

## A carbon-free, dispatchable power source for the UK

### What is green ammonia?

Green ammonia is a **carbon-free molecule** with many useful functions.

It's produced from only **renewable power, water and air**.

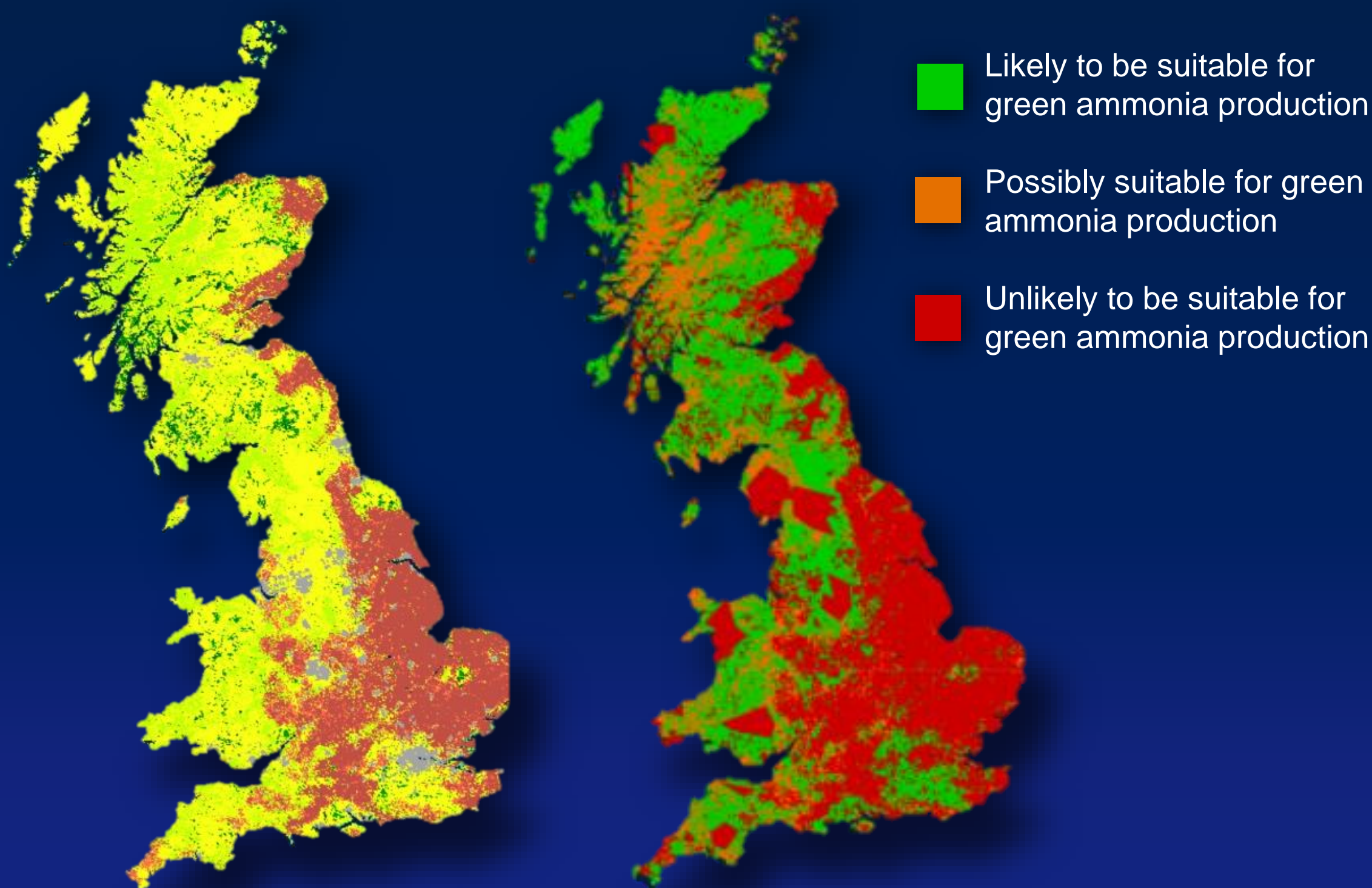
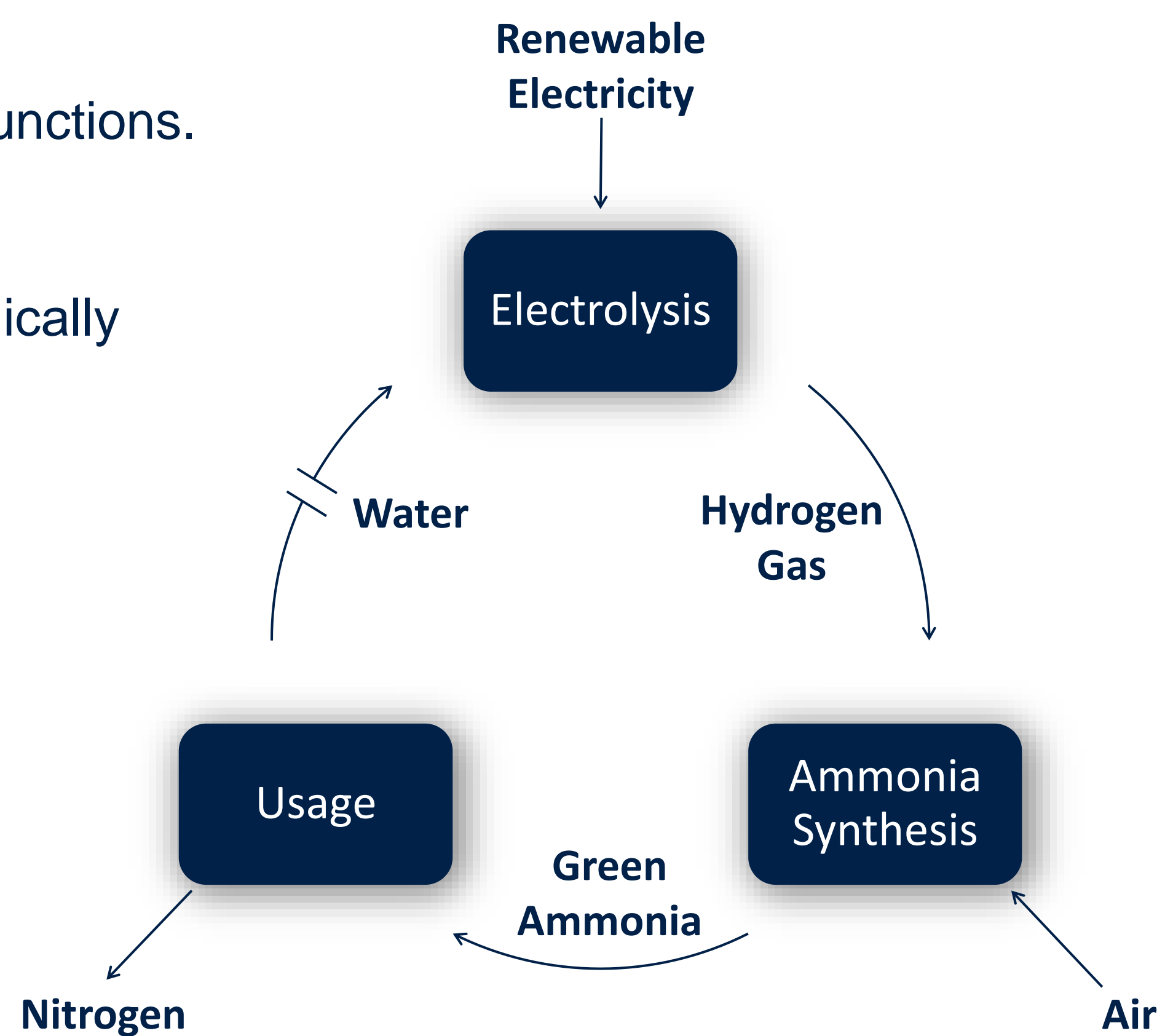
We call it 'green' because of the mode of production – it's chemically identical to the ammonia used in cleaning products.

