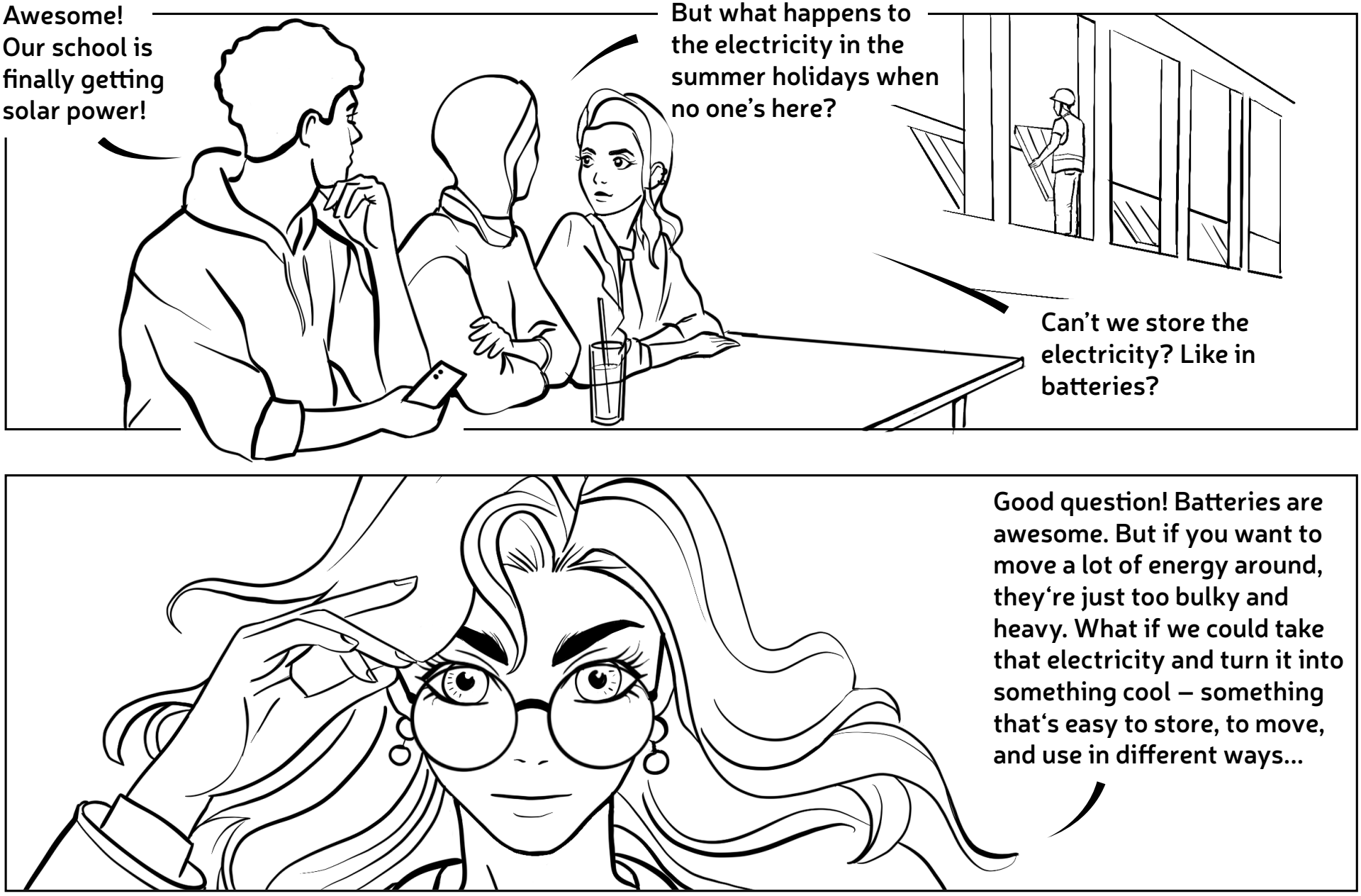

Electra and
THE SECRET
SUPERPOWER
OF WATER

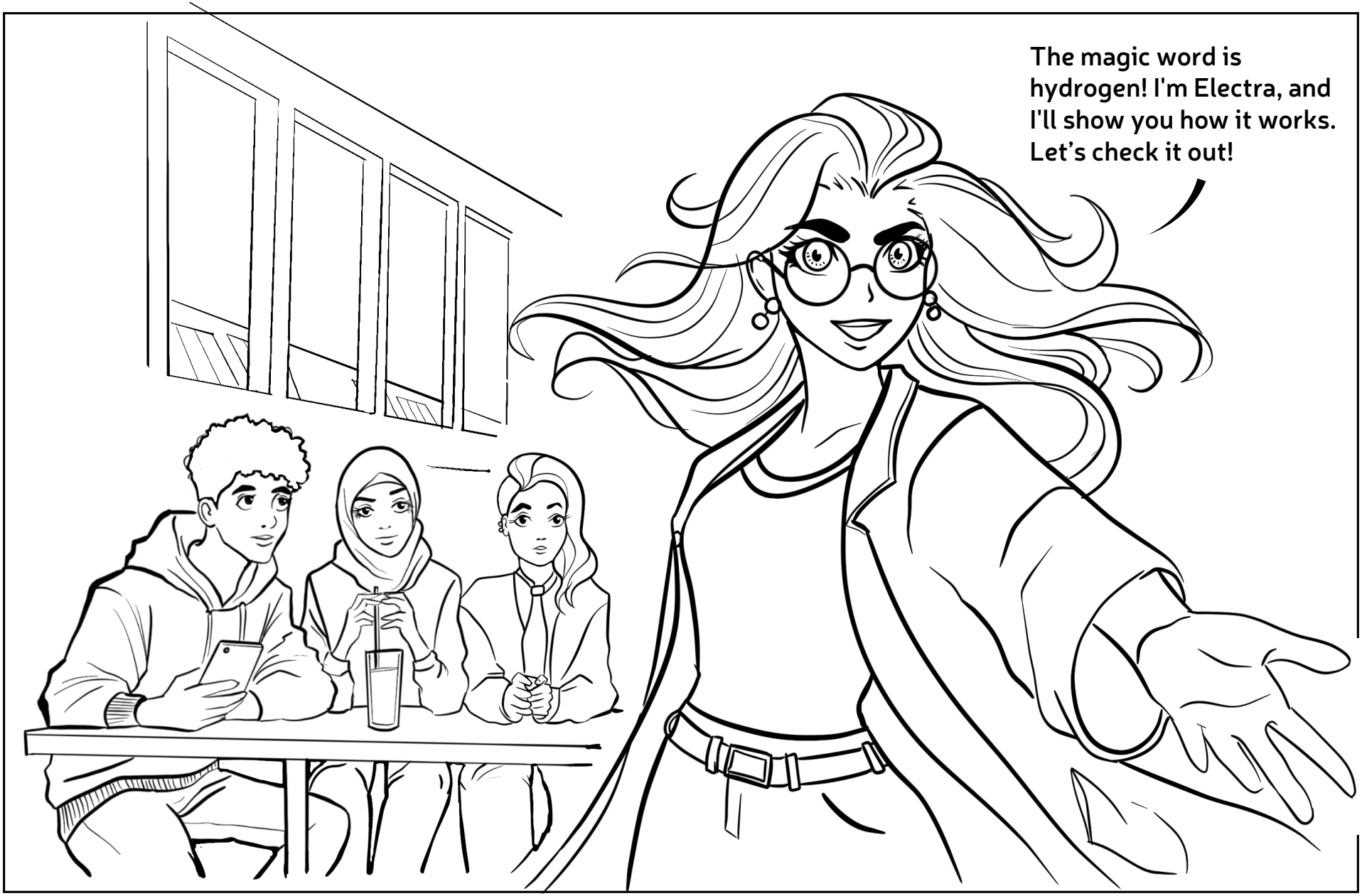
Foreword

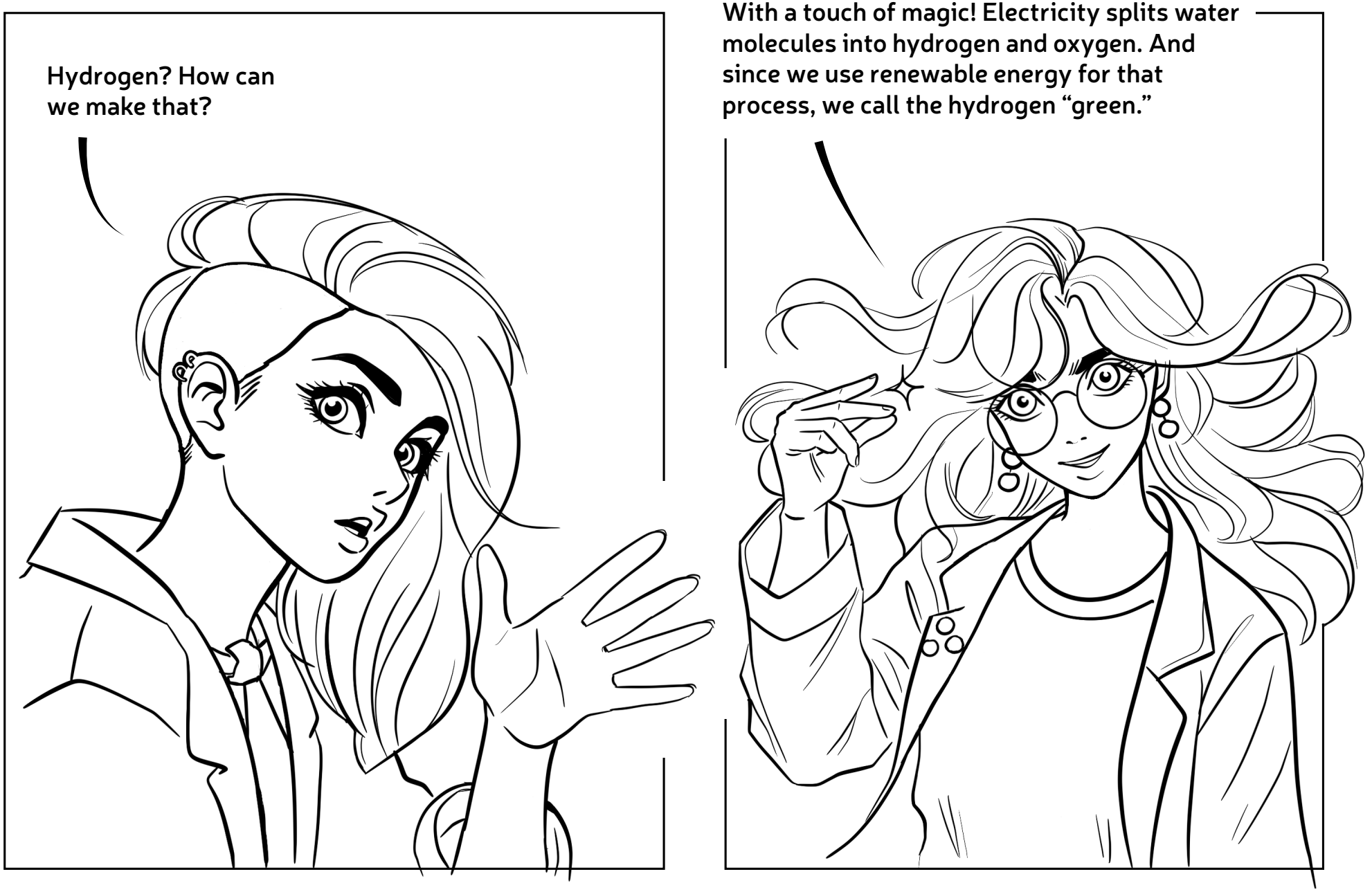
Hello, young explorers,
Welcome to the world of Electra – the clever, strong superhero with a very special mission! She's here to show you how hydrogen – more specifically, green hydrogen – is made, transported, and how it can provide us with clean energy in the future.
Hydrogen is a fascinating gas – it's invisible, super light, and the most common element in the universe. In this colouring book, Electra takes you on an exciting journey into the world of hydrogen. You'll find out why hydrogen plays such an important role in the energy transition – and how it can help protect our climate.

