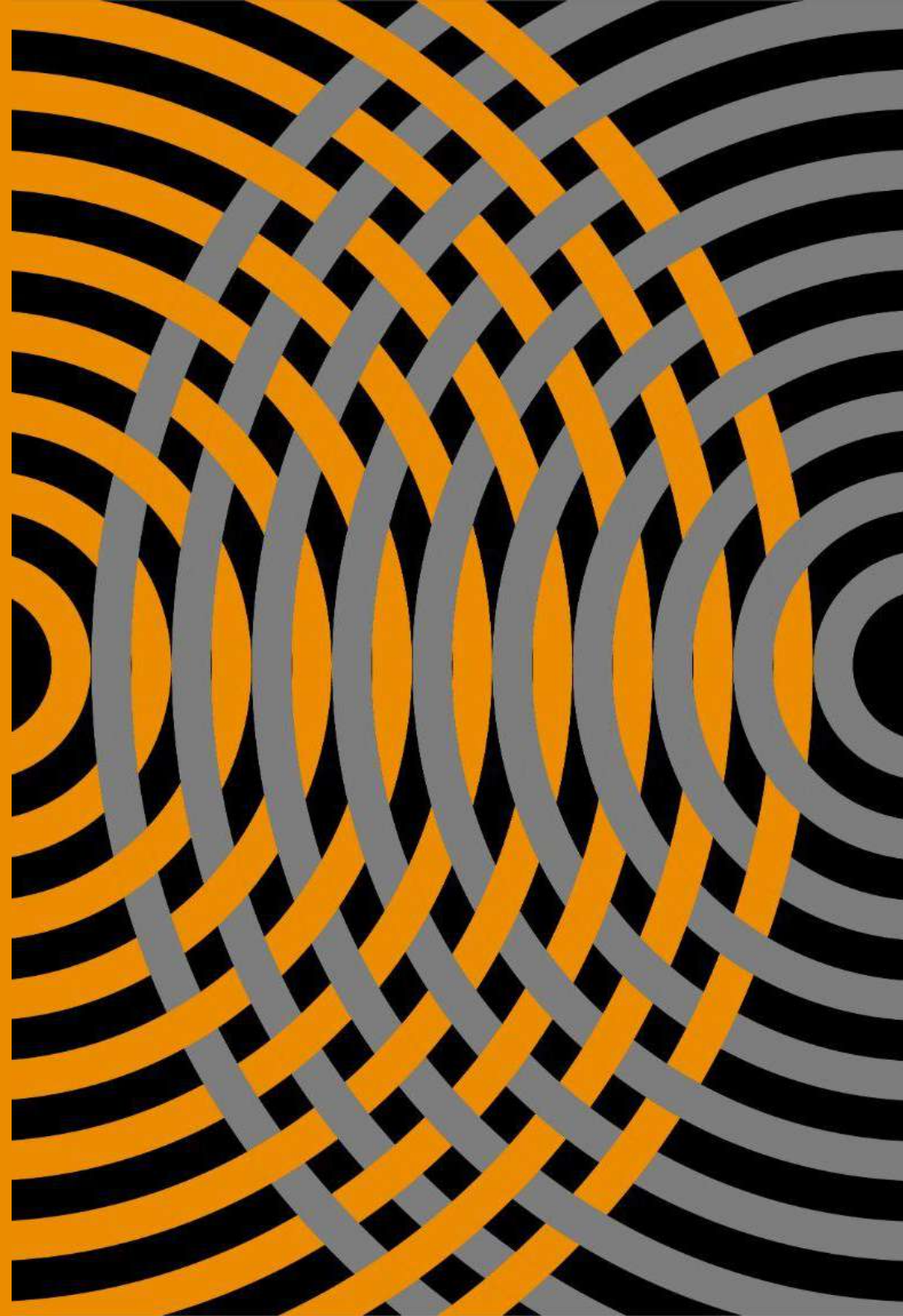
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Executive summary



Aim and purpose of report

Climate change is one of the greatest challenges of our time, and its impact on the world of wine is already evident. Considering how dependent the wine industry is on favourable weather and climate conditions, it is safe to say the industry is particularly exposed to the risks and opportunities associated with climate change.

Vinmonopolet wishes to better understand how climate change impacts the world of wine, both from the perspective of physical and transition risks and opportunities. Vinmonopolet has engaged PwC's Sustainability & Climate Change advisory to support in a comprehensive analysis of climate change risks and opportunities according to the well-recognised recommendations from the **Taskforce on Climate-related Financial Disclosures (TCFD)**.

The TCFD framework provides recommendations for how to categorise and analyse risks and opportunities from climate change, resulting in foundational insights and findings that can be used in public disclosures in line with the recommendations.

This report is a summary of the analysis, divided into two major sections - one dedicated to the physical risks and opportunities of climate change, and one dedicated to the transition risks and opportunities. An introduction is also provided to introduce the reader to broader impacts of climate change on the industry.

The report and its findings are based on comprehensive research of the available scientific literature, interviews with expert and scientists, reviews of major regulatory and technology trends, and more.

As a starting point, the assessment aimed to gather insights that would answer the following questions:

1. **How will the world of wine change across temperature scenarios?**
2. **What are the implications of climate change for Vinmonopolet and its ability to deliver on its mandate?**

The first question is largely geared towards understanding the physical impacts of climate change, whereas the second is focusing more on the transition risks and opportunities that may arise as we shift to a low-carbon society.

Overview

Physical risks & opportunities

The wine industry is exceptionally vulnerable to the impacts of climate change, though the extent of vulnerability is largely dependent on geographical location and the region's ability to adapt through various mitigation measures.

Wine production in warm countries like Spain, Italy, and Australia are particularly vulnerable in a high-emission scenario (4°C of warming), though Italy and Spain are also significantly at risk even in a lower-emission scenario (2°C of warming).

Countries like Germany, New Zealand and the Pacific Northwest of the US may actually gain from climate change, though this is mostly in the lower-emission scenario.

At a global level, the world of wine is significantly at risk in a high-emission scenario, with models projecting potential losses of climate suitability as high as 85% if cultivar diversity remains unchanged.






Overview

Transition risks & opportunities

When considering where transition risks and opportunities may be relevant, a value-chain mapping suggests that all links in the chain are impacted one way or another. How these impacts are categorised is outside the scope of this assessment.

When considering the potential impacts on Vinmonopolet more specifically, however, the most relevant impact areas are recruitment/employee satisfaction, public satisfaction, VMP's ability to meet its climate goals, and financial profitability.

Sixteen potential impact factors were assessed in this analysis, many of which were identified as both a risk and opportunity.

Category		Total
Significant risks		3
Moderate risks		8
Low risks		3
Low opportunities		0
Moderate opportunities		4
Significant opportunities		9

The most common impact area across the 16 potential impact factors was "Public satisfaction," though its impact scores were lower than "VMP's ability to meet its climate goals." Moreover, the three risks identified as significant were all either regulatory or market-based, whereas opportunities were a combination of all types.

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Summary of findings: Physical risk & opportunities for current wine growing regions

Given the vast variety of climatic conditions and grape varieties, the physical impacts of climate change on wine growing countries and regions is fairly fragmented. However, the models and studies referred to in this assessment largely point to a bleak picture as the world warms, especially for regions that are already warm today i.e. those closer to the equator.

The visualization to the right shows a simplified risk diagnostic based on insights related to losses and gains in so-called climate suitability for wine production. Although this assessment does not explicitly predict *net* impacts related to gains or losses across regions, the visualisation allows for some comparison of how regions are placed across scenarios of warming. See page 37 for more detailed information.

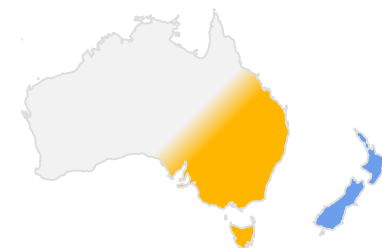
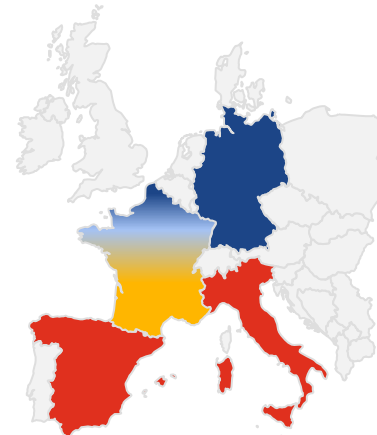
In short, countries like Germany, New Zealand and the Pacific Northwest of the US may gain from climate change, while the remaining regions and countries are highly at risk, especially in a 4°C scenario.

Countries like Italy and Spain are even significantly at risk in the cooler 2°C scenario, whereas France is significantly more at risk in the warmer scenario than in the cooler scenario.

Low-emission scenario: 2°C



Note: Data for the US is solely for California and the Pacific Northeast (Oregon & Washington)

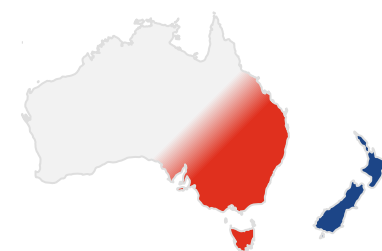
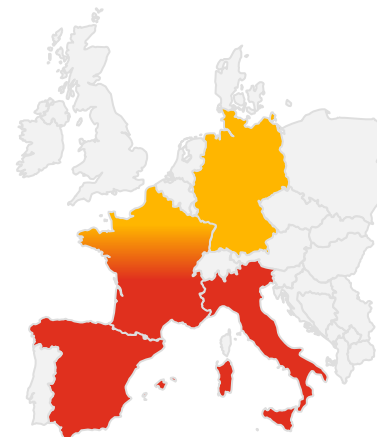


Note: Data for Australia is only for the Southeast

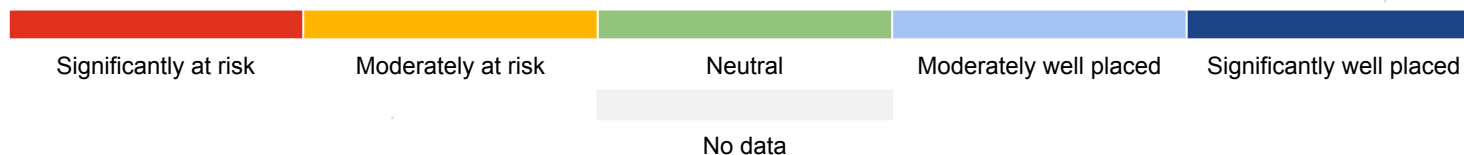
High-emission scenario: 4°C



Note: Data for the US is solely for California and the Pacific Northeast (Oregon & Washington)



Note: Data for Australia is only for the Southeast



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Summary of findings: Transition risk & opportunities

Vinmonopolet is the sole distributor of wine and spirits in Norway, and is therefore uniquely placed in the value chain. In fact, most transition risks and opportunities are primarily relevant for the upstream value chain.

For this reason, four different impact areas (see page 12) were used to assess transitions risks, and whichever impact was determined to have the greatest 'score' became the deciding parameter for this risk assessment.

By referring to page 17, an overview of all risks and opportunities are presented. This section summarises the three most important risks and opportunities, but does not highlight other valuable insights from the assessment.

Significant transition risks

Vinmonopolets own exposure to transition risks are relatively mild and manageable. All three of the significant risks shown to the right are categorised as having "Medium" impact, but because all three are determined to have a "High" likelihood, the final risk score is deemed *Significant*. In turn, the driver behind Vinmonopolet's risk exposure is not the impacts themselves, but rather the inevitability of their presence. In fact, none of the risks assessed had a "High" impact on any of the four impact areas included in this assessment. .

Significant risk	Impact	Likelihood (trend)	Time horizon
Restrained access to products or markets due to extreme weather	Medium	High (rising)	2022 - 2030
Government-mandated emissions reductions	Medium	High (stable)	2025 - 2030
Carbon border tax, or the so-called CBAM	Medium	High (stable)	2026 - 2030

The most immediate implication of this is *the importance of monitoring potential risks' impacts* since this can result in a more adverse risk reality as soon as any given threat is determined to have a "High" impact.

Significant transition opportunities

The most significant opportunities are those that enable Vinmonopolet's ability to reach its own climate goals, either through regulations or changing market dynamics that help bring about necessary change in the value chain.

In other words, of all four impact areas assessed, Vinmonopolet's ability to meet its own climate goals was the area with the highest number of "High" assessments. This is not to say that it was the most important impact area of the four, but it is the impact area with the greatest potential for positive gains.

Significant opportunities	Impact	Likelihood (trend)	Time horizon
Rising CO ₂ prices for fossil fuels	High	High (stable)	2022 - 2030
Changing demand for climate-friendly production or packaging	High	High (stable)	2022 - 2030
Government-mandated emissions reductions	High	High (stable)	2025 - 2030

Interestingly, government-mandated emission reductions is among the most significant risks *and* opportunities, showing the dynamic and nuanced impact potential. However, its impact on Vinmonopolet's ability to reach its own climate goals was the only impact area assessed as "High."

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Implications and potential mitigating measures for climate change risks along the entire value chain.

Grape production



Farmers practicing viticulture are likely the most risk-exposed link in the wine value chain, especially when it comes to the physical risks of climate change. While our report lays out which countries are likely the most at risk, there is a general consensus that adaptation to climatic changes of the coming decades will be necessary across the world.

Research shows the most immediate and important measure farmers can do to mitigate the risks of climate change is to **diversify the varieties that are grown**. This is particularly important when facing the chronic changes of climate change, notably increasing average temperatures. Acute impacts of climate change will require other mitigation measures, though many of these are already being implemented today.

Logistics & transport



Logistics and transportation players are sometimes overlooked in relation to climate change mitigation. On the other hand, transportation-based emissions tend to receive more attention than packaging-based emission, despite the fact that emissions from transport usually only account for around 4% of emissions.

Regardless, **resilient supply chains must also be prioritised, for instance through optimising transport routes and supply chains** to reduce emissions and avoid routes that are more vulnerable to climate change impacts (both at sea and on land).

Logistics players should also **find partners to collaborate with** in order to build resilience for products or services that are more at risk.

Wine production



Wine producers collaborate closely with farmers practicing viticulture, meaning the implications of climate change risks and potential mitigating measures strongly overlap. In turn, wine producers could also actively mitigate the risks of climate change by **encouraging the diversification of varieties being grown**.

Additionally, wine producers are also closely in tune with markets trends of the industry, and arguably hold some influence in shaping them further. In effect, **producers can use their influence to the best of their abilities to promote more sustainable wine production practices**, including organic and biodynamic production methods. **Producers are also key in educating consumers about the changing qualities of wine in light of climate change**.

Vinmonopolet



Vinmonopolet is dependent on actions across the wine value chain to meet their own climate goals. In turn, **working proactively with the various players across the whole industry will be necessary**. This includes seizing opportunities related to decarbonising the value chain, building resilience and promoting more sustainable alternatives.

This could include **forging partnerships** across the whole value chain, **setting up pilot projects** to build knowledge and expertise, **share insights on climate risk** to increase resilience and awareness, **nudging the industry towards sustainable alternatives**, and **collaborating with the other Nordic monopolies** to collectively make a larger impact.

Packaging



Packaging accounts for the majority of carbon emissions from wine production, around 40%. In turn, mitigating the impacts of climate change should ideally target packaging, as there are several readily available solutions out there already.

Packagers should therefore proactively encourage, promote and launch more low-carbon packaging alternatives. This is an important part of increasing the prevalence of low-carbon packaging options in order to **normalise these alternatives amongst consumers**.

Packagers also play a role in educating consumers through labelling and certification schemes that help boost the sales of low-carbon packaging alternatives.

Final consumer



Consumers are arguably the largest driver of change in any retail sector, explained by the power of their purchasing behavior. For this reason, the consumers of wine must be informed about the impacts of climate change in order to contribute to a more resilient wine industry. **In effect, consumers should seek out knowledge** to find out how their behavior has an impact, and **demand more climate-friendly products and services** in order to reduce it.

They should also **apply stakeholder pressure on the rest of the value chain** to further more progress, for instance **by demanding more transparency or supporting new labelling and certification schemes** that promote sustainable practices and climate resilience.

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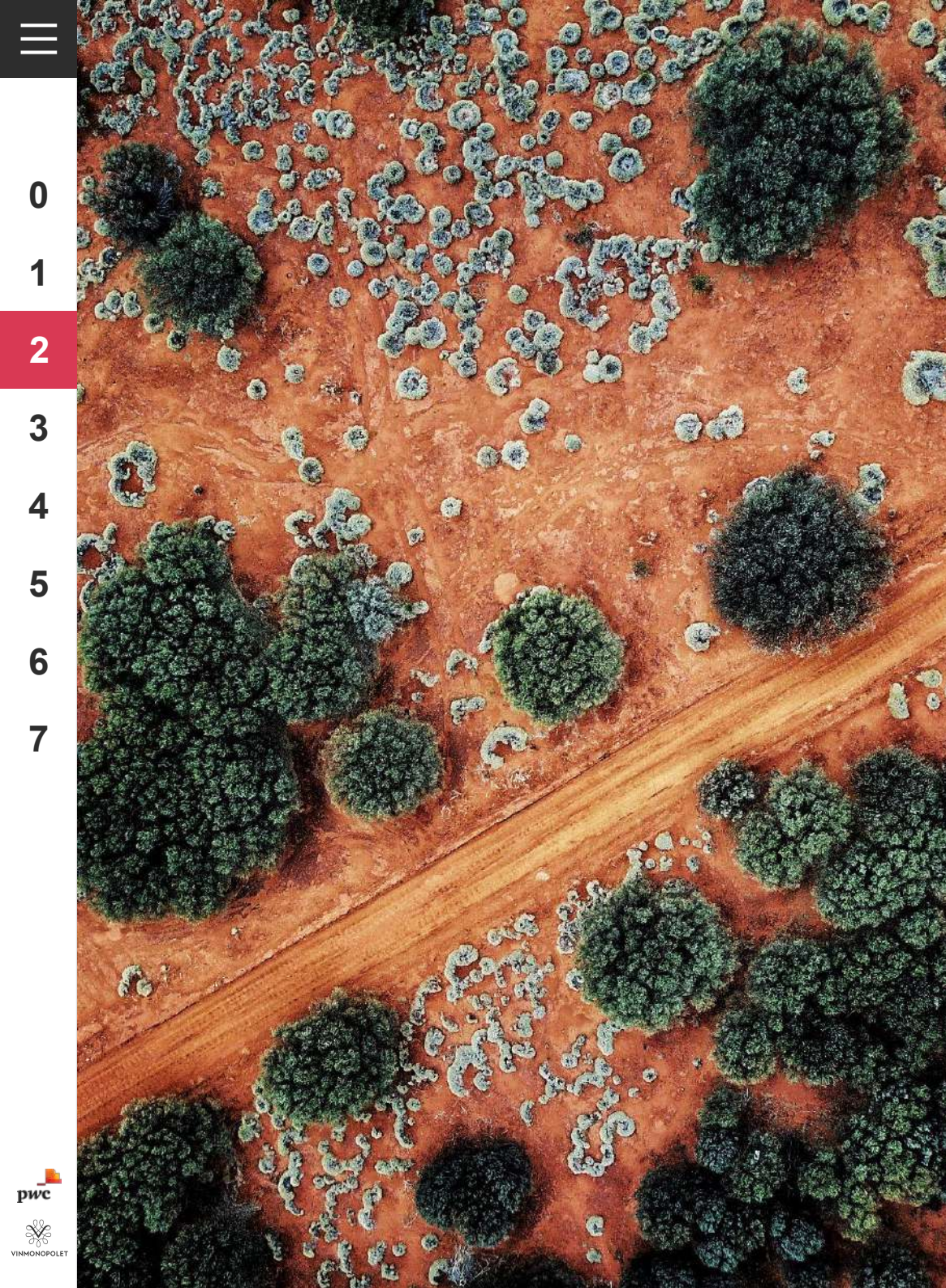
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Introduction

Climate change and its impact on the world of wine

Wine in a warming world

As underpinned by rigorous climate science, a warming world means increased prevalence of extreme weather events, less stability of climatic parameters and more uncertainty in general. For wine production in its agricultural stages, research suggests fairly severe impacts. This is because viticulture is famously sensitive to climate, with temperature and moisture regimes being key elements in *terroir*, or characteristics in wine imparted by the highly local and unique geographical features of the area where the grapes are grown.

