



RYSTAD ENERGY

COVID-19 REPORT

3RD EDITION

GLOBAL OUTBREAK OVERVIEW AND ITS IMPACT
ON THE ENERGY SECTOR

24 MARCH 2020

PUBLIC VERSION

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Summary

In this edition of **Rystad Energy's Covid-19 Report**, we now use an updated model which **leverages data from 196 nations through 23 March**. As such, our simulations now show the estimated *true number of people infected globally*. The calibration gives the highest priority to the “hardest data” which is *fatalities*, weighing *ICU bed usage* as the second key metric and *actual reported cases* as the third key metric.

These factors allow us to estimate the *true number of infected cases* at the regional and country level, as well as the *share of cases reported*.

Overall figures currently show that 2.4 million people were infected globally as of 5 March, explaining the 16,500 confirmed fatalities witnessed as of 23 March (0.63%). This number had grown to 6.5 million infected people by 23 March, and we expect will continue to grow to 19 million people by the end of April *if current strict quarantine measures are maintained*, which is the base assumption in our models. If quarantines are not maintained and the virus is allowed to spread uncontrolled, this number may rise to an astonishing 1.3 billion infected people by the end of April.

As discussed in the previous report, we expect governments will use a strategy aimed at “managing the virus” through various levels of quarantines in order to avoid exceeding Intensive Care Unit (ICU) capacity. With the implementation of these social distancing measures, we expect governments will aim to lengthen the spread and impact of the virus over 12 to 18 months in most countries. **Oil demand will see a larger drop than ever before in the history of oil.**

Read more about the model's inherent assumptions in the Methodology section from slide 37.

Governments face a balancing act between public health and economic impact

Public health impact

Strict preventative measures reduce the spread of the virus and “flatten the curve” of infection. This implies that the number of people infected at any point in time is reduced, and fewer patients are in need of intensive care.

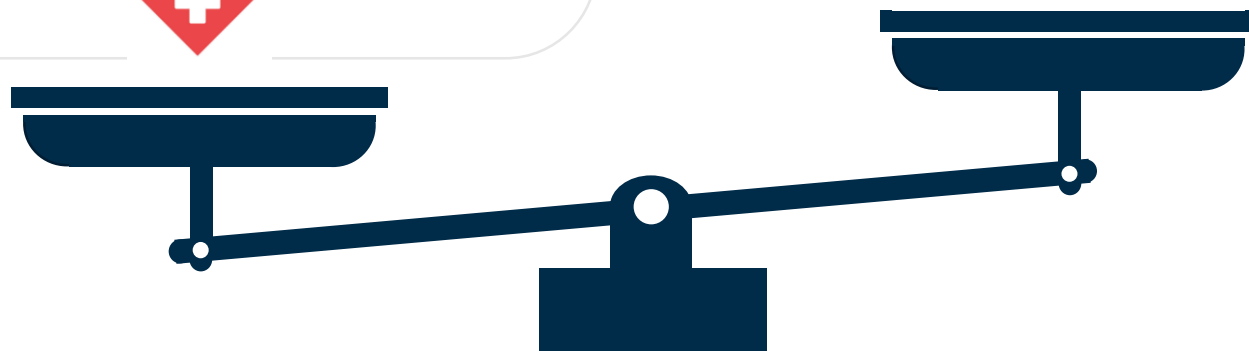
If the number of people in intensive care is lower than the hospital capacity in a given region, this in turn implies fewer people are at risk of dying.



Economic impact

Strict preventative measures such as school closures, home quarantine and travel bans imply reduced revenues for many companies and massive layoffs.

The economic impact will increase relative to the severity of quarantine measures implemented and the time period the measures are in place. At a certain point, governments will consider easing measures either because they have control of the virus or because the economic impact is too severe.



Executive introduction

Scenarios for the Corona Virus pandemic

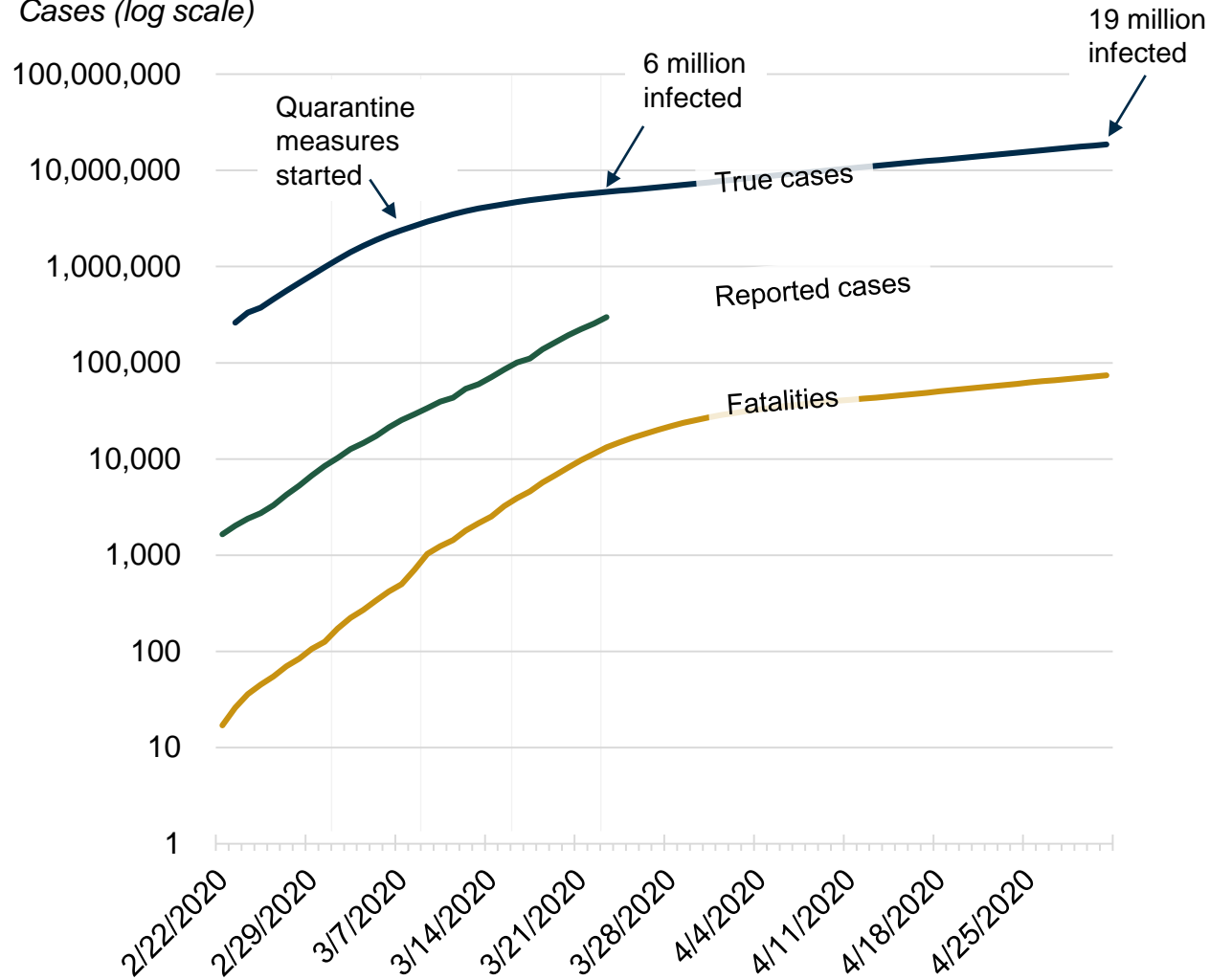
Scenario	Government policy	Benefits	Issues	Impact
Do nothing	<ul style="list-style-type: none"> Do nothing 	<ul style="list-style-type: none"> Economy as usual Life as usual (if not sick) “Finished” in 4 months 	<ul style="list-style-type: none"> 90% of intensive care patients get no help Higher fatality rates Health sector collapse Economy hurt anyway if global recession 	<ul style="list-style-type: none"> Limited negative market impact Negative moral impact – unnecessary loss of loved ones
Manage the virus <i>“Mitigation scenario”</i>	<ul style="list-style-type: none"> No cultural activity Case isolation, home quarantine, social distancing Travel down by 90% 	<ul style="list-style-type: none"> Health system with capacity to handle intensive care cases Immunity for future similar epidemics Vital functions still working 	<ul style="list-style-type: none"> Takes a long time – 6 to 22 months Hurts economy Weakest groups in dire straits Quarantines challenge free movement, liberal values 	<ul style="list-style-type: none"> Severe and long-lasting economic impact Oil market collapse Ethically the right decision
Stop the virus <i>“Effective Prevention scenario”</i>	<ul style="list-style-type: none"> As above, plus... Curfew for all non-essential workers and penalties for non compliance Complete isolation between regions and countries 	<ul style="list-style-type: none"> Mission accomplished in 8 weeks, then back to normal Complete city/country isolation Avoid fatalities - hope vaccination will occur before virus comeback 	<ul style="list-style-type: none"> Too late to stop the virus many places Challenges human rights and liberal values When “finished”, we could see multiple virus comebacks 	<ul style="list-style-type: none"> Very sudden market collapse, but for a short period of time Could win Ethically the right decision, but concerns the infection will comeback

Executive introduction – Number of infected cases, true versus reported

The true number of infected people outside of China is likely around 6 million

Number of cases outside China

Cases (log scale)



As of 23 March, around 6 million people outside of China has been infected according to our model

From 5 March, at which time 1.9 million people were infected, growth has slowed down as quarantines and social distancing measures have been introduced in most countries

Registered fatalities outside of China were 13,219 as of 23 March, i.e. 0.69% relative to infected people 18 days before.

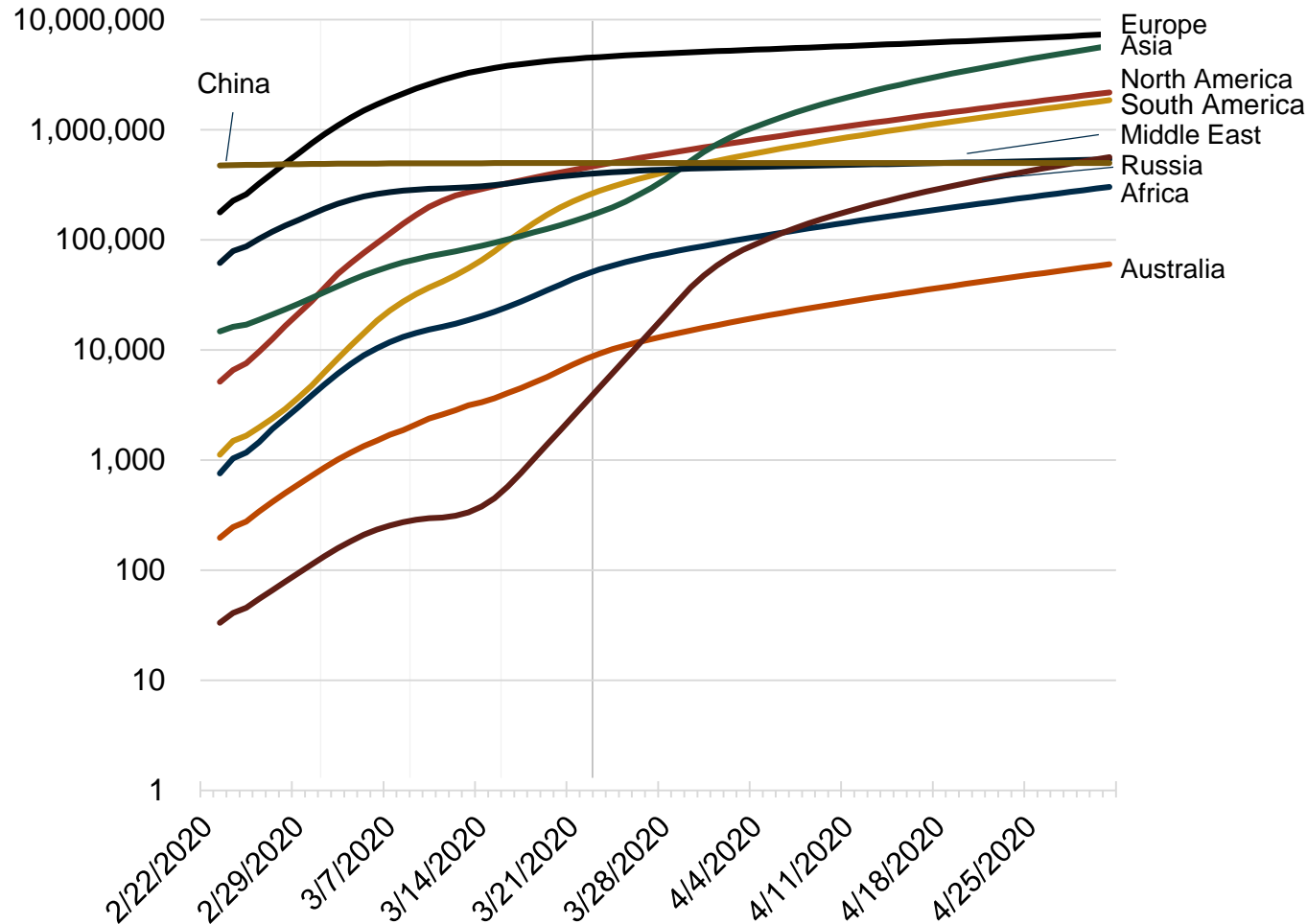
Reported cases were 297,250 as of 23 March, i.e. only 5% of cases were actually reported

Source: Rystad Energy research and analysis

Executive introduction – Number of infected cases, true versus reported Europe on top in current numbers of infected people

Number of cases by main region

Cases (log scale)



As of 23 March, Europe exhibited 4.6 million infected people, of which only 4.3% were reported as infected.

Asia is the second most infected continent and has the highest share of reporting, around 15%.

North America has just below half a million people infected. Only 7% of cases are reported.

Growth rates are currently a function of quarantine measures implemented over the last two weeks.

Continent	True cases March 23rd	Reported cases March 23rd	Share reported
Europe	4 575 652	194 830	4.3 %
Asia excl China	675 422	98 683	14.6 %
China	498 052	81 093	16.3 %
North America	477 380	45 860	9.6 %
Middle East	404 048	28 573	7.1 %
South America	278 400	6 026	2.2 %
Africa	53 765	1 886	3.5 %
Australia	9 230	2 047	22.2 %
Russia	4 533	438	9.7 %

Source: Rystad Energy research and analysis

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Impact on the oil and gas industry

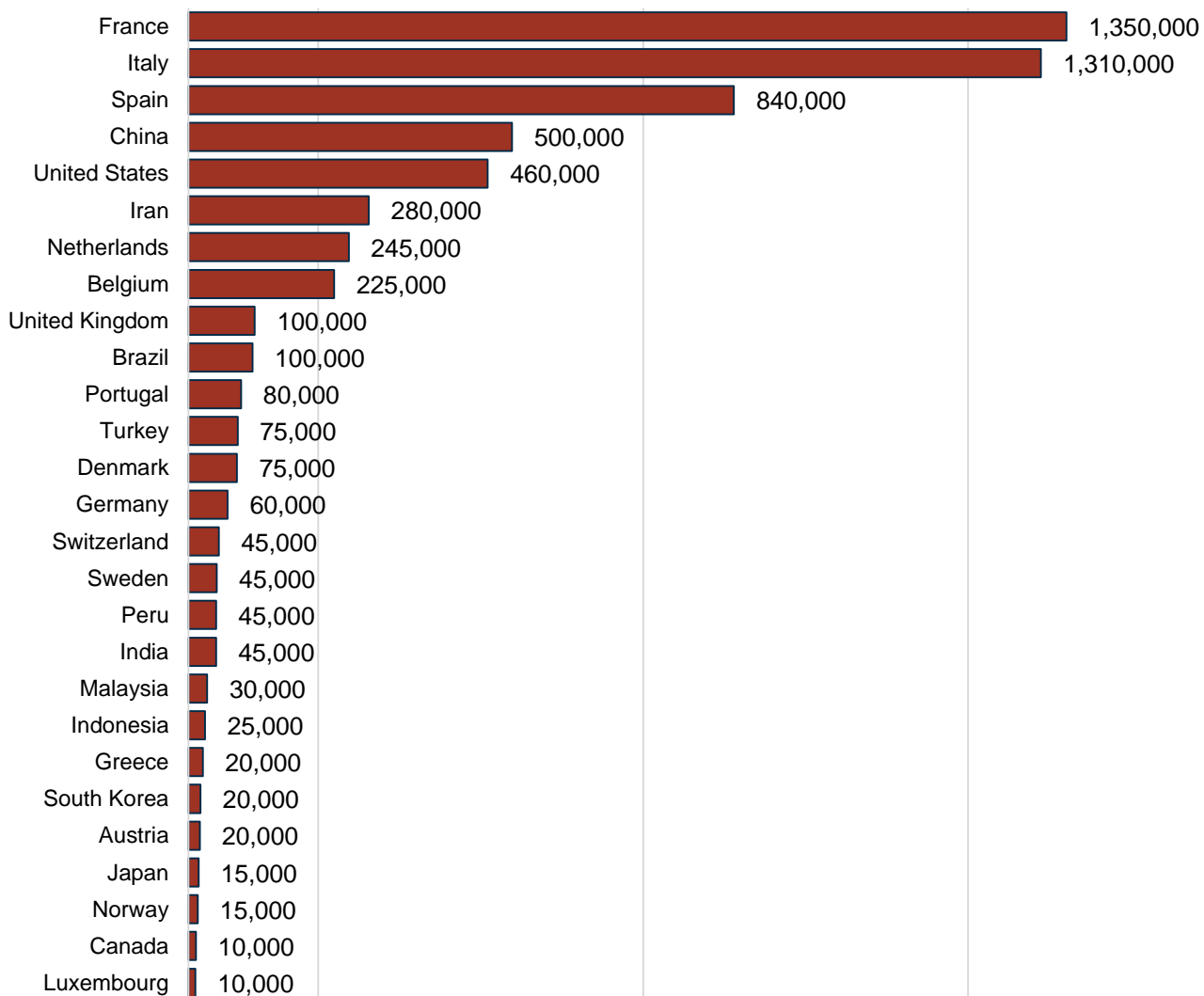
Impact on the renewable energy industry

Methodology

True number of current Covid-19 cases is likely around 6.5 million globally

Current total Covid-19 cases per country, all countries with more than 10,000 cases*