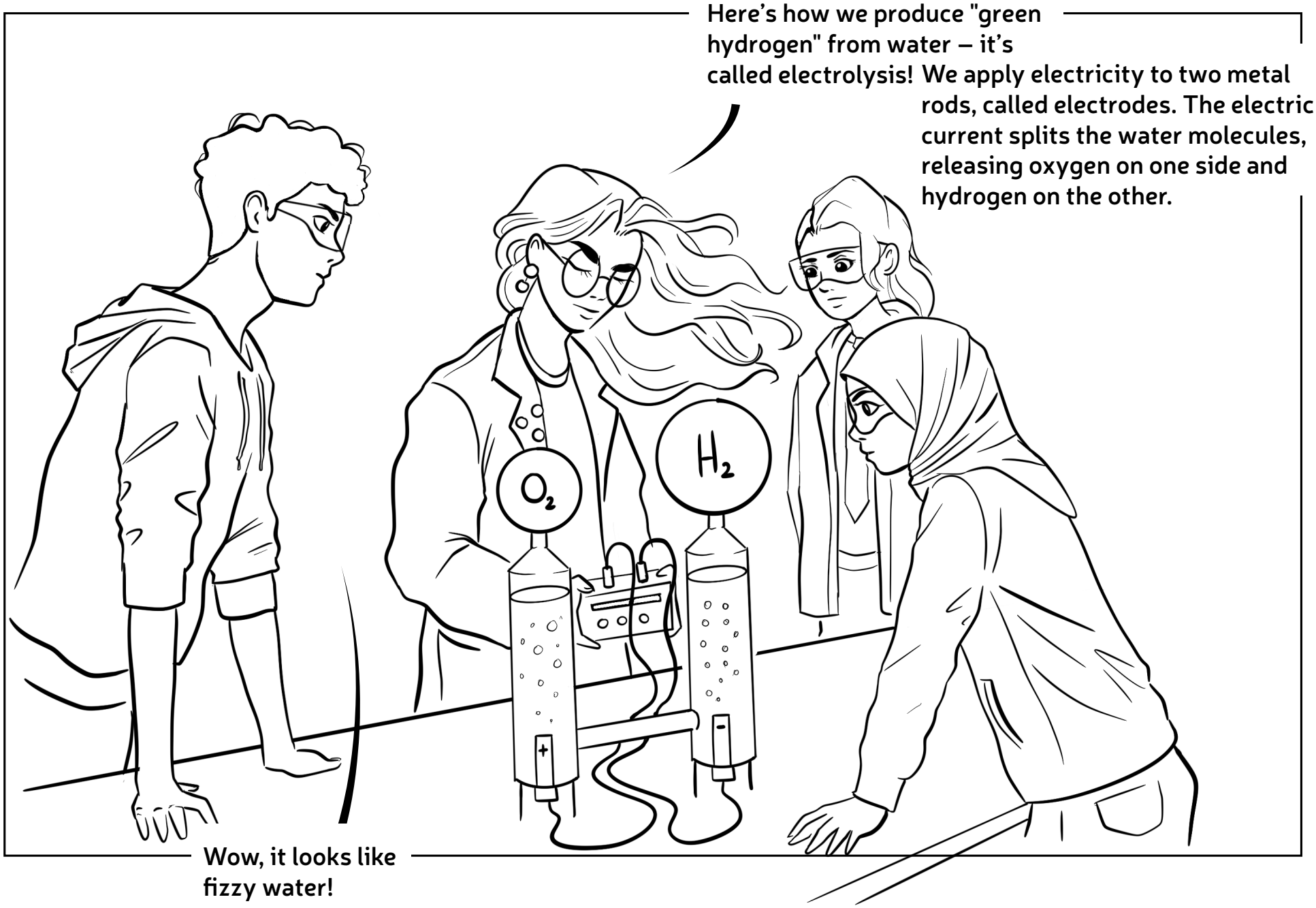
But that's not all: along with colourful pictures to bring to life, there's a fun estimation challenge and some amazing augmented reality experiences waiting for you. You'll get to discover one of the most important technologies of the future in a playful and engaging way.
This colouring book is part of the H_2Giga hydrogen flagship project – a large research initiative focused on green hydrogen. We're not only working on new ideas and technologies – we also want to show you how research works and why it matters. Who knows? Maybe you'll be the hydrogen heroes of tomorrow!

Have fun colouring, exploring and discovering!
Your H_2Giga Team

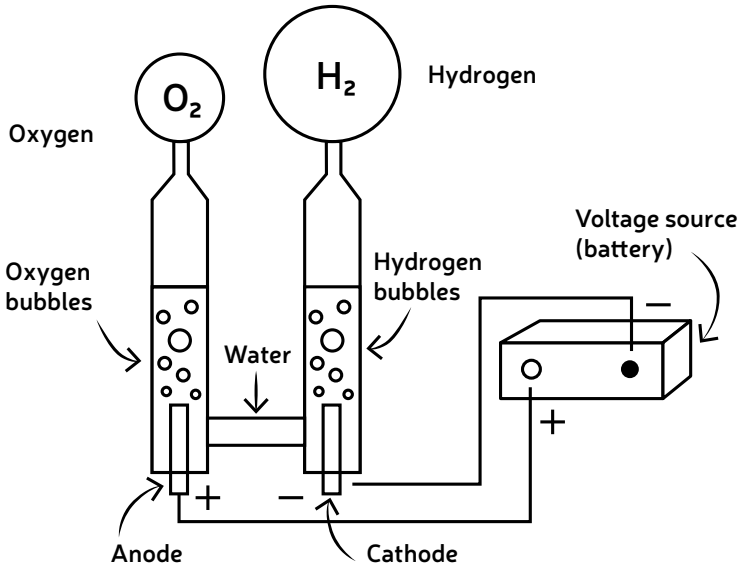

Awesome! Our school is finally getting solar power!
But what happens to the electricity in the summer holidays when no one's here?
Can't we store the electricity? Like in batteries?
Good question! Batteries are awesome. But if you want to move a lot of energy around, they're just too bulky and heavy. What if we could take that electricity and turn it into something cool – something that's easy to store, to move, and use in different ways...


The magic word is hydrogen! I'm Electra, and I'll show you how it works. Let's check it out!

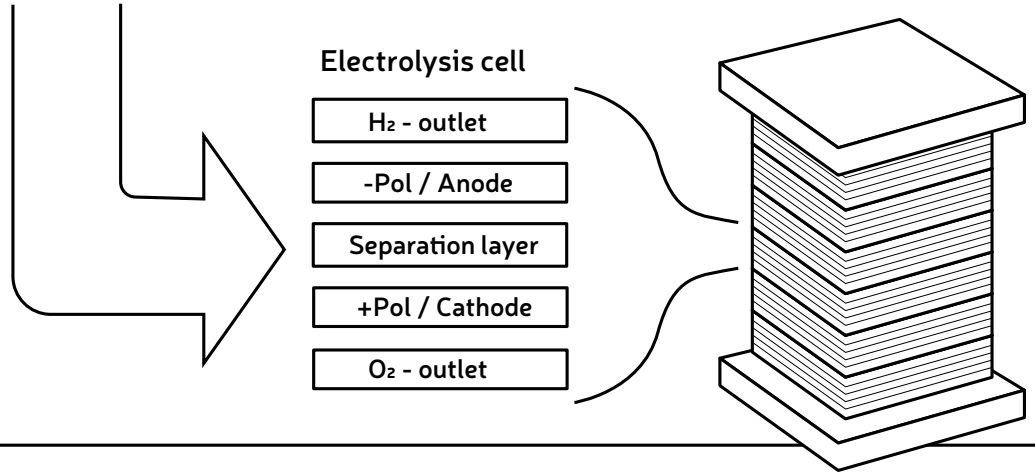

Hydrogen? How can we make that?
With a touch of magic! Electricity splits water molecules into hydrogen and oxygen. And since we use renewable energy for that process, we call the hydrogen “green.”


Here's how we produce "green hydrogen" from water – it's called electrolysis!
We apply electricity to two metal rods, called electrodes. The electric current splits the water molecules, releasing oxygen on one side and hydrogen on the other.
O_2
H_2
+
-
Wow, it looks like fizzy water!

