Blue Hydrogen would enable us to capture 60% of this CO2 with the current market standards (and 90% with more advanced technologies)

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CO2
CO2
CO2
CO2
CO2

This adds 1-3€ per kilogram to your hydrogen production costs, knowing that today's gray Hydrogen costs 1.5-3€ per kilogram.

So, switching from Gray to Blue would double the price tag.

And that's not the only issue:

Today's carbon capture processes involve methane leakages, and Methane on a 20-year time horizon has 86 times the global warming potential CO2! So this Blue Hydrogen is Blackish.

Hence, if Blue isn't really a solution, what color shall we turn to?

Zero emissions can be done by replacing natural gas with biomethane, which has a zero carbon footprint...

That's, for instance, the case with Turquoise, (as we'll see in-depth next week)

... alternatively, you can leverage renewable electricity to run electrolysis of Water and produce green Hydrogen!

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Remember? That's the Hydrogen I was referring to, talking of Germany's excess wind power during nights.

... and that's also the Hydrogen we're mostly looking at, as water professionals, as it requires large amounts of very clean Water.

How much Water, exactly?

For one kilogram of Hydrogen, you need nine kilograms of Water, and the Water has to be pure.

So to decarbonize 90 million tons of gray Hydrogen, we'll need

810 million tons of Water

(aka, cubic meters).

If we factor in the water needs of the cooling process, that roughly multiplies the figure by ten, reaching

9,180 million cubic meters.

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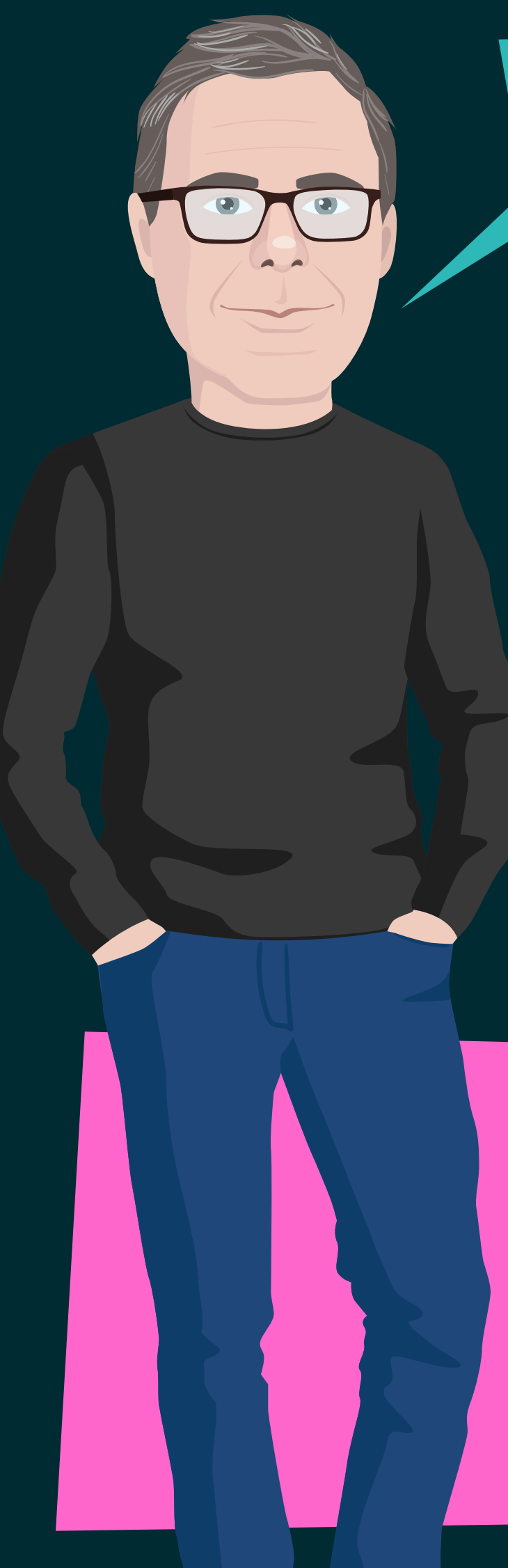
That may sound huge, but compared to the World's projected 6,900 billion m^3 water abstractions in 2030, this isn't very important: we're talking of 0.13% of the World's water use.