Phenology is the study of grape vines used in viticulture (*Vitis vinifera*), which are broadly divided into stages of maturity. Phenology is a key tool for understanding when grapes are ready for harvest, as well as understanding when vines are stressed. Producers all around the world have collected critical insights and data on viticultural parameters against a variety of climatic parameters, ultimately furthering the scientific study of phenology today.

As reaffirmed by Quénol et al. 2017, the temperature increase over the last 50 years has led to the advance of the main phenological stages and a change of wine characteristics mainly related to sugar content and acidity (Jones et al. 2005; Webb et al. 2008; van Leeuwen et al. 2009).

Hanne et al. (2013) was the first major study to map phenology against climate projections published by the UN Intergovernmental Panel on Climate Change (UN IPCC). Their findings mapped potential losses due to climate change impacts across a high- and low- emission scenario.

The researchers found that the area suitable for viticulture would decrease by 25% to 73% in major wine producing regions by 2050 in a high-emission scenario (4°C warming), and between 19% and 62% in the lower-emission scenario (2°C warming). Though the quantification of losses were widespread, the researcher's main finding was that vineyards would likely move production to upland ecosystems to mitigate these risks, consequently clearing wild land and imposing a conservation risk on the natural habitat and biodiversity of the ecosystems.

In 2020 Morales-Castilla et al. published a leading paper that added upon the findings by Hanne et al. by improving the models and methods used. This study, which is discussed in more detail in the chapter on physical climate risks and opportunities, found that a high-emission scenario could result in losses of climate suitability reaching 85%, and 56% in a low-emission scenario. However, if the models allowed for switching to alternative grape varieties, losses could be somewhat abated. In short, cultivar diversity was found to be a major mitigating measure to abate some of the losses of climate change, which decreased to 24% and 58% in the low- and high-emission scenarios respectively.

These studies are very helpful when assessing the granularity of impacts of climate change on the world of wine, but it should be noted that none of these studies provide a certain and definitive prognosis. These findings are a result of models that give indicative insights, and should therefore not be used as a final projection of impacts. However, these are still the most rigorous and up-to-date scientific findings on the topic, and therefore provide invaluable insights for a high-level assessment like the one conducted here.

The physical impacts on climate change are also only one side to the analysis. Indeed, other non-physical impacts are also likely to be experienced in the wine industry as a result of climate change. However, when considering the societal impacts of our transition to low-carbon economy, researched impacts on the wine industry are far less scientific.

This is of course not surprising considering the nature of societal change and its impacts, whether they be political/regulatory, technological, economic or reputational. However, various sources do note some broader changes that should be noted when introducing potential transitions risks and opportunities. As an example, the regulations and standards set for wines produced in various areas (such as the *Appellation d'Origine Contrôlée* in France and the *Denominazione di Origine Controllata e Garantita* in Italy) will likely be forced to change as a result of new cultivar diversity in viticulture, ultimately impacting the market for these wines. Moreover, the market for certain wines will surely be impacted by the changing sugar and acidity content as the climate warms, leading to new wine trends with financial implications.

Another example of broader changes will be in the packaging and labelling of wine in the industry, mainly as a response to the high carbon footprint of glass bottles. These aesthetic changes will be driven by stakeholder demands for climate action, discussed in more detail in the coming section on transition risks and opportunities. On the labelling side, this also entails certifications and standards reflecting the agricultural processes used (such as organic or biodynamic) as well as the packaging material or method. In sum, these changes will likely result in risks and opportunities across the value chain.

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Financial impacts of climate change risks & opportunities

Contextualising financial impacts

The impacts of climate change on wine, introduced on the previous page, will have an evident financial consequence. When assessing climate change risks, especially with the purpose of aligning with the TCFD recommendations, it is important to understand impacts in relation to financial consequences.

This is not to say that all impacts must have a financial consequence that can be measured directly, as there are several impacts of climate change whose impacts are far too diffuse to distill in terms of lost profits or revenues. Examples of this could be the reputational risks related to climate change, or how the loss of various grape varieties across the world can have a negative impact on a country's culture. These are very real consequences that cannot be easily quantified in financial terms.

However, financial impacts of climate change can in some cases be estimated and utilised to better understand the level of risks or opportunities. For example, by understanding the level of gains and losses in land deemed to be climatically suitable for wine production, financial impacts can be deduced based on existing revenues from wine as a baseline. These figures will remain estimates at best, but are still useful when prioritising risks and opportunities. The reason these estimates are difficult to calculate is because of the dynamic nature of potential gains and losses, both acute and chronic.

A recent example of financial costs accrued due to acute impacts of climate change includes the frost disaster in France in early-April of 2021. It was estimated that at least a third of French wine production worth almost €2 billion in sales were lost due to the incident, and the event followed floods in Germany, a scorching heatwave across southern Europe, and drought in California.

According to Fortune Business Insights, the global wine market was valued at around USD 339.5 billion in 2020. In effect, the single frost event in France equated to losses of roughly 0.6% of the global market. This underscores the vulnerability of the sector as a whole when it comes to acute events related to climate and climate change: However, this does not show how chronic gains and losses also play into estimates of financial consequences.

Chronic impacts of climate change and their financial consequences are more difficult to predict. This is mainly due to the slow onset of potential gains and losses, but also because of all the indirect financial components associated with impacts, such as long term costs associated with crop insurance, losses or gains in seasonal labour, local value creation from tourism, and so on. These are indirect financial consequences that are highly relevant, but more difficult to capture in estimates of chronic financial impacts.

This assessment focuses on financial consequences for Vinmonopolet more specifically, and not the larger scope of financial impacts on the wine industry as a whole.

Financial impacts for Vinmonopolet

Vinmonopolet is the sole distributor of wine and spirits in Norway, as mandated by the government. This makes Vinmonopolet the final link in the value chain before products are bought by consumers. In turn, direct financial impacts of climate change are almost exclusively felt upstream in the value chain.

This is not to say that there are no direct financial impacts of climate change for Vinmonopolet, but it does mean most impacts are felt indirectly. This is visualised on page 14, where risks are mapped according to relevance along the value chain. The mapping is based on four impact areas (described on page 13), one of which being financial profitability.

Broadly speaking, financial impacts of climate change for Vinmonopolet are primarily linked to transition risks and opportunities, which are discussed in detail in the next chapter.

Financial consequences of these risks and opportunities are also difficult to estimate, though the most common impact pathway for risks is through increased costs upstream resulting in decreased product margins for Vinmonopolet. Increasing operational costs can also occur through some new regulations or mandates, though these are broadly assessed to be low for Vinmonopolet as coming changes are issued some time before they come into effect, allowing for necessary adjustments to be made.



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Transition risks & opportunities



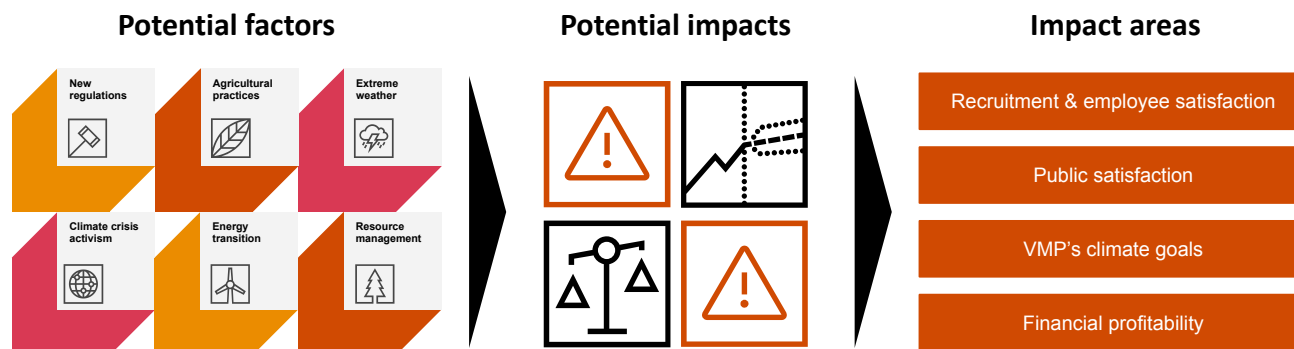
Risk perception at Vinmonopolet

Vinmonopolet is not a normal retail company, primarily because they are the monopolised distributor of wine and spirits wholly owned and mandated by the Norwegian government.

For this reason, risks and opportunities are perceived slightly differently when compared to other comparable businesses. Naturally, operational risks and financial risks are still perceived in a conventional manner, but the company's mandate and mission also means they perceive climate-related risks and opportunities from various alternative perspectives, namely in relation to public satisfaction of the Norwegian public who they are uniquely mandated to serve.

Vinmonopolet's mission is to deliver a full spectrum of quality and diversity within wine and spirits, giving the Norwegian consumer the benefits of choice while still operating under its monopoly. Consequently, Vinmonopolet has a unique social responsibility to deliver upon their mission while satisfying the expectations of their primary stakeholders and customers.

Risks and opportunities are traditionally assessed in relation to the likelihood and consequence of an event. **The consequence of any given event can be described in several ways, but for transition risks and opportunities there were four impact areas determined to be the most relevant for Vinmonopolet.** These are recruitment/employee satisfaction, public satisfaction, VMP's ability to meet its climate goals, and financial profitability.



Recruitment & employee satisfaction

Climate change has resulted in a social movement that has largely changed what expectations current and future employees have for their employer. In a state-owned company that takes social responsibility very seriously, Vinmonopolet is especially impacted by the societal shift. In turn, various transitional risks and opportunities can have a direct consequence for recruitment and employee satisfaction, in a positive and negative way.

Public satisfaction

As a mandated monopoly governed by the state, VMP's existence is contingent on the public's satisfaction of its services. In other words, the most dire consequence for Vinmonopolet would be any event resulting in loss of political support for its mandated monopoly. Similar to recruitment and employee satisfaction, the public's support and perception of Vinmonopolet has to an increasing degree been changed by social movements responding to the climate crisis. In turn, various transitional risks and opportunities have a significant consequence on the public's perception and satisfaction of Vinmonopolet, making it a primary impact area.

VMP's ability to meet its climate goals

Vinmonopolet aims to be a leader in climate action, and therefore handles its ambitions goals with great seriousness. Several transitional climate change risks and opportunities, whether they are regulatory, market-based or technological in nature, could have an immediate or indirect impact on its own ability to meet these climate goals. In turn, this impact area is important for us to map and mitigate accordingly.

Financial profitability

Like any commercial business, financial profitability is important for Vinmonopolet. Although the Norwegian state is Vinmonopolet's sole owner, they have set an expected level of profitability for the company. Understanding if and how transitional risks and opportunities can impact its financial profitability is therefore significant for its own insights, as well as the recommendations from the Taskforce on Climate-related Financial Disclosures (TCFD).

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Our approach for mapping and assessing transition risks & opportunities

Phase 1: Trend analysis

Taking stock of dominant megatrends related to sustainability, climate change, regulation and more.

Identifying which trends can result in relevant outcomes for Vinmonopolet or the wine industry as a whole.

Phase 2: Mapping risks & opportunities

Creating a long list of potential transition risks and opportunities.

Prioritising risks and opportunities into a short list according to relevancy.

Mapping each risk or opportunity according to its impact in the value chain (see table below).







Phase 3: Assessing impact & likelihood

Determining the likelihood of each transition risk or opportunity.

Categorising each transition risk or opportunity according to four impact areas.

Assessing the level of impact as either *high*, *medium*, *low* or *less significant*.

Short-listed factors that are considered to be relevant for Vinmonopolet and its value chain

Potential impact factors	Grape production	Wine production	Packaging	Logistics & transport	Vinmonopolet	Consumer
						
1 Rising CO ₂ prices for fossil fuels	✓	✓	✓	✓	✓	
2 Rising environmental taxes and duties on packaging			✓			✓
3 Changing demand for climate-friendly production or packaging			✓	✓	✓	✓
4 Changing markets as a result of the climate's impact on wine quality	✓	✓				✓
5 Restrained access to products or markets due to extreme weather	✓	✓			✓	
6 Increasing expectations surrounding climate action					✓	✓
7 Publication of inaccurate information, including "greenwashing"			✓		✓	✓
8 Technologies or measures for more energy efficient wine production	✓	✓			✓	
9 New technologies contributing to increased transparency or traceability	✓	✓	✓	✓	✓	
10 Government-mandated emissions reductions					✓	
11 Mandated climate-oriented labelling of products	✓	✓	✓		✓	
12 Strengthened mandates around waste management and recycling			✓		✓	✓
13 Mandated reporting according to the EU Taxonomy					✓	
14 Decreasing accessibility of car in cities to cut emissions and pollution				✓	✓	✓
15 Phasing out fossil fuel vehicles along the value chain				✓		
16 Carbon border tax, or the so-called CBAM from the EU's "Fit for 55"			✓	✓	✓	✓

Potential impact factors can pose both a risk or an opportunity for Vinmonopolet’s impact areas

Before assessing the level of severity for each risk or opportunity, each potential impact factor was identified as either a risk or opportunity for each of the four impact areas.

Some factors could be both a risk and opportunity for any given impact area, which is described in greater detail in the coming pages.

The assessment of likelihood is based on desktop research and analysis of each impact factor.

The key to the right shows how risks and opportunities were mapped according to the potential impact factors, as well as how likelihood was determined for each. An assessment of the impact factor’s trend is also provided to indicate whether or not the likelihood seems to be stable, rising or falling.

Time horizon also shows when the impact factor is likely to remain relevant, leading up to 2030.

Key

- R:** Perceived as a risk for impact area
- O:** Perceived as an opportunity for impact area
- R & O:** Both a risk and an opportunity

- High likelihood:** nearly certain
- Medium likelihood:** at least 50% likely
- Low:** less than 25% likely

Potential impact factors	Impact areas				Likelihood (trend)	Time horizon
	Recruitment & employee satisfaction	Public satisfaction	VMP’s climate goals	Financial profitability		
1 Rising CO ₂ prices for fossil fuels		R	O		High (stable)	2022 - 2030
2 Rising environmental taxes and duties on packaging		R & O	O		High (stable)	2023 - 2030
3 Changing demand for climate-friendly production or packaging		O	O	R	High (stable)	2022 - 2030
4 Changing markets as a result of the climate’s impact on wine quality		R		R	Medium (stable)	2022 - 2030
5 Restrained access to products or markets due to extreme weather		R	R	R	High (rising)	2022 - 2030
6 Increasing expectations surrounding climate action	R & O	R & O	O		Medium (rising)	2022 - 2030
7 Publication of inaccurate information, including “greenwashing”	R	R			Low (stable)	2022 - 2030
8 Technologies or measures for more energy efficient wine production			O		High (stable)	2025 - 2030
9 New technologies contributing to increased transparency or traceability	O	O	O		High (stable)	2024 - 2030
10 Government-mandated emissions reductions		R & O	O	R	High (stable)	2025 - 2030
11 Mandated climate-oriented labelling of products		R & O	O		Medium (stable)	2025 - 2030
12 Strengthened mandates around waste management and recycling		R & O	O		High (stable)	2025 - 2030
13 Mandated reporting according to the EU Taxonomy			O	R	High (stable)	2022 - 2030
14 Decreasing accessibility of car in cities to cut emissions and pollution		R	O		High (stable)	2022 - 2030
15 Phasing out fossil fuel vehicles along the value chain			O	R	High (stable)	2025 - 2030
16 Carbon border tax, or the so-called CBAM from the EU’s “Fit for 55”		R	O	R	High (stable)	2026 - 2030

Our framework for assessing the impact level of risks & opportunities

As described on the previous page, there are four relevant impact areas that Vinmonopolet can use to categorise potential risks and opportunities.

Moreover, the framework offers enough guidance to identify the most severe risks and opportunities without requiring specific estimates or quantification.

In order to assess transition risks and opportunities in a consistent manner, a framework was developed to categorise impact into comprehensive levels.

At this stage, quantification of risks and opportunities is a difficult and ambitious process that yields results with relatively limited value. This is mainly because such a quantitative approach requires a host of assumptions and input factors that increase the uncertainty of any final figures. For the purposes of this analysis, such granularity was not necessary. Instead, and will be considered at a later stage when priority risks and opportunities are identified.

These range from low, medium to high and are described in the table below. The purpose of this framework was to construct impact levels that were flexible enough to be easily used across the various risks and opportunities identified in this analysis.

Assigning a final impact level

Impact levels were assigned for each of the 16 potential impact factor listed on page 9 and 11. Some of these factors can pose both a risk and an opportunity for VMP, resulting in an impact level being assigned for each if needed.

If an impact factor was deemed relevant for more than one of the four impact areas shown in the left side of the table, the highest impact level was chosen in the final assessment. T

If a potential impact factor is not considered to be relevant for the given impact area, a value of *Less significant* was assigned.

	High	Medium	Low	Less significant
Recruitment & employee satisfaction	The impact factor has a significant impact on VMPs ability to recruit and keep talent.	The impact factor has an impact on VMPs ability to recruit and keep talent.	The impact factor has a low impact on VMPs ability to recruit and keep talent.	The impact factor has an insignificant impact on VMPs ability to recruit and keep talent.
Public satisfaction	The impact factor has a significant impact on VMPs political support.	The impact factor has an impact on VMPs general reputation.	The impact factor has a low impact on VMPs general reputation.	The impact factor has an insignificant impact on VMPs general reputation.
VMP's climate goals	The impact factor has a significant impact on VMPs ability to reach its goals.	The impact factor has an impact on VMPs ability to reach its goals.	The impact factor has a low impact on VMPs ability to reach its goals.	The impact factor has an insignificant impact on VMPs ability to reach its goals.
Financial profitability	The impact factor has a significant and sustained (over 1 year) impact on VMPs profitability.	The impact factor has a sustained (over 6 months) impact on VMPs profitability.	The impact factor has an acute and short lived (up to 6 months) impact on VMPs profitability.	The impact factor has an insignificant impact on VMPs profitability.




























