SUMMARY REPORT

EXPERT CONSULTATIONS

CLIMATE & STRATEGY PARTNERS

Finance for innovation: Towards the ETS Innovation Fund

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SUMMARY REPORT

Introduction

The legislative proposal to revise the EU ETS Directive, adopted in July 2015 (COM (2015) 337), puts forward an Innovation Fund, to support demonstration projects of innovative renewable energy, environmentally safe carbon capture, storage and use (CCS/CCU), energy storage and low-carbon innovation in energy intensive industry. At least 400 million allowances should be reserved from 2021 onwards for this purpose. In addition, a further 50 million of the unallocated allowances from 2013-2020 should be set aside, together with remaining funds from the second call of the existing NER 300 Programme, to enable earlier support to eligible projects, before 2021.

Over January – June 2017, the European Commission consulted experts from energy-intensive industries, energy sector and finance, through a set of sector-specific workshops. This Report represents a high-level summary of these expert workshops, as compiled and summarised by specialist low carbon finance consultant Climate Strategy & Partners, and provides expert recommendations as regards the key design elements of the future Innovation Fund.

This expert consultation will be followed by a wider public consultation, during which all stakeholders and general public will be invited to express their views and opinions.

Acknowledgements:

This Report is a high-level summary of sector-specific consultation sessions attended by more than 250 experts. Key outcomes of these sessions were provided as inputs to this Report by session moderators. Special mention and thanks to *Mukund Bhagwat, Jean-Pierre Birat, Hans Bünting, Patrick Clerens, Bernard de Galembert, Vincent Gilles, Eberhard Gschwindt, Jonas Helseth, Alan Kreisberg, Marco Mensink, Gianpiero Nacci, Jean-Baptiste Renard, Fabrice Rivet, and Peter Sweatman, as group rapporteur.*

The following organisations participated at the expert workshops:

A.SPIRE
Aalto University
AAT Geothermae
Adelphi
ADS tec
Air Liquide
Aker Solutions
AkzoNobel
Albermarle Europe
Alcoa
Alfa Mediterranean Enterprises Limited
ArcelorMittal
Ardagh
Argex
Arkema
Atlantis resources
Aurubis
BA Vidro
BASF
Bellona
Bio-based Industries Public-Private partnership (EU Joint Undertaking)
Bolloré
Borealis
BP
Caisse des Dépôts et Consignations
Cambridge Energy Partners
Carbon Capture and Storage Association (CCSA)
Carmeuse
CCS project Cork
Celsian
Cemex
Centro Ceramico Bologna
Confederation of European Paper Industries (CEPI)
The European Ceramic Industry Association (CERAME-UNIE)
Clariant
CMI Group
CO2GeoNET
Complexul Energetic Oltenia
Concawe
Corbion
Covestro
Credit Suisse
CRM Group
CSS Association
Centre Technique du Papier
DCNS Group
Diehl
Dow Chemicals
DP Energy
DSM
Ecocem
Ecofys
European Cement Research Academy (ECRA)
Electricite de France
EGS Energy Ltd
Eiffel IG
Elkem AS
Emerson
Enel SpA
ENGIE
ENI
Ervia
Estela Solar
EuLA/IMA Europe
The Union of Electricity Industry (EURELECTRIC)
Euroatomizado
European Steel Association (EUROFER)
European Non-ferrous Metals Association (EUROMETAUX)
European Association of Mining Industries (EUROMINES)
EuropaBio
European Aluminium Association
European Association for Storage of Energy (EASE)
European Zero Emission Technology and Innovation Platform (ZEP)
European Bank for Reconstruction and Development (EBRD)
European Biomass Industry Association (EUBIA)
European Cement Association (ECA - Cembureau)
European Chemical Industry Council (CEFIC)
European Copper Institute
European Geothermal Energy Council (EGEC)
European Investment Bank
European Power Plant Suppliers Association – (EPPSA)
Evonik Industries

Exide Technologies	Instituto de Technologia Ceramica (ITC)	Sabic
Fels-Werke GmbH	Keraben	Saft
Fertilizer Europe	KREAB	Saint-Gobain
Fonroche	KU Leuven	Sappi
Forschungsgemeinschaft Feuerfest	LafargeHolcim	Schlagmann Poroton
Fraunhofer ISI	Lanxess	Schott
Fuel cells and hydrogen Joint Undertaking (FCH-JU)	LanzaTech	Secil
Fuels Europe	Lasselsberger	SEKAB
Gaelectric	Leclanché	Shell
GasNatural Fenosa	Lhoist	Siemens
Gassnova	Lime Trade Association	Sofidel
General Electric Grid Solutions	Linde	SolarPower Europe
GE Power	LKAB	Solvay
Glass Technology Service	LyondellBasell	SSAB AB
Global Bioenergies	Magnesitas Navarras	Statoil
Global CCS Institute	Miltton	Stazione Sperimentale del Vetro
GreenStream Network Ltd	Ministry of Petroleum and Energy, Norway	Stoelzle Glass Group
Heidelberg Cement AG	Mitsubishi Hitachi Power Systems	Stora Enso
Hüttentechnische Vereinigung der Deutschen Glasindustrie	Moixa	Summit Power
Hydrogen Europe	Neste	TAQA
Hygear	Netherlands Enterprise Agency	Tata Steel
Iberdrola	Nickel Institute	The European Biomass Association (AEBIOM)
IF Steelman	Norsk Hydro ASA	Thyssenkrupp AG
IG BCE	North Sea Basin Task Force	Tocardo
Imerys	Nippon Sheet Glass	TOTAL
Institute for Infrastructure, Environment and Innovation (IMIEU)	Ocean Energy Europe	TRIMET Aluminium
Industriall Europe	Owens-Illinois	Turboden
Ineos	Owens Corning	Uniper
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International Bromine Council (BSEF)	PGE Polska Grupa Energetyczna	Valmet Oy
International Association of Oil & Gas Producers (IOGP)	Plastics Europe	Veerhavencapital
Irish Cement Limited	Port of Rotterdam	Verallia
ISPT	Pöyry Management Consulting	Vestas
	Repsol	Vesuvius
	RHI AG	VoestAlpine
	Innventia	Voith
	ROAD Project	VTT
		Wienerberger
		Wind Europe
		WVMetalle
		Yuasa

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Executive Summary

"When you're doing innovation, the first question is not 'Is this going to work?' but rather, 'If it works, would it matter?" Quote from Eric Toone, vice provost and director of the Duke Innovation & Entrepreneurship Initiative and former principal deputy director of the US Department of Energy's Advanced Research Projects Agency.

Energy-intensive industries and the energy sector need to continue to contribute in the next decade and beyond to meet Europe's climate and energy targets. In order to reach these long term decarbonisation goals, innovation must play a key role and introduce new low-carbon technologies into the market. To help the industry and the power sectors meet these innovation and investment challenges, the Commission proposal for revision of the EU Emission Trading System (EU ETS) post-2020 puts forward an Innovation Fund ("IF"), which will support innovative demonstration projects in energy intensive industries, renewable energy, energy storage and carbon capture, storage and use. The design of the Fund, including eligible technologies and financial modalities, will need to address the specific market needs and demand for low-carbon innovation, while ensuring effective use of the funds available.

