ACCORDO DI COLLABORAZIONE SCIENTIFICA NELL'AMBITO DEL PROGRAMMA "HORIZON EUROPE"

Tra

Il Consorzio Interuniversitario nazionale per la Scienza e Tecnologia dei Materiali - INSTM, di seguito indicato come **"Beneficiario",** con sede legale in Piazza San Marco, 4 e sede amministrativa da utilizzare per tutta la corrispondenza in Via Giusti 9 - Firenze Codice Fiscale 94040540489, Partita IVA 04423980483, rappresentato dal Prof. Andrea Caneschi, in qualità di Direttore

e

L'Università degli Studi di Messina, per il tramite del Dip. Scienze Chimiche, Biologiche, Farmaceutiche ed Ambientali (ChiBioFarAm), di seguito indicata come **"Affiliated Entity",** con sede legale in Messina, Piazza Pugliatti 1 CAP 98122, Codice Fiscale 80004070837, Partita IVA 00724160833, rappresentata dalla Rettrice, Prof.ssa Giovanna Spatari.
(qui di seguito congiuntamente identificate come le "Parti")

premesso

- che la Affiliated Entity risulta essere socio consorziato del Beneficiario come da Statuto e Atto costitutivo approvato dalle Università consorziate in sede di adesione al Consorzio, il quale ha il compito e le competenza per promuovere, svolgere e coordinare le ricerche e le altre attività scientifiche e applicative nel campo della scienza e tecnologia dei materiali, favorendo collaborazioni e progetti anche con il coinvolgimento di Università, di altri Enti di ricerca pubblici e privati e di altri soggetti privati;
- che il Beneficiario ha stipulato con la Commissione Europea il contratto n. 101115456 in data 14/06/2023, per lo svolgimento del progetto *"SUstainable Photo-ElectRochemical VALorization of flue gases - SUPERVAL"* finanziato nell'ambito del Programma Horizon EUROPE dell'Unione Europea, di seguito indicato quale "Grant Agreement";
- che il Beneficiario non impegna costi di personale strutturato del socio consorziato per lo svolgimento del Progetto *SUPERVAL*, ma solo costi di personale a contratto di nuova acquisizione;
- che il responsabile scientifico per il Beneficiario è il prof. Claudio Ampelli;
- che il Progetto prevede il coinvolgimento di gruppi di ricerca afferenti al Dipartimento di Scienze Chimiche, Biologiche, Farmaceutiche ed Ambientali (ChiBioFarAm), sotto la supervisione del responsabile scientifico prof. Claudio Ampelli;
- che l'Università di Messina è qualificata come Affiliated Entity del Beneficiario ai sensi dell'art. 8 del Grant Agreement e dall'Annex 1 al Grant Agreement;
- che il Progetto, di durata 36 mesi, è coordinato da FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA), e prevede il coinvolgimento di 8 partner e 1 affiliated entity;
- che il Progetto è iniziato il 01.11.2023 e terminerà il 31.10.2026;
- che ai sensi dell'Allegato I del Grant Agreement, la Affiliated Entity, che ha le necessarie competenze, collaborerà con il Beneficiario, mettendo a sua disposizione le proprie risorse per la realizzazione del progetto, ottenendone il rimborso secondo le regole di rendicontazione dei progetti Horizon Europe e secondo quanto previsto nel presente accordo;
- che il Beneficiario è l'unico responsabile nei confronti dei predetti partner per l'adempimento degli obblighi derivanti dal Grant Agreement;
- che il Beneficiario deve obbligare la Affiliated Entity al rispetto del dovere di sottoporsi ai controlli della Commissione, della Corte dei Conti e dell'OLAF, ai sensi degli artt. 25 e 26 del Grant Agreement;

convengono e stipulano quanto segue

Art. 1 – Interpretazione e rinvio

1.1 Il presente accordo è collegato al Grant Agreement n. 101115456 accordo è stipulato per consentire l'adempimento delle obbligazioni del Beneficiario nei confronti della Commissione Europea e degli altri beneficiari del Grant Agreement.
1.2 La Affiliated Entity dichiara di essere a conoscenza del contenuto del Grant Agreement dei relativi annessi, e di riceverne una copia.

Art. 2 – Normativa applicabile

2.1 Il presente accordo sarà disciplinato, oltre che dalle disposizioni qui contenute, dal Grant Agreement e dalle seguenti fonti:
- la base giuridica del Programma Horizon Europe, con riferimento al Regolamento Europeo 2021/695 del Parlamento Europeo e del Consiglio (28/04/2021) che stabilisce le regole di partecipazione e di diffusione relativamente al Programma Horizon Europe – Programma Quadro per la Ricerca e l'Innovazione attualmente in uso nell'Unione Europea;
- le altre fonti di diritto dell'Unione Europea applicabili al presente accordo;
- i principi etici fondamentali, così come definiti dal diritto dell'Unione Europea, dalle fonti internazionali e nazionali;
- la prassi della Commissione, che interpreta e applica la disciplina di cui ai punti precedenti, con particolare riguardo al documento "Annotated Model Grant Agreement", ultima versione;
- dalla normativa italiana per quanto non previsto ed a integrazione delle fonti summenzionate.

Art. 3 – Durata del contratto

3.1 Il presente accordo è valido dalla data della firma apposta da entrambe le parti, fino alla fine del Progetto indicata nel Data Sheet del Grant Agreement, incluse eventuali proroghe concesse dalla Commissione Europea.
3.2 In caso di concessione di eventuali proroghe alla durata del Progetto, il Beneficiario si impegna a darne comunicazione per iscritto alla Affiliated Entity.

Art. 4 – Oggetto del Rapporto

4.1 La Affiliated Entity collaborerà con il Beneficiario, mettendo a disposizione proprie risorse come indicato nell'Allegato I del Grant Agreement, nella realizzazione delle attività di seguito descritte:
"University of Messina, thanks to its academic experience, will support INSTM in performing the advanced characterization of the prepared electrodes and in supervising the activities for the development of the reactor for CO_2-water-co-electrolysis in WP2 and for the device integration in WP4, as well as in collaborating and supervising minor activities in the other WPs.
The PM and costs assigned to UNIME is as follows:

- *WP1 Gas separation: 1 PM*
- *WP2 CO_2/water-photo-electrolysis: 8 PM*
- *WP3 Photocatalytic hydrogenation of N_2 and NO_x to NH_3: 2 PM*
- *WP4 Device integration, SUPERVAL technology performance validation and feasibility assessment: 4 PM*
- *WP5 Dissemination, communication and exploitation: 3 PM*
- *WP6 Management: 1 PM*
- *WP7 Portfolio activities: 1 PM*

Art. 5 – Obblighi della Affiliated Entity

5.1. La Affiliated Entity si obbliga in modo specifico:
a) a svolgere, con la speciale diligenza richiesta, l'attività di cui al precedente art. 4, tenuto conto del particolare contenuto dell'attività e tenendo in considerazione che detta attività è necessaria per adempiere le obbligazioni che derivano dal Grant Agreement;

b) a rispettare le direttive del Beneficiario emanate per l'attuazione del Progetto, nelle fasi descritte nell'Allegato I al Grant Agreement, e per permettere al Beneficiario medesimo di adempiere agli obblighi di rendicontazione e relazione;
c) a predisporre, entro le tempistiche indicate dal beneficiario, tutta la documentazione necessaria per la rendicontazione dei costi sostenuti, secondo le regole indicate nella normativa di cui al precedente Articolo 2;
d) a redigere le relazioni richieste dal Beneficiario sull'attività compiuta entro i termini indicati. Detti termini sono considerati perentori ai fini del presente accordo;
e) mantenere il segreto, anche dopo la fine del presente accordo, sulle informazioni riservate di cui viene a conoscenza, sia che riguardino il Beneficiario, sia che riguardino i terzi;
f) a comunicare al Beneficiario, nel più breve tempo possibile, tutti gli eventi che riguardino il presente contratto e in modo particolare quelli che possano compromettere l'esatta esecuzione dell'attività;
g) a mettere a disposizione del Beneficiario i dati e le informazioni richieste dalla Commissione o dagli Stati membri, ai sensi dell'art. 17 del Grant Agreement;
h) a sottoporsi, anche dopo la fine del presente accordo, ai controlli dell'Auditor di primo livello della Commissione Europea (se previsto), della Corte dei Conti, dell'OLAF di cui agli artt. 25 e 26 del Grant Agreement, fornendo tutti i documenti e le informazioni richiesti, permettendo l'accesso nei propri locali e permettendo le ispezioni e verifiche necessarie.

5.2. Le obbligazioni di cui al comma 5.1 non possono essere trasferite.
5.3 Le disposizioni di cui ai commi precedenti continuano ad applicarsi anche dopo il termine finale del presente accordo, in quanto ciò sia compatibile con il contenuto di dette obbligazioni.

Art. 6 – Obblighi del Beneficiario

6.1 Il Beneficiario si obbliga a rispettare la normativa applicabile al presente contratto e, in modo specifico:
a) a mettere a disposizione della Affiliated Entity tutte le informazioni necessarie all'esatta esecuzione dell'attività di cui all'art. 4, tenuto fermo l'obbligo di segretezza;
b) a informare tempestivamente la Affiliated Entity di ogni eventuale decisione della Commissione riguardante le attività che il Beneficiario svolge avvalendosi delle risorse della Affiliated Entity identificate nell'Annex 1;
c) a rimborsare i costi eleggibili sostenuti dalla Affiliated Entity nei modi e nelle quantità previste dal successivo Articolo 7.

Art. 7 – Rimborso

7.1 Il rimborso per l'attività dell'Affiliated Entity sarà al massimo pari ad € 150.000,00 per costi diretti e costi indiretti.
7.2 L'importo di cui al comma precedente è ripartito nel budget preventivo, per categorie di costo, come da previsione contenuta nell'Annex 2 del Grant Agreement.
Ogni modifica di budget deve essere preventivamente concordata con il Beneficiario.

7.3 La somma di cui all'art. 7.1 viene trasferita alla Affiliated Entity secondo le seguenti modalità:
- un anticipo pari al 25% dell'importo dovuto alla Affiliated Entity entro 30 gg dalla firma del presente accordo per l'avvio delle attività o, se successivo, dalla data del ricevimento dell'anticipo da parte della Commissione Europea;
- una seconda rata del 25% dell'importo dovuto alla Affiliated Entity all'incasso del pagamento relativo al primo periodo di rendicontazione (M12 – Novembre 2024), previa valutazione positiva da parte del Beneficiario delle attività portate avanti dalla Affilated Entity, e a seguito della verifica della completezza della documentazione giustificativa dei costi sostenuti.
- una terza rata del 35% dell'importo dovuto alla Affiliated Entity all'incasso del pagamento relativo al secondo periodo di rendicontazione (M36 – Ottobre 2026), previa valutazione positiva da parte del Beneficiario delle attività portate avanti dalla Affiliated Entity, e a seguito della verifica della completezza della documentazione giustificativa dei costi sostenuti.

- il saldo (15%) all'incasso dell'ultimo pagamento, previo completamento delle attività di cui al precedente art. 4 e a seguito della verifica della completezza della documentazione giustificativa dei costi sostenuti.

7.4. Il rimborso dei costi eleggibili sostenuti, nella percentuale prevista dal Grant Agreement, avverrà in ogni caso successivamente e proporzionalmente al rimborso effettuato dalla Commissione Europea al Beneficiario.

7.5 È fatta salva l'applicazione del successivo Articolo 8.

Art. 8 – Responsabilità della Affiliated Entity

8.1. La Affiliated Entity è responsabile per tutti i danni derivanti al Beneficiario dallo svolgimento delle sue attività. In particolare, la Affiliated Entity sarà responsabile se, a causa della sua condotta, il Beneficiario non sarà in grado di adempiere, totalmente o parzialmente, agli obblighi nei confronti della Commissione Europea, così come descritti nel Grant Agreement e quelli assunti nei confronti degli altri partner di progetto.

8.2. La Affiliated Entity inoltre dovrà tenere indenne il Beneficiario dalle pretese di terzi, tra cui i dipendenti e gli altri ausiliari.

8.3. Il Beneficiario, qualora subisca un danno a causa della Affiliated Entity, può rivalersi sulle somme dovute alla stessa e, in caso di maggior danno, può richiedere alla Affiliated Entity il risarcimento dei danni subiti.

Articolo 9 - Coperture Assicurative

9.1 La Affiliated Entity ed il Beneficiario, ognuno per la parte di rispettiva competenza, provvederanno a garantire la copertura assicurativa contro gli infortuni e per responsabilità civile verso terzi del proprio personale impegnato nelle attività oggetto del presente accordo.

Art. 10 – Scioglimento del contratto prima del termine

10.1. Il Beneficiario potrà risolvere il contratto, a seguito dell'inadempimento o della violazione delle obbligazioni gravanti sulla Affiliated Entity dandone un preavviso di almeno quindici giorni, con comunicazione a mezzoPEC all'indirizzo dipartimento.chibiofaram@pec.unime.it, nella quale si dichiara la volontà di esercitare il diritto di cui al presente articolo. È fatta salva l'applicazione del precedente Articolo 8.

10.2. La disposizione di cui al precedente comma si applica anche nel caso di cessazione anticipata del Grant Agreement. In questo caso, in ogni modo, la Affiliated Entity sarà rimborsata per l'attività utilmente compiuta fino alla data di cessazione del Grant Agreement, nei limiti di quanto pagato dalla Commissione al Beneficiario per tale attività.

Art. 11 – Proprietà industriale e intellettuale

11.1 La disciplina relativa alla diffusione dei Risultati, è soggetta al Regolamento generale di partecipazione ai progetti di ricerca del Programma Horizon Europe (Regolamento No 695/2021 del Parlamento europeo e del Consiglio) e alle norme del Grant Agreement e dei relativi annessi. In particolare, ogni forma di diffusione dei Risultati (anche attraverso mezzi elettronici) dovrà dare evidenza che le attività sono state finanziate nell'ambito del Programma UE Horizon 2020, riportando altresì il riferimento al Grant Agreement.

Qualora la Affiliated Entity intenda divulgare i suddetti Risultati, potrà farlo solo previa autorizzazione scritta del Beneficiario, a cui sarà sottoposto il testo da pubblicare almeno 60 giorni prima della divulgazione, salvo diversa indicazione che verrà prevista nel Consortium Agreement.

11.2 La Affiliated Entity si impegna a rispettare le disposizioni in materia di riservatezza previste nel Grant Agreement e nei relativi annessi e a non portare a conoscenza di terzi informazioni, dati tecnici, documenti, notizie di carattere riservato, fatti, ecc., di cui venisse a conoscenza in forza del presente accordo. L'obbligo di segretezza è esteso a tutto il personale partecipante alla ricerca.

Articolo 12 – Referenti dell'accordo

12.1. Le Parti individuano come responsabili del presente accordo e della gestione dello stesso, i sotto indicati referenti:

- Prof.ssa Siglinda Perathoner (indirizzo e-mail: perathon@unime.it – segreteria@instm.it) per il Beneficiario;
- Prof. Claudio Ampelli (indirizzo e-mail: ampellic@unime.it – direzione.chibiofaram@unime.it) per la Affiliated Entity.

12.2 Le comunicazioni relative al presente accordo vanno indirizzate ai soggetti indicati nel comma 1 per e-mail. È fatta salva l'ipotesi di cui al precedente art. 10.

Articolo 13 – Divieto uso nome e/o logo Parti

13.1 Le Parti si impegnano a non utilizzare il nome e/o il logo dell'altra parte in assenza di previa autorizzazione della stessa. La Affiliated Entity si impegna a non utilizzare il nome e/o il logo del Beneficiario in assenza di previa autorizzazione, fatti salvi specifici accordi fra le Parti che prevedano, previa espressa autorizzazione del Beneficiario e le indicazioni del medesimo, le forme di comunicazione, pubblicizzazione delle iniziative oggetto del rapporto, senza snaturarne i limiti dei contenuti ed il conseguente uso del logo, con espressa prescrizione che nessun diritto sullo stesso è trasferito o concesso, né in via temporanea né in via definitiva, all'altra Parte. La Affliated Entity non può essere autorizzata, comunque, ad usare il logo o qualunque altro segno distintivo del Beneficiario per finalità diverse da quelle oggetto del rapporto in essere con il Beneficiario, con espressa avvertenza che l'eventuale uso autorizzato viene meno alla cessazione, per qualsivoglia motivo, del rapporto ed indipendentemente da eventuali contestazioni sulla stessa cessazione.

Art. 14 – Controversie

4.1. Le Parti concordano di definire amichevolmente ogni controversia che possa nascere dalla interpretazione ed esecuzione del presente accordo. Nel caso in cui non sia possibile raggiungere in questo modo l'accordo, le parti indicano esclusivamente il foro di Firenze quale foro competente per qualunque controversia inerente la validità, l'interpretazione l'esecuzione o la risoluzione del presente contratto.
Si accettano in modo specifico le clausole di cui agli articoli:
Art. 3 – Durata del contratto
Art. 10 – Scioglimento del contratto prima del termine
Art. 11 – Proprietà industriale e intellettuale

Articolo 15 - Disposizioni sulla privacy

15.1 Le Parti si danno reciprocamente atto di conoscere ed applicare, nell'ambito delle proprie organizzazioni, tutte le norme vigenti, sia primarie che secondarie, rilevanti per la corretta gestione del trattamento, ivi compreso il Regolamento UE 2016/679 del Parlamento europeo e del Consiglio del 27/04/2016 (di seguito "GDPR").
15.2 Le Parti dichiarano reciprocamente di essere informate (e, per quanto di ragione, espressamente acconsentire) che i "dati personali" forniti, anche verbalmente per l'attività precontrattuale o comunque raccolti in conseguenza e nel corso dell'esecuzione del presente Accordo, vengano trattati esclusivamente per le finalità dell'Accordo medesimo, mediante consultazione, elaborazione, interconnessione, raffronto con altri dati e/o ogni ulteriore elaborazione manuale e/o automatizzata e inoltre, per fini statistici, con esclusivo trattamento dei dati in forma anonima.
15.3 Le parti, nella qualità di titolari, si impegnano a rispettare tutte le normative rilevanti sulla protezione ed il trattamento dei dati personali loro applicabili in base al presente Accordo, compresa l'adozione di misure di sicurezza idonee e adeguate a proteggere i dati personali contro i rischi di distruzione, perdita, anche accidentale, di accesso o modifica non autorizzata dei dati o di trattamento non consentito o non conforme alle finalità connesse all'Accordo.
15.4 Le Parti si impegnano alla ottimale cooperazione reciproca nel caso in cui una di esse risulti destinataria di istanze per l'esercizio dei diritti degli interessati previsti dall'articolo 12 e ss. del GDPR ovvero di richieste delle Autorità di controllo che riguardino ambiti di trattamento di competenza dell'altra Parte.
15.5 I dati di contatto delle Parti ai fini del presente articolo sono i seguenti:

- per il INSTM Titolare del trattamento dei dati è il Consorzio Interuniversitario nazionale per la Scienza e Tecnologia dei Materiali, con sede in Piazza San Marco, 4, 50121 Firenze, nella persona del Presidente legale

rappresentante. I dati di contatto del Titolare sono PEC: instm@pec.it per informazioni e chiarimenti: segreteria@instm.it;

- per UNIME Titolare del trattamento dei dati è l'Università degli Studi di Messina, con sede in Piazza Pugliatti, 1 - 98122 Messina, nella persona della Rettrice. I dati di contatto del Titolare sono PEC: protocollo@pec.unime.it, per informazioni e chiarimenti: rettorato@unime.it; il responsabile della protezione dei dati dell'Università di Messina è la Dott.ssa Daniela Prestipino contattabile a: dpo@unime.it.

16 – Registrazione e bollo

15.1 Il presente Accordo viene redatto in un unico originale e sottoscritto digitalmente dalle Parti.
15.2 Il presente atto è soggetto a registrazione in caso d'uso ai sensi dell'art. 5 punto 1 del D.P.R. 131/86 e dell'art. 4 della tariffa – Parte II - annessa al medesimo decreto, a cura e spese della parte richiedente, nonché al pagamento dell'imposta di bollo che verrà assolta in modo virtuale dall'Università degli Studi di Messina, giusta autorizzazione dell'Agenzia delle Entrate n. 67760 del 2010.

Consorzio INSTM
Il Direttore
Prof. Andrea Caneschi

_____

Università degli Studi di Messina
La Rettrice
Prof.ssa Giovanna Spatari

_____

Si accettano in modo specifico le clausole di cui agli articoli:
Art. 3 – Durata del contratto
Art. 10 – Scioglimento del contratto prima del termine
Art. 14 –Controversie

Allegato A – Grant agreement e Annex
Allegato B – Descrizione attività Affiliated Entity (da Annex I)
Allegato C – Budget progetto

EUROPEAN INNOVATION COUNCIL AND SMES EXECUTIVE AGENCY (EISMEA)

EISMEA – European Innovation Council and SMEs Executive Agency
.EISMEA – European Innovation Council and SMEs Executive Agency

GRANT AGREEMENT

Project 101115456 — SUPERVAL

PREAMBLE

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and

on the other part,

1. 'the coordinator':

FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA), PIC 999548044, established in AVENIDA PAISSOS CATALANS 16, TARRAGONA 43007, Spain,

and the following other beneficiaries, if they sign their 'accession form' (see Annex 3 and Article 40):

2. **ORCHESTRA SCIENTIFIC SOCIEDAD LIMITADA (ORS)**, PIC 905329810, established in AVDA PAISOS CATALANS, 16, TARRAGONA 43007, Spain,

3. **UNIVERSITAT POLITECNICA DE VALENCIA (UPV)**, PIC 999864846, established in CAMINO DE VERA SN EDIFICIO 3A, VALENCIA 46022, Spain,

4. **CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI (INSTM)**, PIC 999991237, established in VIA GIUSTI 9, FIRENZE 50121, Italy,

5. **FORSCHUNGSZENTRUM JULICH GMBH (FZJ)**, PIC 999980470, established in WILHELM JOHNEN STRASSE, JULICH 52428, Germany,

6. **TECHNISCHE UNIVERSITEIT EINDHOVEN (TU/e)**, PIC 999977269, established in GROENE LOPER 3, EINDHOVEN 5612 AE, Netherlands,

7. **VARESER 96 SL (VARESER)**, PIC 884906751, established in AVENIDA AMADO GRANELL MESADO N 75-6, VALENCIA 46013, Spain,

8. **2.-O LCA CONSULTANTS APS (2.-O LCA)**, PIC 986412401, established in RENDSBURGGARDE 14 4 315B, AALBORG 9000, Denmark,

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator and affiliated entities (if any).

If only one beneficiary signs the grant agreement ('mono-beneficiary grant'), all provisions referring to the 'coordinator' or the 'beneficiaries' will be considered — mutatis mutandis — as referring to the beneficiary.

The parties referred to above have agreed to enter into the Agreement.

By signing the Agreement and the accession forms, the beneficiaries accept the grant and agree to implement the action under their own responsibility and in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

The Agreement is composed of:

Preamble

Terms and Conditions (including Data Sheet)

Annex 1 Description of the action[1]

Annex 2 Estimated budget for the action

Annex 2a Additional information on unit costs and contributions (if applicable)

Annex 3 Accession forms (if applicable)[2]

Annex 3a Declaration on joint and several liability of affiliated entities (if applicable)[3]

Annex 4 Model for the financial statements

Annex 5 Specific rules (if applicable)

[1] Template published on Portal Reference Documents.
[2] Template published on Portal Reference Documents.
[3] Template published on Portal Reference Documents.

TERMS AND CONDITIONS

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DATA SHEET

1. General data

Project summary:

Project summary
In the road to sustainability, the treatment of post-combustion emissions is still far from being techno-economically viable. On one end, the low concentration of CO2 in these streams, precludes the use of current carbon capture (CC) technologies. On the other end, even if CC were successfully implemented, there are not plausible final uses, maybe except geological long-term storage. Our ambitious proposal aims to investigate the viability of a technology able to tackle these challenges at once. Our SUPERVAL technology will develop scientific solutions from low-cost, non-critical raw materials and processes, with the added value of removing/valorizing the NOx contaminants from flue gas. We propose to design and realize an autonomous, solar-powered installation able to capture harmful emissions from flue gas, and valorize them as commodities for the chemical industry, using water as sacrificial source of electrons and protons. The CO2 will be transformed into an organic, energy-rich molecule (formate). The NOx will be also captured and transformed, in combination with N2, into ammonia using the hydrogen obtained in the CO2 co-electrolysis processes. This integrated effort will offer the comprehensive capture and valorization of carbon and nitrogen components in post-combustion emissions, thus limiting pollutants and resulting in added-value chemicals. The corresponding techno-economic analysis and life cycle assessment studies will help to shape the components and performance of SUPERVAL as a useful technological advancement in the search for zero net emissions.

