UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Ministry of Trade & Industry
وزارة التجـــارة والصـناعة

EGYPT
GEIPP
GLOBAL ECO-INDUSTRIAL PARKS PROGRAMME

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Economic Affairs SECO

MODULE 2: GUARANTEES OF ORIGIN IN EUROPE

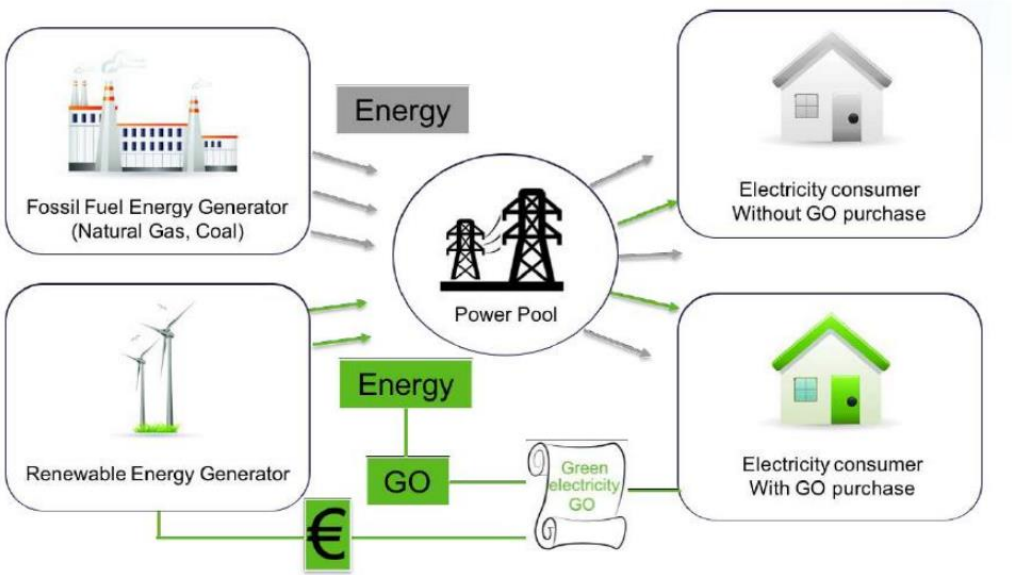
Development of Roadmap for Green Hydrogen Ecosystem in the SCZone (Sokhna). Training

