

International Aspects of a Power-to-X Roadmap



**Results of a study of the WEC Germany in
cooperation with Frontier Economics**

**Weltenergierat – Deutschland
Berlin, 18th October 2018**

Power-to-X is arising as a key topic for the energy transition – nationally as well as internationally

Background and starting point

- The global energy system needs to fundamentally transform towards carbon-neutral energy sources over the next decades to meet the long term goals set in the Paris Agreement.
- The energy transition towards carbon-neutrality is based on a number of key elements such as
 - increasing the efficiencies of energy applications,
 - boosting the supply of renewable energy sources (RES), and
 - deploying other forms of carbon-neutral technologies, such as nuclear power or carbon capture and storage (CCS).



Focus of this study

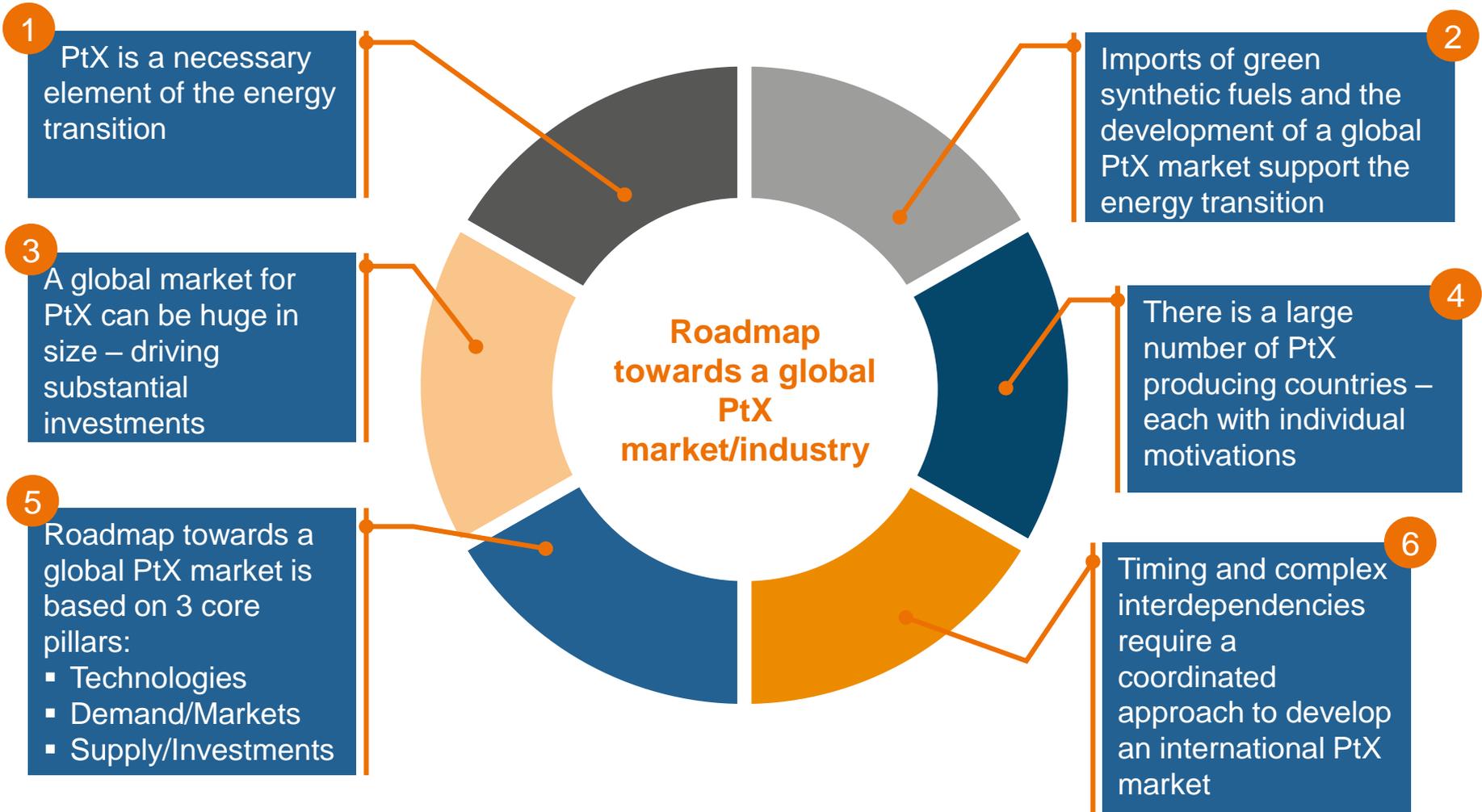
- We focus on synthetic fuels and hydrogen produced from renewable electricity (Power-to-X or PtX), analysing...
 - ...the potential future role of PtX in the global energy transition
 - ...potential PtX exporting countries (case studies)
 - ...the main pillars of a potential roadmap towards a future global PtX market



Approach

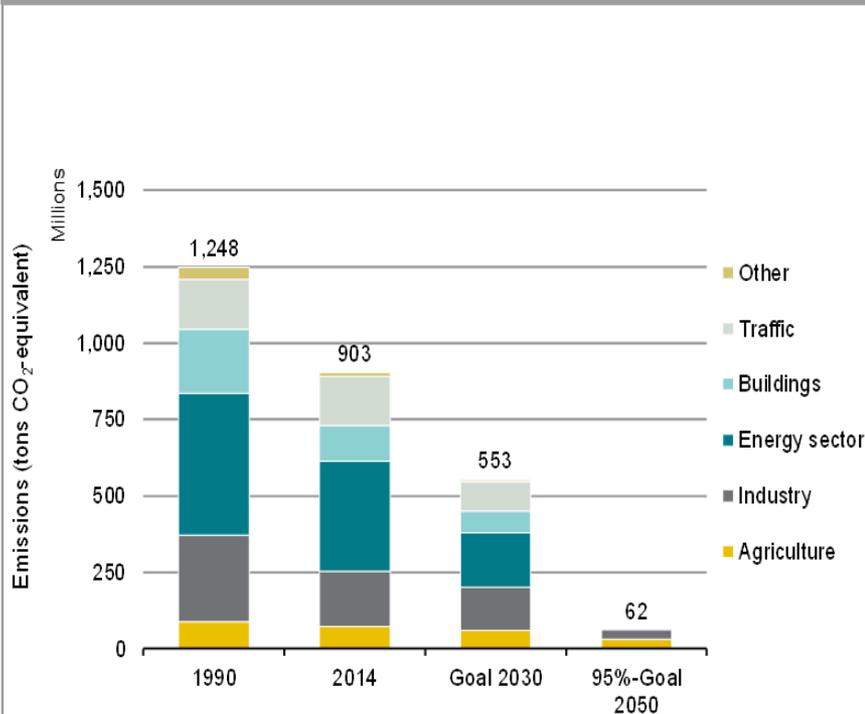
- Desk research
- Three workshops with WEC Germany members
- Interviews with PtX and country experts

