

Advancing Resilient, Affordable and Clean Energy Through T&D Innovation

Henrik Stiesdal, CWIEME Berlin, May 2026



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Europe is at a crossroads

Geopolitical, economic and environmental shifts demand a new approach

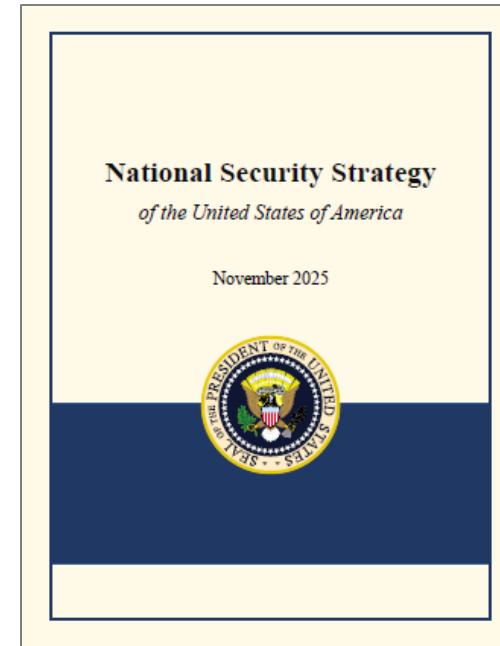
The security situation has changed completely

- All illusions about a trusting relationship with Russia were shattered by the 2022 invasion.



Old allies cannot be counted on anymore

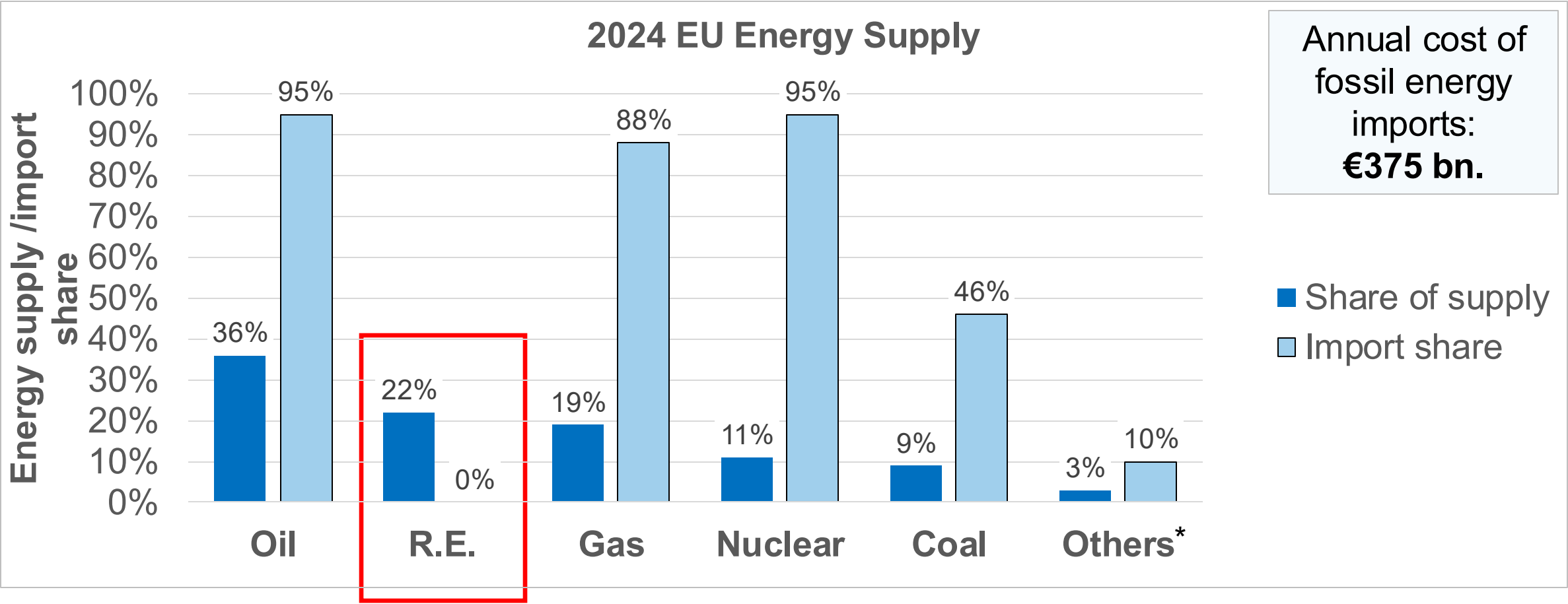
- Amicable, rule-based relations have been replaced by resentment and trade wars.



Europe must assume it is on its own, on security in general and on energy in particular

Our energy system is neither resilient nor clean

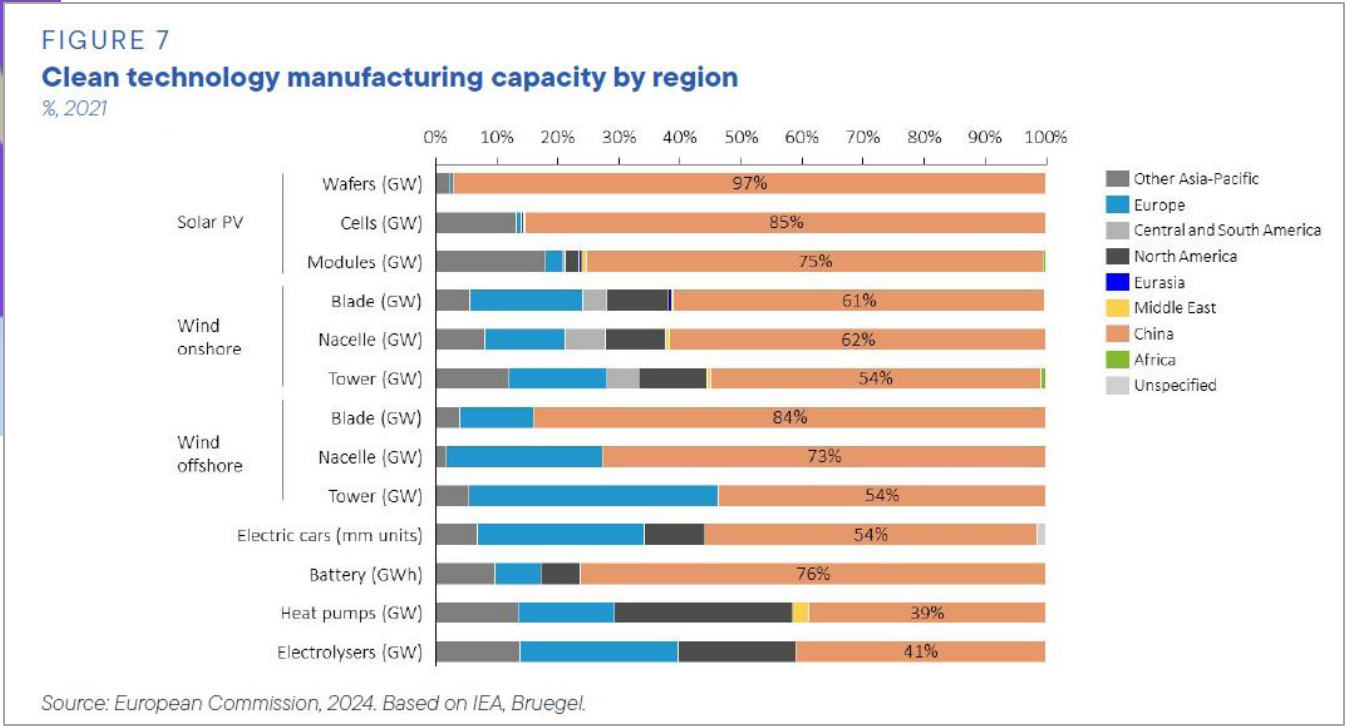
Dependence on imported fuels creates systemic vulnerability