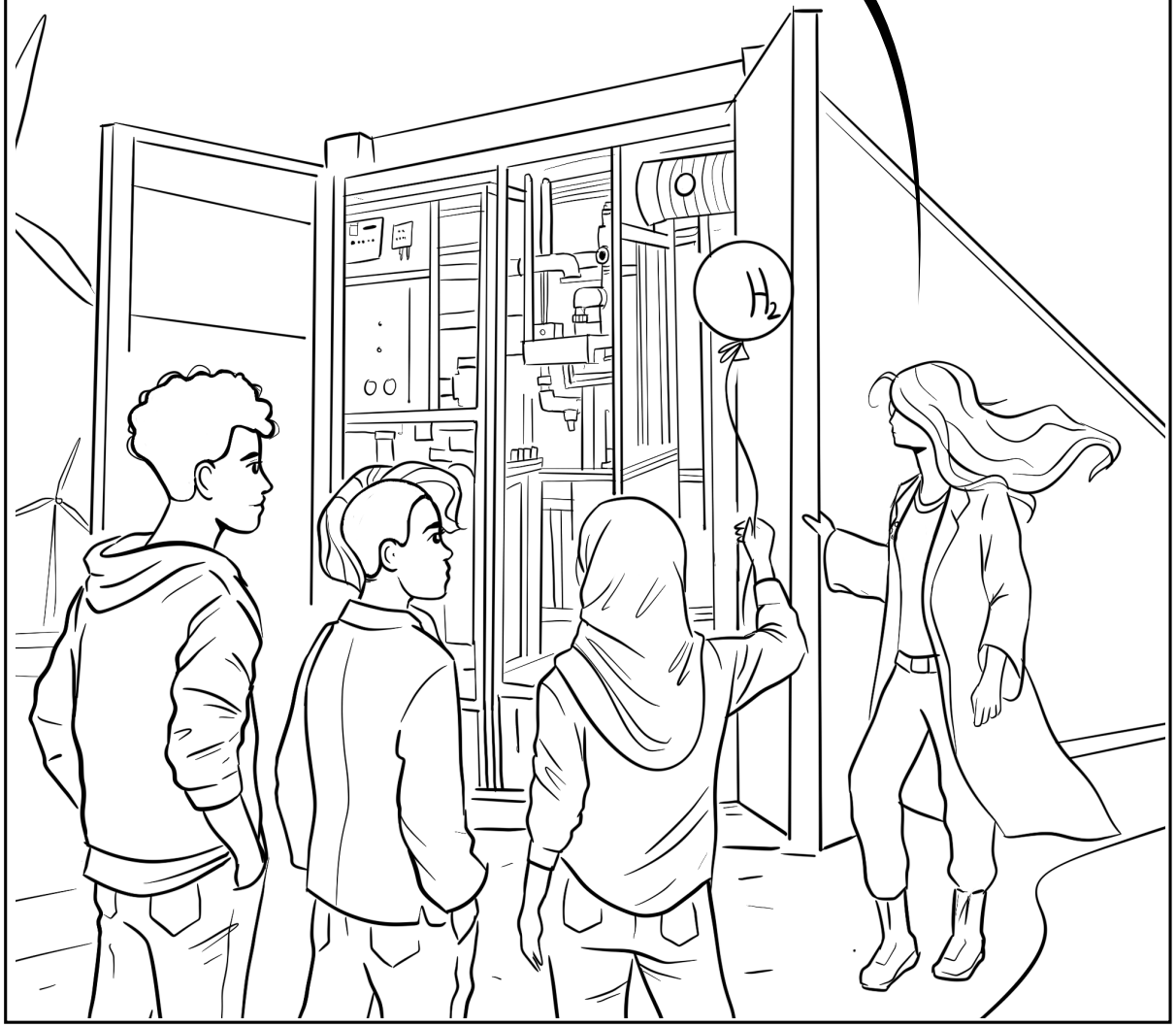
To produce large amounts of hydrogen, we use a stack – a system made up of multiple electrolysis cells. It works similarly to this experiment, but the components are layered like a sandwich.



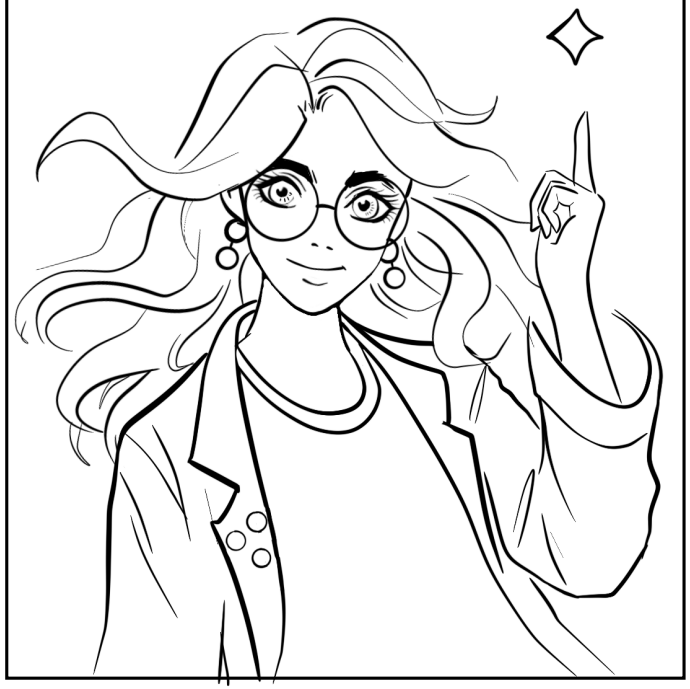
Here's what an electrolysis stack roughly looks like.

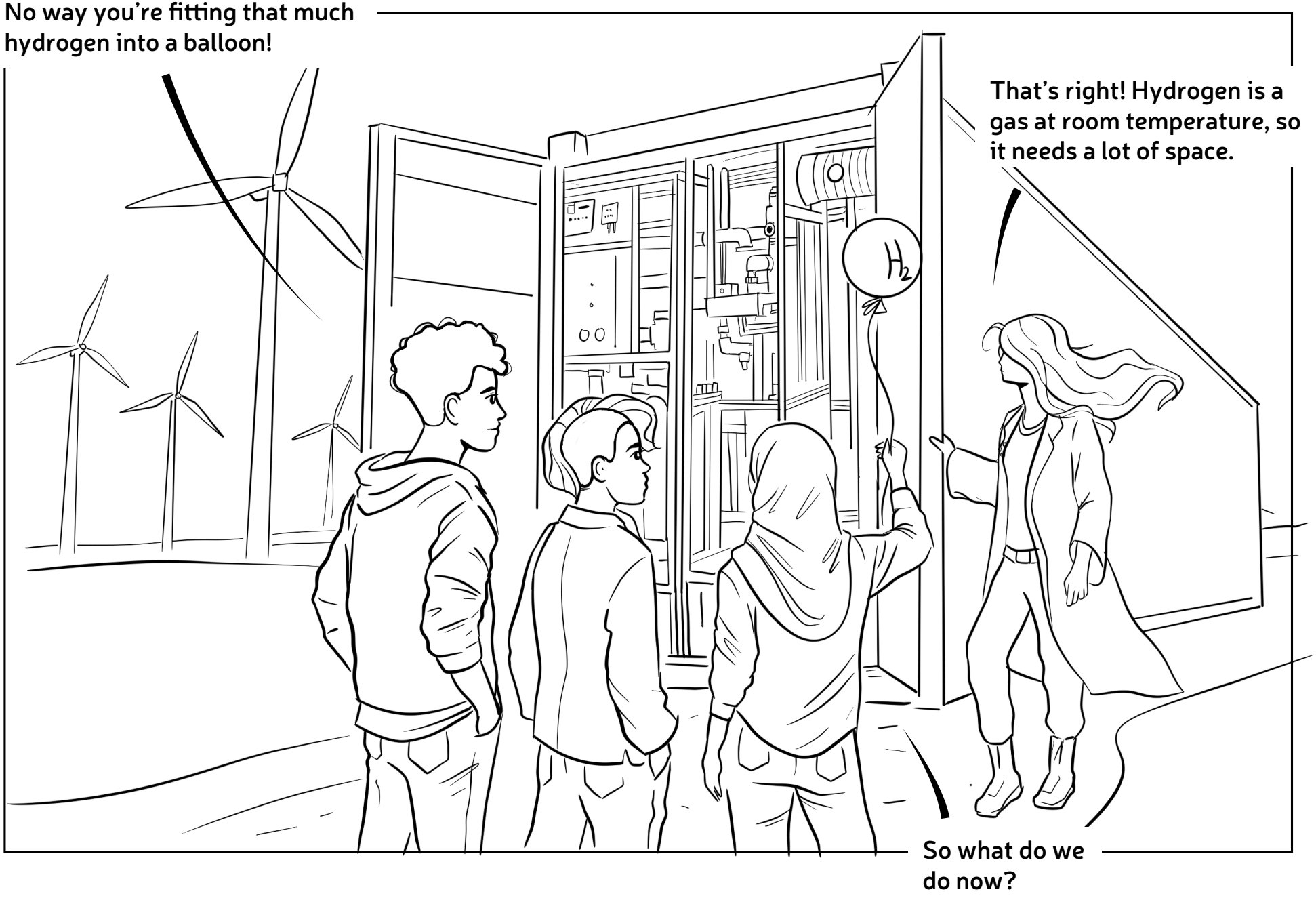


But a single stack isn't enough. We'll also need a few extra things, like a control system, water supply, and much more.

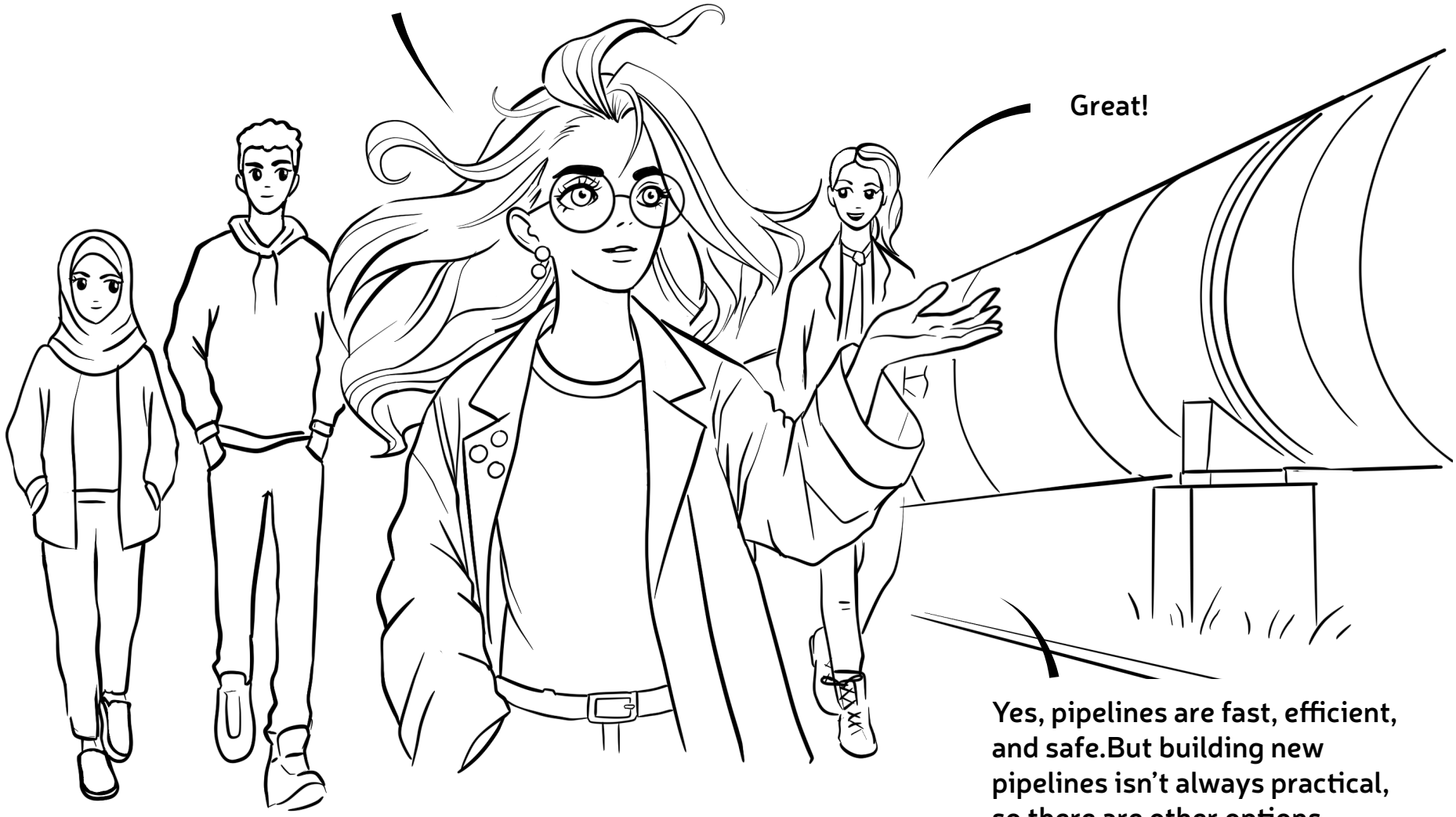


Want to see a real electrolysis system that can be expanded flexibly? Scan the QR code and explore the 3D model in augmented reality!