The roadmap towards a global PtX industry is based on the requirements and opportunities of the global energy transition



PtX will be a key element for the transition of energy systems towards carbon-neutrality

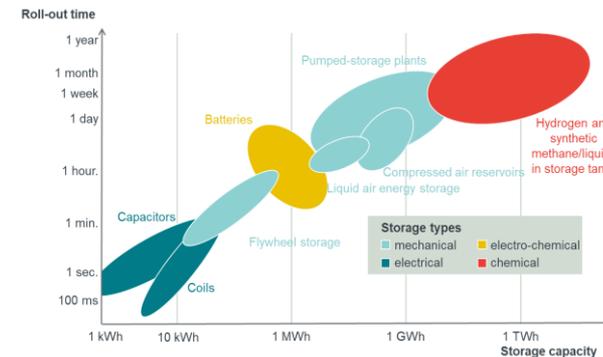
Ambitious climate targets require a de-fossilisation in all sectors



Source: Frontier Economics (historical values based on information from the Federal Environmental Agency: National greenhouse gas inventory 2017, final status 04/2017).

PtX provides essential benefits for the transition towards a carbon-neutral energy system

- Some sectors will inevitably require green synthetic fuels for decarbonisation
- An electricity system based solely on renewables will need massive storing of energy – this requires chemical fuels

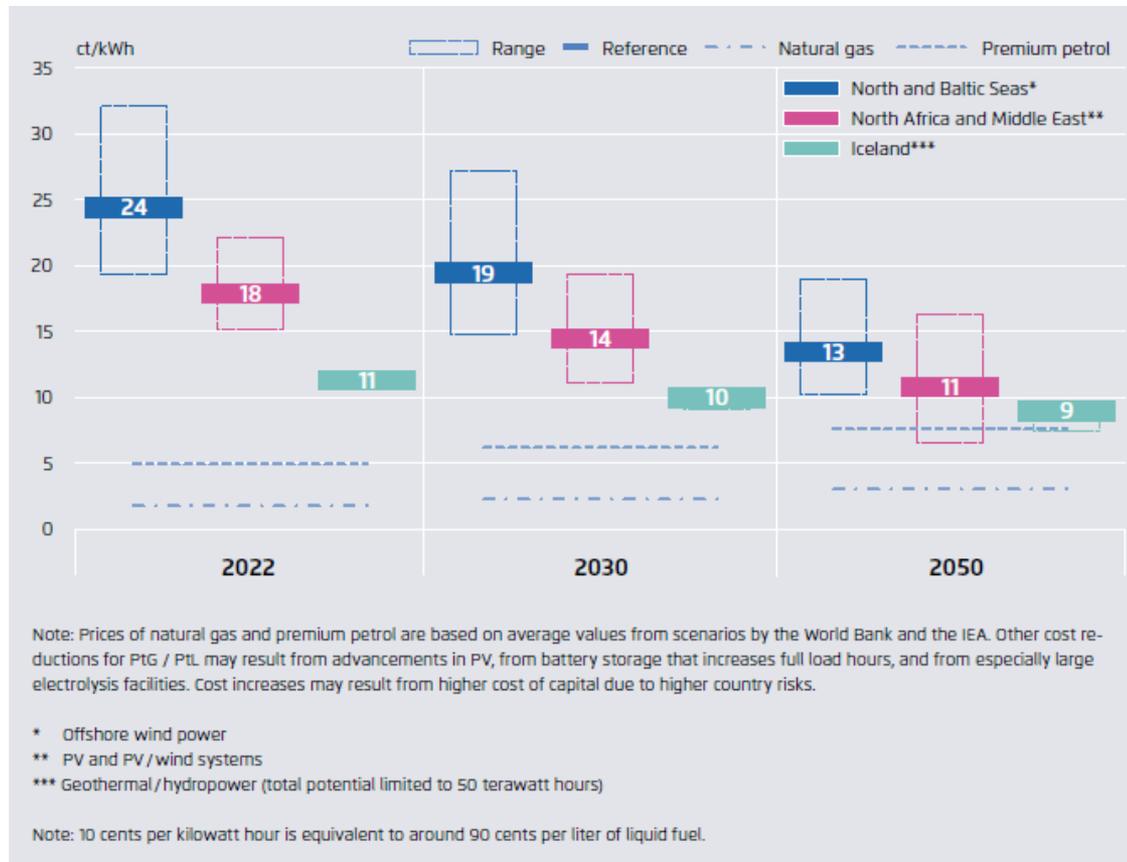


Source: Frontier Economics based on Sterner et al. (2014), and own analyses

- Use of existing infrastructure and applications – with positive implications on
 - System costs
 - Acceptance
 - Acceleration of the speed of the energy transformation

A global market for PtX makes sense – due to the availability of sites for RES-E and cost optimisation

Cost of synthetic fuels / methane



Source: Frontier Economics in: Agora Verkehrswende und Agora Energiewende (2018)