Europe must stop basing resilience on imported fossil energy

Europe faces a major competitiveness challenge

The Draghi Report highlights urgent gaps in clean-tech industrial capacity



Europe must ensure competitiveness through resilient and affordable energy

Affordability and public acceptance are a must

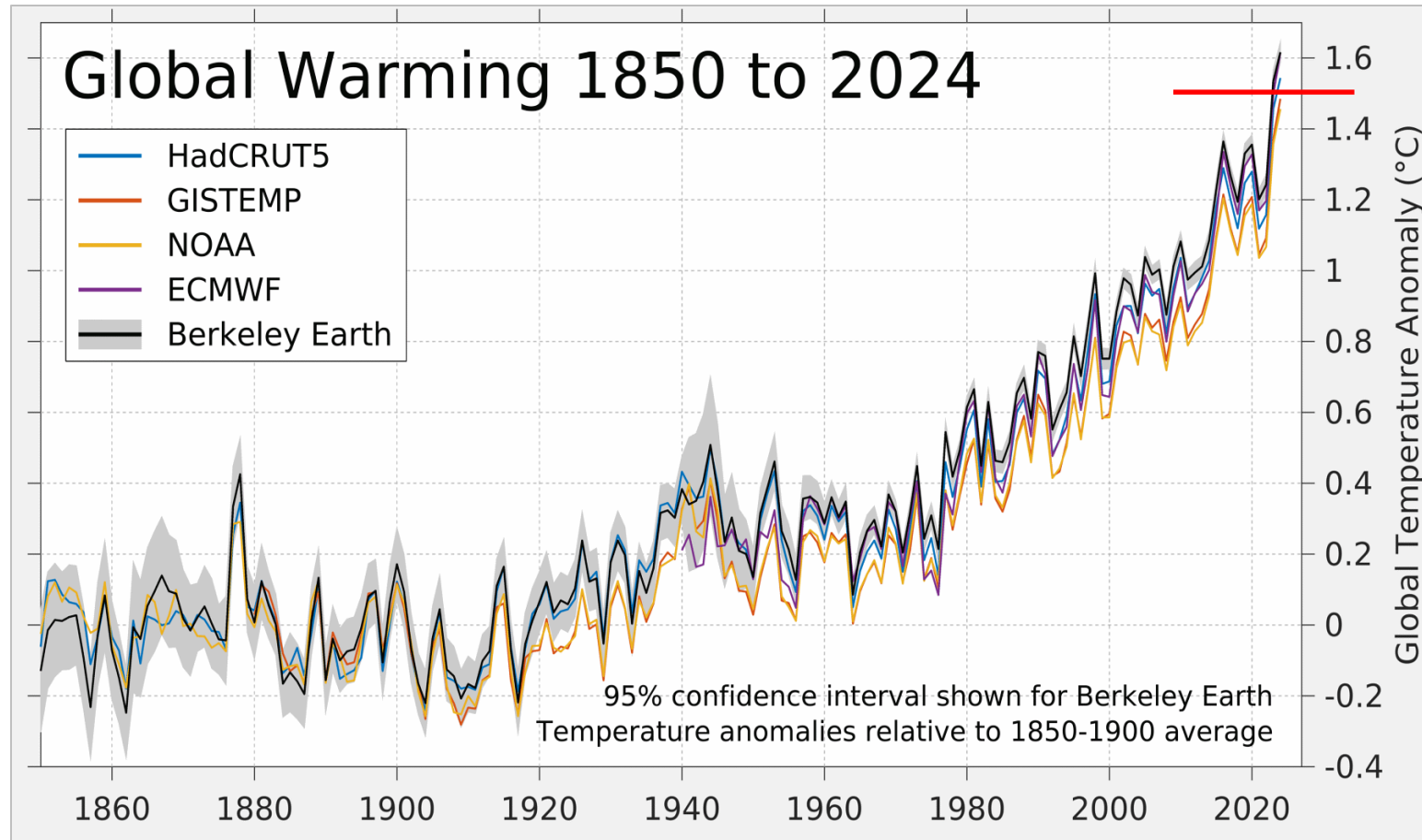
Energy policy has triggered protests across Europe



Europe must keep energy affordable through socially acceptable projects

New priorities do not make climate change go away

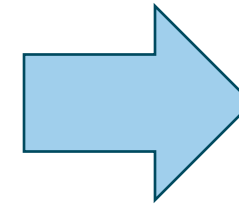
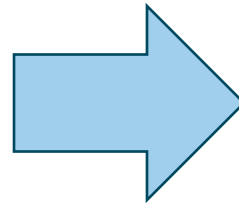
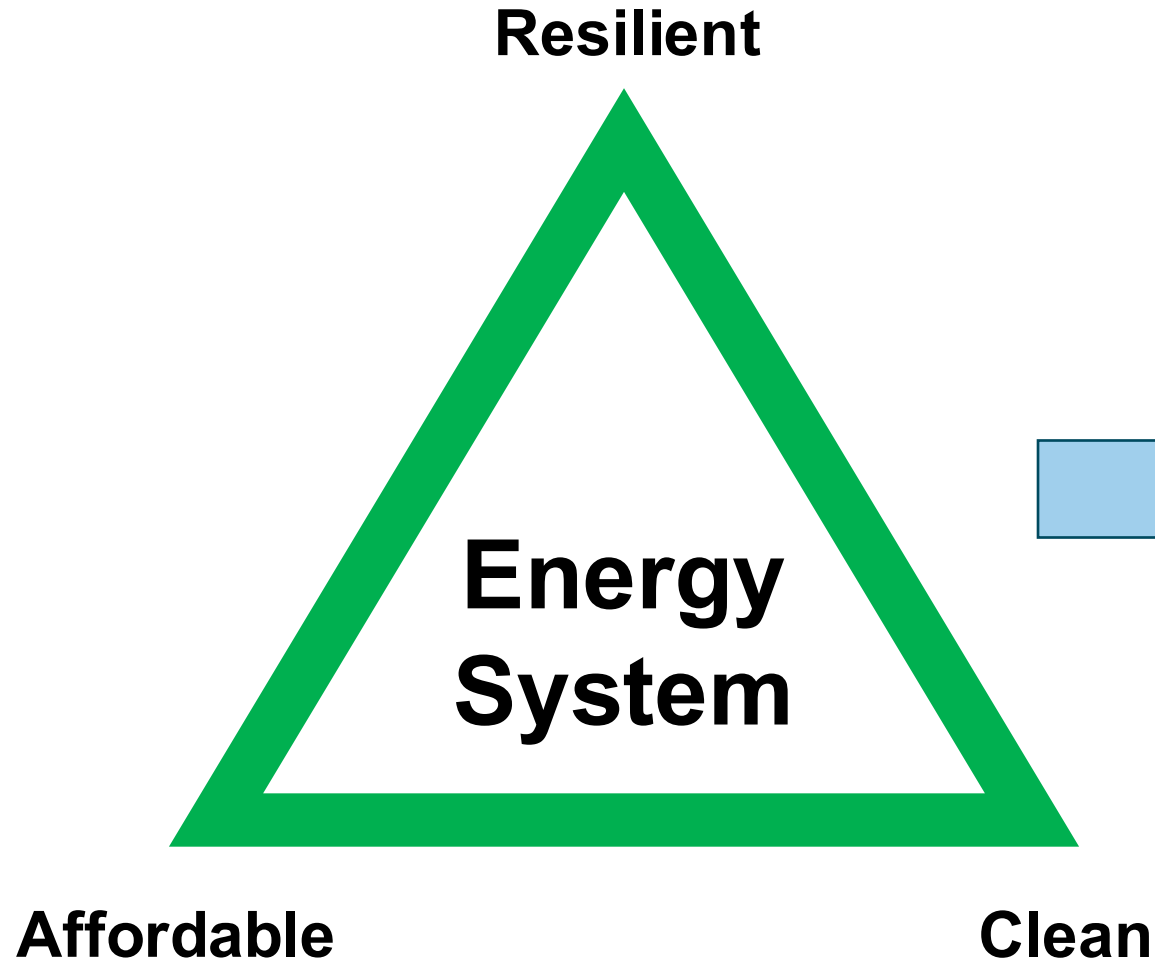
Escalating impacts threaten stability and prosperity



Europe must accelerate the clean transition to avoid escalating climate risks

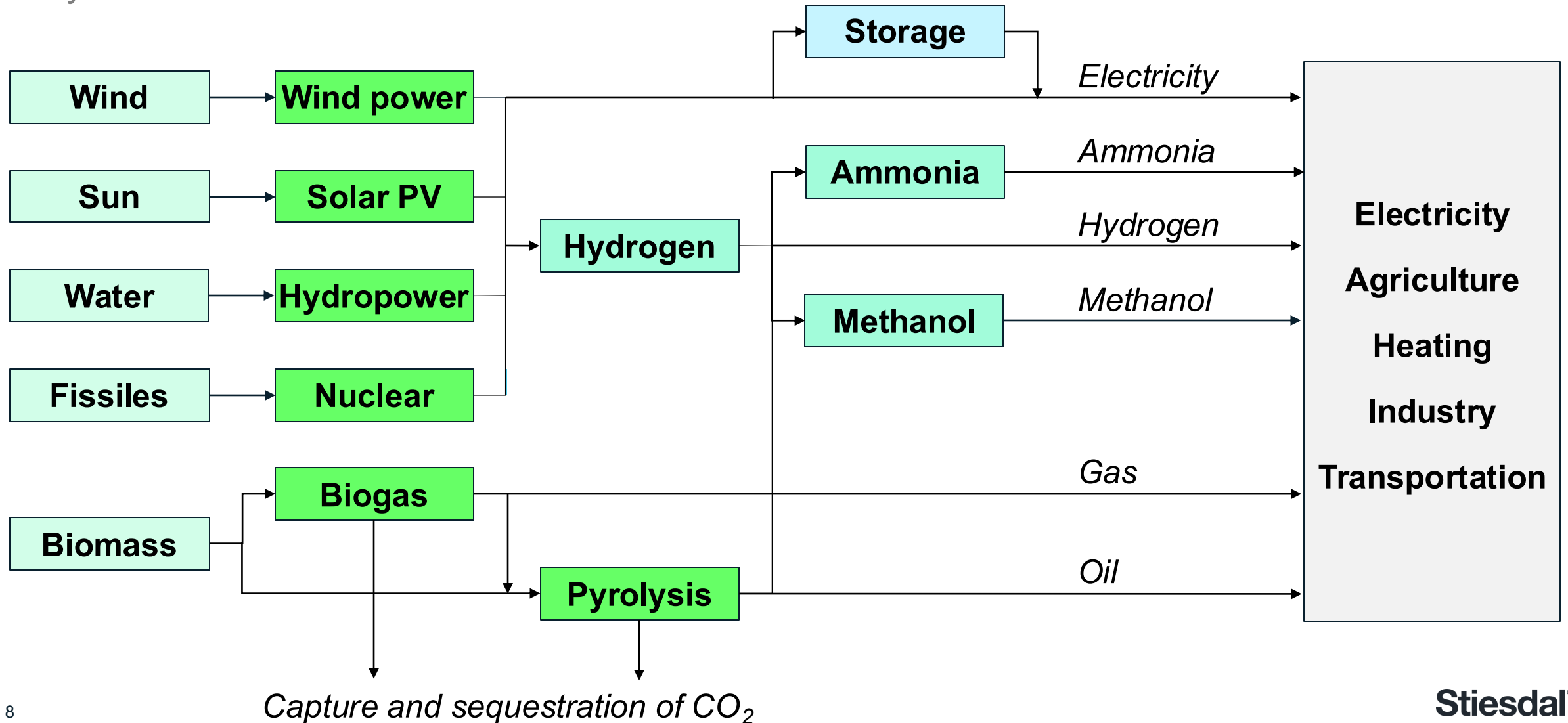
Europe must accelerate the transition of the energy system