In January 2017, DG CLIMA launched a consultation process with representatives of the energy-intensive industries, energy sector and finance sector starting with a high-level conference and followed by five expert roundtables over the following three months and concluded with a final public event in June 2017. These sectorial roundtables consulted key expert representatives of the energy intensive industries, renewable energy, energy storage, carbon capture and storage ("CCS") and finance sectors. The objective of the workshops was to collect expert views on potential pathways for low-carbon innovations and on how the proposed Innovation Fund could be designed to mobilise the required investments. The following energy intensive industrial and energy sectors participated: ferrous metals, non-ferrous metals, pulp & paper, oil refining, chemicals & bio-based industries, cement & lime, glass & ceramics, renewable energy, energy storage and CCS. Workshop moderators, selected for their expertise in the field, were asked to develop session feedback, which formed the basis for this summary report and its recommendations.

Authors and moderators note that this report summarises the key findings from this process and reflects a consensus view of the stakeholders, not the single view of any one stakeholder nor of the authors nor moderators, and clearly does not represent the position of the European Commission.

Each workshop began with a "positioning statement" that described the overall sector context with some information about existing studies and sectorial technology developments. In addition, each sector collectively contributed to a debate around the business drivers for low-carbon innovation and the risks inherent in making corporate investments in this area.

Taking as inputs the healthy debate by experts on the definition of "innovation", the context for the low-carbon challenge in each sector in its own words and the lessons learned of the NER 300 Programme, the **findings from the expert workshops** can be summarised as follows:

- There is no shortage of **low-carbon technology ideas**. Together the sectors have identified over 80 known specific technologies or technology groups (detailed in Chapter 2) for development that when grouped together can lead to various possible decarbonisation pathways. In addition, each sector has identified sector-specific incremental and breakthrough technology needs. Many of the production sectors can also benefit from cross-cutting low-carbon technology solutions such as Carbon Capture and Storage/Use, Green Hydrogen use, Intelligent Energy Management systems, integration of Renewables and Energy Storage.

- Sector experts identified several key **business drivers** for low-carbon innovation, which include:
    1. Cost Savings and Competitiveness;
    2. Carbon Price;
    3. Developing Robust Inter-Industrial Collaboration Models;
    4. Reduced Environmental Externalities (delivering Improved Corporate Sustainability Reputation); and
    5. International Competition for low-carbon products.
- Experts also discussed the various **barriers and risks** to decarbonisation, noting that many barriers and risks cannot be addressed by the Innovation Fund with a particular focus on:
    1. The need to improve, strengthen, or identify the business case for long-term and deep decarbonisation beyond incremental and short-payback measures;
    2. The developing or often changing regulatory framework, for mature and less mature technologies (e.g. second generation renewables, energy storage, self-generation, demand response, CCU and hydrogen infrastructure);
    3. Issues around permitting, licensing and technical quality approvals for new technologies and low-carbon products; and
    4. The overall immaturity of "collaborative solutions" and their frameworks.
- Sectorial innovation **financing needs** were identified (in Chapter 3) through a discussion on a series of focus questions which included innovation funding needs, relevant funding instruments, the potential design features of the IF and its application processes.
- This, in term, gave rise to a series of **specific recommendations** (detailed in Chapter 4) on the structure, and the approach to the design, of the IF, which can be summarised as:
    1. Transparent and clear criteria for project selection;
    2. Clear list of finance products on offer, with investment grants having a major role;
    3. Simple, two-stage application process with multiple competitive calls leading to agile decision making processes supported by adequate resources for IF implementation;
    4. Aligning the timing of support with funding needs (through milestones-based disbursement);
    5. Ensure complementarity between the Innovation Fund and other EU and national funds;
    6. Enable and incentivize cross-sector collaboration by supporting consortia with cross-sector technologies.

1. Key Recommendations

An extensive consultation process was undertaken covering a series of high-level conferences, five expert roundtables, which included input from over 250 experts of the energy intensive industries (steel, non-ferrous metals, pulp & paper, oil refining, chemicals & bio-based industries, cement & lime, glass & ceramics), renewable energy, energy storage, CCS and finance sectors. The workshops collected expert views on possible pathways for low-carbon innovations and on how the proposed Innovation Fund could be designed to support the related investment needs. Diversity in the discussions was evident and derives from the different expert profiles of the various stakeholders.

At the outset, experts discussed the "definition of innovation". This topic came up several times in the discussion, to help define more practically what low-carbon innovation might mean for the purpose of the proposed Innovation Fund ("IF"). Participants discussed that both existing and emerging technologies could be considered as potentially innovative especially if innovative business models are needed to ensure that a given technology can break-through. Generally, however, the more a technology is at an early stage of its development, the more it is perceived as "innovative", and inherently risky, and therefore more likely to need public funding support. What was clear from most experts is that the Innovation Fund should not restrict projects based on a predetermined list of technologies as innovation is "technology neutral" within determined low-carbon pathways or higher-level "technology corridors".

Before describing key recommendations which are clearly emerging from this extensive expert consultation process, it is important to note the structural differences between the sectors, their different approaches, business models and relative maturities (both of technologies and regulatory framework). Some sectors are composed of large multi-nationals, others have more fragmented SMEs; some have developed consensus decarbonisation pathway projects and act together and others do not and so on. In addition, certain specific technology platforms were mentioned as complementary to the IF including: the EU's Strategic Energy Technology (SET) Plan; 41 European Technology Platforms (ETPs) and their Strategic Research and Innovation Agendas; the High-level Panel on the European Decarbonisation Pathways Initiative; and the Low Carbon Technology Partnerships Initiative of WBCSD.

An overriding observation from the workshops is that there is no shortage of technology ideas – together the sectors have identified over 80 and various possible pathways– the question is which pathways and technologies are economically and societally optimal, especially when an optimal pathway is likely to involve cross-sectorial technology solutions and collaboration. Each sector has identified incremental and breakthrough technology needs and many of the production sectors can also benefit from cross-cutting low-carbon technology solutions such as Carbon Capture and Storage/Use, Green Hydrogen, Intelligent Energy Management and Integration of Renewables.

Experts from each sector grouped their business drivers for innovation into five key areas:

1. Cost Savings and Competitiveness;
2. Carbon Price;
3. Developing Robust Inter-Industrial Collaboration Models;
4. Reduced Environmental Externalities (delivering Improved Corporate Sustainability Reputation); and
5. International Competition for low-carbon products.

In terms of the identified barriers and risks, there is an expected multi-sectorial repetition of the need to improve, strengthen, or identify the business case for long-term and deep decarbonisation beyond incremental and short-payback measures. Further, developing or often changing regulatory framework for mature and less mature technologies (e.g. second generation renewables, energy storage, self-generation, demand response, CCU and hydrogen infrastructure) and the possibility

for regulatory change over the likely period between the receipt of support by the Innovation Fund and full commercial roll-out was mentioned in nearly all of the workshops. Importantly, permitting, licensing, technical quality approvals for new technologies and low-carbon products featured in multiple workshops. Finally, the immaturity of "collaborative solutions" and their frameworks is a common theme among identified sectorial risks.