THESIS 1

Renewable energy will have to be imported (to DE/EU) in order to accommodate accelerating demand

THESIS 2

Boosting the scale of renewable energy imports will require chemical energy carriers, including PtX

THESIS 3

International PtX trade will help to accommodate the costs of the energy transition and can diversify the import portfolio

Future global PtX market will rise to a significant size

Corresponds to electrolyser capacity of 3,000-6,000 GW

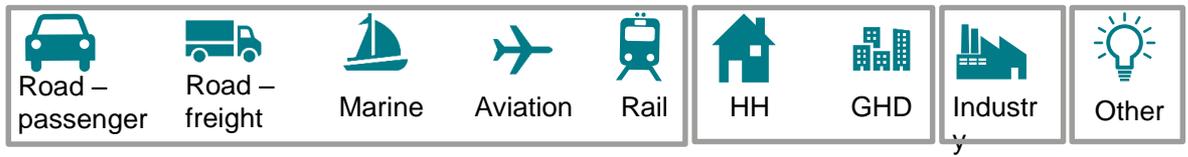
PtX market

Low Case
Ca. 10,000 TWh

Reference Case
Ca. 20,000 TWh

High case
Ca. 41,000 TWh

PtX final demand share



Scenarios based on assumed Market shares

Low Case

Reference Case

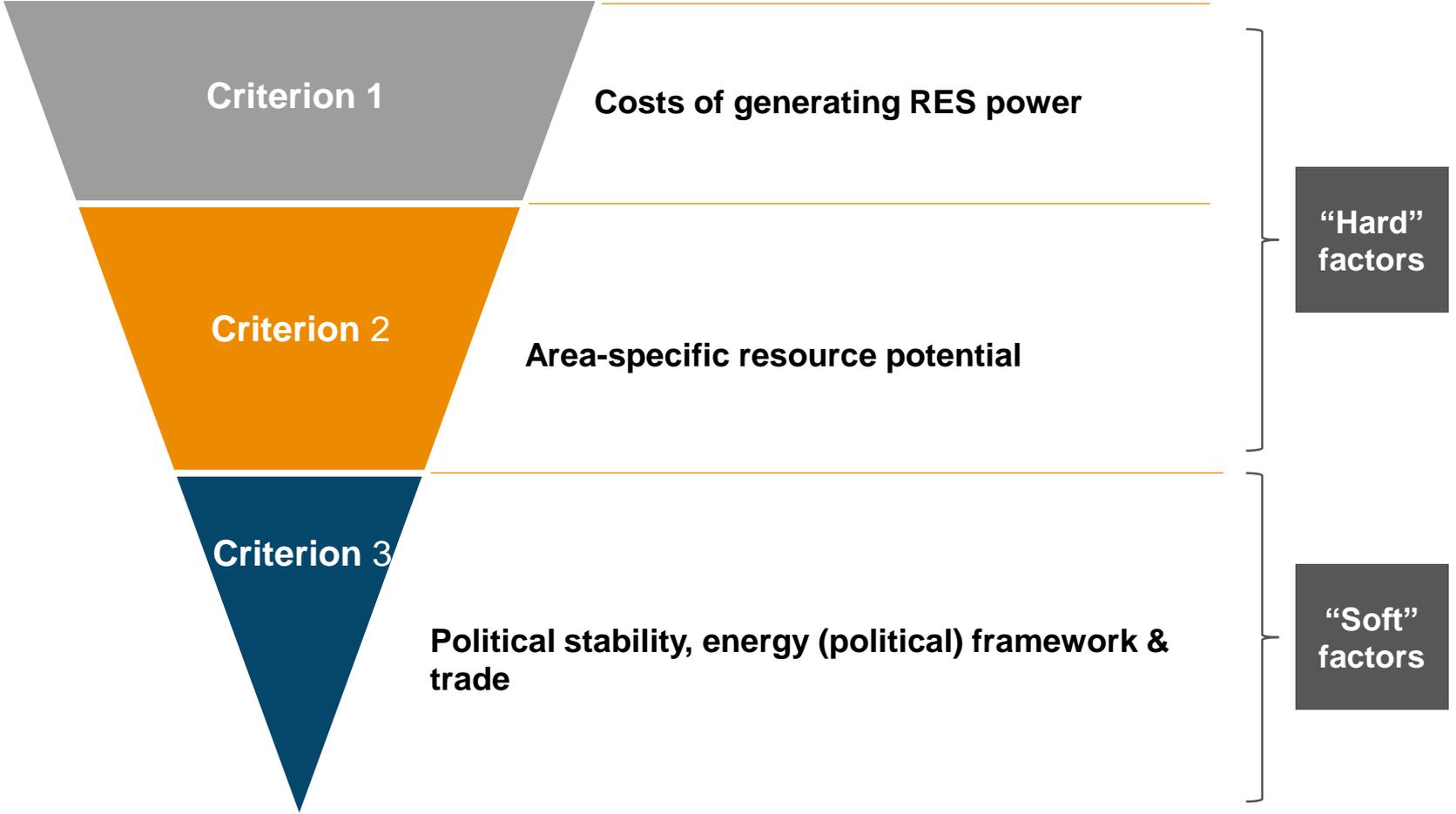
High Case

Division into sectors
Division into geographies

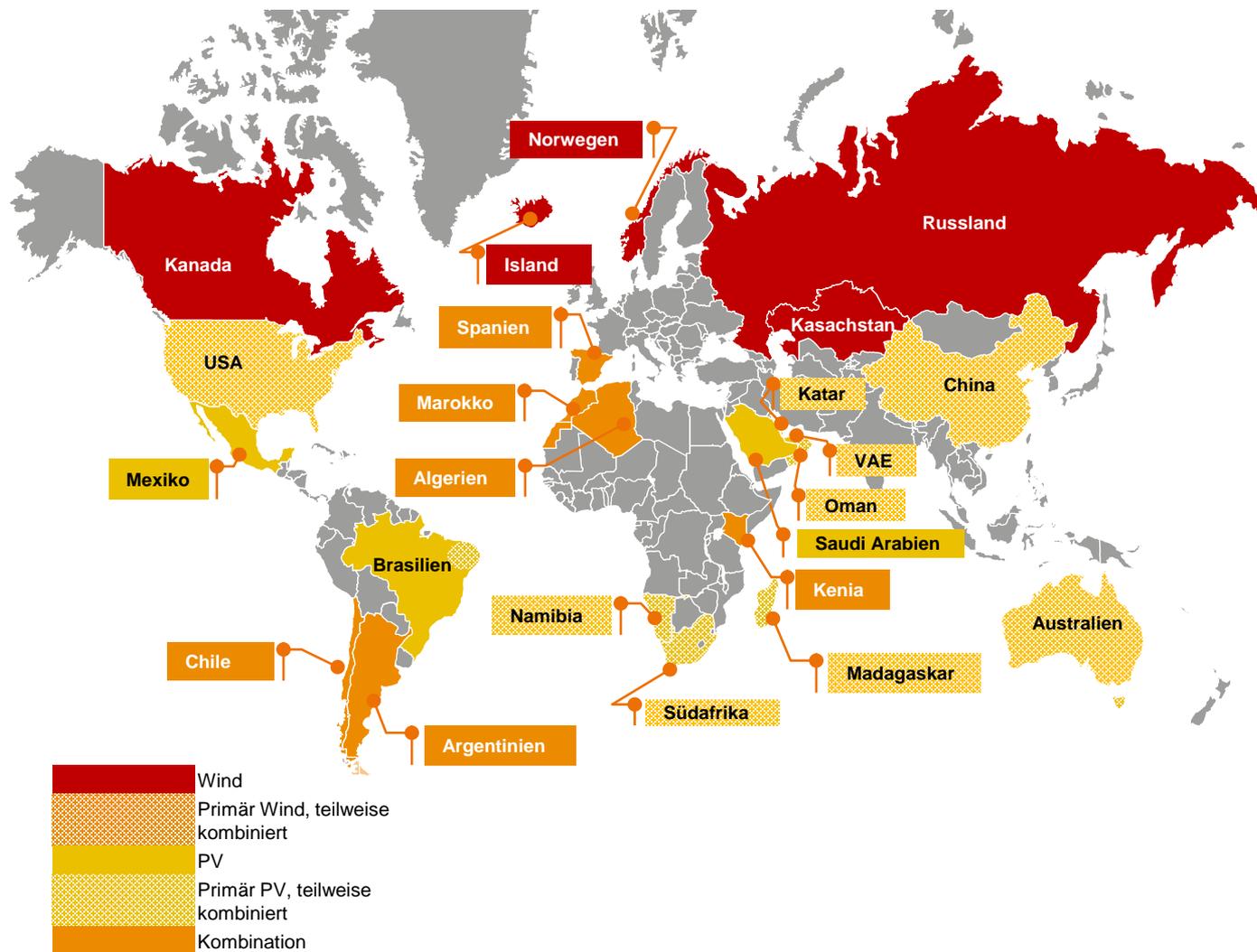


Source: Frontier Economics based on IEA, World Energy Outlook 2016, New Policies Scenario

Potential PtX producing countries require a combination of various factors



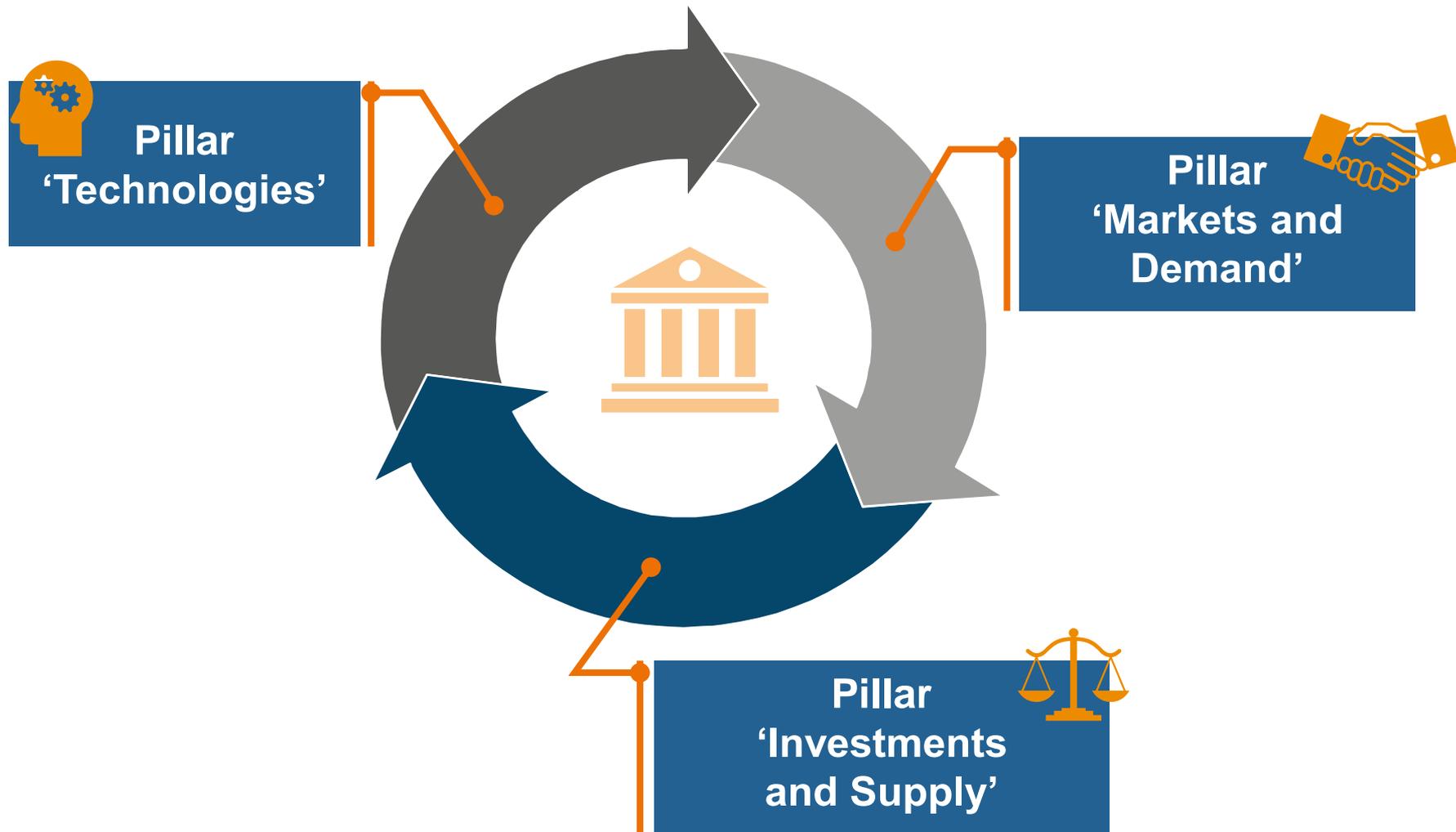
Various countries demonstrate strong potential for production / exports ...