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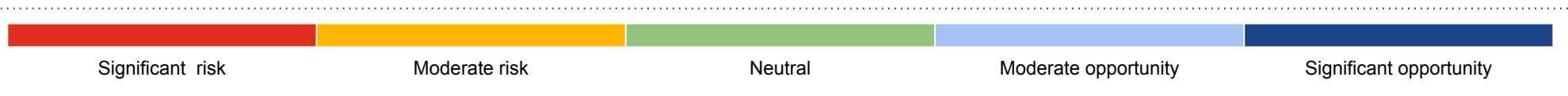
Comprehensive impact assessments

Potential impact factors	Impact areas				Likelihood (trend)	Time horizon
	Recruitment & employee satisfaction	Public satisfaction	VMP's climate goals	Financial profitability		
1 Rising CO ₂ prices for fossil fuels (risk)	Less significant	Low	Less significant	Low	High (stable)	2022 - 2030
1 Rising CO ₂ prices for fossil fuels (opportunity)	Less significant	Less significant	High	Less significant	High (stable)	2022 - 2030
2 Rising environmental taxes and duties on packaging (risk)	Less significant	Low	Less significant	Low	High (stable)	2022 - 2030
2 Rising environmental taxes and duties on packaging (opportunity)	Less significant	Medium	Medium	Less significant	High (stable)	2022 - 2030
3 Changing demand for climate-friendly production or packaging (risk)	Less significant	Less significant	Less significant	Low	High (stable)	2022 - 2030
3 Changing demand for climate-friendly production or packaging (opportunity)	Less significant	Medium	High	Less significant	High (stable)	2022 - 2030
4 Changing markets as a result of the climate's impact on wine quality (risk)	Less significant	Low	Less significant	Low	Medium (stable)	2022 - 2030
5 Restrained access to products or markets due to extreme weather (risk)	Less significant	Medium	Low	Low	High (rising)	2022 - 2030
6 Increasing expectations surrounding climate action (risk)	Medium	Low	Less significant	Less significant	Medium (rising)	2022 - 2030
6 Increasing expectations surrounding climate action (opportunity)	High	High	High	Less significant	Medium (rising)	2022 - 2030
7 Publication of inaccurate information, including "greenwashing" (risk)	Medium	Medium	Less significant	Less significant	Low (stable)	2022 - 2030
8 Technologies for more energy efficient wine production (opportunity)	Less significant	Less significant	Medium	Less significant	High (stable)	2025 - 2030
9 New technologies contributing to increased traceability (opportunity)	Low	Medium	Low	Less significant	High (stable)	2025 - 2030
10 Government-mandated emissions reductions (risk)	Less significant	Medium	Less significant	Medium	High (stable)	2025 - 2030
10 Government-mandated emissions reductions (opportunity)	Less significant	Low	High	Less significant	High (stable)	2025 - 2030
11 Mandated climate-oriented labelling of products (risk)	Less significant	Low	Less significant	Low	Medium (stable)	2025 - 2030
11 Mandated climate-oriented labelling of products (opportunity)	Less significant	Medium	High	Less significant	Medium (stable)	2025 - 2030
12 Strengthened mandates around waste management/recycling (risk)	Less significant	Low	Less significant	Less significant	High (stable)	2022 - 2030
12 Strengthened mandates around waste management/recycling (opportunity)	Less significant	Low	Medium	Less significant	High (stable)	2022 - 2030
13 Mandated reporting according to the EU Taxonomy (risk)	Less significant	Less significant	Less significant	Low	High (stable)	2022 - 2030
13 Mandated reporting according to the EU Taxonomy (opportunity)	Less significant	Less significant	Low	Less significant	High (stable)	2022 - 2030
14 Decreasing accessibility of cars in cities (risk)	Less significant	Low	Less significant	Less significant	High (stable)	2022 - 2030
14 Decreasing accessibility of cars in cities (opportunity)	Less significant	Less significant	Low	Less significant	High (stable)	2022 - 2030
15 Phasing out fossil fuel vehicles along the value chain (risk)	Less significant	Less significant	Less significant	Low	High (stable)	2025 - 2030
15 Phasing out fossil fuel vehicles along the value chain (opportunity)	Less significant	Less significant	Low	Less significant	High (stable)	2025 - 2030
16 Carbon border tax, or the so-called CBAM (risk)	Less significant	Low	Less significant	Medium	High (stable)	2026 - 2030
16 Carbon border tax, or the so-called CBAM (opportunity)	Less significant	Less significant	Low	Less significant	High (stable)	2026 - 2030

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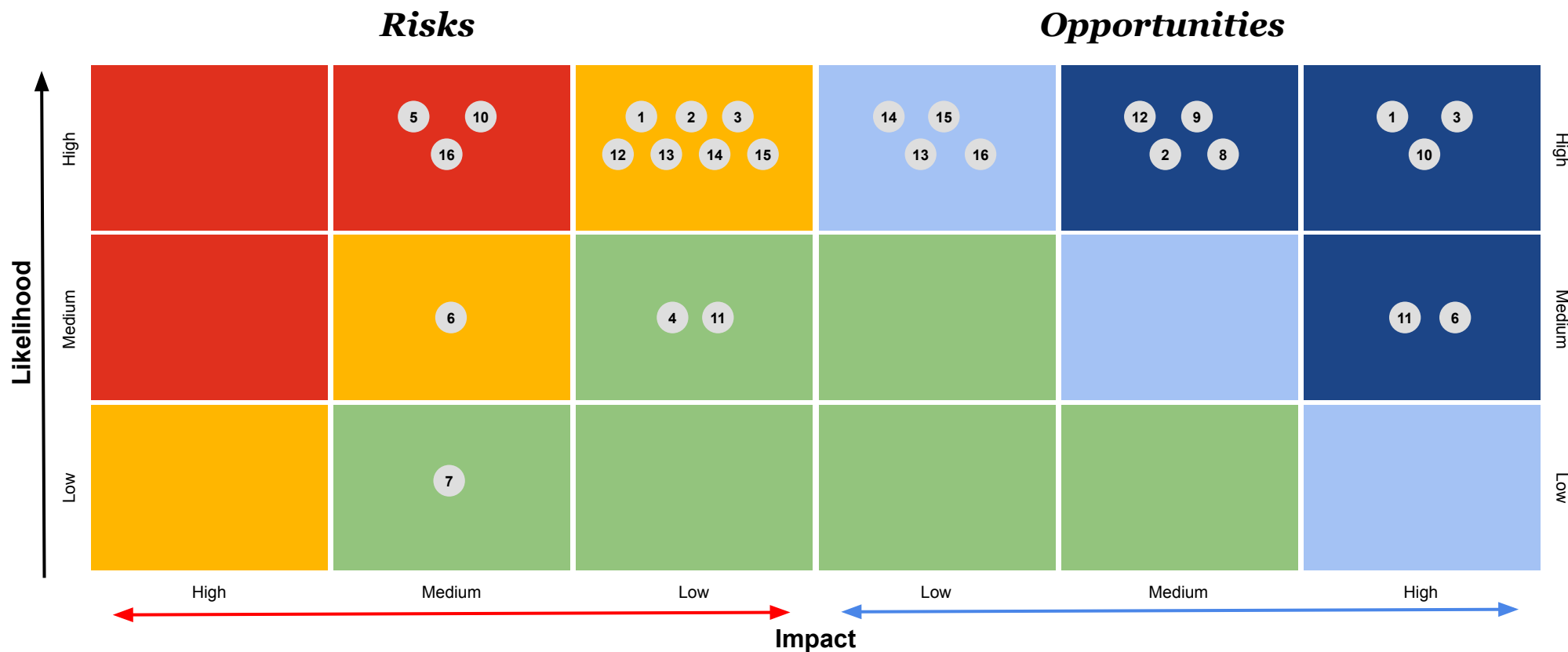
Overall risk & opportunity assessments of all potential impact factors

Potential impact factors	Impact (risk)	Impact (opportunity)	Likelihood (trend)	Overall assessments	Time horizon
1 Rising CO ₂ prices for fossil fuels	Low	High	High (stable)	 	2022 - 2030
2 Rising environmental taxes and duties on packaging	Low	Medium	High (stable)	 	2022 - 2030
3 Changing demand for climate-friendly production or packaging	Low	High	High (stable)	 	2022 - 2030
4 Changing markets as a result of the climate's impact on wine quality	Low	NA	Medium (stable)		2022 - 2030
5 Restrained access to products or markets due to extreme weather	Medium	NA	High (rising)		2022 - 2030
6 Increasing expectations surrounding climate action	Medium	High	Medium (rising)	 	2022 - 2030
7 Publication of inaccurate information, including "greenwashing"	Medium	NA	Low (stable)		2022 - 2030
8 Technologies for more energy efficient wine production	NA	Medium	High (stable)		2025 - 2030
9 New technologies contributing to increased traceability	NA	Medium	High (stable)		2025 - 2030
10 Government-mandated emissions reductions	Medium	High	High (stable)	 	2025 - 2030
11 Mandated climate-oriented labelling of products	Low	High	Medium (stable)	 	2025 - 2030
12 Strengthened mandates around waste management/recycling	Low	Medium	High (stable)	 	2022 - 2030
13 Mandated reporting according to the EU Taxonomy	Low	Low	High (stable)	 	2022 - 2030
14 Decreasing accessibility of cars in cities	Low	Low	High (stable)	 	2022 - 2030
15 Phasing out fossil fuel vehicles along the value chain	Low	Low	High (stable)	 	2025 - 2030
16 Carbon border tax, or the so-called CBAM	Medium	Low	High (stable)	 	2026 - 2030



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Consolidated risk & opportunity assessments



Significant risk	Moderate risk	Low risk / opportunity	Moderate opportunity	Significant opportunity
<ul style="list-style-type: none"> 1. Rising CO₂ prices for fossil fuels 2. Rising environmental taxes and duties on packaging 3. Changing demand for climate-friendly production or packaging 4. Changing markets as a result of the climate's impact on wine quality 5. Restrained access to products or markets due to extreme weather 	<ul style="list-style-type: none"> 6. Increasing expectations surrounding climate action 7. Publication of inaccurate information, including "greenwashing" 8. Technologies for more energy efficient wine production 9. New technologies contributing to increased traceability 10. Government-mandated emissions reductions 	<ul style="list-style-type: none"> 11. Mandated climate-oriented labelling of products 12. Strengthened mandates around waste management/recycling 13. Mandated reporting according to the EU Taxonomy 14. Decreasing accessibility of cars in cities 15. Phasing out fossil fuel vehicles along the value chain 16. Carbon border tax, or the so-called CBAM 		

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Rising CO₂ prices for fossil fuels

Description of impact factor

There has been strong indications that the Norwegian government will implement a cost of 2000 NOK per tonne of CO₂ emissions towards 2030 (Klimaplan for 2021-2030). This cost is a combination of the national CO₂ tax on fossil fuels and the EU carbon price for sectors mandated under the EU Emission Trading Scheme (EU ETS).

The rising cost of carbon emission is intended to induce the transition from carbon intensive fuels and materials towards application of less carbon intensive alternatives. Even though the wine industry is not mandated under the EU ETS, the increasing cost of CO₂ will still affect the industry in different ways. The increasing carbon price will likely affect the cost of wine production and especially the transportation of goods between markets. Vinmonopolet is mostly exposed through its value chain, however the physical distribution of goods between warehouses and stores across the country will likely be affected by the increasing carbon price.

Impact as a potential risk

Rising CO₂ prices could potentially pose a risk for the public's satisfaction for Vinmonopolet, as consumers will see increasing prices on goods, especially carbon-intensive products such as wines stored on heavyweight bottles. However, the price change will slowly increase and it is likely that consumers will accept these changes as they will experience similar effects on other consumer goods. Consequently, the risk is determined to have a low impact. The risk is considered greater further back in the value chain, more specifically related to production and distribution of wine and other products.

Impact as a potential opportunity

An increase in cost of CO₂ will likely contribute to decreased emissions in VMP's value chain (scope 3) and to some extent in their own operations (scope 1 and 2). As a result, the rising CO₂ prices is considered to positively impact Vinmonopolets climate goals. The opportunity is considered to have a high impact on the firm's ability to reach their climate goals as rising CO₂ prices is among the most effective market mechanisms to incentivise carbon reductions.

The trend of increasing taxes and cost of carbon emissions is already apparent today and is likely to continue going forward, thus the time horizon is considered both short and long.

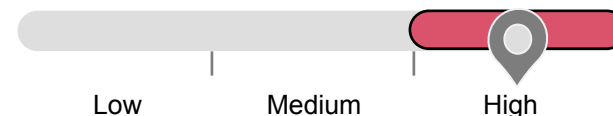
Relevant impact area



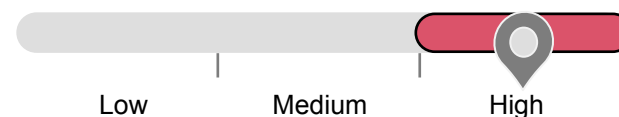
Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Rising environmental taxes and duties on packaging

Description of impact factor

Issues related to waste management is increasing across the global as the need for recyclable packaging is more prominent than ever before. Apart from global warming, the abundance of waste sent to landfill is considered one of the world's major global environmental issues (WWF, 2021). Governments aim to tackle this issue predominantly by forcing taxes and duties on packaging that are considered non-recyclable. Most recently, the EU implemented in 2021 a tax on non-recyclable plastics as part of the European plastics strategy, which includes a cost of 800 EUR per tonne of non-recyclable plastics generated by each member state (Plastics own resource, 2021). Such mechanisms will affect the wine industry through its distribution chain. Wine producers and distribution companies will either meet increasing cost on current packaging materials or seek to substitute with recyclable materials. Either way, the outcome will most likely lead to increasing prices in the packaging and distribution chain.

Norway has implemented an environmental tax rate on glass and metal, plastic and cardboard, with the exemption that all taxes are removed from packaging that have a recyclability rate of 95% or more (Skatteetaten, Beverage Packaging).

This issue will directly affect distribution companies, wine producers packaging their own materials, and indirectly Vinmonopolet through pricing on goods.

Impact as a potential risk

Rising environmental taxes on packaging could potentially pose a risk for the public's satisfaction of Vinmonopolet, as consumers will see increasing prices on products that are packaged in non-recyclable materials. However, the price change will presumably slowly increase and consumers will likely acknowledge price changes as they experience similar effects on other consumer goods. Consequently, the risk is determined to have a low impact. The risk is considered greater further back in the value chain, more specifically related to production and distribution of wine and other products.

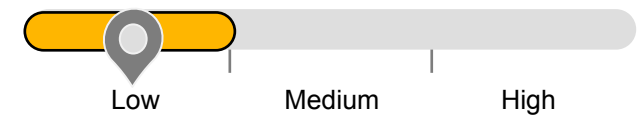
Impact as a potential opportunity

The rising environmental taxes and duties on packaging will positively contribute to Vinmonopolet's climate goals as emissions in the value chain will likely decrease. More specifically, the market mechanism is intended to decrease emissions in packaging, which is the major contributor to Vinmonopolet's scope 3 emissions. The mechanism is therefore determined to have a medium impact on the company's ability to reach its climate goals. The market mechanism is not solely focused on decreasing carbon emissions, as it is also seeking to minimise environmental impact on a general basis, including waste reduction. Consequently, the mechanism will only partially contribute to reduced emissions, making a medium impact is considered likely.

Relevant impact area



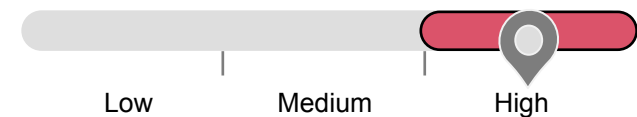
Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Changing demand for climate-friendly production or packaging

Description of impact factor

With the rise of environmental and climate change activism, retail consumers have generally become more aware of climate impacts of the goods and services they consume. For Vinmonopolet and wine more broadly, this means a likely increase in the demand for climate-friendly products and packaging.

According to DataM Intelligence, the market research firm behind the forecast report “Global Organic Wine Market: 2021 - 2028,” organic wine saw an annual growth of over 20% in 2019 and 2020. This was significantly higher than that of conventional wine.

Moreover, the total area of land dedicated to organic vineyards increased by 257% in the last decade alone (Beverage Daily, 2021). Given this consistent growth in both volume and sales, analysts have strong confidence that the trend is highly likely to continue.

When it comes to climate-friendly packaging, the same trend has been observed, though to a slightly lesser degree. New innovations including watertight wood-fibre packaging and flat plastic bottles (to optimise transport) have been developed in recent years, as exemplified by [Garçon Wines](#). This is perhaps less surprising when considering the research showing around 40% of the carbon emissions from a glass bottle of wine are associated with its glass packaging.

Impact as a potential risk

Increased demand for climate-friendly products and packaging may pose a risk for Vinmonopolet's financial profitability. In short, VMP largely sees higher profit margins on more expensive wines, which tend to be higher-quality wines that have aging potential. To date, most wines with less carbon-intensive plastic bottles sold by VMP are cheaper, lower-margin wines that are not meant for aging. In turn, if more sales are derived from low-margin products financial profitability could be at risk. However, in the short-term the impact of this is likely to be low given the small proportion of sales derived from these “climate-friendly” products.

Impact as a potential opportunity

For Vinmonopolet, this is considered to be a medium opportunity for public satisfaction and a high opportunity for organisation's ability to meet their own climate goals, resulting in an overall high opportunity.

In terms of public satisfaction, this impact factor is largely a response to consumer demand and is therefore an opportunity for VMP to win the satisfaction of its customers. Delivering more climate-friendly products would both address the public's desire for climate action, while also meeting the rising demand for organic wines driven by consumers.

Climate-friendly products and packaging are also a key way for VMP to address their Scope 3 emissions, or emissions from the production of sold products.

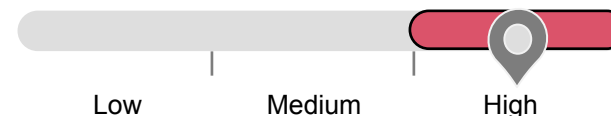
Relevant impact area



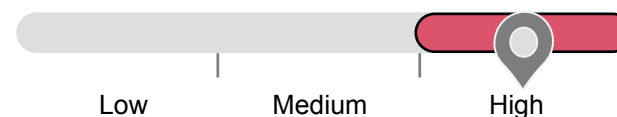
Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Changing markets as a result of the climate's impact on wine quality

Description of impact factor

When considering the physical impacts of climate change, discussed in more detail in the following chapter, there are also transitional risks and opportunities that come as knock-on effects.

Wine is a (luxury) good that to a large extent depends on maintaining a quality component. Quality as a parameter for the demand behind wine is directly linked to climatic conditions and agricultural processes and decisions, both of which are very sensitive to the physical changes of climate change.

A warming world has already directly resulted in increasing the alcohol content of several wines due to higher temperatures advancing phenology. Hotter summers results in grapes that ripen faster, resulting in more sugars that consequently rise the alcohol content of wine. If this increases too much, the quality parameter of wine varieties subject to such change are bound to be impacted.

Another example of how climate change can disrupt wine quality is through the rising probability of infectious diseases in vineyards experiencing warmer temperatures. As a result of milder winters, damp and humid conditions increase the prevalence of a variety of pests, fungi, mildew and disease pressures. These impacts could severely change wine quality, ultimately changing the markets in which they are bought and distributed.

Impact as a potential risk

If the quality of wine suffers due to the impacts of climate change, certain high-priced wines could potentially no longer be seen as desirable. This could pose a risk for Vinmonopolet's financial profitability, as higher-priced wines are often those with higher margins. In the short term this is unlikely to have a significant impact on financial profitability, though towards the long term where the impacts of climate change are more volatile and unpredictable, this could pose a more serious risk.

Public satisfaction could also be impacted by the falling quality of wine as a result of climate change. If VMP is unable to procure and distribute a wide range of wines with quality, or conversely supplies wines that have traditionally been considered high-quality but no longer are, the public could begin to feel dissatisfied with Vinmonopolet's performance. Though much of these impacts will be acute in various regions of the world, VMP's procurement and distribution strategy will likely be agile enough to mitigate these impacts. In turn, the short term impact of this risk is likely to be low-to-medium, though should be monitored closely toward the middle to long-run.

Impact as a potential opportunity

Not relevant

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)

Not relevant

Likelihood



Time horizon



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Restrained access to products or markets due to extreme weather

Description of impact factor

Similar to physical impacts of climate change impacting the quality of wine, these events can also result in major logistical problems. Wine is a global good that is transported from all of the world, resulting in a complex logistical chain that is highly vulnerable to disruptions from extreme weather events.

Even in a low-emission scenario where average global temperatures are kept to a reasonable level of below 2°C, increased prevalence of extreme weather events are practically certain. This is already largely experienced today, with anecdotal events as the flooding in Germany in 2021, the unusually ferocious wildfires in California in 2018 and in and Australia in early 2020. These are examples of how acute weather events can disrupt the access to certain markets, but chronic impacts are also just as relevant. Examples of chronic physical impacts include events that happen slowly over time, such as droughts, sea-level rise and rising average temperatures.

Areas prone to both acute and chronic extreme weather events will therefore be more at risk from a logistical point of view, resulting in less reliable transportation and distribution solutions directly impacting Vinmonopolet's ability to operate in a traditional manner.

Impact as a potential risk

The disruptions from extreme weather events and its impacts on market accessibility and logistics is exclusively regarded as a risk for Vinmonopolet.

These events can result in a multitude of impacts for Vinmonopolet, but the most relevant impact areas are the public's satisfaction, Vinmonopolet's climate goals and to some extent the company financial profitability.

If Vinmonopolet is unable to deliver a diversity of wines from across the world due to the disruptions of extreme weather events, the public may become critical to the company's ability to fulfill its mandate. The impact of this is therefore medium.

Another dimension of this risk is the potential for various European markets being highly inaccessible for periods of time, consequently forcing Vinmonopolet to procure more wines from far away countries that have higher scope 3 emissions. This can therefore be seen as a risk for Vinmonopolet's climate goals, though the impact is deemed to be low in the near term.

Finally, if high-margin wines become less available there is a risk for VMP's profitability, though this is likely a low risk as the company has the ability to procure alternatives on short notice.