Count of cases



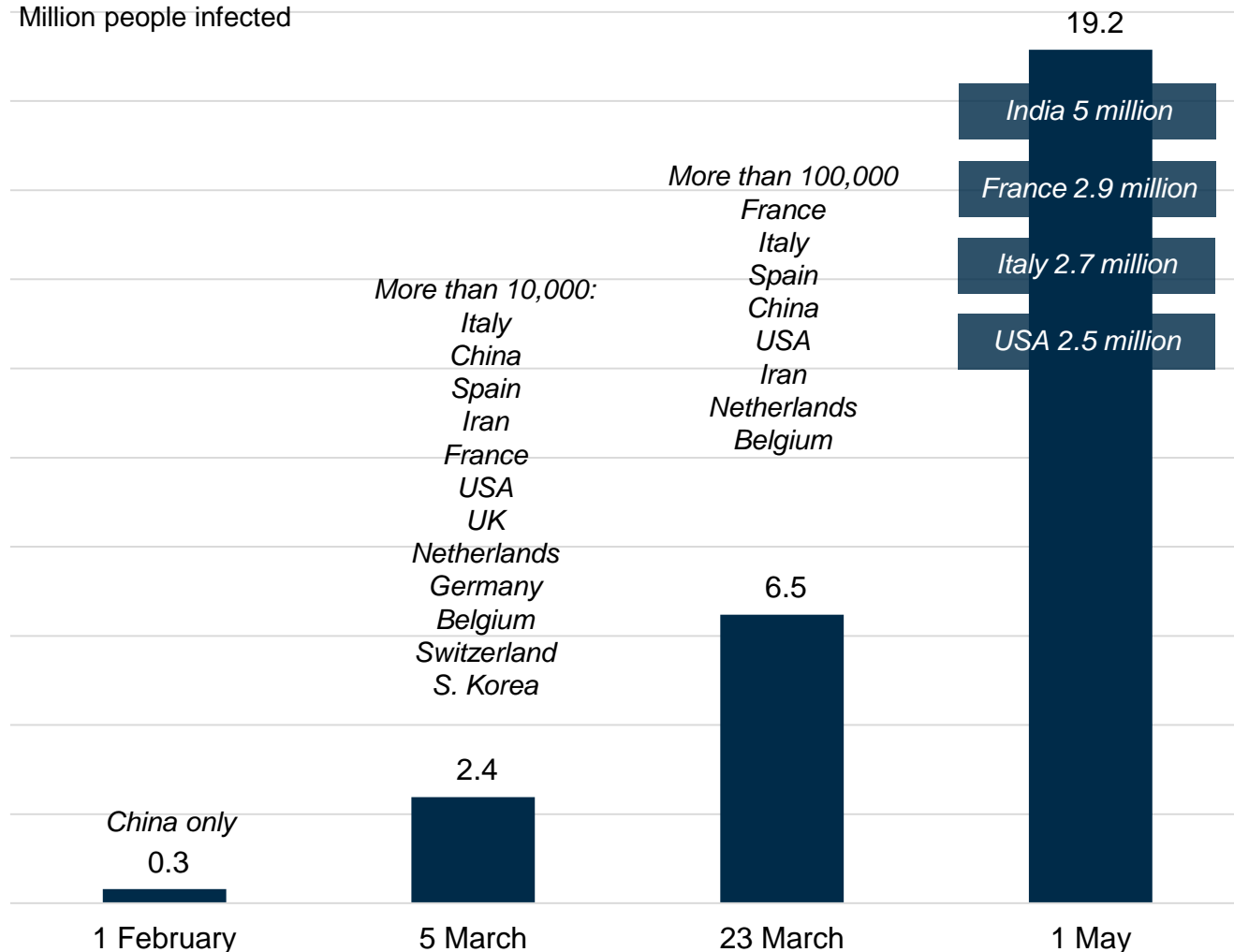
- 195 countries affected
- Total cases around 6.5 million
- 27 countries with more than 10,000 cases and at least 5 fatalities
- France, Italy, Spain and US together represent two-thirds of all cases
- France, Italy and Spain all have 2,000 to 3,000 critical cases under treatment and face a shortage of ICU units in regions of the country

*Source Rystad Energy Global Covid-19 model, see methodology chapter for details

Despite strong measures, the number of infected people could exceed 19 million by 1 May

Covid-19 infected people globally

Million people infected



- Currently about 6.5 million people have been infected globally. Of these, about 1 million have recovered while 5.5 million are active cases
- Despite complete lockdown in 44 countries and closure of businesses in 88 countries, the number of active cases is expected to almost double before the beginning of May
- India, the US and Brazil are among the countries expected to have the highest growth in cases
- India will grow to the top if strict quarantines are not implemented
- The total infected people globally could approach 20 million in early May
- If no quarantine measures was implemented, total number of infected people would have grown to 1300 million people

Source: Rystad Energy Global Covid-19 model. Current preventive measures are taken into account

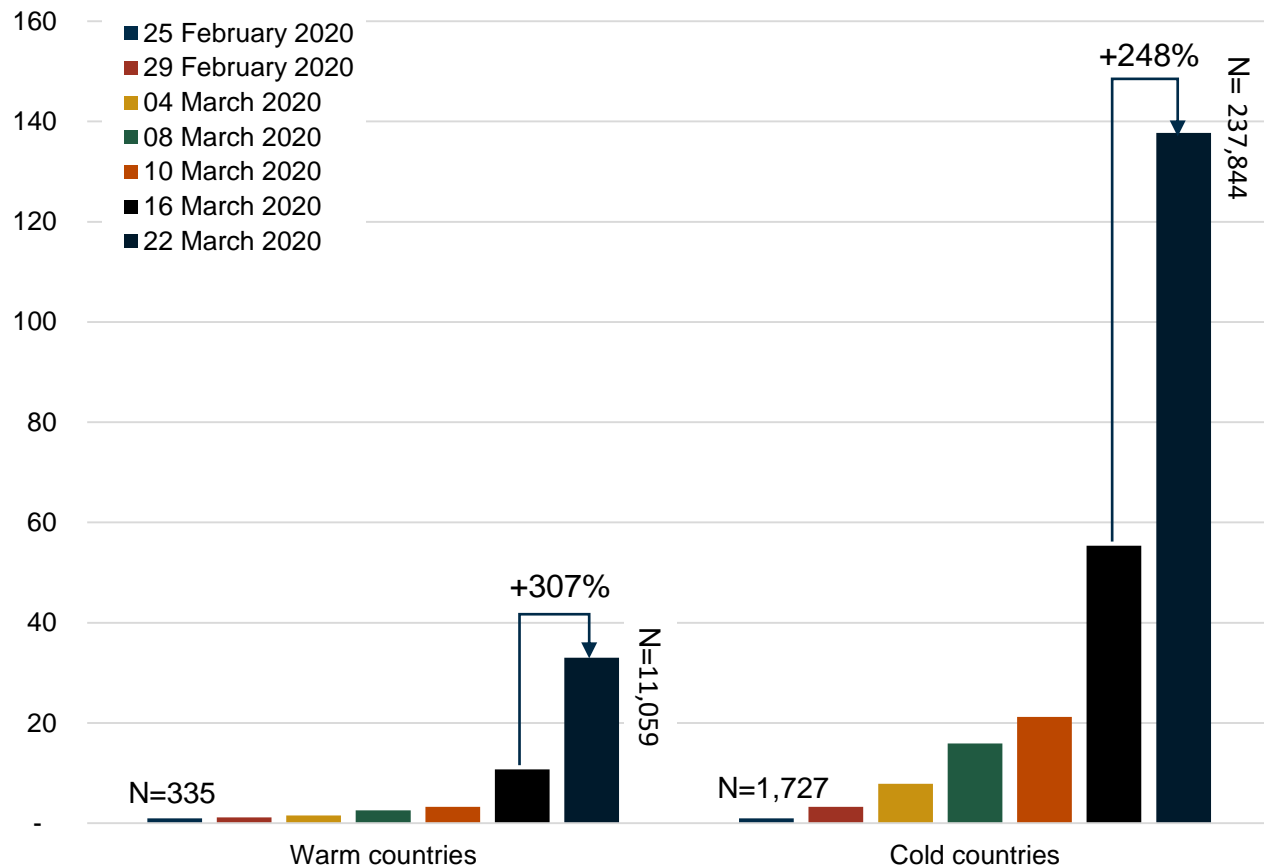
Outbreak status and outlook – Weather considerations

The Covid-19 virus has spread more quickly warmer countries during last week

Reported cases

Indexed (25 February = 1)

Time period:
25 February – 22 March



Relative growth of registered cases grew more quickly in warm countries from 16 to 22 March.

- Countries are separated into two categories: warm countries and cold countries, meaning those exhibiting morning and evening temperatures above or below 10°C in February.
- Reported cases of Covid-19 have increased 140-fold in cold countries since 25 February. In warm countries, this increase was 33 fold.
- This comparison was made to investigate whether the same was true for Covid-19 as for more regular flu epidemics that typically spread in the winter and die out in the spring.
- However, over the past week, relative growth has been higher in warm countries, suggesting that other factors seem to outweigh the regular spring effect.

Cold countries: Afghanistan, Albania, Algeria, Andorra, Armenia, Austria, Azerbaijan, Bahrain, Belarus, Belgium, Bhutan, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kuwait, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Malta, Mexico, Moldova, Monaco, Mongolia, Nepal, Netherlands, New Zealand, Nigeria, North Macedonia, Norway, Oman, Pakistan, Poland, Republic of Ireland, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, UK, Ukraine, US, Vatican City

Warm countries: Argentina, Australia, Bangladesh, Brazil, Brunei, Burkina Faso, Cambodia, Cameroon, Chile, Costa Rica, Dominican Republic, Egypt, French Guinea, Gibraltar, Hong Kong, India, Indonesia, Macau, Malaysia, Maldives, Martinique, Palestine, Panama, Paraguay, Philippines, Qatar, Saint Barthelemy, Saint Martin, Saudi Arabia, Senegal, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, Togo, United Arab Emirates, Vietnam

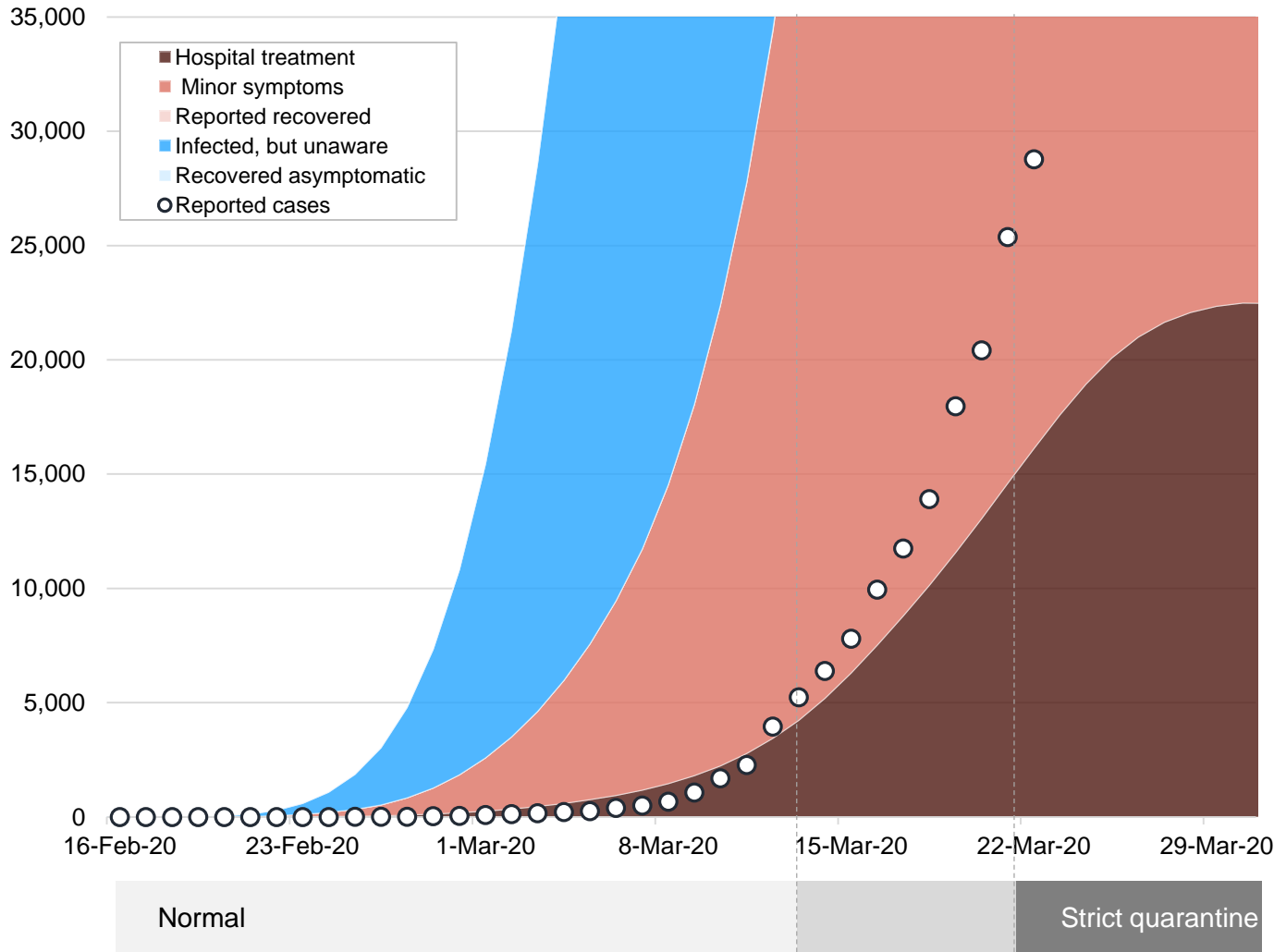
Source: Rystad Energy; Johns Hopkins Center for Systems Science & Engineering (CSSE); Worldometer

Outbreak status and outlook – Spain

Explosive increase in number of cases

Reported and potential total Covid-19 cases by disposition
Number of individual cases

Time period:
16 February – 30 March



- Since our previous Covid-19 report, the number of cases has increased sharply in Spain, in line with the simulation presented in that report.
- As of 23 March, almost 30,000 cases are reported, but most likely near 0.9 million people are infected. A large majority of those will have only minor symptoms.
- Spain's population is 46.6 million people. With an ICU bed capacity of 10 per 100,000, there are 4,700 ICU beds. As of 23 March, 2,355 cases are reported as serious or critical.
- The government declared a state of emergency on 14 March, which will allow the government to restrict free movement and take over control of private hospitals. Immediate strict quarantine measures were started.
- If these measures are as efficient as we assumed in the Effective Prevention Scenario simulation, we will still see the number of cases increasing for almost a week.