Still, that's only true if we're making this Green Hydrogen out of renewable energy.



To make a kilogram of green Hydrogen requires 50-65 kWh of energy. Producing this through a thermal power plant would require orders of magnitude more Water than nine kilograms!

Actually, a study by Michael Webber estimates that order of magnitude at 4,200 kilogram of Water per kilogram of Hydrogen.

1 kg Hydrogen

4,200 kg Water

That would now represent 5.5% of the World's water abstractions, which would hardly be sustainable.

So, if green Hydrogen has to be done from renewables, how much of the World's capacity would that gobble?

To make 90 million per year using the best electrolyzer in the World, you would need 4,500 terawatt-hours of electricity. In 2019, all the wind and solar in the whole World added up to only 2,100 TWh!

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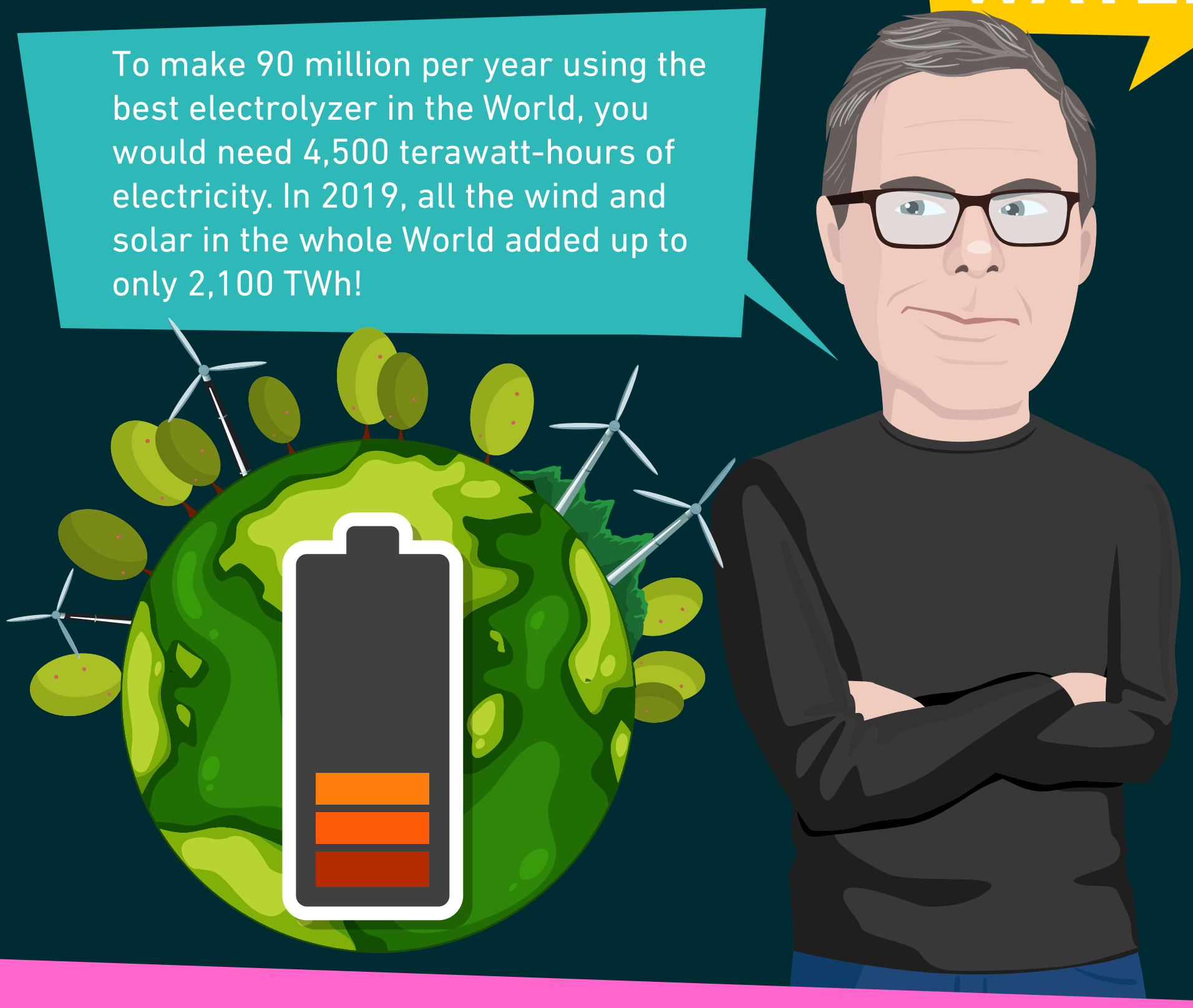