Impact as a potential opportunity

Not relevant

Relevant impact area



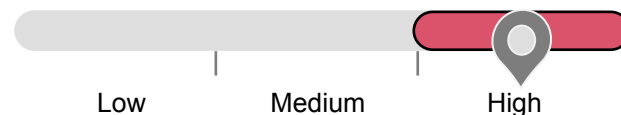
Impact assessment (risk)



Impact assessment (opportunity)

Not relevant

Likelihood



Time horizon



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Increasing expectations surrounding climate action for Vinmonopolet

Description of impact factor

Climate change has been on the global agenda for decades, but in recent years the expectations and activism around the area has truly exploded.

From a business point of view, corporate Net Zero pledges tripled between 2019 and 2020 alone, and according to the Science-based Targets Initiative more than 2,300 businesses and financial institutions are working with the the organisation to reduce their emissions in line with climate science.

With this normalisation of corporate action on climate change, stakeholders are naturally expecting more of companies, whether these stakeholders are employees, investors, owners, customers or regulators.

For a state-owned company like Vinmonopolet that has consistently operated with reputation as a high priority, this impact factor is naturally highly relevant. However, although the general expectations for climate action will rise as a whole, it is slightly less likely that this expectation will be targeted at Vinmonopolet since their contribution towards climate change is considered to be low in the greater scheme of things.

Impact as a potential risk

In the event of failing to meet the expectations surrounding climate action, VMP risks losing the public's satisfaction to some extent (impact assessment: low) while more seriously impacting the company's ability to recruit and retain employees (impact assessment: medium). Studies show that younger employees especially rank this high when considering employment opportunities.

Impact as a potential opportunity

As illustrated in the area to the top right, this impact factor can be a potential opportunity for all three areas highlighted. For recruitment & employee satisfaction, increased climate action is an opportunity for Vinmonopolet to meet or surpass the expectations of their future or current employees, ultimately increasing their pride and satisfaction as an VMP employee that takes its responsibility seriously.

The same is true for the public's satisfaction, which is a major stakeholder that drives the increased expectations for climate action. By meeting or surpassing these expectations, VMP has the ability to significantly sustain the public's satisfaction.

Finally, increased expectations for action is inherently an opportunity for Vinmonopolet's ability to meet their own climate goals as this will increase the likelihood of prioritisation and implementation from management. In short, from an opportunity perspective this impact factor is considered to be high.

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Publication of inaccurate information, including “greenwashing”

Description of impact factor

Greenwashing may be defined as the process of conveying a false impression of sustainability or high environmental performance. The level of intent associated with greenwashing is usually fairly high, suggesting the greenwashing company is doing so purposely. Given Vinmonopolet's track record and prioritisation of social responsibility and corporate governance, intentional greenwashing is not considered to be likely.

However, the unpurposeful publication of inaccurate information is also a severe reputational risk linked to sustainability and climate action. Moreover, since the reputational outcome in the event of such inaccuracies being published is also the loss of good faith from consumers, being labelled as “greenwashing” can happen whether the intention was purposeful or not.

The likelihood of this impact factor is still low, however, considering VMP currently have robust mechanisms in place for external reporting, including the third-party verification of their carbon accounting figures. Regardless of likelihood, however, the reputational outcomes are considered highly relevant and are therefore included in this assessment.

Impact as a potential risk

The publication of misinformation are considered to be a relevant risk for the impact areas “Recruitment & employee satisfaction” and “Public satisfaction”.

Employees, both future and current, hold Vinmonopolet to a high standard and therefore expect that the company acts with integrity and responsibility. In turn, any inaccurate publication of information such as false carbon accounting or labelling could result in reputational damage that will impact both employees and the public more broadly.

When considering the impact severity of this however, it is safe to assume that VMP would be quick to react to such an event and mitigate the reputational damage with a fair degree of success. In turn, the impact of such an even may inherently be high, but after taking mitigating measures into account it is safe to deem the final impact assessment to be medium.

The time horizon for such an event could potentially happen already today, though as stated the mitigation of the event would likely be fairly quick and remediatory.

Impact as a potential opportunity

Not relevant

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)

Not relevant

Likelihood



Time horizon



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Technologies or measures for more energy efficient wine production

Description of impact factor

Although Vinmonopolet is only the distributor of wine and spirits in Norway, they are deeply connected to the upstream value chain that creates the products they sell. This means that in relation to climate change and Vinmonopolet's goals, engaging with and being aware of the trends in this part of the value chain is essential. True decarbonisation happens at the value chain level, meaning energy efficiency and climate-friendly wine production methods are key to Vinmonopolet's success.

According to a 2015 lifecycle analysis on a bottle of wine conducted by VMP, around 24% and 18% of emissions are associated with wine cultivation and the production process respectively, resulting in much potential for optimisation. In the first link of the supply chain this will include measures like electrifying farm equipment, whereas for the wine production link of the supply chain this includes things like making more climate-friendly cooling systems.

According to one study on energy efficiency in grape production by Karimi (2016), energy demanding inputs like nitrogen fertilizer, manure, and irrigation water accounted for 36%, 17%, and 11% of the total energy input, respectively. In turn, reducing resource-intensive agricultural is another dimension of this impact factor, either through technologies related to precision farming or measures like regenerative farming and soil remediation.

Impact as a potential risk

Not relevant

Impact as a potential opportunity

Improving energy efficiency in the upstream value chain through technologies or innovative measures are only considered to be an opportunity for Vinmonopolet.

This is particularly an opportunity for bolstering Vinmonopolert's ability to reach it's own climate goals. Considering Vinmonopolet aims to help decarbonise the entire value chain of wine, not just their own Scope 1 and 2 emissions, improving on-farm energy efficiency could have a fairly significant impact. However, given the relatively low share of emissions being associated with the actual production of wine, the impact level is determined to be medium.

When considering the likely time horizon of this impact factor, the assessment assumes that a medium-term timeframe for the technological innovations are required to truly have an impact. This is largely because of the delay in implementation and scalability of energy efficiency innovations, particularly those that otherwise do not receive a lot of attention or prioritisation.

Relevant impact area



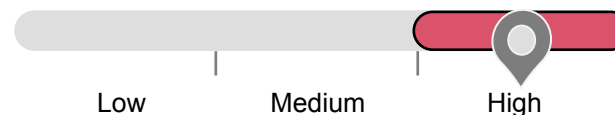
Impact assessment (risk)

Not relevant

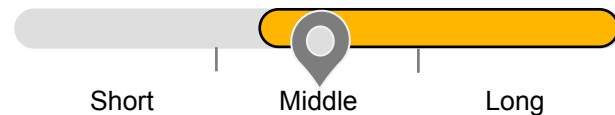
Impact assessment (opportunity)



Likelihood



Time horizon



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New technologies contributing to increased transparency or traceability

Description of impact factor

Traceability in the consumer goods industry is becoming an increasingly prioritised area. This is largely driven by the desires and expectations of consumers wanting to better understand where their products come from, as well as increased need for trust and transparency in light of recent scandals related to fraud, counterfeiting and breaches of human rights.

In relation to climate change, the need for traceability is key to securing an accurate account of emissions throughout the value chain. Although the technologies developing to increase transparency and traceability are largely geared towards ensuring labour rights and other social components of sustainability, the climate-dimension is highly likely to benefit off of this development.

For a luxury good like wine, whose price and demand is largely driven by its geographical location, the need for transparency is also important for Vinmonopolet ensuring quality distribution services.

Perhaps the most relevant technology expected to contribute to increased transparency and traceability is blockchain-embedded supply chains, where an incorruptible decentralised ledger owned by every participating member will allow for secure and verifiable tracking of goods and they flow through the supply chain.

Impact as a potential risk

Not relevant

Impact as a potential opportunity

Increasing transparency and traceability of Vinmonopolet's entire supply chain can be a significant opportunity. In terms of recruitment and employee satisfaction, these technologies that can help create pride amongst employees and new recruits, especially if Vinmonopolet is early to adopt such technologies. Although the impact is not very significant (impact assessment: low), this is still an opportunity for the company.

For the public's satisfaction, on the other hand, the impact is likely a higher (impact assessment: medium), primarily because today's consumers are demanding this traceability and transparency when they purchase (luxury) goods. This trend has also been noted in other retail sectors, such as luxury retail, fashion and food commodities.

Finally, the potential impact of traceability technology on Vinmonopolet's ability to reach its climate goals are likely low, but still important. Achieving a more detailed account of origin and transportation will help create more precision in Vinmonopolet's carbon accounting, ultimately resulting in better mitigating measures from a cost-benefit perspective.

Relevant impact area

Recruitment & employee satisfaction (Opportunity)

Public satisfaction (Opportunity)

VMP's climate goals (Opportunity)

Financial profitability

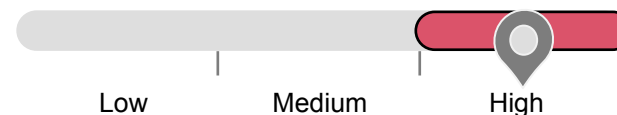
Impact assessment (risk)

Not relevant

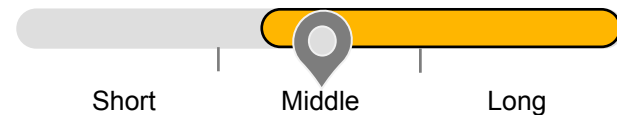
Impact assessment (opportunity)



Likelihood



Time horizon



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Government-mandated emissions reductions

Description of impact factor

As a result of global ambitions to curb climate change enshrined in international accords such as the Paris Agreement, national emission reduction targets have been set across the world.

In Norway, the government has announced their current Nationally Determined Contribution (NDC) under the Paris Agreement to reduce emissions by at least 50-% by 2030, aiming towards 55% below 1990 levels (i.e. 47-52% excluding LULUCF net removals). These cuts in domestic emissions will not be easy, and has so far not included any mandatory emissions reductions for sectors outside of the EU Emission Trading Scheme (EU ETS).

In the years running up to 2030, however, it is likely that the government will enact some form of mandated emission reduction in order to meet its goals. This is likely not something that can be expected until mid-decade at the earliest, nor is it anything that has been forecasted by the government itself.

However, it is important to note that these mandated emissions reductions will not necessarily be in a form that is commonly seen today. For example, these mandates could instead be in the form of mandatory emission budgets or zero-emission vehicles, as most commonly associated with the construction and infrastructure sector. Moreover, this regulatory shift is likely to occur together with other forms of regulating carbon, such as the CO₂-duty and expanding the sectoral reach of the EU ETS.

Impact as a potential risk

Mandated emissions reduction could pose a risk for VMP's financial profitability, as well as the public's overall satisfaction. Beginning with profitability, expensive emission reductions may result in increased costs for VMP, something that result in some sustained losses in profits (impact assessment: medium). As a result of these increased costs, VMP could be forced to increase prices of their wines, something that could have a fairly significant impact on the public's satisfaction with VMP's services (impact assessment: medium).

Impact as a potential opportunity

From the opportunity side, government-mandated emission reductions could pose an upside to VMP's overall reputation as a responsible corporate citizen taking action on climate change, thus increasing the public's satisfaction with its services. Considering the government-wide nature of this regulation, however, the impact of this opportunity is likely low.

Conversely, government-mandated emissions reduction in line with their NDCs will likely be a significant opportunity for VMP's ability to achieve their own climate goals. When emission reduction go from being something debated to something mandated, the cost-benefit discussion are far less demanding (impact assessment: high).

Relevant impact area



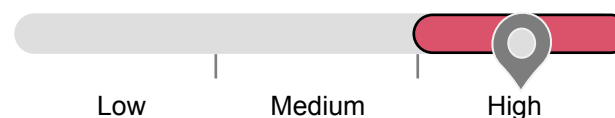
Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Mandated climate-oriented labelling of products

Description of impact factor

As the world decarbonises and the general public become increasingly aware of the individual's role, consumers are likely to demand more transparency around the carbon footprint of the products they consume. Research shows this is an increasing trend that has gained support.

According to a report by The Carbon Trust, two-thirds of consumers support carbon labelling on products, according to their international survey of over 10,000 consumers across France, Germany, Italy, the Netherlands, Spain, Sweden, the UK and the US.

As a result of the growing demand from consumers, government-mandated climate-oriented labelling could be something that is introduced towards the middle-to-end of this decade.

For the wine industry, this would primarily fall on the responsibility of the packaging and labelling link of the supply chain, though the costs associated with deducing the carbon footprint of wines would likely be felt across the entire value chain.

VMP specifically would be held responsible if such a mandate was introduced in Norway or the European Union, even if the wines in question are coming from outside of this jurisdiction.

Impact as a potential risk

In the event of mandated carbon footprint labelling, some consumers may see increased costs of their products in order to compensate for the costs of collecting data on products' carbon footprints, something that could lead to a fall in the public's satisfaction of VMP. Alternatively, certain consumers less interested in climate action may feel like these labels are paternalistic and patronising, something that could also be a risk for the public's satisfaction. However, both of these risks are considered low as the mandate could be mandated across all products.

Impact as a potential opportunity

Mandating carbon footprint labelling would significantly improve the quality of VMP's Scope 3 data, ultimately being a significant opportunity for the company's ability to meet their own climate goals (impact assessment: high).

Moreover, the onset of climate-oriented labelling of products moving beyond labels like "climate-friendly packaging" could be something that increases the public's perception of VMP's reputation (impact assessment: medium).

Relevant impact area



Impact assessment (risk)



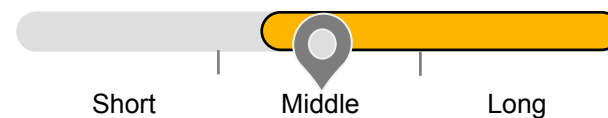
Impact assessment (opportunity)



Likelihood



Time horizon



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Strengthened mandates around waste management and recycling

Description of impact factor

The transition towards a circular economy goes hand-in-hand with the transition to a low-carbon economy.

In 2018, the EU adopted a new waste management regulation mandating that material recycling for household waste and waste from the business sector will be increased to 65% in 2035. According to data from the Norwegian Environment Agency from 2018, Norwegian households sort and recycle only about 38% of food waste and 25% of plastic waste. This gap in circularity highlights the tremendous transition at hand.

For VMP, most wine products are still overwhelmingly packaged in glass bottles, but the increased regulations around waste management are equally relevant. In turn, strengthened mandates around waste management and recycling are considered to be an important transition risk or opportunity factor in this assessment.

Impact as a potential risk

Increased regulations that impact the consumer could pose a risk for VMP's general reputation, though the impact itself is likely to be very low considering this mandated change will be a compliance issue rather than something that VMP has sole responsibility for.

Impact as a potential opportunity

Increased mandates and regulations around waste management and recycling will likely pose an opportunity for VMP's ability to achieve its climate goals, while simultaneously increasing the company's general reputation if consumers are made aware of the share of responsibility the company is taking for the waste it is a part of generating.

In terms of public satisfaction, the impact assessment is determined to be low as it is unlikely that changing mandates would significantly increase the public's political acceptance of VMP, nor significantly impact the company's general reputation against other retail companies.

In terms of VMP's ability to achieve its climate goals, however, improved waste management and the feedback loop this would provoke (i.e. bottles that are designed for recycling and re-use) could have a fairly high impact on the company's scope 3 emission reductions (impact assessment: medium).

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Mandated reporting according to the EU Taxonomy

Description of impact factor

As part of the EU’s comprehensive strategy under the Green New Deal and the so-called “Fit-for-55” regulatory package to help the continent transition to a low-carbon economy, the Sustainable Financial Action Plan (SFAP) was developed and implemented. Included in this regulation was the highly ambitious and innovative EU Taxonomy, essentially a classification of economic activities that are to be considered “green” and sustainable.

The Taxonomy judges economic activities against their impact on or contribution to 6 environmental objectives covering topics like climate change, waste and pollution management, marine and natural resources, and biodiversity. At its core, the EU Taxonomy classifies economic activities by requiring companies to report on how their business activities align with the taxonomy.

VMP is a company that is required to report according to the EU Taxonomy as its meets the regulation’s threshold on revenues and number of employees. Though the complete EU Taxonomy is still unfinished and under development for 4 of the 6 environmental objectives, VMP is preparing to reporting according to the Taxonomy all the same. In its first year, companies must only report which portion of their revenues are generated from economic activities that are so-called “taxonomy-eligible”, before reporting completely on which portion is “taxonomy-aligned” in the following year.

Impact as a potential risk

The reporting requirements of the EU Taxonomy could result in some short term costs increases internally in VMP as more resources are required to establish a grasp and routine over taxonomy-reporting. However, this is likely to be short-term in nature and overall insignificant (impact assessment: Low).

Impact as a potential opportunity

A classification of VMP’s economic activities could result in an opportunity for the company’s ability to better reach their own climate goals. This is mainly because of the EU Taxonomy’s classification of economic activities can implicitly act as a compass for how to steer revenue streams towards more sustainable and climate-friendly forms of business. For example, if revenues generated from the sales of climate-friendly packaged wines ends up being classified as an economic activity with a significant contribution to the environmental objective surrounding waste reduction and circularity, this could indirectly help drive the supply of these products, ultimately decreasing the company’s overall scope 3 emissions. The impact level of this is likely low, however, given the other driving factors that can also result in the same outcome whether or not the economic activity is classified as taxonomy-eligible or not.

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Decreasing accessibility of cars in cities to cut emissions and pollution

Description of impact factor

In recent years various urban cities have began phasing out the accessibility of cars in an effort to increase urban wellbeing, reduce air pollution and cut emissions of carbon dioxide. In Oslo, Norway the municipality has already been reducing the accessibility of cars in the central areas of the city in an effort to phase out traffic and its associated emissions and pollution.

Reducing car traffic in the city centre was a crucial measuring in the municipality's plan to cut emissions and remain within its emissions budget, which was capped at the municipal level and has since garnered significant attention from other urban areas both domestically and internationally.

As a result there is a high likelihood of other cities looking to replicate Oslo's measures, something that could directly impact the accessibility of some of VMP's urban stores. This can impact both the consumer, who may have traditionally driven to the store, as well as the transportation vehicles that supply the physical stores.

Impact as a potential risk

Many of VMP's most well-stocked stores, the so-called "category 6 stores," are in urban areas where population density warrants the size of the stores. In the event of decreased accessibility of cars in cities where these stores are located, the consumer could face new accessibility issues than before when cars were able to drive to the store location. This could result in low public satisfaction with VMP, though this is determined to have a relatively low impact.

Impact as a potential opportunity

Reducing the accessibility of cars in cities could result in replanning logistical routines for stocking and supplying stores in order to drive into cities as infrequently as possible. This could in tern result in lower emissions associated with VMP's regular logistics emissions, ultimately posing an opportunity for the company's ability to meet their own climate goals. However, given the relatively low emissions associated with near-location logistics, the impact level of this opportunity is determined to be low.

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



Phasing out fossil fuel vehicles along the value chain

Description of impact factor

Both at the domestic and international level, fossil fuel cars and transportation vehicles are set to be phased out over the next decade and a half.

In Europe the sale of fossil fuel vehicles will be banned by 2035, and in Norway this is set to occur even earlier.

VMP's supply chain, especially the one across Europe, relies on ground transportation to a large degree. This can be reflected in the company's scope 3 emissions, which according to a 2015 lifecycle analysis showed that transportation accounted for around 4% of total emissions. As fossil fuel-power vehicles are phased out and transition to either electric or hydrogen-powered, the emissions are expected to fall as a result.

In turn, transitioning the supply chain to zero-emission vehicles are an important part of VMP's exposure to climate change risks and opportunities, and therefore something that will be monitored closely.

Impact as a potential risk

Switching to non-conventional transportation vehicles for the sake of reducing emissions and phasing out fossil fuels can be expensive, especially in the short-to-medium term when these technologies are less cost-competitive for vehicles traveling long distances. In turn, the transition to zero-emission vehicles could result in increased costs for VMP as the final distributor, though these costs are likely to be either shared along the value chain or less significant entirely given the gradual switching of the vehicle fleet. In sum, this could pose a risk for VMP's financial profitability, though the impact level is deemed to be low since this transition is likely to happen gradually enough for it to be managed appropriately.