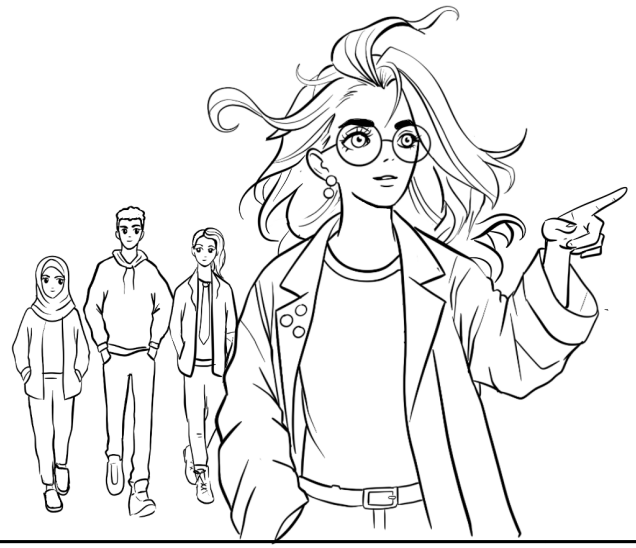

No way you're fitting that much hydrogen into a balloon!
That's right! Hydrogen is a gas at room temperature, so it needs a lot of space.
H_2
So what do we do now?

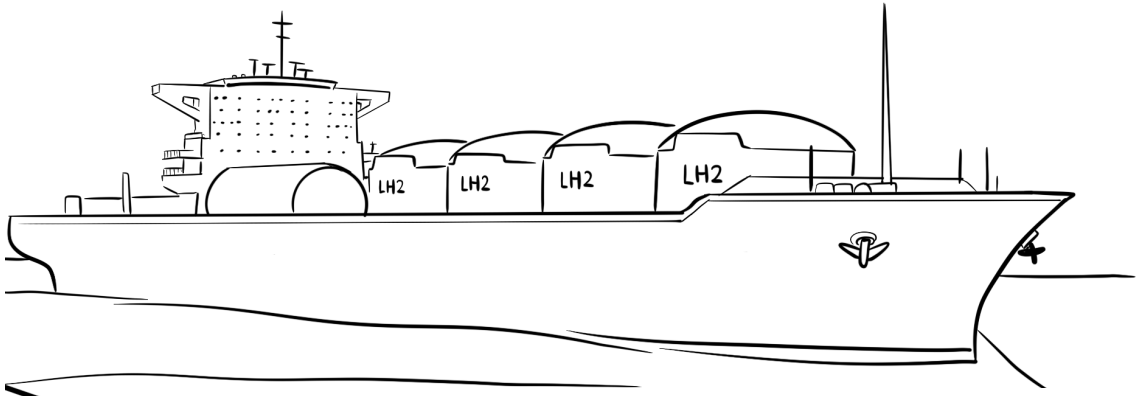
One solution is to transport hydrogen through pipelines. Many natural gas pipelines can be converted for hydrogen, or new ones can be built.



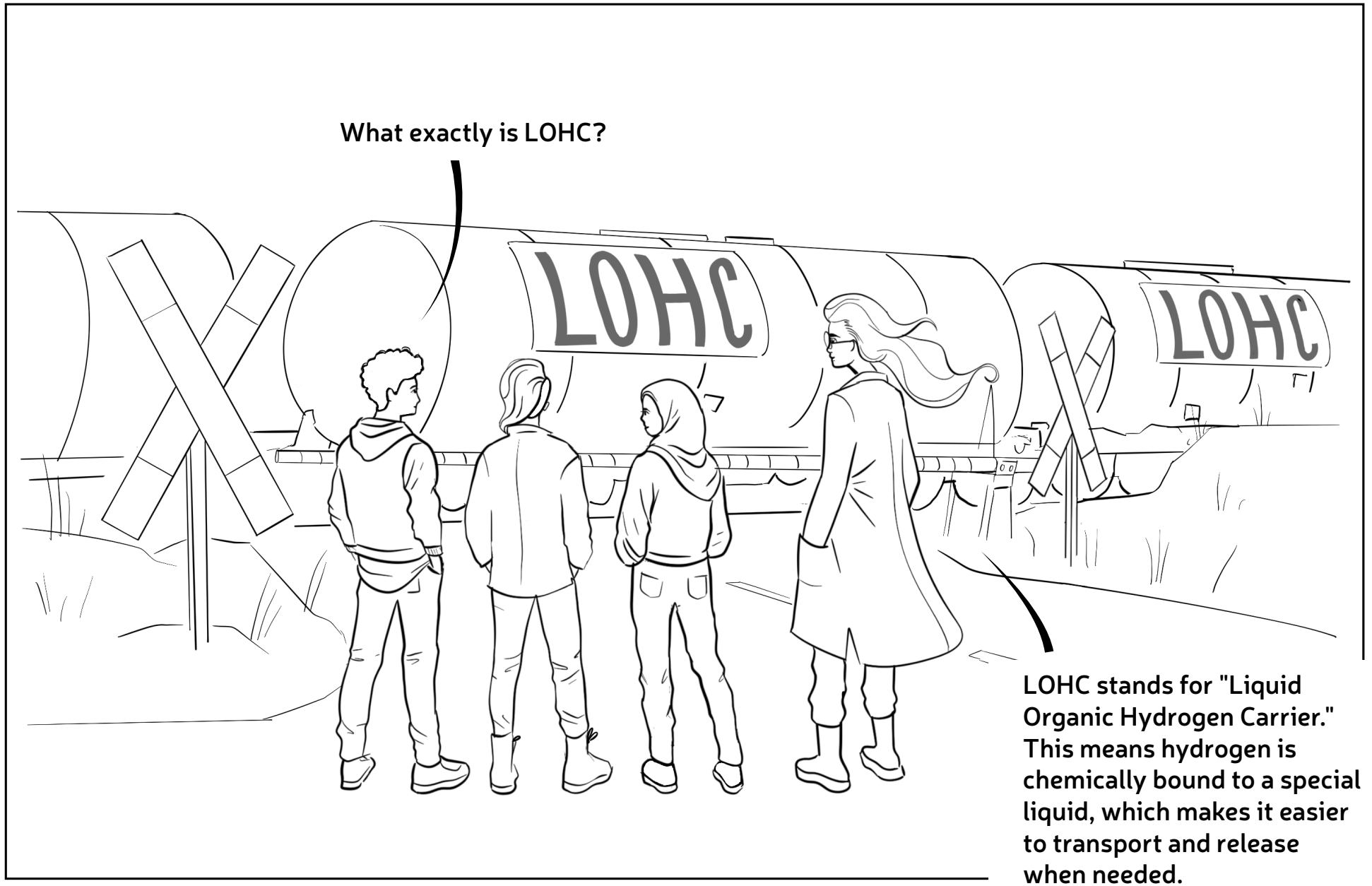
Yes, pipelines are fast, efficient, and safe.But building new pipelines isn't always practical, so there are other options.

We can convert hydrogen into ammonia, which is versatile and easier to transport by tanker truck or ship.

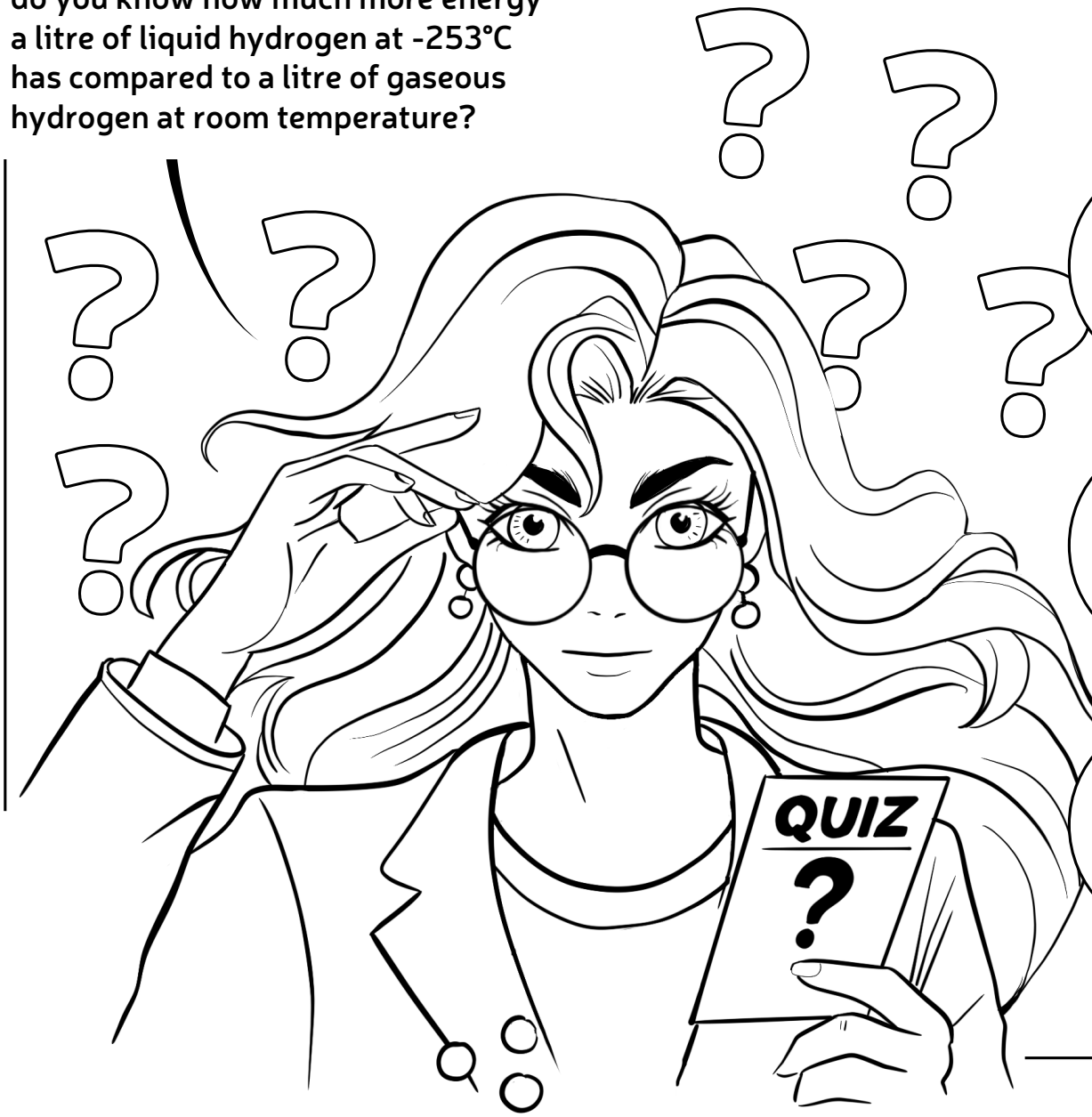




Or we can cool hydrogen down until it becomes liquid and takes up much less space. This requires a lot of energy, but the cold can be used for things like refrigerating food in supermarkets or cooling down servers in data centres.


