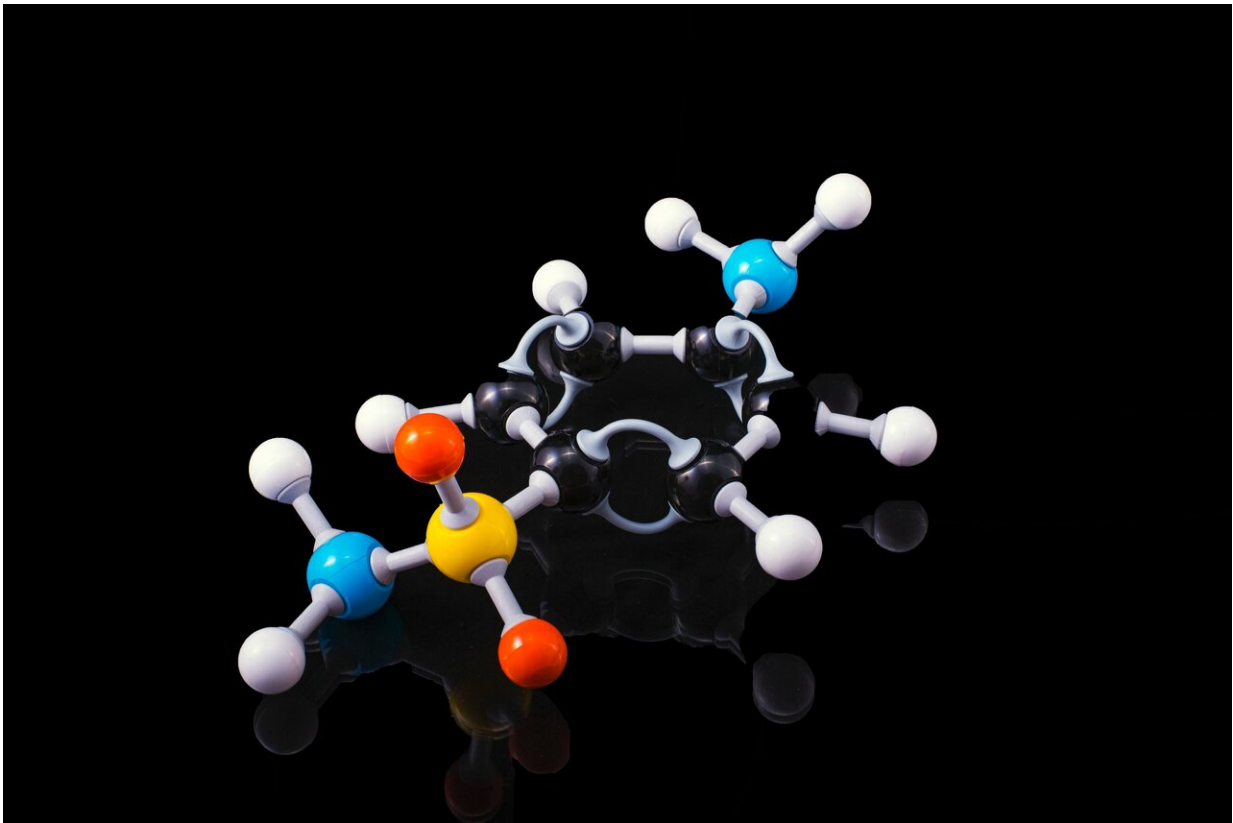


# Norway is going to invest in hydrogen: What happens when there's a gas leak?

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Credit: Unsplash/CC0 Public Domain

Hydrogen is an attractive alternative to fossil fuels, especially for powering trucks, ships and planes, where using batteries isn't so easy.

Batteries quickly become too large and heavy if these large transport vessels and vehicles are going to travel far.

As a result, hydrogen is being discussed like never before. Both Norway and the EU have said they will invest more in hydrogen in the years ahead.

But a lot needs to happen before hydrogen actually becomes climate-friendly. And it's not just about how hydrogen is made, which is one of the challenges the Norwegian government highlighted in its Hydrogen Strategy released in the summer of 2020.

One thing that is rarely discussed is the [hydrogen gas](#) itself. What happens when it leaks into the surroundings?

Researchers at Cicero, the Center for International Climate and Environmental Research in Oslo, are in the process of finding the answers to these and other questions about hydrogen in a new research project.

## **The world's lightest gas**

"It's important that we be aware of the effects that hydrogen can have on the climate and environment, before we start with large-scale production and use. That way, we can avoid making the same mistake as we did when we started using chlorofluorocarbon gases, which would later prove damaging to the [ozone layer](#)," said Maria Sand, a Cicero researcher who is leading the new project.

Some of the hydrogen will inevitably leak out during production, transport, storage and use.

"Hydrogen is the lightest gas in the world, so it's impossible to prevent

leaks," she says.

## **May affect the big picture**

This concept is probably new to many, including politicians and scientists.

"People often think that there are zero emissions from hydrogen, since it is not a greenhouse gas," Sand said.

Hydrogen does not on its own trap heat inside the atmosphere the way that CO<sub>2</sub> and other greenhouse gases do.

But hydrogen can still affect the big picture. At least in theory.

## **Will calculate the effect with climate models**

Researchers at Cicero started the new project in collaboration with both industry and several international research groups.

Sand says when she and her colleagues first began to examine the issue, she was surprised by what they found. The existing studies suggest that hydrogen emissions could have a negative effect.