Impact as a potential opportunity

As the supply chain decarbonises its transportation emissions by switching to zero-emission alternatives, VMP will see a fall in its value chain emission. This is therefore an opportunity for the company's ability to meet its climate goals, though given the small portion of emissions associated with transportation the impact level of this opportunity is determined to be low.

Relevant impact area



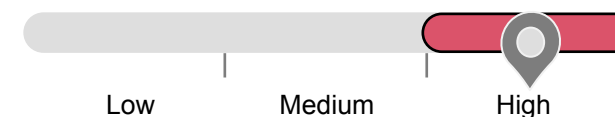
Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon



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Carbon border tax, or the so-called CBAM from the EU’s “Fit for 55”

Description of impact factor

In an effort to decarbonise the European continent by 55% by 2030, a comprehensive package of regulations and measures have been suggested under the region’s EU Fit for 55 package.

One of the intended regulations includes the Carbon Border Adjustment Mechanism (CBAM), or the carbon border tax. The regulation aims to tax goods imported into Europe that have a high carbon footprint in an effort to reduce the “imported emissions” of goods produced with high carbon intensity outside of the regional bloc. This is also a way for the EU to make regional industries that have innovated their way to low-carbon alternatives more cost-competitive against alternatives that are produced with high emissions.

The CBAM is only at the proposal stage. It will only become final once both the European Parliament and Council adopt it. In terms of its intended implementation, the system in its entirety will not enter into force until January 1st 2026. However, in the years before this the regulation will require importers to report imported goods and their embedded GHG emissions on a quarterly basis.

Impact as a potential risk

For VMP the CBAM could mean that products with a high carbon intensity sourced outside of the EU would become far more expensive; a cost that importers would likely pushed further down the value chain. This would consequently rise the prices of wines from far-away countries, potentially impacting both VMP’s financial profitability and the customer’s general satisfaction with VMP’s delivery of services. The impact level on the public’s satisfaction is likely to be low as this would be felt across the entire economy, though the financial impact could be medium and consequently require an alternative procurement strategy.

Impact as a potential opportunity

Any measure that helps VMP’s value chain decarbonise is an opportunity for the company’s ability to meet its climate goals. In the case of the CBAM and emissions embedded in products from far-away countries, the impact is likely low as the majority of emissions are not from transportation but rather the glass bottles that would still exist in Europe.

Relevant impact area



Impact assessment (risk)



Impact assessment (opportunity)



Likelihood



Time horizon





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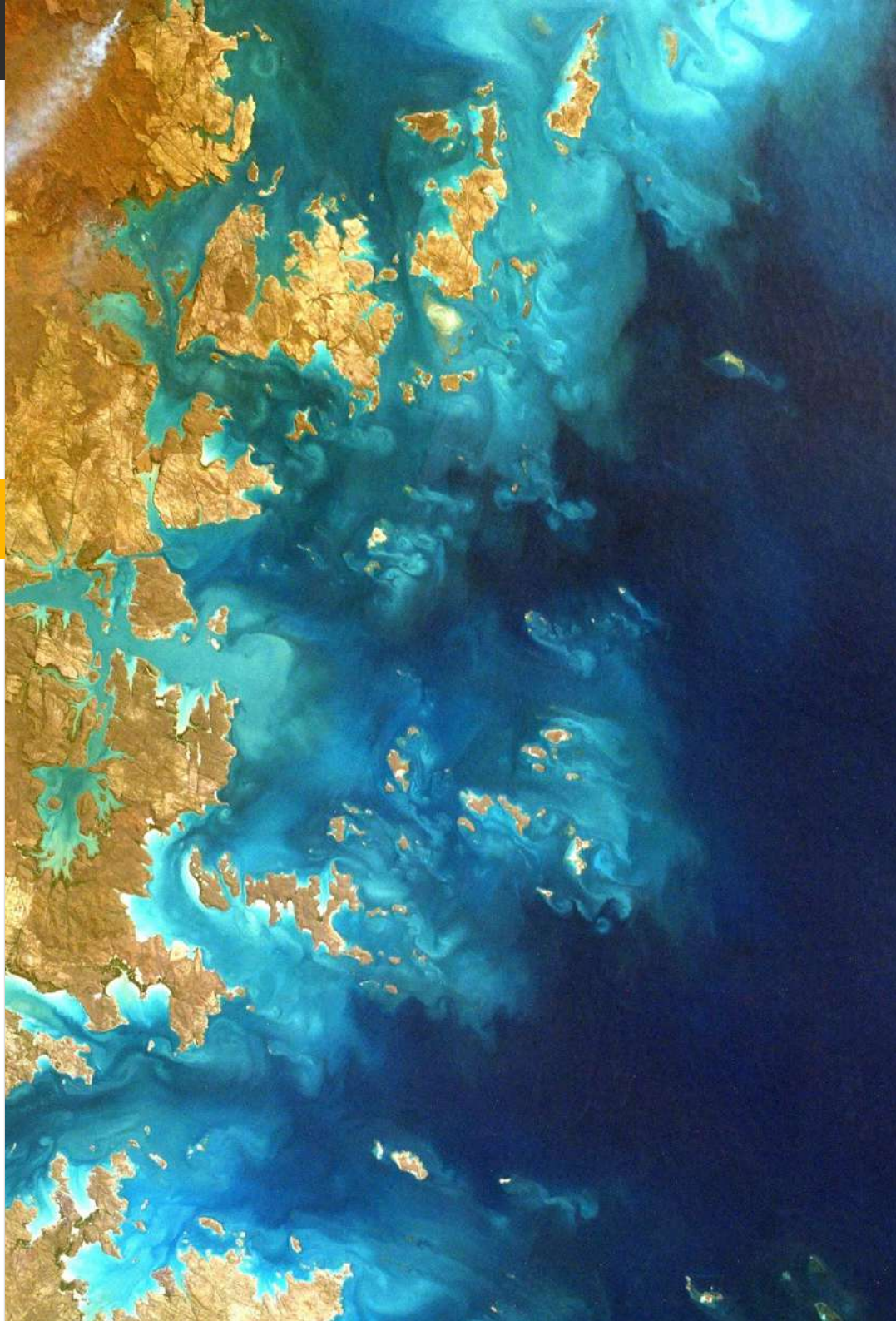
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Physical risks & opportunities

Including summarised impacts for:

France
Spain
Germany
New Zealand
California, USA
Pacific Northwest, USA
Southeast Australia
World
Italy

Modelling and predicting climate suitability

Climate change forecasting relies on constructing data models that are robust enough to project into the future with sufficient confidence. This underpins the importance of scenario analysis when assessing climate change risks and opportunities. Of course, no model will even have the power to predict the future entirely, but data modelling and forecasting offers unparalleled insights into risk and opportunity assessments.

The same is true for forecasting climate impacts on the world of wine. As discussed in depth in Chapter 2 (Literature Review), numerous studies have documented and investigated the potential impacts of climate change on the wine industry. However, robust models that merge both wine growing data (known as phenological data) with climate change data are less numerous.

Moreover, the number of studies or models that offer the right balance between flexibility for extrapolation and certainty of projections are even fewer. In short, an ultra-specific model based on detailed historical data may be able to project very few parameters with greater certainty, but does not offer flexibility to project parameters outside the model. Conversely, an overly reductionist model may offer lots of flexibility in projections, but will be based on less specific historical data that yield less precise predictions.

In turn, the literature on climate change impacts on wine required a new approach that struck a balance between these features while providing the desired insights at a global level.

A recent study by Morales-Castilla et al. (2020) appears to have struck this balance in a pragmatic and scientifically sound manner. The paper aims to explain how climate change impacts the so-called “climate suitability” of major grape varieties across a 2°C and 4°C scenario of average global warming.

This research also revealed insights into the resilience and vulnerabilities of both regions and varieties alike, ultimately providing highly useful in an assessment of physical climate risks and opportunities.

The phenological model

To model and predict climate suitability, researchers combined three sources of data: (1) historical data on the biological development of wine grapes (also known as *phenology*), (2) historical data on climate parameters associated with the recorded phenology, and (3) global data on the distribution of the major wine growing regions of the world according to a published geographical atlas of winegrowing.

Using detailed historical records on phenology dating back to 1975 primarily from France, researchers were able to develop and validate a phenological model that accurately predicted budbreak, flowering and ripening (known as *veraison*) for 11 common grape varieties. This model could then be used to predict whether or not a given region was suitable for growing the 11 varieties in a 2°C and 4°C scenario across the regions of the winegrowing atlas.

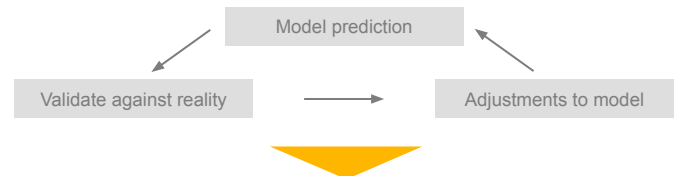
Finally, the researchers were able to quantify the losses and gains in climate suitability by comparing predictions for a 2°C and 4°C scenario against today’s baseline. Losses and gains were calculated for 8 regions/countries, and summarised at a global level.

Visualising the modelling methodology

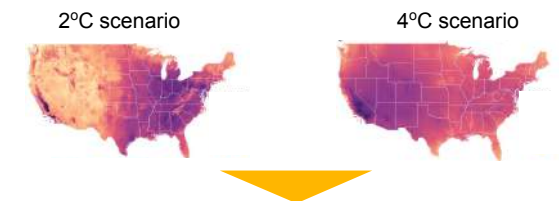
1 Collect historical bioclimatic data

Variety	Date	Temperature	Phenological phase
Merlot	06.01.79	24°C	Flowering
Merlot	07.29.79	28°C	Veraison
...

2 Establish and validate phenological model



3 Test climate suitability for wine regions



4 Calculate losses and gains against today’s baseline (proportional change in hectares)

Variety	Baseline	Loss 2°C	Gains 2°C	Loss 4°C	Gains 4°C
Merlot	10000 ha	-15%	5%	-41%	2%
Pinot noir	50000 ha	-33%	8%	-68%	4%
...

“Climate suitability” is the combination of conditions required for a grape variety to be considered suitable for growth in any given area, as predicted by the validated phenological model established by Morales-Castilla et al. (2020).

Climate suitability is largely an outcome of how the plant biologically responds to climatic factors such as minimum, maximum and average daily temperatures to name a few.

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Overview of risk and opportunity classification

Categorising losses and gains of climate suitability

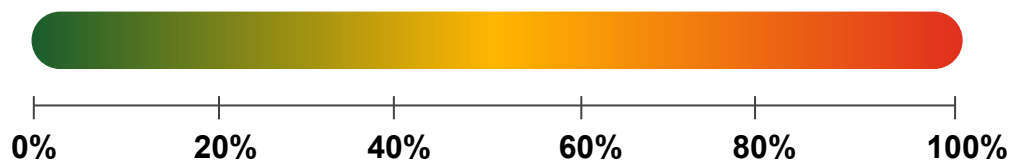
Climate suitability can both increase and decrease as a product of the impacts of a warming world. Moreover, climate suitability is a parameter that is specifically defined for each of the 11 grape varieties modelled by Morales et al. (2020).

In turn, any given country or region can in sum experience both gains *and* losses in climate suitability at the same time. This is because the country in question may lose the climatic conditions that are suitable for an early-ripening variety, but simultaneously gain the conditions that are suitable for certain late-ripening varieties. Alternatively, a variety may become unsuitable in a southern region but simultaneously become suitability more north.

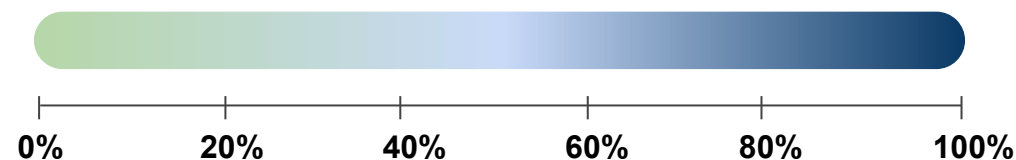
Projected losses and gains can therefore be roughly categorised into levels of risk and opportunity. For losses, this poses a risk for existing viticulture, but an opportunity for new viticulture if new varieties are cultivated where they are currently not planted.

Below is a sliding scale for categorising projected losses and gains. These sliding scales reflect the total breadth of projections across the world, allowing for comparisons between countries, regions and specific varieties.

Projected losses, in proportional change to current situation



Projected gains, in proportional change to current situation



Categorising losses and gains of climate suitability is not intended to be a final prescription for risks and opportunities, but rather an indication of the degrees of change from the current baseline scenario in the world of wine.

In turn, these sliding scales are primarily intended to communicate the various differences between projections for grape varieties across multiple countries. The ultimate aim is to display the full range of projections in a concise manner.

Note also that there is no discussion or projections surrounding *net* gains/losses, as this is outside the limits of the model's projections. Climate suitability does not prescribe what will actually be produced in a given country or region, meaning we are unable to project net figures.

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Based on available modelling, the world of wine as we know it is drastically at risk

Given the vast variety of climatic conditions and grape varieties, the physical impacts of climate change on wine growing countries and regions is highly fragmented.

In order to better understand these complex impacts more easily, however, a comparative assessment across countries and modelled climate suitability allows for some nuanced and understandable overview.

The table below summarises the modelled gains and losses for each of the regions and countries that have been included in this assessments' scope.

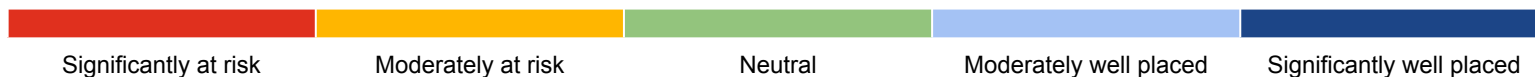
Findings are based on the comprehensive modelling by Morales-Castilla et al. (2020) of climate suitability across eleven grape varieties.

Although this is *not* an assessment of net impacts, this visualisation allows for some comparison of how regions are placed across scenarios of warming.

In short, countries like Germany, New Zealand and the Pacific Northwest of the US may gain from climate change, while the remaining regions and countries are highly at risk, especially in a 4°C scenario.

Countries like Italy and Spain are even significantly at risk in the cooler 2°C scenario, whereas France is significantly more at risk in the warmer scenario than in the cooler scenario.

Country /region	2°C scenario, overall assessment		4°C scenario, overall assessment	
World	Moderate-to-high losses, moderate gains	●	Devastating losses and generally low gains	●
France	Low-to-moderate losses with low-to-moderate gains	●	Very high losses and low gains for most varieties	●
Italy	High losses and low gains	●	Very high losses and low gains	●
Spain	High losses and very low gains	●	Very high losses and very low gains	●
Germany	Very low losses and moderate-to-high gains	●	Moderate losses and low-to-moderate gains	●
New Zealand	Very low losses and moderate gains	●	Low losses and moderate-to-high gains	●
California, USA	Moderately high losses and moderately low gains	●	Very high losses and fairly low gains	●
Pacific Northwest, USA	Very low losses and moderate-to-very high gains	●	Very low losses and very high gains	●
Southeast Australia	Moderately high losses and moderately low gains	●	Very high losses and very low gains	●



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France - 2°C warming scenario

Low-to-moderate losses with low-to-moderate gains

General comments

All of the 11 grape varieties included in the model are relevant for certain French wine regions.

In northern regions like Burgundy varieties like Pinot noir and Chardonnay are dominant, whereas southern regions like the Rhone valley and Languedoc-Roussillon are primarily planted with Syrah and Grenache.

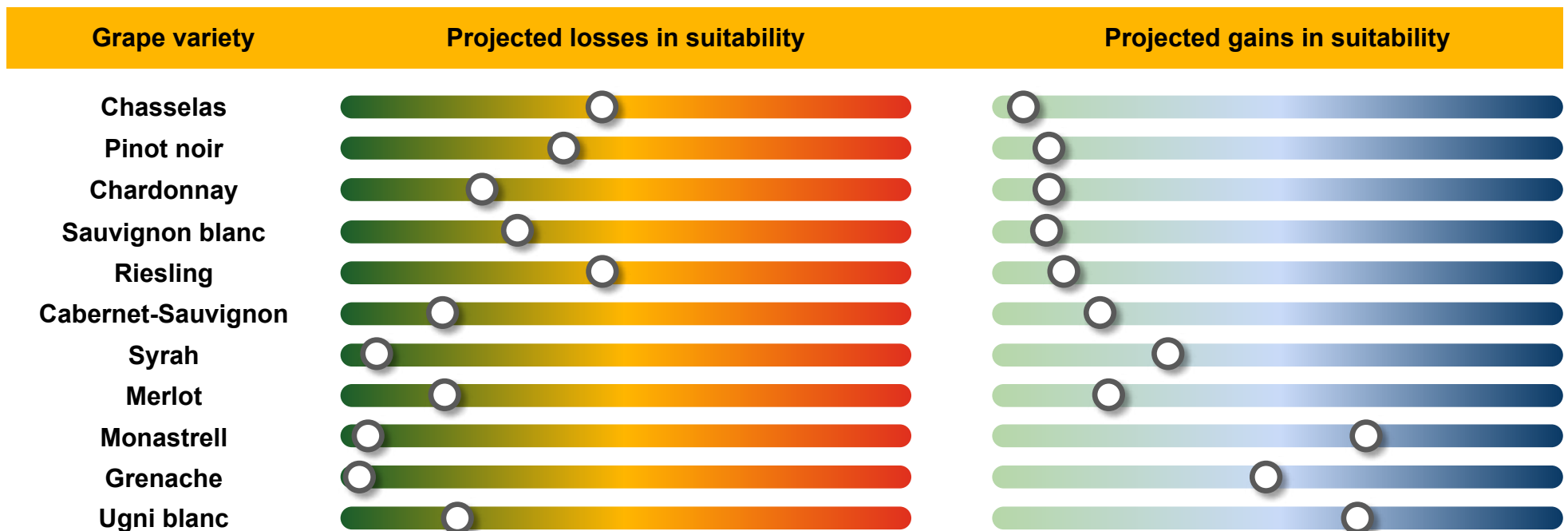
The famous region of Bordeaux is particularly dominated by Merlot and Cabernet-Sauvignon.

Summary of projections for 2°C scenario

In a 2°C scenario, France is projected to see balanced losses (22%) and gains (25%) at an accumulated level.

Based on the grape-specific results shown below, projected gains seem to be more significant for late-ripening varieties like Monastrell and Grenache, and project losses are generally higher for early-ripening varieties like Pinot noir, Chasselas and Riesling.

At a more regional level, the study states that Chardonnay's climate suitability in Burgundy is expected to experience relatively small decreases ($\approx 5\%$) compared to Pinot Noir ($\approx 15\%$).



France - 4°C warming scenario

Very high losses and low gains for most varieties

General comments

All of the 11 grape varieties included in the model are relevant for certain French wine regions.

In northern regions like Burgundy varieties like Pinot noir and Chardonnay are dominant, whereas southern regions like the Rhone valley and Languedoc-Roussillon are primarily planted with Syrah and Grenache.