Keywords:

- Carbon capture and sequestration
- Chemical engineering
- Chemical sciences
- CMM Computational methods
- Greenhouse gases
- Photochemistry
- road to zero emissions, post-combustion capture, flue gas, CCU, ammonia, LCA

Project number: 101115456

Project name: SUstainable Photo-ElectRochemical VALorization of flue gases

Project acronym: SUPERVAL

Call: HORIZON-EIC-2022-PATHFINDERCHALLENGES-01

Topic: HORIZON-EIC-2022-PATHFINDERCHALLENGES-01-01

Type of action: HORIZON EIC Grants

Granting authority: European Innovation Council and SMEs Executive Agency

Grant managed through EU Funding & Tenders Portal: Yes (eGrants)

Project starting date: fixed date: 1 November 2023

Project end date: 31 October 2026

Project duration: 36 months

Consortium agreement: Yes

2. Participants

List of participants:

N°	Role	Short name	Legal name	Ctry	PIC	Total eligible costs (BEN and AE)	Max grant amount
1	COO	ICIQ-CERCA	FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA	ES	999548044	650 750.00	650 750.00
2	BEN	ORS	ORCHESTRA SCIENTIFIC SOCIEDAD LIMITADA	ES	905329810	573 656.25	573 656.25
3	BEN	UPV	UNIVERSITAT POLITECNICA DE VALENCIA	ES	999864846	489 875.00	489 875.00
4	BEN	INSTM	CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI	IT	999991237	395 250.00	395 250.00
4.1	AE	UniME	UNIVERSITA DEGLI STUDI DI MESSINA	IT	999662601	150 000.00	150 000.00
5	BEN	FZJ	FORSCHUNGSZENTRUM JULICH GMBH	DE	999980470	525 933.75	525 933.75
6	BEN	TU/e	TECHNISCHE UNIVERSITEIT EINDHOVEN	NL	999977269	448 618.75	448 618.75
7	BEN	VARESER	VARESER 96 SL	ES	884906751	200 125.00	200 125.00
8	BEN	2.-O LCA	2.-O LCA CONSULTANTS APS	DK	986412401	137 500.00	137 500.00
Total						3 571 708.75	3 571 708.75

Coordinator:

– FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA)

3. Grant

Maximum grant amount, total estimated eligible costs and contributions and funding rate:

Total eligible costs (BEN and AE)	Funding rate (%)	Maximum grant amount (Annex 2)	Maximum grant amount (award decision)
3 571 708.75	100	3 571 708.75	3 571 708.75

Grant form: Budget-based

Grant mode: Action grant

Budget categories/activity types:

- A. Personnel costs
  - A.1 Employees, A.2 Natural persons under direct contract, A.3 Seconded persons
  - A.4 SME owners and natural person beneficiaries
- B. Subcontracting costs
- C. Purchase costs
  - C.1 Travel and subsistence
  - C.2 Equipment
  - C.3 Other goods, works and services
- D. Other cost categories
  - D.2 Internally invoiced goods and services
- E. Indirect costs

Cost eligibility options:

- In-kind contributions eligible costs
- Parental leave

- Project-based supplementary payments
- Average personnel costs (unit cost according to usual cost accounting practices)
- Limitation for subcontracting
- Travel and subsistence:
  - Travel: Actual costs
  - Accommodation: Actual costs
  - Subsistence: Actual costs
- Equipment: depreciation only
- Indirect cost flat-rate: 25% of the eligible direct costs (categories A-D, except volunteers costs, subcontracting costs, financial support to third parties and exempted specific cost categories, if any)
- VAT: Yes
- Other ineligible costs

Budget flexibility: Yes (no flexibility cap)

4. Reporting, payments and recoveries

4.1 Continuous reporting (art 21)

Deliverables: see Funding & Tenders Portal Continuous Reporting tool

Progress meetings: Yes (with 30 days prior notice)

4.2 Periodic reporting and payments

Reporting and payment schedule (art 21, 22):

Reporting					Payments	
Reporting periods			Type	Deadline	Type	Deadline (time to pay)
RP No	Month from	Month to				
					Initial prefinancing	30 days from entry into force/10 days before starting date – whichever is the latest
1	1	12	Periodic report	60 days after end of reporting period	Interim payment	90 days from receiving periodic report
2	13	36	Periodic report	60 days after end of reporting period	Final payment	90 days from receiving periodic report

Prefinancing payments and guarantees:

Prefinancing payment	
Type	Amount
Prefinancing 1 (initial)	2 857 367.00

Reporting and payment modalities (art 21, 22):

Mutual Insurance Mechanism (MIM): Yes

MIM contribution: 5% of the maximum grant amount (178 585.44), retained from the initial prefinancing

Restrictions on distribution of initial prefinancing: The prefinancing may be distributed only if the minimum number of beneficiaries set out in the call condititions (if any) have acceded to the Agreement and only to beneficiaries that have acceded.

Interim payment ceiling (if any): 90% of the maximum grant amount

Exception for revenues: Yes

No-profit rule: Yes

Late payment interest: ECB + 3.5%

Bank account for payments:

ES8321000006310201452393

Conversion into euros: Double conversion

Reporting language: Language of the Agreement

4.3 Certificates (art 24):

Certificates on the financial statements (CFS):

Conditions:

Schedule: only at final payment, if threshold is reached

Standard threshold (beneficiary-level):

- financial statement: requested EU contribution to costs ≥ EUR 430 000.00

Special threshold for beneficiaries with a systems and process audit(see Article 24): financial statement: requested EU contribution to costs ≥ EUR 725 000.00

4.4 Recoveries (art 22)

First-line liability for recoveries:

Beneficiary termination: Beneficiary concerned

Final payment: Each beneficiary for their own debt

After final payment: Beneficiary concerned

Joint and several liability for enforced recoveries (in case of non-payment):

Individual financial responsibility: Each beneficiary is liable only for its own debts (and those of its affiliated entities, if any)

5. Consequences of non-compliance, applicable law & dispute settlement forum

Suspension and termination:

Additional suspension grounds (art 31)

Additional termination grounds (art 32)

Applicable law (art 43):

Standard applicable law regime: EU law + law of Belgium

Dispute settlement forum (art 43):

Standard dispute settlement forum:

EU beneficiaries: EU General Court + EU Court of Justice (on appeal)

Non-EU beneficiaries: Courts of Brussels, Belgium (unless an international agreement provides for the enforceability of EU court judgements)

6. Other

Specific rules (Annex 5): Yes

Standard time-limits after project end:

Confidentiality (for X years after final payment): 5

Record-keeping (for X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Reviews (up to X years after final payment): 2

Audits (up to X years after final payment): 2

Extension of findings from other grants to this grant (no later than X years after final payment): 2

Impact evaluation (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

CHAPTER 1 GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and terms and conditions applicable to the grant awarded for the implementation of the action set out in Chapter 2.

ARTICLE 2 — DEFINITIONS

For the purpose of this Agreement, the following definitions apply:

Actions — The project which is being funded in the context of this Agreement.

Grant — The grant awarded in the context of this Agreement.

EU grants — Grants awarded by EU institutions, bodies, offices or agencies (including EU executive agencies, EU regulatory agencies, EDA, joint undertakings, etc.).

Participants — Entities participating in the action as beneficiaries, affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties.

Beneficiaries (BEN) — The signatories of this Agreement (either directly or through an accession form).

Affiliated entities (AE) — Entities affiliated to a beneficiary within the meaning of Article 187 of EU Financial Regulation 2018/1046[4] which participate in the action with similar rights and obligations as the beneficiaries (obligation to implement action tasks and right to charge costs and claim contributions).

Associated partners (AP) — Entities which participate in the action, but without the right to charge costs or claim contributions.

Purchases — Contracts for goods, works or services needed to carry out the action (e.g. equipment, consumables and supplies) but which are not part of the action tasks (see Annex 1).

Subcontracting — Contracts for goods, works or services that are part of the action tasks (see Annex 1).

In-kind contributions — In-kind contributions within the meaning of Article 2(36) of EU Financial

[4] For the definition, see Article 187 Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012 ('EU Financial Regulation') (OJ L 193, 30.7.2018, p. 1): "**affiliated entities** [are]:
(a) entities that form a sole beneficiary [(i.e. where an entity is formed of several entities that satisfy the criteria for being awarded a grant, including where the entity is specifically established for the purpose of implementing an action to be financed by a grant)];
(b) entities that satisfy the eligibility criteria and that do not fall within one of the situations referred to in Article 136(1) and 141(1) and that have a link with the beneficiary, in particular a legal or capital link, which is neither limited to the action nor established for the sole purpose of its implementation".

Regulation 2018/1046, i.e. non-financial resources made available free of charge by third parties.

Fraud — Fraud within the meaning of Article 3 of EU Directive 2017/1371[5] and Article 1 of the Convention on the protection of the European Communities' financial interests, drawn up by the Council Act of 26 July 1995[6], as well as any other wrongful or criminal deception intended to result in financial or personal gain.

Irregularities — Any type of breach (regulatory or contractual) which could impact the EU financial interests, including irregularities within the meaning of Article 1(2) of EU Regulation 2988/95[7].

Grave professional misconduct — Any type of unacceptable or improper behaviour in exercising one's profession, especially by employees, including grave professional misconduct within the meaning of Article 136(1)(c) of EU Financial Regulation 2018/1046.

Applicable EU, international and national law — Any legal acts or other (binding or non-binding) rules and guidance in the area concerned.

Portal — EU Funding & Tenders Portal; electronic portal and exchange system managed by the European Commission and used by itself and other EU institutions, bodies, offices or agencies for the management of their funding programmes (grants, procurements, prizes, etc.).

CHAPTER 2 ACTION

ARTICLE 3 — ACTION

The grant is awarded for the action **101115456 — SUPERVAL** ('action'), as described in Annex 1.

ARTICLE 4 — DURATION AND STARTING DATE

The duration and the starting date of the action are set out in the Data Sheet (see Point 1).

CHAPTER 3 GRANT

ARTICLE 5 — GRANT

5.1 Form of grant

The grant is an action grant[8] which takes the form of a budget-based mixed actual cost grant (i.e. a

[5] Directive (EU) 2017/1371 of the European Parliament and of the Council of 5 July 2017 on the fight against fraud to the Union's financial interests by means of criminal law (OJ L 198, 28.7.2017, p. 29).
[6] OJ C 316, 27.11.1995, p. 48.
[7] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).
[8] For the definition, see Article 180(2)(a) EU Financial Regulation 2018/1046: '**action grant**' means an EU grant to finance "an action intended to help achieve a Union policy objective".

grant based on actual costs incurred, but which may also include other forms of funding, such as unit costs or contributions, flat-rate costs or contributions, lump sum costs or contributions or financing not linked to costs).

5.2 Maximum grant amount

The maximum grant amount is set out in the Data Sheet (see Point 3) and in the estimated budget (Annex 2).

5.3 Funding rate

The funding rate for costs is 100% of the action's eligible costs.

Contributions are not subject to any funding rate.

5.4 Estimated budget, budget categories and forms of funding

The estimated budget for the action is set out in Annex 2.

It contains the estimated eligible costs and contributions for the action, broken down by participant and budget category.

Annex 2 also shows the types of costs and contributions (forms of funding)[9] to be used for each budget category.

If unit costs or contributions are used, the details on the calculation will be explained in Annex 2a.

5.5 Budget flexibility

The budget breakdown may be adjusted — without an amendment (see Article 39) — by transfers (between participants and budget categories), as long as this does not imply any substantive or important change to the description of the action in Annex 1.

However:

- changes to the budget category for volunteers (if used) always require an amendment
- changes to budget categories with lump sums costs or contributions (if used; including financing not linked to costs) always require an amendment
- changes to budget categories with higher funding rates or budget ceilings (if used) always require an amendment
- addition of amounts for subcontracts not provided for in Annex 1 either require an amendment or simplified approval in accordance with Article 6.2
- other changes require an amendment or simplified approval, if specifically provided for in Article 6.2
- flexibility caps: not applicable.

[9] See Article 125 EU Financial Regulation 2018/1046.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS AND CONTRIBUTIONS

In order to be eligible, costs and contributions must meet the **eligibility** conditions set out in this Article.

6.1 General eligibility conditions

The **general eligibility conditions** are the following:

(a) for actual costs:

(i) they must be actually incurred by the beneficiary

(ii) they must be incurred in the period set out in Article 4 (with the exception of costs relating to the submission of the final periodic report, which may be incurred afterwards; see Article 21)

(iii) they must be declared under one of the budget categories set out in Article 6.2 and Annex 2

(iv) they must be incurred in connection with the action as described in Annex 1 and necessary for its implementation

(v) they must be identifiable and verifiable, in particular recorded in the beneficiary's accounts in accordance with the accounting standards applicable in the country where the beneficiary is established and with the beneficiary's usual cost accounting practices

(vi) they must comply with the applicable national law on taxes, labour and social security and

(vii) they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency

(b) for unit costs or contributions (if any):

(i) they must be declared under one of the budget categories set out in Article 6.2 and Annex 2

(ii) the units must:

- be actually used or produced by the beneficiary in the period set out in Article 4 (with the exception of units relating to the submission of the final periodic report, which may be used or produced afterwards; see Article 21)

- be necessary for the implementation of the action and

(iii) the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 20)

(c) for flat-rate costs or contributions (if any):

(i) they must be declared under one of the budget categories set out in Article 6.2 and Annex 2

(ii) the costs or contributions to which the flat-rate is applied must:

- be eligible
- relate to the period set out in Article 4 (with the exception of costs or contributions relating to the submission of the final periodic report, which may be incurred afterwards; see Article 21)

(d) for lump sum costs or contributions (if any):

(i) they must be declared under one of the budget categories set out in Article 6.2 and Annex 2

(ii) the work must be properly implemented by the beneficiary in accordance with Annex 1

(iii) the deliverables/outputs must be achieved in the period set out in Article 4 (with the exception of deliverables/outputs relating to the submission of the final periodic report, which may be achieved afterwards; see Article 21)

(e) for unit, flat-rate or lump sum costs or contributions according to usual cost accounting practices (if any):

(i) they must fulfil the general eligibility conditions for the type of cost concerned

(ii) the cost accounting practices must be applied in a consistent manner, based on objective criteria, regardless of the source of funding

(f) for financing not linked to costs (if any): the results must be achieved or the conditions must be fulfilled as described in Annex 1.

In addition, for direct cost categories (e.g. personnel, travel & subsistence, subcontracting and other direct costs) only costs that are directly linked to the action implementation and can therefore be attributed to it directly are eligible. They must not include any indirect costs (i.e. costs that are only indirectly linked to the action, e.g. via cost drivers).

In-kind contributions provided by third parties free of charge may be declared as eligible direct costs by the beneficiaries which use them (under the same conditions as if they were their own, provided that they concern only direct costs and that the third parties and their in-kind contributions are set out in Annex 1 (or approved ex post in the periodic report, if their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants; 'simplified approval procedure').

6.2 Specific eligibility conditions for each budget category

For each budget category, the **specific eligibility conditions** are as follows:

Direct costs

A. Personnel costs

A.1 Costs for employees (or equivalent) are eligible as personnel costs if they fulfil the general eligibility conditions and are related to personnel working for the beneficiary under an employment contract (or equivalent appointing act) and assigned to the action.

They must be limited to salaries (including net payments during parental leave), social security contributions, taxes and other costs linked to the remuneration, if they arise from national law or the employment contract (or equivalent appointing act) and be calculated on the basis of the costs actually incurred, in accordance with the following method:

{daily rate for the person

multiplied by

number of day-equivalents worked on the action (rounded up or down to the nearest half-day)}.

The daily rate must be calculated as:

{annual personnel costs for the person

divided by

215}.

The number of day-equivalents declared for a person must be identifiable and verifiable (see Article 20).

The actual time spent on parental leave by a person assigned to the action may be deducted from the 215 days indicated in the above formula.

The total number of day-equivalents declared in EU grants, for a person for a year, cannot be higher than 215, minus time spent on parental leave (if any).

For personnel which receives supplementary payments for work in projects (project-based remuneration), the personnel costs must be calculated at a rate which:

- corresponds to the actual remuneration costs paid by the beneficiary for the time worked by the person in the action over the reporting period
- does not exceed the remuneration costs paid by the beneficiary for work in similar projects funded by national schemes (‘national projects reference’)
- is defined based on objective criteria allowing to determine the amount to which the person is entitled

and

- reflects the usual practice of the beneficiary to pay consistently bonuses or supplementary payments for work in projects funded by national schemes.

The national projects reference is the remuneration defined in national law, collective labour agreement or written internal rules of the beneficiary applicable to work in projects funded by national schemes.

If there is no such national law, collective labour agreement or written internal rules or if the project-based remuneration is not based on objective criteria, the national project reference will be the average

remuneration of the person in the last full calendar year covered by the reporting period, excluding remuneration paid for work in EU actions.

If the beneficiary uses average personnel costs (unit cost according to usual cost accounting practices), the personnel costs must fulfil the general eligibility conditions for such unit costs and the daily rate must be calculated:

- using the actual personnel costs recorded in the beneficiary's accounts and excluding any costs which are ineligible or already included in other budget categories; the actual personnel costs may be adjusted on the basis of budgeted or estimated elements, if they are relevant for calculating the personnel costs, reasonable and correspond to objective and verifiable information

and

- according to usual cost accounting practices which are applied in a consistent manner, based on objective criteria, regardless of the source of funding.

A.2 and **A.3 Costs for natural persons working under a direct contract** other than an employment contract and costs for **seconded persons by a third party against payment** are also eligible as personnel costs, if they are assigned to the action, fulfil the general eligibility conditions and:

(a) work under conditions similar to those of an employee (in particular regarding the way the work is organised, the tasks that are performed and the premises where they are performed) and

(b) the result of the work belongs to the beneficiary (unless agreed otherwise).

They must be calculated on the basis of a rate which corresponds to the costs actually incurred for the direct contract or secondment and must not be significantly different from those for personnel performing similar tasks under an employment contract with the beneficiary.

A.4 The work of **SME owners** for the action (i.e. owners of beneficiaries that are small and medium-sized enterprises[10] not receiving a salary) or **natural person beneficiaries** (i.e. beneficiaries that are natural persons not receiving a salary) may be declared as personnel costs, if they fulfil the general eligibility conditions and are calculated as unit costs in accordance with the method set out in Annex 2a.

B. Subcontracting costs

Subcontracting costs for the action (including related duties, taxes and charges, such as non-deductible or non-refundable value added tax (VAT)) are eligible, if they are calculated on the basis of the costs actually incurred, fulfil the general eligibility conditions and are awarded using the

[10] For the definition, see Commission Recommendation 2003/361/EC: micro, small or medium-sized enterprise (SME) are enterprises

- engaged in an economic activity, irrespective of their legal form (including, in particular, self- employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity) and

- employing fewer than 250 persons (expressed in 'annual working units' as defined in Article 5 of the Recommendation) and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.

beneficiary's usual purchasing practices — provided these ensure subcontracts with best value for money (or if appropriate the lowest price) and that there is no conflict of interests (see Article 12).

Beneficiaries that are 'contracting authorities/entities' within the meaning of the EU Directives on public procurement must also comply with the applicable national law on public procurement.

Subcontracting may cover only a limited part of the action.

The tasks to be subcontracted and the estimated cost for each subcontract must be set out in Annex 1 and the total estimated costs of subcontracting per beneficiary must be set out in Annex 2 (or may be approved ex post in the periodic report, if the use of subcontracting does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants; 'simplified approval procedure').

C. Purchase costs

Purchase costs for the action (including related duties, taxes and charges, such as non-deductible or non-refundable value added tax (VAT)) are eligible if they fulfil the general eligibility conditions and are bought using the beneficiary's usual purchasing practices — provided these ensure purchases with best value for money (or if appropriate the lowest price) and that there is no conflict of interests (see Article 12).

Beneficiaries that are 'contracting authorities/entities' within the meaning of the EU Directives on public procurement must also comply with the applicable national law on public procurement.

C.1 Travel and subsistence

Purchases for **travel, accommodation** and **subsistence** must be calculated as follows:

- travel: on the basis of the costs actually incurred and in line with the beneficiary's usual practices on travel
- accommodation: on the basis of the costs actually incurred and in line with the beneficiary's usual practices on travel
- subsistence: on the basis of the costs actually incurred and in line with the beneficiary's usual practices on travel .

C.2 Equipment

Purchases of **equipment, infrastructure or other assets** used for the action must be declared as depreciation costs, calculated on the basis of the costs actually incurred and written off in accordance with international accounting standards and the beneficiary's usual accounting practices.

Only the portion of the costs that corresponds to the rate of actual use for the action during the action duration can be taken into account.

Costs for **renting or leasing** equipment, infrastructure or other assets are also eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets and do not include any financing fees.

C.3 Other goods, works and services

Purchases of **other goods, works and services** must be calculated on the basis of the costs actually incurred.

Such goods, works and services include, for instance, consumables and supplies, promotion, dissemination, protection of results, translations, publications, certificates and financial guarantees, if required under the Agreement.

D. Other cost categories

D.2 Internally invoiced goods and services

Costs for internally invoiced goods and services directly used for the action may be declared as unit cost according to usual cost accounting practices, if and as declared eligible in the call conditions, if they fulfil the general eligibility conditions for such unit costs and the amount per unit is calculated:

- using the actual costs for the good or service recorded in the beneficiary's accounts, attributed either by direct measurement or on the basis of cost drivers, and excluding any cost which are ineligible or already included in other budget categories; the actual costs may be adjusted on the basis of budgeted or estimated elements, if they are relevant for calculating the costs, reasonable and correspond to objective and verifiable information

and

- according to usual cost accounting practices which are applied in a consistent manner, based on objective criteria, regardless of the source of funding.

'Internally invoiced goods and services' means goods or services which are provided within the beneficiary's organisation directly for the action and which the beneficiary values on the basis of its usual cost accounting practices.

This cost will not be taken into account for the indirect cost flat-rate.

Indirect costs

E. Indirect costs

Indirect costs will be reimbursed at the flat-rate of 25% of the eligible direct costs (categories A-D, except volunteers costs, subcontracting costs, financial support to third parties and exempted specific cost categories, if any).

Contributions

Not applicable

6.3 Ineligible costs and contributions

The following costs or contributions are **ineligible**:

(a) costs or contributions that do not comply with the conditions set out above (Article 6.1 and 6.2), in particular:

(i) costs related to return on capital and dividends paid by a beneficiary

(ii) debt and debt service charges

(iii) provisions for future losses or debts

(iv) interest owed

(v) currency exchange losses

(vi) bank costs charged by the beneficiary's bank for transfers from the granting authority

(vii) excessive or reckless expenditure

(viii) deductible or refundable VAT (including VAT paid by public bodies acting as public authority)

(ix) costs incurred or contributions for activities implemented during grant agreement suspension (see Article 31)

(x) in-kind contributions by third parties: not applicable

(b) costs or contributions declared under other EU grants (or grants awarded by an EU Member State, non-EU country or other body implementing the EU budget), except for the following cases:

(i) Synergy actions: not applicable

(ii) if the action grant is combined with an operating grant[11] running during the same period and the beneficiary can demonstrate that the operating grant does not cover any (direct or indirect) costs of the action grant

(c) costs or contributions for staff of a national (or regional/local) administration, for activities that are part of the administration's normal activities (i.e. not undertaken only because of the grant)

(d) costs or contributions (especially travel and subsistence) for staff or representatives of EU institutions, bodies or agencies

(e) other :

(i) country restrictions for eligible costs: not applicable

(ii) costs or contributions declared specifically ineligible in the call conditions.

6.4 Consequences of non-compliance

If a beneficiary declares costs or contributions that are ineligible, they will be rejected (see Article 27).

This may also lead to other measures described in Chapter 5.

[11] For the definition, see Article 180(2)(b) of EU Financial Regulation 2018/1046: '**operating grant**' means an EU grant to finance "the functioning of a body which has an objective forming part of and supporting an EU policy".

CHAPTER 4 GRANT IMPLEMENTATION

SECTION 1 CONSORTIUM: BENEFICIARIES, AFFILIATED ENTITIES AND OTHER PARTICIPANTS

ARTICLE 7 — BENEFICIARIES

The beneficiaries, as signatories of the Agreement, are fully responsible towards the granting authority for implementing it and for complying with all its obligations.

They must implement the Agreement to their best abilities, in good faith and in accordance with all the obligations and terms and conditions it sets out.

They must have the appropriate resources to implement the action and implement the action under their own responsibility and in accordance with Article 11. If they rely on affiliated entities or other participants (see Articles 8 and 9), they retain sole responsibility towards the granting authority and the other beneficiaries.

They are jointly responsible for the *technical* implementation of the action. If one of the beneficiaries fails to implement their part of the action, the other beneficiaries must ensure that this part is implemented by someone else (without being entitled to an increase of the maximum grant amount and subject to an amendment; see Article 39). The *financial* responsibility of each beneficiary in case of recoveries is governed by Article 22.

The beneficiaries (and their action) must remain eligible under the EU programme funding the grant for the entire duration of the action. Costs and contributions will be eligible only as long as the beneficiary and the action are eligible.

The **internal roles and responsibilities** of the beneficiaries are divided as follows:

(a) Each beneficiary must:

(i) keep information stored in the Portal Participant Register up to date (see Article 19)

(ii) inform the granting authority (and the other beneficiaries) immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 19)

(iii) submit to the coordinator in good time:

- the prefinancing guarantees (if required; see Article 23)
- the financial statements and certificates on the financial statements (CFS) (if required; see Articles 21 and 24.2 and Data Sheet, Point 4.3)
- the contribution to the deliverables and technical reports (see Article 21)
- any other documents or information required by the granting authority under the Agreement

(iv) submit via the Portal data and information related to the participation of their affiliated entities.