...however, potential PtX suppliers vary in terms of incentives and readiness to adjust

Type	PtX motivation and readiness	Examples
 Frontrunners	<ul style="list-style-type: none"> Especially favourable in early stages of market penetration 	 Norway
 Hidden Champions	<ul style="list-style-type: none"> PtX could readily become a serious topic if facilitated appropriately 	 Chile
 Giants	<ul style="list-style-type: none"> Provide order of PtX magnitudes demanded in mature market 	 Australia
 Hyped Potentials	<ul style="list-style-type: none"> Potential to lead technology development; may depend strongly on solid political facilitation 	 Morocco
 Converters	<ul style="list-style-type: none"> Strong motivation for PtX export technology development; may require political facilitation 	 Saudi Arabia
 Uncertain Candidates	<ul style="list-style-type: none"> May drive PtX technology development, export uncertain 	 China

A PtX roadmap towards an international market requires a sustainable framework



Pillar 'Technologies': Development of a PtX industry requires further technological progress

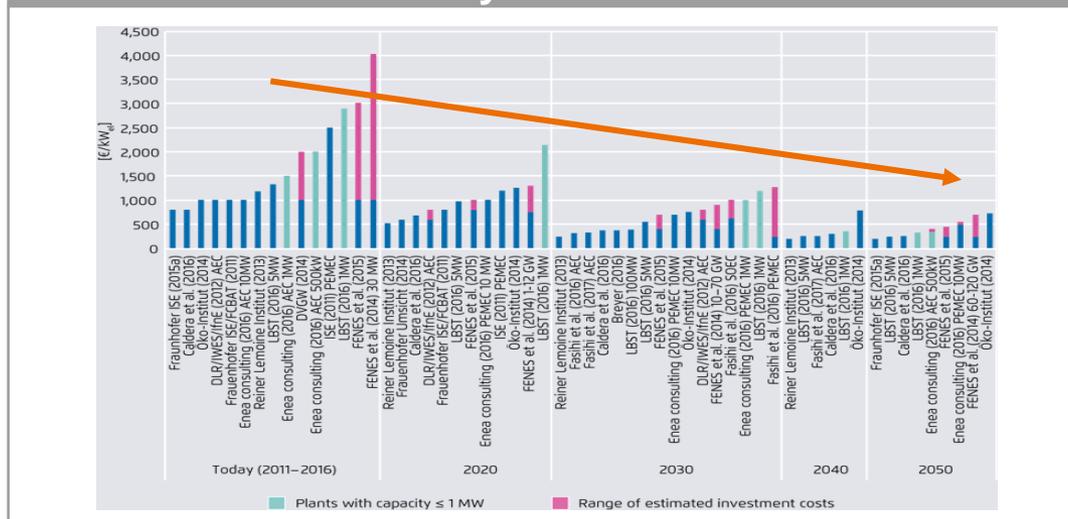


Source: Siemens

Key drivers to achieve cost savings...