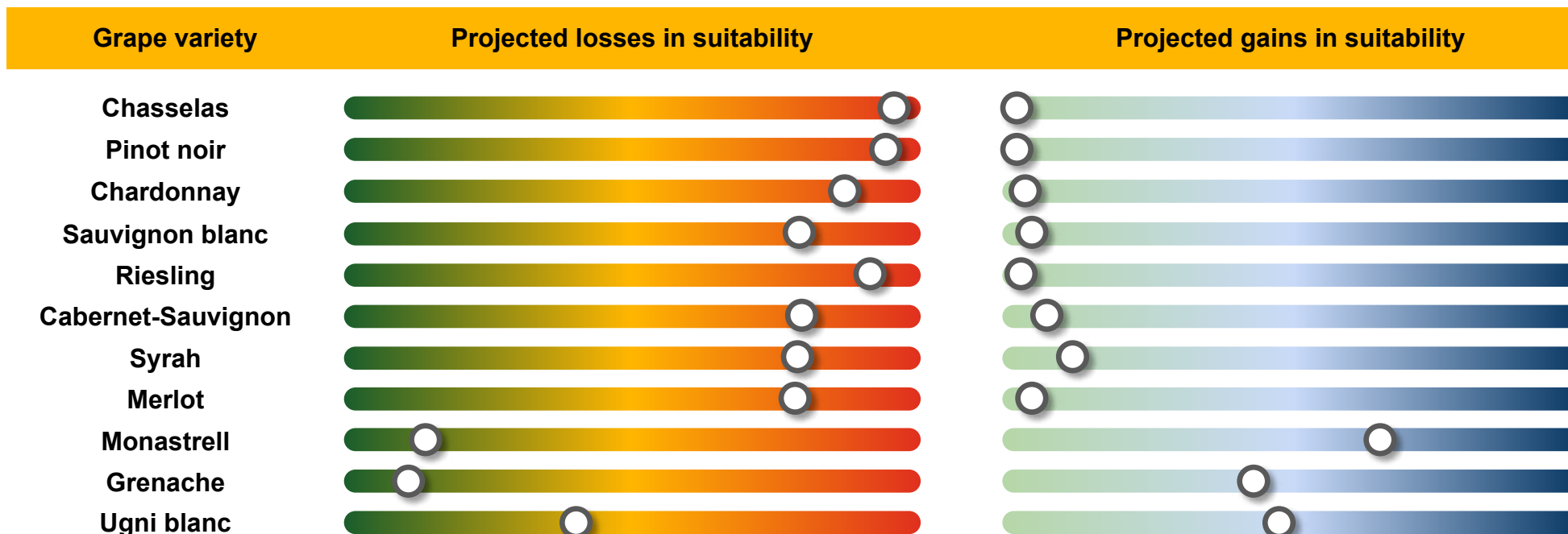
The famous region of Bordeaux is particularly dominated by Merlot and Cabernet-Sauvignon.

Summary of projections for 4°C scenario

In a 4°C scenario, losses increase quite dramatically compared to the cooler 2°C scenario.

Early varieties like Pinot Noir and Chardonnay are protected to see devastating losses ranging between 85 - 95% at the country level. In Burgundy specifically, Chardonnay is expected to fall by ≈13% compared to a 2°C scenario, and Pinot noir's is projected to fall sharply by ≈34%.

Pinot noir in Burgundy area is predicted to advance veraison by 24 days. The same is true for veraison of late-ripening varieties, such as Cabernet-Sauvignon in the Bordeaux area, which can be advanced by 28 days.



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Spain- 2°C warming scenario

High losses and very low gains

General comments

Spanish wine regions are diverse in topography and climate, ranging from cooler regions by the Pyrenees to sandy and sunny regions in the south.

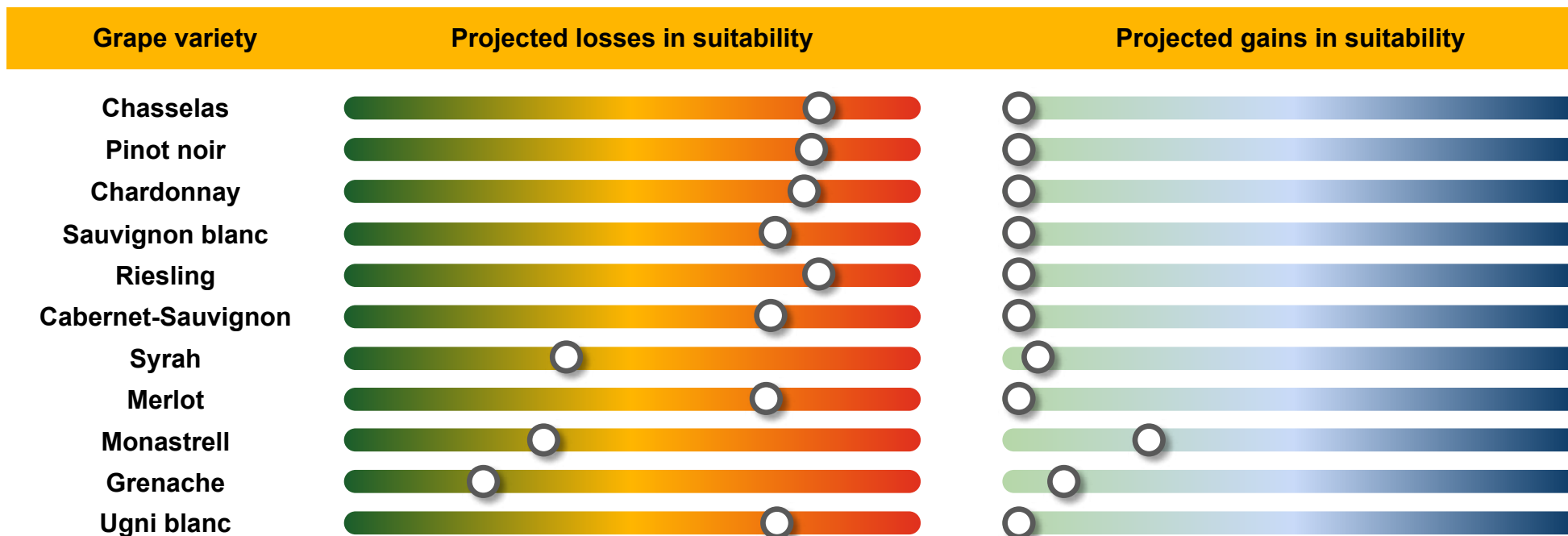
Spain's wine grape varieties are less numerous than their European counterparts. However, Grenache and Monastrell are particularly relevant from the 11 sampled in the model.

Summary of projections for 2°C scenario

In a 2°C scenario, losses at the country-level are expected to be as high as 65% in Spain, with gains projected at only 5%.

Early-ripening varieties see practically no gains in this scenario, and only Monastrell is projected to see noticeable gains. Monastrell is also expected to see lower losses than other varieties, along with Grenache and Syrah.

However, losses for the remaining varieties included in the model are very high compared France's 2°C scenario, showing devastating losses similar to what is projected for Italy.



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Spain- 4°C warming scenario

Very high losses and very low gains

General comments

Spanish wine regions are diverse in topography and climate, ranging from cooler regions by the Pyrenees to sandy and sunny regions in the south.

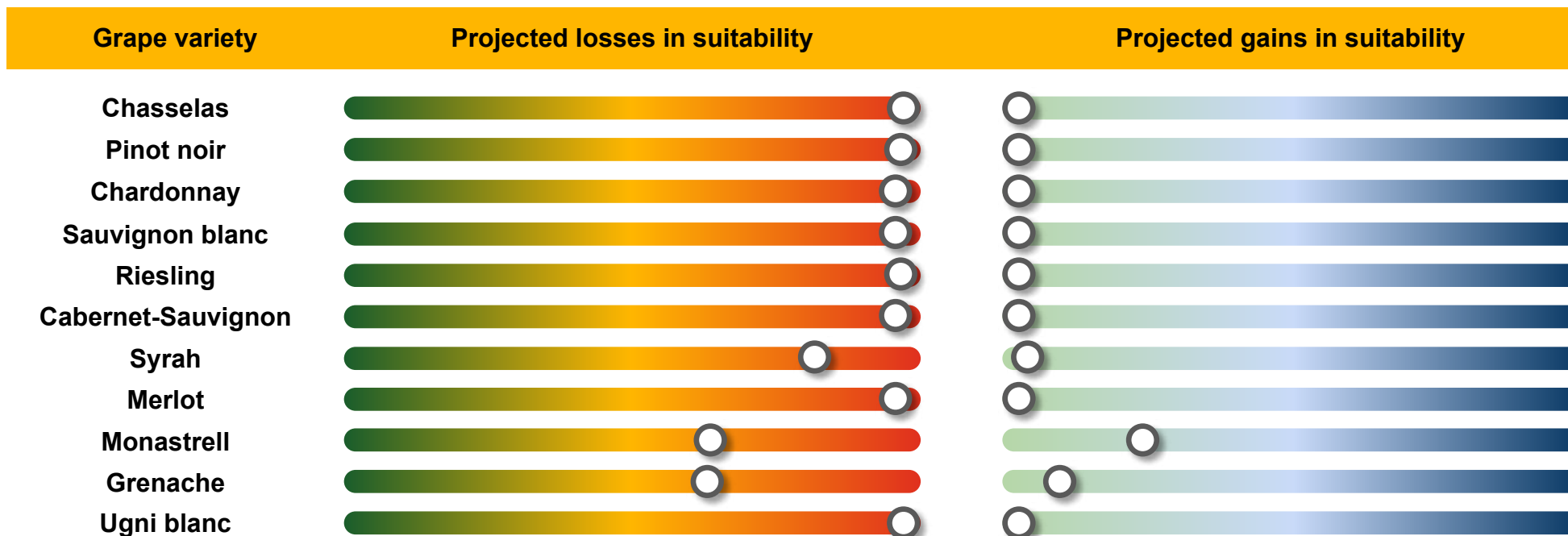
Spain's wine grape varieties are less numerous than their European counterparts. However, Grenache and Monastrell are particularly relevant from the 11 sampled in the model.

Summary of projections for 4°C scenario

In a 4°C scenario, losses at the country level are projected to be as high as ≈90%, similar to predictions for Italy.

Comparatively, gains in this scenario are practically unchanged from the 2°C scenario, suggesting Spain has nothing to gain from increased warming.

Monastrell and Grenache are the only varieties that will see losses lower than ≈70%, with the rest expected to lose nearly all climate-suitability based on the model's outputs.



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Germany - 2°C warming scenario

Very low losses and moderate-to-high gains

General comments

Germany currently includes more than 100,000 hectares of vineyards, with white grape varieties accounting for around two-thirds of the area.

Germany is a major producer of Riesling, making up nearly a quarter of all wine grown in the country. In recent years however, German Spätburgunder (Pinot Noir) has also begun emerging in various regions, particularly Baden, Pfalz and the Ahr Valley.

Summary of projections for 2°C scenario

In a 2°C scenario, Germany is predicted to see little to no losses in climate-suitability based on the 11 varieties included in the model.

In contrast, certain varieties will actually see significant gains in suitability under this warming scenario. Early varieties like Pinot noir, Chardonnay, Sauvignon blanc and Riesling will all see gains of around 35%.

Red varieties like Cabernet-Sauvignon, Syrah and Merlot are projected to see gains higher than 90%, but late-ripening varieties like Monastrell and Grenache are not predicted to be climate-suitable.



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Germany - 4°C warming scenario

Moderate losses and low-to-moderate gains

General comments

Germany currently includes more than 100,000 hectares of vineyards, with white grape varieties accounting for around two-thirds of the area.

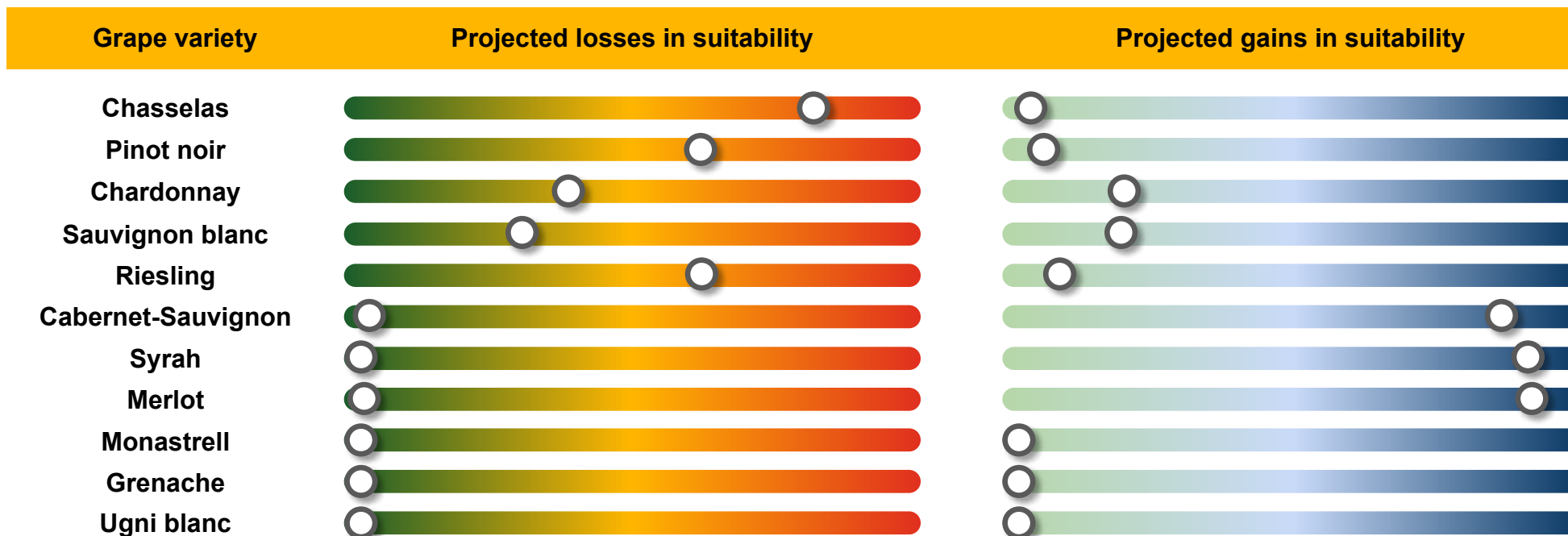
Germany is a major producer of Riesling, making up nearly a quarter of all wine grown in the country. In recent years however, German Spätburgunder (Pinot Noir) has also begun emerging in various regions, particularly Baden, Pfalz and the Ahr Valley.

Summary of projections for 4°C scenario

In a 4°C scenario, losses of early-ripening varieties are quite significant compared to the modest losses predicted in the 2°C scenario. With this increased warming varieties like Pinot Noir and Riesling are expected to lose around 60% of climate-suitability.

The three red varieties of Cabernet-Sauvignon, Syrah and Merlot see slightly lower gains than in the 2°C scenario, though gains are still around 80%.

For early-ripening grapes like Pinot noir and Chardonnay, gains fall quite steeply when compared to the 2°C scenario, from around 35% to around 10%.



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New Zealand - 2°C warming scenario

Very low losses and moderate gains

General comments

Spread across two main islands, New Zealand has 10 major wine regions, the most important of which is Marlborough.

Sauvignon Blanc is the country's primary grape, making up around 60 percent of planted vines and around 85 percent of wine exports. However, plenty of other varieties like Riesling, Syrah, Merlot and Cabernet-Sauvignon are planted as well, segmented by the warm climate in the north and the cooler climate in the south.

Summary of projections for 2°C scenario

In a 2°C scenario, losses are predicted to be low and gains fairly high.

Riesling, Pinot noir and Chasselas are projected to see less than 10% losses, with the remaining grapes from the model seeing no losses at all.

Early-ripening varieties are projected to see gains of around 35 - 40%, with Monastrell, Grenache and Ugni blanc seeing gains as high as 60%.

In short, New Zealand at the country level seems to gain quite favourably in the 2°C scenario, similar to Germany.



New Zealand - 4°C warming scenario

Low losses and moderate-to-high gains

General comments

Spread across two main islands, New Zealand has 10 major wine regions, the most important of which is Marlborough.

Sauvignon Blanc is the country's primary grape, making up around 60 percent of planted vines and around 85 percent of wine exports. However, plenty of other varieties like Riesling, Syrah, Merlot and Cabernet-Sauvignon are planted as well, segmented by the warm climate in the north and the cooler climate in the south.

Summary of projections for 4°C scenario

In a 4°C scenario, losses rise modestly compared to the 2°C scenario, but projected gains actually increase. In fact, New Zealand is the only country in the analysis that sees more gains in the 4°C scenario than the 2°C scenario.

Most varieties included in the model see an increase in projected gains of between 10 and 20%, with losses only significantly increasing for varieties like Chasselas, Pinot noir, Riesling and Ugni Blanc.

Considering the importance of Sauvignon-blanc for the country, both warming scenarios seem to benefit New Zealand quite significantly.



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California, USA - 2°C warming scenario

Moderately high losses and moderately low gains

General comments

California is the largest and most important wine region in the USA. The state also spans almost ten degrees of latitude, offering mountains, valleys, plains and plateaus with diverse climates.

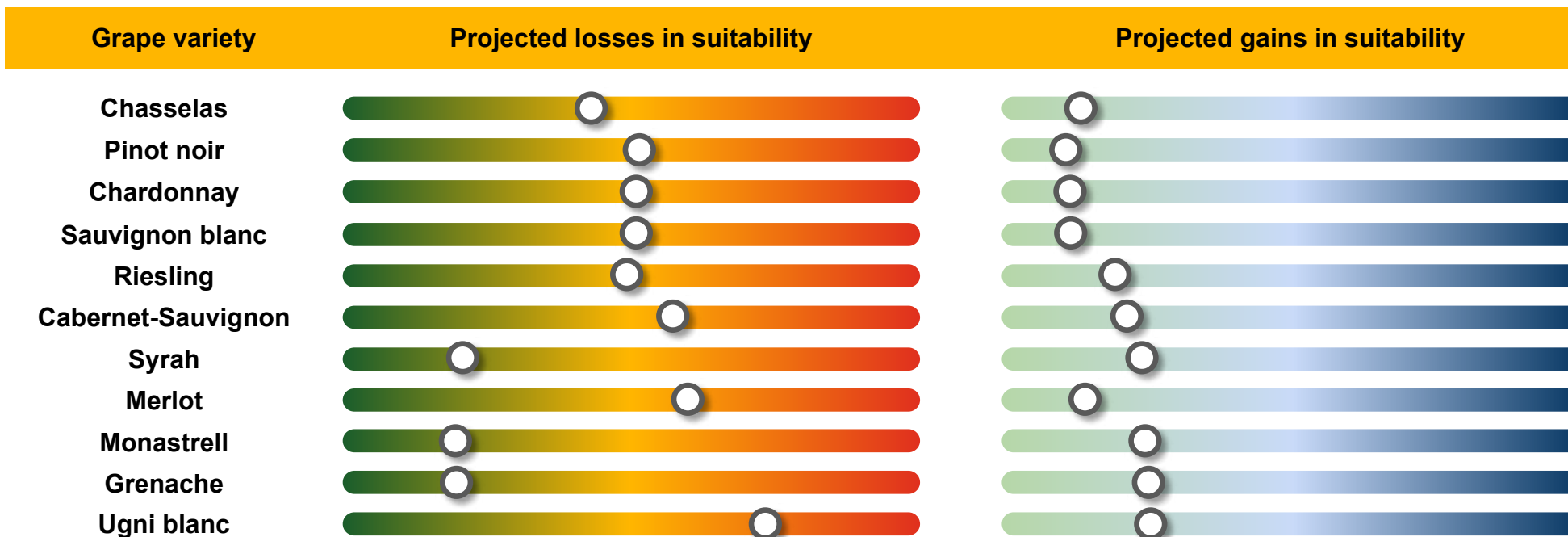
The most important varieties grown in California today are Cabernet Sauvignon and Chardonnay. However, a wide range of traditional European vines also flourish, including Pinot Noir, Merlot and Syrah.

Summary of projections for 2°C scenario

In a 2°C scenario, California is expected to see fairly high levels of losses with modest gains.

Only varieties like Syrah, Monastrell and Grenache are predicted to have losses lower than 20%. The remaining varieties included in the assessed model are predicted to see losses of around 50 - 60%.

All 11 varieties included in the assessed model are predicted to see relatively low gains ranging from 15 - 25% at best. Syrah, Monastrell and Grenache seem to be the only clear “winners” in this scenario, with low losses and modest gains.



California, USA - 4°C warming scenario

Very high losses and fairly low gains

General comments

California is the largest and most important wine region in the USA. The state also spans almost ten degrees of latitude, offering mountains, valleys, plains and plateaus with diverse climates.