"Even though hydrogen is not a greenhouse gas, it can affect the composition of the atmosphere," she says.

But the extent to which this is happening—or could—is still uncertain.

"We don't know if the effect is large, but we also don't know if it's small either," Sand said.

So researchers at Cicero reached out to other scientists who have studied the issue in the US and Europe, so they could collectively put their heads together.

The plan is to calculate the answers using five different climate models. They will also use real measurements of hydrogen in the atmosphere to check if their calculations are correct.

## **The ozone layer can be damaged**

The researchers will look at a range of possible effects.

The first is that hydrogen can potentially damage the ozone layer.

The gas can cause beautiful clouds to form in the sky. But the explanation for why the clouds form is not so beautiful.

When hydrogen is released into the air, it is often converted to water. This can happen high in the stratosphere, where the ozone layer is.

"The ozone layer is very dry, but some reactions with hydrogen cause can water vapor to form there," Sand says.

This is not good news for ozone.

What happens is the same as when the weather is very cold, which can cause pearlescent clouds to form in the sky.

These colorful clouds are actually evidence that the ozone layer is being broken down.

## **More methane in the atmosphere**

More hydrogen can also—indirectly—give us more methane in the atmosphere. And methane is a potent greenhouse gas.

The explanation for how this can happen revolves around a substance called hydroxide.

This substance usually acts as a kind of drain that removes methane from the atmosphere. However, if hydrogen is present, the process can be disrupted.

"The hydroxide vacuums up methane from the atmosphere, but it also removes hydrogen. So then the hydrogen starts to compete with the methane," Sand said.

## **Amplifying effects**

All told, several different chemical reactions can affect both the climate and the environment.

"It's not just a matter of adding the various contributions together, because everything is connected to everything and reactions can reinforce each other," says Sand.

The climate models that the researchers will use are called chemical models, which take into account the different chemical reactions that take place in the air above us.

## **A welcome research project**

Steffen Møller-Holst has worked with hydrogen technology for 30 years, previously as a researcher and the last ten years as marketing director at SINTEF, Scandinavia's largest independent research institute.

He says he would be surprised if hydrogen emissions have a significant negative effect on the climate, but that he welcomes the research project and is curious about the results.

"It's important to figure this out. If there are major effects, we definitely need to know," Møller-Holst said.

At the same time, he points to some other challenges that must also be addressed before hydrogen can become a real low-emission technology.

## **Fossil energy the main source**

The least climate friendly aspect of hydrogen right now is how it is produced.

"Most of the hydrogen today is produced from [fossil energy](#), such as coal, oil or natural gas, which produces CO<sub>2</sub> emissions," Møller-Holst said.

This is also one of the reasons why Norway has a good starting point for producing hydrogen.

Norway has access to lots of green power, such as hydropower. Eventually this will be augmented by power from the wind and sun.

## **Water as the by-product**

The energy from waterfalls, sun or wind, can turn water into hydrogen. In theory, the only thing that is released is oxygen.

This method is called water electrolysis and has been labeled "green hydrogen."

When the hydrogen is to be used as fuel, for example in a truck, the process goes in the opposite direction.

Then the truck sucks in oxygen from the air, which together with the hydrogen drives the engine. The only emissions, in theory anyway, are pure water.

## **Sun and wind fall in price**

Hydrogen from [renewable energy](#) has been too expensive in recent years for companies to use this most climate-friendly solution.

But now that both solar and wind power are falling in price, more people are switching to making "green" hydrogen, Møller-Holst said.

"Yara has recently said they will return to using renewable sources," he says.

Yara is a Norwegian company that makes fertilizer. For many years, company engineers have made hydrogen to make artificial fertilizer.

They initially used hydropower for this process, but during the 1960s they gradually switched to using natural gas because it was cheaper, Møller-Holst said.

## **Natural gas with carbon capture**

The Norwegian government has also committed to investing in hydrogen production with natural gas, of which the country has ample amounts from its oil industry.

But then the technology will be combined with carbon capture and

storage, to make it more climate-friendly. This is often called "blue hydrogen."

Møller-Holst believes that hydrogen made this way can play an important role in Europe, as countries shift to becoming carbon-free.

On the other hand, there could be a financial risk to investing large sums in carbon capture and storage, he said.

When Europe prioritizes producing hydrogen from renewable sources, this can lead to a gradual decline in demand for "blue" hydrogen, he said.

## **Low efficiency less important**

But there is also another valid critique of hydrogen.

The problem is that much of the energy that goes into making it is lost along the way. In other words, the technology has a relatively low efficiency.

Møller-Holst believes that efficiency will be less and less important.

As the world moves to make hydrogen with renewable energy, he says, energy consumption will no longer lead to more emissions.

"Solar cells have an efficiency of 20–25 percent. No one is upset and says that we should stop using solar cells because the efficiency is so poor," he said.

So even though hydrogen has not yet become climate-friendly, the marketing director believes it is important that Norway doesn't sit on the fence.



"Since we know that we need hydrogen to reach [zero emissions](#) in 2050, we are doing ourselves a disservice if we don't invest now," he says.

## Expect results in 2022

But this calculation does not include hydrogen emissions that come from natural sources. So far, scientists don't know enough about what effect they will have.

The Cicero researchers behind the new project think their first results will be available in 2022.

Sand believes that [hydrogen](#) will be the best option in some cases.

"Not everything can be electrified, such as long-distance transport and heavy transport. Hydrogen can play an important role there. But it always depends on what it replaces," Sand said.

Provided by ScienceNordic

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