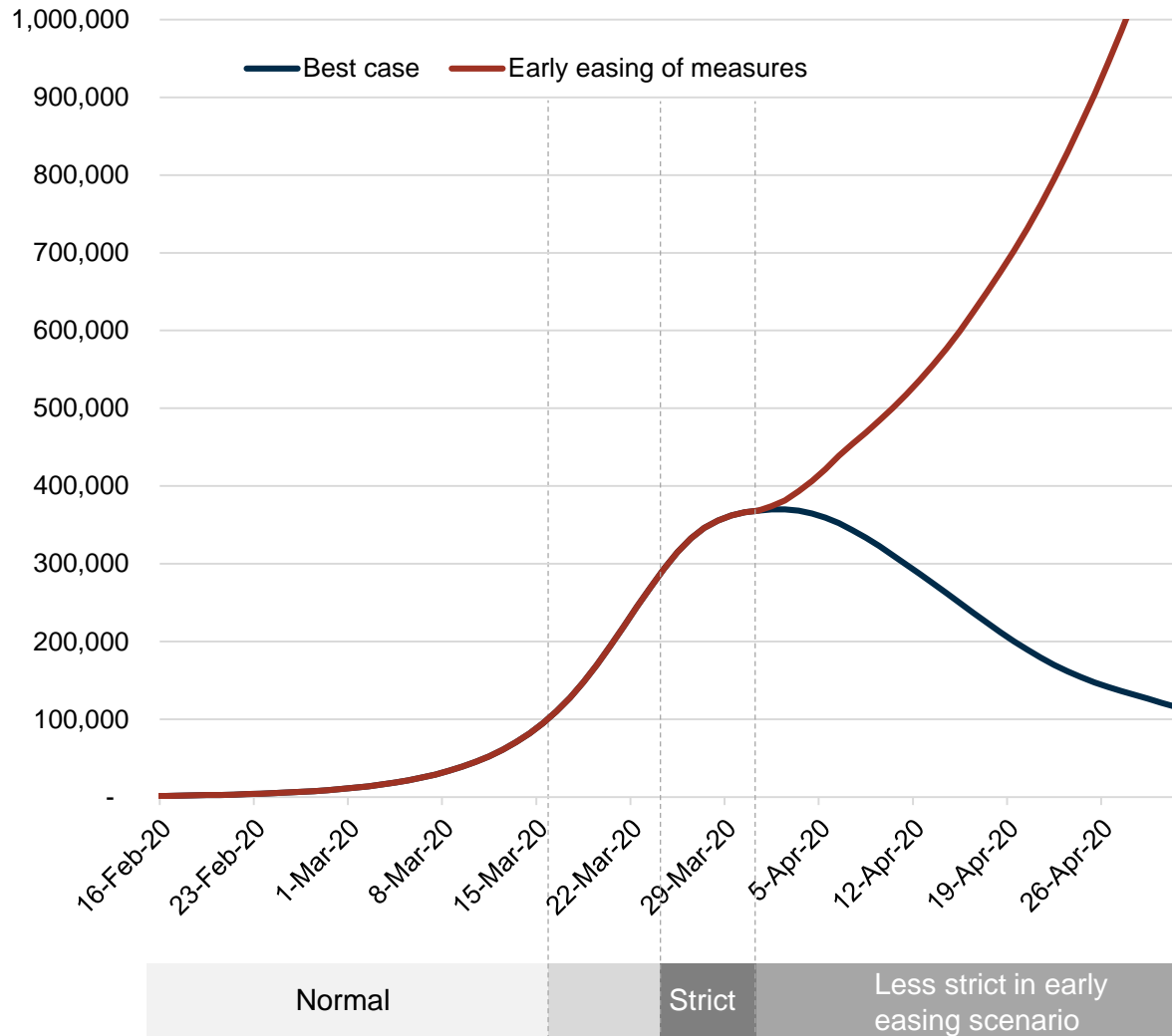
Source: Rystad Energy research and analysis

Outbreak status and outlook – United States

The US considers easing measures earlier than expected

Reported and potential total Covid-19 cases by disposition
Number of individual cases

Time period:
16 February – 1 May



- In a press conference on 23 March, president Trump suggested he may ease quarantine measures when the current 15 day measures end on 30 March, due to the economic impact.
- The states hardest hit by the infection will likely keep strict measures in place, even if national measures are relaxed.
- Assuming that the possible change on national-level quarantine measures will increase the number of contact points to a modest four, on average per day, then after 30 March, the number of infected people will increase sharply just when the best case would begin declining.
- Early easing of restrictions would rapidly cause most of the population to be infected until herd immunity is achieved. In this simulation, we see a peak above 50 million active cases in September, with 260 million in total having been infected.
- Military hospitals and naval hospital ships are currently being deployed to New York, Los Angeles and Seattle. Such assistance will be necessary if early easing of measures becomes a reality.
- Assuming 1 in 400 will need ICU treatment, we might see 125,000 people requiring an ICU bed in September. This far exceeds the total number of ICU beds in the US, which is currently is around 100,000, of which a significant proportion is designated for specific cases such as neonatal or burn injuries.

Source: Rystad Energy research and analysis; Reported cases from Worldometer.

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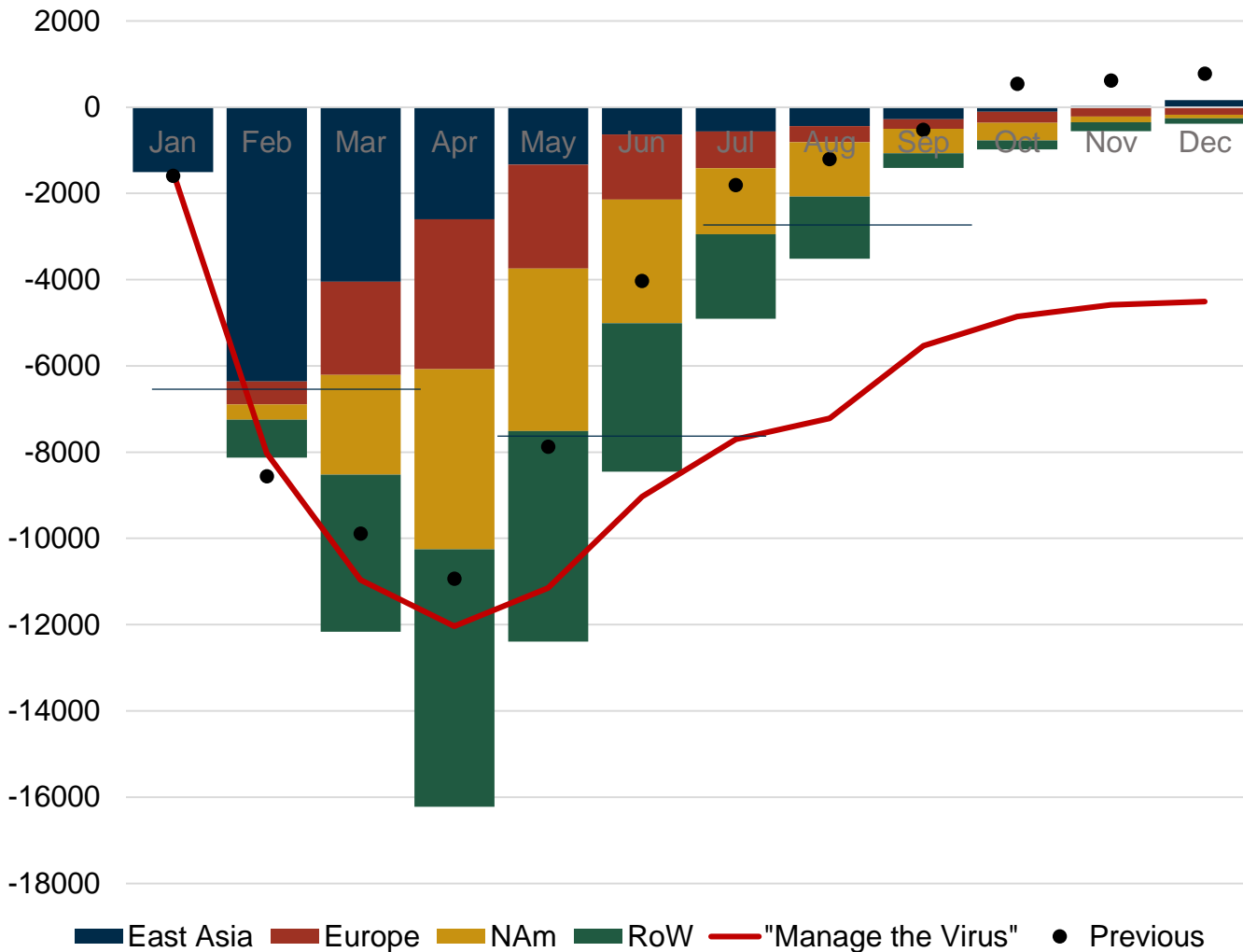
Methodology

Impact on global oil demand

Global oil demand to contract by 16 million bpd in April and 2 billion barrels over the year

Effective Prevention Scenario

Thousand bpd



We now estimate 2 billion barrel less oil demand in 2020 due to the virus outbreak, with an average daily production of 95.5 million bpd for the year, i.e. -4.5% contraction vs the 2019 level of 100 million bpd.

A large part of the global population – from East Asia to Europe and North America – is currently working from home.

Over the past week, these restrictions have been extended to Africa and Latin America.

France now observes a full curfew in large cities. Such war-like restrictions have over the past week also been introduced in Germany, Spain and the rest of Europe, and now even in the UK.

TomTom data indicates that rush hour commuting traffic across Europe dropped from more than 50% congestion levels to less than 10% last week.

The coming weeks will see very little commuting traffic in the largest cities in all corners of the world.

On all continents, leisure activities are coming to a halt, as people increasingly prefer isolation also during weekends.

The impact on heavy duty transport, which represents one-third of total road fuel demand, will be much less pronounced.

The negative impact on oil demand could amount to between 12 million and 16 million bpd over the next two months.

The impact in East Asia is now estimated to have been a drop of 8 million bpd in February. In the rest of the world, we expect the impact to be twice as high over a longer period.

Some 2 billion barrels, or 5% of global oil demand, is poised to be removed from the supply/demand balances. Our estimate before the virus outbreak was that global oil demand in 2020 would grow 1% year-on-year. Now we see global oil demand contracting by 4% in 2020.

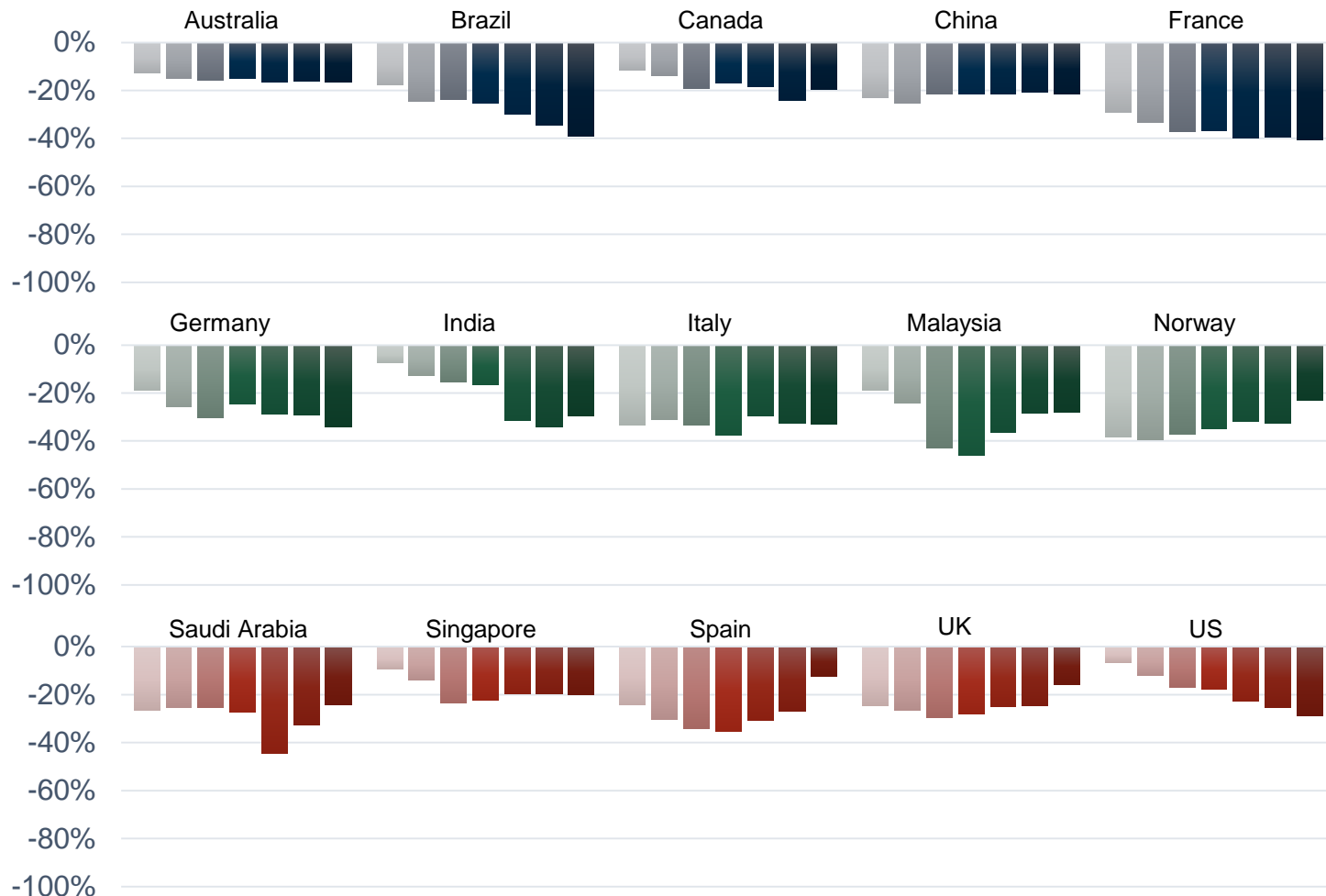
In the "Manage the Virus" scenario, more people will have to be quarantined over a longer period, thus causing an even more dramatic impact on oil demand through the year.

Source: Rystad Energy research and analysis

Cancellation of flights continues globally, with emphasis shifting towards Brazil and the US

Average cancellation rates in and out of various countries across the world

Percent, day-by-day from 17 March to 23 March

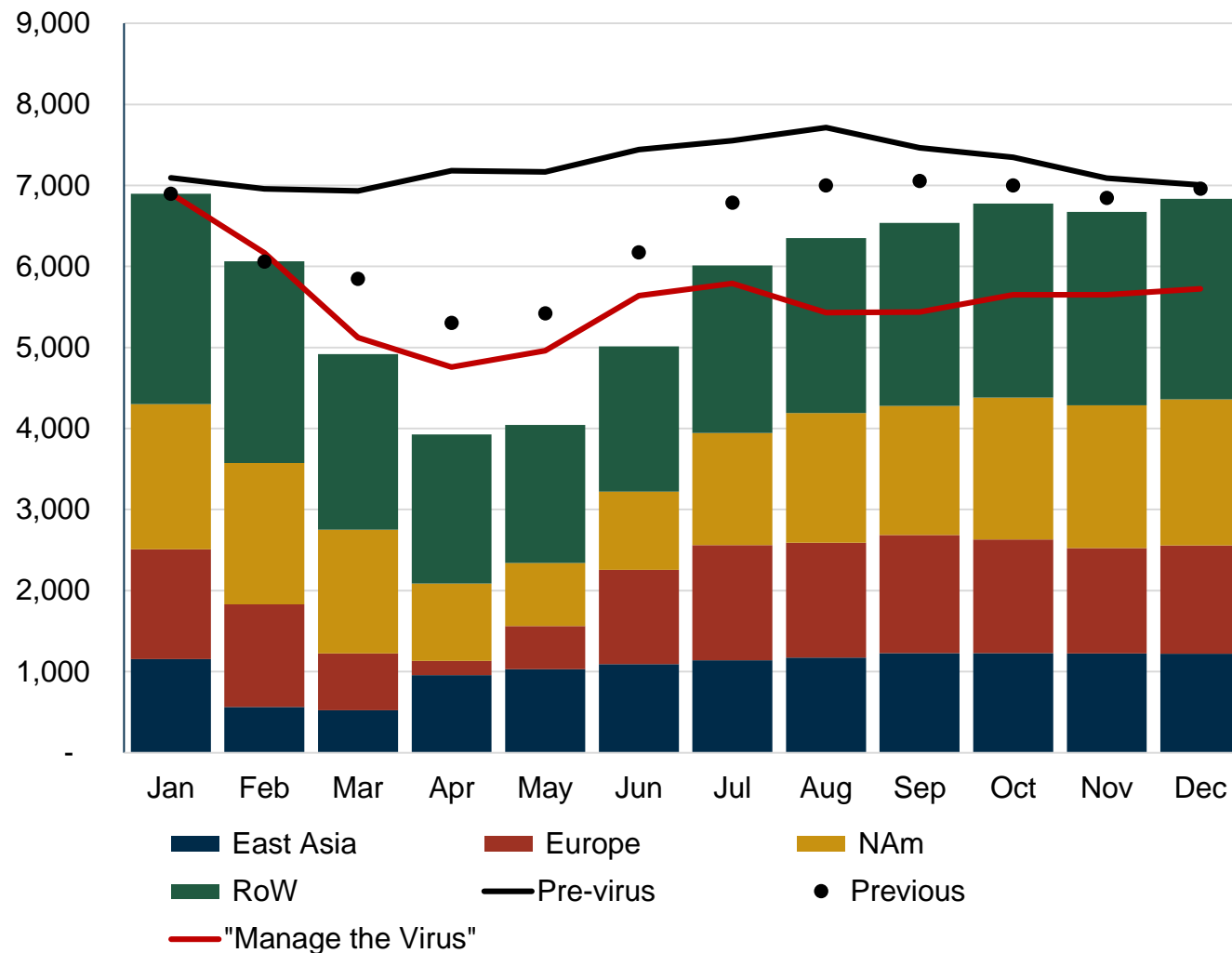


- To further prevent the spread of Covid-19, many governments impose travel restrictions to and from high-risk areas.
- Flights are being suspended, reduced or cut by numerous airlines due to a massive drop in demand.
- The chart to the left shows average cancellation rates for domestic and international flights in 15 countries over the past seven days, from 17 to 23 March.
- We see an increasing trend in countries such as Brazil and the US, with cancellation rates of 40% and 29%, respectively.
- Countries with strict travel restrictions and relatively high cancellation rates are France (41%), Italy (33%), Germany (34%), India (27%) and Malaysia (29%).
- As of 23 March, other countries have a cancellation rate less than 20%.