An independent, affordable and clean energy system will underpin competitiveness



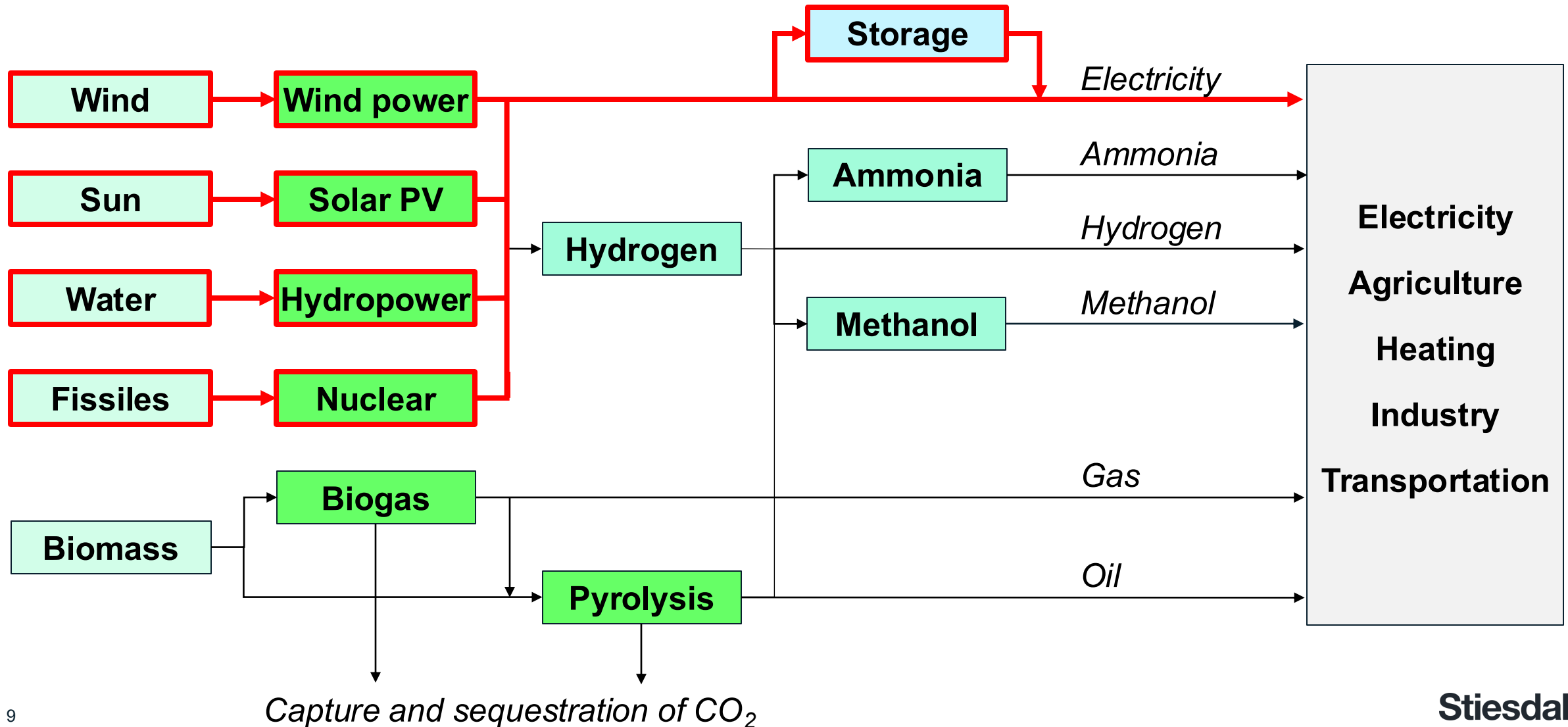
An independent, affordable, and clean energy system

We can meet all of society's needs without new technologies; we just need scale, and a grid that can carry it



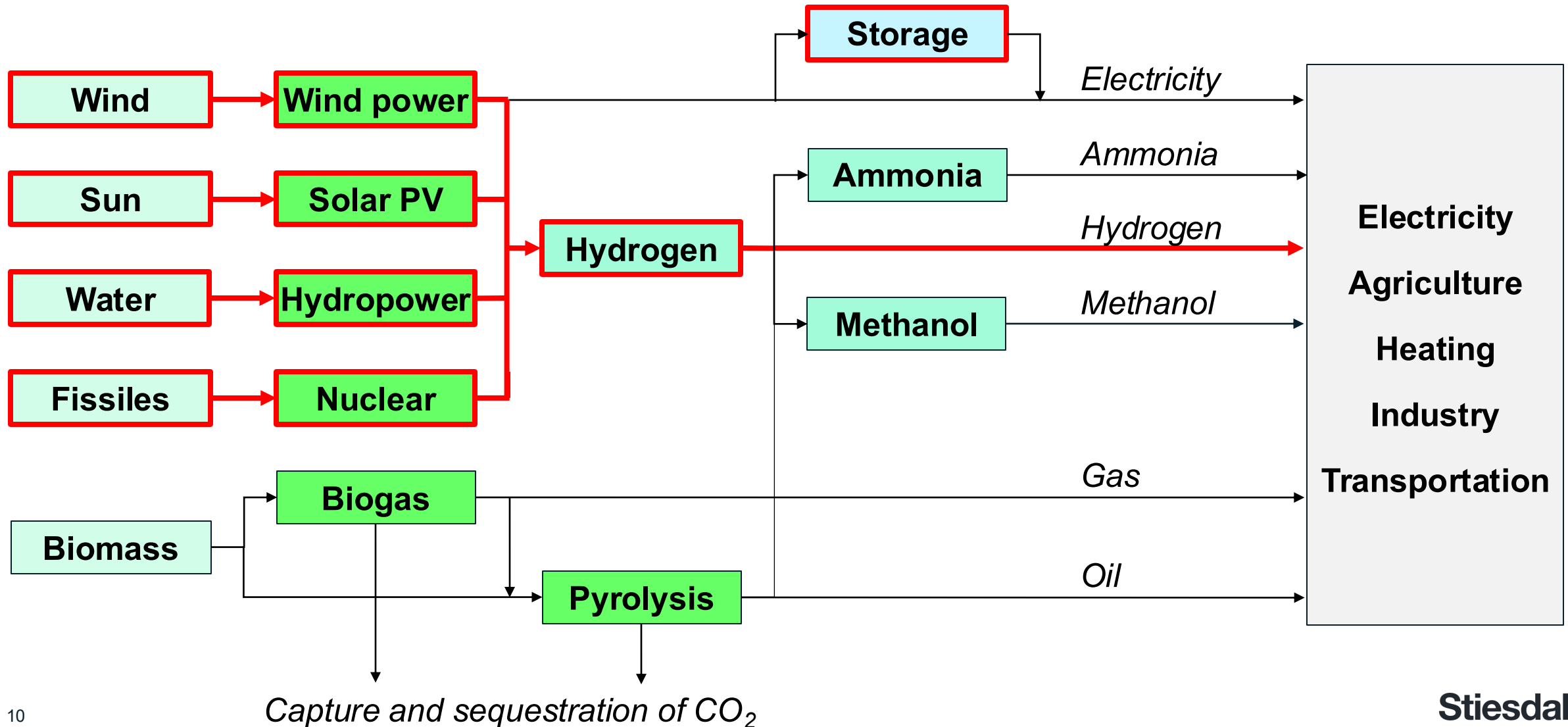
An independent, affordable, and clean energy system