INDEX

INDEX

INTRODUCTION

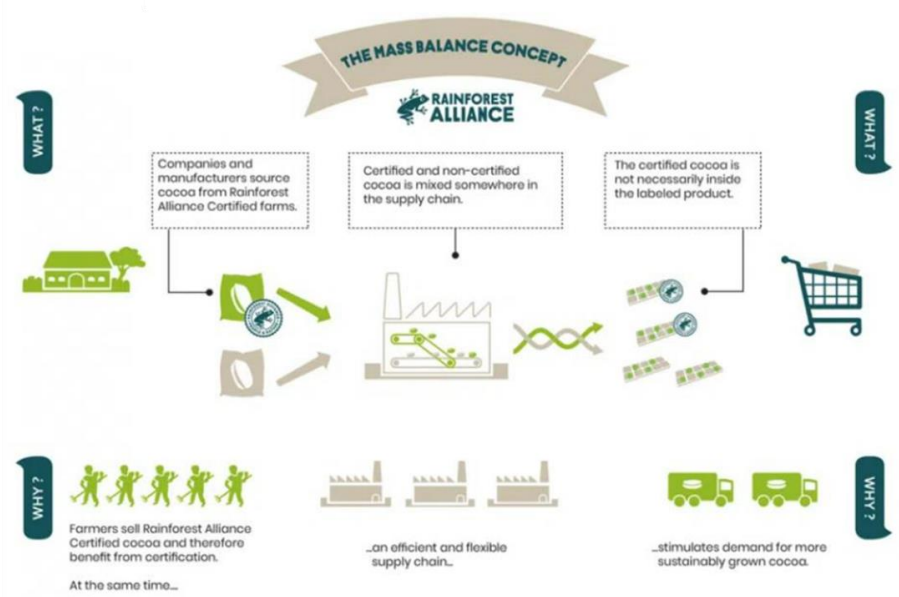
Introduction to Guarantees of Origin



INTRODUCTION

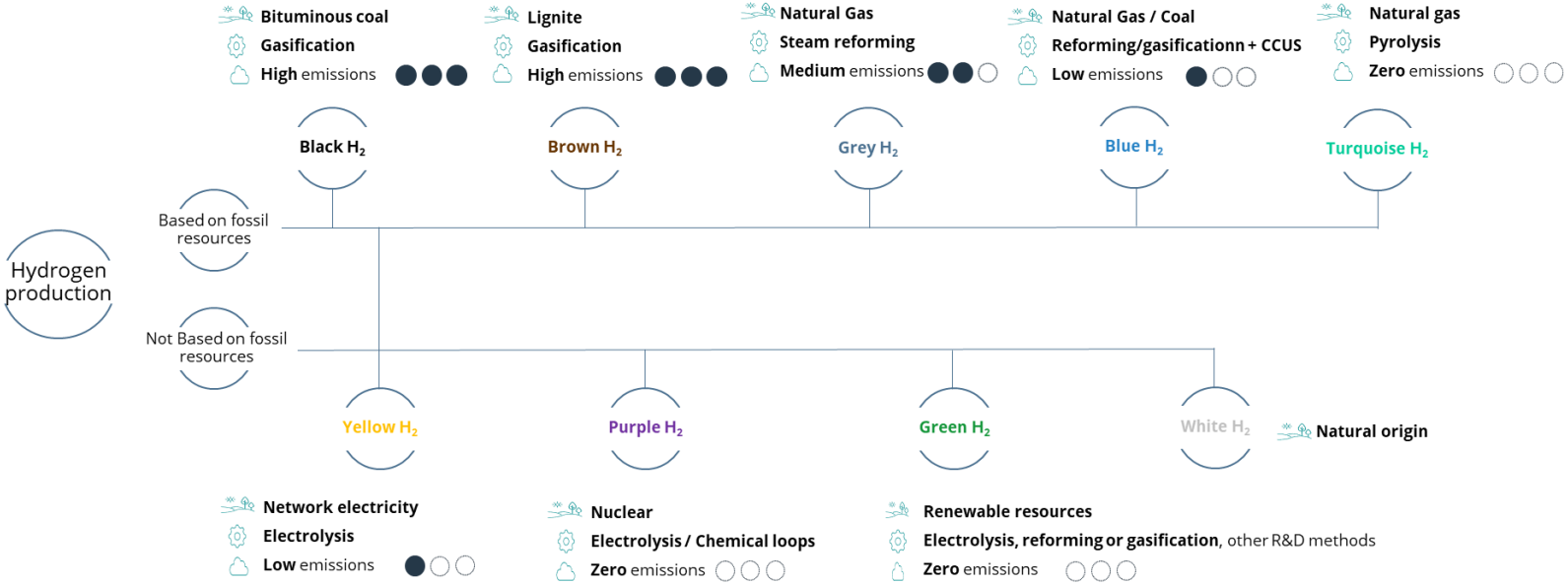
Introduction to Guarantees of Origin

1. **Renewable energy generation:** Renewable energy is produced in power plants.
2. **Guarantees of Origin (GoOs):** Each unit of renewable energy generated is associated with a Guarantee of Origin certificate (GoO) that confirms its renewable source and generation details.
3. **Registration and tracking:** GoOs are registered and tracked in a centralized system, with unique identification numbers and detailed information about the generating plant, the amount of energy generated, the renewable source type, and the generation period.
4. **Purchase and consumption of renewable energy:** Energy consumers can buy renewable energy and receive GoOs to support their consumption. The purchased energy is backed by GoOs that demonstrate its renewable origin.
5. **Retirement of Guarantees of Origin:** When a consumer purchases renewable energy, an equivalent amount of GoOs is retired from the centralized system. These retired GoOs are considered "used" and cannot be reused or resold.
6. **Mass balance:** Mass balance is performed by comparing the amount of renewable energy generated and the GoOs retired from the system with the amount of renewable energy consumed and the GoOs used by consumers. The aim is to ensure that the withdrawn GoOs match the consumed renewable energy.