That may still not be the strongest limiting factor. As BlueTech Research underlines in their hydrogen economy insider report, Green Hydrogen costs 5-7 times more than Gray Hydrogen.

So, on the flip side, it's carbon neutral.

But on the downside, it may be costly in Water if not done from renewables; the renewables installed base is far from being sufficient, and it's expensive.

End of the story?

When you double the cumulated production capacity, the price drops by a percentage. For wind and solar, it was around 30%, for Hydrogen, it is supposed to be between 10 and 17%.

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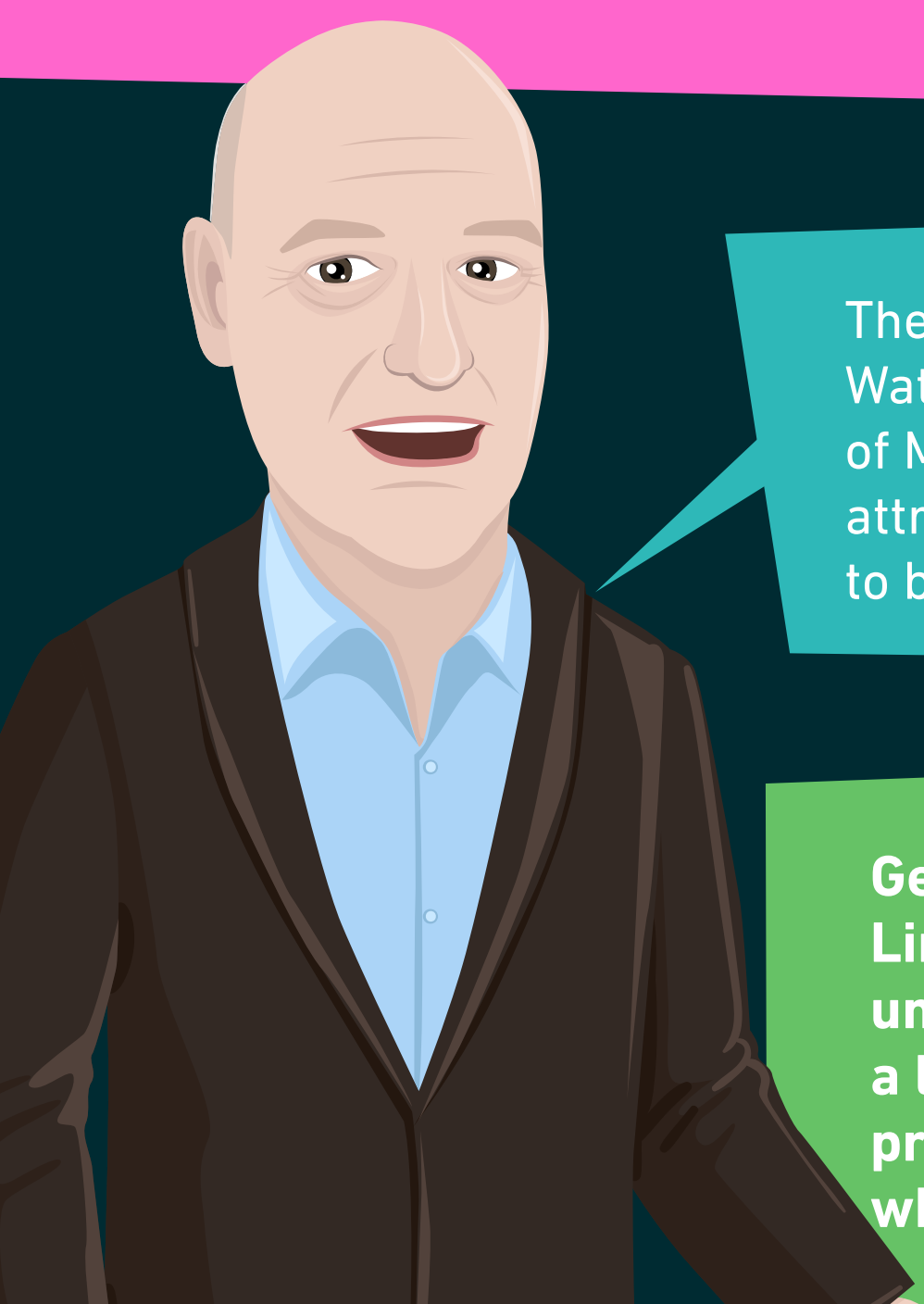
So there are scale effects to expect! However:

We're more earnest in desiring decarbonization, and renewable electricity is getting cheaper and cheaper. Yet, in terms of thermodynamics, nothing's changed!

Hence, there's a limit as to how low the price can go, and that limit has much to do with the nature of the electrolysis process itself.



The hydrogen-oxygen double bond of Water, as opposed to the single bond of Methane, has an incredibly strong attraction and takes a lot more energy to break.

Geoff Ward is the CEO of Hazer Group Limited, a pioneering company undertaking the commercialization of a low-emission hydrogen and graphite production process - more to that when we tackle Turquoise Hydrogen.

But back to my question:

Is that the end of the story for Green Hydrogen?

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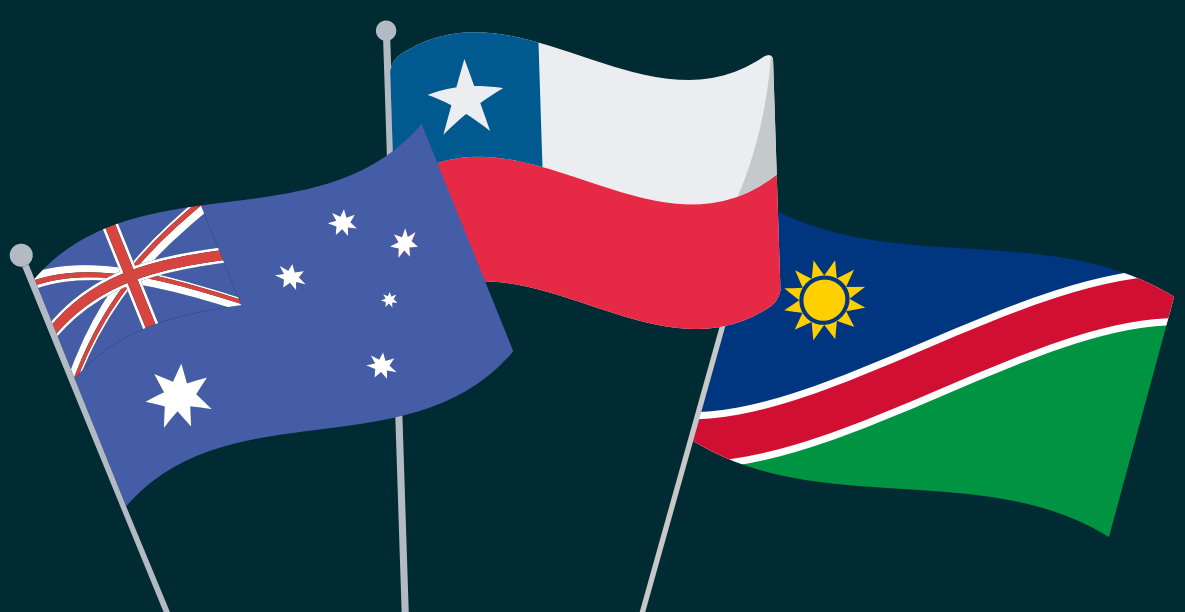
That's where our Hydrogen guides disagree the most.

