

# World Economic Forum



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*Regulation and standards to  
kick-start the development of  
initial domestic uses of low-  
carbon hydrogen*

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# Initiative Introduction

The following document offers a guide to creating an *Enabling Measures Roadmaps* for Green Hydrogen in new geographies.

The Roadmap is a toolbox for policy makers, identifying the top ten enabling measures and critical timelines required to reach scale.

The first Roadmaps were developed through the World Economic Forum's *Accelerating Clean Hydrogen Initiative* for Europe and Japan.

## Activities under the initiative:

- 1 Identify barriers to scale up markets and the corresponding critical enabling measures needed to support their removal.
- 2 Identify priority enabling measures requiring accelerated action.
- 3 Convene dialogue and collaborative activities between policy makers, industry and other key stakeholders to accelerate priority enabling measures.

# Overview and Outputs

The Roadmaps show the **enabling measures** that need to be implemented to **boost the clean hydrogen economy globally**. They aim to **enhance public-private dialogue** to turn industry recommendations into concrete policy measures and **accelerate action on the path to net-zero**.

## Outputs:

- Defines key objectives
- Describes ~60 enabling measures per roadmap required by 2030
- Details suggested timeline for implementation up to 2030
- x1 deepdive per enabling measures showing key actions and ongoing work



## The roadmaps address the 7 core barriers to market development



# Europe and Japan Roadmaps – Enabling Measures

**2** Key of supporting information for the enabling measures

**1** Top objectives grouped by the relevant barrier to market development

KEY:		Policy Required				Responsible Policy Maker / Department	
		Technology Evolution & R&D	Standards & Certification	Markets & Financing	Matching Supply & Demand	Responsible policy maker	Note: MS = Member State, EU = European Union, TSO Reg = TSO Regulator
<b>Top 10 Objectives and supporting Enabling Measures to scale the green hydrogen market (1/2)</b>							
<b>Cost:</b> Remove cost and regulatory barriers for hydrogen production	1a. Ensure additionality rules while supporting increased RE deployment <small>Energy (MS)</small>	1b. Decrease high electricity prices with dedicated support <small>Industry (MS)</small>	1c. Ease additionality rules for first movers <small>Energy (MS)</small>	1d. Decrease investment costs of electrolyser with dedicated support (e.g. grants/loans) <small>Energy (MS)</small>			
<b>Cost:</b> Deploy mechanisms to close the cost gap for hydrogen use in hard-to-abate sectors	2a. Create one-stop-shop for hydrogen finance* <small>Finance (MS)</small>	2b. Provide fiscal incentives (tax level differentiation & tax relief for green goods)* <small>Finance (MS)</small>	2c. Implement Carbon Contracts for Difference* <small>Industry (MS)</small>	2d. Introduce ecolabelling to green products, including hydrogen production routes* <small>Environment (MS)</small>	2e. Phase-out free ETS allowances for grey hydrogen and use revenues for green <small>Environment (MS)</small>		
<b>Demand:</b> Drive <i>critical mass</i> demand through major hydrogen projects	3a. Identify high-value / efficient applications and define targets by end-use sector in line with net zero* <small>Energy (MS)</small>	3b. Incentivize the development of hydrogen valleys through promotion of regional and sectoral targets <small>Industry (MS)</small>	3c. Drive sustainable public procurement* <small>Finance (MS)</small>	3d. Accelerate fuel shift in industrial applications through major transformation policy <small>Industry (MS)</small>			
<b>Demand:</b> Drive efficient allocation of capital within Europe and for imports	4a. Ensure alignment of efforts and strategies across Member States through coordination and continuous knowledge exchange <small>Energy (EU)</small>	4b. Set ambitious capacity targets for trade facilities (e.g. ports, (re)conversion facilities) <small>Industry (MS)</small>	4c. Define market design and operating rules for hydrogen trading (including derivatives)* <small>Trade (EU)</small>				
<b>Demand:</b> Reduce fossil fuel consumption through mandates and obligations	5a. Phase-out fossil fuel-based technologies (grey production, steel, etc.)* <small>Environment (MS)</small>	5b. Introduce quotas and mandates for green products / basic materials (e.g., green fertiliser, green steel)* <small>Industry (MS)</small>	5c. Design Carbon Border Adjustment based on lifecycle carbon content to promote green goods <small>Trade (EU)</small>				