INTRODUCTION

Colours of hydrogen



INDEX

WAYS TO DECARBONISATION

Low carbon hydrogen

H_2 Blue

Pros
- Valorisation of existing infrastructures
- Scalability, profitability

Cons
- Minimising GHG emissions
- What to do with CO2?
- Maintain fossil dependence

Natural gas / Coal

Reforming / Gasification + CCUS

H_2 Turquoise

Natural Gas

Pyrolysis

Pros
- Two value-added products
- Zero GHG emissions

Cons
- Low market volume of solid carbon
- Maintains fossil dependence

H_2 Purple

Pros
- Constant power (improved electrolyser efficiency)
- Possibility to use the heat

Cons
- Competition with grid electricity use
- High cost, low LRT (cycles)

Nuclear

Electrolysis / Termochemical loops
- S - I
- Ca – Br
- HyS
- Cu- Cl

H_2 Yellow

Network electricity

Electrolysis

Pros
- Constant power (improved electrolyser efficiency)
  o
- Flexibility of electrical system

Cons
- Regulatioin

WAYS TO DECARBONISATION

Green hydrogen

Electrolysis

Water + Electricity (+ Heat) = Hydrogen + Oxygen

- Alkaline
- PEM
- SOEC
- AEM

Pros

- Zero GHG emissions
- Increased RES-E penetration in electricity mix

Cons

- Continuing to improve efficiency
- Adaptability to variable renewable resource
- Scalability
- Cost (CAPEX, optimisation...)

Biomass and biological processes

Biomass/biogas/bioalcohols thermochemical processes:
- Gasification
- Steam reforming
- Pyrolysis
- Aqueous reforming
- Partial oxidation

+

Biological processes:
- Biological Water Gas Shift (BWGS)
- Dark fermentation
- Photofermentation
- Algae (photobiological water splitting)

Pros

- Net zero emissions (but possible local CO2 emissions)
- Negative net emissions possible (combined with CCUS)

Cons

- Competition with other uses of biomass
- Increasing TRL and improving scalability of biological processes

Other R&D processes

- Photoelectrocatalysis of wáter
- Water thermolysis
- Thermochemical cycles
- Waste + plasma
- ...

Pros

- Zero GHG emissions
- High potential

Cons

- Profitability
- Increase TRL and improve scalability

INDEX

CERTIFICATION SCHEMES AND G.O.

G.O. Necessities

The Guarantee of Origin (GO) provides consumers with accurate information about the origin of the product they are buying.
Through a traceability system, it ensures the quality of the final product, in this case the $H2H_2$

Drivers of green H_2 : why will consumers demand green H_2?

- Regulation and penalisation of polluting emissions (CO2, NOX, SOX, etc.).
- Access to possible subsidies and incentives
- Need for energy storage / Possibility of using renewable energy surpluses
- Company image and environmental commitment

Hydrogen Guarantee of Origin Initiatives:

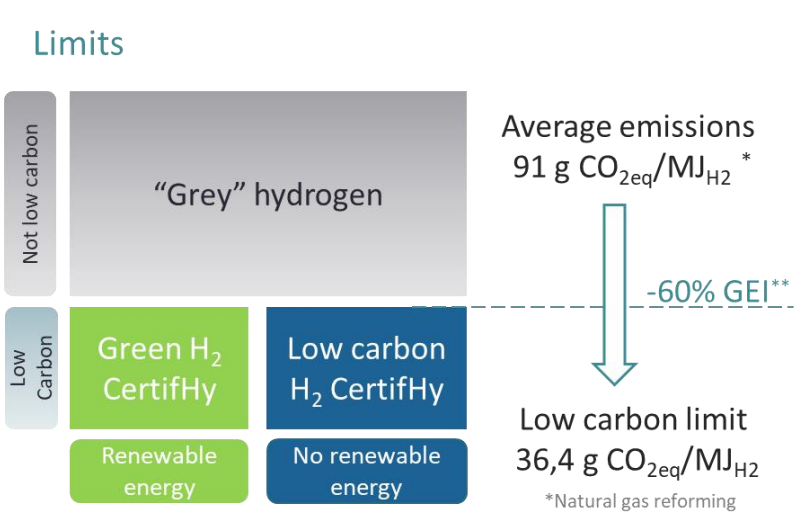
TÜV SÜD
Department of Energy & Climate Change
Clean Energy Partnership CEP
AFHYPAC Association française pour l'hydrogène et les piles à combustible
CertifHy