The hierarchy is simple: Everything that can be electrified must be electrified



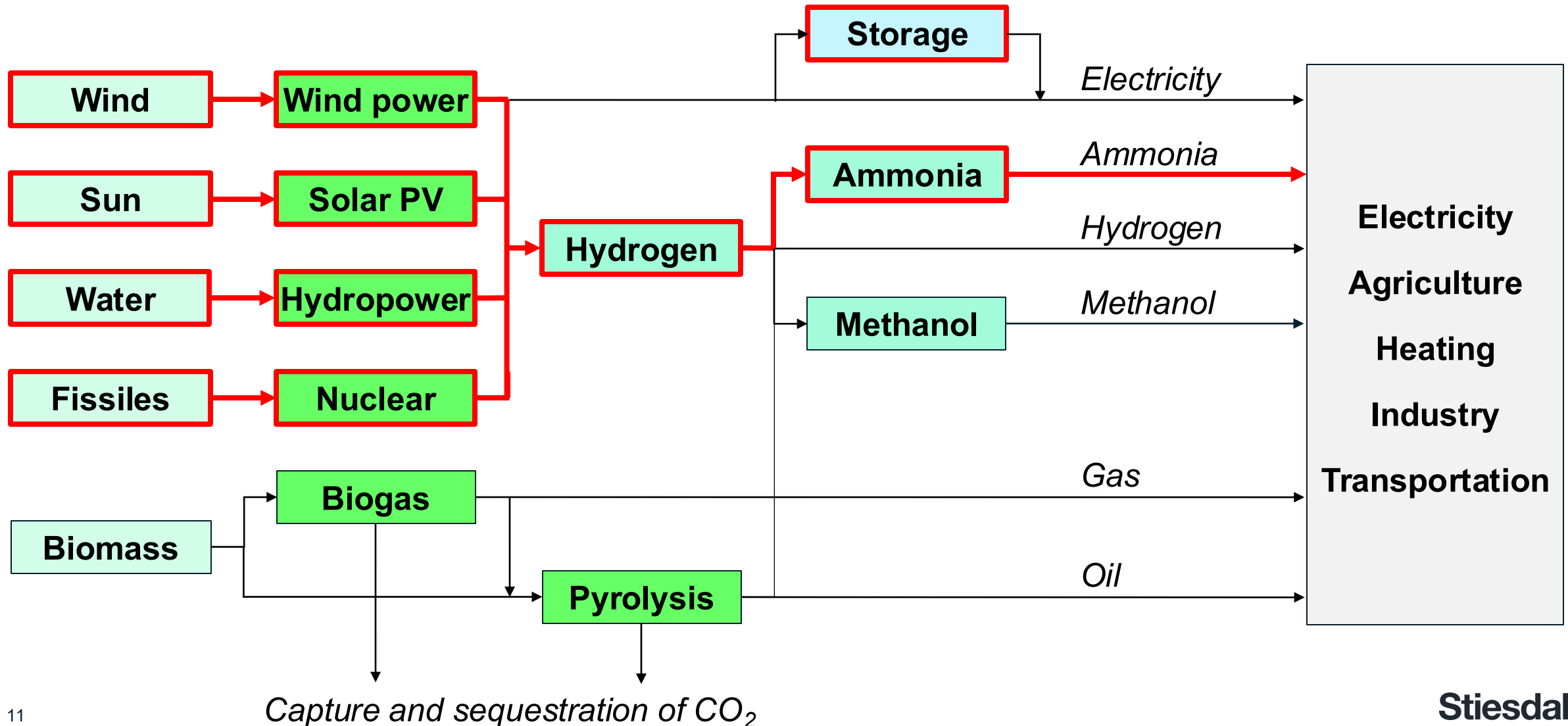
An independent, affordable, and clean energy system

Where direct electrification is not possible, hydrogen is the universal key



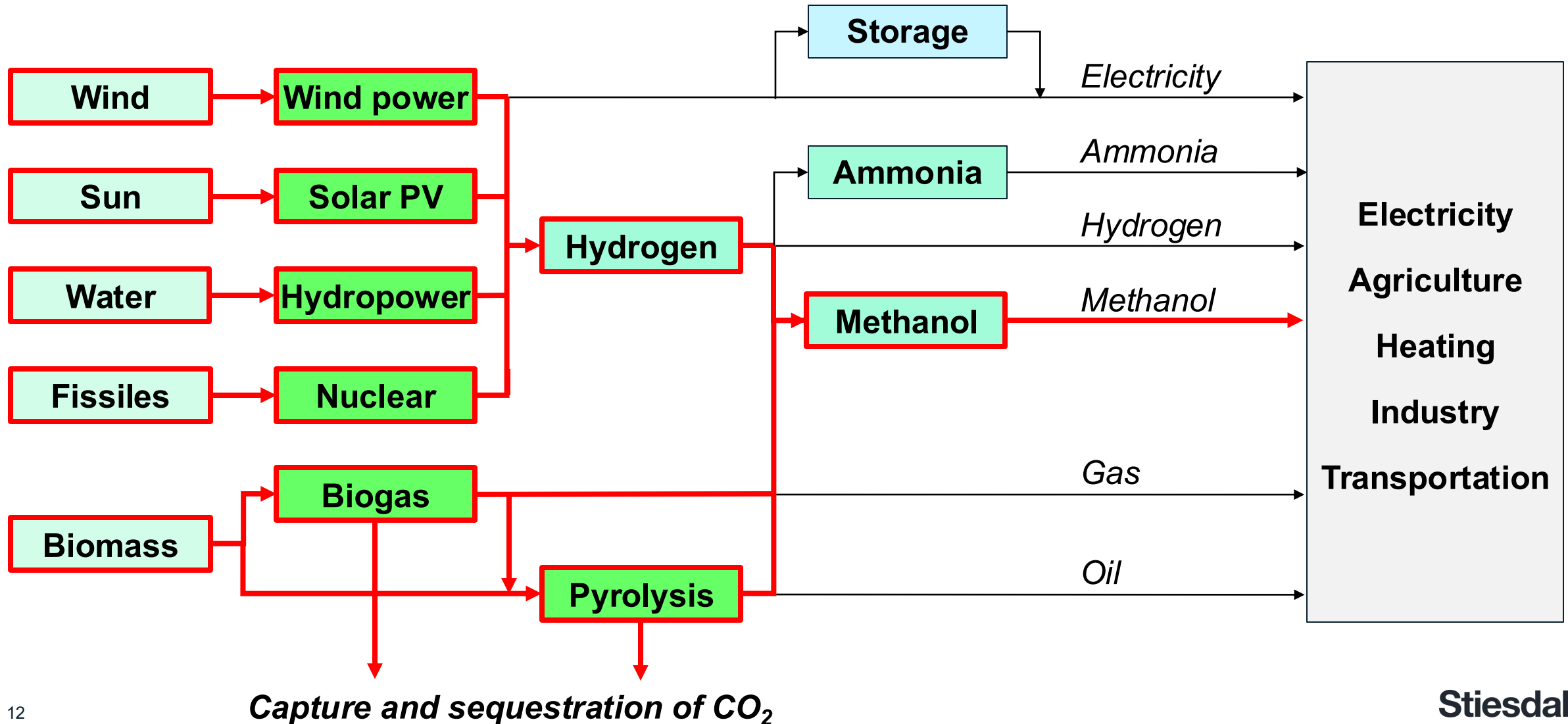
An independent, affordable, and clean energy system

Hydrogen may be converted to ammonia for transportation and for fertilizer and chemical use



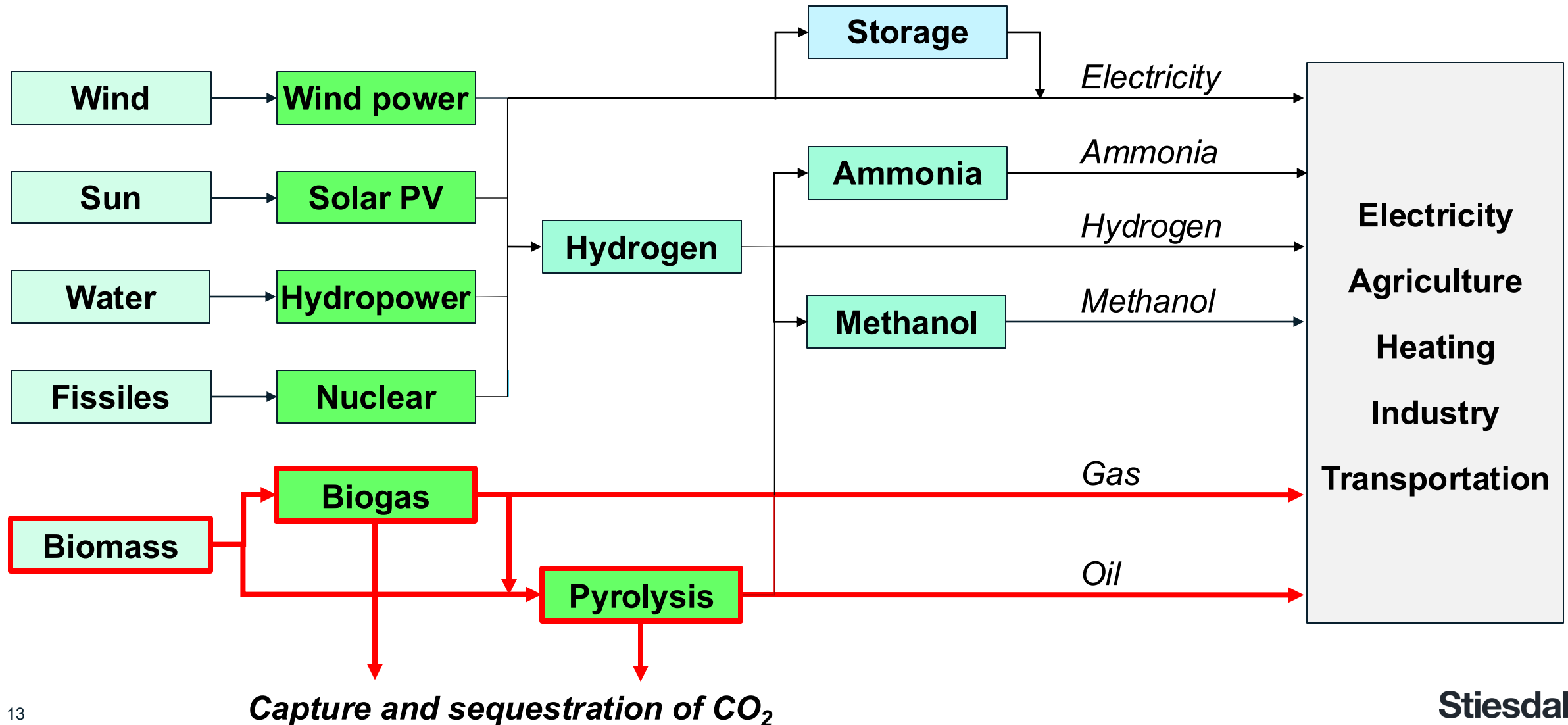
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Hydrogen may also be combined with green carbon for methanol synthesis