Sources: ICAO; IATA; CARNOC; Airport websites; Airline websites; Johns Hopkins CSSE; Rystad Energy research and analysis

Global consumption of jet fuel to fall by 3 million bpd and summer peak will not happen

Global jet fuel consumption, thousand bpd



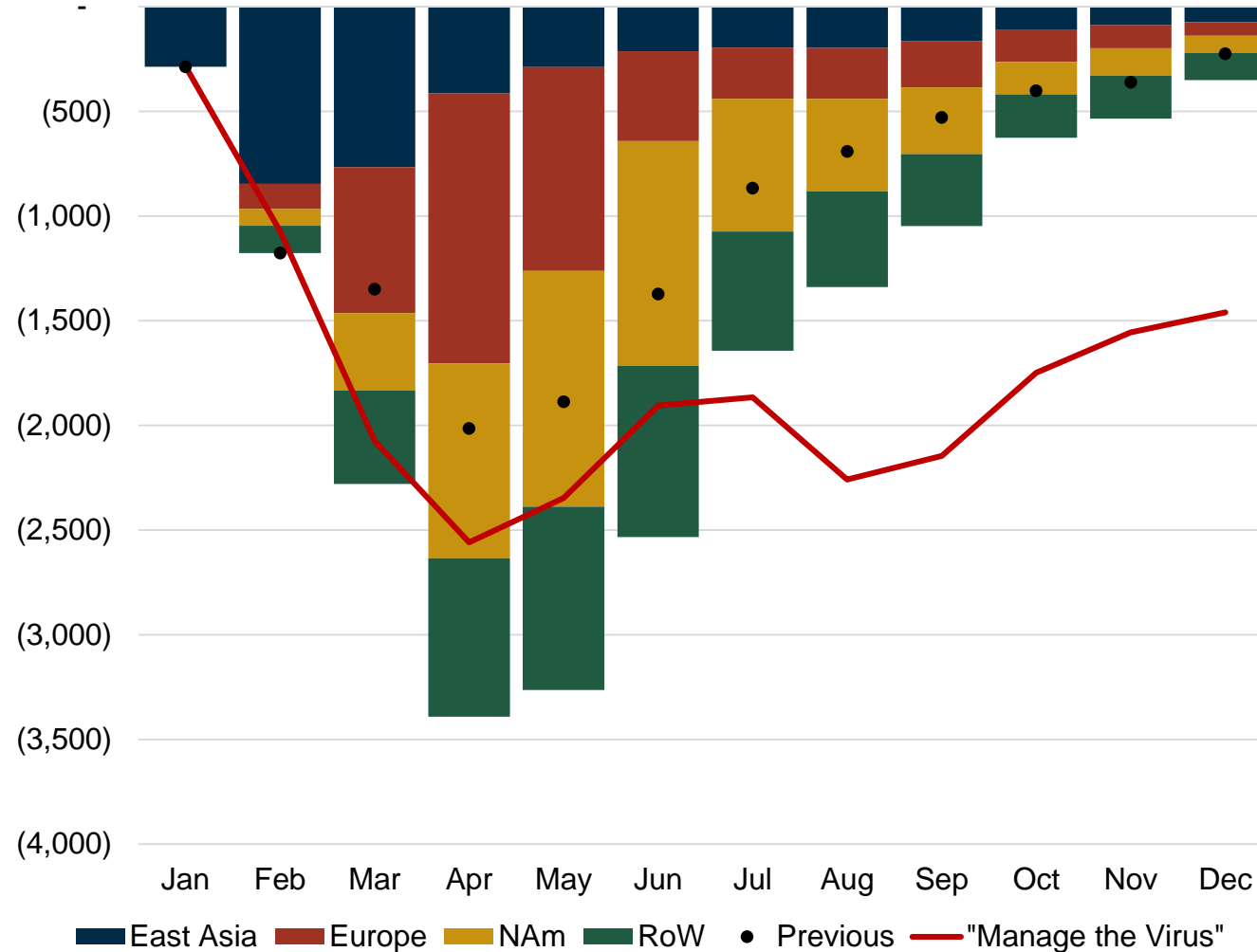
- Transatlantic flights are cancelled
- Most borders in Europe are closed
- Cancellation rates for international flights up to 70%
- Cancellation rate for domestic flights in Europe is already 50%
- Cargo and other flights much less impacted
- The normal summer peak will not happen
- Revision from previous week's report is due to a higher share of long haul and large aircraft cancellations than what we saw one week ago.

Source: Rystad Energy research and analysis

Impact on global oil demand – Aviation

Impact on jet fuel will be particularly dramatic, with 20% of demand removed for the year

Global jet fuel consumption growth year-on-year, thousand bpd



The peak of the impact will be painful in April and May, as Europe and the US fight against further spread of the virus across their borders.

Above and beyond the restrictions being imposed, travelers themselves are voluntarily suspending journeys.

We expect fewer cancellations in June as flights come back gradually ahead of the summer.

The summer peak will be lower than usual due to fewer long haul flights, as many travelers will likely prefer domestic vacations.

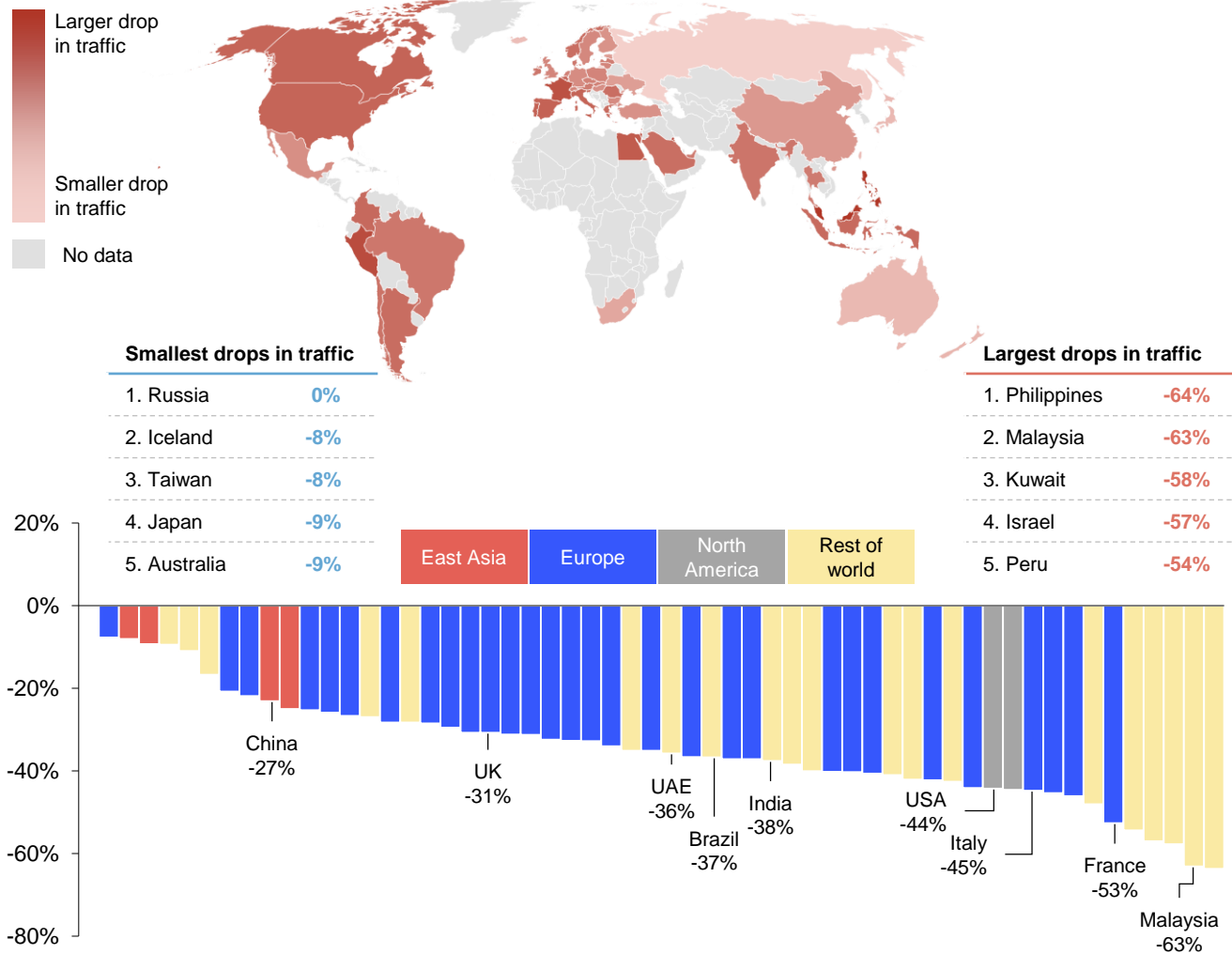


Source: Rystad Energy research and analysis

Global traffic down by more than one third as governments impose measures worldwide

Reduction in traffic versus normal levels

Percent difference year-on-year, 5-day moving average



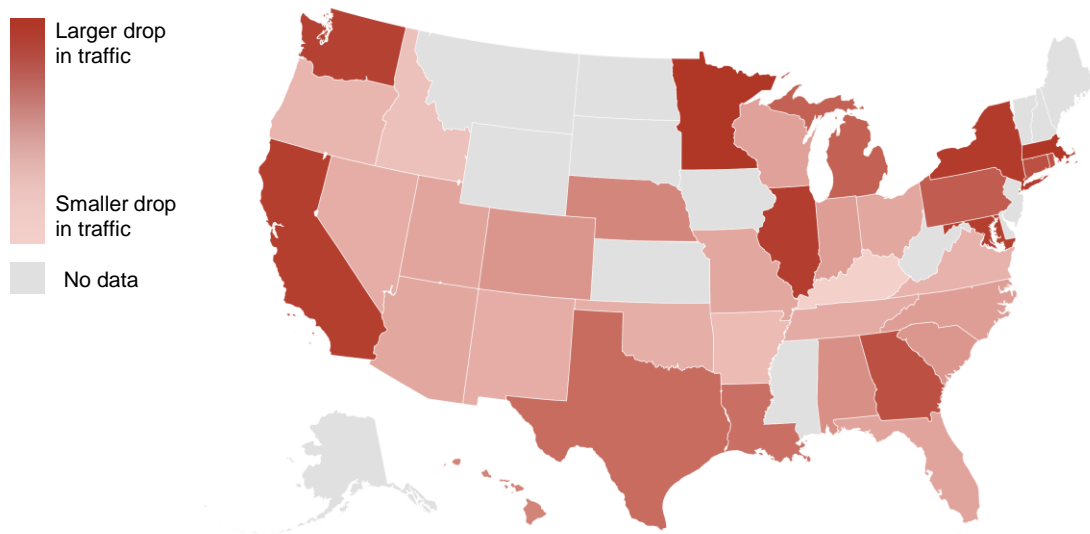
- Fewer than 20 out of 400+ cities in our road traffic dataset showed an increase in traffic last week compared to levels seen a year ago.
- Several countries in Southeast Asia imposed stricter measures at the start of last week, resulting in large reductions in traffic. By the end of the week, Malaysia was the country with the largest reduction in traffic compared to 2019 levels, with a massive 63% reduction.
- Other regions impacted by stricter restrictions were South America and South Asia.
- In Europe, countries in the south generally have larger traffic reductions, at around 45%, while similar reductions for Northern Europe lie at around 35%.

Source: TomTom Traffic Index; Rystad Energy research and analysis

Road traffic in the US sees the largest drop yet at 40% below 2019 levels

Average state by state reduction in traffic versus last year

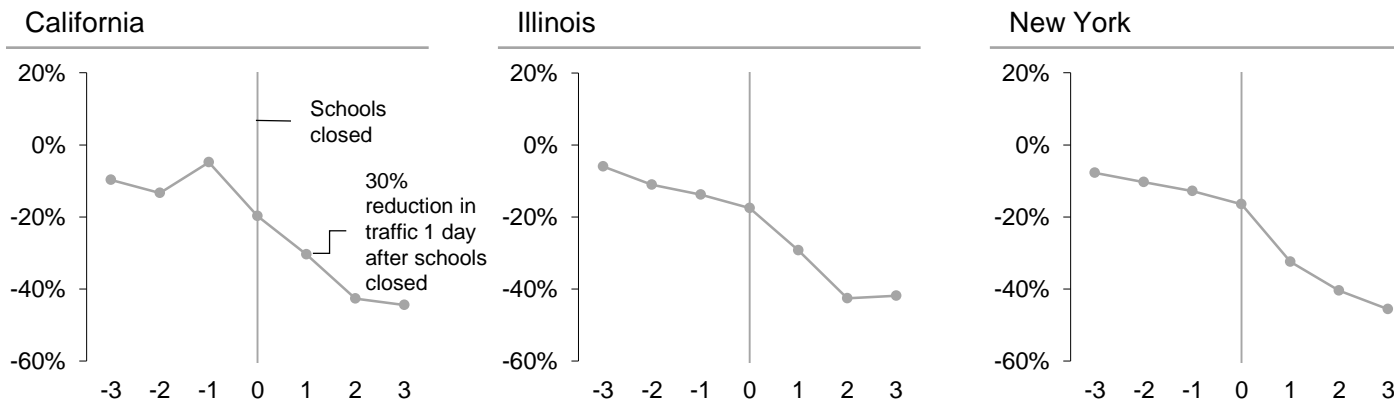
Percent difference year-on-year, 5-day moving average



- Road traffic in most US states dropped significantly last week after several states decided to close down schools.
- In the three most populous states California, Texas and Florida, traffic dropped by 46%, 39% and 31%, respectively, from average levels observed in 2019.
- Major hubs along the East Coast are also experiencing significant declines, with New York dropping by 47% and Georgia, home of the busiest airport in the world, falling by 44%.
- Nevada, Arizona, New Mexico and Oklahoma were the states with the largest reductions from Monday to Friday last week, going from around 10% traffic reductions to over 30% reductions.