(b) The coordinator must:

(i) monitor that the action is implemented properly (see Article 11)

(ii) act as the intermediary for all communications between the consortium and the granting authority, unless the Agreement or granting authority specifies otherwise, and in particular:

- submit the prefinancing guarantees to the granting authority (if any)
- request and review any documents or information required and verify their quality and completeness before passing them on to the granting authority
- submit the deliverables and reports to the granting authority
- inform the granting authority about the payments made to the other beneficiaries (report on the distribution of payments; if required, see Articles 22 and 32)

(iii) distribute the payments received from the granting authority to the other beneficiaries without unjustified delay (see Article 22).

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including affiliated entities).

However, coordinators which are public bodies may delegate the tasks set out in Point (b)(ii) last indent and (iii) above to entities with 'authorisation to administer' which they have created or which are controlled by or affiliated to them. In this case, the coordinator retains sole responsibility for the payments and for compliance with the obligations under the Agreement.

Moreover, coordinators which are 'sole beneficiaries'[12] (or similar, such as European research infrastructure consortia (ERICs)) may delegate the tasks set out in Point (b)(i) to (iii) above to one of their members. The coordinator retains sole responsibility for compliance with the obligations under the Agreement.

The beneficiaries must have **internal arrangements** regarding their operation and co-ordination, to ensure that the action is implemented properly.

If required by the granting authority (see Data Sheet, Point 1), these arrangements must be set out in a written **consortium agreement** between the beneficiaries, covering for instance:

- the internal organisation of the consortium
- the management of access to the Portal
- different distribution keys for the payments and financial responsibilities in case of recoveries (if any)
- additional rules on rights and obligations related to background and results (see Article 16)

[12] For the definition, see Article 187(2) EU Financial Regulation 2018/1046: "Where several entities satisfy the criteria for being awarded a grant and together form one entity, that entity may be treated as the **sole beneficiary**, including where it is specifically established for the purpose of implementing the action financed by the grant."

- settlement of internal disputes
- liability, indemnification and confidentiality arrangements between the beneficiaries.

The internal arrangements must not contain any provision contrary to this Agreement.

ARTICLE 8 — AFFILIATED ENTITIES

The following entities which are linked to a beneficiary will participate in the action as 'affiliated entities':

- **UNIVERSITA DEGLI STUDI DI MESSINA (UniME)**, PIC 999662601, linked to CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI (INSTM)

Affiliated entities can charge costs and contributions to the action under the same conditions as the beneficiaries and must implement the action tasks attributed to them in Annex 1 in accordance with Article 11.

Their costs and contributions will be included in Annex 2 and will be taken into account for the calculation of the grant.

The beneficiaries must ensure that all their obligations under this Agreement also apply to their affiliated entities.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the affiliated entities.

Breaches by affiliated entities will be handled in the same manner as breaches by beneficiaries. Recovery of undue amounts will be handled through the beneficiaries.

If the granting authority requires joint and several liability of affiliated entities (see Data Sheet, Point 4.4), they must sign the declaration set out in Annex 3a and may be held liable in case of enforced recoveries against their beneficiaries (see Article 22.2 and 22.4).

ARTICLE 9 — OTHER PARTICIPANTS INVOLVED IN THE ACTION

9.1 Associated partners

Not applicable

9.2 Third parties giving in-kind contributions to the action

Other third parties may give in-kind contributions to the action (i.e. personnel, equipment, other goods, works and services, etc. which are free-of-charge) if necessary for the implementation.

Third parties giving in-kind contributions do not implement any action tasks. They may not charge costs or contributions to the action, but the costs for the in-kind contributions are eligible and may be charged by the beneficiaries which use them, under the conditions set out in Article 6. The costs will be included in Annex 2 as part of the beneficiaries' costs.

The third parties and their in-kind contributions should be set out in Annex 1.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the third parties giving in-kind contributions.

9.3 Subcontractors

Subcontractors may participate in the action, if necessary for the implementation.

Subcontractors must implement their action tasks in accordance with Article 11. The costs for the subcontracted tasks (invoiced price from the subcontractor) are eligible and may be charged by the beneficiaries, under the conditions set out in Article 6. The costs will be included in Annex 2 as part of the beneficiaries' costs.

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the subcontractors.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the subcontractors.

9.4 Recipients of financial support to third parties

If the action includes providing financial support to third parties (e.g. grants, prizes or similar forms of support), the beneficiaries must ensure that their contractual obligations under Articles 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping)also apply to the third parties receiving the support (recipients).

The beneficiaries must also ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the recipients.

ARTICLE 10 — PARTICIPANTS WITH SPECIAL STATUS

10.1 Non-EU participants

Participants which are established in a non-EU country (if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)
- for the submission of certificates under Article 24: to use qualified external auditors which are independent and comply with comparable standards as those set out in EU Directive 2006/43/EC[13]
- for the controls under Article 25: to allow for checks, reviews, audits and investigations

[13] Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts or similar national regulations (OJ L 157, 9.6.2006, p. 87).

(including on-the-spot checks, visits and inspections) by the bodies mentioned in that Article (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.).

Special rules on dispute settlement apply (see Data Sheet, Point 5).

10.2 Participants which are international organisations

Participants which are international organisations (IOs; if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)

- for the submission of certificates under Article 24: to use either independent public officers or external auditors which comply with comparable standards as those set out in EU Directive 2006/43/EC

- for the controls under Article 25: to allow for the checks, reviews, audits and investigations by the bodies mentioned in that Article, taking into account the specific agreements concluded by them and the EU (if any).

For such participants, nothing in the Agreement will be interpreted as a waiver of their privileges or immunities, as accorded by their constituent documents or international law.

Special rules on applicable law and dispute settlement apply (see Article 43 and Data Sheet, Point 5).

10.3 Pillar-assessed participants

Pillar-assessed participants (if any) may rely on their own systems, rules and procedures, in so far as they have been positively assessed and do not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries.

'Pillar-assessment' means a review by the European Commission on the systems, rules and procedures which participants use for managing EU grants (in particular internal control system, accounting system, external audits, financing of third parties, rules on recovery and exclusion, information on recipients and protection of personal data; see Article 154 EU Financial Regulation 2018/1046).

Participants with a positive pillar assessment may rely on their own systems, rules and procedures, in particular for:

- record-keeping (Article 20): may be done in accordance with internal standards, rules and procedures

- currency conversion for financial statements (Article 21): may be done in accordance with usual accounting practices

- guarantees (Article 23): for public law bodies, prefinancing guarantees are not needed

- certificates (Article 24):

    - certificates on the financial statements (CFS): may be provided by their regular internal

or external auditors and in accordance with their internal financial regulations and procedures

- certificates on usual accounting practices (CoMUC): are not needed if those practices are covered by an ex-ante assessment

and use the following specific rules, for:

- recoveries (Article 22): in case of financial support to third parties, there will be no recovery if the participant has done everything possible to retrieve the undue amounts from the third party receiving the support (including legal proceedings) and non-recovery is not due to an error or negligence on its part

- checks, reviews, audits and investigations by the EU (Article 25): will be conducted taking into account the rules and procedures specifically agreed between them and the framework agreement (if any)

- impact evaluation (Article 26): will be conducted in accordance with the participant's internal rules and procedures and the framework agreement (if any)

- grant agreement suspension (Article 31): certain costs incurred during grant suspension are eligible (notably, minimum costs necessary for a possible resumption of the action and costs relating to contracts which were entered into before the pre-information letter was received and which could not reasonably be suspended, reallocated or terminated on legal grounds)

- grant agreement termination (Article 32): the final grant amount and final payment will be calculated taking into account also costs relating to contracts due for execution only after termination takes effect, if the contract was entered into before the pre-information letter was received and could not reasonably be terminated on legal grounds

- liability for damages (Article 33.2): the granting authority must be compensated for damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement only if the damage is due to an infringement of the participant's internal rules and procedures or due to a violation of third parties' rights by the participant or one of its employees or individual for whom the employees are responsible.

Participants whose pillar assessment covers procurement and granting procedures may also do purchases, subcontracting and financial support to third parties (Article 6.2) in accordance with their internal rules and procedures for purchases, subcontracting and financial support.

Participants whose pillar assessment covers data protection rules may rely on their internal standards, rules and procedures for data protection (Article 15).

The participants may however not rely on provisions which would breach the principle of equal treatment of applicants or beneficiaries or call into question the decision awarding the grant, such as in particular:

- eligibility (Article 6)

- consortium roles and set-up (Articles 7-9)

- security and ethics (Articles 13, 14)
- IPR (including background and results, access rights and rights of use), communication, dissemination and visibility (Articles 16 and 17)
- information obligation (Article 19)
- payment, reporting and amendments (Articles 21, 22 and 39)
- rejections, reductions, suspensions and terminations (Articles 27, 28, 29-32)

If the pillar assessment was subject to remedial measures, reliance on the internal systems, rules and procedures is subject to compliance with those remedial measures.

Participants whose assessment has not yet been updated to cover (the new rules on) data protection may rely on their internal systems, rules and procedures, provided that they ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subject
- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes
- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed
- accurate and, where necessary, kept up to date
- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and
- processed in a manner that ensures appropriate security of the personal data.

Participants must inform the coordinator without delay of any changes to the systems, rules and procedures that were part of the pillar assessment. The coordinator must immediately inform the granting authority.

Pillar-assessed participants that have also concluded a framework agreement with the EU, may moreover — under the same conditions as those above (i.e. not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries) — rely on the provisions set out in that framework agreement.

SECTION 2 RULES FOR CARRYING OUT THE ACTION

ARTICLE 11 — PROPER IMPLEMENTATION OF THE ACTION

11.1 Obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement, the call conditions and all legal obligations under applicable EU, international and national law.

11.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 12 — CONFLICT OF INTERESTS

12.1 Conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the Agreement could be compromised for reasons involving family, emotional life, political or national affinity, economic interest or any other direct or indirect interest (‘conflict of interests’).

They must formally notify the granting authority without delay of any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The granting authority may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the beneficiary may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 13 — CONFIDENTIALITY AND SECURITY

13.1 Sensitive information

The parties must keep confidential any data, documents or other material (in any form) that is identified as sensitive in writing (‘sensitive information’) — during the implementation of the action and for at least until the time-limit set out in the Data Sheet (see Point 6).

If a beneficiary requests, the granting authority may agree to keep such information confidential for a longer period.

Unless otherwise agreed between the parties, they may use sensitive information only to implement the Agreement.

The beneficiaries may disclose sensitive information to their personnel or other participants involved in the action only if they:

(a) need to know it in order to implement the Agreement and

(b) are bound by an obligation of confidentiality.

The granting authority may disclose sensitive information to its staff and to other EU institutions and bodies.

It may moreover disclose sensitive information to third parties, if:

(a) this is necessary to implement the Agreement or safeguard the EU financial interests and

(b) the recipients of the information are bound by an obligation of confidentiality.

The confidentiality obligations no longer apply if:

(a) the disclosing party agrees to release the other party

(b) the information becomes publicly available, without breaching any confidentiality obligation

(c) the disclosure of the sensitive information is required by EU, international or national law.

Specific confidentiality rules (if any) are set out in Annex 5.

13.2 Classified information

The parties must handle classified information in accordance with the applicable EU, international or national law on classified information (in particular, Decision 2015/444[14] and its implementing rules).

Deliverables which contain classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving classified information may be subcontracted only after explicit approval (in writing) from the granting authority.

Classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

Specific security rules (if any) are set out in Annex 5.

13.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 14 — ETHICS AND VALUES

14.1 Ethics

The action must be carried out in line with the highest ethical standards and the applicable EU, international and national law on ethical principles.

Specific ethics rules (if any) are set out in Annex 5.

14.2 Values

The beneficiaries must commit to and ensure the respect of basic EU values (such as respect for

[14] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

human dignity, freedom, democracy, equality, the rule of law and human rights, including the rights of minorities).

Specific rules on values (if any) are set out in Annex 5.

14.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 15 — DATA PROTECTION

15.1 Data processing by the granting authority

Any personal data under the Agreement will be processed under the responsibility of the data controller of the granting authority in accordance with and for the purposes set out in the Portal Privacy Statement.

For grants where the granting authority is the European Commission, an EU regulatory or executive agency, joint undertaking or other EU body, the processing will be subject to Regulation 2018/1725[15].

15.2 Data processing by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679[16]).

They must ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subjects
- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes
- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed
- accurate and, where necessary, kept up to date
- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and
- processed in a manner that ensures appropriate security of the data.

[15] Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC (OJ L 295, 21.11.2018, p. 39).

[16] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (‘GDPR’) (OJ L 119, 4.5.2016, p. 1).

The beneficiaries may grant their personnel access to personal data only if it is strictly necessary for implementing, managing and monitoring the Agreement. The beneficiaries must ensure that the personnel is under a confidentiality obligation.

The beneficiaries must inform the persons whose data are transferred to the granting authority and provide them with the Portal Privacy Statement.

15.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 16 — INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS —ACCESS RIGHTS AND RIGHTS OF USE

16.1 Background and access rights to background

The beneficiaries must give each other and the other participants access to the background identified as needed for implementing the action, subject to any specific rules in Annex 5.

'Background' means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that is:

(a) held by the beneficiaries before they acceded to the Agreement and

(b) needed to implement the action or exploit the results.

If background is subject to rights of a third party, the beneficiary concerned must ensure that it is able to comply with its obligations under the Agreement.

16.2 Ownership of results

The granting authority does not obtain ownership of the results produced under the action.

'Results' means any tangible or intangible effect of the action, such as data, know-how or information, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.

16.3 Rights of use of the granting authority on materials, documents and information received for policy, information, communication, dissemination and publicity purposes

The granting authority has the right to use non-sensitive information relating to the action and materials and documents received from the beneficiaries (notably summaries for publication, deliverables, as well as any other material, such as pictures or audio-visual material, in paper or electronic form) for policy, information, communication, dissemination and publicity purposes — during the action or afterwards.

The right to use the beneficiaries' materials, documents and information is granted in the form of a royalty-free, non-exclusive and irrevocable licence, which includes the following rights:

(a) **use for its own purposes** (in particular, making them available to persons working for the granting authority or any other EU service (including institutions, bodies, offices, agencies, etc.) or EU Member State institution or body; copying or reproducing them in whole or in part, in unlimited numbers; and communication through press information services)

(b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes)

(c) **editing or redrafting** (including shortening, summarising, inserting other elements (e.g. meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation)

(d) **translation**

(e) **storage** in paper, electronic or other form

(f) **archiving**, in line with applicable document-management rules

(g) the right to authorise **third parties** to act on its behalf or sub-license to third parties the modes of use set out in Points (b), (c), (d) and (f), if needed for the information, communication and publicity activity of the granting authority

(h) **processing**, analysing, aggregating the materials, documents and information received and **producing derivative works**.

The rights of use are granted for the whole duration of the industrial or intellectual property rights concerned.

If materials or documents are subject to moral rights or third party rights (including intellectual property rights or rights of natural persons on their image and voice), the beneficiaries must ensure that they comply with their obligations under this Agreement (in particular, by obtaining the necessary licences and authorisations from the rights holders concerned).

Where applicable, the granting authority will insert the following information:

> "© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the [name of granting authority] under conditions."

16.4 Specific rules on IPR, results and background

Specific rules regarding intellectual property rights, results and background (if any) are set out in Annex 5.

16.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

ARTICLE 17 — COMMUNICATION, DISSEMINATION AND VISIBILITY

17.1 Communication — Dissemination — Promoting the action

Unless otherwise agreed with the granting authority, the beneficiaries must promote the action and its results by providing targeted information to multiple audiences (including the media and the public), in accordance with Annex 1 and in a strategic, coherent and effective manner.

Before engaging in a communication or dissemination activity expected to have a major media impact, the beneficiaries must inform the granting authority.

17.2 Visibility — European flag and funding statement

Unless otherwise agreed with the granting authority, communication activities of the beneficiaries related to the action (including media relations, conferences, seminars, information material, such as brochures, leaflets, posters, presentations, etc., in electronic form, via traditional or social media, etc.), dissemination activities and any infrastructure, equipment, vehicles, supplies or major result funded by the grant must acknowledge EU support and display the European flag (emblem) and funding statement (translated into local languages, where appropriate):

Funded by the
European Union

Co-funded by the
European Union

The emblem must remain distinct and separate and cannot be modified by adding other visual marks, brands or text.

Apart from the emblem, no other visual identity or logo may be used to highlight the EU support.

When displayed in association with other logos (e.g. of beneficiaries or sponsors), the emblem must be displayed at least as prominently and visibly as the other logos.

For the purposes of their obligations under this Article, the beneficiaries may use the emblem without first obtaining approval from the granting authority. This does not, however, give them the right to

exclusive use. Moreover, they may not appropriate the emblem or any similar trademark or logo, either by registration or by any other means.

17.3 Quality of information — Disclaimer

Any communication or dissemination activity related to the action must use factually accurate information.

Moreover, it must indicate the following disclaimer (translated into local languages where appropriate):

> "Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or [name of the granting authority]. Neither the European Union nor the granting authority can be held responsible for them."

17.4 Specific communication, dissemination and visibility rules

Specific communication, dissemination and visibility rules (if any) are set out in Annex 5.

17.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 18 — SPECIFIC RULES FOR CARRYING OUT THE ACTION

18.1 Specific rules for carrying out the action

Specific rules for implementing the action (if any) are set out in Annex 5.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

SECTION 3 GRANT ADMINISTRATION

ARTICLE 19 — GENERAL INFORMATION OBLIGATIONS

19.1 Information requests

The beneficiaries must provide — during the action or afterwards and in accordance with Article 7 — any information requested in order to verify eligibility of the costs or contributions declared, proper implementation of the action and compliance with the other obligations under the Agreement.

The information provided must be accurate, precise and complete and in the format requested, including electronic format.

19.2 Participant Register data updates

The beneficiaries must keep — at all times, during the action or afterwards — their information stored in the Portal Participant Register up to date, in particular, their name, address, legal representatives, legal form and organisation type.

19.3 Information about events and circumstances which impact the action

The beneficiaries must immediately inform the granting authority (and the other beneficiaries) of any of the following:

(a) **events** which are likely to affect or delay the implementation of the action or affect the EU's financial interests, in particular:

(i) changes in their legal, financial, technical, organisational or ownership situation (including changes linked to one of the exclusion grounds listed in the declaration of honour signed before grant signature)

(ii) linked action information: not applicable

(b) **circumstances** affecting:

(i) the decision to award the grant or

(ii) compliance with requirements under the Agreement.

19.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 20 — RECORD-KEEPING

20.1 Keeping records and supporting documents

The beneficiaries must — at least until the time-limit set out in the Data Sheet (see Point 6) — keep records and other supporting documents to prove the proper implementation of the action in line with the accepted standards in the respective field (if any).

In addition, the beneficiaries must — for the same period — keep the following to justify the amounts declared:

(a) for actual costs: adequate records and supporting documents to prove the costs declared (such as contracts, subcontracts, invoices and accounting records); in addition, the beneficiaries' usual accounting and internal control procedures must enable direct reconciliation between the amounts declared, the amounts recorded in their accounts and the amounts stated in the supporting documents

(b) for flat-rate costs and contributions (if any): adequate records and supporting documents to prove the eligibility of the costs or contributions to which the flat-rate is applied

(c) for the following simplified costs and contributions: the beneficiaries do not need to keep specific records on the actual costs incurred, but must keep:

(i) for unit costs and contributions (if any): adequate records and supporting documents to prove the number of units declared

(ii) for lump sum costs and contributions (if any): adequate records and supporting documents to prove proper implementation of the work as described in Annex 1

(iii) for financing not linked to costs (if any): adequate records and supporting documents to prove the achievement of the results or the fulfilment of the conditions as described in Annex 1

(d) for unit, flat-rate and lump sum costs and contributions according to usual cost accounting practices (if any): the beneficiaries must keep any adequate records and supporting documents to prove that their cost accounting practices have been applied in a consistent manner, based on objective criteria, regardless of the source of funding, and that they comply with the eligibility conditions set out in Articles 6.1 and 6.2.

Moreover, the following is needed for specific budget categories:

(e) for personnel costs: time worked for the beneficiary under the action must be supported by declarations signed monthly by the person and their supervisor, unless another reliable time-record system is in place; the granting authority may accept alternative evidence supporting the time worked for the action declared, if it considers that it offers an adequate level of assurance

(f) additional record-keeping rules: not applicable

The records and supporting documents must be made available upon request (see Article 19) or in the context of checks, reviews, audits or investigations (see Article 25).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Article 25), the beneficiaries must keep these records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The granting authority may accept non-original documents if they offer a comparable level of assurance.

20.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs or contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 21 — REPORTING

21.1 Continuous reporting

The beneficiaries must continuously report on the progress of the action (e.g. **deliverables, milestones, outputs/outcomes, critical risks, indicators,** etc; if any), in the Portal Continuous Reporting tool and in accordance with the timing and conditions it sets out (as agreed with the granting authority).

Standardised deliverables (e.g. progress reports not linked to payments, reports on cumulative expenditure, special reports, etc; if any) must be submitted using the templates published on the Portal.

21.2 Periodic reporting: Technical reports and financial statements

In addition, the beneficiaries must provide reports to request payments, in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2):

- for additional prefinancings (if any): an **additional prefinancing report**
- for interim payments (if any) and the final payment: a **periodic report**.

The prefinancing and periodic reports include a technical and financial part.

The technical part includes an overview of the action implementation. It must be prepared using the template available in the Portal Periodic Reporting tool.

The financial part of the additional prefinancing report includes a statement on the use of the previous prefinancing payment.

The financial part of the periodic report includes:

- the financial statements (individual and consolidated; for all beneficiaries/affiliated entities)
- the explanation on the use of resources (or detailed cost reporting table, if required)
- the certificates on the financial statements (CFS) (if required; see Article 24.2 and Data Sheet, Point 4.3).

The **financial statements** must detail the eligible costs and contributions for each budget category and, for the final payment, also the revenues for the action (see Articles 6 and 22).

All eligible costs and contributions incurred should be declared, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Amounts that are not declared in the individual financial statements will not be taken into account by the granting authority.

By signing the financial statements (directly in the Portal Periodic Reporting tool), the beneficiaries confirm that:

- the information provided is complete, reliable and true
- the costs and contributions declared are eligible (see Article 6)
- the costs and contributions can be substantiated by adequate records and supporting documents (see Article 20) that will be produced upon request (see Article 19) or in the context of checks, reviews, audits and investigations (see Article 25)
- for the final periodic report: all the revenues have been declared (if required; see Article 22).

Beneficiaries will have to submit also the financial statements of their affiliated entities (if any). In case of recoveries (see Article 22), beneficiaries will be held responsible also for the financial statements of their affiliated entities.

21.3 Currency for financial statements and conversion into euros

The financial statements must be drafted in euro.

Beneficiaries with general accounts established in a currency other than the euro must convert the costs recorded in their accounts into euro, at the average of the daily exchange rates published in the C series of the *Official Journal of the European Union* (ECB website), calculated over the corresponding reporting period.

If no daily euro exchange rate is published in the *Official Journal* for the currency in question, they must be converted at the average of the monthly accounting exchange rates published on the European Commission website (InforEuro), calculated over the corresponding reporting period.

Beneficiaries with general accounts in euro must convert costs incurred in another currency into euro according to their usual accounting practices.

21.4 Reporting language

The reporting must be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

21.5 Consequences of non-compliance

If a report submitted does not comply with this Article, the granting authority may suspend the payment deadline (see Article 29) and apply other measures described in Chapter 5.

If the coordinator breaches its reporting obligations, the granting authority may terminate the grant or the coordinator's participation (see Article 32) or apply other measures described in Chapter 5.

ARTICLE 22 — PAYMENTS AND RECOVERIES — CALCULATION OF AMOUNTS DUE

22.1 Payments and payment arrangements

Payments will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

They will be made in euro to the bank account indicated by the coordinator (see Data Sheet, Point 4.2) and must be distributed without unjustified delay (restrictions may apply to distribution of the initial prefinancing payment; see Data Sheet, Point 4.2).

Payments to this bank account will discharge the granting authority from its payment obligation.

The cost of payment transfers will be borne as follows:

- the granting authority bears the cost of transfers charged by its bank
- the beneficiary bears the cost of transfers charged by its bank

- the party causing a repetition of a transfer bears all costs of the repeated transfer.

Payments by the granting authority will be considered to have been carried out on the date when they are debited to its account.

22.2 Recoveries

Recoveries will be made, if — at beneficiary termination, final payment or afterwards — it turns out that the granting authority has paid too much and needs to recover the amounts undue.

Each beneficiary's financial responsibility in case of recovery is in principle limited to their own debt and undue amounts of their affiliated entities.

In case of enforced recoveries (see Article 22.4), affiliated entities will be held liable for repaying debts of their beneficiaries, if required by the granting authority (see Data Sheet, Point 4.4).

22.3 Amounts due

22.3.1 Prefinancing payments

The aim of the prefinancing is to provide the beneficiaries with a float.