An analysis of the different funding needs for innovation in each sector gave rise to multiple solutions and recommendations which were suggested from each of the sector workshops for the Innovation Fund to address. The key recommendations which are provided in greater detail in chapter 4 can be summarized as follows:

Key recommendations	
Transparent and Clear Project selection Criteria	The Innovation Fund should have clear project selection criteria and a transparent set of requirements, procedures and decision making processes. This can avoid confusion and overlap with other funding instruments, reduce administrative inefficiencies and enable project proponents to present just those projects likely to meet the criteria. Examples of possible criteria mentioned include: 1. Technology Readiness Levels 6-9; 2. A range of funding requests considered between Euro 5 and 200 million; 3. Innovativeness and performance, project viability and robustness of business model; 4. Selection upon clear evaluation grid with identified criteria.
Clear List of Finance Products on Offer	The IF should mainly offer grants, complemented with partial grants and / or de-risked loans or equity (depending on the maturity of the technology) with higher levels of grant intensity for early stage projects.
The Innovation Fund should be a revolving fund	While a strong consensus of experts across groups believes that the IF should be a "revolving fund", many note that this was at odds with having grants as the major product on offer.
Simple, Two-stage Application Process with Multiple Competitive Calls	There was a consensus from experts for a two-stage IF application process with stage 1 being "light" to pre-qualify projects against a grid of criteria and then stage 2 would involve a fuller project description and more detailed due diligence. A two-stage process is expected to reduce the administrative and financial cost of non-qualification and make the application process more user friendly and clear, encouraging a broader participation and range of ideas in the first round.
IF Decision Making Processes and Resources	IF should be independent and have robust and transparent internal procedures with sufficient resources to properly undertake its responsibilities. Experts felt that the evaluation process should be "short" (1-year timeframe was proposed from submission in Stage 1 to decision after Stage 2). The involvement of independent sector experts was also seen as critical.
Milestone based disbursement, in line with the ETS proposal.	IF funding should be provided when the project has a funding gap, leading to a form of contracted "funding against milestones" approach. This has the advantage of providing timely funding to successful projects which are meeting their milestones and also quickly terminating those which fail freeing up spare capital for new innovation funding rounds.
Signposting as a "Service" provided by IF	The Innovation Fund should complement and not overlap with existing EU and national funding programmes. A project development service for prospective but less mature projects would add value and reduce the lead times.
Preferences for "Collaborative Consortia" with Cross-sector Technologies	IF could focus on supporting an enlargement of value chains, increasing cross industry cooperation and to innovate horizontally applicable, integrated solutions and innovation that results in services replacing or complementing existing products. IF is encouraged to promote cooperation across sectors and support partnerships with technology service providers that have the potential to cross-fertilize different industries with key low-carbon technologies. IF might incentivize the formation of "collaborative consortia" with "cross-sectorial" technologies through awarding extra points in consideration of Stage 1 scoring.

2. Low-carbon Technology Innovation Needs

Experts were very forthcoming around the different sectorial decarbonisation technology innovation needs during the workshops. It also became clear that each sector benefits from, in some cases decades, and certainly multi-annual processes designed to identify the different low-carbon technologies and pathways open to it.

An overriding observation is that there is no shortage of technology ideas and possible pathways for any sector – the question is which pathways and technologies are economically and societally optimal, especially when they involve cross-sectorial technology solutions and collaboration. Each sector has identified incremental and breakthrough technology needs and many of the production sectors can also benefit from cross-cutting low-carbon technology solutions such as carbon capture and storage/use, green hydrogen, more intelligent energy management and energy storage. However, by definition, a fund designed to finance innovation may not know in advance the full set of possible technologies which maybe invented from 2020-30 and hence should not try to restrict projects in planning based on a predetermined list of technologies.

Technology Readiness Level[1]	Description
TRL 1	basic principles observed
TRL 2	technology concept formulated
TRL 3	experimental proof of concept
TRL 4	technology validated in lab
TRL 5	technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	system prototype demonstration in operational environment
TRL 8	system complete and qualified
TRL 9	actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

A consensus of experts felt that support is needed to develop innovative technologies through the so called "valley of death", which is typically the critical upscaling demonstration phase found between technology readiness levels (TRLs) 6-9. This means funding for technology demonstration in the relevant industrial environment (TRL 6), system prototype demonstration and qualification in the operating environment (TRLs 7-8) and actual system proofs in the competitive production and commercial environment allowing for massive roll-out (TRL 9).

Experts noted that the likely development cycle for a successful technology that is at TRL 7 would be 5-10 years and that the opportunity to implement a new technology comes "once every 15 years" in a classic economic plant life-cycle (yet in much shorter windows in renewables, energy storage, CCS and hydrogen). As sectorial decarbonisation cannot wait until 2040 (the result of a 10 year maturing technology funded at TRL 7 in 2030, for example), it may be the case that an Innovation Fund needs to narrow and raise its TRL levels funded during its life from 2020-30, subject to market feedback. The fund should "allow these options to be commercially available within the next 15 years".

Certain terms, discussions and concepts were repeated in many of the workshops and can be summarised as follows:

Process, Product or System Innovation: This refers to "where" in the supply chain the low-carbon technology innovation is required: Upstream (decarbonising energy and resource inputs), Process (decarbonising the existing transformation assets) or Downstream (decarbonising demand through replacement with lower carbon intense alternatives). Life Cycle Assessment (LCA) methodologies (or simplified LCA-like calculations) and sustainability indicators (at different TRLs) were mentioned as useful tools to provide a "heat mapping" per product to help determine where

[1] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

in the product life-cycle the greatest and most cost effective decarbonisation opportunities may lie, which clearly differs dramatically between sectors.

The detailed list of technologies and pathways highlighted by the different experts as the initial prospective categories and areas for innovation needs in each sector with CCS, renewable energy, energy storage and "green" hydrogen treated as separate "cross-sectorial" categories:

Sector	Technology Innovation Roadmaps and Categories
Ferrous Metals/Steel	Two innovation initiatives were cited: ULCOS ("Ultra-Low Carbon dioxide (CO2) Steelmaking") consisting of a consortium of 48 European entities (incl. all major EU steel companies, some engineering partners, research institutes and universities) whose aim is to reduce the CO2 emissions by at least 50%; and the CO2 Breakthrough program (conducted within the world steel organization). 1. Improving energy efficiency beyond the state-of-the art 2. New Smelting Reduction technologies 3. Direct Reduction technologies, based on natural gas 4. Direct Reduction technologies, based on hydrogen 5. Direct use of electricity for iron ore reduction 6. Use of biomass in steel production 7. More recycling of steel 8. Other breakthrough solution paths for low-carbon steel production
Non Ferrous Metals	1. Switching fuel / reaction agents 2. Innovating the extraction, refining and electrolysis metallurgy 3. Developing new, highly performing NFM alloys and compounds 4. Developing simulation models and emulators 5. Establishing new circular value chains, Leasing of metals 6. 3D printing for bionic design and more efficient use of materials 7. Creating a market for 'green products' 8. Substitute carbon intensive products with low-carbon products. (e.g. Anodes in Al processing). 9. New CCU techniques to capture carbon from waste gases and converting it to either synthetic fuels or other useful products on an industrial scale needs to be demonstrated.
Pulp & Paper	The Confederation of European Paper Industries ("CEPI") Two Team Project (2013) that used competition to innovate and identify disruptive breakthrough technologies able to decarbonize the pulp and paper making process by 80% by 2050 and CEPI´s 2017 report "Investing in Europe for Industry Transformation – 2050 Roadmap to a low-carbon bio economy" were cited. 1. Integrated process management (e.g., Deep Eutectic Solvent, foam forming technologies, superheated steam drying, water removal without evaporation, drying techs including: Condebelt, osmotic, infrared, diffusion and yankee cylinders) 2. Fuel switching 3. Material efficiency 4. Material substitution 5. Innovative technologies for recycling and reuse
Oil & Refining	1. Process improvement technologies that reduce operations emissions 2. Heat recycling and reuse 3. Renewable ("green")/low CO2 hydrogen 4. Alternative feedstocks, advanced biofuels
Chemicals & Bio-Based	Industry driven PPPs such as Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) and Bio-based Industries (BBI) were cited as "having a key role to play" in the new low-carbon technologies. Various process and product priority lines (ex. RES/ Green H2) were identified including: 1. Significantly increased resource and energy efficiency of process technologies 2. Utilization of renewable electricity, alternative energy sources, production of Hydrogen with low carbon footprint 3. Better utilization of alternative sources of carbon: biomass, waste & recycled materials (CO_2 from industrial flue gases – chemical valorization of CO_2)

	4. More robust and tolerant production systems 5. Integration of advanced process modelling, control technologies and digitization 6. Industrial symbiosis 7. Materials "breakthroughs" including better eco-design of materials, development of advanced sustainable recycling process, high performance functional materials for low-carbon energy, mobility and housing.
Cement & Lime	The Cembureau and WBCSD-IEA published roadmaps were cited for decarbonisation reference. Deep decarbonisation of the cement and lime industry presents a special challenge as only 35-40% of GHG emissions come from combustion of fuel. To reach >80% reduction in emissions a "fundamental change to the existing business models" with a "wide range of solutions must be simultaneously employed". The cement industry identified 40 technologies grouped into 9 categories (shown below) that are in TRL 6-9. 1. Reduction in Manufacturing Emissions (EE, Fuel switch, WHR and alternate fuels) 2. Lower clinker content in concrete (Ultra-low clinker concrete & additives) 3. Changes in concrete composition (CEM X, CSA-Belite, Suplhated, Alt CSH, Geopolymer, Solidia, Carbstone) 4. Use of recycled materials/ components (cement recycling, use of carbonated wastes, by design) 5. Extension of lifetime (e.g. Self-healing concrete) 6. Reduced user energy consumption in Use phase (Core activation, EE in Buildings) 7. Carbon capture in concrete (Mineral CO2, Carbon8, Solida, Carbstone) 8. Carbon capture (Separation of CO2 streams in process) 9. Co2 Utilisation (Reutilisation processes, Reuse in fuels, biofeed, Storage) Lime: Although most of the cement technology priorities could apply to lime (such as CCS/CCU and CO2 as fuel), few additional technology innovations are: 1. Increase of CO2 concentration e.g. by looping 2. Indirect calcination 3. Methanisation 4. Low concentration CO2 -> Direct use for e.g. plant/algae/bacteria growth/feeding or flue gas cleaning 5. Combination with Oxyfuel process 6. Carbonation 7. Carbon dioxide Storage by Mineralisation (CSM)
Glass & Ceramics	The following technology areas were identified in Glass and Ceramics separately as "breakthrough" innovation areas for decarbonisation: Glass: 1. Electric furnaces (subject to power sector decarbonisation and electricity price) 2. Fuel switch to bio fuels and hydrogen 3. Fuel flexibility (firing of different fuels) 4. Waste heat recovery 5. Closed loop glass recycling 6. Batch reformulation & batch palletisation (e.g. non-carbonated materials or glass with lower melting temperature) Ceramics: 1. Electric furnaces and dryers (subject to power sector decarbonisation and electricity price). 2. Natural gas in gas-fired furnaces (state of the art) not only to provide heat, but is also a reaction partner for some types of ceramic products (i.e. tableware/porcelain products, bricks, some types of refractories). 3. Waste heat recovery 4. Design of non-fired/ low-fired products (products which don't need to be put in a furnace/ low Temp furnace, yet achieve the same technical quality) 5. Increase of recycling 6. 3D-printing only for prototyping

	7. Other product innovations (light weight)
Renewable Energy	The EU Technology Platforms and the SET-PLAN management bodies should be referenced as well as "respective discussion papers of associations prepared for the NER 300". 1. Innovations in Wind (next gen turbines, floating foundations, data and energy management systems) 2. Innovations in Solar energy (e.g. Concentrated Solar Power, building integrated PV, flexible organic cells, solar roof-tiles, solar highways, floating PV installations) 3. Synthetic fuels produced with renewable electricity (e.g. high density liquid fuels, renewable methanol, synthetic natural gas, hydrogen) 4. Advanced biofuels. 5. "Hybrid systems" of renewable electricity generation plus storage (e.g. battery, hydro-pumped storage, power-to-gas storage) 6. Smart technologies and innovative management in the distribution grid 7. Thermal grids and networks, low temperature district heating and cooling 8. "Synergetic applications" with co-uses (e.g. desalination, water management, horticulture, Digital economy, pharma or electric car industry) 9. Ocean Energy 10. Geothermal energy
Energy Storage	Participants emphasised the importance of sector interfaces (e.g. links between gas and electricity or heating and electricity) and system integration of storage technology to enable energy decarbonisation. There is no single technological solution, as technologies are maturing rapidly, however experts identified the following three categories and technologies: 1. Process innovation: Including approaches through: i. Electric Vehicle for the Vehicle to Grid application ii. Thermal Storage: Sensible heat, latent heat and thermos-mechanical heat storage iii. Power to X iv. Pumped Hydro Storage v. Flow Batteries vi. Lithium Ion technology & post lithium technologies (M-air, Na-Ion) vii. Compressed Air and Liquid Air Energy Storage; 2. Product innovation; including: Energy Management Systems, Block chain technologies and Artificial Intelligence (AI); and 3. System innovation; including approaches which replace existing systems in their entirety.
"Green" Hydrogen	The use of renewable energy to produce "Green Hydrogen" to deliver process decarbonisation, fuel and storage alternatives was mentioned as a potential cross-sectorial deep decarbonisation vertical and the following initiatives and approaches were highlight in the workshops: 1. HYBRIT, H2Future, SuSteel and SALCOS (Steel) 2. Hydrogen as a reducing agent (cf. the CIRCORED process – Steel) 3. Hydrogen based production processes (NFM) 4. Hydrogen to take Sulphur out of transport fuels and for conversion schemes (O&R) 5. Fatal H2 generated as side stream (C&BB) 6. Hydrogen as low-carbon fuel for the transport sector (RES) 7. Renewable hydrogen as storage medium (ES) 8. Hydrogen production with CCS
CCS/ CCU	Carbon Capture and Storage (CCS) and/ or Usage (CCU) were identified as "end of pipe" and necessary solutions to achieve cross-sectorial deep decarbonisation and the following initiatives and approaches were highlight in the workshops: 1. Detailed feasibility study, complete with requests for storage authorizations, was an integral part of the ULCOS-II program proposed around the ULCOS-BF project under NER-300 2. Carbon2Chem (ThyssenKrupp Steel) and Steelanol (ArcelorMittal & Lanzatech) 3. Building materials incorporating CO2 (C&L) 4. Conversion to Syn-fuels (NFM) 5. Biogenic & boosting forest carbon capture (P&P)