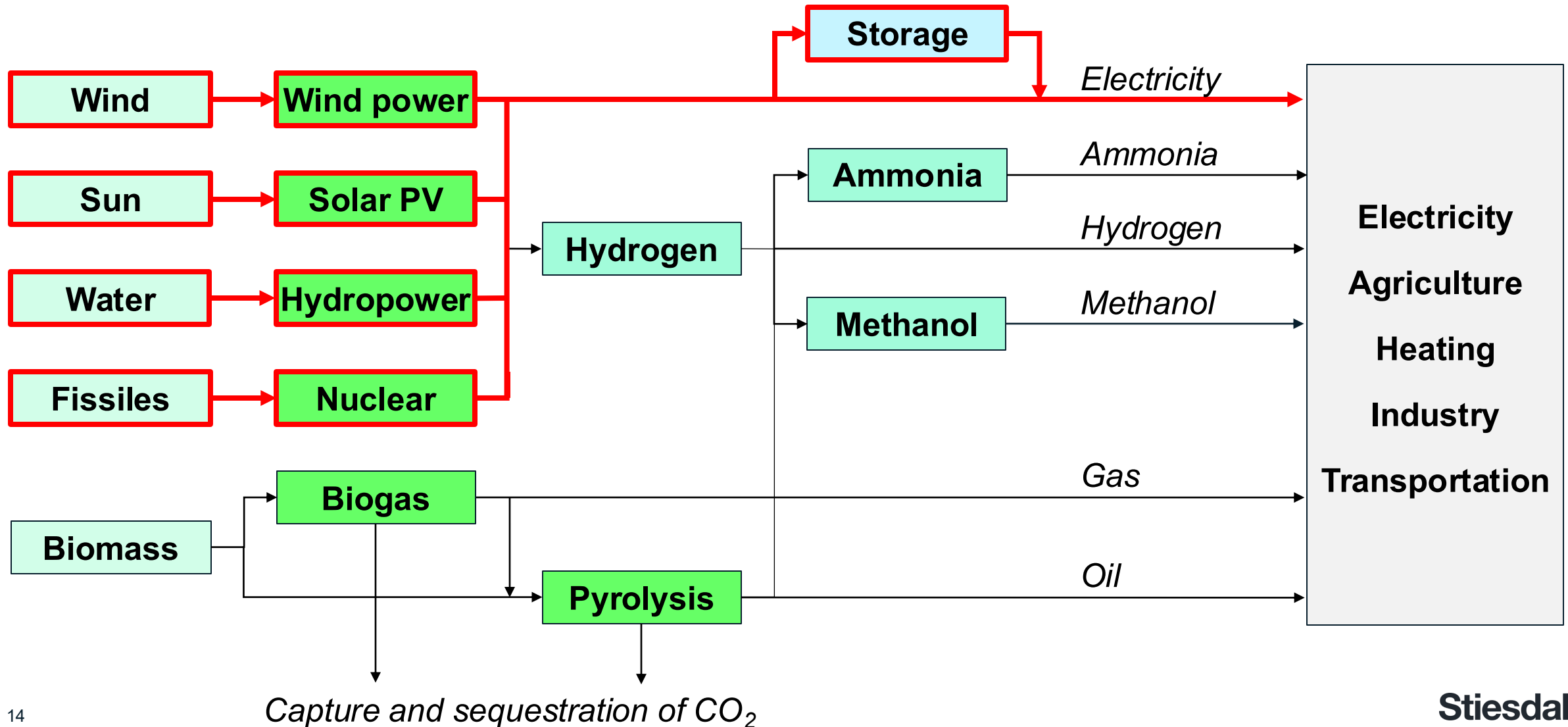
An independent, affordable, and clean energy system

Green carbon fuels may be supplied directly where needed



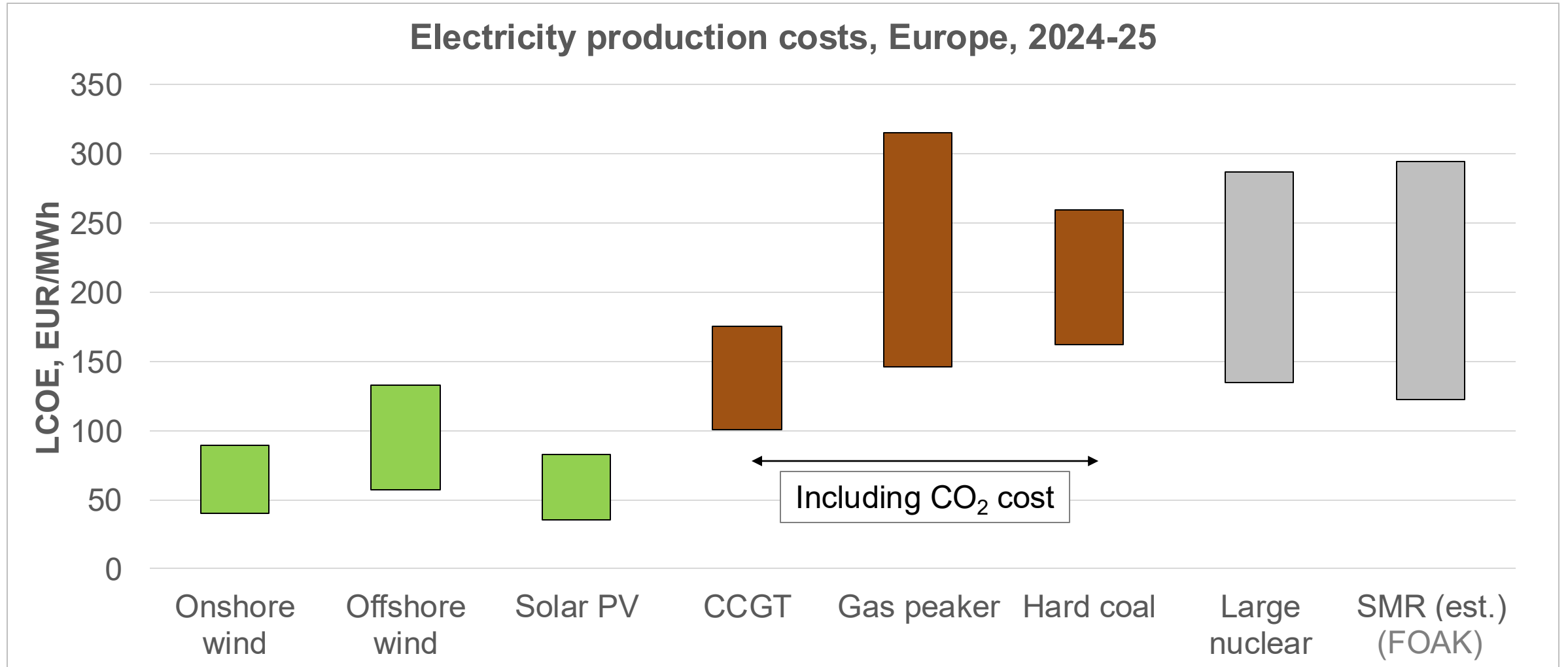
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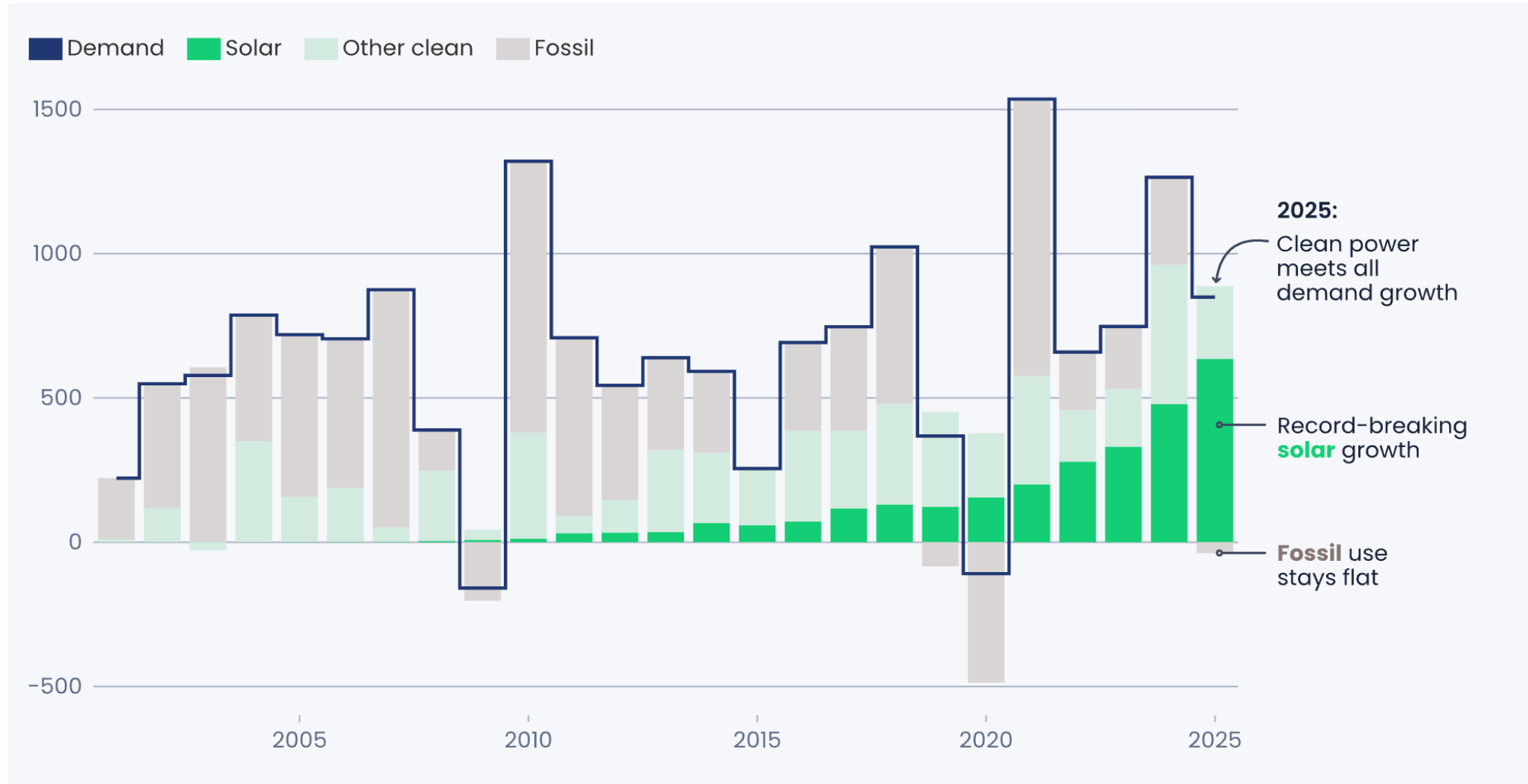
The new energy system boosts competitiveness