For Paul Martin, to minimize the extra cost associated with Green Hydrogen as a necessary evil to wipe out gray Hydrogen, some areas shall specialize in producing it.

You need a desert with an ocean to the west. So you get a high capacity solar factor, and every night the land cools down and triggers strong winds.

This provides you with a good potential for renewable energy, while the ocean also serves as a water source through desalination.



This is a major opportunity for places like Western Australia, Chile, or maybe Namibia!

But whenever we start thinking of using that green Hydrogen for anything else than replacement of the gray one, Paul is adamant:

Hydrogen is amazing, but it's just a tool that needs to be used for the right purposes, and burning it as fuel is not the right purpose for it.

An opinion he supports with hard facts, ranging from the low power density of Hydrogen to the cost we already discussed through the narrow path to scale.

That's where Alena Fargere disagrees:

You can make a lot of things with Hydrogen! You can power cars, buses, trucks, trains, planes, boats...

There's even a section of that market where Hydrogen is cost-competitive:

the Forklifts.

The Idea in the mobility scenario is to cover the long distances that may be problematic for batteries.

But that's not the only perk:

With two technologies (electricity and Hydrogen), you can do more than with only one. You become more cost-efficient if you decrease the 100% electric vehicles scenario and add 10% of hydrogen fuel cells!

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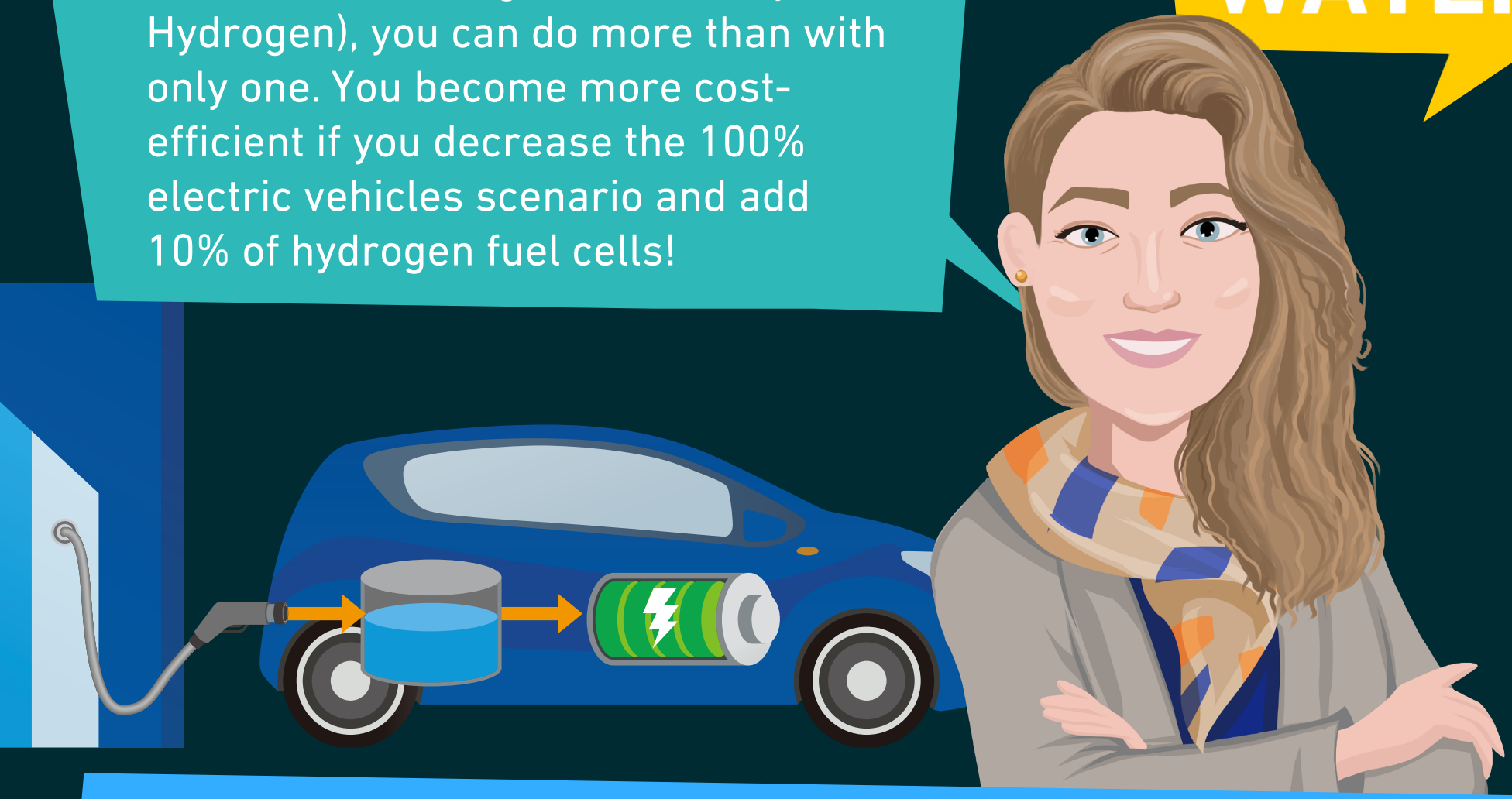