	6. Chemical valorization of CO2 (and CO) from gaseous industrial effluents (C&BB) 7. Pre-and post-combustion capture (O&R) 8. Soda-ash production (local small scale application - G&C) 9. Carbon sequestration and reuse (C&L) 10. Second generation capture technologies (such as high pressure turbines or subsea separation) 11. Innovations in transport of CO_2 (gas pipelines, buffer storage, ship transport and their combinations and sharing of infrastructure) 12. Increasing of storage capacity by pressure management, better knowledge sharing, development of CCS hubs and clusters, Enhanced Oil Recovery demonstration For CCU, there remains a question of scale: "The CO2 emissions from one single cement plant could saturate the current market for a specific CCU product"

3. Financing Needs for Innovation

In terms of financing needs there was a stronger consensus among the sector workshops and experts which was also supported and created through initial consensus formation through specific finance sessions attended by multiple sector experts and stakeholders. This allows reporting on the financing needs for innovation to be provided by specific paragraphs answering the core questions with "exception reporting" in the case where a specific sector might have had a different view (out of line with the consensus) rather than producing a long table of individual sector views – as was necessary for technology needs.

The following summaries collect comments on the innovation financing needs of the sectors covered in the workshops in specific areas or responding to specific discussions which were repeated in various expert working groups:

- **When is Innovation Funding needed?** A consensus of experts felt that the key "funding gap" in innovation is the so called "valley of death" which is typically the critical upscaling demonstration phase found between technology readiness levels (TRLs) 6-9. This includes technology demonstration in the relevant industrial environments (TRL 6), system prototype demonstration projects and qualification in their operating environments (TRLs 7-8) and actual system proofs in the competitive production and commercial environment allowing for roll-out (TRL 9).

  A few experts thought that "IF should not provide support for commercial scale technologies/projects" (as they have access to market finance). It was noted that private financiers need a profitable project to invest in it. This condition might be met for late TRLs and roll-outs of respective technologies in TRL 9+. The Cement and Lime sectors wanted to see the Innovation Fund accept all TRLs and the "one stop shop" concept was discussed by various experts (see below). The "valley of death" often represents a significant up-scale in funding amounts and generally banks and private equity are not yet willing to take the risk of unproven technologies and business models at this point.

- **How much funding is needed per "transaction-demonstration of new solution"?** Several sectors offered ball-park figures that helped frame the question of "amount per innovation transaction". Two examples include: the refining industry, which invests billions of dollars every year in Europe (with individual projects in the €50m – 1bn range), and the low-carbon investments needs for just the Pulp and Paper industry are estimated at EUR 25 billion until 2030. This discussion indicates the framework for IF and that the total financial needs for Europe's industrial decarbonisation are very substantial and far above the Innovation Fund resources alone.

  Several experts identified funding needs "by technology" using the following examples: CCU needs about Euro 10 million per unit; CCS and its infrastructure needs around Euro 60-1,000 million for a pilot/demonstrator. Other experts in separate workshops used expressions like: "Financing a few million Euros to Euro 200 million per project is required" and "to be material and impactful, any support to a specific project is likely to be in the hundreds of millions".

  Other experts recommended that the fund be "flexible enough to accommodate all these different types of needs (single entity small and multiple entity large)" and recommended that the innovation fund be able to address different financing needs through separate funding windows: one for small projects (less than €10m); one for medium sized projects (<€25m); and one for larger projects. It was noted that the Innovation Fund should not only focus on very large projects. It was also noted that established and larger companies, such as utilities or manufacturers, will tend to prefer larger projects while developers and SMEs, such as in ceramics and lime industries, would tend to prefer smaller ones. Broadly

speaking a per transaction range of Euro 5-200 million would cover the majority of needs including infrastructure, especially in the case of cross-sector innovation.

- **What financing products are needed from the Innovation Fund?** A wide spectrum of financing products were discussed by experts including: grants, concessionary debt or equity, risk sharing instruments, guarantees, revenue support, insurance, working capital facilities (OPEX) and hybrids (a mix of two or more instruments). There was a tendency to prefer grants from all the sectors, especially for the earlier stage development projects (e.g. TRL 6-7) without revenues or pre-cash flow generation, as at this stage there are no predictable cash flows to repay other instruments and the risk of failure is still very high (although equity could also be an option). The grant intensity can vary according to the project size (typically higher for small companies with less attractive balance sheets and no corporate finance alternatives). Experts felt that grants are needed to support piloting and pre-commercial development and where there is a high technological risk. CCS for example is not considered financially viable, hence requiring such general CAPEX and continuous OPEX support. It is interesting to note the absence of detailed debate among experts on the benefits of grants vs equity.

  At later stages in the development of an innovative technology when it is in the later stages of proof in the industrial environment (TRL 8-9) there could be enough cash flow generated through the sale of the low-carbon product to allow complementary sources of finance to enter with a level of minimum revenue guarantee, insurance or de-risking instrument provided by the Innovation Fund. Loans will only be offered (by any entity) when revenues start to be generated. Project financing can be structured once the project's cash flow is consolidated so if the IF can support projects until they generate a stable cash flow then market based financial arrangements can be structured at an earlier stage (than they would have without IF involvement).

  The need for working capital (or OPEX) financing was mentioned several times for various stakeholders (from developers to manufacturers). Working capital, by definition, is a short-term need to cover the differences in timings between receivables and payables or invoice timings and could be covered by a regular bank working capital facility if the overall credit risk of the entity was guaranteed by the IF during that phase of development. One sector felt that the fund should support just CAPEX and cover development and technology risks only.

  Many felt that the funding (i.e. cash) should come when needed (normally upfront, or based upon project milestones) and not several years after the end of the project (based upon success) as was the case in the NER-300 scheme: Innovation funding is supposed to alleviate risks for this kind of technology demonstration and not be "risk free" (i.e. paid only on success). Not surprisingly, developers and SMEs tend to favour front-end, or milestone, financing while manufacturers, utilities, storage specialists and larger companies have larger balance sheets and can better sustain cash-flow timing differences, provided a certain level of returns is anticipated. Some groups discussed insurance products and performance guarantees that could be considered for specific types of projects at specific (later) TRLs. Convertible instruments (i.e., mezzanine finance and convertible loans) could leverage the overall funds available in the Innovation Fund allowing them to "go further".

- **What procedures and structures are needed by the market?** Many experts felt that the Innovation fund should have transparent procedures, simple administration, reduce the "weight" of procedures through a two-stage application (giving greater certainty of funding at later stage to allay due diligence costs) and provide funding upfront and against milestones (which could include evidence of scalability and transferability of the technologies and to reward co-benefits). Staged calls can also prevent all the funds being spent in IF's early years. Due diligence by the fund should be 'effective' with many experts

asking for 'less red tape' and greater speed with direct management at the EU Level. If the EIB, or other institution, will be responsible for projects assessment or due diligence process, this process should be transparent and known to applicants in advance.