What exactly is LOHC?
LOHC
LOHC
LOHC stands for "Liquid Organic Hydrogen Carrier." This means hydrogen is chemically bound to a special liquid, which makes it easier to transport and release when needed.

Question:
do you know how much more energy a litre of liquid hydrogen at -253°C has compared to a litre of gaseous hydrogen at room temperature?



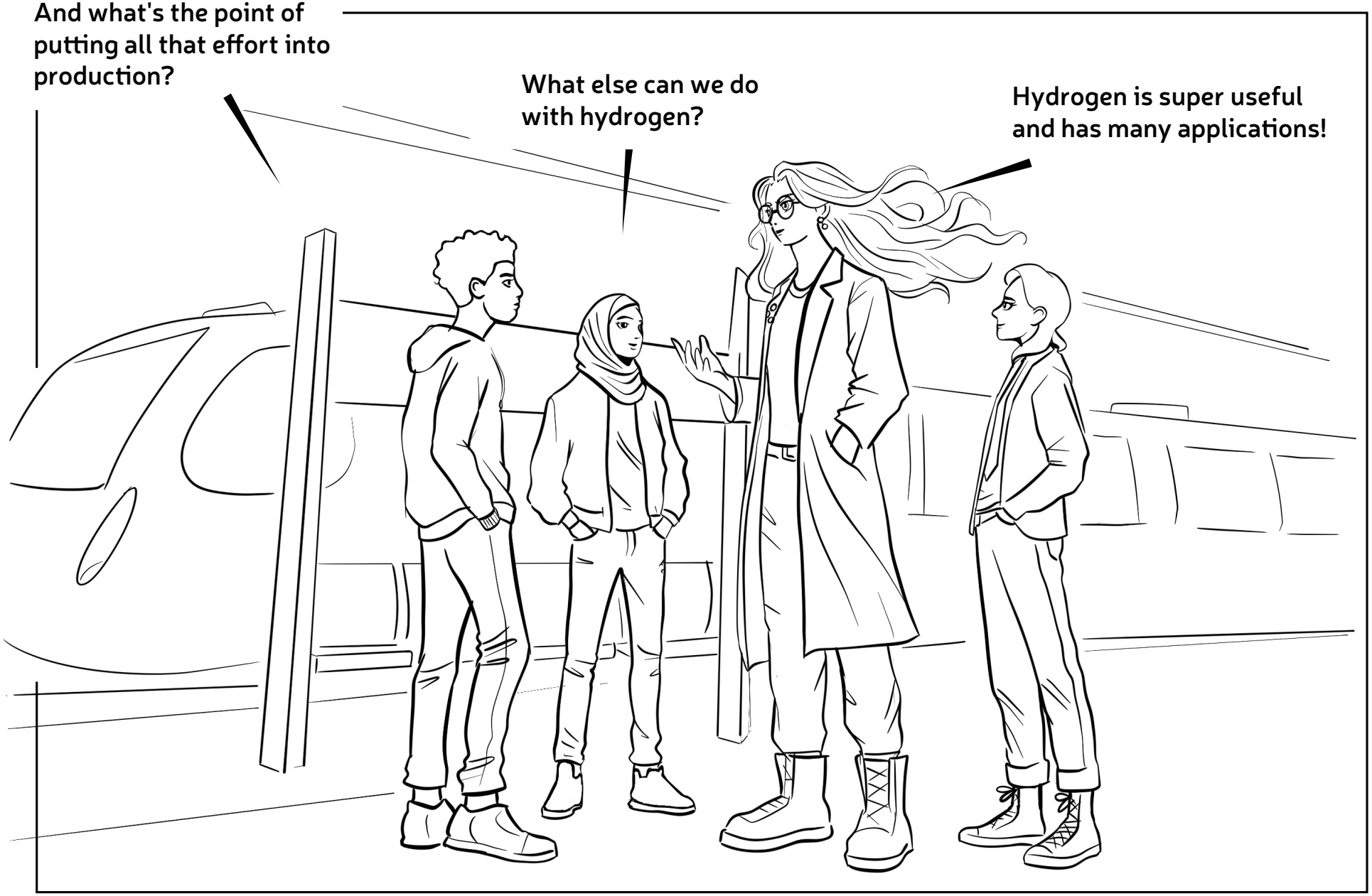
8 times

80 times

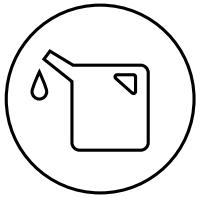
800 times

more

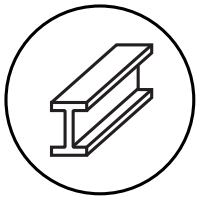
Answer on the last page


And what's the point of putting all that effort into production?
What else can we do with hydrogen?
Hydrogen is super useful and has many applications!

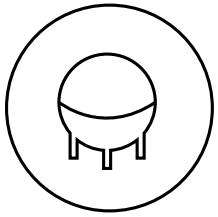
We can use it as a raw material to make other chemicals, like methanol, ammonia, and fertiliser.



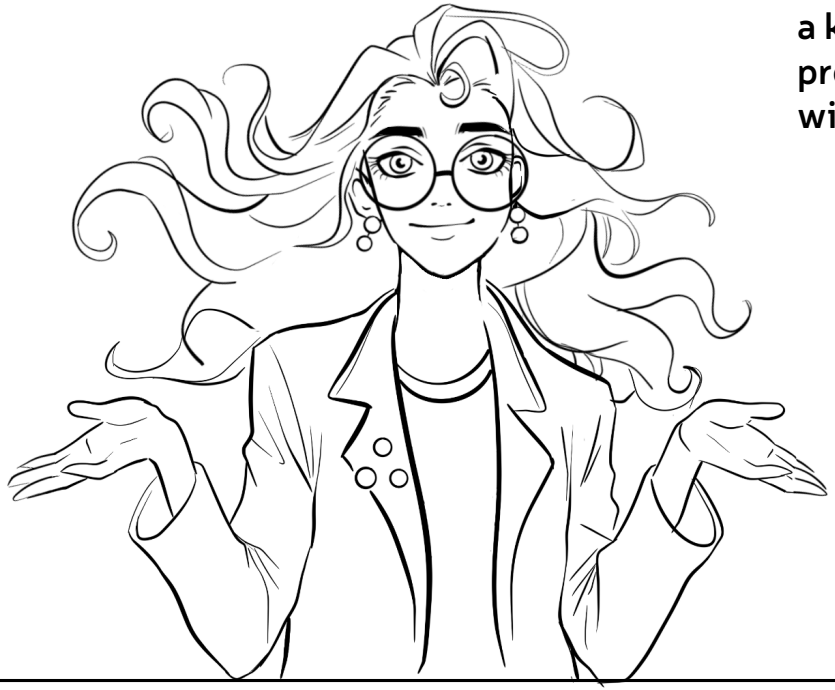
It can even be used as fuel for long-distance lorries and rockets. When it's converted, it can also be used as fuel for ships and airplanes.



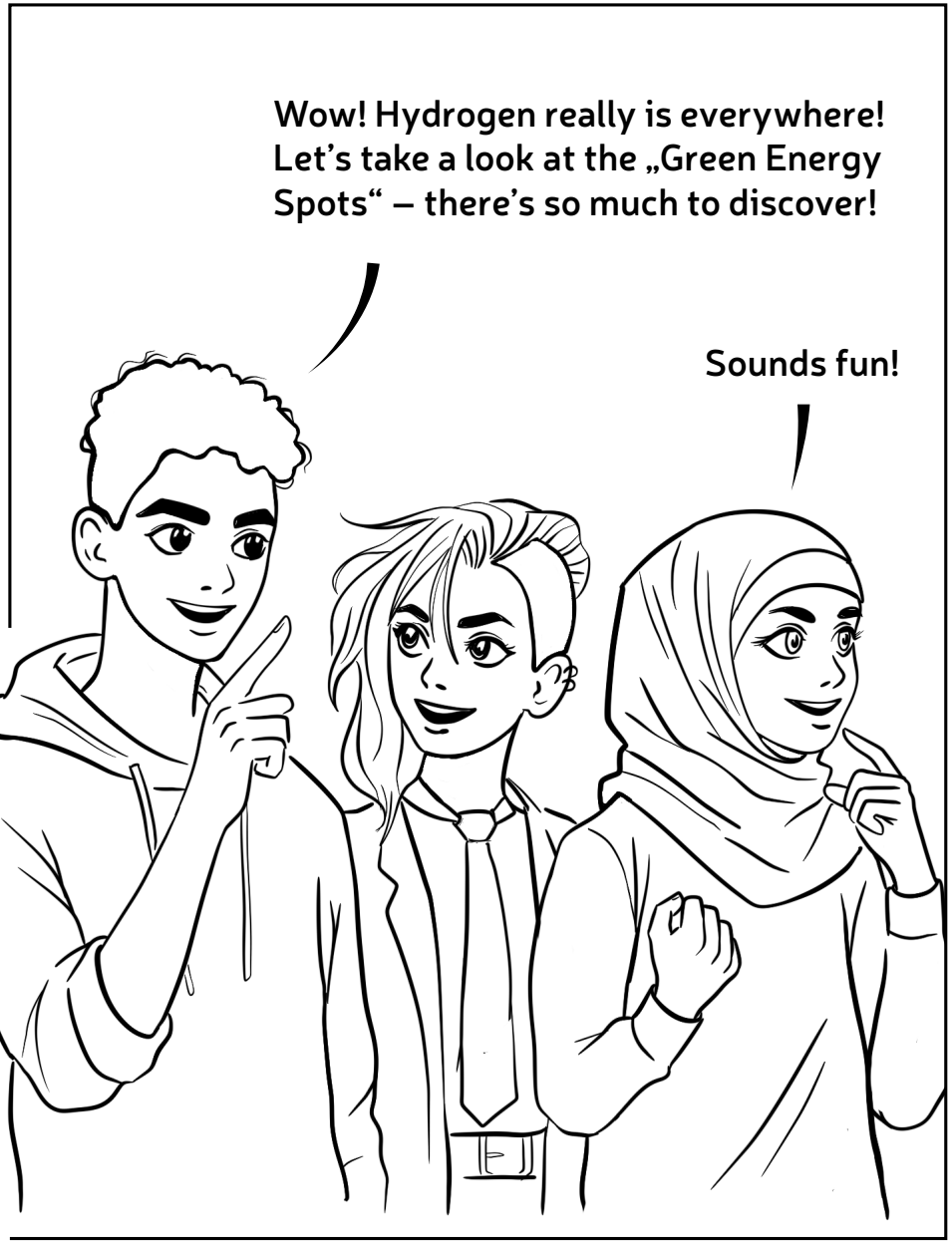
In steelmaking, hydrogen is a key reactant that makes production of steel possible without releasing CO_2.