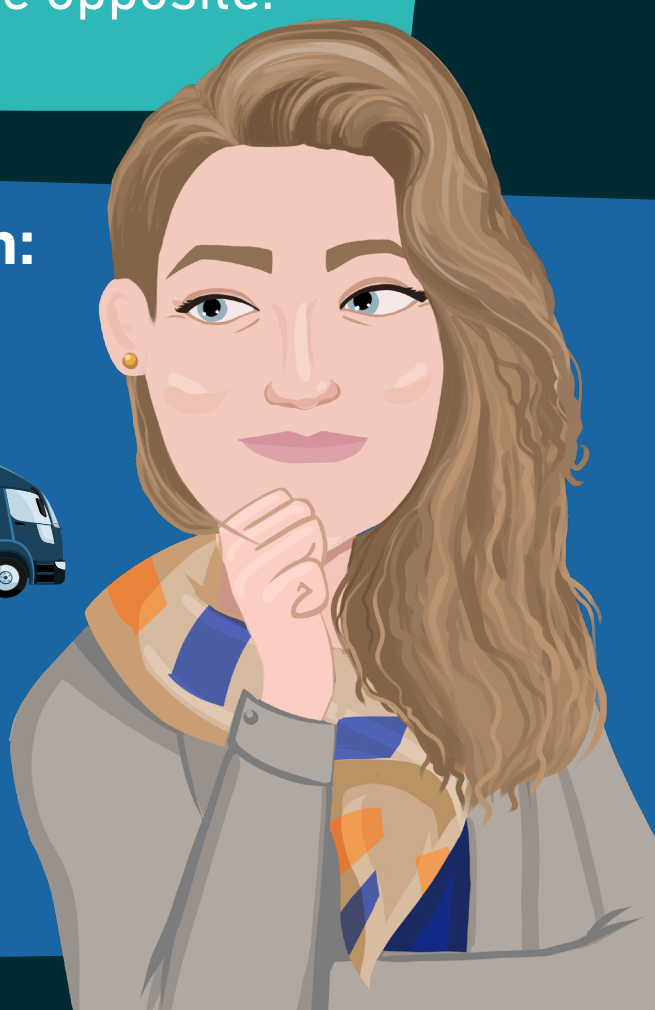
The Idea is that the last percentages (from 90 to 100% electric vehicles) involve expensive investments and grid reinforcements to cover the peaks - something hydrogen fuel cells would flatten out.

Yet, as BlueTech reports, large-scale Hydrogen mobility programs such as Volvo Trucks' one have recently been stopped.

There is a path to scale for batteries, for Hydrogen it's quite the opposite.

Alena sees further uses of Hydrogen, though:

Green Hydrogen can replace the Gray one in the industry and replace some other carbon-based fuels.



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To be continued...