Designing a European Green Hydrogen Guarantee of Origin

CertifHy

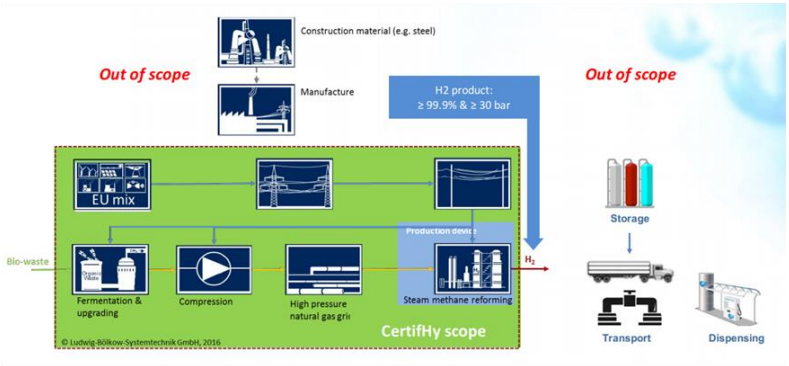
CERTIFICATION SCHEMES AND G.O.

CertifHy – limits



Definition of Green Hydrogen and Low carbon Hydrogen. CertifHy

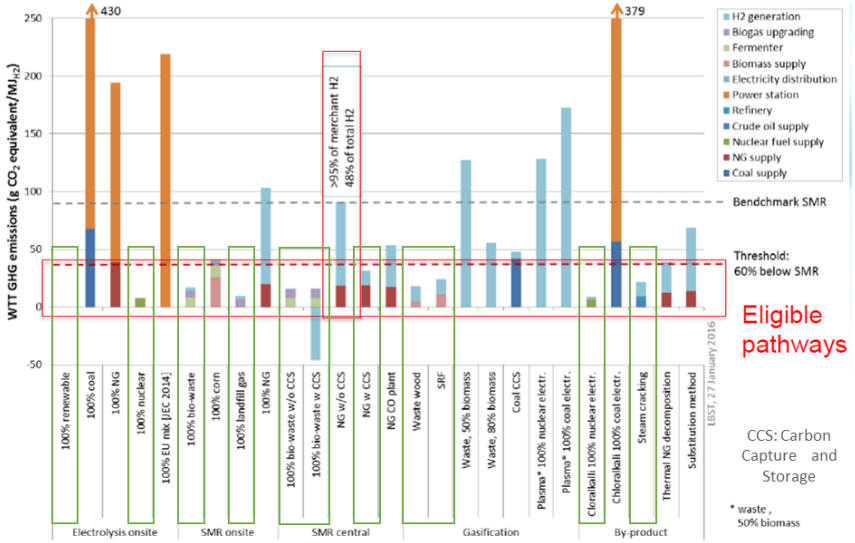
CertifHy®



Source: CertifHy Creating the 1st EU-wide Guarantee of Origin for Green Hydrogen. Webinar. Wouter Vanhoudt

CERTIFICATION SCHEMES AND G.O.

CertifHy – Green hydrogen and low carbon hydrogen production methods

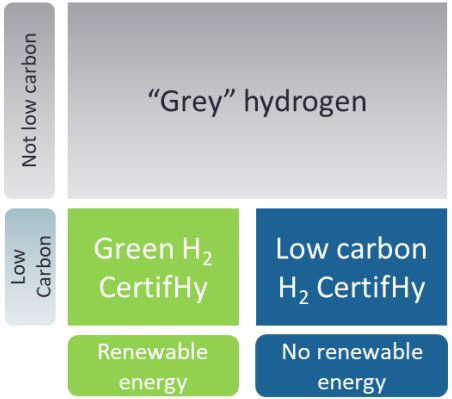


- The RED and FQD* method is used to calculate GHG emissions.
- CO2 emissions from biomass combustion are assumed to be neutral.
- CO2, CH4 and N2O emissions from primary energy extraction to H2** production are considered.
- Emissions associated with the construction and/or decommissioning of the installations involved shall not be considered.

Source: Definition of Green Hydrogen, outcome & scope LCA analysis. CertifHy.

CERTIFICATION SCHEMES AND G.O.

CertifHy – Classification of the hydrogen produced, according to CertifHy



"H_2 will be as green as the energy used to produce it."