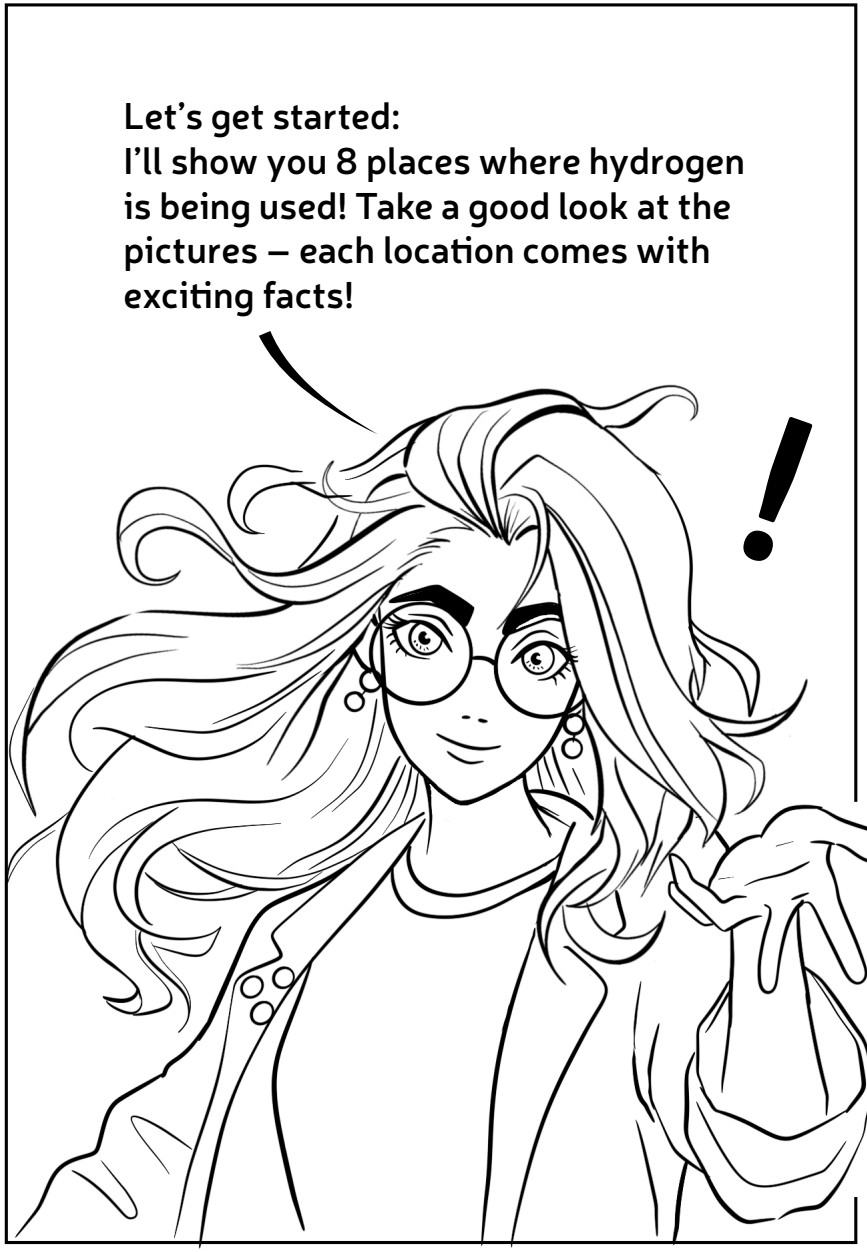


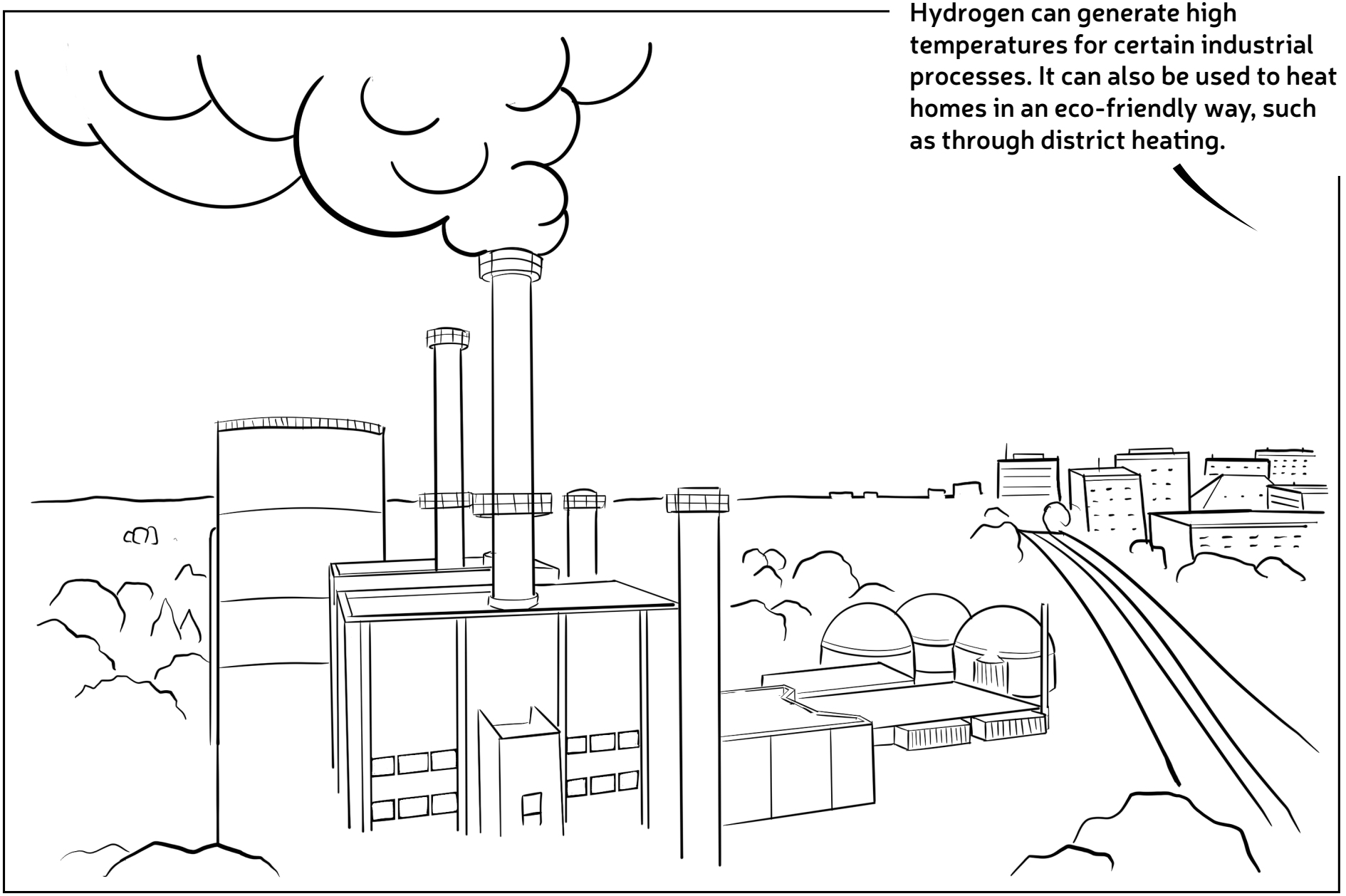
Hydrogen can store renewable energy for long periods of time.

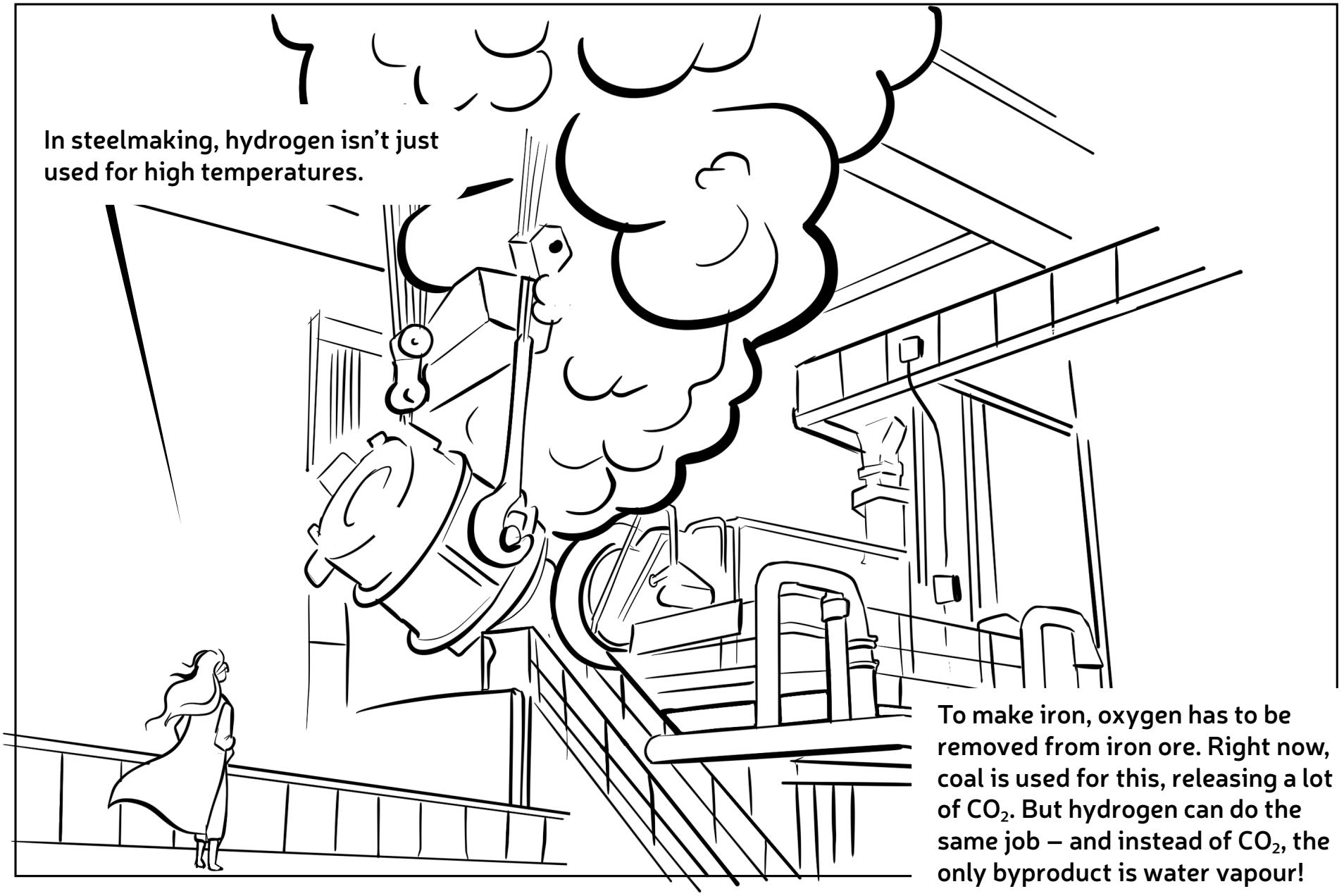


By the way, hydrogen can also be a source of heat for industry!