Reduction in traffic versus normal levels before and after schools are closed

Percent difference, year-over-year



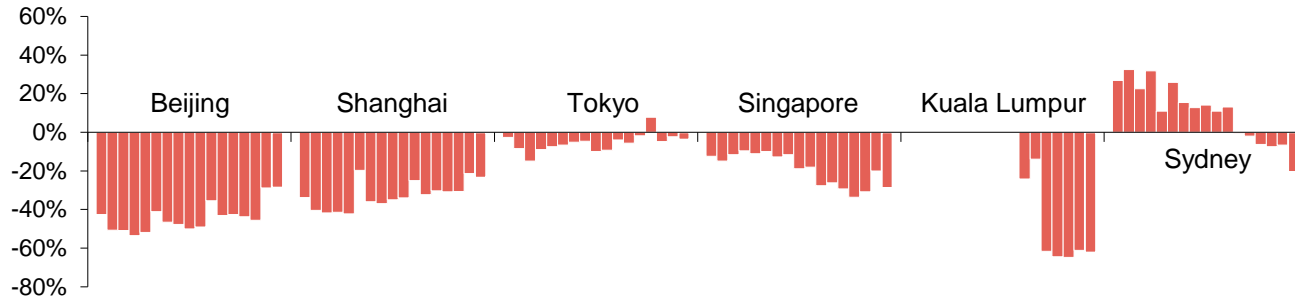
Source: TomTom Traffic Index; Rystad Energy research and analysis

Road traffic in most major hubs worldwide are down by more than 20% from normal levels

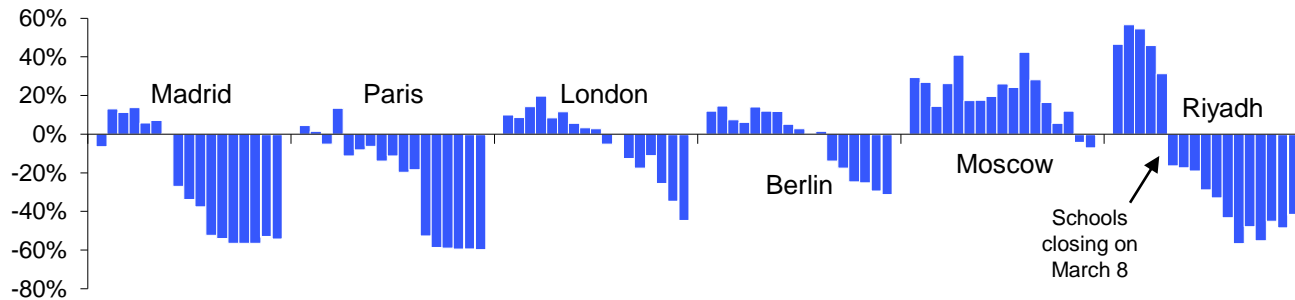
Traffic levels* for last 17 working days compared to average 2019 levels

Percent difference year-on-year

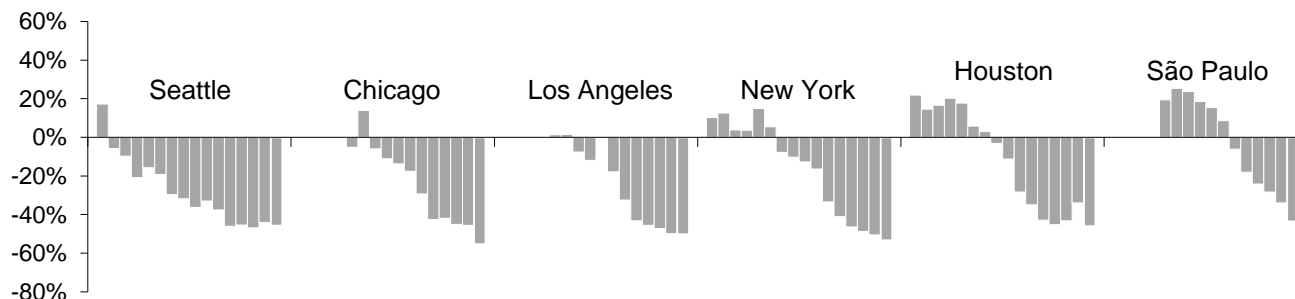
Asia



Europe & Middle East



Americas



- Using congestion levels in cities from the TomTom Traffic Index, we estimate the reduction in traffic.
- Looking at data over the past 17 working days for 18 metropolises, traffic levels are down significantly compared to 2019 levels.
- In East Asia, traffic is starting to normalize, whereas traffic in Southeast Asia has dropped significantly during the past week, the result of government restrictions across the region.
- In Europe and the Middle East, Moscow is the only major city where traffic is not down by more than 10%.
- In Saudi Arabia, traffic went from 31% above normal levels to 16% below normal levels after schools were closed on 8 March, and fell further to more than 40% below normal levels after additional restrictions were introduced on 15 March.

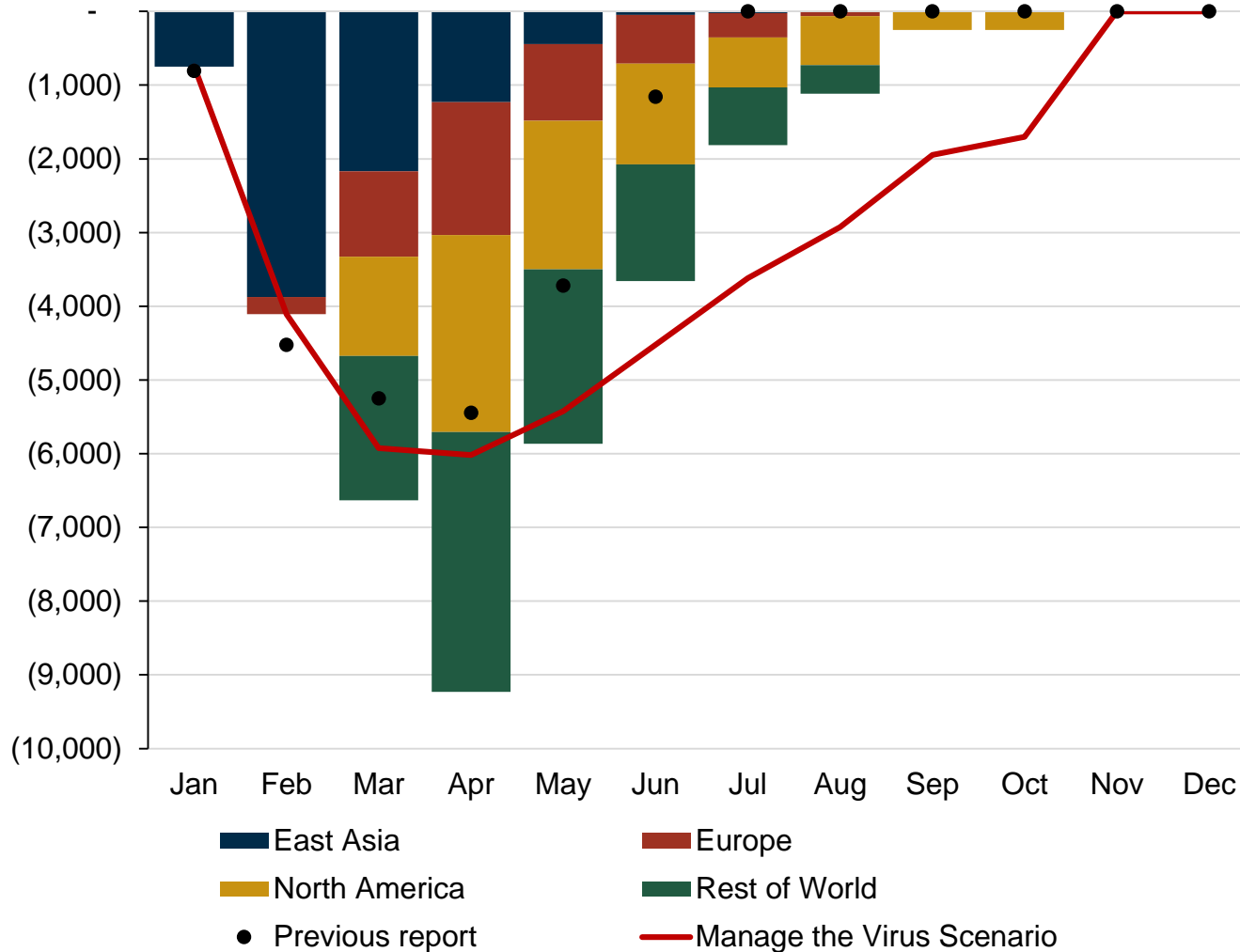
* Prior version of the Covid-19 report used congestion levels. In this version, we use traffic levels calibrated from congestion levels, so the numbers in the graphs are lower than before.

Source: TomTom Traffic Index; Rystad Energy research and analysis

Global road fuel consumption will likely drop by 9 million bpd during the coming weeks

Global gasoline and road diesel consumption growth year-on-year

Thousand barrels per day



A large part of the global population – from East Asia to Europe and North America – is currently working from home.

Over the last week, these restrictions have extended to Africa and Latin America.

France now observes a full curfew in large cities. Such war-like restrictions have over the last week also been introduced in Germany, Spain and the rest of Europe, even in the UK.

TomTom data indicates that commuting rush-hour traffic dropped from more than 50% congestion levels to less than 10% across Europe last week.

The following weeks will see very little commuting traffic in the largest cities in almost all parts of the world.

On all continents, leisure activities have come to a halt, as most people now prefer isolation, even during the weekends.

The impact on commercial transport traffic will be much less apparent.

The maximum impact outside China is expected to be equal to what was observed in China in February.

Assuming effective containment, Europe and North America will gradually come back to normal levels before the summer.



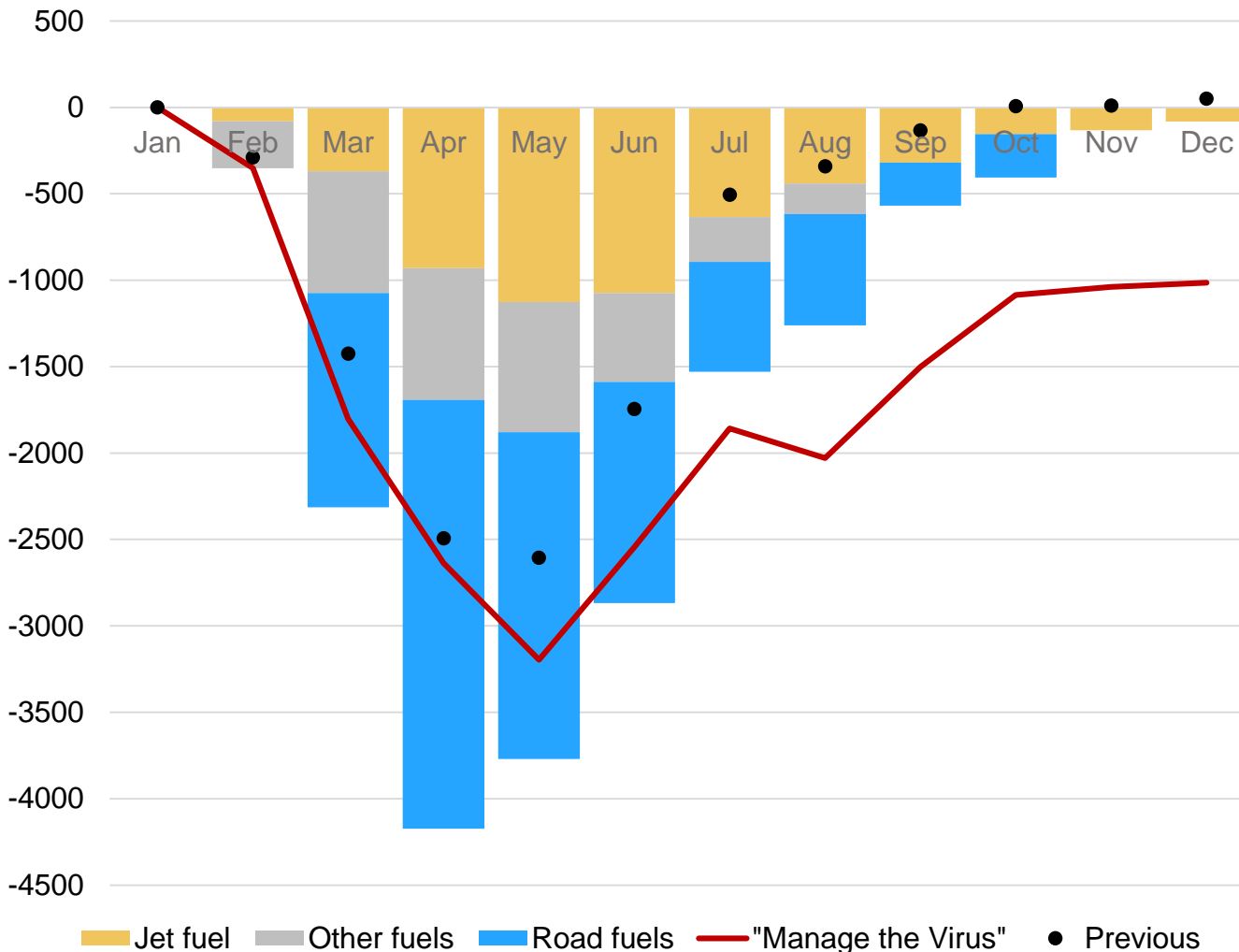
Source: Rystad Energy research and analysis

Impact on global oil demand – North America

US+Canada oil and petroleum products could contract by 4 million bpd in April

Effective Prevention Scenario

Thousand bpd



We see state-level and city-level quarantine measures being implemented across the US, although still no federal quarantine measures have been taken.

We expect existing and future quarantine measures and travel restrictions in the northern states and Canada to peak in April 2020.

We expect future travel restrictions and quarantine measures to peak in the southern states in May 2020.

As a result, we expect North American oil demand to hit bottom in April and May 2020 at 18.5 million and 19 million bpd, respectively, compared to our pre-virus estimate of close to 23 million bpd.

As more cities and states introduce quarantine measures, we expect a more significant road fuel impact than in our last week report.

We forecast road fuel demand to be impacted by 2.5 million bpd and 1.9 million bpd in April and May 2020, respectively.

Overall, as much as 4 million bpd of oil demand will be impacted in April and around 3.6 million bpd in 2Q 2020 on average.

We now also see restrictions lasting longer and affecting 3Q 2020 demand as well.

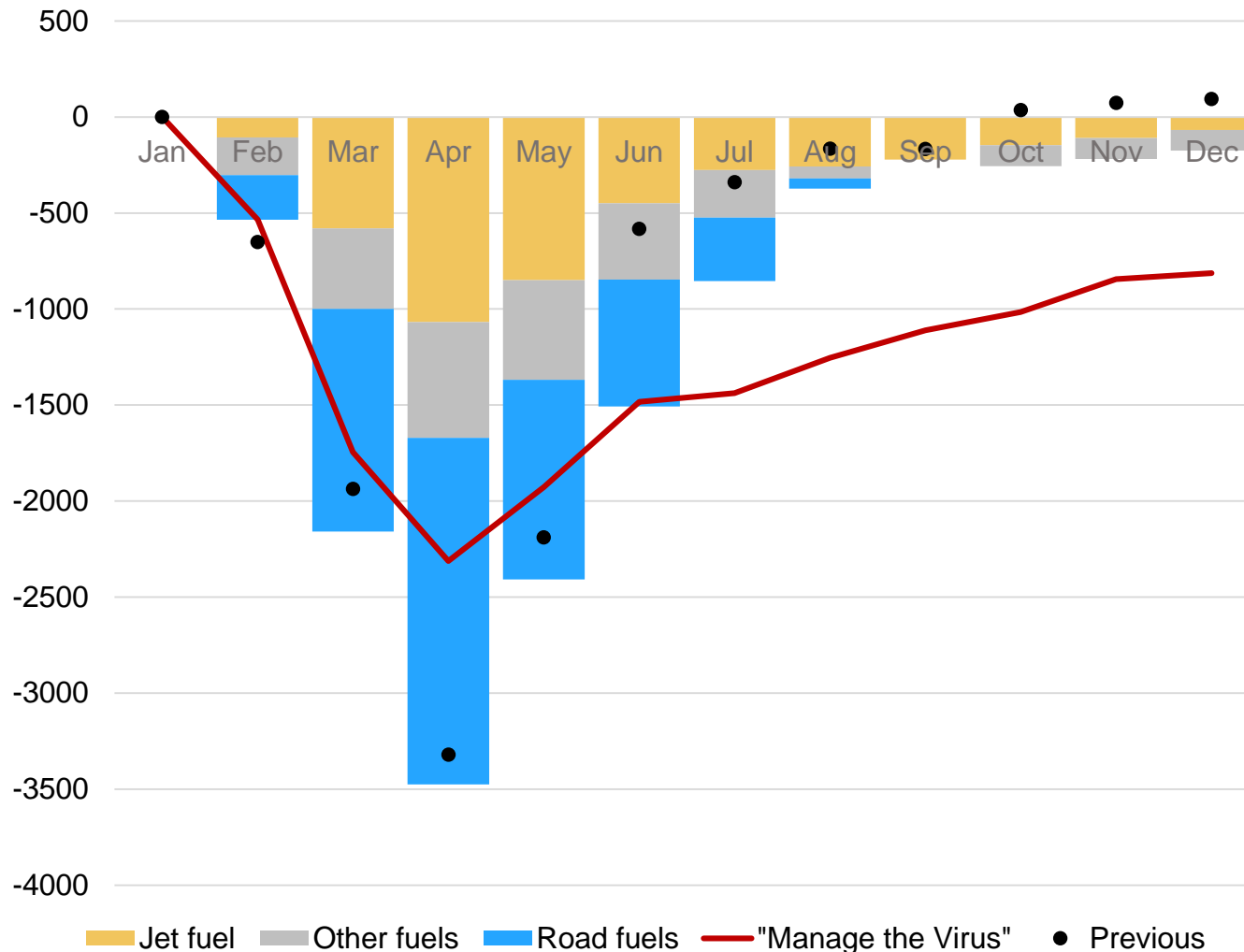
Source: Rystad Energy research and analysis

Impact on global oil demand

Global oil and petroleum products could contract by 15 million bpd in April

Effective Prevention Scenario

Thousand bpd



More European countries have introduced travel restrictions and quarantines since our previous Covid-19 report was released a week ago.

France, Spain and most recently the UK have introduced travel restrictions and quarantines. The effects had already been accounted for in our previous report.

At the same time, we now see countries extending existing quarantines and travel restrictions, such as Denmark extending its quarantine regime until mid-April. We expect other European countries to follow the same pattern and we therefore anticipate lower European oil demand in 3Q 2020.