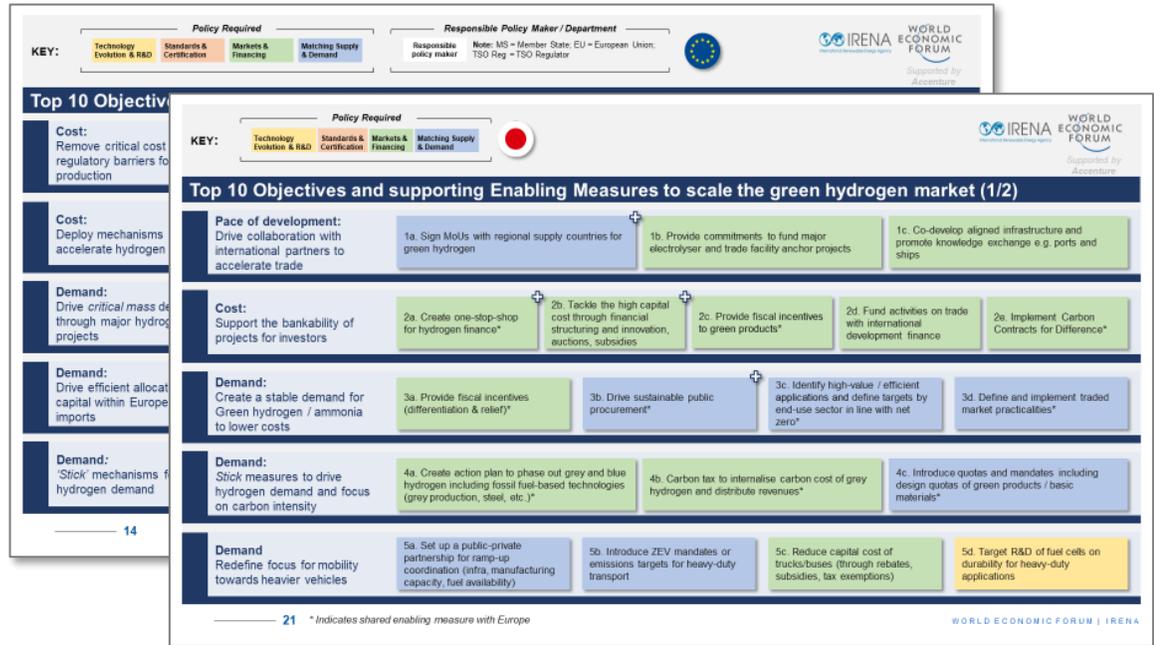
**3** Key enabling measures required to achieve the identified objective

**4**  **'Click here'** link to each Enabling Measure's Deepdive information

# Europe and Japan Roadmaps Highlights – Timeline for implementation

## Top 10 objectives and enabling measures

## Enabling measures implementation timeline



# Europe and Japan Roadmaps Highlights

## Breakdown of Barriers

<b>Cost</b>	No carbon cost internalisation Lack of upstream support Lack of downstream support Unfit market design
<b>Demand</b>	Hydrogen uptake uncertainty Global competitiveness Availability of supply
<b>Infrastructure</b>	Lack of infrastructure support and development Infrastructure uncertainty
<b>Standards &amp; Certification</b>	No certification of hydrogen No certification of hydrogen derivatives Incompatibility across borders Lack of clarity on environmental impact beyond GHG Standardisation (design, safety etc.)
<b>Pace of development</b>	Slow renewable capacity deployment & unclear additionality Slow electrolyser manufacturing Industrial assets lifetime Fuel cell manufacturing capacity
<b>Technology</b>	Materials use in equipment De-risking new industrial applications Electrolyser and fuel cells performance (efficiency, power density etc.) Assessing compatibility of the existing gas grid De-risking integrated PtX pathways