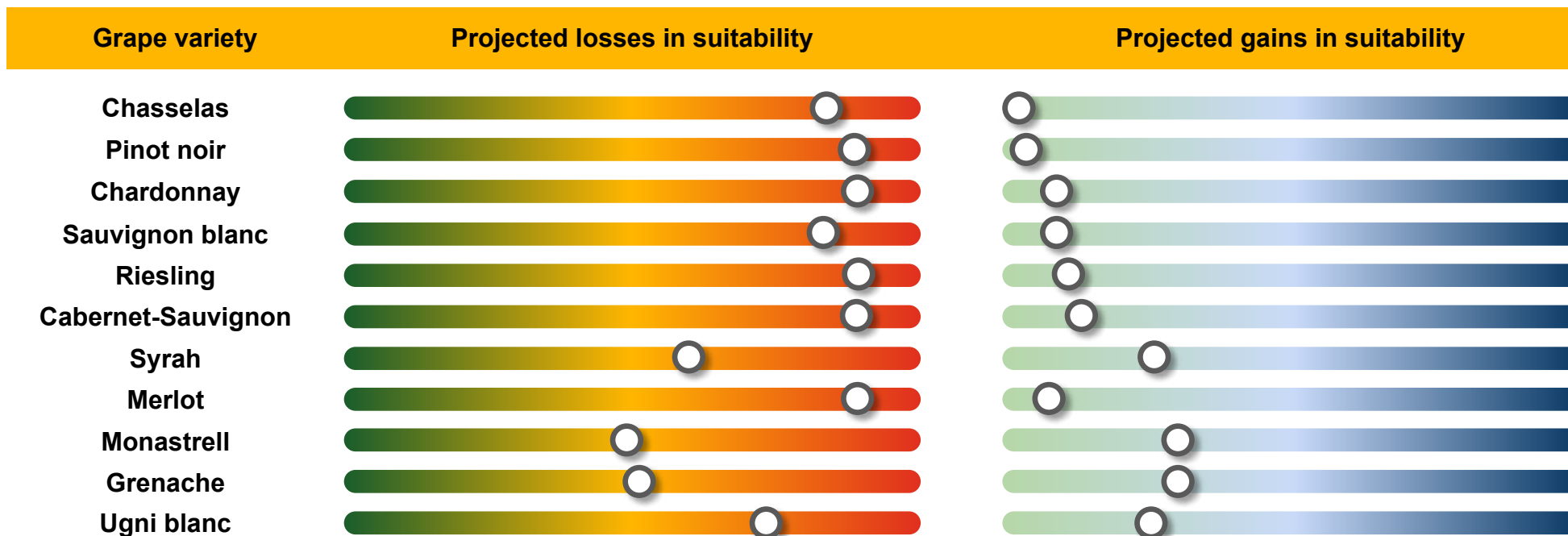
The most important varieties grown in California today are Cabernet Sauvignon and Chardonnay. However, a wide range of traditional European vines also flourish, including Pinot Noir, Merlot and Syrah.

Summary of projections for 4°C scenario

In a 4°C scenario, losses rise sharply for nearly all of the 11 varieties and gains fall modestly for early-ripening varieties.

For important varieties like Cabernet-Sauvignon, Pinot noir, Chardonnay, and Merlot, losses rise to around 80 - 90%.

Interestingly, this warmer 4°C scenario is predicted to see higher gains for Syrah, Monastrell and Grenache compared to the 2°C scenario. However, compared to the 2°C scenario these same three varieties will simultaneously see loses in climate-suitability jump from lower than 20% to loss in the 50 - 60% range.



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Pacific Northwest, USA - 2°C warming scenario

Very low losses and moderate-to-very high gains

General comments

The Pacific Northwest of the USA includes the states of Oregon and Washington, which totals to around 35,000 hectares of planted land.

Twenty thousand of those hectares are in Washington, which mainly grow Chardonnay, Riesling, Merlot, Cabernet-Sauvignon and Syrah.

Oregon is one of the youngest wine regions relatively speaking, where nearly 60% of vineyards are dedicated to Pinot noir.

Summary of projections for 2°C scenario

In a 2°C scenario, the Pacific Northwest is predicted to see no losses for all 11 varieties included in the model. The model therefore suggest the Pacific Northwest will see nothing but gains across all varietals.

Gains in this scenario are relatively fair for early-ripening varieties like Pinot noir and Chardonnay ($\approx 35\%$), but later-ripening varieties like Cabernet-Sauvignon, Syrah, Syrah and Grenache are predicted to see gains around 95 - 100%.



Pacific Northwest, USA - 4°C warming scenario

Very low losses and very high gains

General comments

The Pacific Northwest of the USA includes the states of Oregon and Washington, which totals to around 35,000 hectares of planted land.

Twenty thousand of those hectares are in Washington, which mainly grow Chardonnay, Riesling, Merlot, Cabernet-Sauvignon and Syrah.

Oregon is one of the youngest wine regions relatively speaking, where nearly 60% of vineyards are dedicated to Pinot noir.

Summary of projections for 4°C scenario

In a 4°C scenario, losses are fairly similar to those predicted in the 2°C scenario. Gains are predicted to increase in this warmer scenario, making the region similar to the findings for New Zealand.

Varieties like Chasselas and Pinot noir are the only two out of the eleven from the model that are predicted to see any losses in this scenario, and both of these are relatively low (≈10%).

Conversely, gains for all eleven varieties are predicted to be at least 50 - 60%, with late-ripening varieties rising to around 100%.



Southeast Australia - 2°C warming scenario

Moderately high losses and moderately low gains

General comments

Southeast Australia is an official geographical indication (GI) that covers around a third of Australia. Most of the massive region is not suitable for wine production, but the cooler coastal areas hosts a wine range of varieties.

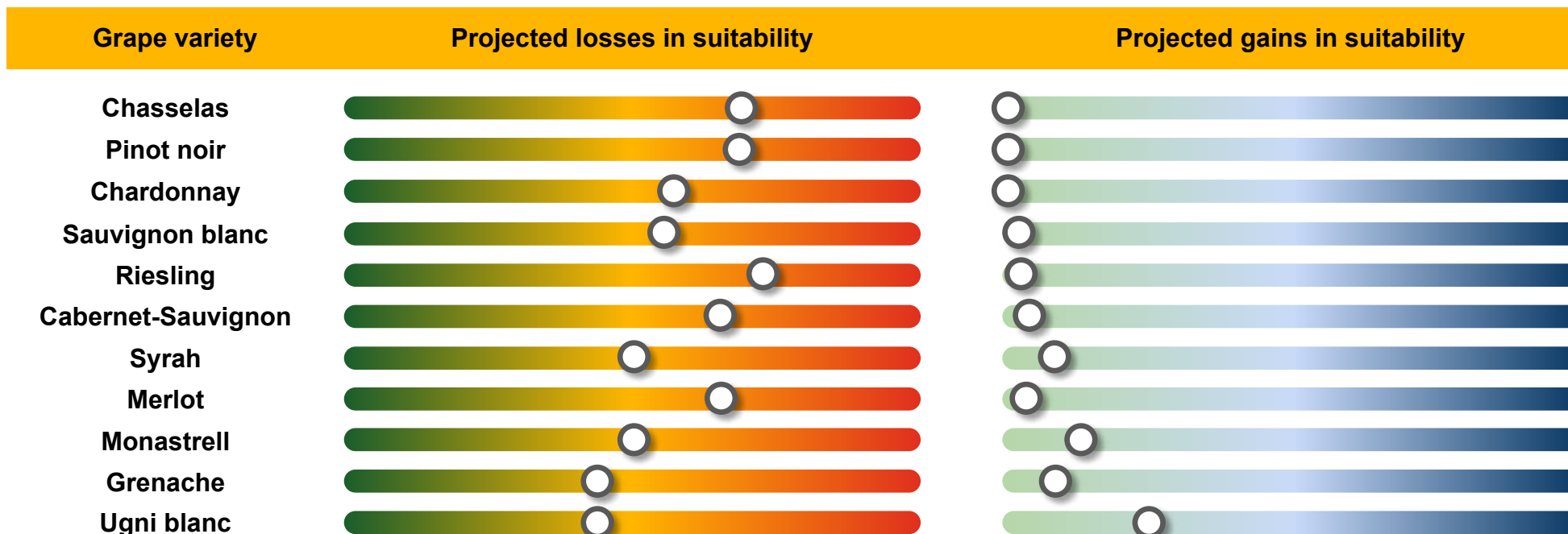
Chardonnay, Semillon and Sauvignon Blanc are the most common white wine varieties, and Merlot, Syrah and Cabernet-Sauvignon are the most common red varieties.

Summary of projections for 2°C scenario

In a 2°C scenario, losses are fairly high across all of the modelled varieties, and gains are relatively low.

Early-ripening varieties like Pinot noir, Chardonnay and Sauvignon blanc are expected to see losses of around 70% even in this cooler scenario, and the gains for these same varieties are essentially 0%.

Other important varieties for the region, such as Merlot, Syrah and Cabernet-Sauvignon, are also predicted to see losses ranging from 50 - 70% with gains lower than 10%.



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Southeast Australia - 4°C warming scenario

Very high losses and very low gains

General comments

Southeast Australia is an official geographical indication (GI) that covers around a third of Australia. Most of the massive region is not suitable for wine production, but the cooler coastal areas hosts a wine range of varieties.

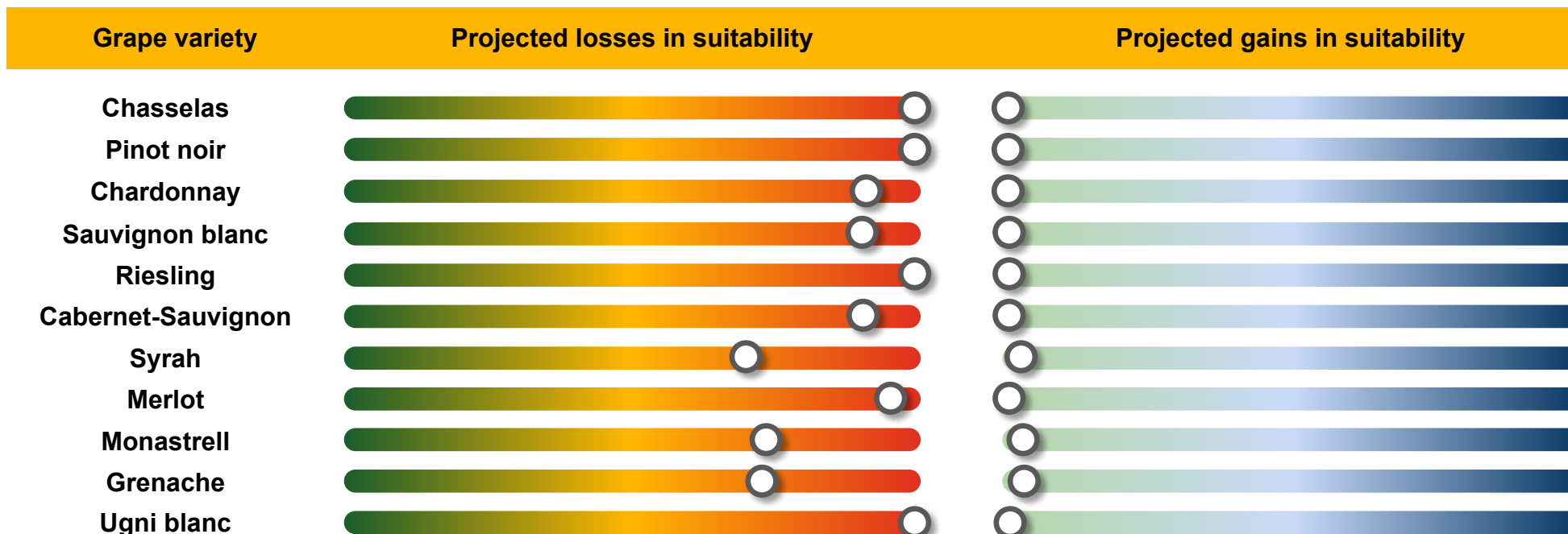
Chardonnay, Semillon and Sauvignon Blanc are the most common white wine varieties, and Merlot, Syrah and Cabernet-Sauvignon are the most common red varieties.

Summary of projections for 4°C scenario

In a 4°C scenario, losses rise even higher than those already predicted in the cooler scenario, and gains fall to a negligible level.

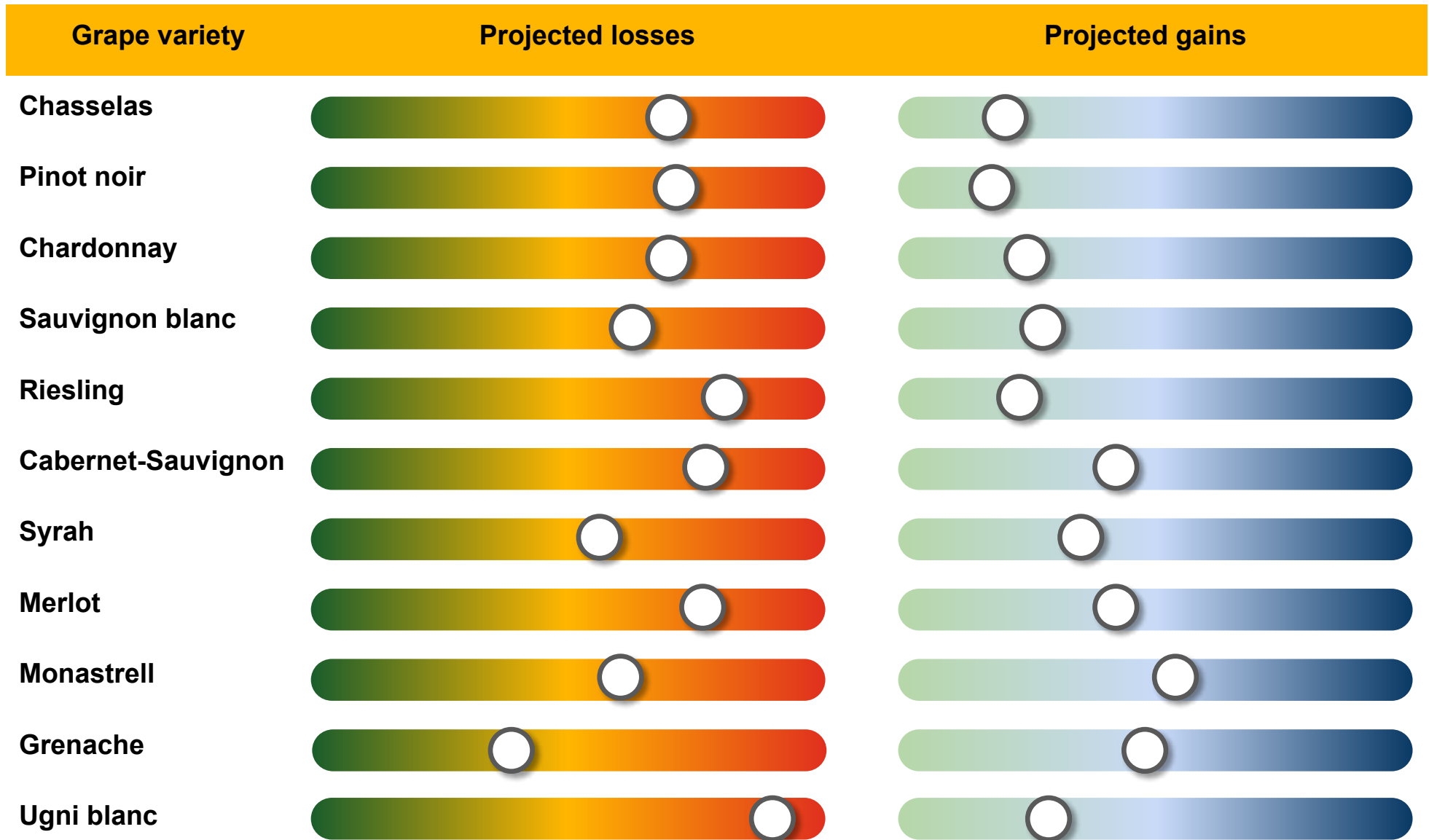
Early-ripening varieties like Pinot noir, Chardonnay and Sauvignon blanc are expected to see losses of at least 90%, and gains for these varieties fall to 0%.

Important red varieties for the region (Merlot, Syrah and Cabernet-Sauvignon) also see higher losses in this warmer scenario, with Syrah losing around 70% and Merlot and Cabernet-Sauvignon rising to over 90%.



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World - 2°C scenario, all eleven grape varieties included in the assessed model



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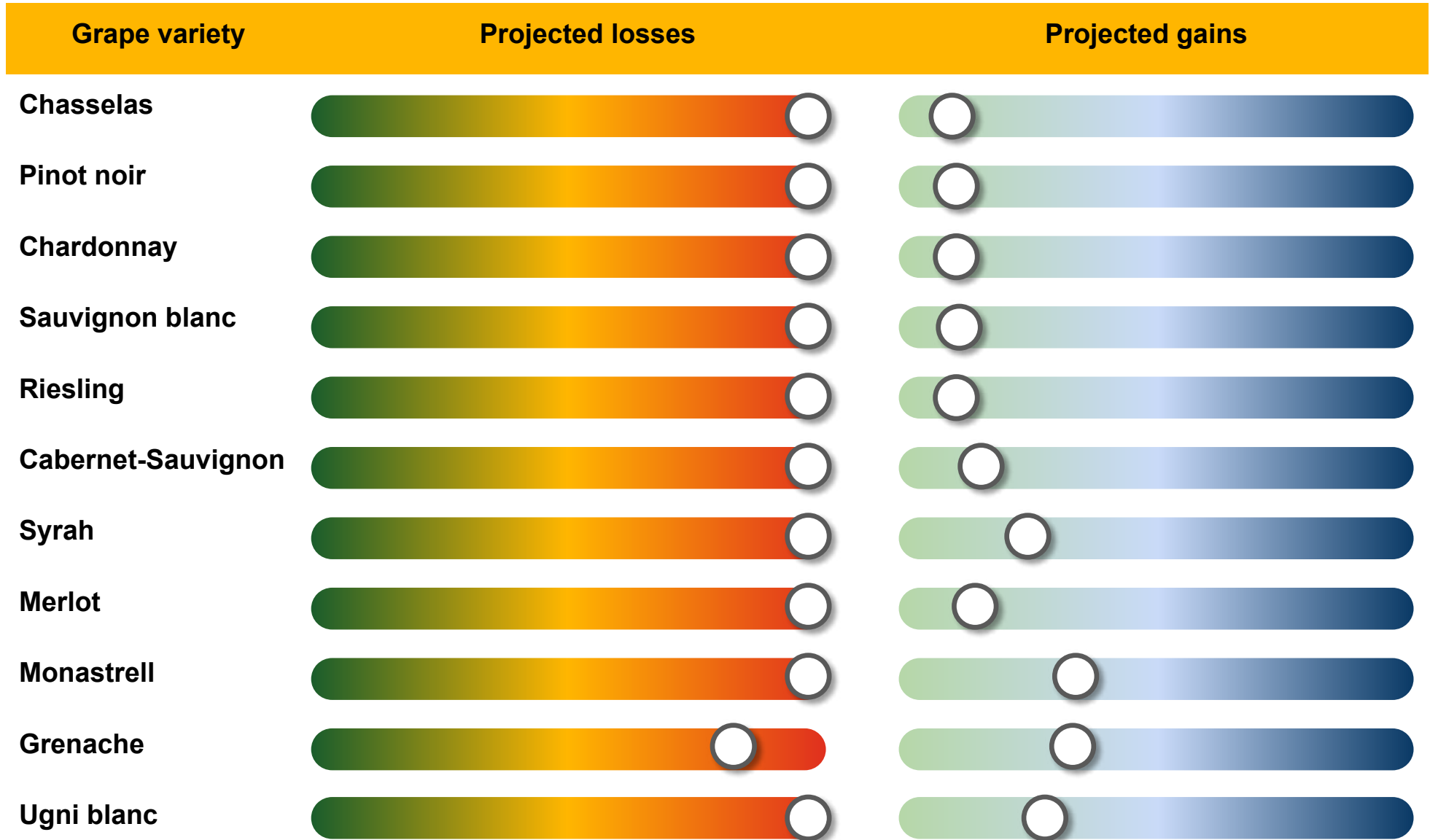
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World - 4°C scenario, all eleven grape varieties included in the assessed model



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Italy - a high level assessment using a variety of sources

Italian wine is the most distributed wine by Vinmonopolel by volume, i.e. it is the Vinmonopolel's largest source of wine by country. It is therefore a very important country to understand when assessing climate change risks.

However, the Morales et al. (2020) study features grape varieties that are not commonly grown in Italy. For this reason, there was a need to look for other sources and studies to understand the impacts of climate change more specifically to Italy.