We expect the impact on European demand to peak at -3.5 million bpd, mostly stemming from road fuels and jet fuel.

On average for 2Q 2020, we expect 2.5 million bpd of demand to be removed in Europe.

We also forecast demand to stay weak in June and July 2020, with a negative impact of 1.5 million bpd and 900,000 bpd, respectively. This represents a deeper decline than we envisaged in last week's report.

Current quarantines and travel restrictions are likely to be extended in Europe, with stronger impact for 2Q and 3Q 2020 in our updated forecast.

Source: Rystad Energy research and analysis

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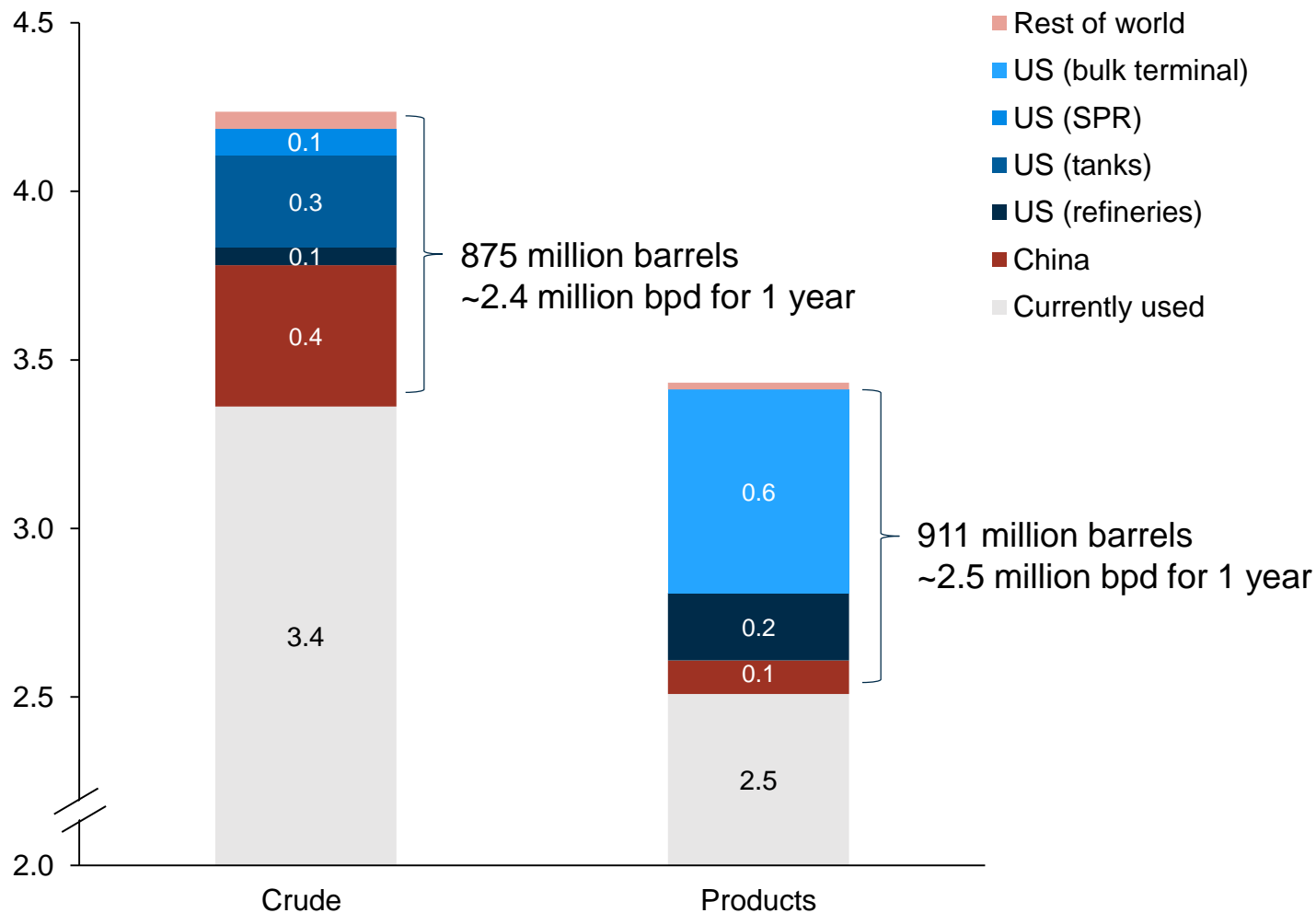
Methodology

Impact on the oil and gas industry – Crude and products storage capacity

Global crude storage lasts for 50 days, production or Brent will have to blink first

Global available storage capacity, by region by type

Billion barrels



The world currently has in storage around 7.2 billion barrels of crude and products onshore, including 1.3 billion barrels currently onboard oil tankers at sea.

No idle storage capacity is available on tankers.

About 76% of the world's oil storage capacity is already full.

In theory, the available storage capacity is currently 1.7 billion barrels onshore for crude and products combined, but the practical storage capacity is less because storage due to operational issues cannot be filled up to 100% of capacity.

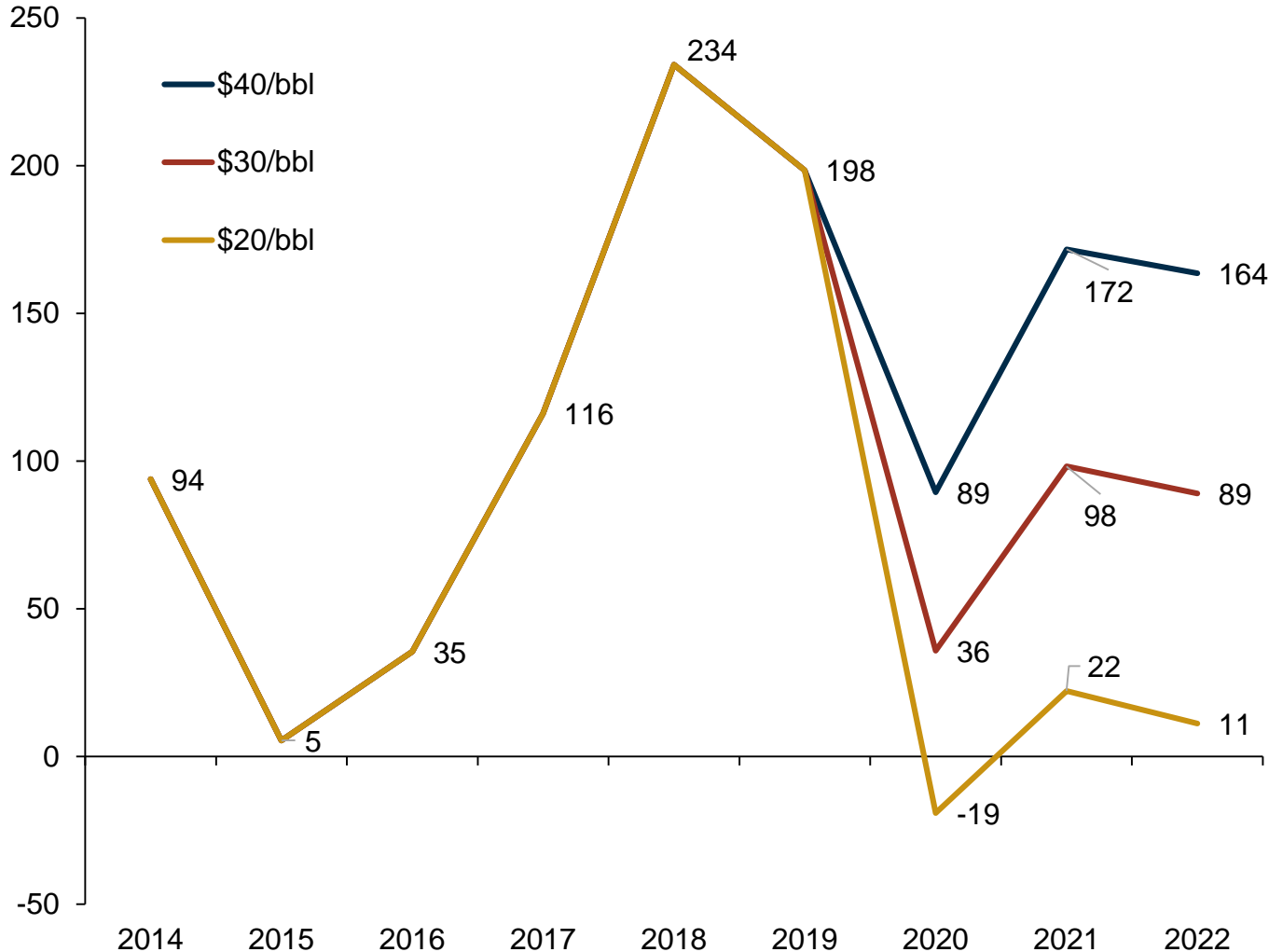
Considering an oversupply of 15 million barrels per day in next two months, it would take about 58 days to fill 875 million barrels of available crude. In reality it would be even quicker as refineries will now start reducing runs as the crack margins are evaporating.

Source: Rystad Energy research and analysis, IEA, EIA, SCIG. US storage capacity excludes pipelines.

Impact on the oil and gas industry – Cash flow situation

With oil at \$30/barrel, free cash flow* from public E&Ps will drop 86% to \$36 billion

Total upstream free cash flow from public E&P companies for different oil price scenarios*
Billion USD



With the new oil price outlook, the free cash flow (FCF) for the global E&P companies is set to fall considerably during 2020.

Assuming an average Brent oil price of \$30 per barrel in 2020, the FCF is expected to drop to around \$36 billion. If the average Brent oil price ends up at \$20 per barrel, the FCF will be negative.

However, even with an average 2020 oil price of \$20 per barrel, the E&P companies' FCF position is still going to be better than it was in both 2015 and 2016.

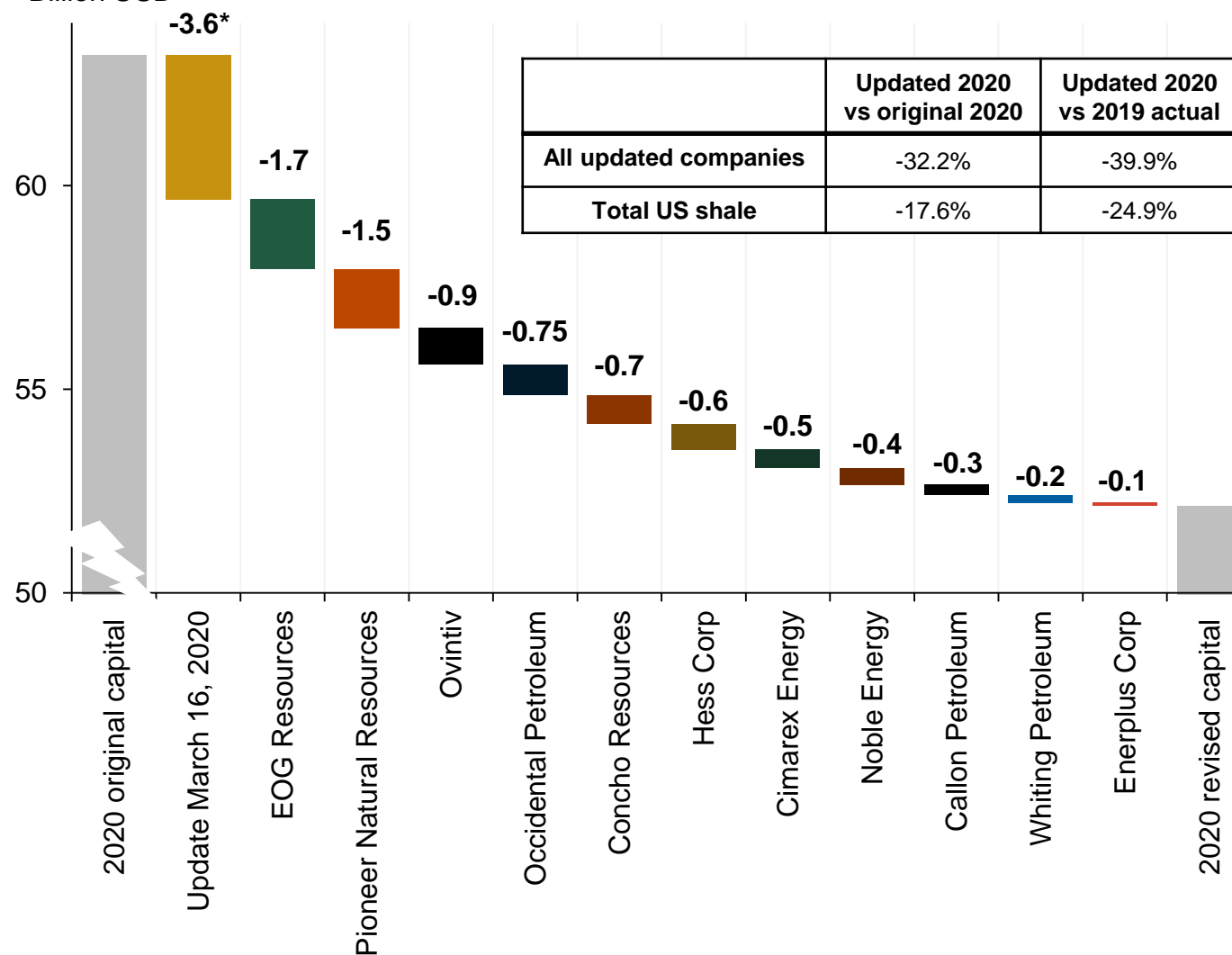
This shows that the E&P companies are in a much better position now than they were after the last oil price collapse.

*FCF is upstream only, net of finance. Figures exclude China.
Source: Rystad Energy UCube March 2020

Total spending in US shale is now likely to fall by about 40% in 2020

Updated 2020 capital guidance vs original 2020 budget by company

Billion USD



US shale E&Ps are rapidly adjusting their initial activity programs for 2020 in response to the oil price crash. Half of the companies in our peer group of 40 public E&Ps have already announced significant activity reductions to achieve an adequate cash flow balance. Diamondback Energy and Parsley Energy have already released updated guidance twice since 9 March, 2020.

On average, E&Ps have reduced their target 2020 spending by 32.2% compared to the original guidance. This implies a 40% contraction in the spending compared to 2019 levels. In terms of the running rate of activity (rigs and frac spreads), such a full-year capex cut implies an expected decline of about 60% from the current level before the end of 2020.

Including the companies that have not yet provided updated guidance, US shale 2020 spending currently is seen down by 25% compared to 2019, but we expect that the companies with fast communication will eventually be representative for industry-wide average behavior. Private operators are set to react even faster, but this might be partially offset by less significant activity declines from supermajors.

*Includes additional activity update by Parsley Energy and Diamondback
Source: Company reporting, Rystad Energy research and analysis

Oil production from US Land set for a 12% decline in 2020 based on latest guidance

2020 guided oil production growth tracker, original guidance vs revised

	Original	16 March, 2020	19 March, 2020
<i>FY 2020 vs FY 2019 – Revised companies</i>	7.4%	-1.3%	-2.4%
<i>FY 2020 vs 4Q19 – Revised companies</i>	3.3%	-5.1%	-6.1%
<i>4Q20 vs 4Q19 – Revised companies</i>	6.5%	-10.1%	-12.2%
<i>FY 2020 vs FY 2019 – Total shale</i>	8.1%	6.2%	1.9%
<i>FY 2020 vs 4Q19 – Total shale</i>	2.9%	1.1%	-3.0%
<i>4Q20 vs 4Q19 – Total shale</i>	5.9%	2.1%	-6.1%

Public shale E&P companies initially targeted sequential US oil production growth of about 6% between 4Q19 and 4Q20. The updated guidance suggests a 6% decline as opposed to a 6% increase (approximately 700,000 bpd). Yet it should be noted that only half of the companies in the peer group have so far announced guidance revisions. If we only look at the companies that have updated their guidance, their implied sequential production change (4Q19 to 4Q20) has shifted from 6.5% growth to a decline of 12.2%.