All energy that cannot guarantee its origin (GO) will be considered 100% non-renewable (e.g., electricity from the mix)

Examples:

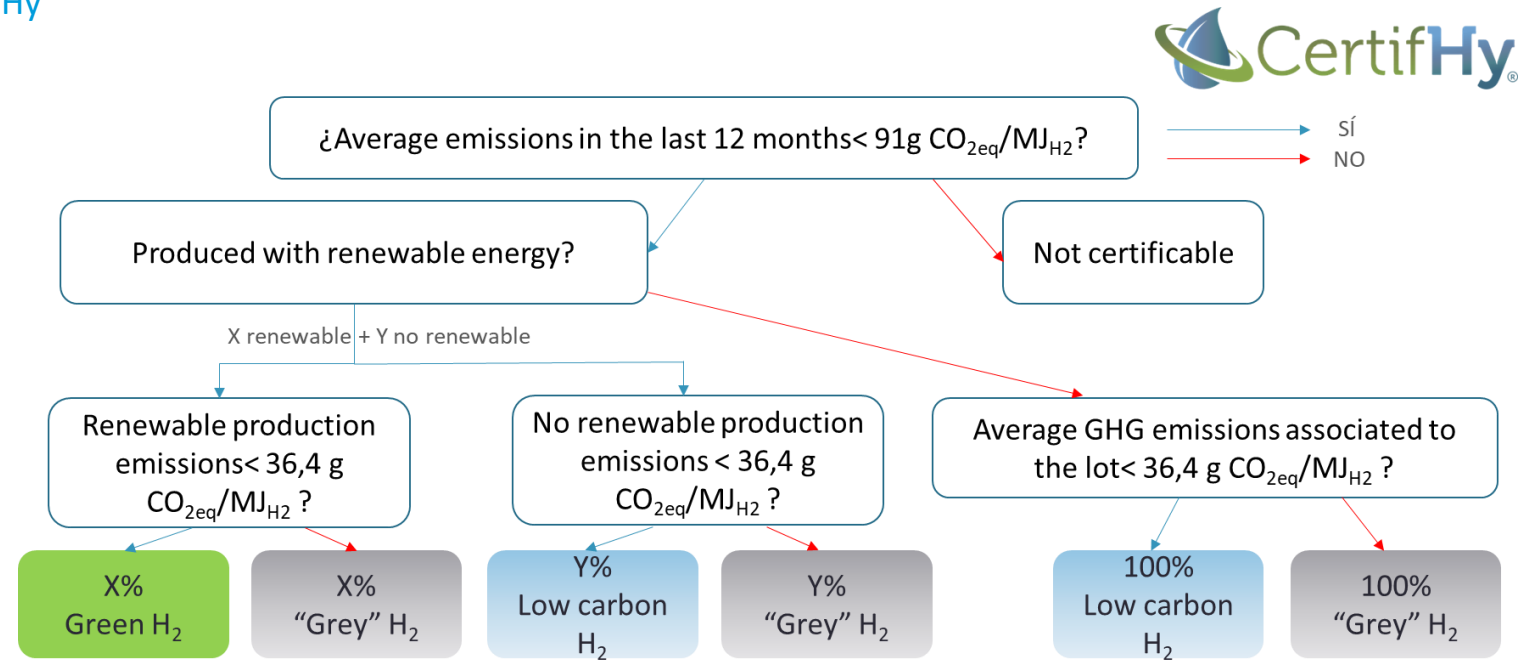
Electrolysis 60% renewable (with GO) + 40% electricity mix = H_2 60% renewable

SMR 70% biomethane (with GO) + 30% Natural Gas= H_2 70% renewable

Source: Definition of Green Hydrogen, outcome & scope LCA analysis. CertifHy.

CERTIFICATION SCHEMES AND G.O.