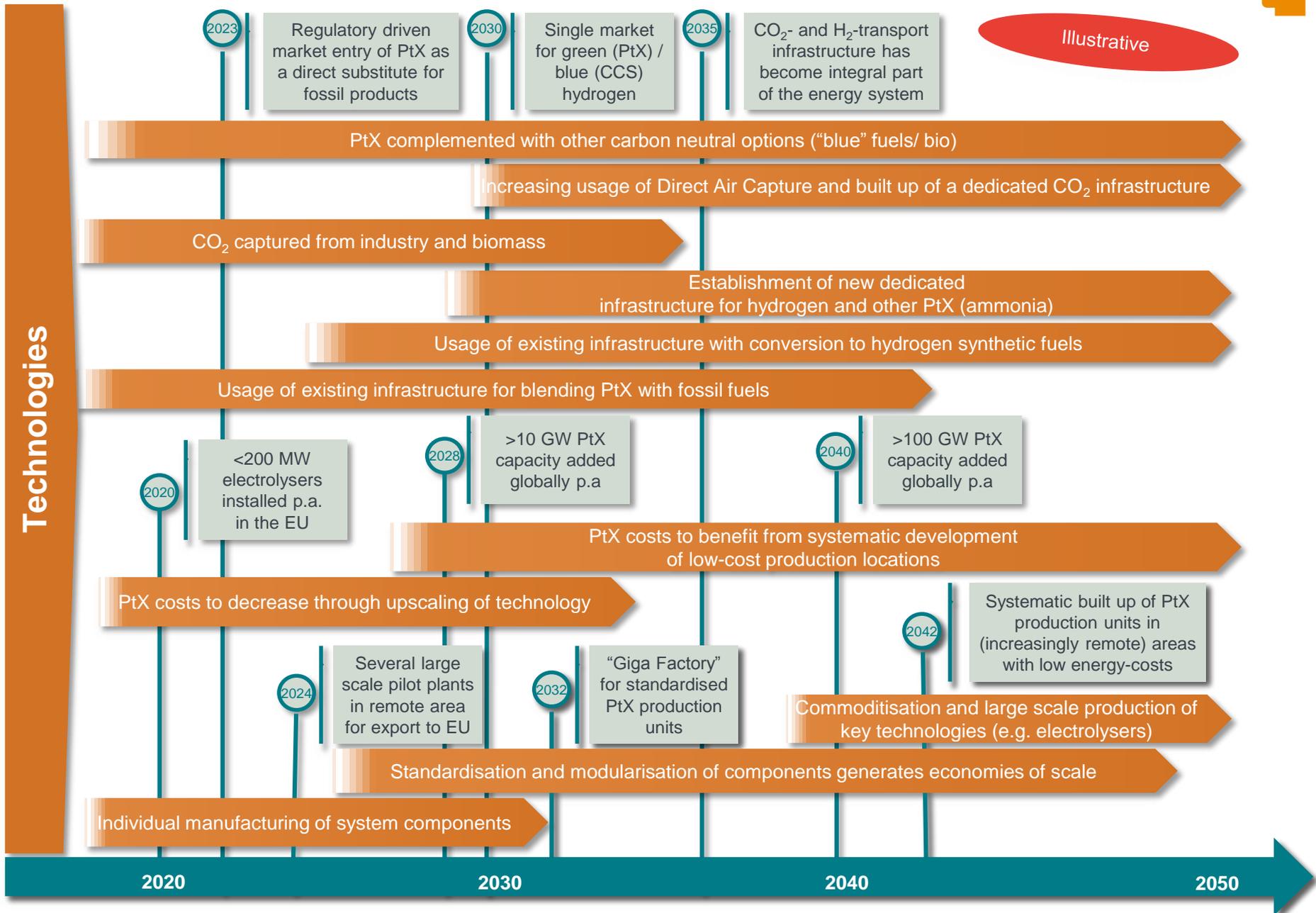
- Scaling up of plant sizes
- Standardisation of components / modules and of processes to build installations

... lead to investment cost reductions for the construction of electrolyzers

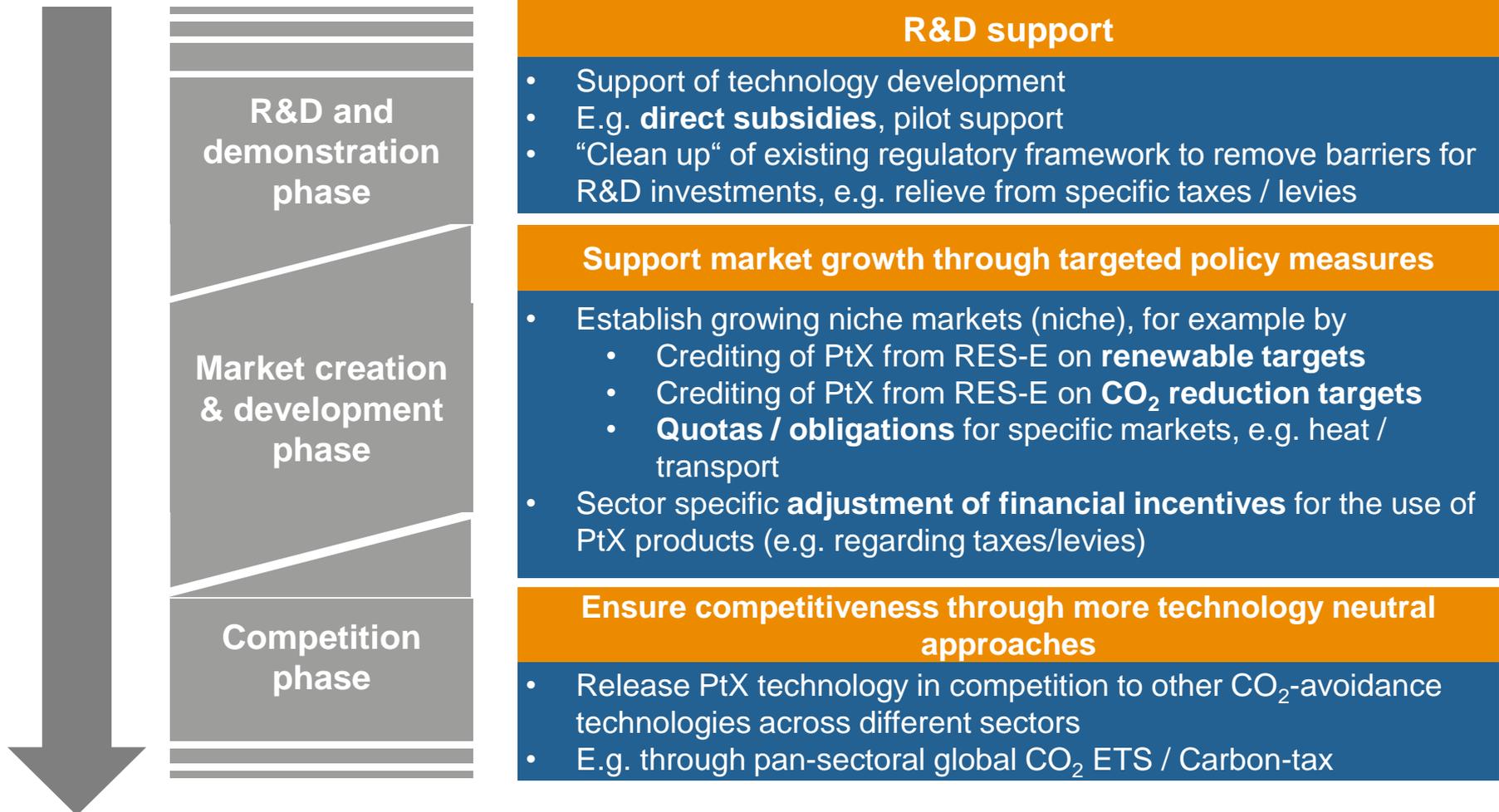


Source: Agora Verkehrswende, Agora Energiewende and Frontier Economics (2018)