Based on our survey of the literature and discussion with researchers investigating this specifically, **the scientific coverage of climate change impacts on Italian wine is relatively sparse**, and there is no consistent methodological approach in the studies that have been done thus far.

For the sake of consistency, the next two pages shows Morales et al. (2020)'s assessment of Italy, though this model is considered less relevant for the cultivar profile of Italy.

Since there are no studies that have investigated 'climate suitability' in the exact same way as Morales et al. (2020), it is difficult to compare a high-level assessment of Italy using various sources with the findings presented so far in this report.

However, as a result the following text is an attempt to gather other relevant findings available at this time.

Alikadic et al. (2019) The impact of climate change on grapevine phenology and the influence of altitude: A regional study

Charalampopoulos (2021)'s metastudy, "*Future Climate Change Impacts on European Viticulture: A Review on Recent Scientific Advances*," notes three regional studies that have been conducted since 2010 on climate change impacts on Italian wine. **All three studies find that rising temperatures will have a significant impact on wine growing, including impacts such as earlier harvesting dates and advancement of phenological stages, notably at higher altitudes.** The study with the most relevant research approach for this assessment is Alikadic et al. (2019).

The aim of Alikadic et al. (2019) was to assess the influence of climate change on grapevine phenology, considering the different features of five varieties (*Chardonnay, Pinot Noir, Sauvignon Blanc, Merlot, Pinot Gris*) and five phenological phases (Bud burst, Flowering, Fruit set, Veraison, Harvest) at different altitudes (from 67 m to 950 m a.s.l.), carried out in two future periods of time (2021-2050 and 2071-2099) for the province of Trento (Italian Alps).

The five varieties, despite not being highly unique Italian varieties, were selected because they had the best historical data, as argued by Morales et al. (2020). Although climate suitability was not included in the study, the findings are consistent with the conclusions and implications of Morales et al. (2020). **The most important findings include:**

- Veraison was predicted to see the highest shift as a result of warming temperatures compared to the other phenological phases
- Temperature is projected to increase more at higher altitudes, thus a comparatively shorter "technical growing season" (TGS: budburst to harvest) is predicted for vineyards located at higher altitudes.
- Pinot Noir, Chardonnay and Sauvignon Blanc were the varieties with the greatest change/shock compared to today's baseline..

Although this does not quantify the losses and gains of Italian wine growing regions like Morales et al. (2020), the findings are consistent enough to suggest that Italy's current wine growing regions are at risk as temperatures increase.

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Italy - 2°C warming scenario, according to the Morales et al. (2020) model

High losses and low gains

General comments

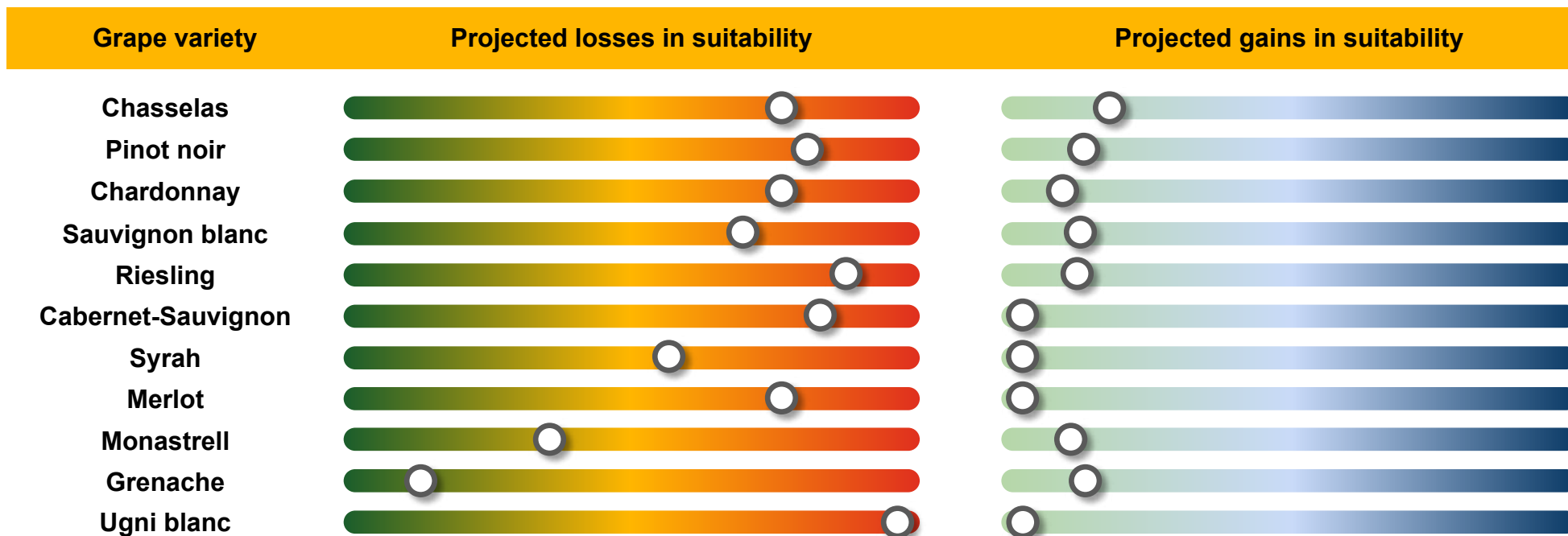
Despite several distinctly Italian grape varieties such as Nebbiolo, Barbera, Sangiovese and Montepulciano were not included in the model, findings for climate suitability of the 11 varieties included in the model can be helpful for indicating what climatic impacts can be expected for Italy.

Summary of projections for 2°C scenario

In a 2°C scenario, losses in Italy at the country-level are projected to reach 68% compared to today's reference scenario, with gains projected at only 9%.

Varieties like Ugni blanc, Riesling, Cabernet-Sauvignon and Pinot noir see the highest projected losses, whereas Grenache is by far the variety with the lowest losses ($\approx 15\%$) in this cooler scenario.

Chasselas and Grenache see the highest projected gains compared to others, though all gains are modest at best, with none being over $\approx 18\%$.



Italy - 4°C warming scenario, according to the Morales et al. (2020) model

Very high losses and low gains

General comments

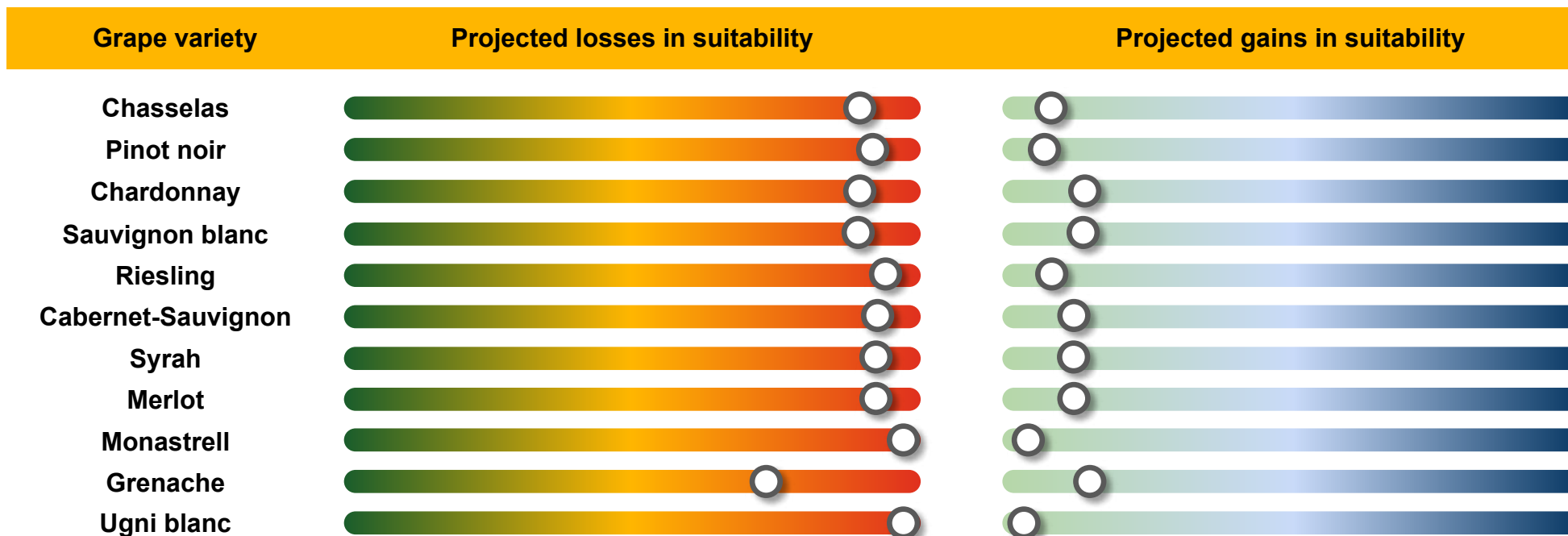
Despite several distinctly Italian grape varieties such as Nebbiolo, Barbera, Sangiovese and Montepulciano were not included in the model, findings for climate suitability of the 11 varieties included in the model can be helpful for indicating what climatic impacts can be expected for Italy.

Summary of projections for 4°C scenario

In a 4°C scenario, losses are projected to be as high as 90% compared to today's reference scenario.

Varieties like Ugni blanc could see slightly higher gains than the other varieties, though it's projected losses (in current regions) are among the highest of the 11 varieties modelled. Grenache sees the lowest amount of losses ($\approx 75\%$), and is the only variety with projections lower than $\approx 90\%$ losses.

All varieties see more losses in this scenario than the cooler one, but Sauvignon blanc, Chardonnay, Cabernet-Sauvignon, Syrah, Merlot and Ugni blanc see slightly higher gains than in the cooler scenario.





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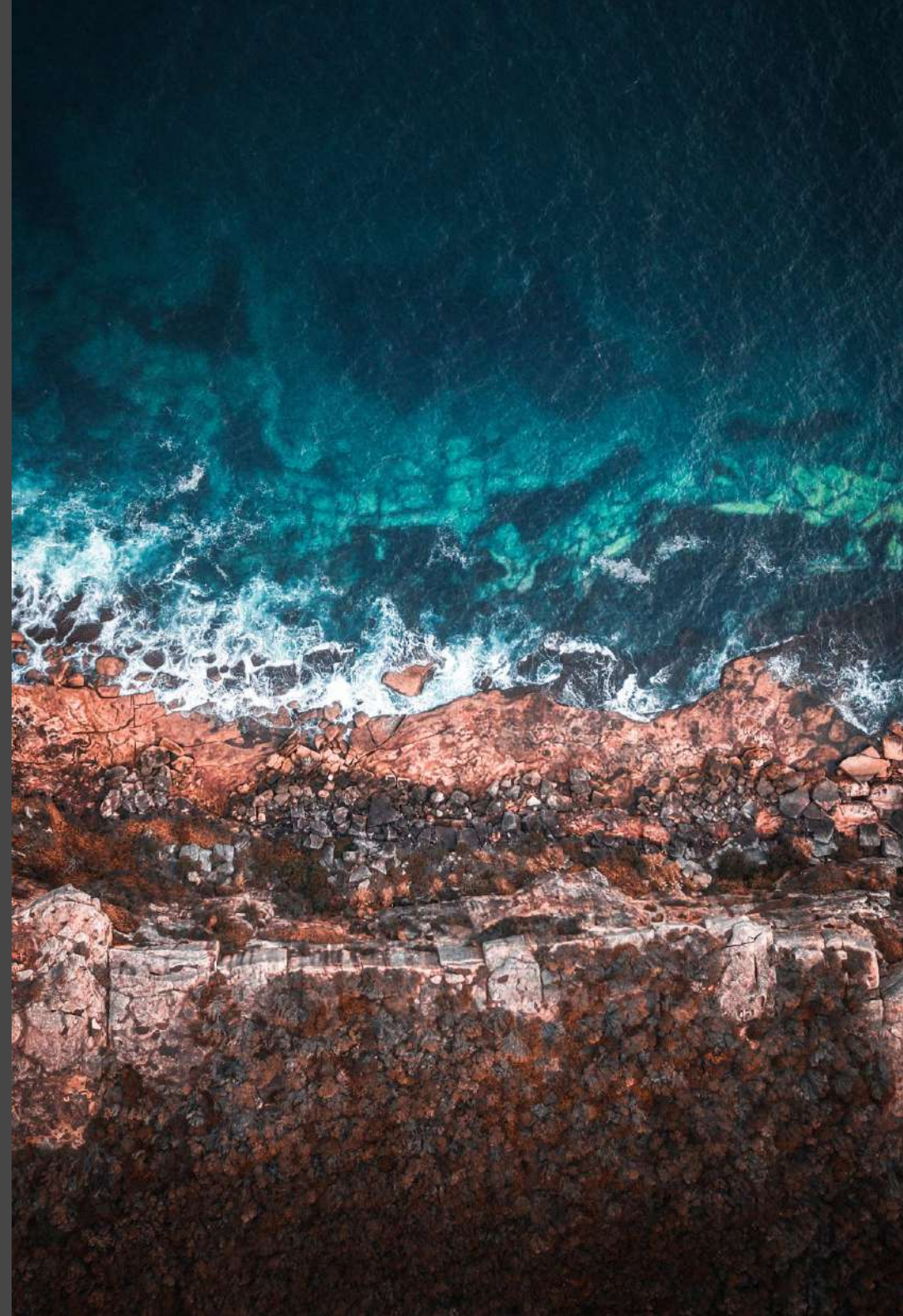
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Conclusion

What now?



The implications of climate change risks and opportunities for the wine industry

Climate change has a myriad of impacts on the world of wine and the wine industry as we know it. In the immediate term, acute physical impacts will continue impacting the industry as it has for centuries, but there is little to no scientific doubt that chronic impacts such as increasing temperatures will massively disrupt current viticultural practices in the longer term.

Transitional impacts will also be felt more in the immediate future, with coming regulations and market trends shifting as a result of the transition to a low-carbon economy. These impacts will affect the industry as a whole, though its distribution across the value chain is far more fragmented than the impacts of physical climate change that mainly impact grape growers in warmer regions.

The assessment presented in this report has found compelling evidence for both risks and opportunities as a result of climate change, and has detailed what these mean for Vinmonopole and their four priority impact areas. This information is useful for the company's own mitigation strategies and governance practices, though the implications for the industry as a whole are more nuanced and specific (see page 7 for more).

In this final section of the report, we present key conclusions and implications of what has been discussed in the report thus far, as well as potential avenues going forward.

1. Farmer are at the forefront of climate change impacts, but have the potential to mitigate and adapt to incoming risks if appropriate action is taken. As uncovered in our assessment, today's wine producing areas will likely undergo massive change as a result of changing growing conditions. Farmers, already highly adaptive and resilient by trade, must make decisions today for the sake of tomorrow. Cultivar diversity is not a mitigating measure that is implemented overnight - vines planted today will not reach their full potential for several years, underpinning the importance of making these decisions sooner rather than later.

2. Wholesalers hold part of the responsibility to push the market in the right direction. Wholesalers are the middle-men between farmers "on the front line" and the remaining downstream value chain, currently holding significant influence over the market. Nudges have a definite impact, but unleashing the full potential of transition opportunities will require the active decisions of wholesalers to perform more sustainably. This entails using influence to promote more sustainable production practices, along with actions towards better labelling and packaging.

3. Major knowledge and awareness gaps must be addressed. Despite being an industry highly at risk in various ways, there is generally a low level of awareness and preparedness for the coming changes in sight. All links in the value chain, especially the consumer, needs to increase their awareness of climate risk, as well as their role in mitigating it.

4. Vinmonopole's climate change goals are largely dependent on the actions of the value chain as a whole. Resilience must be achieved across the board. Decarbonising the value chain is a major part of Vinmonopole's own goals of halving emissions by 2030, but achieving this goal will rely heavily on reductions occurring elsewhere. Similarly, ensuring climate resilience for Vinmonopole will also require mitigation and adaptation from all players, especially farmers. In order to ensure that goals are met, Vinmonopole must begin working more closely across the entire value chain to enable the change necessary for its own success.





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VINMONOPOLET

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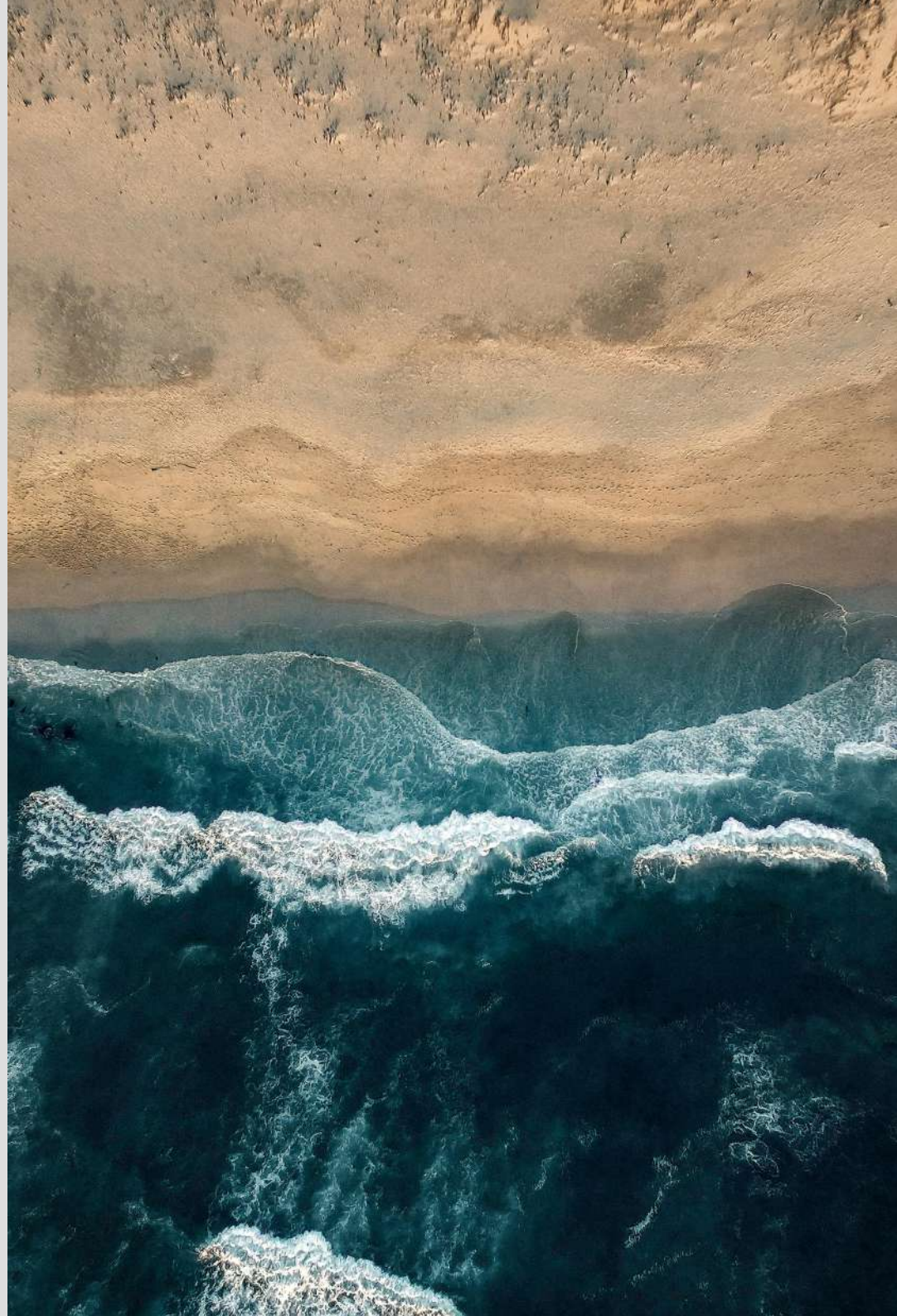
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Hanne Løvstad

Partner
Sustainability & Climate Change, PwC Norway
hanne.lovstad@pwc.com



Erlend Bjørklund

Senior Associate
Sustainability & Climate Change, PwC Norge
erlend.bjorklund@pwc.com

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