It remains the property of the EU until the final payment.

For **initial prefinancings** (if any), the amount due, schedule and modalities are set out in the Data Sheet (see Point 4.2).

For **additional prefinancings** (if any), the amount due, schedule and modalities are also set out in the Data Sheet (see Point 4.2). However, if the statement on the use of the previous prefinancing payment shows that less than 70% was used, the amount set out in the Data Sheet will be reduced by the difference between the 70% threshold and the amount used.

The contribution to the Mutual Insurance Mechanism will be retained from the prefinancing payments (at the rate and in accordance with the modalities set out in the Data Sheet, see Point 4.2) and transferred to the Mechanism.

Prefinancing payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.2 Amount due at beneficiary termination — Recovery

In case of beneficiary termination, the granting authority will determine the provisional amount due for the beneficiary concerned. Payments (if any) will be made with the next interim or final payment.

The **amount due** will be calculated in the following step:

Step 1 — Calculation of the total accepted EU contribution

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the beneficiary for all reporting periods, by calculating the 'maximum EU contribution to costs' (applying the funding rate to the accepted costs of the beneficiary), taking into account requests for a lower contribution to costs and CFS threshold cappings (if any; see Article 24.5) and adding the contributions (accepted unit, flat-rate or lump sum contributions and financing not linked to costs, if any).

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution' for the beneficiary.

The **balance** is then calculated by deducting the payments received (if any; see report on the distribution of payments in Article 32), from the total accepted EU contribution:

{total accepted EU contribution for the beneficiary

minus

{prefinancing and interim payments received (if any)}}.

If the balance is **positive**, the amount will be included in the next interim or final payment to the consortium.

If the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount due, the amount to be recovered and the reasons why and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered and ask this amount to be paid to the coordinator (**confirmation letter**).

If payment is not made to the coordinator by the date specified in the confirmation letter, the granting authority may call on the Mutual Insurance Mechanism to intervene, if continuation of the action is guaranteed and the conditions set out in the rules governing the Mechanism are met.

In this case, it will send a **beneficiary recovery letter**, together with a **debit note** with the terms and date for payment.

The debit note for the beneficiary will include the amount calculated for the affiliated entities which also had to end their participation (if any).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

The amounts will later on also be taken into account for the next interim or final payment.

22.3.3 Interim payments

Interim payments reimburse the eligible costs and contributions claimed for the implementation of the action during the reporting periods (if any).

Interim payments (if any) will be made in accordance with the schedule and modalities set out the Data Sheet (see Point 4.2).

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of compliance, authenticity, completeness or correctness of its content.

The **interim payment** will be calculated by the granting authority in the following steps:

Step 1 — Calculation of the total accepted EU contribution

Step 2 — Limit to the interim payment ceiling

Step 1 — Calculation of the total accepted EU contribution

The granting authority will calculate the 'accepted EU contribution' for the action for the reporting period, by first calculating the 'maximum EU contribution to costs' (applying the funding rate to the accepted costs of each beneficiary), taking into account requests for a lower contribution to costs, and CFS threshold cappings (if any; see Article 24.5) and adding the contributions (accepted unit, flat-rate or lump sum contributions and financing not linked to costs, if any).

After that, the granting authority will take into account grant reductions from beneficiary termination (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the interim payment ceiling

The resulting amount is then capped to ensure that the total amount of prefinancing and interim payments (if any) does not exceed the interim payment ceiling set out in the Data Sheet (see Point 4.2).

Interim payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.4 Final payment — Final grant amount — Revenues and Profit — Recovery

The final payment (payment of the balance) reimburses the remaining part of the eligible costs and contributions claimed for the implementation of the action (if any).

The final payment will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

Payment is subject to the approval of the final periodic report. Its approval does not imply recognition of compliance, authenticity, completeness or correctness of its content.

The **final grant amount for the action** will be calculated in the following steps:

Step 1 — Calculation of the total accepted EU contribution

Step 2 — Limit to the maximum grant amount

Step 3 — Reduction due to the no-profit rule

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for all reporting periods, by calculating the 'maximum EU contribution to costs' (applying the funding rate to the total accepted costs of each beneficiary), taking into account requests for a lower contribution to costs, CFS threshold cappings (if any; see Article 24.5) and adding the contributions (accepted unit, flat-rate or lump sum contributions and financing not linked to costs, if any).

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the maximum grant amount

If the resulting amount is higher than the maximum grant amount set out in Article 5.2, it will be limited to the latter.

Step 3 — Reduction due to the no-profit rule

If the no-profit rule is provided for in the Data Sheet (see Point 4.2), the grant must not produce a profit (i.e. surplus of the amount obtained following Step 2 plus the action's revenues, over the eligible costs and contributions approved by the granting authority).

'Revenue' is all income generated by the action, during its duration (see Article 4), for beneficiaries that are profit legal entities (— with the exception of income generated by the exploitation of results, which are not considered as revenues).

If there is a profit, it will be deducted in proportion to the final rate of reimbursement of the eligible costs approved by the granting authority (as compared to the amount calculated following Steps 1 and 2 minus the contributions).

The **balance** (final payment) is then calculated by deducting the total amount of prefinancing and interim payments already made (if any), from the final grant amount:

{final grant amount

minus

{prefinancing and interim payments made (if any)}}.

If the balance is **positive**, it will be **paid** to the coordinator.

The amount retained for the Mutual Insurance Mechanism (see above) will be released and **paid** to the coordinator (in accordance with the rules governing the Mechanism).

The final payment (or part of it) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency,

offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

If — despite the release of the Mutual Insurance Mechanism contribution — the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to recover, the final grant amount, the amount to be recovered and the reasons why
- requesting a report on the distribution of payments to the beneficiaries within 30 days of receiving notification and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received) and the coordinator has submitted the report on the distribution of payments, it will calculate the **share of the debt per beneficiary**, by:

(a) identifying the beneficiaries for which the amount calculated as follows is negative:

{{{total accepted EU contribution for the beneficiary

divided by

total accepted EU contribution for the action}

multiplied by

final grant amount for the action},

minus

{prefinancing and interim payments received by the beneficiary (if any)}}

and

(b) dividing the debt:

{{amount calculated according to point (a) for the beneficiary concerned

divided by

the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a)}

multiplied by

the amount to be recovered}.

and confirm the amount to be recovered from each beneficiary concerned (**confirmation letter**), together with **debit notes** with the terms and date for payment.

The debit notes for beneficiaries will include the amounts calculated for their affiliated entities (if any).

If the coordinator has not submitted the report on the distribution of payments, the granting authority will **recover** the full amount from the coordinator (**confirmation letter** and **debit note** with the terms and date for payment).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.3.5 Audit implementation after final payment — Revised final grant amount — Recovery

If — after the final payment (in particular, after checks, reviews, audits or investigations; see Article 25) — the granting authority rejects costs or contributions (see Article 27) or reduces the grant (see Article 28), it will calculate the **revised final grant amount** for the beneficiary concerned.

The **beneficiary revised final grant amount** will be calculated in the following step:

Step 1 — Calculation of the revised total accepted EU contribution

Step 1 — Calculation of the revised total accepted EU contribution

The granting authority will first calculate the 'revised accepted EU contribution' for the beneficiary, by calculating the 'revised accepted costs' and 'revised accepted contributions'.

After that, it will take into account grant reductions (if any). The resulting 'revised total accepted EU contribution' is the beneficiary revised final grant amount.

If the revised final grant amount is lower than the beneficiary's final grant amount (i.e. its share in the final grant amount for the action), it will be **recovered** in accordance with the following procedure:

The **beneficiary final grant amount** (i.e. share in the final grant amount for the action) is calculated as follows:

{{total accepted EU contribution for the beneficiary

divided by

total accepted EU contribution for the action}

multiplied by

final grant amount for the action}.

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount to be recovered and the reasons why and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered (**confirmation letter**), together with a **debit note** with the terms and the date for payment.

Recoveries against affiliated entities (if any) will be handled through their beneficiaries.

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.4 Enforced recovery

If payment is not made by the date specified in the debit note, the amount due will be recovered:

(a) by offsetting the amount — without the coordinator or beneficiary's consent — against any amounts owed to the coordinator or beneficiary by the granting authority.

In exceptional circumstances, to safeguard the EU financial interests, the amount may be offset before the payment date specified in the debit note.

For grants where the granting authority is the European Commission or an EU executive agency, debts may also be offset against amounts owed by other Commission services or executive agencies.

(b) financial guarantee(s): not applicable

(c) joint and several liability of beneficiaries: not applicable

(d) by holding affiliated entities jointly and severally liable (if any, see Data Sheet, Point 4.4)

(e) by taking legal action (see Article 43) or, provided that the granting authority is the European Commission or an EU executive agency, by adopting an enforceable decision under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 100(2) of EU Financial Regulation 2018/1046.

If the Mutual Insurance Mechanism was called on by the granting authority to intervene, recovery will be continued in the name of the Mutual Insurance Mechanism. If two debit notes were sent, the second one (in the name of the Mutual Insurance Mechanism) will be considered to replace the first one (in the name of the granting authority). Where the MIM intervened, offsetting, enforceable decisions or any other of the above-mentioned forms of enforced recovery may be used mutatis mutandis.

The amount to be recovered will be increased by **late-payment interest** at the rate set out in Article 22.5, from the day following the payment date in the debit note, up to and including the date the full payment is received.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2015/2366[17] applies.

For grants where the granting authority is an EU executive agency, enforced recovery by offsetting or enforceable decision will be done by the services of the European Commission (see also Article 43).

22.5 Consequences of non-compliance

[17] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (OJ L 337, 23.12.2015, p. 35).

22.5.1 If the granting authority does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus the rate specified in the Data Sheet (Point 4.2). The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only on request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

If payments or the payment deadline are suspended (see Articles 29 and 30), payment will not be considered as late.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

22.5.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the coordinator may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 23 — GUARANTEES

Not applicable

ARTICLE 24 — CERTIFICATES

24.1 Operational verification report (OVR)

Not applicable

24.2 Certificate on the financial statements (CFS)

If required by the granting authority (see Data Sheet, Point 4.3), the beneficiaries must provide certificates on their financial statements (CFS), in accordance with the schedule, threshold and conditions set out in the Data Sheet.

The coordinator must submit them as part of the periodic report (see Article 21).

The certificates must be drawn up using the template published on the Portal, cover the costs declared on the basis of actual costs and costs according to usual cost accounting practices (if any), and fulfil the following conditions:

(a) be provided by a qualified approved external auditor which is independent and complies with Directive 2006/43/EC[18] (or for public bodies: by a competent independent public officer)

(b) the verification must be carried out according to the highest professional standards to ensure that the financial statements comply with the provisions under the Agreement and that the costs declared are eligible.

The certificates will not affect the granting authority's right to carry out its own checks, reviews or audits, nor preclude the European Court of Auditors (ECA), the European Public Prosecutor's Office (EPPO) or the European Anti-Fraud Office (OLAF) from using their prerogatives for audits and investigations under the Agreement (see Article 25).

If the costs (or a part of them) were already audited by the granting authority, these costs do not need to be covered by the certificate and will not be counted for calculating the threshold (if any).

24.3 Certificate on the compliance of usual cost accounting practices (CoMUC)

Not applicable

24.4 Systems and process audit (SPA)

Beneficiaries which:

- use unit, flat rate or lump sum costs or contributions according to documented (i.e. formally approved and in writing) usual costs accounting practices (if any) or

- have formalised documentation on the systems and processes for calculating their costs and contributions (i.e. formally approved and in writing), have participated in at least 150 actions under Horizon 2020 or the Euratom Research and Training Programme (2014-2018 or 2019-2020) and participate in at least 3 ongoing actions under Horizon Europe or the Euratom Research and Training Programme (2021-2025 or 2026-2027)

may apply to the granting authority for a systems and process audit (SPA).

This audit will be carried out as follows:

Step 1 – Application by the beneficiary.

Step 2 – If the application is accepted, the granting authority will carry out the systems and process audit, complemented by an audit of transactions (on a sample of the beneficiary's Horizon Europe or the Euratom Research and Training Programme financial statements).

Step 3 – The audit result will take the form of a risk assessment classification for the beneficiary: low, medium or high.

Low-risk beneficiaries will benefit from less (or less in-depth) ex-post audits (see Article 25) and a higher threshold for submitting certificates on the financial statements (CFS; see Articles 21 and 24.2 and Data Sheet, Point 4.3).

[18] Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts or similar national regulations (OJ L 157, 9.6.2006, p. 87).

24.5 Consequences of non-compliance

If a beneficiary does not submit a certificate on the financial statements (CFS) or the certificate is rejected, the accepted EU contribution to costs will be capped to reflect the CFS threshold.

If a beneficiary breaches any of its other obligations under this Article, the granting authority may apply the measures described in Chapter 5.

ARTICLE 25 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

25.1 Granting authority checks, reviews and audits

25.1.1 Internal checks

The granting authority may — during the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing costs and contributions, deliverables and reports.

25.1.2 Project reviews

The granting authority may carry out reviews on the proper implementation of the action and compliance with the obligations under the Agreement (general project reviews or specific issues reviews).

Such project reviews may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiary concerned and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent, outside experts. If it uses outside experts, the coordinator or beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The coordinator or beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted (including information on the use of resources). The granting authority may request beneficiaries to provide such information to it directly. Sensitive information and documents will be treated in accordance with Article 13.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with the outside experts.

For **on-the-spot visits**, the beneficiary concerned must allow access to sites and premises (including to the outside experts) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a **project review report** will be drawn up.

The granting authority will formally notify the project review report to the coordinator or beneficiary concerned, which has 30 days from receiving notification to make observations.

Project reviews (including project review reports) will be in the language of the Agreement.

25.1.3 Audits

The granting authority may carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Such audits may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the beneficiary concerned and will be considered to start on the date of the notification.

The granting authority may use its own audit service, delegate audits to a centralised service or use external audit firms. If it uses an external firm, the beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. Sensitive information and documents will be treated in accordance with Article 13.

For **on-the-spot** visits, the beneficiary concerned must allow access to sites and premises (including for the external audit firm) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a **draft audit report** will be drawn up.

The auditors will formally notify the draft audit report to the beneficiary concerned, which has 30 days from receiving notification to make observations (contradictory audit procedure).

The **final audit report** will take into account observations by the beneficiary concerned and will be formally notified to them.

Audits (including audit reports) will be in the language of the Agreement.

25.2 European Commission checks, reviews and audits in grants of other granting authorities

Where the granting authority is not the European Commission, the latter has the same rights of checks, reviews and audits as the granting authority.

25.3 Access to records for assessing simplified forms of funding

The beneficiaries must give the European Commission access to their statutory records for the periodic assessment of simplified forms of funding which are used in EU programmes.

25.4 OLAF, EPPO and ECA audits and investigations

The following bodies may also carry out checks, reviews, audits and investigations — during the action or afterwards:

- the European Anti-Fraud Office (OLAF) under Regulations No 883/2013[19] and No 2185/96[20]

- the European Public Prosecutor's Office (EPPO) under Regulation 2017/1939

- the European Court of Auditors (ECA) under Article 287 of the Treaty on the Functioning of the EU (TFEU) and Article 257 of EU Financial Regulation 2018/1046.

If requested by these bodies, the beneficiary concerned must provide full, accurate and complete information in the format requested (including complete accounts, individual salary statements or other personal data, including in electronic format) and allow access to sites and premises for on-the-spot visits or inspections — as provided for under these Regulations.

To this end, the beneficiary concerned must keep all relevant information relating to the action, at least until the time-limit set out in the Data Sheet (Point 6) and, in any case, until any ongoing checks, reviews, audits, investigations, litigation or other pursuits of claims have been concluded.

25.5 Consequences of checks, reviews, audits and investigations — Extension of results of reviews, audits or investigations

25.5.1 Consequences of checks, reviews, audits and investigations in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to rejections (see Article 27), grant reduction (see Article 28) or other measures described in Chapter 5.

Rejections or grant reductions after the final payment will lead to a revised final grant amount (see Article 22).

Findings in checks, reviews, audits or investigations during the action implementation may lead to a request for amendment (see Article 39), to change the description of the action set out in Annex 1.

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations in any EU grant may also lead to consequences in other EU grants awarded under similar conditions ('extension to other grants').

Moreover, findings arising from an OLAF or EPPO investigation may lead to criminal prosecution under national law.

25.5.2 Extension from other grants

Results of checks, reviews, audits or investigations in other grants may be extended to this grant, if:

(a) the beneficiary concerned is found, in other EU grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and

[19] Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18/09/2013, p. 1).

[20] Council Regulation (Euratom, EC) No 2185/96 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15/11/1996, p. 2).

(b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — within the time-limit for audits set out in the Data Sheet (see Point 6).

The granting authority will formally notify the beneficiary concerned of the intention to extend the findings and the list of grants affected.

If the extension concerns **rejections of costs or contributions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings

(b) the request to submit revised financial statements for all grants affected

(c) the correction rate for extrapolation, established on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected, if the beneficiary concerned:

(i) considers that the submission of revised financial statements is not possible or practicable or

(ii) does not submit revised financial statements.

If the extension concerns **grant reductions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings and

(b) the **correction rate for extrapolation**, established on the basis of the systemic or recurrent errors and the principle of proportionality.

The beneficiary concerned has **60 days** from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method/rate**.

On the basis of this, the granting authority will analyse the impact and decide on the implementation (i.e. start rejection or grant reduction procedures, either on the basis of the revised financial statements or the announced/alternative method/rate or a mix of those; see Articles 27 and 28).

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs or contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 26 — IMPACT EVALUATIONS

26.1 Impact evaluation

The granting authority may carry out impact evaluations of the action, measured against the objectives and indicators of the EU programme funding the grant.

Such evaluations may be started during implementation of the action and until the time-limit set out

in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiaries and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent outside experts.

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

26.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the granting authority may apply the measures described in Chapter 5.

CHAPTER 5 CONSEQUENCES OF NON-COMPLIANCE

SECTION 1 REJECTIONS AND GRANT REDUCTION

ARTICLE 27 — REJECTION OF COSTS AND CONTRIBUTIONS

27.1 Conditions

The granting authority will — at beneficiary termination, interim payment, final payment or afterwards — reject any costs or contributions which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 25).

The rejection may also be based on the extension of findings from other grants to this grant (see Article 25).

Ineligible costs or contributions will be rejected.

27.2 Procedure

If the rejection does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the rejection, the amounts and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the rejection (payment review procedure).

If the rejection leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

27.3 Effects

If the granting authority rejects costs or contributions, it will deduct them from the costs or contributions declared and then calculate the amount due (and, if needed, make a recovery; see Article 22).

ARTICLE 28 — GRANT REDUCTION

28.1 Conditions

The granting authority may — at beneficiary termination, final payment or afterwards — reduce the grant for a beneficiary, if:

(a) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (see Article 25).

The amount of the reduction will be calculated for each beneficiary concerned and proportionate to the seriousness and the duration of the errors, irregularities or fraud or breach of obligations, by applying an individual reduction rate to their accepted EU contribution.

28.2 Procedure

If the grant reduction does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the reduction, the amount to be reduced and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the reduction (payment review procedure).

If the grant reduction leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

28.3 Effects

If the granting authority reduces the grant, it will deduct the reduction and then calculate the amount due (and, if needed, make a recovery; see Article 22).

SECTION 2 SUSPENSION AND TERMINATION

ARTICLE 29 — PAYMENT DEADLINE SUSPENSION

29.1 Conditions

The granting authority may — at any moment — suspend the payment deadline if a payment cannot be processed because:

(a) the required report (see Article 21) has not been submitted or is not complete or additional information is needed

(b) there are doubts about the amount to be paid (e.g. ongoing audit extension procedure, queries

about eligibility, need for a grant reduction, etc.) and additional checks, reviews, audits or investigations are necessary, or

(c) there are other issues affecting the EU financial interests.

29.2 Procedure

The granting authority will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day the notification is sent.

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining time to pay (see Data Sheet, Point 4.2) will resume.

If the suspension exceeds two months, the coordinator may request the granting authority to confirm if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the report and the revised report is not submitted (or was submitted but is also rejected), the granting authority may also terminate the grant or the participation of the coordinator (see Article 32).

ARTICLE 30 — PAYMENT SUSPENSION

30.1 Conditions

The granting authority may — at any moment — suspend payments, in whole or in part for one or more beneficiaries, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant.

If payments are suspended for one or more beneficiaries, the granting authority will make partial payment(s) for the part(s) not suspended. If suspension concerns the final payment, the payment (or recovery) of the remaining amount after suspension is lifted will be considered to be the payment that closes the action.

30.2 Procedure

Before suspending payments, the granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to suspend payments and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

At the end of the suspension procedure, the granting authority will also inform the coordinator.

The suspension will **take effect** the day after the confirmation notification is sent.

If the conditions for resuming payments are met, the suspension will be **lifted**. The granting authority will formally notify the beneficiary concerned (and the coordinator) and set the suspension end date.

During the suspension, no prefinancing will be paid to the beneficiaries concerned. For interim payments, the periodic reports for all reporting periods except the last one (see Article 21) must not contain any financial statements from the beneficiary concerned (or its affiliated entities). The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last periodic report.

ARTICLE 31 — GRANT AGREEMENT SUSPENSION

31.1 Consortium-requested GA suspension

31.1.1 Conditions and procedure

The beneficiaries may request the suspension of the grant or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 35) — make implementation impossible or excessively difficult.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the date the suspension takes effect; this date may be before the date of the submission of the amendment request and
- the expected date of resumption.

The suspension will **take effect** on the day specified in the amendment.

Once circumstances allow for implementation to resume, the coordinator must immediately request another **amendment** of the Agreement to set the suspension end date, the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the amendment. This date may be before the date of the submission of the amendment request.

During the suspension, no prefinancing will be paid. Costs incurred or contributions for activities implemented during grant suspension are not eligible (see Article 6.3).

31.2 EU-initiated GA suspension

31.2.1 Conditions

The granting authority may suspend the grant or any part of it, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant

(c) other:

(i) linked action issues: not applicable

(ii) the action has lost its scientific or technological relevance, for EIC Accelerator actions: the action has lost its economic relevance, for challenge-based EIC Pathfinder actions and Horizon Europe Missions: the action has lost its relevance as part of the Portfolio for which it has been initially selected

31.2.2 Procedure

Before suspending the grant, the granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to suspend the grant and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

The suspension will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification).

Once the conditions for resuming implementation of the action are met, the granting authority will formally notify the coordinator a **lifting of suspension letter**, in which it will set the suspension end date and invite the coordinator to request an amendment of the Agreement to set the resumption

date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the lifting of suspension letter. This date may be before the date on which the letter is sent.

During the suspension, no prefinancing will be paid. Costs incurred or contributions for activities implemented during suspension are not eligible (see Article 6.3).

The beneficiaries may not claim damages due to suspension by the granting authority (see Article 33).

Grant suspension does not affect the granting authority's right to terminate the grant or a beneficiary (see Article 32) or reduce the grant (see Article 28).

ARTICLE 32 — GRANT AGREEMENT OR BENEFICIARY TERMINATION

32.1 Consortium-requested GA termination

32.1.1 Conditions and procedure

The beneficiaries may request the termination of the grant.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the date the consortium ends work on the action ('end of work date') and
- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

The termination will **take effect** on the termination date specified in the amendment.

If no reasons are given or if the granting authority considers the reasons do not justify termination, it may consider the grant terminated improperly.

32.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the costs incurred and contributions for activities implemented before the end of work date (see Article 22). Costs relating to contracts due for execution only after the end of work are not eligible.

If the granting authority does not receive the report within the deadline, only costs and contributions which are included in an approved periodic report will be taken into account (no costs/contributions if no periodic report was ever approved).

Improper termination may lead to a grant reduction (see Article 28).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks,

reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.2 Consortium-requested beneficiary termination

32.2.1 Conditions and procedure

The coordinator may request the termination of the participation of one or more beneficiaries, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing)
- the date the beneficiary ends work on the action ('end of work date')
- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

If the termination concerns the coordinator and is done without its agreement, the amendment request must be submitted by another beneficiary (acting on behalf of the consortium).

The termination will **take effect** on the termination date specified in the amendment.

If no information is given or if the granting authority considers that the reasons do not justify termination, it may consider the beneficiary to have been terminated improperly.

32.2.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a **report on the distribution of payments** to the beneficiary concerned

(ii) a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, the financial statement, the explanation on the use of resources, and, if applicable, the certificate on the financial statement (CFS; see Articles 21 and 24.2 and Data Sheet, Point 4.3)

(iii) a second **request for amendment** (see Article 39) with other amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted and taking into account the costs incurred and contributions for activities implemented before the end of work date (see Article 22). Costs relating to contracts due for execution only after the end of work are not eligible.