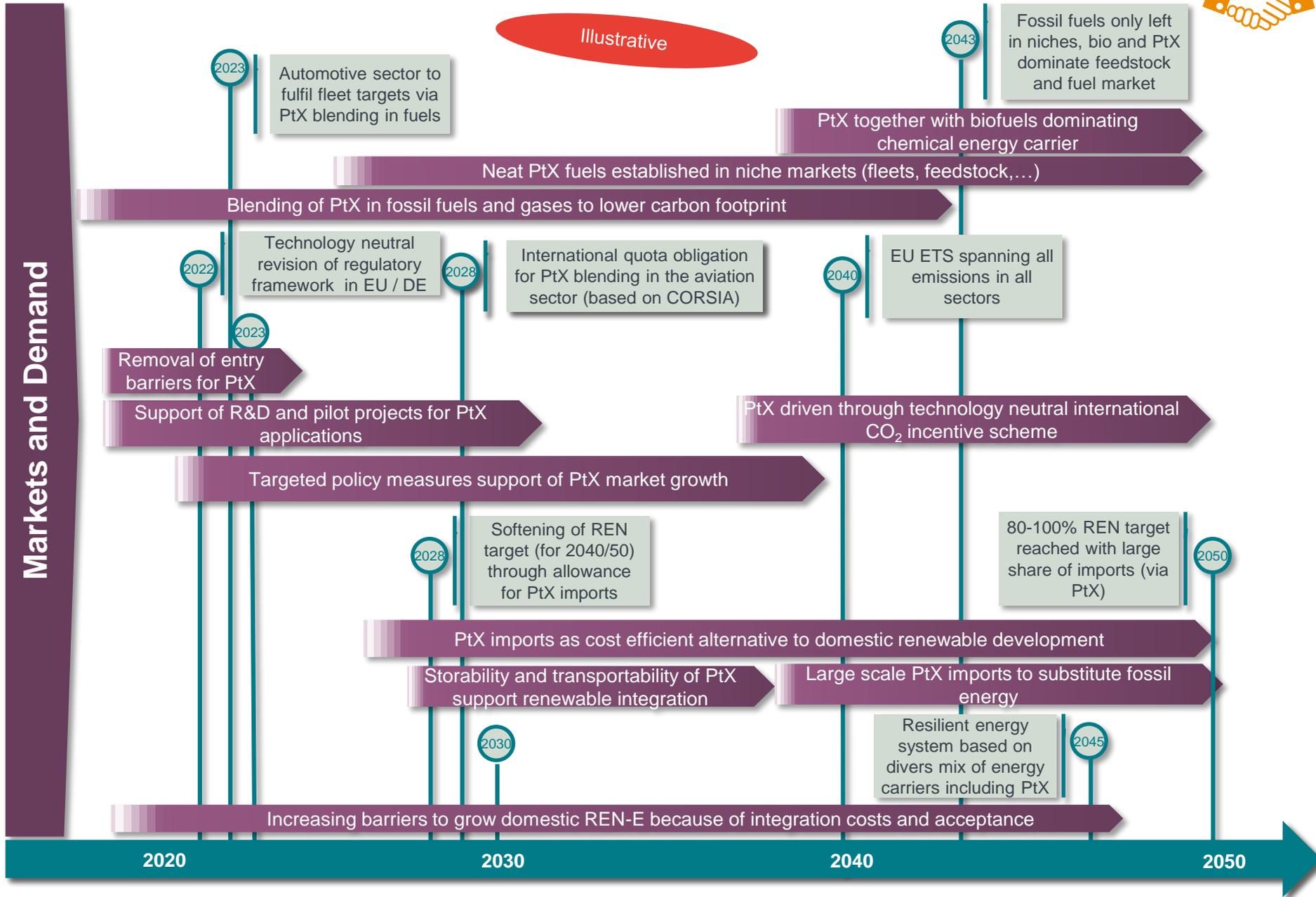
Pillar ‘Markets and Demand’: Regulation and political facilitation is needed to create PtX markets and demand





Markets and Demand

Illustrative



2020

2030

2040

2050

Pillar 'Investments and Supply': Politicians can help to reduce risks for investors



Place PtX on the **international climate policy and renewable agenda**



Financial instruments to mitigate the impact of country risks for investors



Promoting **bilateral co-operations and collaboration** such as energy partnerships