The IF should remain flexible, (technology neutral) as much can happen over a decade (reference made to NER 300 lessons learned) to accommodate mishaps and uncertainties requiring change of strategy and evolution in a project. Frequent calls or continuous applications to multiple windows for different products allowing project hosts and applicants to be more tailored, for IF staff to be more focused and to lower wasted resources for unsuccessful applications. IF can target support at projects that produce (or are brought by) collaborative partnerships among technology providers, R&D organisations, financiers and industrial companies and/or synergies within value chains. The duration of the fund (investment period) should be 2020-2030.

- **What is the maturity or term of the financing need?** Many industries noted the long-term nature of innovation investments, recognising that facilities can have economic lives of 15-40 years and serious refurbishment opportunities (for technology switches) once every 15 years. Experts felt that the likely development cycle for a successful technology that is funded at TRL 7 would be 5-10 years to become commercial and that the opportunity to implement a new technology comes "once every 15 years" in a classic economic plant life-cycle (and longer in some sectors), while shorter in the case of renewables. Participants agree that long-term financial support is of the essence for successful projects to proceed to high TRLs.
- **What kind of returns can be expected of Innovation Finance?** No consensus was reached as the required payback time of innovative projects is strongly influenced by the policy and market framework: the more stable it is, the longer the payback can be (lower required returns). One sector felt that payback periods needed to be between 1-10 years with IRR targets of 5-50% (others felt that innovation projects are so risky that talk of returns doesn't make sense in this context, especially if the target instrument is a grant). The following levels of returns were mentioned by manufacturers: A maritime power project could achieve 8-12% project IRR at the demonstration/ pre-commercial stage; and developers target a wide range of 12 to 25% project IRR.

  The IRR concept seems adequate for low-risk innovation investments and for roll-outs of innovative projects, yet it was found inadequate by many experts for high-risk investments such as decarbonisation which are seen as "highly disruptive". In the earlier phases of innovation investments (lower TRLs), no immediate and attributable IRR could be expected and that the IF should adopt a portfolio approach to manage the high risk of failures of technologies in low TRLs. For more mature low-carbon technology investments (TRL 8-9), a longer payback time horizon would be required. Also, experts noted that "the strategic dimension" of such investment decisions would have to be taken into account, therefore not lending themselves towards the application of a simple IRR calculation.
- **Can IF be a "One stop shop"?** Many of the experts expressed a desire for the IF to be a "one stop shop" for all kinds of financing needs and to streamline complex application procedures for funds at EU and national level. It is therefore important that the IF would enable links with other relevant Financial Instruments. Experts thought that low-TRL, R&D and other applied research funders should be encouraged to post successful projects to IF for consideration once they reach the higher-TRLs and require demonstration projects; and that IF can also signpost to the earlier TRL funders (e.g. RFCS) if they receive submissions which IF believes are below TRL 6. It was noted that the relationship of the IF with complementary EU funds such as the H2020, the InnovFin, CEF, the EU's venture Capital EIF and the EFSI should be clear so that applicant and reviewer time is optimised.

4. How could the Innovation Fund Address the Needs

Multiple recommendations were offered from each of the sector workshops for the Innovation Fund to address each of the identified sectorial funding needs and again there was a level of initial consensus formation through specific multi-stakeholder finance sessions. In fact, it was usually difficult to separate the "funding needs" from the recommendations for the fund as experts were usually keen to answer each need with a recommendation – or, in cases, jump directly to the recommendation. Therefore, as for the previous chapter on the financing needs for innovation, this section divides into "consensus responses" to the identified needs with added "exception reporting" where some experts or specific sectors had a different view.

The following summaries collect comments on the ways in which the Innovation Fund can address the identified funding needs (outlined in the prior chapter) of the sectors covered in the workshops:

- **Transparent and Clear Project Selection Criteria:** All groups and experts agreed that the Innovation Fund should have clear criteria and a highly transparent set of requirements, procedures and decision making processes. This would avoid confusion, overlap with other funding instruments, reduce administrative inefficiencies and enable project proponents to present just those projects likely to meet the criteria. The following are some examples of clear and transparent criteria for IF consideration:
  - **Technology Readiness Levels 6-9**: A consensus of experts felt that the key "funding gap" in innovation is the so called "valley of death" which is often the critical upscaling demonstration phase found between technology readiness levels (TRLs) 6-9. This includes technology demonstration in the relevant industrial environments (TRL 6), system prototype demonstration projects and qualification in their operating environments (TRLs 7-8) and actual system proofs in the competitive production and commercial environment allowing for roll-out (TRL 9). Some experts noted that TRL (as defined by the EU) is a strong indicator, but not the only one: High TRLs don't necessarily mean that the manufacturing processes, the market, the regulation and the society are also "mature" (e.g. Energy Storage). Others suggested a criterion that irrespective of TRL, the technology must be proven to be commercially available within the next 15 years.
  - **Funding Requests Considered between Euro 5 to 200 million**: Several experts commented that the minimum funding threshold should be below the €25m mark (which is the EIB threshold for direct support) and thought that "a minimum funding threshold of at least €10m" was needed. Others felt that "a minimum financing threshold of €10m seems acceptable for all groups, the right overall balance between small scale and large scale projects needs to be explored in more detail". This gave rise to a suggestion to allocate a separate segment/ budget for small scale projects (e.g. Euro 5-10 million, noted especially by Glass & Ceramics and Lime) with a simplified application, evaluation and reporting procedure.
  - **Evaluation Grid with Identified Criteria**: "Cost-Per-Unit Performance" (CPUP) was the unique reference criteria used for prioritising funding under NER 300. There was a consensus that this single criterion was too limited and inappropriate for wider variety of potential innovations which the IF will need to consider, in its expanded sectorial scope. In addition, there was a consensus that the IF should be based on broad "technology corridors", not on a detailed, closed list of technologies.

    There was a wide ranging set of opinions regarding which new criteria to use to determine which projects should receive funding. Illustrated by the diversity in the following proposed criteria, consolidated from many more:

- The carbon cost at which the project is bankable and the cost of carbon at which the proposed technology would be economically viable at commercial scale;
- Subsidy per unit of CO2 saved (CO2 savings in downstream applications could also be taken into account in this context);
- Cost of GHG mitigation (€/t of CO2 avoided compared to a reference case or "cost effectiveness with regard to CO2 reduction potential" – "LCOE reductions can be a metric for electricity related projects");
- Total project potential GHG savings including savings over the life cycle of use (not just production, and using a well-known and transparent existing technology reference benchmark or standard for comparison);
- Total aggregate CO2 savings if technology proven and applied across all potential sectors and installations (based on based on replicability and scalability in the market);
- CO2 abatement costs based on "target" costs also taking into account expected cost reduction/ learning curves for the future roll out of the innovation;
- Duration of CO2 savings –whether the CO2 is stored or utilized (same for other natural resources);
- Potential generation of revenue over the time horizon for making the process profitable as well as total global addressable market for the product/service proposed;
- Prerequisites for achieving economic breakeven point (like the existence of pipelines for H2 or CO2)
- Creation of synergies between sectors (also considering additional system costs or benefits like flexibility, stability and secured capacity);
- Potential for developing profitable and volume business;
- Sustainability criteria with integration of life cycle approach;
- Quantifiable environmental benefits of the project;
- Exclude "bankable projects" by design and just support projects that cannot be funded (alone) by commercial equity and debt;
- Potential for the technology to be implemented across an industry or range of industries;
- Ability for knowledge sharing of the innovation;
- Indication of how EU funds can be leveraged with other public and private sources;
- Duration: Whether it is a short/long-term project (faster projects should be prioritized);
- "Impact" and "degree of innovation" should be among key criteria (with special credit to "First-of-its-kind" approaches or "breakthrough innovations");
- Solution is effective for the population of companies in the consortium applying to IF;
- Required absolute volume for financing and co-financing opportunities (noting that complex financial rules would be a barrier) but with strong focus on matched private sector funding;
- Value proposition for European economies (e.g. value chain effects, competitiveness on the global technology markets). Some participants suggested that the promotion of European industry should be the main target of the IF ("technology realised in Europe");
- Technology SWOT analysis and full risk assessment (differentiating between different risks including technology and market specific risks).

The conclusion drawn from this long list of criteria is that experts felt that a greater degree of analysis and due diligence was required of low-carbon innovation projects (going beyond a single criterion approach which was adopted for NER 300). There are "clusters" of criteria, such as those relating to CO2 savings potentials, costs and stabilization market prices for the technology to "work". There is a cluster around the addressable market, economics and sustainability of the technology. There is a cluster around technologies which serve or connect multiple sectors allowing for shared knowledge development and there is a cluster

around more financial aspects of the project itself (such as co-funding and availability of market instruments).

In the discussions around criteria, participants were clear that any criteria selected should apply fairly to all proposals in order to compare them on an objective common basis. In addition, that prioritization should not be carried out in an overly simplistic way, therefore not be based on a single criterion but perhaps a scoring system over multiple criteria ("a weighted scoring model could be applied where projects can earn scores according to their respective benefits"). Nearly all the working groups favour an approach based on "broad technology corridors", not a specific list of technologies – although there was support for eligible technologies being identified around a limited number of innovation themes.

In terms of return or target IRRs, experts highlighted the extreme complexity to precisely define levels of IRR that could be achieved in each technology within the framework of a fund. There was no agreement between the various representatives on a 'typical' pay-back period as it is entirely dependent upon the degree of innovation of the project ('the more innovative and new a technology is the longer the pay-back').

The idea of "breakthrough technologies (and business models), rather than incremental innovations" was highlighted several times. Several groups wanted to ensure that start-ups and SMEs were not excluded, but others recognised that this applied more to some sectors than to others. The discussion on % of co-financing and risks was held across several of the groups and discussion questions and experts believed that IF should be independent in its decision making and analysis.

- **Clear List of Finance Products on Offer:** The strong preference of experts was that the IF should offer grants – even recognising the impact that would have on non-revolving nature of the IF and therefore also limiting its overall "fire-power" over time. Nonetheless, it is fair to say that most experts were also open and supportive of the IF providing other instruments along grants.

  Some experts referred to "partial grants and / or de-risked loans" depending on the maturity of the technology (its TRL) and the nature of innovation; some suggested that higher levels of grant intensity could be provided for early stage projects (lower TRLs), Several experts thought that simplicity was paramount and that the IF should avoid proposing complex financial instruments. Many believed that "a grant component should remain", as FOAK projects typically are not bankable (and consequently cannot be properly supported with debt instruments).

  The second class of potential IF instrument discussed were "de-risking mechanisms" although the exact structural details of these de-risking instruments varied between expert and group. A good indication of expert views is that these de-risking instruments "should reduce private financing barriers and costs by providing some recourse elements" including first loss guarantees, performance guarantees, revenue insurance or guarantees. Others felt that risk sharing was needed for all "first of a kind plants" to facilitate these higher risk investments in Europe. Insurance schemes were mentioned by refiners concerned about the disruptive potential of untested and innovative technologies "putting their existing operations at risk". One group suggested that sub-funds could provide different types of finances, with one sub-fund focused on providing insurance to all projects awarded finance, across all technologies, thus de-risking them all at the lowest cost and drastically lowering their cost of capital.

  Some groups of experts thought that the Innovation Fund should provide a range of financial instruments, tailored to projects' needs – from this arose the "one-stop-shop" concept which resonated in many of the workshops. "Stepped-up risk taking" by an EIB

InnovFin[2] style approach and type of financing was seen as useful (however EFSI products were not seen as useful for innovation by some experts as they sit very far down the technology development lifecycle). Some experts felt that later phase projects (higher TRLs and with stronger project proponents) could support de-risk instruments (e.g. equity or loan guarantees) and loan funding, but only "under defined conditions". Convertible loans and "grace periods" were also raised as possibilities by individual experts as well as loans to support CAPEX which - if the project does not evolve as planned can firstly convert to zero-interest loans, then partially into a grant. Of course, this mechanism could be applied in reverse giving the IF rights of some partial or whole grant repayment if the recipient project (of a grant) is commercially successful.

To stabilise the revenue stream of projects, some experts suggested a support for the OPEX, ensuring that the initial "pricing" differential could be addressed, allowing for higher chances to access private financing once projects are operational.

A final category of instrument that relates to the IF's unique position as an EU instrument can be broadly described as an "innovation deal", where IF funding comes with "some administrative support under precise conditions that are implemented as part of the IF procedure", such as via the project development assistance.

- **The Innovation Fund should be a revolving fund**: While a strong consensus of experts across groups believes that the IF should be a "revolving fund", many also noted that with grants and the long-term needs for financing (15 years in many cases) the amount and timings of any revolving cash to the IF could be from 2035 onwards. However, experts agreed that projects which did not meet their milestones should have their IF funding commitments reviewed and potentially (after a warning and appropriate procedure) revoked to ensure that projects which fail, fail fast to ensure that new innovations which arise in later years can access the capacity "freed up" from funding pledges to failed projects. Many participants also felt that the IF should not rush to commit all of its funds immediately and that funding commitments should emerge over a series of years (like a normal fund's "investment period"). Others noted the complementarity in the cash-flow needs inherent in the IF offering a portfolio of products: For example, a grant could require up-front cash and funding vs milestones commits future cash against achievements. In addition, experts felt that remaining NER 300 funds from the second call should be used to kick-start the IF before 2021.

- **Simple, Two-stage Application Process with Multiple Competitive Calls:** There was a consensus from participants that the "two call" and Member State controlled application process of the NER 300 could be "significantly improved". The idea of a "one-stop shop, managed at EU level, with easy administration and common rules" gives a sense of participants' direction of travel.

  Experts clearly favour a multi-stage process ("funnel-type application procedure") with a consensus opting for a two-stage process (for simplicity, clarity and to reduce administrative burdens). Stage 1 could be "light" (a "concept presentation"or "expression of interest") with simple descriptive requirements providing insights into how the project expects to perform against the "key selection criteria". Projects which qualify through Stage 1 would pass to Stage 2 and then would require the submission of a far more detailed project information pack for detailed technical and business due diligence.