Renewables lower system-wide energy costs



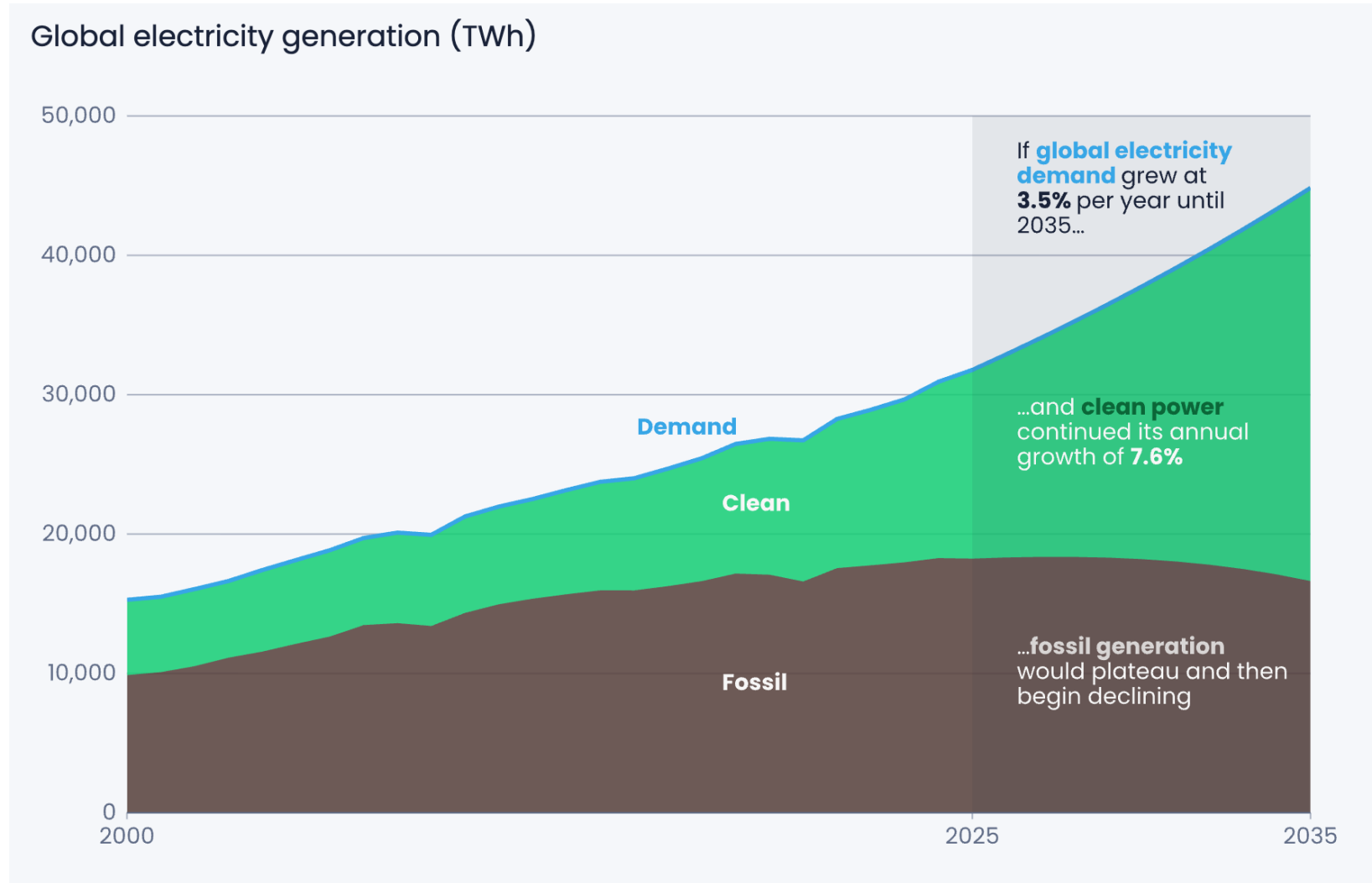
And we are getting there ...

In 2025, the growth in clean energy sources for the first time overtook demand



... with clear (but late) positive consequences for the climate

Indications are that we have reached peak fossil energy

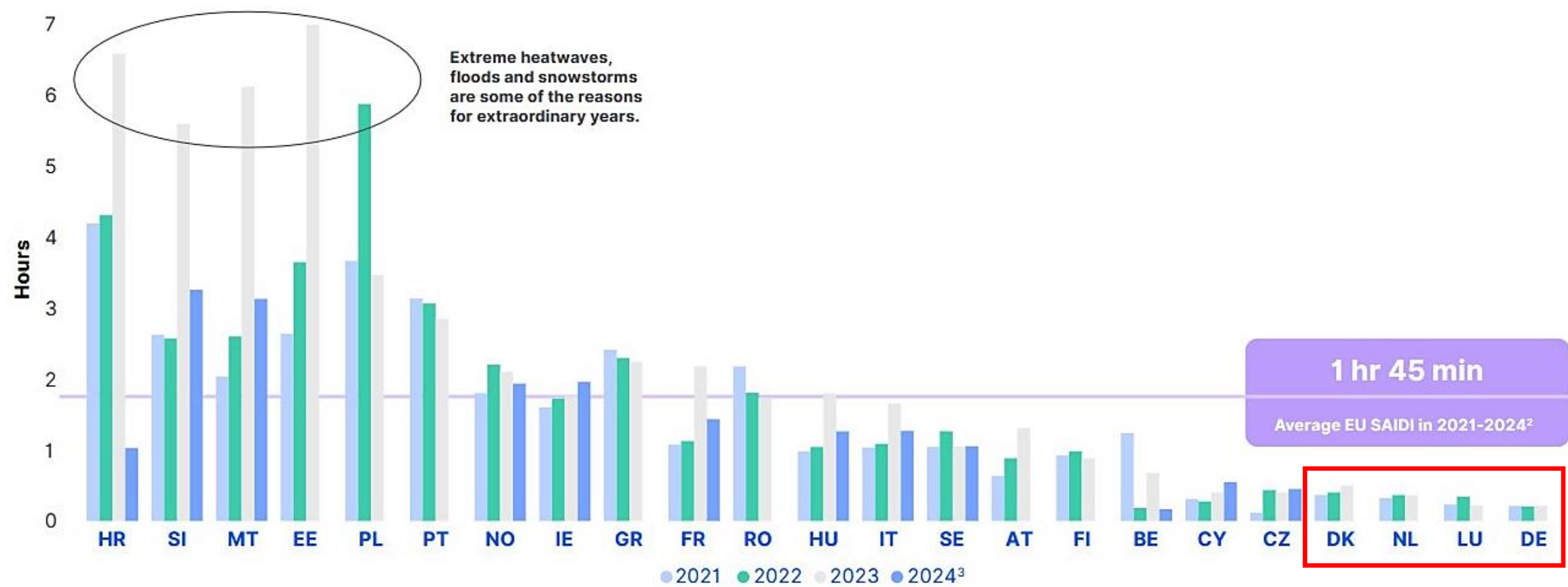


The grid holds up well to the changing conditions

European grid supply reliability is second to none in the world – and with some genuine outliers

How long were the lights out during the year?

System average interruption duration index (SAIDI), EU-27, 2021-2024 (hr)¹



We all benefit from being connected to a larger system

Sharing creates robustness. Still, it has its limitations

The interconnected European power system offers resilience against sudden shocks, largely thanks to its scale. It allows to trade resources efficiently, lowering the costs and provide extra capacity in critical moments.

Still, outages are a reality across Europe. Viewed annually, the average interruption time has remained under 2 hours in recent years. **Notably, not a single one was caused by inadequate supply.**

The largest outages in 2025



28 April

Iberian blackout
Major blackout with
10-hour interruption.
Investigation is ongoing.



4 July

Outages in Czechia
4-hour long interruption
involving Prague.
Investigation is ongoing.