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only costs and contributions which are included in an approved periodic report will be taken into account (no costs/ contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

If the second request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the second request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

Improper termination may lead to a reduction of the grant (see Article 31) or grant termination (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.3 EU-initiated GA or beneficiary termination

32.3.1 Conditions

The granting authority may terminate the grant or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 40)

(b) a change to the action or the legal, financial, technical, organisational or ownership situation of a beneficiary is likely to substantially affect the implementation of the action or calls into question the decision to award the grant (including changes linked to one of the exclusion grounds listed in the declaration of honour)

(c) following termination of one or more beneficiaries, the necessary changes to the Agreement (and their impact on the action) would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(d) implementation of the action has become impossible or the changes necessary for its continuation would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(e) a beneficiary (or person with unlimited liability for its debts) is subject to bankruptcy proceedings or similar (including insolvency, winding-up, administration by a liquidator or court, arrangement with creditors, suspension of business activities, etc.)

(f) a beneficiary (or person with unlimited liability for its debts) is in breach of social security or tax obligations

(g) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has been found guilty of grave professional misconduct

(h) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed fraud, corruption, or is involved in a criminal organisation, money laundering, terrorism-related crimes (including terrorism financing), child labour or human trafficking

(i) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) was created under a different jurisdiction with the intent to circumvent fiscal, social or other legal obligations in the country of origin (or created another entity with this purpose)

(j) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.)

(k) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings from other grants to this grant; see Article 25)

(l) despite a specific request by the granting authority, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its affiliated entities or associated partners that is in one of the situations under points (d), (f), (e), (g), (h), (i) or (j) and to reallocate its tasks, or

(m) other:

  (i) linked action issues: not applicable

  (ii) the action has lost its scientific or technological relevance, for EIC Accelerator actions: the action has lost its economic relevance, for challenge-based EIC Pathfinder actions and Horizon Europe Missions: the action has lost its relevance as part of the Portfolio for which it has been initially selected

32.3.2 Procedure

Before terminating the grant or participation of one or more beneficiaries, the granting authority will send **a pre-information letter** to the coordinator or beneficiary concerned:

- formally notifying the intention to terminate and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the termination and the date it will take effect (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

For beneficiary terminations, the granting authority will — at the end of the procedure — also inform the coordinator.

The termination will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification; 'termination date').

32.3.3 Effects

(a) for **GA termination**:

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the last open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the costs incurred and contributions for activities implemented before termination takes effect (see Article 22). Costs relating to contracts due for execution only after termination are not eligible.

If the grant is terminated for breach of the obligation to submit reports, the coordinator may not submit any report after termination.

If the granting authority does not receive the report within the deadline, only costs and contributions which are included in an approved periodic report will be taken into account (no costs/contributions if no periodic report was ever approved).

Termination does not affect the granting authority's right to reduce the grant (see Article 28) or to impose administrative sanctions (see Article 34).

The beneficiaries may not claim damages due to termination by the granting authority (see Article 33).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

(b) for **beneficiary termination**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a **report on the distribution of payments** to the beneficiary concerned

(ii) a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, the financial

statement, the explanation on the use of resources, and, if applicable, the certificate on the financial statement (CFS; see Articles 21 and 24.2 and Data Sheet, Point 4.3)

(iii) a **request for amendment** (see Article 39) with any amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted and taking into account the costs incurred and contributions for activities implemented before termination takes effect (see Article 22). Costs relating to contracts due for execution only after termination are not eligible.

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only costs and contributions included in an approved periodic report will be taken into account (no costs/ contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

If the request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

SECTION 3 OTHER CONSEQUENCES: DAMAGES AND ADMINISTRATIVE SANCTIONS

ARTICLE 33 — DAMAGES

33.1 Liability of the granting authority

The granting authority cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of the implementation of the Agreement, including for gross negligence.

The granting authority cannot be held liable for any damage caused by any of the beneficiaries or other participants involved in the action, as a consequence of the implementation of the Agreement.

33.2 Liability of the beneficiaries

The beneficiaries must compensate the granting authority for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement, provided that it was caused by gross negligence or wilful act.

The liability does not extend to indirect or consequential losses or similar damage (such as loss of profit, loss of revenue or loss of contracts), provided such damage was not caused by wilful act or by a breach of confidentiality.

ARTICLE 34 — ADMINISTRATIVE SANCTIONS AND OTHER MEASURES

Nothing in this Agreement may be construed as preventing the adoption of administrative sanctions (i.e. exclusion from EU award procedures and/or financial penalties) or other public law measures, in addition or as an alternative to the contractual measures provided under this Agreement (see, for instance, Articles 135 to 145 EU Financial Regulation 2018/1046 and Articles 4 and 7 of Regulation 2988/95[21]).

SECTION 4 FORCE MAJEURE

ARTICLE 35 — FORCE MAJEURE

A party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,
- was unforeseeable, exceptional situation and beyond the parties' control,
- was not due to error or negligence on their part (or on the part of other participants involved in the action), and
- proves to be inevitable in spite of exercising all due diligence.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

CHAPTER 6 FINAL PROVISIONS

ARTICLE 36 — COMMUNICATION BETWEEN THE PARTIES

36.1 Forms and means of communication — Electronic management

[21] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

EU grants are managed fully electronically through the EU Funding & Tenders Portal ('Portal').

All communications must be made electronically through the Portal, in accordance with the Portal Terms and Conditions and using the forms and templates provided there (except if explicitly instructed otherwise by the granting authority).

Communications must be made in writing and clearly identify the grant agreement (project number and acronym).

Communications must be made by persons authorised according to the Portal Terms and Conditions. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a 'legal entity appointed representative (LEAR)'. The role and tasks of the LEAR are stipulated in their appointment letter (see Portal Terms and Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Portal.

36.2 Date of communication

The sending date for communications made through the Portal will be the date and time of sending, as indicated by the time logs.

The receiving date for communications made through the Portal will be the date and time the communication is accessed, as indicated by the time logs. Formal notifications that have not been accessed within 10 days after sending, will be considered to have been accessed (see Portal Terms and Conditions).

If a communication is exceptionally made on paper (by e-mail or postal service), general principles apply (i.e. date of sending/receipt). Formal notifications by registered post with proof of delivery will be considered to have been received either on the delivery date registered by the postal service or the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

36.3 Addresses for communication

The Portal can be accessed via the Europa website.

The address for paper communications to the granting authority (if exceptionally allowed) is the official mailing address indicated on its website.

For beneficiaries, it is the legal address specified in the Portal Participant Register.

ARTICLE 37 — INTERPRETATION OF THE AGREEMENT

The provisions in the Data Sheet take precedence over the rest of the Terms and Conditions of the Agreement.

Annex 5 takes precedence over the Terms and Conditions; the Terms and Conditions take precedence over the Annexes other than Annex 5.

Annex 2 takes precedence over Annex 1.

ARTICLE 38 — CALCULATION OF PERIODS AND DEADLINES

In accordance with Regulation No 1182/71[22], periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

'Days' means calendar days, not working days.

ARTICLE 39 — AMENDMENTS

39.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

39.2 Procedure

The party requesting an amendment must submit a request for amendment signed directly in the Portal Amendment tool.

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3). If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why
- the appropriate supporting documents and
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The granting authority may request additional information.

If the party receiving the request agrees, it must sign the amendment in the tool within 45 days of receiving notification (or any additional information the granting authority has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected.

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date of entry into force or other date specified in the amendment.

[22] Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8/6/1971, p. 1).

ARTICLE 40 — ACCESSION AND ADDITION OF NEW BENEFICIARIES

40.1 Accession of the beneficiaries mentioned in the Preamble

The beneficiaries which are not coordinator must accede to the grant by signing the accession form (see Annex 3) directly in the Portal Grant Preparation tool, within 30 days after the entry into force of the Agreement (see Article 44).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 44).

If a beneficiary does not accede to the grant within the above deadline, the coordinator must — within 30 days — request an amendment (see Article 39) to terminate the beneficiary and make any changes necessary to ensure proper implementation of the action. This does not affect the granting authority's right to terminate the grant (see Article 32).

40.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 39. It must include an accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool.

New beneficiaries will assume the rights and obligations under the Agreement with effect from the date of their accession specified in the accession form (see Annex 3).

Additions are also possible in mono-beneficiary grants.

ARTICLE 41 — TRANSFER OF THE AGREEMENT

In justified cases, the beneficiary of a mono-beneficiary grant may request the transfer of the grant to a new beneficiary, provided that this would not call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiary must submit a request for **amendment** (see Article 39), with

- the reasons why
- the accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool and
- additional supporting documents (if required by the granting authority).

The new beneficiary will assume the rights and obligations under the Agreement with effect from the date of accession specified in the accession form (see Annex 3).

ARTICLE 42 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE GRANTING AUTHORITY

The beneficiaries may not assign any of their claims for payment against the granting authority to

any third party, except if expressly approved in writing by the granting authority on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the granting authority has not accepted the assignment or if the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the granting authority.

ARTICLE 43 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

43.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

Special rules may apply for beneficiaries which are international organisations (if any; see Data Sheet, Point 5).

43.2 Dispute settlement

If a dispute concerns the interpretation, application or validity of the Agreement, the parties must bring action before the EU General Court — or, on appeal, the EU Court of Justice — under Article 272 of the Treaty on the Functioning of the EU (TFEU).

For non-EU beneficiaries (if any), such disputes must be brought before the courts of Brussels, Belgium — unless an international agreement provides for the enforceability of EU court judgements.

For beneficiaries with arbitration as special dispute settlement forum (if any; see Data Sheet, Point 5), the dispute will — in the absence of an amicable settlement — be settled in accordance with the Rules for Arbitration published on the Portal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 22 and 34), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice — under Article 263 TFEU.

For grants where the granting authority is an EU executive agency (see Preamble), actions against offsetting and enforceable decisions must be brought against the European Commission (not against the granting authority; see also Article 22).

ARTICLE 44 — ENTRY INTO FORCE

The Agreement will enter into force on the day of signature by the granting authority or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

Emilio Palomares with ECAS id n0048uuh signed in the Participant Portal on 14/06/2023 at 15:32:22 (transaction id SigId-294093-XTcM7caxJWaPfHhY8r39LuFP1Bw6ev9NZL4VYFcX6JmTdRNNpNZykHI2HfZMlRb2eZPKtvnHVpblXc8F4yqH1G-yntOf97TTHqJXwStD2tm9a-Av75HQAbx7kJ7pFUjWizaGmeDaqy1SnXAuzfYD17p7uVGOjzdszzN098XV0D1xgwecsKSscQu08ZPZculEIOcnn). Timestamp by third party at 2023.06.14 15:32:27 CEST

For the granting authority

Signed by Timo HALLANTIE with ECAS id hallato as an authorised representative on 14-06-2023 16:57:05 (transaction id SigId-296196-SCzGExaSUnsb9h4bhzcj3FYsLU09LCcB9LzpO26f4MZWDDzuajGWioa4NBmRnW1jZcPEPMvBFxzUC1OUzukALADG-yntOf97TTHqJXwStD2tm9a-wcCzyZAYNQP6kEq9KhqKn0QIKWzlcUa24Ue8l2KWyHoK7tv7M131ZRovKvyQEzZe5jBsFg09Y0ZBHsLzl0dT93y) 2023.06.14 16:57:59 CEST

ANNEX 1

Horizon Europe (HORIZON)

Description of the action (DoA)

Part A

Part B

DESCRIPTION OF THE ACTION (PART A)

COVER PAGE

Part A of the Description of the Action (DoA) must be completed directly on the Portal Grant Preparation screens.

PROJECT *Grant Preparation (General Information screen) — Enter the info.*	
Project number:	101115456
Project name:	SUstainable Photo-ElectRochemical VALorization of flue gases
Project acronym:	SUPERVAL
Call:	HORIZON-EIC-2022-PATHFINDERCHALLENGES-01
Topic:	HORIZON-EIC-2022-PATHFINDERCHALLENGES-01-01
Type of action:	HORIZON-EIC
Service:	EISMEA/E/01
Project starting date:	fixed date: 1 November 2023
Project duration:	36 months

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Associated with document Ref. Ares(2023)4125863 - 14/06/2023

PROJECT SUMMARY

Project summary

Grant Preparation (General Information screen) — Provide an overall description of your project (including context and overall objectives, planned activities and main achievements, and expected results and impacts (on target groups, change procedures, capacities, innovation etc)). This summary should give readers a clear idea of what your project is about.

Use the project summary from your proposal.

In the road to sustainability, the treatment of post-combustion emissions is still far from being techno-economically viable. On one end, the low concentration of CO2 in these streams, precludes the use of current carbon capture (CC) technologies. On the other end, even if CC were successfully implemented, there are not plausible final uses, maybe except geological long-term storage. Our ambitious proposal aims to investigate the viability of a technology able to tackle these challenges at once. Our SUPERVAL technology will develop scientific solutions from low-cost, non-critical raw materials and processes, with the added value of removing/valorizing the NOx contaminants from flue gas.
We propose to design and realize an autonomous, solar-powered installation able to capture harmful emissions from flue gas, and valorize them as commodities for the chemical industry, using water as sacrificial source of electrons and protons. The CO2 will be transformed into an organic, energy-rich molecule (formate). The NOx will be also captured and transformed, in combination with N2, into ammonia using the hydrogen obtained in the CO2 co-electrolysis processes. This integrated effort will offer the comprehensive capture and valorization of carbon and nitrogen components in post-combustion emissions, thus limiting pollutants and resulting in added-value chemicals. The corresponding techno-economic analysis and life cycle assessment studies will help to shape the components and performance of SUPERVAL as a useful technological advancement in the search for zero net emissions.

LIST OF PARTICIPANTS

PARTICIPANTS

Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
1	COO	ICIQ-CERCA	FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA	ES	999548044
2	BEN	ORS	ORCHESTRA SCIENTIFIC SOCIEDAD LIMITADA	ES	905329810
3	BEN	UPV	UNIVERSITAT POLITECNICA DE VALENCIA	ES	999864846
4	BEN	INSTM	CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI	IT	999991237
4.1	AE	UniME	UNIVERSITA DEGLI STUDI DI MESSINA	IT	999662601
5	BEN	FZJ	FORSCHUNGSZENTRUM JULICH GMBH	DE	999980470
6	BEN	TU/e	TECHNISCHE UNIVERSITEIT EINDHOVEN	NL	999977269
7	BEN	VARESER	VARESER 96 SL	ES	884906751
8	BEN	2.-O LCA	2.-O LCA CONSULTANTS APS	DK	986412401

LIST OF WORK PACKAGES

Work packages

Grant Preparation (Work Packages screen) — Enter the info.

Work Package No	Work Package name	Lead Beneficiary	Effort (Person-Months)	Start Month	End Month	Deliverables
WP1	Gas separation	2 - ORS	57.00	1	33	D1.1 – TAMOF-1 Pelletisation D1.2 – Adsorption properties D1.3 – Module for CO2/N2 separation D1.4 – Module for CO2/H2 separation
WP2	CO2/water-photo-electrolysis	4 - INSTM	105.00	1	33	D2.1 – PEC cathode D2.2 – PEC anode D2.3 – Electrochemical Cell D2.4 – Solar Panel D2.5 – PEC D2.6 – Computational modelling WP2
WP3	Photocatalytic hydrogenation of N2 and NOx to NH3	3 - UPV	68.00	1	33	D3.1 – Catalyst for N2/NOx photo-hydrogenation D3.2 – NH3 production photoreactors D3.3 – Computational modelling WP3
WP4	Device integration, SUPERVAL technology performance validation and feasibility assessment	6 - TU/e	135.00	1	36	D4.1 – SUPERVAL design D4.2 – SUPERVAL prototype D4.3 – SUPERVAL feasibility D4.4 – SUPERVAL viability D4.5 – SUPERVAL scale-up strategy
WP5	Dissemination, communication and exploitation	1 - ICIQ-CERCA	52.00	1	36	D5.1 – Plan for Dissemination and Exploitation Including Communication Activities D5.2 – Final version of Plan for Dissemination and Exploitation Including Communication Activities

Work packages

Grant Preparation (Work Packages screen) — Enter the info.

Work Package No	Work Package name	Lead Beneficiary	Effort (Person-Months)	Start Month	End Month	Deliverables
WP6	Management	1 - ICIQ-CERCA	20.00	1	36	D6.1 – Website and project logo D6.2 – Project management handbook D6.3 – Governance structures D6.4 – Data management plan D6.5 – RP1 Technical/scientific review meeting documents D6.6 – RP2 update of the Data Management Plan D6.7 – RP2 Technical/scientific review meeting documents
WP7	Portfolio activities	1 - ICIQ-CERCA	13.00	1	36	D7.1 – Report on portfolio activities and Action Plan 1 D7.2 – Report on portfolio activities and Action Plan 2 D7.3 – Report on portfolio activities and Action Plan 3 D7.4 – Technologies potentials assessment 1 D7.5 – Technologies potentials assessment 2

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Work package WP1 – Gas separation

Work Package Number	WP1	Lead Beneficiary	2. ORS
Work Package Name	Gas separation		
Start Month	1	End Month	33

Objectives
- Cost affordable and sustainable synthesis of TAMOF-1 pellets. - Development of a theoretical model for TAMOF-1 gas separation behaviour. - Design of a low-energy adsorption process for CO2/N2 separation. - Design of a low-energy adsorption process for CO2/H2 separation. - Design of a low-energy process for NOx (NO/NO2) capture from flue gas

Description
This WP will be dedicated to the development of two low-energy carbon capture technologies based on TAMOF-1 for separation and purification of CO2 from gas mixtures: flue gas, and post-electrolysis CO2/H2; and to the implementation of a technology for the separation and purification of NOx. Task 1.1 Pelletisation of TAMOF-1 (ORS, ICIQ, M1-M9). We will develop shaping methodologies to obtain a scalable formulation of TAMOF-1 pellets that offers mechanical stability (crushing tests >20N) as well as specific surface area (N2 adsorption), providing optimal volummetric CO2 capacity and CO2/N2 selectivity. This task will examine binder types (clays, polymeric, carbons, etc.) and loadings (typically > 70 wt%). The objective is to produce round shaped bodies (2-5 mm diameter) that can withstand adsorption operating conditions while minimizing sacrificial CO2 uptake performance due to compression or additives. The pellets will be characterized using powder X-Ray diffraction, TGA analysis, BET surface area, adsorption isotherms (CO2, N2, H2), and crushing/attrition tests. Task 1.2 Experimental data collection for gas adsorption properties (ORS, ICIQ, TU/e, M3-M15). In addition to the adsorption isotherms (i.e. equilibrium measurements) carried out in Task 1.1, we will perform fixed-bed breakthrough tests for studying the adsorption/desorption kinetics in flow conditions for pure and gas mixtures. Breakthrough behavior will be evaluated at different and relevant inlet gas composition, flow, temperature and pressure. Steady state adsorption/ desorption performance of TAMOF-1 pellets will be finally assessed to define cycling times, recovery yield, and gas purity. We will investigate different regeneration procedures: vacuum/and or flow of inert gas, and/or heating). Task 1.3 TAMOF-1 performance modelling (TU/e, ICIQ M7-M33). The data obtained in Task 1.2 will guide and validate the TAMOF-1 performance modeling. We will compute adsorption and desorption isotherms by developing a predictive multi-site Langmuir isotherm-based approach. Transport inside the MOF will be described by the Maxwell-Stefan approach for mass transfer. Different adsorption sites will be automatically identified in TAMOF-1 based upon an adsorption energy landscape computed by Widom's particle insertion method and structural pore-size distributions. The saturation loading of each site will be estimated with the liquid density of guest molecules and corresponding pore volume. For the determination of kinetics we will compute partition functions and free energy landscapes of guest molecules in TAMOF-1. We will also apply transition-state-theory to estimate diffusion coefficients, which will then be correlated with the geometrical properties of the MOF to establish a predictive model for diffusivities and permselectivity (as the product of adsorption and diffusion selectivities). We will develop numerical methods to automatically compute breakthrough curves from adsorption isotherms, diffusion data, and adsorption energetics. We already have developed beta-version software for the computation of breakthrough code for isothermal systems in which the adsorption of a gas mixture is described using the Ideal Adsorbed Solution Theory (IAST). Here, rather than using IAST we will calculate multicomponent adsorption isotherms which can be used directly in the software. The energy balance will be included in the computer model, using as inputs the heats of adsorption, the heat capacity of TAMOF-1, and the heat capacity of the gas. Task 1.4 Design, construction and performance validation of TAMOF-1 based carbon capture module for CO2/N2 separation and purification. (ORS, ICIQ, UPV, INSTM, TU/e, VARESER, M12-M21) We will design (mass balance, flows, column features and number, type and time of the adsorption/desorption steps) a TAMOF-1 based carbon capture device for the separation and purification of the CO2 and N2 components of flue gas streams. Task foundation will be both the experimental data previously collected (task 1.2) and the theoretical model developed (task 1.3). The device will be thus constructed, taking into considerations all the components (compressor, vacuum pump, tube and fittings) and the performance validated with a simulated inlet gas mixture (10%CO2/85% N2/5%O2, inlet flow: 100 Nml/min) at the optimum temperature and adsorption pressure. design and construction of a gas separation module able to recover

(> 80%) and purify both CO2 (purity to be defined based on the requirements of the PEC cathode), and H2 (purity: CO2 < 0.5%) and working at minimum T (< 40 °C) and minimum pressure (< 3bar).
Task 1.5: Design, construction and performance validation of TAMOF-1 based carbon capture module for CO2/H2 separation and purification. (ORS, ICIQ, UPV, INSTM, TU/e, VARESER, M18-M27). Similar to the previous task, a device for the CO2/H2 separation and purification will be designed and realised. This task will receive inputs from the tasks 1.2 and 1.3 and from the WP2. In particular, the lab-scale module will be specifically adapted to cathode requirements of the CO2 photo-electrolytic cell. Effect of water content on TAMOF-1 will be also evaluated and the limiting relative humidity identified.
Task 1.6 NOx capture in active carbon supports (ORS, ICIQ, UPV, M1-M18). Within this task, NOx (1000ppm, 95% NO) in a simulated flue gas mixture (10%CO2/85%N2/5%O2) will be adsorbed on activated carbon as a pretreatment before the CO2 separation module (WP1.1). Quantitative NOx adsorption will be evaluated at different temperatures (–20 ºC to 25 ºC). A convenient desorption method will be developed. Recovery yield and NOx purity and composition will be thus addressed. Alternatively, the resistance of TAMOF-1 columns to the presence of NOx will be assessed to define the limiting NOx content in the CC technology.

Work package WP2 – CO2/water-photo-electrolysis

Work Package Number	WP2	**Lead Beneficiary**	4. INSTM
Work Package Name	CO2/water-photo-electrolysis		
Start Month	1	**End Month**	33

Objectives
- Development of a device for CO2-water-co-electrolysis. - Obtain a mechanistic understanding for all the catalyst under reaction conditions. - Development of photovoltaic panel based on perovskites with the right I-V features to power the electrolyzer. - Assessment of the integrated photo-eletrochemical performance.

Description
WP2 concerns the development of a photo-electrochemical cell for the reduction of CO2 and protons coming from water into formate and hydrogen. This WP will be lead by the INSTM. Task 2.1 Cathode optimization (INSTM, ICIQ M1-M15). The INSTM will optimize the cathode in order to a) minimise CO formation b) enhance electrocatalysis (onset potential, maximum current density) and c) modulate formate/hydrogen faradaic efficiency. Copper sulfides (Cu-S) will be synthesised by the solvothermal method (A-LEAF approach) with the aims of suppressing CO formation. Alternatively, different Cu-S phases (digenite, djurleite, chalcocite, etc.) will be prepared by a novel reactive thermal annealing, performed during ambient pressure chemical vapor deposition and followed by a top-down exfoliation. The catalytic performance of the different copper sulfides phases will then be evaluated, also after doping with non-CRM metals elements (such as Al, Mn, Zn) to form single-atom electrocatalysts with fine-tuned architecture. a different series of catalysts based on stable metal alloys will be synthesized on Sn-based electrodes (particularly selective for formate formation) in combination with Cu. Carbon-based gas-diffusion layers will be used as the electrode substrates. The prepared electrodes will be characterized to evaluate their morphological and structural (by SEM-EDX, X-ray diffraction, XPS, Raman) and electrochemical (by LSV, CV, EIS) properties. Task 2.2 Anode optimization (ICIQ, INSTM, M1-M15). We will develop a novel anode with promising catalytic performance and stability at neutral pH (7pH8). As a fist option, Prussian blue analogs will be synthesised substituting the critical Co in the framework by earth abundant metals as Mn or Ni. In alternative, partially hydrophobic electrodes will be prepared adding partially hydrophobic binder to the electrode architecture, either as an additive to the ionomer ink, or as a decoration of the catalyst surface. As catalyst, we will target transition metal oxides with non-CRM metals: Fe, Mn and Ni. The materials will be characterized per- and postportem with a variety of techniques: X-ray diffraction; XPS; and Raman. Task 2.3 An insight into the electrocatalytic activity (ICIQ, TU/e M7-M34). All catalytic materials will be explored by first principles simulations with three objectives, determine the most stable structures under reaction conditions, determine the reaction mechanisms, and identify the descriptors for the activity and selectivity observed. The DFT models will be consolidated by the electrochemical characterization. Computational results will offer optimization strategies, as to propose further optimization strategies for activity and selectivity. Task 2.4 Electrochemical cell design and performance characterisation (INSTM, ICIQ, ORS, UPV, TU/e, VARESER

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M13-M24). After developing both cathode and anode, a compact electrolytic cell will be designed and assembled. We will construct compact flow-through system optimised to allow a better CO2 flow distribution on the electrode surface and enhance the local concentration of CO2 close to the electrocatalytic active sites. Moreover, we will adopt a low-resistance anode-membrane assembly configuration where the anode and the membrane are in direct contact. The electrolytic performance of the cell such as the I-V curve and the cathode faradaic efficiency will be determined by analytical methods (NMR, GC, IonicC and HPLC) and the durability assessed by chronoamperometry. The effect of the inlet flow and of the CO2 concentration at the cathode will be also investigated, and the minimum allowed CO2 purity determined.