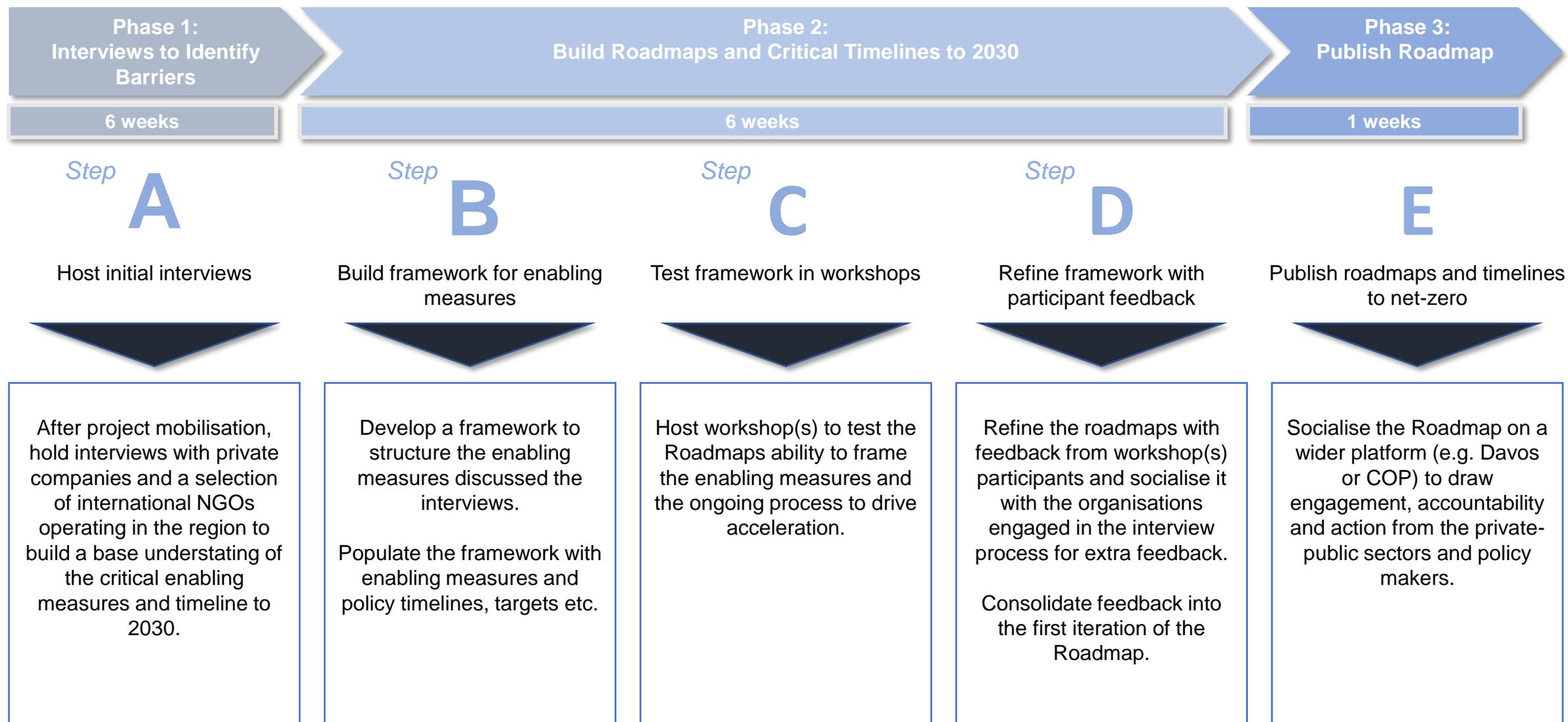


# Outcomes per Barrier for Europe

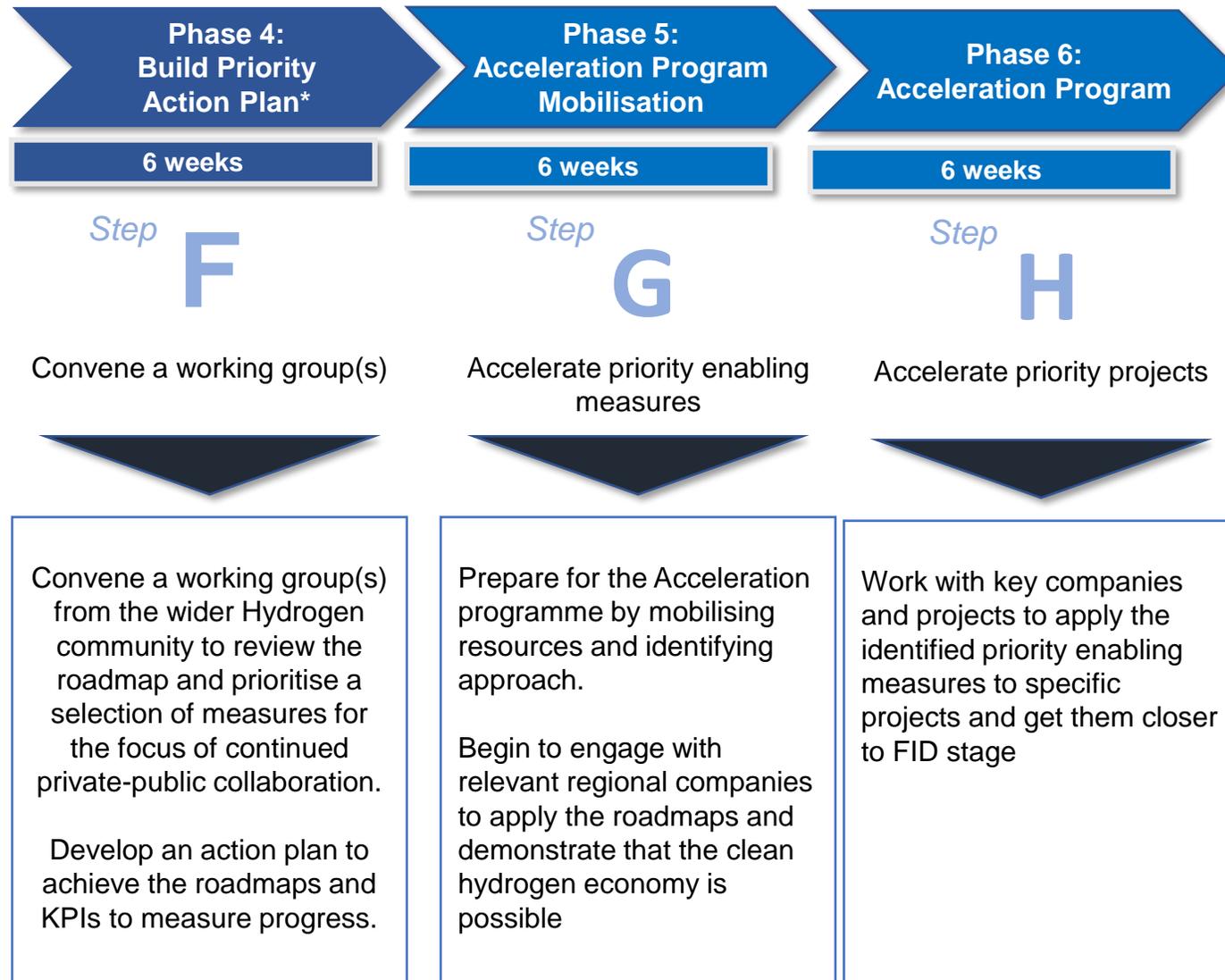
Indicative outcomes if enabling measures are implemented and objectives achieved