In the future, it will be much more difficult

Overall electrification and new entrants with divergent production/load profiles cause huge challenges



Our networks were built for a world that no longer exists

Designed for controllable generation chasing fixed demand, not variable supply

The system we built

- Large central plants generate continuously
- Consumers draw power whenever they need it
- Generation adjusts to follow demand
- Predictable, dispatchable, one-directional

The system we now have

- Solar generation varies with daylight
- Wind fluctuates with the weather
- Demand patterns stay relatively fixed
- The mismatch lands on transmission and distribution

The grid inherited a problem it was never designed for

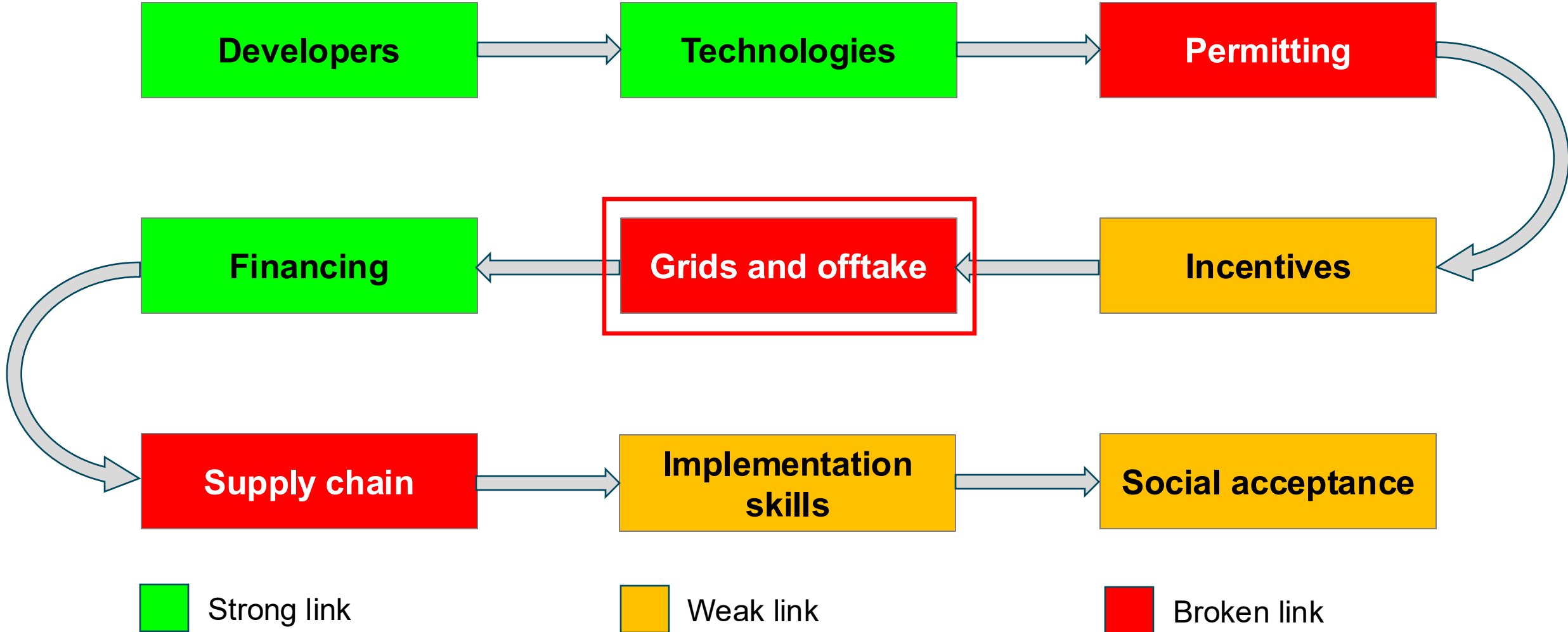
For both producers and consumers, the chain is broken

Our strategy for implementation is no stronger than the weakest link



The real chain of European energy independence

The chain has three types of links – strong, weak and broken



Denmark shows what this looks like in practice

When the demand to connect outruns the ability to connect

7 GW

Peak electricity demand

60+ GW

In the grid connection queue

Paused

New connection agreements, 2026

And Denmark is just the canary in the coalmine

~1,700 GW

Renewable projects in European connection queues,
16 countries, 2024

> 50%

Of the transmission needed by 2030 still awaits
permits

Curtailment and congestion cost reached about EUR 8.9 billion in 2024

Grid access, not generation, is now the binding constraint

We cannot build our way out of this

The instinct is more cables and substations, but utilisation is the real lever

A build-led grid

- Sized to the maximum peak
- Around 50 percent average utilisation under N-1
- Capital-heavy and slow to permit
- Expensive infrastructure that sits largely unused

A utilisation-led grid

- Flexible demand and storage flatten the peaks
- Existing assets carry far more energy
- New build is deferred, not avoided
- Capacity factor, not nameplate, becomes the metric

The cheapest new grid capacity is the capacity we already have

The flexibility already exists, but we act as if it does not

Millions of small, controllable assets could add up to system-scale capacity

1

Electric vehicle fleets

- Denmark already has over 1 million EVs; on standard 11 kW chargers they exceed the entire national peak demand

2

Cold storage, industry and hydrogen

- Refrigerated warehouses, industrial processes and hydrogen electrolyzers can typically shift in time when designed for variable load

3

Data centres and clusters

- Large loads can balance flexibly and present a stable profile to the operator

4

The real gap is recognition

- The technology is not new; the system still operates as though it is not there

A million EVs is a power plant we are choosing not to use

The hardest part is not technical

Moving from unlimited power on demand to a dynamic supply and demand relationship

The inherited assumption

- Unlimited power available must be at any moment
- Generators carry the duty to meet demand
- Grid access itself is the product
- Rational in a fossil, dispatchable system

What a renewable system needs

- Flexibility is rewarded, not penalised
- Demand becomes an active participant
- Coordination is the product
- Innovation in markets and regulation, not only hardware

The grid is not just hardware, it is coordination

Treat standalone storage as a primary grid asset

Not a bolt-on to generation or demand, but a distinct category in its own right

How storage is treated today

- An accessory to other assets
- Credited only for reducing its owner's draw
- One element inside a virtual power plant
- At risk of ranking last in the connection queue

How it should be treated

- A distinct project category
- Rewarded for active system services delivered
- Among the fastest to commission, 12 to 18 months from FID
- UK fleet past 5 GW, heading to 25 to 30 GW by 2030

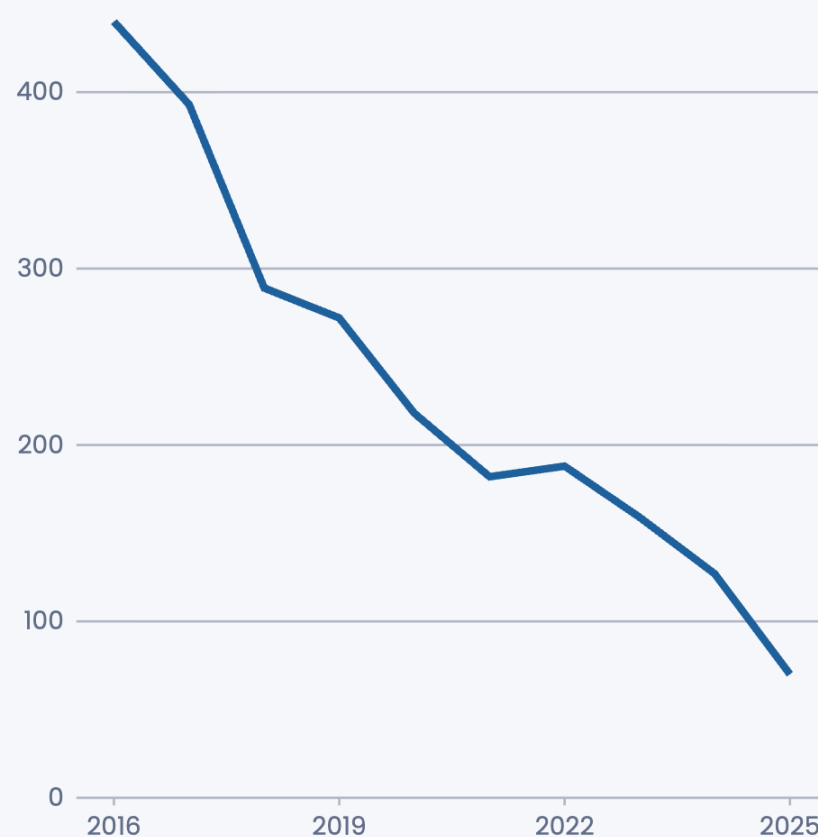
A regulated battery can be more grid-friendly than a flat industrial load