### Why do we need green ammonia?

Current 'brown' ammonia production for fertilisers causes **~2% of global CO<sub>2</sub> emissions**, but is critical for food security.

But green ammonia can go further – it can also be used as a fuel for ships, as a carrier to transport valuable hydrogen, or to make electricity.

It can be used to make clean energy when the **wind isn't blowing** or the **sun isn't shining**.



There are many distinct uses for land in the UK, represented by the range of colours shown here

Only some land types are suitable for green ammonia production without damaging other industries or the environment

### The challenges?

Ammonia needs a **reliable renewable resource** to be made cheaply

**Space is limited** for renewable energy in the UK, and the high quality resources may be needed for other uses, like electricity generation.

### Our solution – Production on the ocean

Wind in the ocean blows with **high reliability**.

Using wind turbines to make and transport ammonia is cheaper than transporting electricity.

The UK already has strategic advantages in offshore energy production, including in floating wind turbines for **far offshore** applications.

### Our research

We use **optimisation models** to predict the cheapest way of making green ammonia using a mix of wind and solar electricity in different places with different weather conditions.

We combine those results **with estimates for the available land** for producing renewable energy to determine the capacity to produce ammonia.

Results show that to satisfy demand for ammonia, it is **more affordable to make ammonia offshore** – even though offshore wind turbines are **almost triple the cost** of onshore technology.