[2] *By 2020, EIB-EIF's InnovFin is expected to make over EUR 24bn of debt and equity financing available to innovative companies to support EUR 48bn of final R&I investments. 2007-2013 programming period, the Risk-Sharing Finance Facility financed 114 RDI projects to the tune of EUR 11.3bn and signed 29 guarantee contracts with a total guarantee amount of over EUR 1.4bn.*

A two-stage process reduces the administrative and financial cost of non-qualification ("only limited efforts are spent by applicants, until more visibility is received about probable success for receiving grant" – thereby making applicants more likely to apply) and it will reduce the IF resources required to diligence large packs of information from projects which clearly do not meet the IF criteria at Stage 1. The Global Innovation Lab for Climate Finance[3] provides a useful example of a successful public-private and innovative two-stage application process.

Many experts called for a "user friendly, simple application procedure" and a "standard template" with the possibility of "less burdensome process for smaller projects". Experts underlined that a staged process can encourage a broader participation and range of ideas in the first round but that "control of the process should be at the EU level and allow for direct IF feedback with applicants (not via member state institutions)".

There was a debate between experts that felt a "continuous open process throughout the year" (like most private sector funds that accept project applications at any time) was better than a multi-call system to "increase the competitive element between projects". Proponents of a continuous application process suggested there should also be "a certain consideration for sector balance (a mix between earmarked money per sector and non-pre-allocated budget)". While proponents of a multiple call process believed that this would allow "funding allocation to be staged across the whole next decade until 2030, allowing for later innovations" and greater benefits of competition to focus and sharpen innovators' projects. "First come, first served" was also seen as a sub-optimal procedure, improved by multi-stage, multi-call approaches. One group felt that calls should be done on a regular basis (e.g. every 6 months) and that the time between the introduction of the dossier and the selection decisions should also be limited (2 to 3 months instead of the current typical 1 to 2 years).

- **IF Decision Making Processes and Resources:** Experts were in strong agreement that the IF needed to be independent, have robust and transparent internal procedures and sufficient resources to properly undertake its responsibilities. In addition, experts highlighted the need to ensure low red tape and high professionalism of decision making. Funding innovation in technical and core sectors for Europe's future competitively is a highly complex and risky undertaking and workshop participants strongly recommended the inclusion of independent sector experts within the IF decision making processes to properly assess and analyse these factors (e.g. complexity of permitting process). Independent experts could be drawn from within each industry and also from the financial sector and their role should not be limited to supporting investment decisions but also "mentoring" projects. External experts could be identified through the EU technology platforms or SET Plan management bodies and through direct contacts with industries and finance sector, noting the need for balanced regional experience and actor diversity.

  Some experts felt that IF should target supporting a limited number of selected projects (e.g. 50-100 projects over 10 years). Others described an "investment window" of between 4 and 10 years, with the audience agreeing that this would require a case-by-case review for each sector against its low-carbon technology pathways. Experts felt that the evaluation process should be "short" (1-year timeframe was proposed from submission in Stage 1 to decision after Stage 2).

  Many experts with experience of NER 300 suggested that Member States could play a key-role in "top-up" funding after the IF had selected and contracted for its funding to "winning projects" on a voluntary basis. The overarching fear of combining funding from different

[3] The climate lab: Source: http://climatefinancelab.org/

sources was clearly increased administrative complexity. The questions of whether the private sector could "run the fund" and the "role of the EIB" should be considered.

For CCS, the backing of projects by the relevant Member State(s) is a must to reduce the regulatory and policy related risks and hurdles (e.g. related to the London Protocol). In addition, competition of funding between EU and MS should be avoided and adapted models for public-private partnerships (PPPs) should be pursued.

- **Milestone based support**: There was a strong consensus that cash flow would be required by innovative technology demonstration and deployment projects "when it was needed" – in other words the IF should aim to fund against needs and not 100% at the end of the project or after other funders. This leads to a form of contracted "funding against milestones" – meaning that each project submits a business plan with expected and independently visible milestones which unlock subsequent funding tranches. This would not obviate the need for some "up-front" funding, but it would "level the playing field" for SMEs and project consortia which do not have strong balance sheets, but who do have innovative technology projects. One group believed that allowing financing of project milestones, without a need to commercially deploy the developed solution, would encourage industry to undertake more innovation. Experts felt that milestones reduce overall project risk as they provide mitigation options in case of negative prospects, and also can provide the possibility of refunding in case of positive confirmation of milestones, thereby releasing funds for new operations as risks are reduced and other (market) alternatives become available.

  Another advantage of milestone based disbursement contracts is the ability to limit the support provided to underperforming projects. Projects in dire straits should be withdrawn rapidly and then IF resources can be refocused into more promising projects. Funding is clearly needed "in the year of the expense" from the launch of the project and in each phase of the project's development. While "ex-post financing" can superficially reduce risk, it also reduces the scope for innovation as – by definition – the cash flows must be funded "as needed" and therefore either the project has to enter into a factoring contract for the expected future IF payment (discounted by the cost of funds of the provider) or be an entity with a large balance sheet.

- **Signposting as a "Service" provided by IF**: There were repeated calls for the IF to be a "one stop shop" for all kinds of financing needs at multiple TRLs for lots of different projects. This is at odds with clarity and transparency of criteria and mandate. Many believe that the Innovation Fund has to be designed to complement, not overlap with existing funding schemes and that the setup of the Innovation Fund should include "mechanisms to ensure proper coordination between EU and national funding" as well as "complement R&D support under Horizon 2020 programme and other EU-level programmes (e.g. InnovFin or Connecting Europe Facility)". As a compromise EU designed funds for innovation and their successors should be aware of the ecosystem of financial supports which are available and signpost to projects which are ineligible for IF the other potential funding sources available.

- **Advantages for "Collaborative Consortia" with Cross-sector Technologies:** A number of the working groups believe that priority from IF should be given to support an enlargement of value chains, increasing cross industry cooperation and to innovate horizontally applicable technologies (e.g. heat recovery or carbon capture and use), integrated solutions and innovation that results in services replacing or complementing existing products. Experts felt that the IF "should make room for cross-sectorial synergies and projects" to "increase the likelihood that consortia would deliver on target in the most effective way" encouraging "cooperative/ symbiosis projects" with a "risk sharing nature". In addition, the IF is encouraged to "promote cooperation across sectors in areas such as CCS/CCU, Green

Hydrogen or waste to fuels" and "support partnerships with technology service providers" to "cross-fertilise different industries with key low-carbon technologies" and support "the harmonisation of European infrastructure". In addition, experts felt that partnerships or consortia including SMEs providing cross-sectorial solutions can be encouraged also "enabling the process of sharing the financial burden of putting the technologies together". In conclusion, potentially the IF can incentivise the formation of "collaborative consortia" with "cross-sectorial" technologies through awarding extra points in Stage 1 scoring, but not to the detriment of other critical criteria. A special role for collaborative consortia and PPPs was highlighted in particular in the CCS sector, where sharing of infrastructure for CO_2 transport and storage is a strong business-case enhancing factor and enabler. The role of the Member States and regional public authorities has been very clearly underlined in the CCS sector.

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