Task 2.5 Development of a no-critical-raw-materials free perovskite solar module (JÜLICH, INSTM M1-M30). Within SUPERVAL, We will develop a critical-raw-material free halide perovskite solar module. The Indium Tin Oxide (ITO) transparent conductive contact layer will be exchanged with ZnO:Al (AZO) layer. A highly efficient perovskite solar cells (PSCs) with an inverted structure (often referred to as the p-i-n architecture) will be developed at first. The voltage of a single halide perovskite solar cell is not enough to drive the electrochemical reactions, therefore a low-cost perovskite module with highly tuneable photovoltages in the range between 2V and 4V will be realized by connecting a few solar cells in series. The interconnection of the individual solar cell into a module will be performed by laser scribing process developed in Jülich. State of the art, nanosecond (ns) and ps pulsed lasers with the wavelengths of 355, 532, and 1064 nm will be used to achieve low series resistance interconnection processes. The point contact interconnection design will be applied. Although a purpose of the point contact interconnection is to minimize the inactive area loss, its implementation will also affect the sheet resistance loss as well as the electrical loss. Finally, the halide perovskite modules will be encapsulated with glass at the front and foil at the back side and wire connected to the EC components. The actual number of cells in the perovskite module will be defined by the V(J) characteristics of the electrochemical cell (EC). The coupling procedure between EC and PV will be performed by properly matching the polarization curves to work at the maximum power point under certified sunlight irradiation (AM1.5G, 1 SUN=100 mW·cm–2) to maximize the solar to fuel conversion >10%.

In this task, a reference pathway will be followed in parallel to the perovskite solar module developments. A shingled silicon heterojunction (SHJ) module without Indium Tin Oxide transparent conductive contacts will be developed. The photovoltaic parameters of the SHJ module will be optimized for integration with electrochemical (EC) component developed in Task 2.1 and Task 2.2. JULICH will develop shingled silicon heterojunction (SHJ) module with various voltage and currents and target conversion efficiency of 22%. First, a proper contact geometry and laser cutting optimizations will be performed in order to minimize loss of solar conversion efficiency due to edge effects. Next, module encapsulation will be optimized for coupling to the electrochemical cell developed in Task 2.4. The shingled module will be connected to the EC cell following wired approach. The current-voltage (IV) characteristics and the photovoltaic (PV) parameters of the PV modules will be measured in Jülich under standard test conditions (illumination intensity of 100 mW·cm-² with an AM1.5G spectrum at 25 °C) by using Wacom Solar Simulator WXS-140S-Super. Additionally, a braid range of broad range of realistic irradiance of 100 – 1000 W/m2 (0.1-1 sun) and temperatures (25 - 60°C) will be explored.

Task 2.6 Design, construction and performance validation of the integrated photo-electrochemical cell (INSTM, JÜLICH, ICIQ, ORS, UPV, TU/e, VARESER M16-M34). Within this task, the integrated photo-electrochemical cell will be designed and constructed. The cell will be adapted to the specific conditions required for the trial of the final SUPERVAL technology (WP4). The cell performance will be assessed by determination of the influence of active area ratio on coupling and solar to fuel efficiency of lab scale prototype for CO2 conversion. Low-cost perovskite modules with variable output characteristics will be developed in Jülich to drive photoelectrochemical reactions for CO2 conversion in the lab scale prototype from WP2. The PV module for integration with the EC cell will contain 2/3 serially connected perovskite solar cells or 4/5 serially connected silicon heterojunction (SH) cells to provide a maximum power point voltage in the range of 2.0 – 4.0 V. The actual number of cells will be defined by the V(J) characteristics of the electrochemical cell (EC) developed at Messina. By variation of the number of cells in the PV module and eventually fine tuning of the active area ratios of the PV and EC components the optimal matching will be achieved at target broad range of realistic irradiance of 100–1000 W/m2 (0.1-1 sun) and temperatures (25-60°C).

Work package WP3 – Photocatalytic hydrogenation of N2 and NOx to NH3

Work Package Number	WP3	**Lead Beneficiary**	3. UPV
Work Package Name	Photocatalytic hydrogenation of N2 and NOx to NH3		
Start Month	1	**End Month**	33

Objectives
- Development of an efficient catalyst for photo-hydrogenation of NOx into NH3. - Development of an efficient catalyst for photo-hydrogenation of N2 into NH3. - Development of a photo-reactor for NOx upgrading into NH3 - Modeling of the photocatalytic processes identifying key reaction descriptors.

Description
WP3 deals with the development of catalysts and reactors for the photo-hydrogenation of N2 and NOx into NH3. This WP will be led by UPV. Task 3.1 Catalyst preparation (UPV, M1-M18). We will synthesize the catalysts for the nitrogen (N2 and NOx) photo-upgrading into NH3. Both starting materials may be activated with a single catalysts, or a combination of them. So our target is to develop a multi-task photoreactor. For this task, we envision the investigation of catalysts based on nanoparticles/clusters of non-critical transition metals such as Cu, Fe, Mn, Ni?. or their bimetallic combinations and supported on defective graphenes prepared by pyrolysis of biopolymers obtained from biomass wastes. Different catalyst loading, surface area, pore size and graphenic precursor will be investigated. In the latter case indeed, depending on the precursor, different heteroatoms can co-exists with the metallic particles and affect performance. As alternatives, we will also evaluate a) metallic or bimetallic catalytic nanoparticles or small clusters deposited on metal oxides by ex-solution method to obtain perovskites or hydroxyapatites structures containing the metal nanoparticles and b) MOF derived photo-catalyst. In the latter case, MOFs such as TAMOF1, HKUST-1 (Cu), MIL-100(Fe), MIL-68(Fe), or ZIF-8 (Cu) will be first synthesized, impregnated with metal ions and pyrolyzed (inert Ar atmosphere) or air calcinated to prepare respectively metal oxide or porous carbonaceous materials containing the catalytic particle as single atoms or clusters. Reaction promoters as alkali or earth-alkali metal species will be also introduced by wet impregnation method into the catalytic materials. The composition, structure and morphology of the prepared materials will be characterised by different techniques such as ICP-OES, XPS, Raman spectroscopy, for the ghaphenes supported catalysts, PXRD, HRFESEM and HRTEM. Task 3.2 Characterisation of catalytic performance (UPV, ICIQ, INSTM, M1-M24). The materials prepared within the task 2.1 will be characterised to asses catalytic photo-hydrogenation performance. The reactions will run into a customized fixed bed reactor irradiated with a 300 W xenon lamp (1080 W/m2). Our reactant targets are N2, NO2 and NO and the effect of the reaction parameters will be evaluated: reactant stoichiometry, flow-catalytic area ratio, temperature, pressure, the intensity and the wavelength effect of the solar spectrum. The N source of the produced NH3 will be confirmed by 15N2 isotopic experiments Task 3.3 Computational modelling (ICIQ, UPV, TU/e M1-M30): As in the case of electrocatalysis, the three main performance indicators, activity, selectivity and stability will be studied for the photocatalysts depeloped in this WP. The overall idea is to understand and control the photoreactivity of these materials by coupling ground and excited state simulations of the processes. DFT modelization of the photocatalysts, and their reactivity/affinity to *NO, *NO2, *NNO, *N2 and *N2H will allow to determine the key descriptors, to propose optimization strategies for catalysts and optimum working conditions for reactor design and realization. Task 3.4 Photo-reactors design, construction and performance validation (UPV, ICIQ, ORS, INSTM, JÜLICH, TU/e, VARESER M21-M30). The photo-reactor for NH3 production will be designed based on the specific reaction requirements assessed in the tasks 3.2-3.3. The units will be then constructed and the catalytic performance validated under the target conditions set for the final SUPERVAL technology trial.

Work package WP4 – Device integration, SUPERVAL technology performance validation and feasibility assessment

Work Package Number	WP4	**Lead Beneficiary**	6. TU/e
Work Package Name	Device integration, SUPERVAL technology performance validation and feasibility assessment		
Start Month	1	**End Month**	36

Objectives
- Design, and construction of the SUPERVAL technology. - SUPERVAL technology performance validation and demonstration at lab-scale.

- Techno-economic analysis (TEA).
- Life cycle assessment (LCA).

Description
Within WP4, SUPERVAL technology will be designed and a lab-scale pilot plant constructed. Its performance validated at lab scale. Techno-economic analysis and LCA will be performed to evaluate the viability of the SUPERVAL strategy at the technical, environmental and economic level. This WP will be lead by the TU/e, coordinating all tasks of technology manufacturing and testing. Task4.1 Device design and integration (TU/e, all partners M19-M32). The mini-plant design will be modeled, giving specifications for the final modules built and validated in previous WPs. The different units for module integration in the mini-plant will be determined, according to the optimum working conditions (piping, pumps, valves, etc.). The mini-plant will also incorporate flow meters, pressure/temperature controllers, vacuum and gas detection systems (gas chromatography, mass spectrometer) to monitor performance. The system will be powerd with solar simulators. If necessary, cylinders for momentaneous gas storage will be also considered to homogenise flows and adapt them to the requirements of the single devices. Task 4.2 SUPERVAL Performance validation (INSTM, all partners M25-M36). After construction and installation, the SUPERVAL lab-scale mini-plant will be validated. Our initial SUPERVAL target is to treat 100 Nmil/min of synthetic flue gas (10%CO2/85%N2/5%O2). SUPERVAL efficiency and durability will be determined under continuous and intermittent light irradiation. It is particularly relevant to confirm the long-term stability of the system under autonomous, intermittent operation. The data will be gather for each module and also for the whole plant, to identify the weak components to propose mitigation strategies. Task 4.3. Life cycle assessment (2LCA, all partners M1-M36). The LCA study will start at the beginning of the project, by building a life cycle model for the current production of industrial products (ammonia, formic acid), which will be used as benchmark for the SUPERVAL technology. At later stages of the project, life cycle models will be built for the different materials, components, etc. that will ultimately be integrated in the demonstration unit. All these models will then be integrated to reflect the SUPERVAL technology, as implemented in a hypothetical industrial scale. The LCA study will follow the ISO 14040/14044 standards and will be performed in the software SimaPro, addressing not only emissions of greenhouse-gases, but also other impacts in human health, ecosystems and natural resources. The study will also serve the purpose of identifying strategies for the environmental performance of this technology at early stages of development. Task 4.4 Techno-economic analysis (VARESER, all partners M1-M36). The proposed method will analyze SUPERVAL as an industrially scalable project through cost-benefit analysis (CBA) techniques, both internal linked to the internal functioning of the system, and external that influence the system, such as those related to the environment (CO2 emissions, energy sustainability, reduction of other pollutants, etc.) or health, linked to the above. A a computer-guided model based on the above variables will be defined

Work package WP5 – Dissemination, communication and exploitation

Work Package Number	WP5	**Lead Beneficiary**	1. ICIQ-CERCA
Work Package Name	Dissemination, communication and exploitation		
Start Month	1	**End Month**	36

Objectives
: - Dissemination of project results in appropriate and impactful channels. - Definition of data and publication policy management. - Design of an exploitation plan during and beyond the lifetime of the project. - Communication and outreach activities - Exploitation Committee (EC) will supervise the exploitation strategy of the project (lead by ORS and PMB).

Description
Task 5.1 Dissemination, exploitation and communication strategy (ICIQ, all partners M1-M36) and monitoring of its implementation. Our strategy will outline the multi-layer activities to maximize the impact of the project results.

Dissemination and Communication actions will be monitored so that they can be optimized during the project. The Monitoring results will feed into Best Practices of Dissemination and Communication Actions.
Task 5.2 Dissemination and engagement activities (ICIQ, all partners M4-M36). The technical results will be disseminated to the scientific community and key stakeholders via relevant national and international OA scientific journals, Open Research Europe and technical conferences, and direct exchange with key stakeholders.
Task 5.3 IP Management (ORS, all partners M4-M36) Continuous technology surveillance during the Project will be used to identify protectable IPR spaces and protect generated know-how by means of patents and/or utility models, or industrial secret; following the strategy that is considered more appropriate following exploitation plan. Legal support will be used to transfer the scientific and technological information into legal terms to ensure good legal protection. At this point, we envision at least one patent to protect the CO2 separation and purification technology, as a follow-on patent to the IP on the material, protected by Patent EP16382480.8.
Task 5.4 Exploitation Pathways (ORS, all partners M1-M36) The results from previous tasks will help us to identify the most plausible exploitation pathways, with a three-year horizon after the project ends. The target is to maximize commercial and scientific impact of the results. We will contact existing business parties, presumably of considerable size, age and market shares, to position ourselves as a serious and reliable future player in the market depending on the exploitation scenario we finally choose.
Task 5.5 Communication and outreach activities (ICIQ, all partners M1-M36). A social media strategy will be implemented to communicate project results to target groups. Supporting communication material (brochures, posters, rollups, etc.) will be prepared to strengthen offline communication. We will also create audiovisual materials to communicate the project in a comprehensive manner to wider audiences, including video news release.

Work package WP6 – Management

Work Package Number	WP6	**Lead Beneficiary**	1. ICIQ-CERCA
Work Package Name	Management		
Start Month	1	**End Month**	36

Objectives

The aim of WP6 is to ensure the proper progress and management of the project and consortium. Additionaly, the Project Management Board (PMB) and constant monitoring of the project progress will be done with the organization of the meetings of other project committees. Main objectives:
- Monitoring, coordination, and control of the overall progress of the project;
- Implementation of management structures and guidelines to ensure timely progress and adherence to the central focus of the work plans;
- Management of the administrative and logistical tasks, reporting procedures, financial and technical reporting; iv) to ensure communication flow amongst partners, the EC and stakeholders.
- Risk management including the administration of contingency plan execution, if required.
- Adequate implementation of gender equality and diversity matters.

Description

Description of the work: The Project Management Board (PMB, formed by the project coordinator and an ICIQ's senior project manager (PM)) of SUPERVAL will be responsible for the day-to-day management, financial, administrative and contractual issues and will act as an intermediary between the contractors and the European Commission. The PM will lead WP6 and chair the PMB.
Task 6.1 Coordination and Governance (ICIQ, all partners M1-M36). ICIQ will be in charge of monitoring and coordinating the implementation of SUPERVAL's objectives controlling the tasks within the WPs; collecting, reviewing and submitting deliverables; organizing meetings; implementation of consortium decisions; budget administration; intitiate, coordinate and organize WPs. In accordance with the Article 41.2 of the AGA, ICIQ will ensure the progress of the project and that the expected schedule is respected. ICIQ will organize and lead online monthly WPL meetings (about an hour) to keep all the partners involved and updated on the progress of the project.
DMP (D6.3) will be prepared to define the types of data and metadata to be stored and curated; protocols for data handling following FAIR principles, storage, quality assurance, oversight, backups, categories, etc.
Task 6.2 Project and financial management (ICIQ, all) (M1-M36). ICIQ will be in charge of the overall administration and logistics. A project management handbook will be distributed in month 2 (D6.2) amongst the partners that contains

information about the project structure, meeting plans, templates, and internal quality control forms. ICIQ will be in constant contact with all members of the Consortium and will be the communication reference with the EC. Financial protocols and milestones will be established for the Consortium, and ICIQ will manage the finances of the project, collecting cost reports (i.e. management reports, audit certificates, etc) from the participants and will be submitted to the EC.
Task 6.3 Organization of project meetings and information circulation (ICIQ, all partners) Technical management meetings will be held with regular deadlines (at least one per year), to monitor the progress of the project, emerging critical issues, proposing corrective actions as well as discussion of technical results and deliverable preparation. Conference calls will be organized to discuss specific topics, partial results or critical issues that need a quick resolution. During the project, information and data must be shared among the partners. For this purpose, ICIQ will organize a data and document repository (cloud storage), accessible via internet, where partners can upload and download documents in an accessible, traceable, and secure way. The system will inform the partners of any performed operations in real time.
Task 6.4 Reporting (ICIQ, all partners) Reports will be prepared to describe the activities in progress and the results achieved during the duration of the project. The coordinator will collect all the contributions for the final version to write the reports. Progress reports will include technical progress circumstances likely to affect progress and outline planned activities for the next reporting period. In this way, any problems can be identified and dealt with when they arise.

Work package WP7 – Portfolio activities

Work Package Number	WP7	**Lead Beneficiary**	1. ICIQ-CERCA
Work Package Name	Portfolio activities		
Start Month	1	**End Month**	36

Objectives

Compare key results of the project with the ones of the other projects funded under the Challenge “Carbon dioxide and nitrogen management and valorisation” in call for proposals HORIZON-EIC-2022-PATHFINDERCHALLENGES-01-01 to build a shared roadmap of technologies competitiveness and key challenges to accelerate the development of their innovation potential.
2. Enhancing the commercialization/exploitation potential of the individual project, because of its participation in the portfolio: Ensuring that portfolio members, can access their value and supply chain actors.
3. Mapping the different stakeholders and develop synergies and collaborations with all of them including beneficiaries of the other funded projects in the portfolio of the challenge. The objectives of the WP are steered by the EISMEA Programme Managers in charge of the portfolio.
4. Contributing to potential improvements and further development of the CO2 and N management regulatory framework to accelerate the scale up of the technologies avoiding regulatory barriers.
5. Ensuring that the outcome of the collective work of the portfolio will effectively reach early stage private and corporate investors respectively.

Description

Task 7.1: Portfolio management and project governance
This task will require regular meetings and exchanges between projects from the portfolio, EISMEA Project Officers and Programme Managers to explore and eventually establish collaborations on specific technical aspects and exchange of information to overcome shared hurdles. Such meetings, called and steered by the PM, will have a minimum biannual frequency, and will include:
at M1: project kick-off meeting, to be held in hybrid mode, and a dedicated meeting between each project and the PM,
at M2: portfolio meeting to be held in physical presence in Brussels.
At M1 each project will have to set up an operational internal governance made of three managers to ensure targeted workflows within the portfolio and a clear hierarchy within the project consortia. These managers and their specific roles are:
1) Innovation manager, who have the following roles and tasks:
i. Discusses and collects the exploitation strategies of the different partners and coordinates the writing of a “flexible” project exploitation plan (this includes also the IPR strategy).
ii. Identifies the market and state of the art studies needed to be done and coordinate the writing of the market studies.
iii. Manages the stakeholder, value and supply chain analysis.

iv. Oversees the coordination of the task 7.2 (including the writing of the task's reports and deliverables), identifies the business opportunities, and coordinates the discussion of these with the partners (this includes also fundraising strategy).
2) Portfolio manager, who have the following roles and tasks:
Oversees the coordination of the task 7.1 (including the writing of the task's reports and Ref. Ares(2023)2273829 - 29/03/2023
deliverables):
o identification and establishment of synergies, shared components and collaboration opportunities with one or more portfolio projects;
o assessment of the competitiveness of the proposed technologies for different applications;
o participation in data collection for monitoring the technology development.
3) Communication managers, who have the following roles and tasks:
Coordinates the portfolio members preparation of a joint (portfolio) communication strategy, including common repertory and database for events on an online platform such as Microsoft Teams, communication activities and shared database of scientific instruments;
Implements the portfolio communication and dissemination activities, described in detail in the joint communication strategy.
Task 7.2 Cross-catalyse innovation within the portfolio and address shared challenges
To establish collaborations with other projects of the portfolio on technological developments and know-how generated by the beneficiaries at M4 it will be prepared the portfolio action plan that will define the specific activities to be implemented by the portfolio in its entirety. It should be noted that the portfolio action plan can be updated along the way, as needed.
Task 7.3 Stimulate innovation opportunities/actions
Create opportunities to nurture innovations arising from the project via collaboration (e.g. licensee agreement) or fundraising with private stakeholders (e.g. corporates or financial investors), EIC Business Acceleration Services, coaching and mentoring, European IP Helpdesk services or access to additional funding opportunities, like the EIC Booster grant or the Fast Track scheme under the EIC Accelerator. To stimulate innovation opportunities, the project will be involved in actions aimed at strengthening the EU research community on CO2 and N-compounds management and valorisation. This task will include:
mapping, categorization of all the stakeholders and include potentially the establishment of key partnership(s),
exchange of the market research analysis results in between the portfolio projects.
early on and continuous engagement with strategic partners and stakeholders (e.g. investors and corporations) with the aim to catalyse potential R&D opportunities and to commonly tackle investment barriers.
Task 7.4 Implementation of portfolio dissemination and exploitation activities
Design and participate in outreach events (e.g. stakeholder matchmaking, industry trade fairs) at the portfolio level to facilitate connection with stakeholders and to showcase the technologies under development. Meetings could be restricted to portfolio beneficiaries (e.g. to discuss the progress of the portfolio as a whole) or could involve external participants (e.g. to facilitate successful completion of shared objectives by interaction with regulatory entities).
Task 7.5 Assessment of the competitiveness of the proposed technologies for different applications
Compare key results and assess the competitiveness of the technology proposed with competing alternatives addressed by other projects in the portfolio. Collaborate with the other projects in the portfolio to contribute to a common document on the key technical and non-technical factors that influence the adoption of the proposed technology in each final user segment.

STAFF EFFORT

Staff effort per participant

Grant Preparation (Work packages - Effort screen) — Enter the info.