Barrier	Outcome 2021 - 2023	Outcome 2023 - 2026	Outcome 2026 – 2030
<b>Cost</b>	Clarity on type (grants, CCfD, auctions), magnitude (i.e. level of support) and time horizon for policy instruments to cover the cost gap of green hydrogen and imported products.	Policy instruments are fully in place at the EU and Member State level, providing confidence for business cases across multiple applications.	Demand growth has spurred cost decrease across the value chain combined with ambitious GHG targets make hydrogen the most attractive for new facilities across industry and long-haul transport.
<b>Demand</b>	Policy instruments to promote hydrogen uptake have been identified by sector and Member State, and has been set in legislation.	Green hydrogen is replacing fossil-based hydrogen in industrial applications and its use is rapidly increasing across new applications.	The value of hydrogen is recognized across applications and uptake has been enough to decrease costs to competitive levels and develop experience through deployment.
<b>Infrastructure</b>	Clarity on governance of hydrogen infrastructure, financing mechanisms (including cost recovery) and regulation.	First few hydrogen clusters are being connected with pipelines. Largest ports are ready to receive multiple hydrogen carriers and distribute further inland.	Major industrial sites across Europe are interconnected with hydrogen pipelines. Largest ports across Europe are developing commercial-scale hydrogen import projects.
<b>Standards and certification</b>	Basic scope defined including criteria (what is being measured), levels (how much reduction), methodology (including boundaries), certifying bodies, auditing, traceability, issuing and cancelling processes, risk management and communication.	Full consistency between EU's standards and potential exporting countries. Full consistency between energy carriers. Certification has been extended to cover derivatives (including ammonia, synthetic fuels and steel).	Internationally agreed standards being used for first few commercial projects.
<b>Pace of development</b>	The electrolyser value chain has been mapped to ensure there are no bottlenecks in specific components. Electrolyzer manufacturers have a platform to coordinate efforts (e.g. Clean Hydrogen Alliance).	Cash flow for electrolyser manufacturers is positive and are able to fund manufacturing capacity expansion. Capacity is ahead of deployment and does not represent a bottleneck for deployment.	Burgeoning market growth has spurred competition and triggered innovation. Manufacturers have expanded capacity and have also greatly reduced cost to stay competitive resulting in lower capital costs.
<b>Technology</b>	Europe has aligned R&D agenda of the Clean Hydrogen Partnership with other leading hydrogen economies targeting electrolyser, conversion, shipping and re-conversion technologies.	The performance (cost, efficiency, and durability) of electrolysers have improved towards long-term goals. All the integrated pathways for hydrogen carriers have been demonstrated with multiple pilot projects. There is clarity on the conditions that favour one carrier over another that facilitates focused efforts and further progress.	R&D has been successful in bringing energy consumption of liquefaction, ammonia cracking, liquid organic hydrogen carriers dehydrogenation down. Solid oxide and anion exchange membrane have been added to the portfolio of commercial technologies.
<b>Available Renewable Electricity</b>	Clarity and certainty on the additionality rules have been provided with criteria for changes over time (in case of progressive tightening) and adjustment of renewable targets.	Green hydrogen deployment is not displacing more effective uses of renewable electricity and it is not constrained by an overly-restrictive additionality criteria.	Renewable targets, renewable deployment rates and capital mobilized have been increased to account for green hydrogen deployment.

# Developing a regional Enabling Measures Roadmap



# Taking the roadmap to the next level – Project Accelerator



# Roles and Responsibilities

The Enabling Measures Roadmap is carried out by the World Economic Forum and IRENA, supported by Accenture.



- Lead the engagement plan and owns relationship with organisations and stakeholders.
- Provide content input and feedback to the development of the Roadmap.

- Co-lead the engagement plan with World Economic Forum.
- Provide content expertise for enabling measures and policies during the development of the Roadmap working sessions, 1:1s and direct editing

- Provide global insight and work with WEF/IRENA to draw expertise into the Roadmap development.
- Develop framework and structure for the Roadmap using interviews and workshop(s), collate outputs