Wow! Hydrogen really is everywhere! Let's take a look at the „Green Energy Spots“ – there's so much to discover!
Sounds fun!

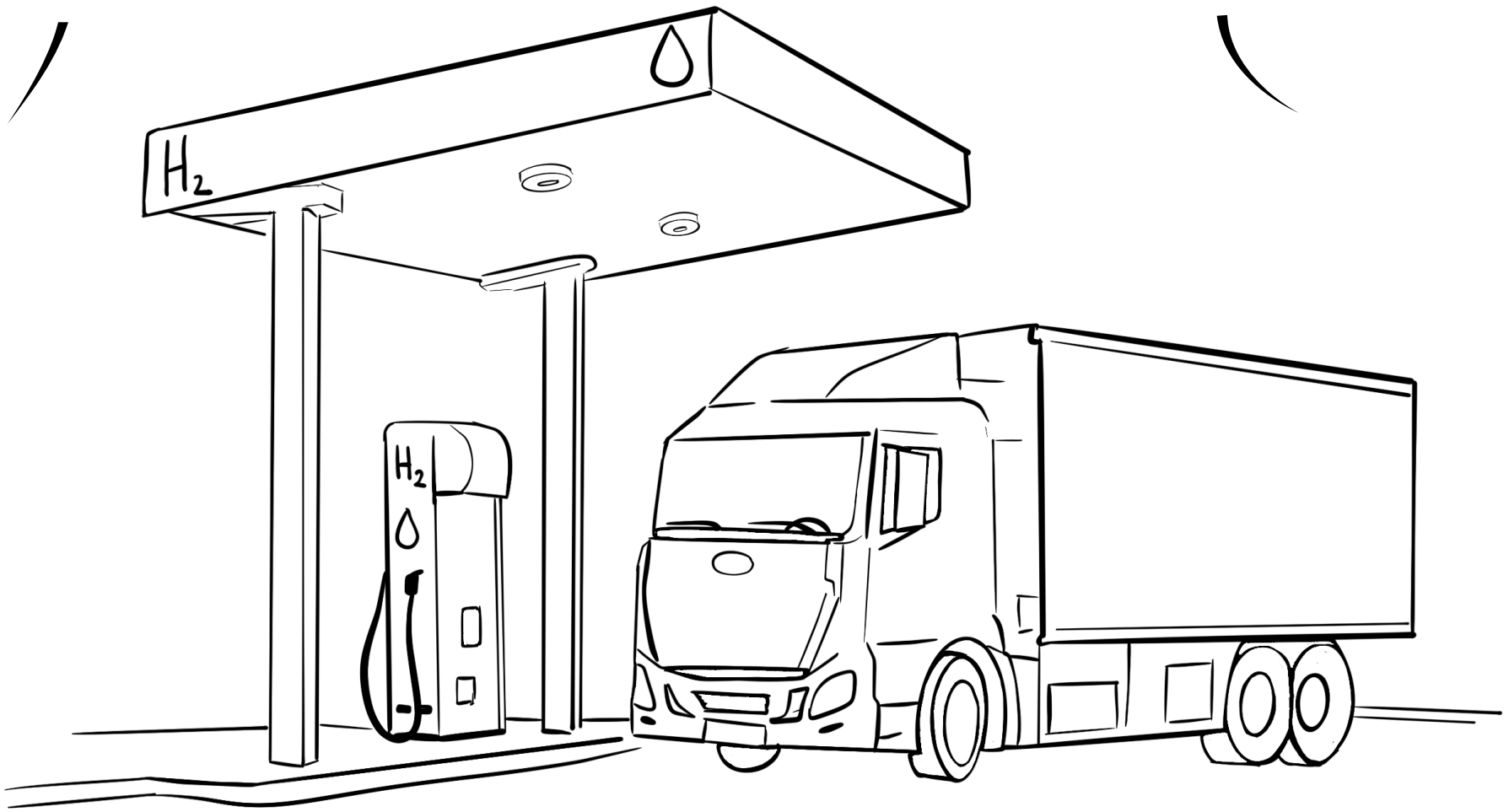

Let's get started:
I'll show you 8 places where hydrogen is being used! Take a good look at the pictures – each location comes with exciting facts!


Hydrogen can generate high temperatures for certain industrial processes. It can also be used to heat homes in an eco-friendly way, such as through district heating.

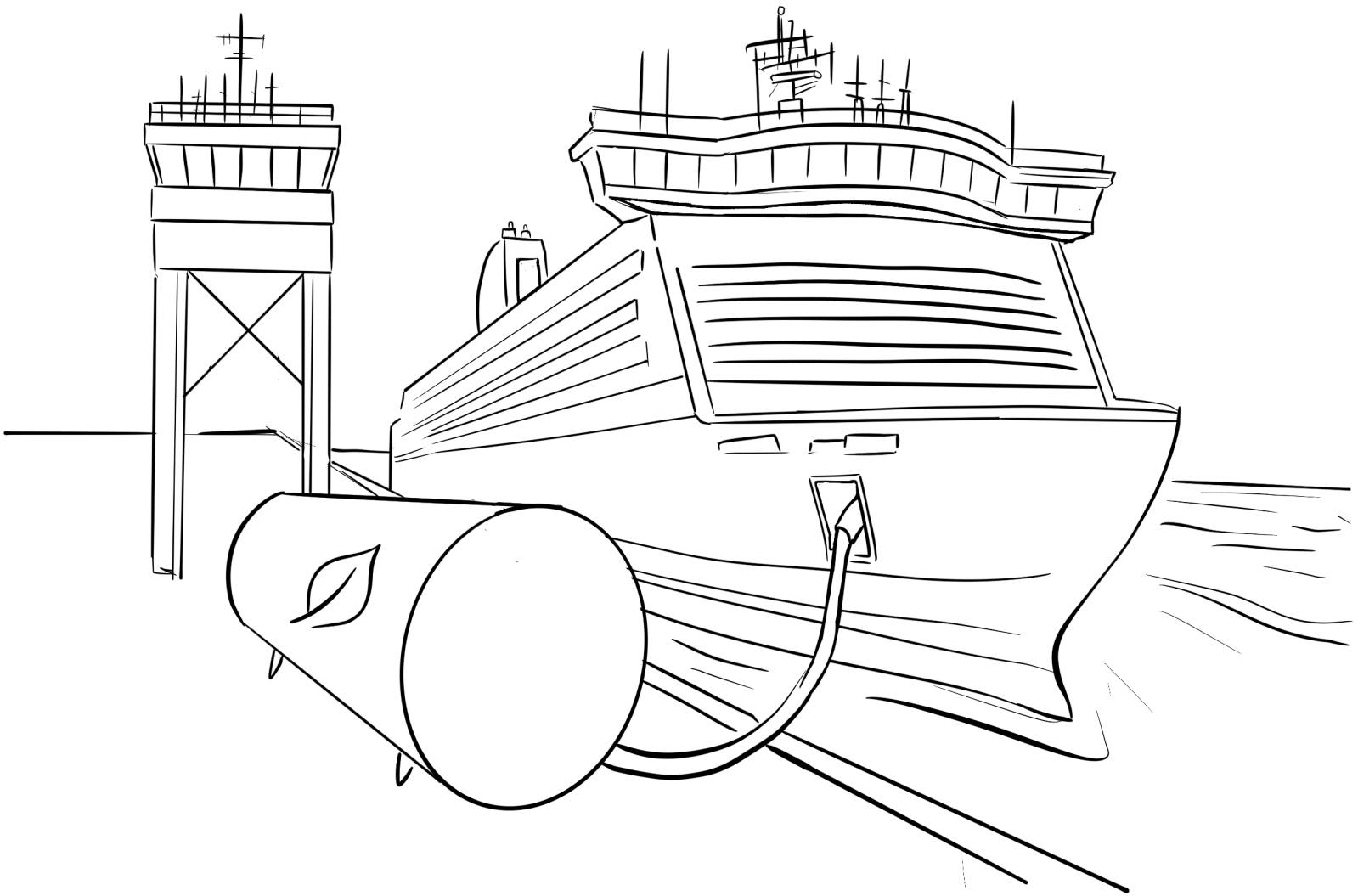

In steelmaking, hydrogen isn't just used for high temperatures.
To make iron, oxygen has to be removed from iron ore. Right now, coal is used for this, releasing a lot of CO_2. But hydrogen can do the same job – and instead of CO_2, the only byproduct is water vapour!