Participant	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total Person-Months
1 - ICIQ-CERCA	18.00	24.00	12.00	12.00	14.00	12.00	3.00	95.00
2 - ORS	20.00	1.00	3.00	22.00	10.00	2.00	3.00	61.00
3 - UPV	3.00	15.00	36.00	12.00	6.00	1.00	1.00	74.00
4 - INSTM	2.00	24.00	4.00	14.00	9.00		1.00	54.00
4.1 - UniME	1.00	8.00	2.00	4.00	3.00	1.00	1.00	20.00
5 - FZJ		32.00	6.00	18.00	3.00	1.00	1.00	61.00
6 - TU/e	12.00		2.00	24.00	3.00	1.00	1.00	43.00
7 - VARESER	1.00	1.00	3.00	14.00	4.00	1.00	1.00	25.00
8 - 2.-O LCA				15.00		1.00	1.00	17.00
Total Person-Months	57.00	105.00	68.00	135.00	52.00	20.00	13.00	450.00

LIST OF DELIVERABLES

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

Public — fully open (⚠ automatically posted online)
Sensitive — limited under the conditions of the Grant Agreement
EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	TAMOF-1 Pelletisation	WP1	2 - ORS	R — Document, report	SEN - Sensitive	9
D1.2	Adsorption properties	WP1	6 - TU/e	R — Document, report	SEN - Sensitive	18
D1.3	Module for CO2/N2 separation	WP1	2 - ORS	R — Document, report	SEN - Sensitive	21
D1.4	Module for CO2/H2 separation	WP1	2 - ORS	R — Document, report	SEN - Sensitive	27
D2.1	PEC cathode	WP2	4 - INSTM	R — Document, report	SEN - Sensitive	15
D2.2	PEC anode	WP2	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	15
D2.3	Electrochemical Cell	WP2	4 - INSTM	R — Document, report	SEN - Sensitive	18
D2.4	Solar Panel	WP2	5 - FZJ	R — Document, report	SEN - Sensitive	24
D2.5	PEC	WP2	4 - INSTM	R — Document, report	SEN - Sensitive	27
D2.6	Computational modelling WP2	WP2	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	33
D3.1	Catalyst for N2/NOx photo-hydrogenation	WP3	3 - UPV	R — Document, report	SEN - Sensitive	24
D3.2	NH3 production photoreactors	WP3	3 - UPV	R — Document, report	SEN - Sensitive	27
D3.3	Computational modelling WP3	WP3	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	33
D4.1	SUPERVAL design	WP4	6 - TU/e	R — Document, report	SEN - Sensitive	27
D4.2	SUPERVAL prototype	WP4	2 - ORS	R — Document, report	SEN - Sensitive	32

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Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D4.3	SUPERVAL feasibility	WP4	7 - VARESER	R — Document, report	SEN - Sensitive	36
D4.4	SUPERVAL viability	WP4	8 - 2.-O LCA	R — Document, report	SEN - Sensitive	36
D4.5	SUPERVAL scale-up strategy	WP4	6 - TU/e	R — Document, report	SEN - Sensitive	36
D5.1	Plan for Dissemination and Exploitation Including Communication Activities	WP5	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	6
D5.2	Final version of Plan for Dissemination and Exploitation Including Communication Activities	WP5	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	36
D6.1	Website and project logo	WP6	1 - ICIQ-CERCA	R — Document, report	PU - Public	2
D6.2	Project management handbook	WP6	1 - ICIQ-CERCA	R — Document, report	PU - Public	2
D6.3	Governance structures	WP6	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	3
D6.4	Data management plan	WP6	1 - ICIQ-CERCA	DMP — Data Management Plan	PU - Public	6
D6.5	RP1 Technical/scientific review meeting documents	WP6	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	13
D6.6	RP2 update of the Data Management Plan	WP6	1 - ICIQ-CERCA	DMP — Data Management Plan	PU - Public	36
D6.7	RP2 Technical/scientific review meeting documents	WP6	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	36

Deliverables

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Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D7.1	Report on portfolio activities and Action Plan 1	WP7	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	12
D7.2	Report on portfolio activities and Action Plan 2	WP7	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	24
D7.3	Report on portfolio activities and Action Plan 3	WP7	1 - ICIQ-CERCA	R — Document, report	SEN - Sensitive	36
D7.4	Technologies potentials assessment 1	WP7	2 - ORS	R — Document, report	SEN - Sensitive	24
D7.5	Technologies potentials assessment 2	WP7	2 - ORS	R — Document, report	SEN - Sensitive	36

Deliverable D1.1 – TAMOF-1 Pelletisation

Deliverable Number	D1.1	**Lead Beneficiary**	2. ORS
Deliverable Name	TAMOF-1 Pelletisation		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	9	**Work Package No**	WP1

Description
Report on pelletization and scaling

Deliverable D1.2 – Adsorption properties

Deliverable Number	D1.2	**Lead Beneficiary**	6. TU/e
Deliverable Name	Adsorption properties		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	18	**Work Package No**	WP1

Description
Report on computational and experimental results

Deliverable D1.3 – Module for CO2/N2 separation

Deliverable Number	D1.3	**Lead Beneficiary**	2. ORS
Deliverable Name	Module for CO2/N2 separation		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	21	**Work Package No**	WP1

Description
Description of the concept design and specifications for the module

Deliverable D1.4 – Module for CO2/H2 separation

Deliverable Number	D1.4	**Lead Beneficiary**	2. ORS
Deliverable Name	Module for CO2/H2 separation		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	27	**Work Package No**	WP1

Description
Description of the concept design and specifications for the module

Associated with document Ref. Ares(2023)4125863 - 14/06/2023

Deliverable D2.1 – PEC cathode

Deliverable Number	D2.1	Lead Beneficiary	4. INSTM
Deliverable Name	PEC cathode		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	15	Work Package No	WP2

Description
Definition of cathode components and geometries

Deliverable D2.2 – PEC anode

Deliverable Number	D2.2	Lead Beneficiary	1. ICIQ-CERCA
Deliverable Name	PEC anode		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	15	Work Package No	WP2

Description
Definition of anode components and geometries

Deliverable D2.3 – Electrochemical Cell

Deliverable Number	D2.3	Lead Beneficiary	4. INSTM
Deliverable Name	Electrochemical Cell		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	18	Work Package No	WP2

Description
Description of concept design for the electrolyzer module

Deliverable D2.4 – Solar Panel

Deliverable Number	D2.4	Lead Beneficiary	5. FZJ
Deliverable Name	Solar Panel		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP2

Description
Report on the specifications for the optimum photovoltaic panel

Deliverable D2.5 – PEC

Deliverable Number	D2.5	Lead Beneficiary	4. INSTM
Deliverable Name	PEC		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	27	Work Package No	WP2

Description
Report on PEC components and performance

Deliverable D2.6 – Computational modelling WP2

Deliverable Number	D2.6	Lead Beneficiary	1. ICIQ-CERCA
Deliverable Name	Computational modelling WP2		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	33	Work Package No	WP2

Description
Report on key descriptors for reduction and oxidation catalysts

Deliverable D3.1 – Catalyst for N2/NOx photo-hydrogenation

Deliverable Number	D3.1	Lead Beneficiary	3. UPV
Deliverable Name	Catalyst for N2/NOx photo-hydrogenation		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP3

Description
Report on catalyst performance

Deliverable D3.2 – NH3 production photoreactors

Deliverable Number	D3.2	Lead Beneficiary	3. UPV
Deliverable Name	NH3 production photoreactors		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	27	Work Package No	WP3

Description
Description of concept design for the photocatalytic module

Associated with document Ref. Ares(2023)4125863 - 14/06/2023

Deliverable D3.3 – Computational modelling WP3

Deliverable Number	D3.3	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Computational modelling WP3		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	33	**Work Package No**	WP3

Description
Report in key descriptors for N2/NOx hydrogenation catalysts

Deliverable D4.1 – SUPERVAL design

Deliverable Number	D4.1	**Lead Beneficiary**	6. TU/e
Deliverable Name	SUPERVAL design		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	27	**Work Package No**	WP4

Description
Description of the concept design for the lab-scale mini-plant

Deliverable D4.2 – SUPERVAL prototype

Deliverable Number	D4.2	**Lead Beneficiary**	2. ORS
Deliverable Name	SUPERVAL prototype		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	32	**Work Package No**	WP4

Description
Delivery and Instalation of prototype

Deliverable D4.3 – SUPERVAL feasibility

Deliverable Number	D4.3	**Lead Beneficiary**	7. VARESER
Deliverable Name	SUPERVAL feasibility		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	36	**Work Package No**	WP4

Description
Techno-economic assessment

Deliverable D4.4 – SUPERVAL viability

Deliverable Number	D4.4	Lead Beneficiary	8. 2.-O LCA
Deliverable Name	SUPERVAL viability		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	36	Work Package No	WP4

Description
LCA report

Deliverable D4.5 – SUPERVAL scale-up strategy

Deliverable Number	D4.5	Lead Beneficiary	6. TU/e
Deliverable Name	SUPERVAL scale-up strategy		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	36	Work Package No	WP4

Description
Report on scale-up opportunities and future strategy

Deliverable D5.1 – Plan for Dissemination and Exploitation Including Communication Activities

Deliverable Number	D5.1	Lead Beneficiary	1. ICIQ-CERCA
Deliverable Name	Plan for Dissemination and Exploitation Including Communication Activities		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	6	Work Package No	WP5

Description
Definition of the Dissemination and Exploitation Plan

Deliverable D5.2 – Final version of Plan for Dissemination and Exploitation Including Communication Activities

Deliverable Number	D5.2	Lead Beneficiary	1. ICIQ-CERCA
Deliverable Name	Final version of Plan for Dissemination and Exploitation Including Communication Activities		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	36	Work Package No	WP5

Description
Definition of the final Dissemination and Exploitation Plan

Deliverable D6.1 – Website and project logo

Deliverable Number	D6.1	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Website and project logo		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	2	**Work Package No**	WP6

Description
Website and project logo information with also social media links

Deliverable D6.2 – Project management handbook

Deliverable Number	D6.2	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Project management handbook		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	2	**Work Package No**	WP6

Description
Tools for management/ information flow, project structure, etc

Deliverable D6.3 – Governance structures

Deliverable Number	D6.3	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Governance structures		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	3	**Work Package No**	WP6

Description
Governance structures Consortia bodies structure and risk assessment procedures

Deliverable D6.4 – Data management plan

Deliverable Number	D6.4	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Data management plan		
Type	DMP — Data Management Plan	**Dissemination Level**	PU - Public
Due Date (month)	6	**Work Package No**	WP6

Description
Definition of the Data Management Plan

Deliverable D6.5 – RP1 Technical/scientific review meeting documents

Deliverable Number	D6.5	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	RP1 Technical/scientific review meeting documents		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	13	**Work Package No**	WP6

Description
The draft agenda, list of participants and presentations to be delivered during the review meeting

Deliverable D6.6 – RP2 update of the Data Management Plan

Deliverable Number	D6.6	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	RP2 update of the Data Management Plan		
Type	DMP — Data Management Plan	**Dissemination Level**	PU - Public
Due Date (month)	36	**Work Package No**	WP6

Description
Definition of the revised Data Management Plan

Deliverable D6.7 – RP2 Technical/scientific review meeting documents

Deliverable Number	D6.7	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	RP2 Technical/scientific review meeting documents		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	36	**Work Package No**	WP6

Description
The draft agenda, list of participants and presentations to be delivered during the review meeting

Deliverable D7.1 – Report on portfolio activities and Action Plan 1

Deliverable Number	D7.1	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Report on portfolio activities and Action Plan 1		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	12	**Work Package No**	WP7

Description
Report of portfolio collaboration activities targeting the transition to the market, and roadmap of future actions and synergies

Deliverable D7.2 – Report on portfolio activities and Action Plan 2

Deliverable Number	D7.2	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Report on portfolio activities and Action Plan 2		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	24	**Work Package No**	WP7

Description
Updated report of collaboration activities targeting the transition to the market, and roadmap of future actions and synergies

Deliverable D7.3 – Report on portfolio activities and Action Plan 3

Deliverable Number	D7.3	**Lead Beneficiary**	1. ICIQ-CERCA
Deliverable Name	Report on portfolio activities and Action Plan 3		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	36	**Work Package No**	WP7

Description
Final Report of collaboration activities targeting the transition to the market, and roadmap of future actions and synergies

Deliverable D7.4 – Technologies potentials assessment 1

Deliverable Number	D7.4	**Lead Beneficiary**	2. ORS
Deliverable Name	Technologies potentials assessment 1		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	24	**Work Package No**	WP7

Description
A joint portfolio report on the key factors affecting the penetration of the proposed technologies in each market segment and the relative competitiveness of each solution in different end user applications

Deliverable D7.5 – Technologies potentials assessment 2

Deliverable Number	D7.5	**Lead Beneficiary**	2. ORS
Deliverable Name	Technologies potentials assessment 2		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	36	**Work Package No**	WP7

Description
Final joint portfolio report on the key factors affecting the penetration of the proposed technologies in each market segment and the relative competitiveness of each solution in different end user applications

LIST OF MILESTONES

Milestones

Grant Preparation (Milestones screen) — Enter the info.

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
1	First TAMOF-1 pellets successfully obtained	WP1	2-ORS	Characterization: size, uniformity and breakthrough performance (D1.1)	9
2	Definition/validation of force-fields to predict TAMOF-1 performance	WP1	2-ORS	Reproduce experimental data (adsorption isotherms, breakthrough curves and capture performance) (D1.2)	18
3	Identification of optimum catalysts for all modules in SUPERVAL technology	WP3, WP2	1-ICIQ-CERCA	Computational and experimental assessment (D2.1, D2.2, D3.1)	24
4	Definition of the photovoltaic panel to support SUPERVAL lab-scale plant	WP2	5-FZJ	Computational plant design (D2.3, D2.4, D2.5)	25
5	Identification of components for LCA and technoeconomic assessment	WP4	8-2.-O LCA	Computational and experimental assessment (D4.1)	27
6	SUPERVAL lab-scale prototype	WP4	4-INSTM	Up and running (D4.2)	32

Associated with document Ref. Ares(2023)4125863 - 14/06/2023

LIST OF CRITICAL RISKS

Critical risks & risk management strategy

Grant Preparation (Critical Risks screen) — Enter the info.

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
1	Failure obtaining TAMOF-1 pellets by extrussion	WP1	We will consider alternative procedures such as granulation or direct synthesis of monoliths. We will also study the flow rate limitations when using TAMOF-1 as prepared.
2	Poor performance of adsorption CC unit	WP1	Identification of the critical aspects leading to failure in obtaining the adsorption CO2/N2 separation unit. Working with different inlet flows. Use of alternative adsorbents, as zeolite 13-X
3	Failure in limiting CO cathodic production	WP2	CO limiting concentration for module/device failure will be evaluated. Conversion of CO into CO2 with gas shift reaction
4	Failure developing a non-CRM anode at pH < 8	WP2	Use the “A-LEAF” strategy, maintaining anode and cathode at different pH
5	The cathode does not reach the target performance	WP2	Identification of the critical aspects. Modification of working conditions (CO2 purity, flow rate, electrodes surface area)
6	Failure in obtaining perovskite photovoltaic panel with the target performance	WP2	If perovskite limitations can not be addressed, we envision the use of a photovoltaic panel based on silicon heterojunction technology with known and stable performance
7	Failure in developing a non-CRM catalyst for N2/ NOx photohydrogenation	WP3	Implementation of an alternative catalyst as the Cs-decorated strontium titanate-supported Ru nanoparticles, reported by our partner UPV, to facilitate the progress of the project
8	Lack of a single catalyst to activate N2 and NOx	WP3	Incorporation of two catalysts, or development of two independent photo-reactors
9	Photo-reactors do not achieve expected targets	WP3	Increasing working temperature. This may be powered by PVcells, keeping the autonomous character of SUPERVAL
10	Mismatched integration of single modules	WP4	Design of additional gas storage steps, and flows to module the working features of each individual unit
11	Partners and stakeholders not delivering data to run the LCA on time	WP4	Implementation of an intranet tool to facilitate engagement among partners. Additional technical meetings with 2LCA. Use of data from literature

Critical risks & risk management strategy

Grant Preparation (Critical Risks screen) — Enter the info.

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
12	Partner goes bankrupt or withdraws	WP6	No partners face critical financial problems. Early monitoring situation, negotiate with EC a replacement
13	Key milestones or critical deliverables delayed, for example pilot plant units	WP7, WP6, WP3, WP5, WP1, WP2, WP4	As soon as any delay is deemed likely, mitigation actions will start: a) allocation of extra-resources to go back to schedule; b) modification of subsequent tasks to diminish delay impact; c) changes to the overall project schedule to accommodate
14	Budget deviations in construction and operation of module units and plant	WP7, WP6, WP3, WP5, WP1, WP2, WP4	Costs will be monitored to detect any deviations. Contingency actions: a) seek alternative engineering solutions; b) transfer budgets between activities; c) increase partner contribution
15	Partner fails to deliver work according to proposal	WP7, WP6, WP3, WP5, WP1, WP2, WP4	Continuous project monitoring, increase involvement of WP Leaders; shift part of the work to other beneficiaries

PROJECT REVIEWS

Project Reviews

Grant Preparation (Reviews screen) — Enter the info.

Review No	**Timing** (month)	**Location**	**Comments**
RV1	14	Online	TBC
RV2	37	Online	TBC

HISTORY OF CHANGES		
VERSION	PUBLICATION DATE	CHANGE
1.0	20/10/2022	Initial version (submitted in Funding and Tenders Portal)
2.0	28/03/2023	Modifications of the submitted version to create the DoA Part B following the instructions
2.1	29/03/2023	Addition of UNIME as Affiliated entity to INSTM. Adjustment of the budget for INSTM and UNIME. Due to the addition of UNIME the total personnel costs are higher than the original budget due to the higher costs of PMs at the UdR ME (Unit of Research Messina). To cover this increase on personnel budget there has been a reallocation of 44.000 € from "purchase costs" that are expected to be covered using internal resources at UdR ME.
2.2	31/03/2023	Addition of a new deliverable in WP4 ("SUPERVAL prototype" that was missing)
2.3	17/04/2023	- Update part 3.1 with the addition of the description of UNIME - Update table 3.2h with breakdown of costs - Update ORS budget (the equipment considered in the budget is already amortized, the budget has been transferred to other goods, works and services because the budged for the IP and audit certificate was underestimated). - Gantt Chart has been updated including all deliverables and milestones. - Update the milestones due date and numbering to match the deliverables dates (MS2, MS3, MS4 and MS5) - Update the information for the in kind contribution in a table format with the amount and justification

Table of Contents

1 Excellence

1.1 Objectives and relevance to the Challenge

SUPERVAL overarching objective is to **realize** a novel **lab-scale validated modular technology,** built with non critical raw materials (CRM), able **to capture and valorise the components of flue gas** streams **using sunlight** as primary energy source, **and water** as source of hydrogen (protons and electrons).

The intense human activity of the last 50 years and the extensive use of fossil fuels is provoking sever environmental, health, economic and social issues. Addressing these challenges requires overcoming the concept of "capture and storage" with that of "**capture, valorisation, storage, reuse**". Moreover, the valorisation process must lean on renewable energy sources to boost the phase-out from fossil fuels. EU is strongly implementing and promoting actions to reach the ambitious goals of "circularity" and climate neutrality in the 2050 (EU Grean Deal[1] and Fit for 55 package[2]) by cutting down environmental emissions through sustainable valorisation approaches. Flue gases, produced in industries and power plants are one of the main responsible of both CO_2 and NO_x emissions into the atmosphere. Carbon dioxide is considered the main green-house gas (GHG).[3] NO_x are hazardous and highly reactive compounds causing major health (cardiovascular and respiratory problems, asthma) and environmental (acid rain, photochemical smog, depletion of stratospheric ozone, promoting formation of secondary aerosol) issues.[4] Moreover, flue gases are mostly composed of nitrogen (around 65-90%) which is just released into the atmosphere and wasted. The complete removal of pollutants from flue gas streams and the sustainable valorisation of all the components of the mixture by using renewable energy would have tremendous environmental and economic impacts, taking also into account the economic profits due to the reduction of the price of the emission rights as well as the benefits related to the synthesis of added value products. **We aim to address all the specific objectives and scope proposed by this challenge**:

SUPERVAL **multidisciplinary and cross-sectorial approach** envisions: **a) to capture CO_2 from flue gases streams and store and convert it into added value formate**, the easier and safer storage form of formic acid (FA). In particular, **SUPERVAL adopts** as strategy a **photovoltaic powered CO_2-water-co-electrolysis**, where CO_2 and protons are electrocatalytically reduced to FA and hydrogen, while water is electrocatalytically co-oxidized at the anode providing protons and electrons to the cathode and, ultimately, to the full SUPERVALorisation process; **b) to develop a "N"** (NO_x and N_2) **integrated sustainable management cycle** by i) cutting down NO_x flue gas emissions into the atmosphere, ii) photo-converting both, "non-reactive" (N_2) and reactive (NO_x) nitrogen components of flue gas streams into added value ammonia and ii) integrating both processes in a circular technology that uses the green hydrogen obtained in the CO_2 valorisation cell for the nitrogen photo-fixation; **c) to implement a sustainable valorisation cycle powered by sun** and targeting the minimization of all energy inputs other than the solar power (e.g. molecule separation); **d) to follow a strict critical-raw-material** (CRM)[5] **free approach; e) to develop and validate a modular and integrated flue gas valorisation technology at lab scale; f)** to quantify by life cycle assessment (**LCA)** direct and indirect environmental benefits of SUPERVAL technology, including, but not limited to the decarbonization impact, and also extended to the effects in human health through NO_x exposure. The LCA study will also be used to identify strategies for this technology to improve its environmental performance, thus steering it to the right direction from the early stages of development. Moreover, feasibility of the technology will be assessed by techno-economic analysis; **g) to define a deployment strategy for the technology and identify the steps for its scale up.** We will assess and contact potential key stakeholders. Moreover, we will give high relevance to process scalability regarding material type (no-CRM) and preparation procedures (price, scalability, suitable material shapes) but also the design of photo-reactors, PEC cells and gas separation units specifically adapted to the process requirements.

SUPERVAL project aims to reach several **specific objectives**:

1) To discover a non-CRM catalyst for photo-fixation of NO_x (NO_2 and/or NO) **into NH_3**: production rate > 500 μmol(NH_3) $g_{catalyst}^{-1}$ h^{-1} (1 sun light intensity) and working for more than 100 h at T < 400 °C and 1 bar.

2) To discover a novel non-CRM catalytic photo-fixation of N_2 into NH_3 with production rate > 3000 μmol(NH_3) $g_{catalyst}^{-1}$ h^{-1} (1 Sun light intensity) and working for more than 100 h at T < 400 °C and 1 bar.

3) To develop a cost-affordable carbon capture (CC) technology based on TAMOF-1 adsorbent: a) Synthesis of TAMOF-1 pellets of round shape (1-3 mm diameter), with crash strength > 20N and retaining CO_2 adsorption capacity and CO_2/N_2 and CO_2/H_2 selectivity of the material in powder form (< 10% of reduction). 3.b) Implementation of a flue gas CC technology working at T < 40 °C, adsorption pressure < 3 bar abs, CO_2 recovery yield > 80%, CO_2 purity: required for valorisation, N_2 purity: CO_2 < 0.5%. c) Realisation of a CC technology for CO_2/H_2 separation with same targets specified in previous point. d) Model and prediction of TAMOF-1 gas separation: CO_2, N_2, H_2, O_2, NO_x.

4) To realise a photo-powered CRM free electrocatalytic cell for CO_2 reduction (FA) and H_2 production: a) Development of a non-CRM cathode: with >99% carbon faradaic efficiency (FE) to FA, CO < 0.1% in the cathode outlet flow, FA/H_2 molar ratio < 0.5, performance loss < 1 μV after 1000 h operation. b) Development of a non-CRM water oxidation anode: working at 7< pH< 8, minimum current density (I): > 25 mA/cm^2, performance loss: < 1 μV after 1000 h operation. c) Computational understanding of the catalytic processes: modeling of electrocatalysis and identification of key performance indicators. d) Implementation of a non-CRM and up-scalable perovskite solar

module: long-term stability, ITO contact free. e) Realisation of a photo-powered electrochemical cell: solar-to-chemicals efficiency > 12% (FA > 8 % and H_2 > 4 %), with electrochemical current density >17 mA cm^{-2}.

5) To develop the SUPERVAL integrated technology for flue gas CO_2 and "N" (N_2 and NOx) valorisation: flue gas CO_2 capture > 80%, NO_x emission abatment > 80%, CO_2 conversion efficiency (CE) (converted CO_2 / captured CO_2) > 10% , N_2 CE > 5%, NO_x CE > 80%, solar-to-chemical conversion efficiency > 12%.

SUPERVAL specifically meets all the different categories from the portfolio addressed by this challenge: Molecule removal: removal and purification of both CO_2 and "N sources" (NO_x and N_2). Type of stream from which CO_2 and N are recovered: post-combustion flue gas streams. Scale levels of the applications: centralized solution for power plants. Valorisation of CO_2 and N processes: valorisation of CO_2 and N by chemical, electrochemical processes (photo-electrochemical, photo-catalytic). Final use: conversion of CO_2 and N into chemicals and fuels for industrial and agricultural applications (NH_3 and FA). Secondary added benefits: emissions reductions. Systems integration: coupling the processes to renewable energy, green hydrogen pathway, retrofit of power plants for sector coupling options (to produce fertilizers, bulk chemicals, or other commodities). Methodologies for materials and components selection/optimization: adoption of computational chemistry and digitalization to lead optimum selection and development of components/devices/system level.

1.2 Novelty

SUPERVAL unique and breakthrough vision encompasses: a) the valorisation of C- and N- containing flue gas components b) the abatement of significant flue gas pollutants c) the development of a sustainable, integrated process powered by the sun and c) avoiding the use of critical-raw-materials. SUPERVAL vision, is one of a kind and proposes, for the first time, a technology aimed to purify and valorise the main flue gas components ("C" and "N"). On the contrary, state-of-the-art solutions have been nowadays addressed on flue gas CO_2 capture and conversion.[6,7] Flue gas are complex mixtures, with composition strongly dependent on the source and consisting of several other impurities (particles, SO_2, metals compounds, H_2O, O_2). However, to address all the challenges related to the treatment of all impurities goes beyond SUPERVAL goals and synthetic gas mixtures just with the target molecules will be investigated. State-of-the-art technologies for the separation of all the impurities will be instead considered in the SUPERVAL techno-economic analysis. **SUPERVAL uniqueness lies not only in the objectives but also in the versatile and multidisciplinary top-down strategy adopted.**

Carbon capture technologies: TAMOF-1 the new outstanding and versatile CO_2 adsorbent

Pure gases are generally required for the valorisation reactions ensuring high concentration of reactants (faster kinetics), reaction selectivity and avoiding catalyst deactivation by impurities. Within SUPERVAL, we envision two carbon capture installations for the separation and purification of i) CO_2 and N_2 components of the flue gas streams; and b) H_2 and CO_2 coming out from the cathode chamber of the CO_2 valorisation PEC. Thanks to the versatility and robustness of our TAMOF-1, both challenges can be tackled with this CO_2 adsorbent material.

Post-combustion CO_2 capture: post-combustion CO_2 capture (CC) is a difficult challenge on which huge efforts and resources are currently being addressed. Post-combustion exhaust gas streams are, in general, low-pressure (atmospheric) mixtures mostly composed of N_2 (≈65-90%) and CO_2 (5-30%) with small amounts of oxygen (≈5%) and other minor impurities (water, NO_x, SO_2). Existing technologies for CO_2 capture face two main issues that have still to be solved to finally deploy technoeconomically viable CC strategies: a) the low CO_2 partial pressure limits the performance and b) the high operating costs due to low selectivity of the adsorbents, and high energy-consuming regeneration. It is significantly more expensive to capture CO_2 with current commercial solutions than to acquire emission rights. Amine scrubbing is the state-of-the-art technology however, it suffers from important limitations such as a) high energy consumption for solvent regeneration, b) waste generation (solid salts and gaseous compounds due to chemical degradation of amines), and c) the large footprint (unviable for small production or transportation).[8]

Carbon capture for hydrogen/CO_2 separation and purification. Hydrogen/CO_2 separation is another prominent challenge especially addressed to H_2 purification into pre-combustion gases. In this case, state-of-the-art technology is the adsorption into zeolites. SUPERVAL aims to develop a novel, low-energy and custom-made process specifically designed and optimized to the operating parameters of the cathodic gas exiting from the photo-eletrochemical cell (PEC) (H_2/CO_2 concentrations, flow, T, P, water content).