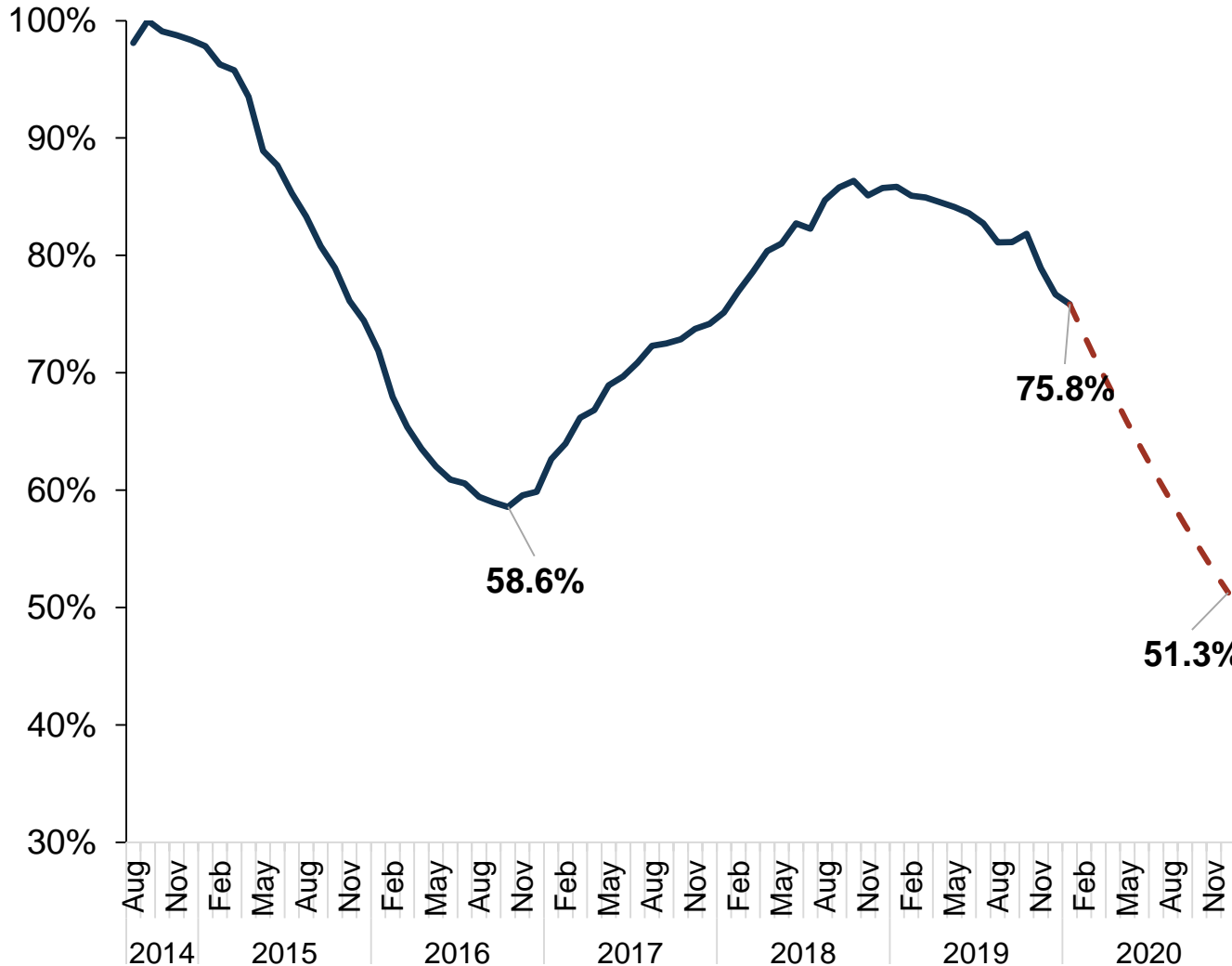
Most companies say that the new guidance is based on WTI assumptions of \$30 to \$35 per barrel for the remainder of the year. Hence, there is no doubt that the reaction of E&Ps this time will be faster than in 2015, with frac spreads being adjusted simultaneously with rig counts (as opposed to the lagged reaction of frac activity). US oil production is now set to fall by more than 1 million bpd in a \$30/barrel WTI environment between 4Q19 and 4Q20. The decline might be closer to 2 million bpd if we end up in a \$20/barrel WTI environment.

Revised numbers as of 19 March, 2020 incorporate updated activity programs reported by 11 additional producers as discussed above
Source: Company reporting, Rystad Energy research and analysis

Impact on the oil and gas industry – US workforce

US service companies could cut staff by one-third by end of 2020

Number of employees in oil and gas support activities, United States
 Indexed to September 2014 (330,000 employees)



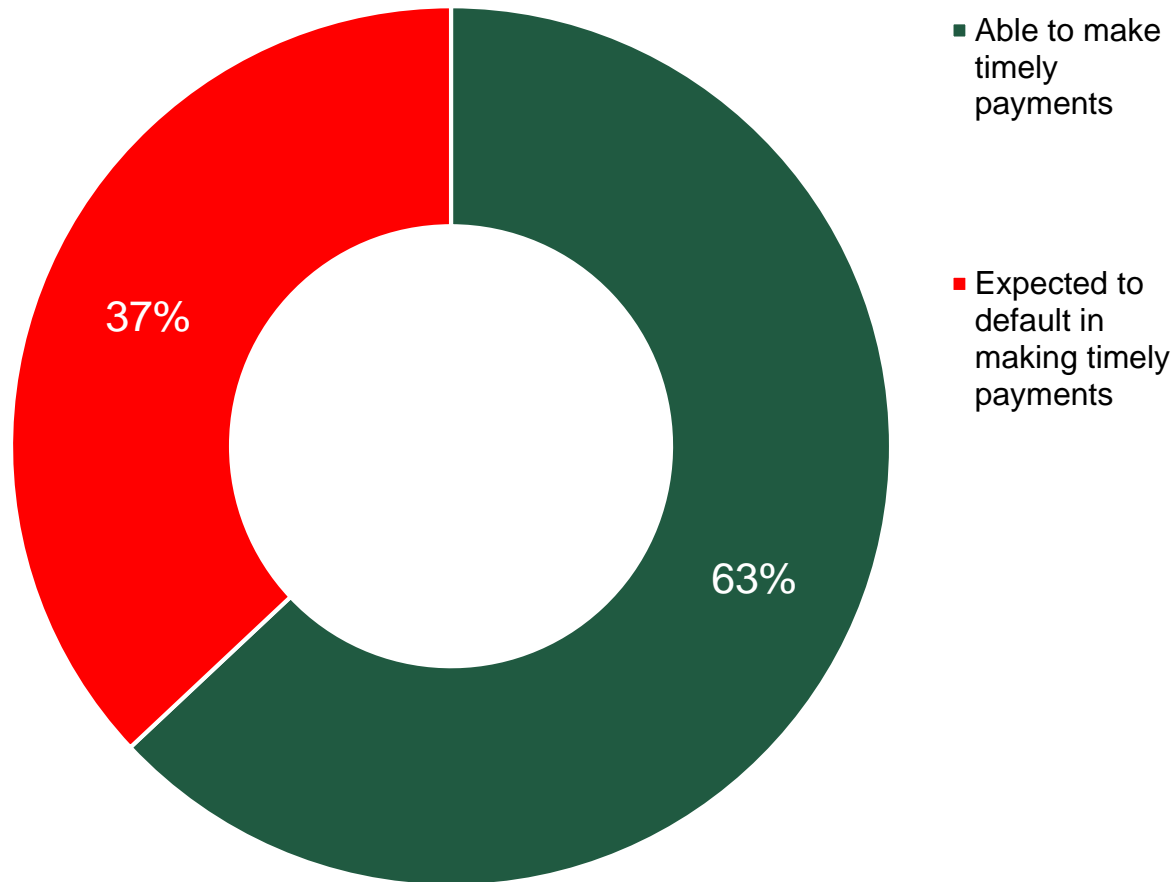
The number of employees in the US oil and gas supply chain dropped as much as 42% from September 2014 to October 2016. Already in 2019, the employee count was coming down as E&P companies within shale started to slow down their investments.

With Brent crude oil prices at \$30 per barrel throughout 2020 and the direct consequences of the Covid-19 outbreak, Rystad Energy expects that the number of employees in these services segments would be lower in December 2020 than it was in 2016, dropping to half of the total number of people employed at the maximum point in 2014.

Source: U.S. Bureau of Labor Statistics

More than one-third of public oilfield service companies might default on debt in 2020

Companies expected to default on interest payments in 2020



Rystad Energy has analyzed 100 listed companies that collectively accounted for nearly 63% of the publicly traded oilfield services equities in 2019. The result is dire news for the OFS providers as we found that more than one in three companies across the service segments will be unable to meet their interest payment obligations on time this year. Offshore drillers and offshore vessel providers in particular will be living on the edge in the coming months.

We have calculated the numbers of companies that are likely to default in payment of interest obligations in 2020 based on cash flows. The estimate is based on reported cash flow from operations and capex of 2019 and interest obligations due in 2020. Based on our analysis, 37 out of the peer group of 100 companies could default this year.

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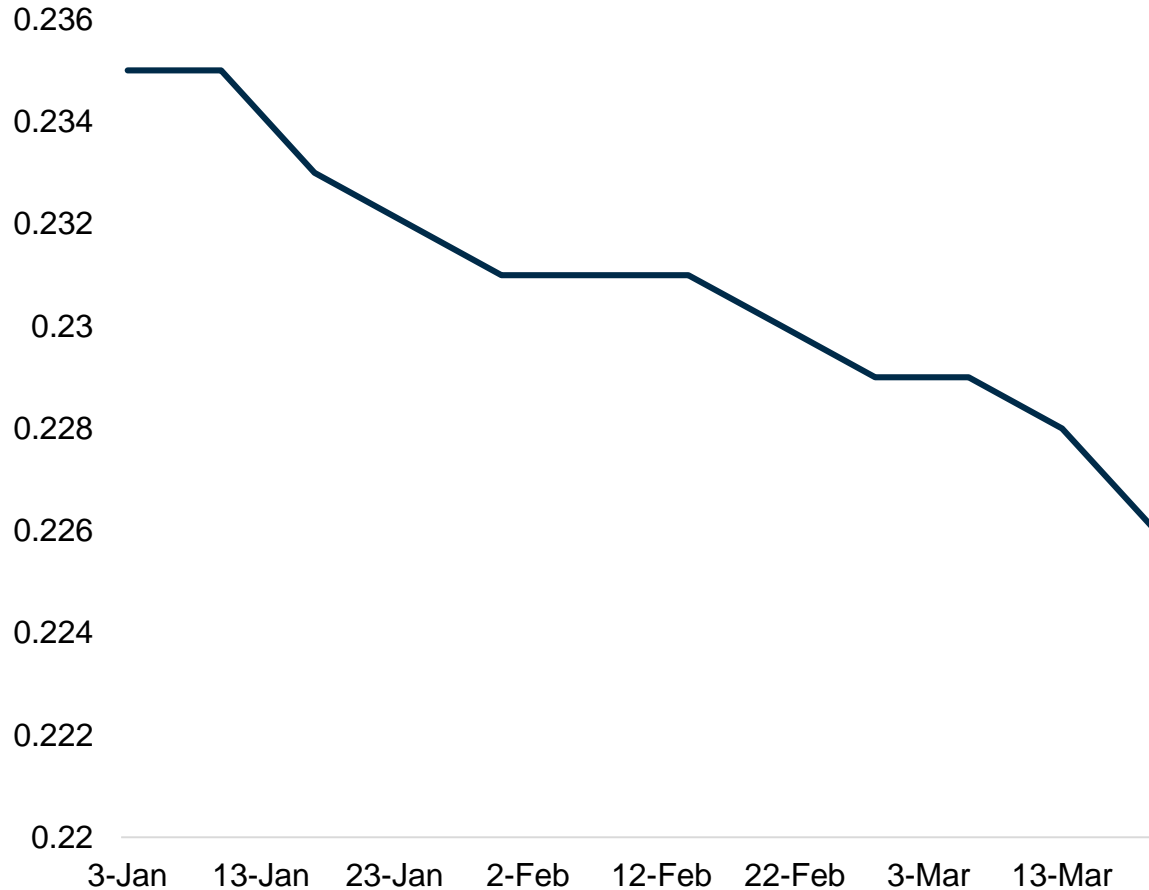
Impact on the oil and gas industry

Impact on the renewable energy industry

Methodology

Renewable projects most impacted will be from emerging markets

Thin film PV module spot price
USD per watt

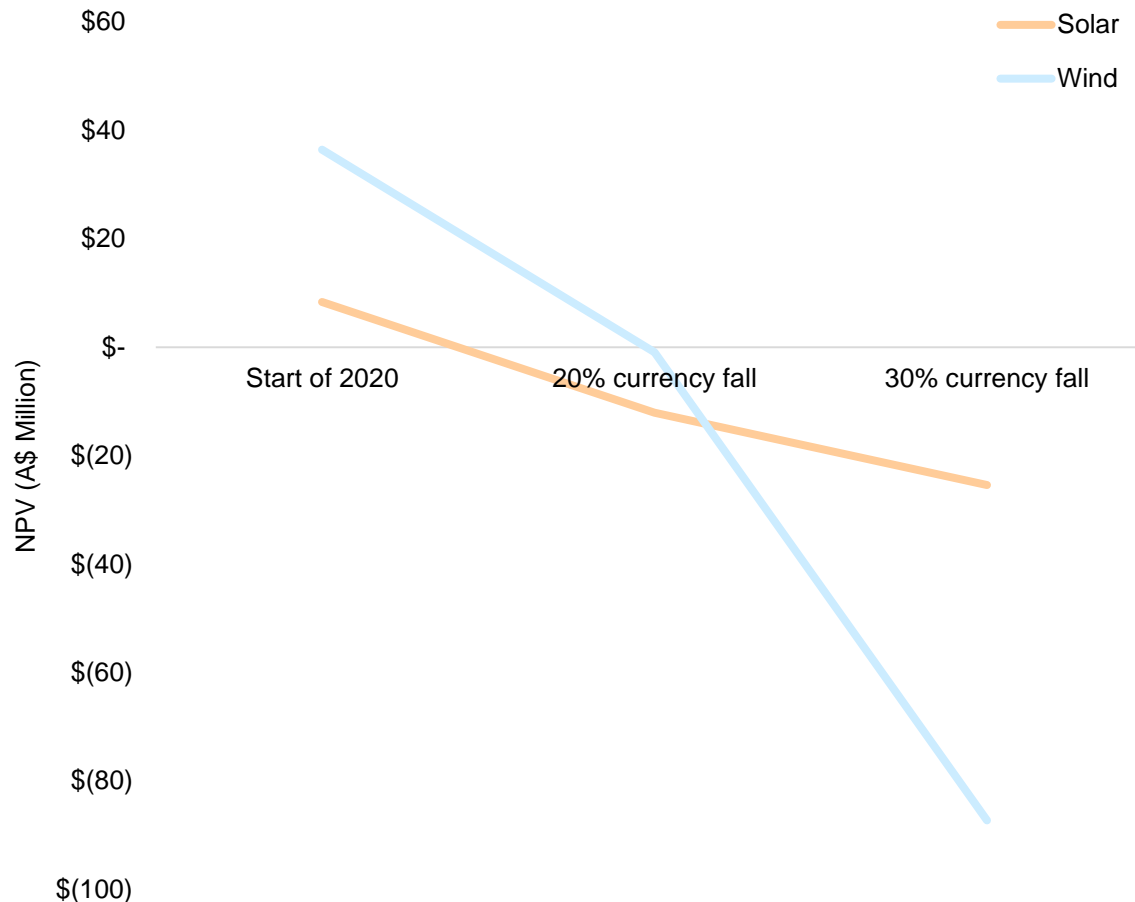


- We expect macro-economic knock on effects will reach into 2021 and beyond, with companies pausing on procuring projects which would have been commissioned in and after 2021.
- Countries most impacted will be from emerging markets in Asia, the Middle East, India and Latin America, where the bulk of solar growth had previously been expected.
- China and the US will be least impacted by exchange fluctuations, and we expect the number of solar installations in these countries to remain fairly stable.
- In Europe, over 20 GW of solar capacity was expected pre-crisis, on par with 2019 levels. However, the Euro's steep slide in recent weeks means that all gains on the US dollar from the beginning of the year have now been lost. Strict travel restrictions implemented across the continent have now halted projects under construction, impacting the movement of workers and suppliers traveling to service sites.
- In Latin America, Mexico and Brazil have the greatest capacity of utility solar PV projects under construction, with over 1 GW of growth for 2020 and 2021. However, both countries are experiencing the steepest currency declines versus the US dollar, falling 30% and 23% respectively. Procurement is expected to come to a complete halt on most – if not all – projects yet to be committed. Projects hoping to be commissioned in 2021 will be significantly slowed or even indefinitely delayed.

Source: Rystad Energy research and analysis; Bloomberg

Impact of currency falls on Net Present Value (NPV)

A\$ million



- The Australian dollar hit a 17 year low this month, as investors seek the traditional safe haven of US dollars. This fall decreases the likelihood that renewable asset components will be procured from abroad in the near term.
- Developers already appear to have cooled on orders that were otherwise imminent. Much of the 2 GW utility PV solar expected to start in 2020 in the country is already built and in the commissioning phase however, and work will continue on these projects; the key determiner of success will be the process of grid connection.
- On the other hand, projects seeking financial close and currently procuring will surely stop, reducing the likelihood that the country will achieve its goal of 1.8 GW of utility solar PV capacity coming online in 2021. Given the longer lead times for wind energy, 4.5 GW of wind turbine capacity is committed and still expected to come online between 2020 and 2021.
- However the 1.5 GW worth of approved projects scheduled for 2022 are at risk of delay. Figures 3 and 4 illustrate the impact of a stronger US dollar on a solar farm with 110 MWac of capacity, and a wind farm with 210 MWac of capacity.
- Within our analysis, both are expected to reach FID this year, and both exhibit negative NPVs at today's exchange rate, compared to pre-crisis, with risks of further decreases. Given this, we feel it is now unlikely we will see a standalone wind farm reach financial close in 2020.