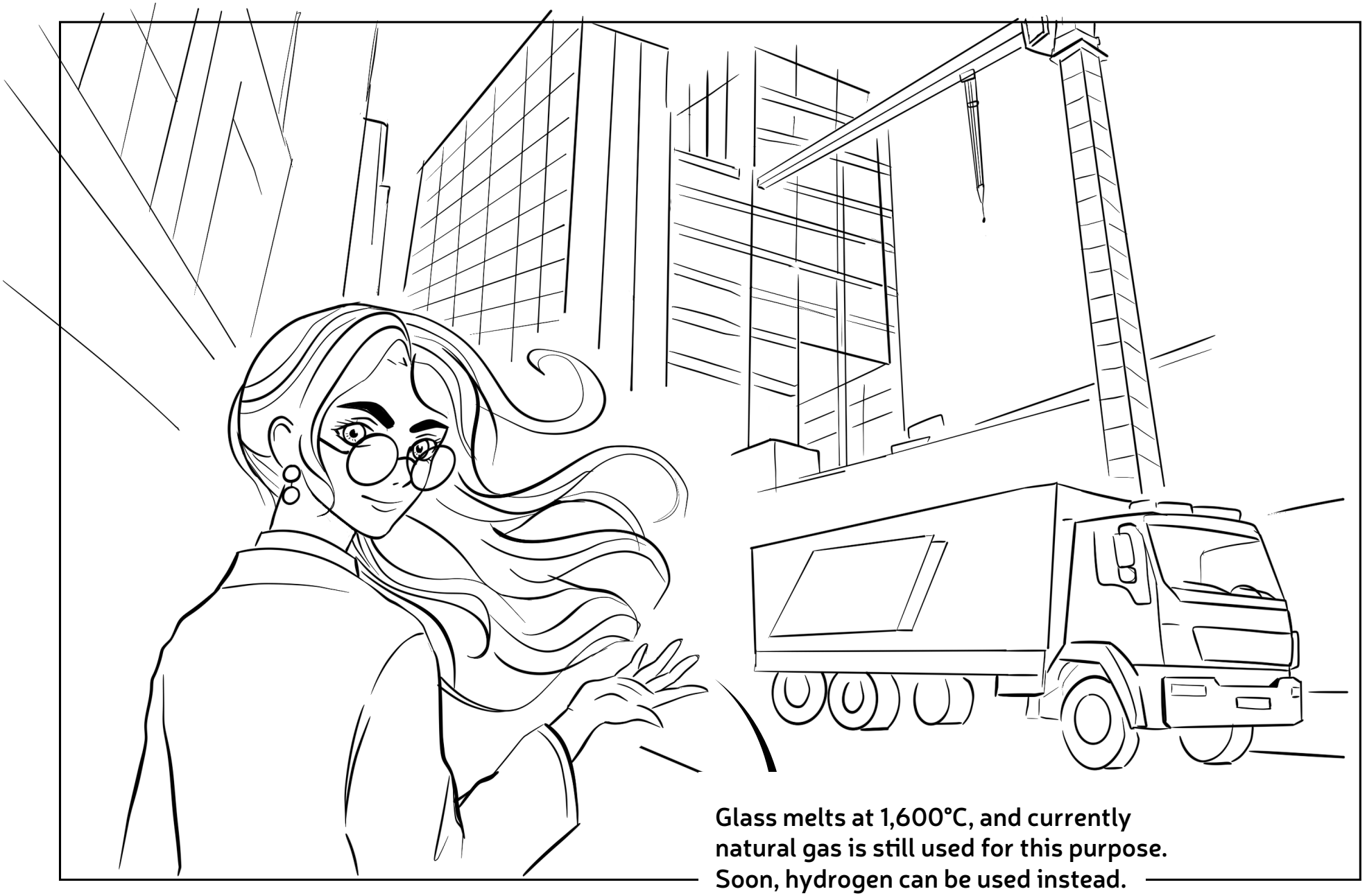
Why doesn't it just refuel with electricity?

For long distances and very heavy loads, we would need a massive battery. Hydrogen gives us a longer range and faster refuelling.

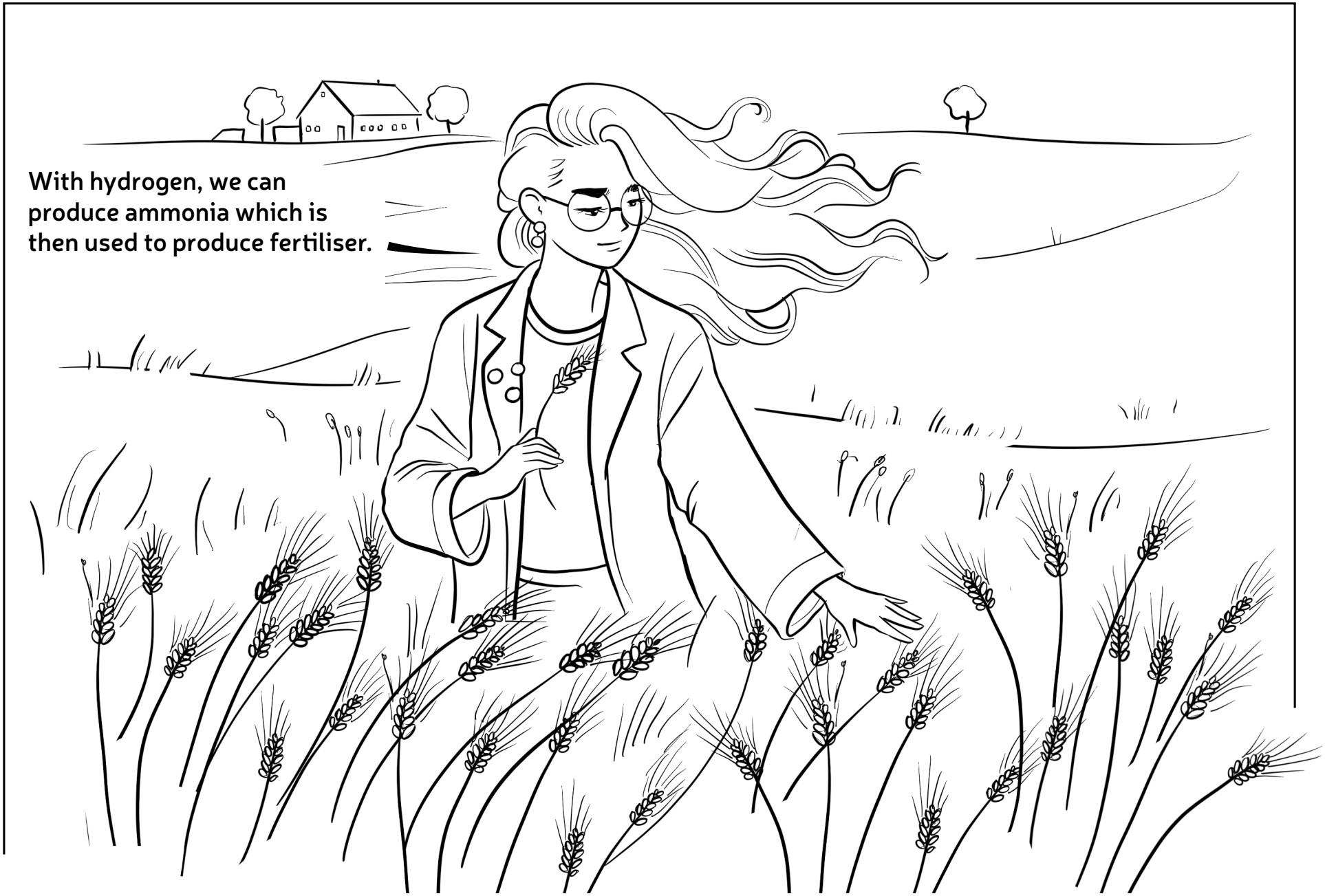


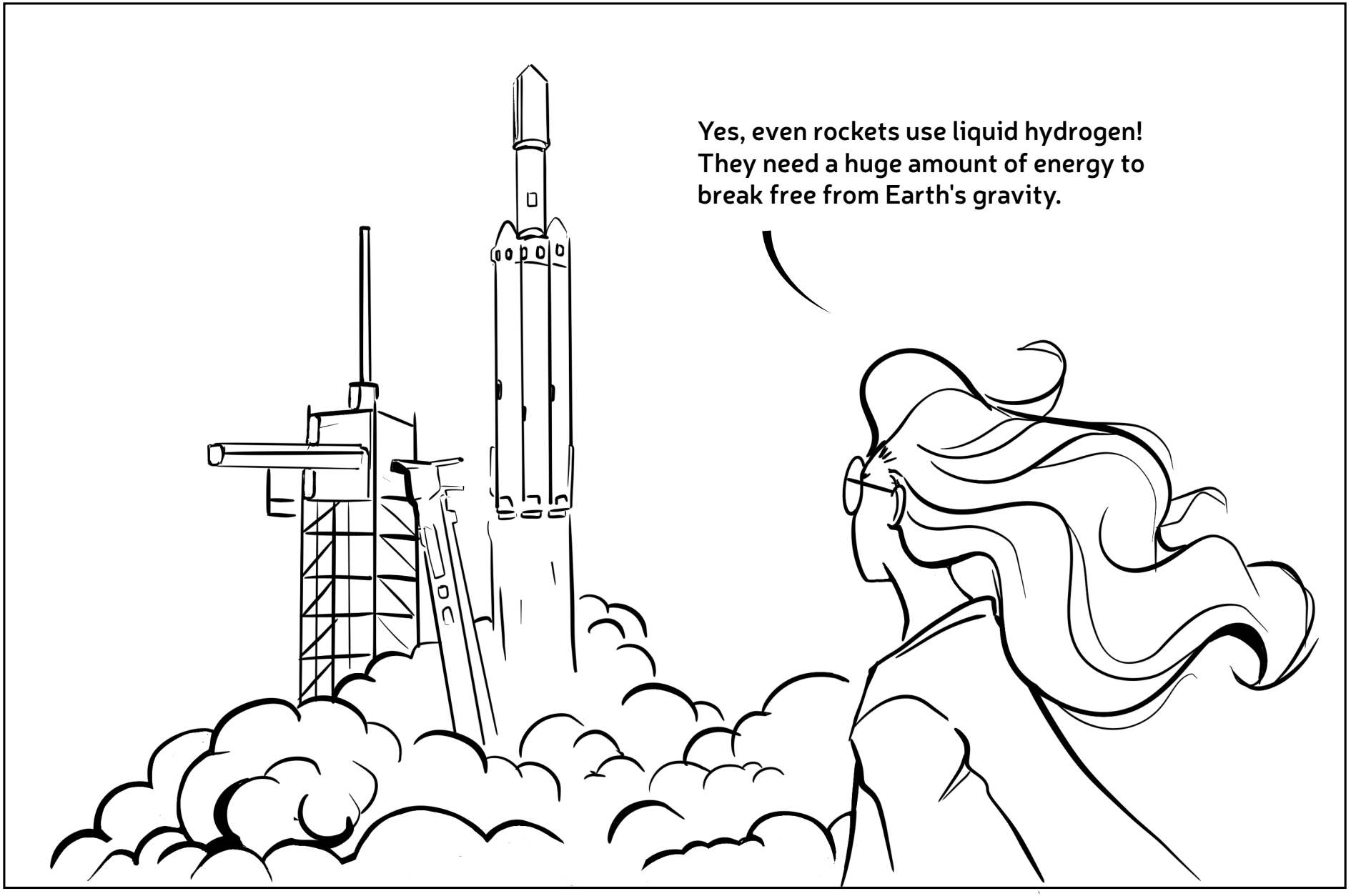
This ship runs on fuel that is made from hydrogen.





Glass melts at 1,600°C, and currently natural gas is still used for this purpose. Soon, hydrogen can be used instead.


With hydrogen, we can produce ammonia which is then used to produce fertiliser.


Yes, even rockets use liquid hydrogen!
They need a huge amount of energy to
break free from Earth's gravity.


Wow, what a day!
I'm exhausted.
Even the foam in your mattress can be made from hydrogen and carbon compounds!
Hydrogen really is everywhere!

You've proven you're real energy detectives – hydrogen is no mystery to you anymore!

Thanks for taking the time to explore the world of hydrogen with me. I hope, you enjoyed it, too!

Are you curious about what a greener world might look like? Want to see how the future of hydrogen is coming to life? Then scan the QR code to explore HyVision – a digital map that shows the results and progress of Germany's Hydrogen Flagship Projects – or visit our website: https://www.wasserstoff-leitprojekte.de/projects/h2giga

Quiz answer

800 times more energy!
Isn't that crazy?!

IMPRINT

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Illustrations and Design: sapera studios
Published by: Hydrogen Flagship Projects, www.wasserstoff-leitprojekte.de

Flagship Project
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With funding from the:

Federal Ministry
of Research, Technology
and Space

Funded by
the European Union
NextGenerationEU