The development in storage cost is incredible

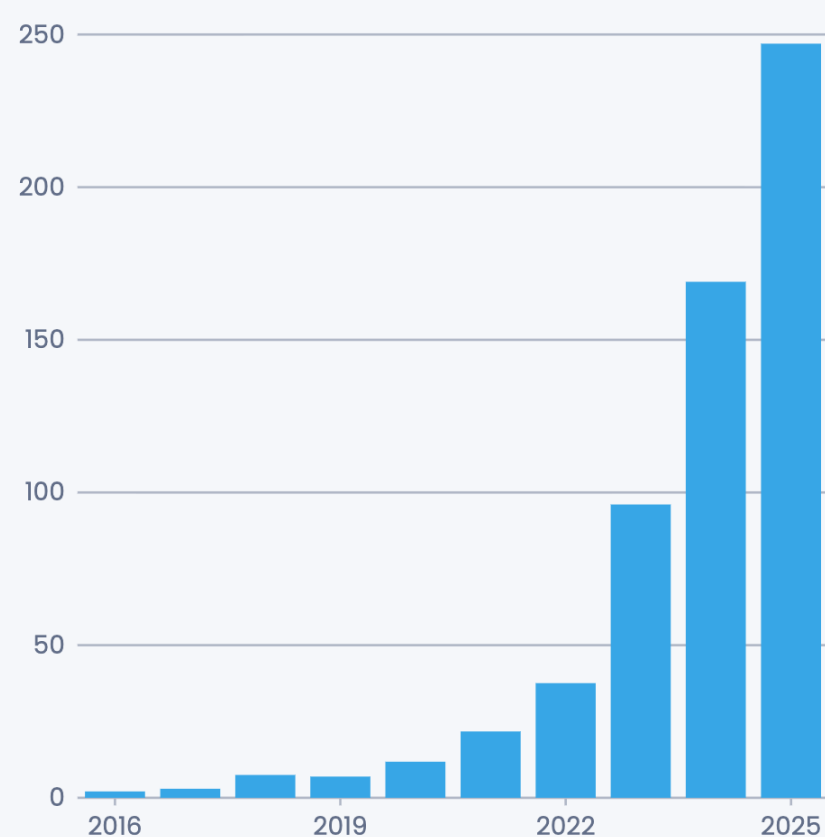
Battery costs just keep dropping

Battery prices continued their free fall in 2025 while installations are surging

Battery pack price - stationary storage (USD/kWh)

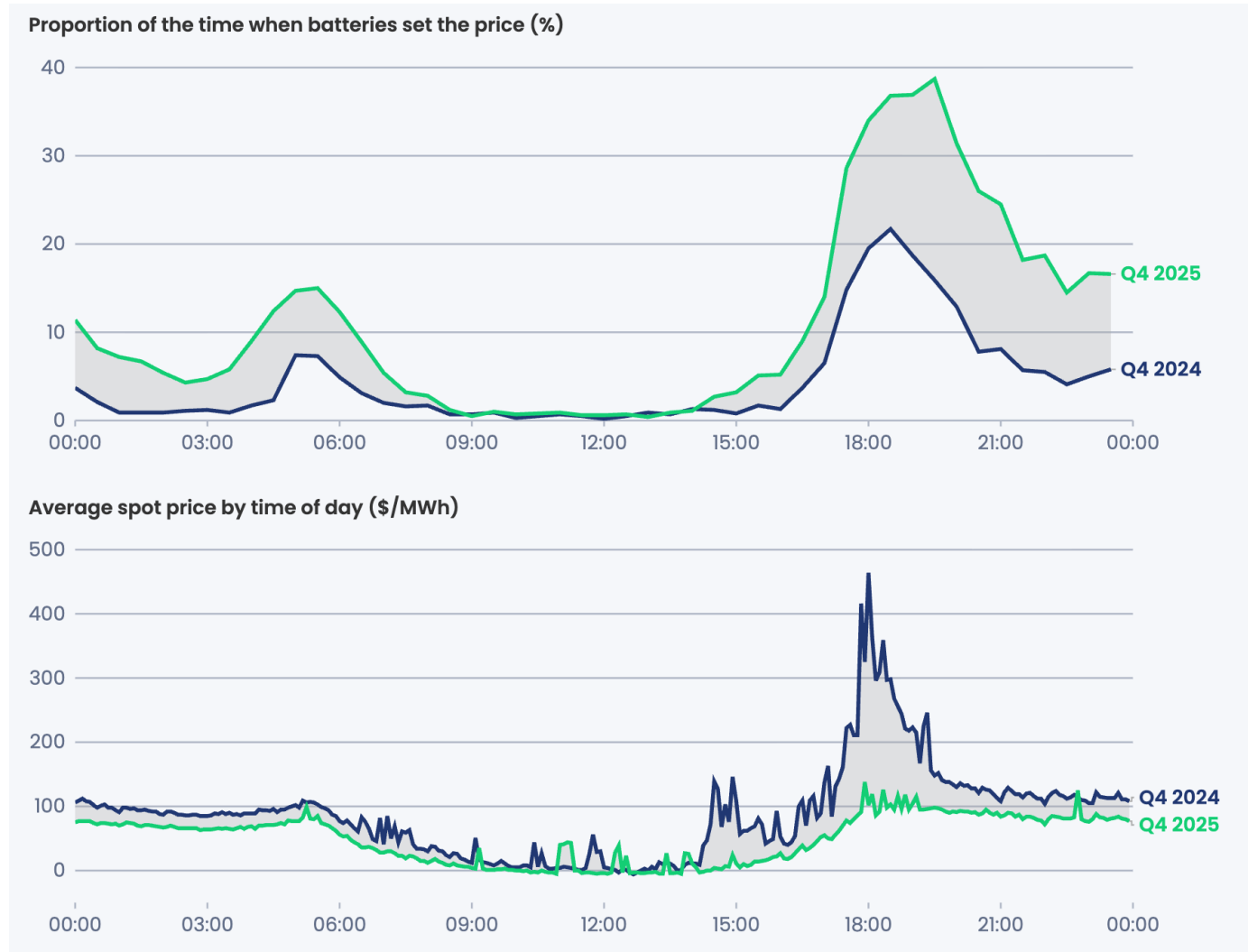


Battery storage capacity additions (GWh)



The effects are immediate, and positive

Batteries have changed the pricing dramatically



Fix the queue before fixing the wires

From first come first served to grid-friendly and first ready first served

- 1 Grid-friendliness criterion**
 - Reward willingness to be curtailed, contracted draw below installed capacity, co-location
- 2 First ready, first served**
 - Capacity goes to mature projects that can actually be built, not to whoever applied first
- 3 Milestone and security gates**
 - Permits, land and financial security required to hold a place in the queue
- 4 Flexible connection agreements**
 - Faster, cheaper access in exchange for accepting limits in a defined share of hours

Prioritise the projects that strengthen the system, not those that queued earliest

Grid-friendly technologies

Both producers and consumers can serve the grid



Make the price signal tell the truth

Tariffs that reflect when and where the grid is actually stressed

Today's tariff

- Based on energy and contracted capacity
- Blind to coincidence with system peak
- Blind to location on the network
- Charges for access, not for burden imposed

A truthful tariff

- Granular in time and in location
- Rewards grid-friendly behaviour
- Defers network investment
- Interim step, publish peak-period forecasts

Reward the behaviour that defers the next billion in build

Get more out of the wires we already have

Non-wire solutions can defer or replace conventional reinforcement

Dynamic ratings

- Dynamic line and transformer rating release headroom that fixed seasonal limits leave unused

Power-flow control and topology

- Advanced power-flow control and topology optimisation route energy around bottlenecks

Capacity maps and AI queue

- Forward-looking capacity maps, real-time transparency and AI-assisted application validation

Strategic storage at nodes

- Supplement producer and consumer flexibility with T&D level storage, batteries for short-term, hydrogen for long-term

More capacity from the same corridors, faster than new corridors

Most of the demand sits where planning is weakest

The biggest flexibility prize is on the distribution grid

The gap

- Most demand is, and stays, on distribution
- Transmission-level reform alone is insufficient
- Planning is siloed between TSO and DSO
- Limited and non-firm products rarely reach the DSO level

The fix

- Integrated, jointly owned development plans
- Shared scenarios and real-time load data
- Coordinated connection-point decisions
- Co-location and overplanting rules, already approved in Denmark

A transmission solution that stops at the substation is only half a solution

Europe is building its energy super-highways

The December 2025 EU Grids Package and the eight Energy Highways

EUR 1.2 tn

Electricity grid investment needed by 2040, EUR 730
bn distribution alone

8

Energy Highways designated for accelerated cross-
border delivery

Bornholm Energy Island, a 3 GW Danish-German hub, is the flagship first delivery

The hardware answer is being funded, now it needs the flexibility answer beneath it

Baltic Energy Island

Combining system integration with renewable generation



The system-thinking case is no longer contrarian

The EU Grid Connection Guidance now recommends what this talk argues

- 1 Beyond first come first served**
 - Milestone-based prioritisation and structured connection criteria, now EU guidance
- 2 Flexible connection agreements**
 - Non-firm access explicitly recommended to unlock grid-friendly projects, now EU guidance
- 3 Time and location tariffs**
 - Locational and time-of-use network signals endorsed, now EU guidance
- 4 Non-wire solutions**
 - Dynamic ratings, power-flow control and digitalisation made eligible, now EU guidance

What was contrarian engineering is now European policy

Does a renewables-heavy grid stay reliable? Yes.

Even without storage, but with good interconnectors, Denmark's system works really well

~99.99%

Supply availability

~23-27 min

Outage minutes per year

60-63%

Wind and solar share of
consumption

High renewables and high reliability are not in conflict, the evidence is in

We will need a combination of solutions

The most efficient build-out requires innovation across the board

Grid planning

- Grid planning should be carried out with reference to the EU super-highway concept where relevant
- Planning should assume flexible producer and consumer requirements

Grid software

- Advanced power-flow control and topology optimisation for routing energy around bottlenecks and mobilising producer and consumer services

Grid hardware

- Basic grid hardware is not expected to change much
- Certain new technologies will be required, including hardware for direct control of battery charging

Producer / consumer interface

- Significant efforts required to make producers and customers aware and cooperative on new arrangements
- New mindset required and entirely logic, but needs effort

The task is significant, but the solutions are straightforward

Tackling the energy transformation is not easy!

When considering the task ahead of us, we can take inspiration from Chinese Mandarin language

Crisis

Weijī

危机

Danger

Opportunity

Thanks for your attention



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