Source: Rystad Energy RenewableCube

*Economics run on a 110 MWac utility solar project and 210 MWac wind farm in Australia, expecting to reach FID in 2020

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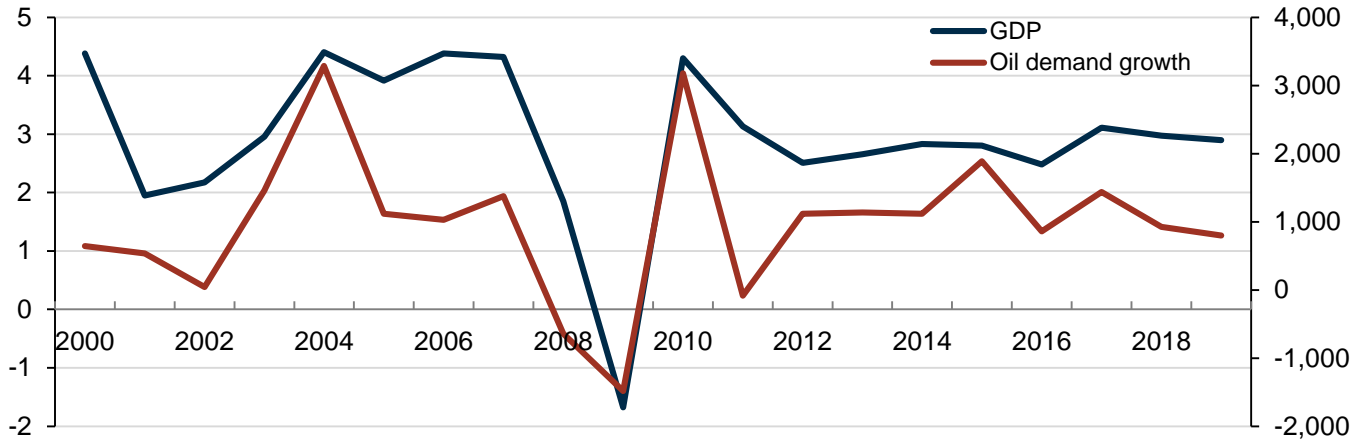
Impact on the renewable energy industry

Methodology

Methodology – Estimating other uses of oil based on economic activity

Global GDP growth possibly contracting by 1%, global oil demand contracting by 4%

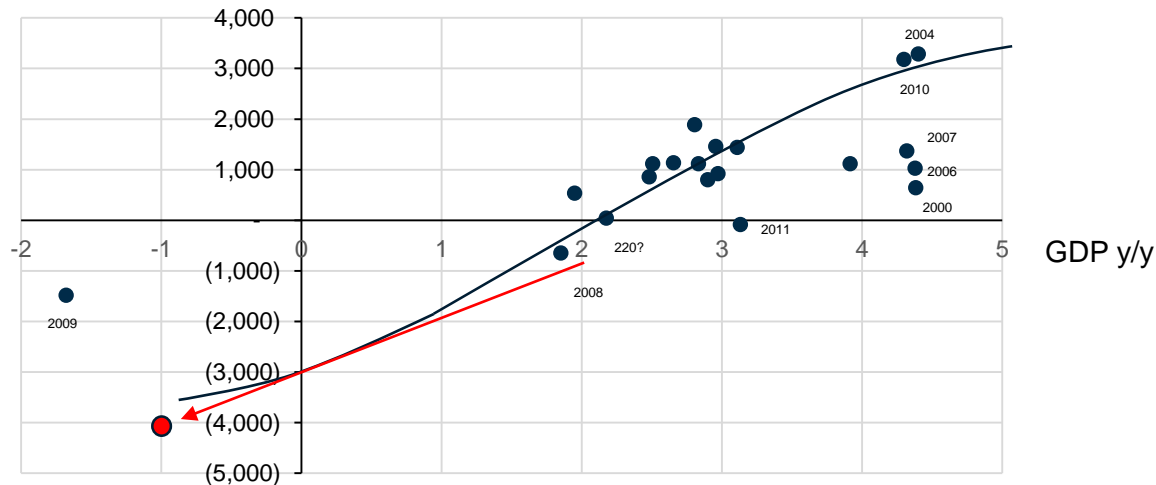
GDP growth (percent, LHS) versus oil demand growth (thousand bpd, RHS) per year



Global oil demand growth is strongly related to GDP growth. The relationship is given by oil demand intensity, which gradually decreases with improved fuel efficiency and – going forward – electric vehicle market penetration. The correlation is not fully linear due to demand elasticities.

Our research indicates that pre-virus global oil demand in 2020 would be flat if GDP growth was to slow down to 2% (IMF: “global recession”), while oil demand growth would be 1 million bpd if global GDP was to expand by 3%.

GDP growth (x-axis, percent) versus oil demand growth (y-axis, thousand bpd) per year 2000–2019



However, based on the latest reporting on the spread of Covid-19 and the state of the stock markets, some macro analysts now see global GDP contracting.

Our latest estimate for a global oil demand contraction of 4 million barrels per day is in line with this empiric model of correlation between oil demand and GDP.

Source: Rystad Energy research and analysis

Methodology

Scenario definitions

This regular report addresses the novel coronavirus situation through three possible scenarios, hinging upon one key factor – the probability of transmitting the virus between individuals. This can be understood as the number of interactions per person per day over a given time frame, multiplied by the probability that each contact will transmit the virus to the other persons. We assume a basic reproduction number of 2.1, meaning that one infected individual will pass novel coronavirus, or Covid-19, to 4% of the 10 people they interact with over the course of one day. We also assume this will occur over 5.2 days, until they are aware they have become infected and change their behavior.

The precise virility of Covid-19 remains unclear, subject to a variety of as-yet-unknown variables. Nevertheless, if the virus behaves similarly to its cousin influenza A, we can assume that warmer weather will reduce the rate of transmission. This possible “spring effect” however seems less likely based on data this week, as many warm countries see strong growth of Covid-19.

The **Effective Prevention** Scenario plots the spread of Covid-19 under the assumption that drastic social distancing measures are taken, which are considered to be a strict and lasting quarantines. This scenario will suppress the virus, but could be in conflict with maintaining vital functions in society as well as human rights, as free movement is very limited.

The **“Manage the virus”** Scenario still exhibits strong social distancing regulations, but is somewhat less strict than the Effective Prevention Scenario. In this scenario, governments no longer aim to stop the virus completely, but are focused on managing the rate of infection to prevent overloading Intensive Care capacity.

We considers “quarantines” to mean social distancing measures that reduce contact rates to 1 or below, low enough to completely control the spread of Covid-19.

- **Red tones**
 - Includes those that understand they are infected and/or behave as if they were infected. This group complies with preventative measures and exhibit low transmissibility once diagnosed.
- **Blue tones**
 - Includes those who do not understand they are infected or do not behave as if they were infected. This group does not comply with preventative measures and exhibit high transmissibility if infected.
- **Hospital treatment and critical**
 - Those who are admitted to a hospital for treatment, including fatalities.
- **Minor symptoms**
 - Those who either have been diagnosed, or suspect they may be infected and behave accordingly
- **Reported recovered**
 - Those who have recovered after a known infection
- **Infected, undiagnosed**
 - Those who are infected but have not been diagnosed and do not behave as if they were infected
- **Recovered, undiagnosed**
 - Those who have recovered without ever realizing they were infected.
- **Reported cases**
 - Official reported cases of Covid-19 infection

The drivers behind our new model for global automatic history matching

Reported numbers of infected people are not reliable numbers, as countries have very different practices for the testing and reporting of Covid-19 cases.

Reported figures for deaths due to Covid-19 are more reliable, even if some cases may be miscounted, for example elderly individuals who expire outside of the hospital setting. Thus, we utilize fatalities as the most important number for calibration in our models. As recent new articles have suggested, we know that the average time from onset to death is 17.8 days (Variety et. al.) and that the average Infection Fatality Rate (IFR) is 0.66% for an average population. Ferguson et. al. has used an IFR of 0.9% for the British population, after adjusting for demographics. In our models, Rystad Energy has used the average global number of 0.66% IFR with 18 days as the time from onset to death. This means that for every new death, in the model we assume 150 additional infected people, who contracted the virus 18 days prior.

The second most important calibration metric is the number of people in Intensive Care Unit (ICU) beds within hospitals. According to the Norwegian Institute of Public Health (FHI), 0.25% of Covid-19 patients will be in need of intensive care treatment 12 days after onset. Ferguson et. al. used 1.32% for the *British population*, and calculated that this percentage of the population would require treatment beginning 16 days after being infected (This considers that 4.4% of infected will be hospitalized and 30% of those in ICU beds. The time estimated in an ICU bed is 10 days, after 6 days in regular hospital bed, and after 5 days of being ill before hospitalization, and an incubation time of 5.1 days).

For a global population, we initially assumed 0.25% of those infected would need an ICU bed. However, after calibrating with global data for 74 countries up to 23 March, we have adjusted this factor to 0.50% (see next page). This means that for each *new* person entering an ICU bed, 200 people have been infected over the 12 previous days.

Thus, the automatic calibration and calculation of the current and future number of cases works as follows:

- *If fatalities have occurred and ICU beds are used*, we find the number of infected people 18 days prior based on the total number of fatalities. We then “grow” this figure according to contact rate (CR); we assume a CR of 10 or fewer if quarantine/social distance measures are put in place. We also apply transmissibility (4%) and the number of days individuals are within the infectious stage (7 days). However, we adjust the growth according to actual ICU bed utilization as well, first by taking a weighted average of the model for fatalities (weight 4 of 5) and ICU beds (weight 1 of 5). Then, for the next six days with only ICU beds as indicators (days 17 to 12 previous to today). We then use the number of occupied ICU beds to adjust growth up or down versus results using assumed contact rate only. Then from day 11 until today, we use the largest of “absolute growth in reported figures” and “growth based on CR” .
- *If fatalities have occurred, but no ICU beds are in use*, we follow the methodology above, except we do not adjust recent growth based on ICU bed occupancy.
- *If no fatalities, but ICU beds are in use*, we use the model for total infected population until 12 days ago based on “200 new infected per 1 new ICU bed occupant”. For the recent 11 days, we use the largest of “absolute growth in reported figures” and “growth based on CR”.
- *If no fatalities and no ICU beds are in use*, we use reported figures, adjusted for typical underreporting based on the calibration of reported figures versus the actual figures for countries that have both fatalities, ICU bed use and reported figures. For many new countries this could be 1:20, i.e. 5% is reported, but figures vary from 1% to 50% being reported.

Calibrating ICU bed method and fatality method

As described on the previous page, 74 countries in total have experienced both fatalities and the use of ICU beds up until 23 March.

This allows us to calibrate the parameters used in the model. Originally we used figures from the Norwegian Institute of Public Health (FHI), which stated that 0.25% of all infected cases will need intensive care. However, after calibrating these figures with the reported number of fatality, we have concluded to change this metric and have used the following figures:

- 200 infected 12 days before admittance per 1 new ICU bed in use. Also, we assume half of fatalities occur after being in an ICU bed.
- 152 infected per fatality 18 days before death (0.66% fatality rate)

As seen, with these parameters the model fits well for many countries. At first sight, one could argue that the ICU formula somewhat underestimates the infected cases, especially for Italy and Spain, and some other European countries. For France, South Korea, Japan, Denmark and Portugal however, the figures seems to be very well calibrated.

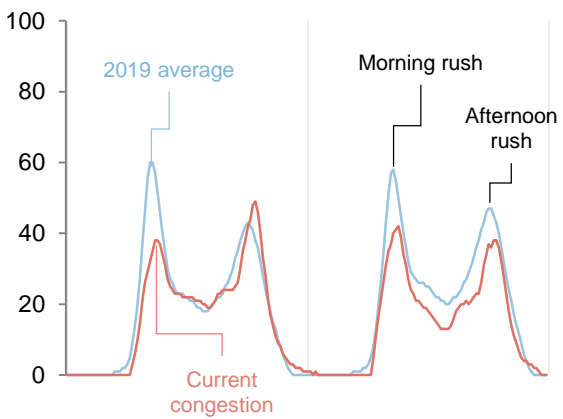
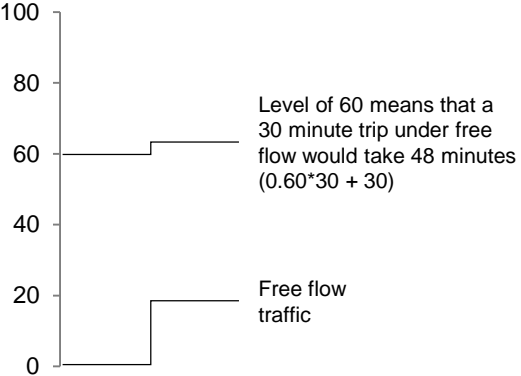
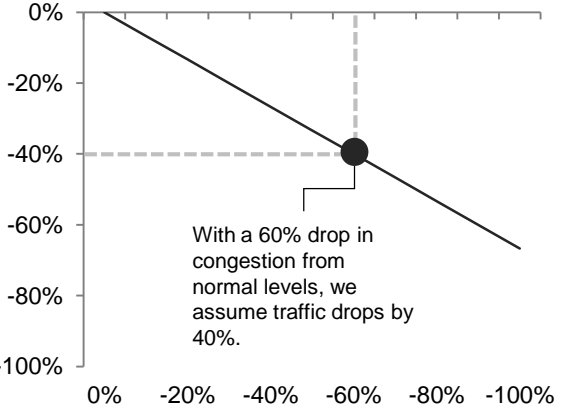
We believe that the reason for the deviation in the cases of Spain and Italy is the lack of access to a sufficient number of ICU beds. Thus, if more beds were available in the right city/region, more beds would have been in use. For some other European countries, we have just recently seen a ramp-up of cases, and we expect ICU beds to be filled in a few days; it is still too early to expect a good match.

For China, it would be relevant to look at the status during the same growth phase in January, but reliable figures for ICU bed usage during that period have not been available to us, thus China is omitted.

Country	Calculated 5 March infected base based on critical care 17 March	Calculated 5 March infected base based on fatalities as of 23 March	ICU method versus fatality model
Italy	586 833	920 758	64 %
Spain	157 200	350 152	45 %
Iran	90 000	274 545	33 %
France	131 400	130 303	101 %
United States	52 793	82 576	64 %
United Kingdom	11 133	50 758	22 %
Netherlands	12 967	32 273	40 %
Germany	2 667	18 636	14 %
Switzerland	2 400	18 182	13 %
South Korea	14 667	16 818	87 %
Belgium	7 600	13 333	57 %
Indonesia	967	7 424	13 %
Japan	5 067	6 364	80 %
Turkey	67	5 606	1 %
Brazil	2 667	5 152	52 %
Philippines	1 467	5 000	29 %
Sweden	1 867	3 788	49 %
Denmark	3 867	3 636	106 %
Portugal	3 733	3 485	107 %
Iraq	967	3 485	28 %
Canada	700	3 485	20 %
Austria	2 700	3 182	85 %
San Marino	2 733	3 030	90 %
Egypt	400	2 879	14 %
Ecuador	433	2 727	16 %
Greece	2 000	2 576	78 %
Algeria	533	2 576	21 %
Malaysia	2 400	2 121	113 %
Norway	5 800	1 515	383 %
India	267	1 515	18 %
Luxembourg	1 567	1 212	129 %
Poland	1 067	1 212	88 %
Other 41 countries	17 400	19 242	90 %
Total	1 128 327	1 999 545	56 %

Source: Rystad Energy Covid-19 global model. Raw data from Worldometer as of March 23rd.

Calculating the impact on global oil demand – Ground transportation

Data	Interpretation	Impact on oil demand
<p>TomTom Traffic Index levels over two days</p>  <p>The TomTom Traffic Index measures real-time congestion through data points from over 600 million drivers spread across the world.</p>	<p>Interpretation of values along the index</p>  <p>The index ranges from 0 to 100, where 0 represents a traffic level with no congestion.</p>	<p>Relationship between congestion and traffic</p>  <p>To translate these numbers into oil demand, we compute reductions in live traffic relative to historical averages and assume that free flow traffic occurs when one-third of the traffic is active.</p> <p>We also consider that this applies to LDV traffic only. HDV fuel consumption, which is about one-third of total road fuel demand, is more closely tied to overall economic activity.</p>

Source: TomTom Traffic Index; Rystad Energy research and analysis

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RYSTAD ENERGY

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