Backing of investments by **multilateral energy treaties and agreements**

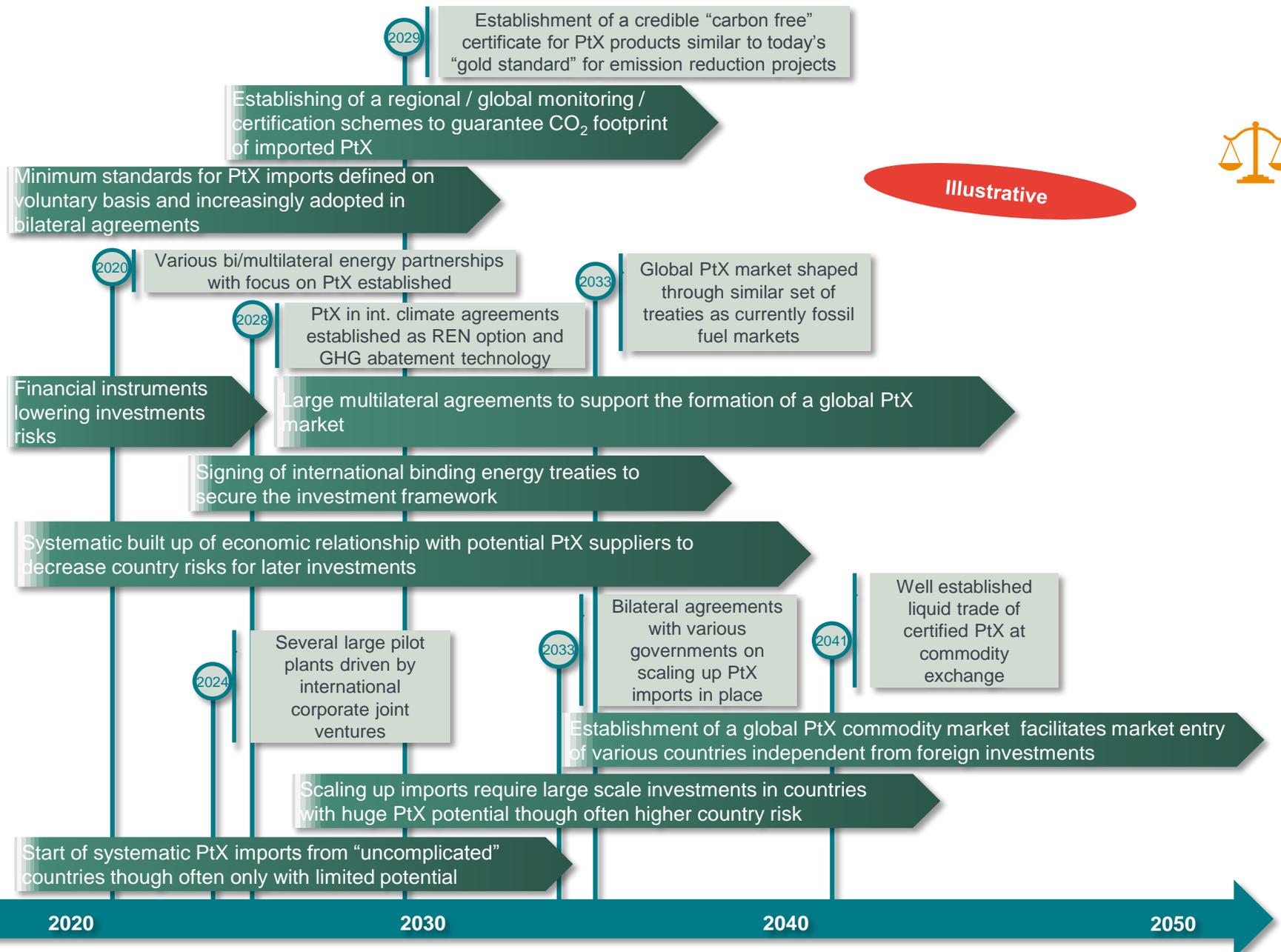


Establishing **criteria for sustainability assessment**



Establishing a **green certification system**

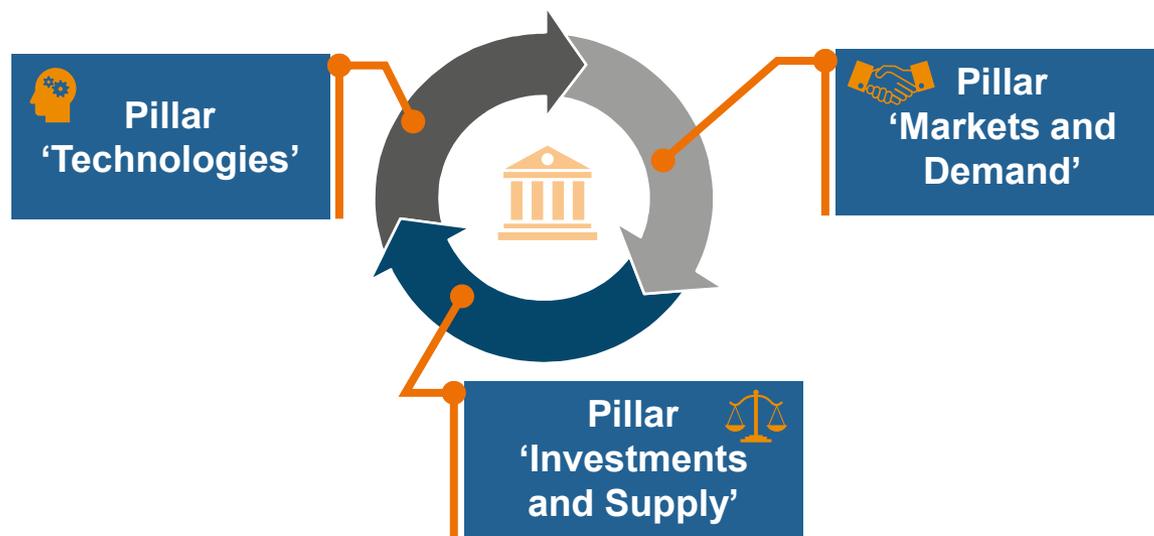
Supply and Investments



Illustrative



A coordinated approach is required to develop a global PtX market – political action is needed as of today



17 Study supporters from different sectors

Member companies / organisations

- DVGW
- E.ON SE
- EnBW Energie Baden- Württemberg AG
- Mitsubishi Hitachi Power Systems Europe GmbH
- Robert Bosch GmbH
- RWE AG
- Siemens AG
- VCI Verband der Chemischen Industrie e. V.
- 50Hertz Transmission GmbH



External partners

- Bundesverband der Deutschen Luftverkehrswirtschaft (BDL)
- Innogy
- IWO Institut für Wärme und Oeltechnik e. V.
- MEW Mittelständische Energiewirtschaft Deutschland e. V.
- Mineralölwirtschaftsverband e. V. (MWV)
- Open Grid Europe GmbH
- UNITI Bundesverband mittelständischer Mineralölunternehmen e. V.
- Volkswagen AG

Thank You

Download Study here:

<https://www.weltenergieerat.de/ptxstudie/>

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