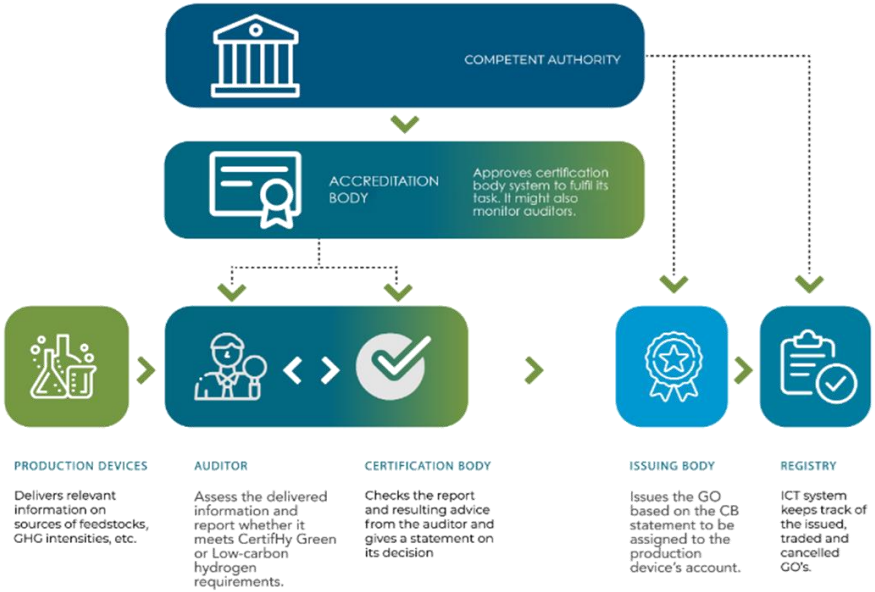
CertifHy



CERTIFICATION SCHEMES AND G.O.

CertifHy – Key players

CertifHy®



CERTIFICATION SCHEMES AND G.O.

CertifHy – Production plants in europe using different methods

CertifHy

Four hydrogen production plants in Europe using different methods:

Port Jerome, France

SMR

NG + CSS

Low carbon H_2

Biomethane

Green H_2

Rotterdam, Netherlands

Chloro-alkaline electrolysis

Green H_2

Halle, Belgium

Electrolysis

Green H_2

Public HRS 08/10/2018

Falkenhagen, Germany

Electrolysis

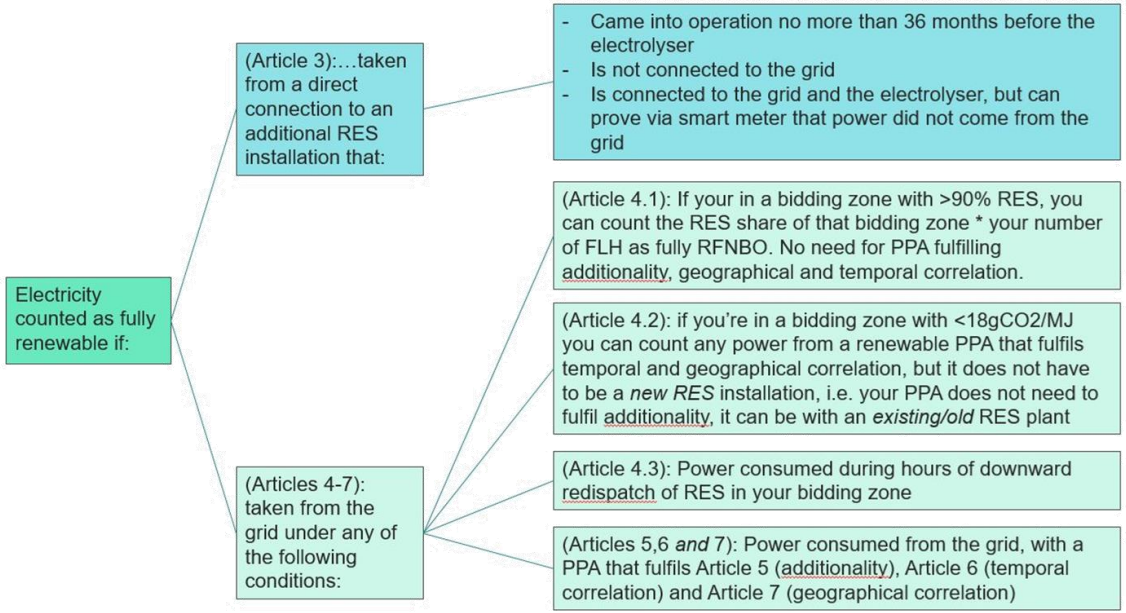
Green H_2

Blending in NG Grid or methanation

INDEX

EUROPEAN DELEGATE ACT

Most remarkable aspects



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Ministry of Trade & Industry
وزارة التجـــارة والصـــناعة

EGYPT

GEIPP
GLOBAL ECO-INDUSTRIAL PARKS PROGRAMME

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Economic Affairs SECO

VISIT THE **UNIDO KNOWLEDGE HUB** FOR MORE RESOURCES ON ECO-INDUSTRIAL PARKS