Our solution: adsorption technology. Physisorption is a highly promising and well-known methodology for gas separation even also at industrial scale (e.g. H_2 production). This process involves at least two consecutive steps. In the first one, CO_2 is selectively adsorbed by the active component at high pressure and/or low temperature while other molecules such as N_2 or H_2 can fastly diffuse into the adsorption bed and exit as purified gases. In the following step, the CO_2 saturated adsorbent is regenerated by desorption at low pressure/vacuum or/and at high temperature and thus pure CO_2 can be recovered. To work in continuous, this technology requires thus multiple (two or more) beds working in tandem with adsorption and desorption steps occurring simultaneously. Due to the physical nature of the interactions involved, physisorption is theoretically considered advantageous as demands lower energy consumption during the second (regeneration) step when compared to processes ruled by strong chemical interactions such absorption into amine, or chemisorption in solid adsorbents. However, the capacity of this technology is limited. To reach competitive performance with that of amine scrubbing, high pressures (> 4 bar) with complex and expensive pressurization

components are needed.[9] Currently, the benchmark adsorbent is the zeolite 13X.[10] This commercially available zeolite has acceptable CO_2 adsorption capacity and selectivity. However, its regeneration requires high energy consumption, very similar to that needed for amine scrubbing.[11] Indeed, an efficient cyclic, continuous 13X-based process with good cost-effective capacity for reliable CO_2 flue gas removal requires high adsorption pressures (high ΔP) and/or high desorption temperatures. Even in these conditions, recovering high purity gases (>98%) remains a challenge, since N_2 or H_2 adsorption capacity increases whereas CO_2 selectivity decreases at higher pressure.[12] The lack of suitable materials with improved performance in selective CO_2 uptake at low adsorption pressure and low-energy CO_2 release is nowadays still limiting the use of adsorption technologies just to niche applications.

Our breakthrough novelty: TAMOF-1 adsorbent. Metal-organic-frameworks (MOFs) have been proposed as cutting-edge alternative adsorbents for CO_2 capture.[13] The most successful examples are based on selective chemisorption: excellent CO_2 capture performance, but with highly endothermic regeneration processes, and uncertain chemical stability.[14] MOF materials offering physisorption processes and combining high CO_2 uptake and low energy consumption upon CO_2 release are just emerging.[14] In this line, the research teams of Prof. José Ramón Galán-Mascarós (ICIQ) and Orchestra, have developed TAMOF-1 ($[Cu(L_1)_2].xH_2O$),[15,16] the first in a series of novel homochiral MOFs based on natural animo acid derivatives. (*Fig. 1*). TAMOF-1 is a non-CRM and can be synthesized just by reaction of a copper(II) acetate in water with L-histedine derivative (imidazole-5-ylmethyl)-(1,2,4–triazol-4-yl)acetate (L_1). TAMOF-1 has high chemical and hydro-thermal stability retaining its crystal structure after solvation/desolvation cycling in the 100K-403K temperature range. Hydrothermal stability is an essential requirement for adsorbents considering that water is present on most of the interest gas mixtures. TAMOF-1 is highly porous with BET specific surface area of 980±50 $m^2\ g^{-1}$ and has high open volume with a network of interpenetrated 1 nm-wide channels suitable to discriminate CO_2 from other molecules (N_2, H_2). Single gas adsorption isotherms prove that CO_2 can be selectively separated from both N_2 and H_2 (*Fig. 1*). These results have been further confirmed in dynamic conditions by fixed bed adsorption measures. Outstanding separation performance was obtained at very low adsorption pressures (1.1 bar abs) with high CO_2 adsorption capacities (up to 2 mmol/g in dynamic breakthrough (BT) conditions) and very high estimated selectivity (> 20). At this stage, it was not possible to precisely quantify selectivity as both N_2 and H_2 elutes so fast from the column that the BT times were negligible. TAMOF-1 performance is highly versatile as CO_2 can be captured and separated from different gases in wide range of concentration (1-90%), T (25-80°C) and pressures (1-10 bar). Finally, we probed TAMOF-1 regeneration capability. TAMOF-1 can be regenerated even at room T with remarkably faster kinetics and with lower energy with respect to state-of-the-art zeolite 13X. Preliminary results shows that we have a candidate with high potential to outperform the state-of-art for both target applications. However, several major challenges have still to be addressed: a) can we pelletise TAMOF-1 into shaped bodies of required shape, dimensions and performance? b) can we develop low-energy continuous processes specific for both CO_2/N_2 and CO_2/hydrogen separation able to recover pure gases with very high yield? d) what is the real effect of impurities (water) on separation performance? e) can we understand at fundamental level TAMOF-1/guests interactions, calculate diffusion kinetic of molecules through the bed and define a model to a-priori predict TAMOF-1 performance for different applications and at different scales?

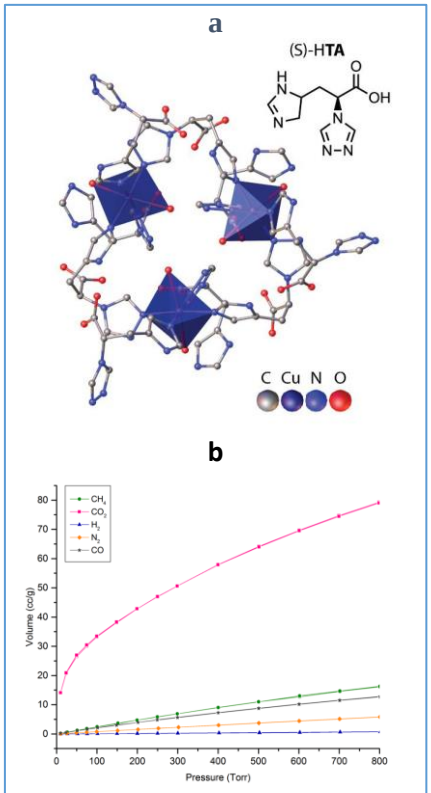


Figure 1. (a) Representation of the crystal structure of TAMOF-1. (b) Adsorption isotherms for a variety of permanent gases.

Photo-electrochemical CO_2 valorisation: beyond A-LEAF

Our aim is also to establish a cornerstone on sustainable CO_2 conversion into added value chemicals/fuels:

Our own inspiration: the-state-of-the-art. The state-of-the-art technology for sustainable CO_2 conversion has been recently developed within the framework of the H2020 FET Proactive Project A-LEAF (grant 732840, ended on June 2021), in which three partners of this consortium participated (ICIQ, INSTM, Julich). This technology allows for the conversion of CO_2, sunlight and water into fuels (FA, H_2) and O_2. The A-LEAF system (validated at TRL 3) can achieve over 6 % solar-to-fuel efficiency to FA combined with about 4 % solar-to-H_2 with world-record current densities (16±1 mA cm^{-2}) with respect to comparable devices without adding sacrificial donors or electrical bias (Fig. 2).[17] The A-LEAF configuration brings a second relevant benefit: the gas and liquid products are produced in different chambers, facilitating immediate separation/purification. The lab-scale PEC device used advanced gas diffusion electrodes (GDEs) based on Cu-S for CO_2 reduction and Ni-Fe-Zn oxide for water oxidation. Moreover, it was demonstrated that the use of a GDE and feeding CO_2 in the gas phase improves the efficiency and selectivity towards CO_2-reduction products when comparing vs analogous liquid electrolyte performance.[18,19] Noteworthy, some unwanted CO (0.6% CO) was produced at the cathode. CO is a harmful chemical and when mixed with H_2 would poison "N"

photo-hydrogenation catalysts. The A-LEAF PEC, has another important limitation: catholyte (separating the cathode from the membrane) and the anolite work at sensibly different pH. In particular, the catholyte was at close to neutral pH because alkaline solutions get carbonated when CO_2 dissolves in, decreasing the pH until it reaches the buffer equilibrium. On the contrary, alkaline anolite (1 M KOH) was employed to allow for the use of non-CRM oxygen evolution catalyst (Ni-Fe oxides) wich are typically unstable at lower pH. Finally, the electrochemical device was coupled with a highly efficient photovoltaic (PV) module based on silicon heterojunction (SHJ) technology. SHJ solar cells with amorphous silicon passivation layers deposited on monocrystalline silicon wafers show very high efficiencies in the traditional double-side contacted design, and hold the absolute record of 26.6% among single junction silicon solar cells in back-side contacted configuration.[20,21]

Our breakthrough: within SUPERVAL, we aim to make a disruptive turning point in the field. Our strategy to go beyond the state-of-the-art responds to the following challenges a) can we set new records for power density? b) can we completely suppress CO formation at the cathode? c) can we modulate and increase H_2/FA molar ratio to provide the H_2 needed for the "N"photo-upgrading? d) can we develop an earth abundant high performing anode working at close to neutral pH (7 < pH < 8)? e) can we replace the state-of-the-art SHJ PV module with a non-CRM based one, while mantaining competitive solar-to-chemical conversion? e) can we screen for potential materials and define optimum implementation through theoretical methods?

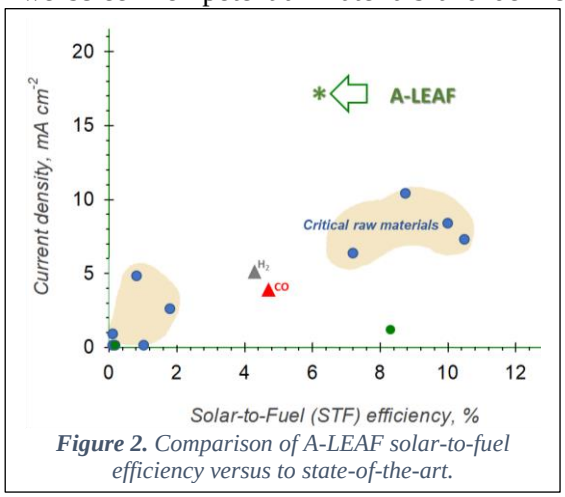


Figure 2. *Comparison of A-LEAF solar-to-fuel efficiency versus to state-of-the-art.*

Nitrogen (N_2 and NO_x) photohydrogenation to ammonia.

N_2 fixation: sustainable ammonia synthesis is one of the main challenges in chemistry. Nowadays, more than 95% of the NH_3 is produced by thermo-catalytic N_2 hydrogenation (Haber-Bosh process) using H_2 coming from fossil fuels. However, the state-of-the-art Haber-Bosh process is a low efficiency (15%) and high energy demanding reaction needing high temperature (400-450 °C) and pressures (15-25Mpa).[22] Great attention is directed to a) develop alternative processes that directly use o can be coupled with renewable energy sources and b) develop green H_2 production to feed the process. **Within SUPERVAL, we are addressing both challenges by proposing a photo-upgrading pathway using the green H_2 photo-eletrochemically produced**. The complexity of the N_2 fixation is intrinsic with the reaction requiring N_2 activation and dissociation, as well as H_2 splitting to hydride. N_2 is indeed a highly stable ("non-reactive") molecule showing very sluggish reaction kinetics. We envision a photo-hydrogenation pathway directly induced by solar light. This approach has the advantages of a) directly convert solar energy into chemicals minimising loses; and b) avoid competitive reactions (e.g. H_2 production) occuring in electrochemical conditions. The assistance of light can increase the yield of a large variety of industrial relevant chemical reactions such as hydrogenations, oxidations, couplings, rearrangements.[23] The beneficial effect can be generally ascribed to a) a photo-thermal mechanism where light absorption on the catalytic active side locally increases the temperature and drastically enhances catalysis, this effect is promoted by low thermal conductive supports, b) photo-chemical by photoinduced electron-hole separation or c) combination or both effects. Light-assisted N_2 fixation is a new research field still barely investigated although promising results were reported for CO_2 photo-hydrogenation.[24,25] Our partner (research team of Prof. Hermenegildo García, UPV), set a precedent in this field, reporting Cs-promoted ruthenium nanoparticles supported on strontium titanate as photocatalyst able to assist the N_2 hydrogenation at atmospheric pressure and temperatures below 400 °C under near 1 sun light intensity, using ca. 95% of the solar light spectrum and reaching values that are among the highest reported so far. Experiments prove that a photo-induced hot carrier mechanism is responsible for the catalytic behaviour. Moreover, Cs play a critical role increasing basicity of the Ru active sides and promoting NH_3 desorption. Finally, the catalyst proved to be very stable under 120h of operation. Our aim is to mark a breakthrough in the field through different actions: a) the development of a novel non-CRM high performing photo-catalyst with high conversion rate, working at minimum temperature (possibly at room T) and b) an insight into the catalytic mechanism combining both experimental data and computational chemistry in order to rationally drive future material optimization.

NO_x fixation: NO_x present in flue gases, although in very small concentration (100-1000ppm), receives great attention due to their sever harmful health and environmental effects. NO_x are mostly composed by NO (≈95% by volume) and NO_2 and are generally adsorbed and/or catalytically converted into N_2 to be safely released into the atmosphere.[26,27] In addition, in these processes, NH_3 or H_2 are wasted. Just few recent attempts tried to valorise NO into ammonia or hydroxylamine by electrocatalytic reduction in presence of water as hydrogen source.[28,29,30] Very interestingly, this reaction was electrocatalytically promoted by non-CRM metals and in particular Cu and Fe. We should also point out that the few studies conducted so far just focused on the predominant NO. However, the oxygen present in flow gases could easily oxide it into NO_2 in presence of *i.e.* activated carbon which is generally used in the capture process.[31] The NO-NO_2 conversion makes the challenge even more complicated. SUPERVAL aims to surpass the "valuable to

worthless chemicals" paradigms with the one that foresees the pollutant to valuable chemicals' conversion. We will propose for the first time, the photo-hydrogenation approach already envisioned for N_2. We believe this strategy could be beneficial also for NO_x taking into account its remarkably higher reactivity. To address the problem of NO_x concentration and purity, a step for separation and purification of NO_x is required. NO_x can be reversibly adsorbed, involving NO to NO_2 oxidative conversion. Different adsorbents have been proposed such as, silica, zeolites and MOFs although carbonaceous materials offer the best solution in terms of process reversibility and cost. Activated carbon has been indeed succesfully used to selectively capture NO_x at industrial scale.[31] Also in this case, theoretical chemistry will allow to understand the actual mechanism and the descriptors controlling the process.

1.3 Plausibility of methodology

Within SUPERVAL, we propose a convenient modular approach, breaking down a complex multicomponent process into single steps, those will be developed and optimized separately and finally integrated in a single lab-scale-validated device (TRL4). We strongly believe our **methodology** will allow us to address in a more efficient way the intrinsic complexity and heterogeneity of the challenge requiring a) molecule separation, b) different and complex reactions (CO_2, N_2 and NO_x conversion) with several different specific requirements c) product separation and purification; d) integration with renewable energy sources and e) without the use of CRM materials. **SUPERVAL** approach **will have several additional advantages as a) performance maximization of different processes** through a custom-designed, computationally-aided developing strategies; b) **flexibility** through the implementation of self-standing optimised devices that could be used independently and individually for several applications; c) versatility to adapt to different flue gas streams; and thus c) **amortization of the high risk** challenge. **Process scalability, economic viability, sustainability and Life Cycle Assessment (LCA) will be thoroughly assessed from the beginning of the technology development**. Even at low TRL, these studies will help in the decision making processes, as to select those materials, components and parts that show better compliance with these crucial aspects.

Development of a low-energy gas separation technology based on TAMOF-1

Within SUPERVAL, we aim to develop novel, low-energy CC technologies to a) separate and purify CO_2 and N_2 from flue gases; and b) separate and purify the H_2 obtained at the gaseous PEC chamber. The Hydrogen produced at the cathode of the PEC will be mixed with unreacted CO_2. Hydrogen has to be separated to be used in the N_2 photo-fixation reactor, and the unreacted CO_2 will also be separated to be recirculated into the PEC, increasing the valorisation yield. Preliminary results prove TAMOF-1 is a versatile and high-performance adsorbent able to separate CO_2 from both N_2 and H_2 in a wide range of conditions. Our ambition is to exploit these features to implement two adsorption technologies outperforming state-of-art zeolites in carbon capture capability and gas purity while working with significantly lower energy requirements. This will be possible thanks to the better selectivity, and easier regeneration that TAMOF-1 has shown when compared with current PSA/VSA technologies, mostly based on porous carbon-based materials or zeolites. TAMOF-1 sustainable, and large scale (> 10 kg) synthesis yields a fine powder (< 10 μm). As first step, TAMOF-1 will have to be shaped into mechanically robust pellets (1-3 mm) retaining gas separation performance. These pellets are required for actual CC applicability to minimize adsorption pressure drop (low energy) and enhance mass transport within the bed (better molecule diffusion) while avoiding powder loss, and aggregation which may block device components. We will process TAMOF-1 pellets by a cost-affordable and scalable extrusion method working at ambient *T* and using low pressures. A mimimum amount of binder such as bentonite or polyvinyl butyral (PVB), will be incorporated if needed. The TAMOF-1 pellets will be characterized by a variety of methods to assess structural and performance integrity. X-ray diffraction, electro microscopy, porosity (BET surface area) and single gas (CO_2, N_2, O_2, H_2) adsorption/desorption isotherms will be first evaluated. The desorption procedure (depressurization, vacuum, heating, inert gas, combination) will be carefully evaluated since this is the step that will be relevant to guarantee a low-energy consumption technology. Dynamic fixed bed adsorption (breakthrough curves) will be evaluated for different mixtures and operating conditions specific for the two target applications (inlet gas mixture composition, T, P, humidity). Finally, we will assess, sequential adsorption/desorption performance cycles including the suitable regeneration step. The collected data will be used as input to theoretically determine TAMOF-1/guest interaction, diffusions of relevant molecules (CO_2/N_2/O_2), multicomponent adsorption isotherms and breakthrough curves and design a model to predict performance and to optimize column geometry and size. This approach, using state of-the-art simulation, methodology and theory,[32] will be used to define *in silico* the design, components and optimum operating conditions of a lab-scale plant.

Development of photo-electro-catalytic CO_2 valorisation cell

We aim to realise a photovoltaic-powered electrocatalytic cell able to convert CO_2 and water into FA, H_2 and O_2.

Cathode optimization: within the A-LEAF project, efficient and stable non CRM cathode for CO_2 reduction and formation of FA and H_2 in molar ratio (2:1) was achieved with a total solar-to-fuels (STF) 10% efficiency with a Cu-S electroctatalysts. These catyalysts will be the starting point for SUPERVAL development, with the challenge to increase productivity and STF efficiency, and avoiding the production of CO, that was still detected at the cathode (<0.01%). The Cu-S performance will be optimized through different approaches: a) modulating the S content on the electrode surface and adding a second component to increase Cu-S stability at high currents/potentials; b) applying a

reactive thermal annealing, followed by a top-down exfoliation, since flakes may exhibit superior electrocatalytic activity due to their 2D structure and 2D planar defects;[33] c) exploiting these 2D Cu-S flakes as substrates to perform the deposition of single atom catalysts, which can help to tune the selectivity and performance by additional doping with earth-abundant elements (Al, S, Mn, Zn). As alternatives to Cu-S, we will also explore a second series of electrocatalysts with the addition of Sn or Pb. Both are particularly selective for formate formation. The new cathodes will be optimized to: i) minimize the production of CO and ii) to lower the potential window at maximum efficiency.

Anode development: the A-LEAF project incorporated OER catalysts that are unstable below pH 11, putting into question the sustainability and long term performance of the cell. This problem will be solved in SUPERVAL by developing stable anodes able to work in a compatible pH (pH < 8) with the catholyte while matching the current density required for optimum cathodic performance. We propose two approaches. In the first one, we will investigate bimetallic *Prussian blue analogs* (PBAs),[34] which are highly active oxidation catalysts with a ≈ 100% OER selectivity,[35] and stable in a large pH range (pH 0–13). As molecular materials, they are also very easy to process as thin films or nanostructures, with high intrinsic catalytic activity.[36] Our challenge in this project is to substitute Co following an strict non–CRM approach. We propose: a) substitution of Co in the PB framework by Mn or Ni, which are also OER active metal sites; b) tune the electronic state of the active centres to maximize OER activity; and c) process PBAs as nanostructures on conducting supports (metal or semi-conductor nanoparticles or thin films) to improve charge transfer kinetics. In the second approach, we will develop partially hydrophobic electrodes. Partners in this consortium demonstrated that partially hydrophobic binders are able to stabilize molecular but also bulk transition metal oxides to promote OER even in highly acidic media.[37] Our challenge for this project will be to incorporate a partially hydrophobic binder to the electrode architecture, either as an additive to the ionomer ink, or as a decoration of the catalyst surface. We will target transition metal oxides with non-CRM metals: Fe, Mn, Ni.

Catalysts optimization *in silico*: The electrochemical performance and structural features will be modelled by computational methods (DFT-based) to determine the major key descriptors limiting catalytic activity, and proposing electronic and/or structural modifications to further optimize the electrocatalytic features.

Cell design and optimization: a full cell will be designed and constructed to maximize performance. Engineering will target a highly compact flow-through system, maintaining the 2-compartment cathode, where a CO_2 gas flow passes through a porous inert support in direct contact to a GDE-type electrode. This option will allow to distribute uniformly the CO_2 gas flow on the electrode surface and to increase the local concentration of CO_2 close to the electrocatalytic active sites, offering immediate separation of gas a liquid products. The anode will be completely re-designed, since now catholyte and anolyte will be identical. This will also allow us to use a membrane-electrode-assembly (MEA) configuration to preclude any iR drop due to the anolyte. The minimization of electrolyte and ion-exchange distances will increase the efficiency, and also the productivity of the SUPERVAL CO_2-valorization photoelectrolyzer.

Photovoltaic panel development and integration: the device will incorporate an external CRM free PV module wired to the electrochemical cell (EC) to reach the required photo potential. Our strategy to address this high ambitious challenge involves the development of non-CRM highly efficient halide perovskite module where the Indium Tin Oxide (ITO) transparent conductive contact layer will be exchanged with ZnO:Al (AZO) layer. Power conversion efficiency of perovskite solar cells (PSCs) has been boosted to 25% among the highest efficiency for single-junction solar cells, making PSCs extremely promising to realize industrial production and commercialization. Scaling up PSCs to fabricate efficient PSCs is the next crucial step for applications. In view of the commercialization of perovskite PV, several key challenges remain unsolved including long-term operational stability, toxicity, and upscaling to industrially relevant device areas. All-perovskite single and tandem modules after upscaling showed champion efficiencies of 16.6 % and 21% on aperture areas of 51cm^2 and 14.3 cm^2, respectively. Another interesting property, is the possibility to easily tune the band gap to make them attractive for direct coupling with PV-driven electrochemical devices. The voltages of single halide perovskite solar cells are not enough to drive the electrochemical reactions, therefore a low-cost perovskite module with highly tuneable photovoltages in the range between 2V and 4V will be realized by connecting a few solar cells in series. The interconnection of the individual solar cell into a module will be performed by laser scribing process.[38,39,40] The actual number of cells in the perovskite module will be defined by the V(J) characteristics of the electrochemical cell (EC). The coupling procedure between EC and PV will be performed by properly matching the polarization curves to work at the maximum power point under certified sunlight irradiation (AM1.5G, 1 SUN=100 mW·cm^{-2}) to maximize the solar to fuel conversion at > 10%.

Photo-hydrogenation of N_2/NO_x to NH_3

Within SUPERVAL, we will investigate different photo-hydrogenation catalysts based on nanoparticles/clusters of Cu, Fe, Mn, Ni among others non-critical transition metals or their bimetallic combinations. These metals have been reported to be active for N_2 and NO electro-catalytic oxidation and also for CO_2 photo-hydrogenation into CH_4. In this project, we will investigate 3 type of electrodes:

Metallic/bimetallic nanoparticles or small clusters supported on defective graphenes. Defective graphenes supporting transition metal nanoparticles or small clusters have exhibited improved activity for CO_2 photo- methanization.[24] These electrodes will be prepared in a sustainable and environmental friendly way by pyrolysis of biopolymers obtained from biomass wastes, such as chitosan, alginate or carragenane. These graphene precursors can be typically dissolved in

water. In the present case, we will introduce melting salts such as NaOH, NaCl, KOH, KCl, CsOH, CsCl, etc. Depending on the metal cation and the salts concentration, carbon-based material exhibiting different pore size and surface area can be obtained. Transition metal salts will be also included in the precursor solution at convenient concentrations. The obtained clear solution will be dried, the obtained powder grinded and milled, and pyrolyzed under Ar atmosphere. The prepared materials will be profusely washed in water to remove the melting salts. Moreover, depending on the graphenic precursor, different heteroatoms, such as N, O, P or S, can co-exist with the metallic particles. The defective graphenes supported metal particles will be fully characterized.

Metallic or bimetallic nanoparticles or small clusters deposited on metal oxides. These electrodes will be synthesised by the ex-solution methods,[41] made from metal Perovskites or hydroxyapatites structures.

MOF-derived photocatalysts: MOFs will be first synthetized following the typical preparation procedures reported in the literature. Then, these can be impregnated with other metal ions, which will be located in the porous network of the MOFs or on its surface. Then, the MOFs can be calcined under air conditions or pyrolyzed under inert atmosphere in order to obtain metal oxides or porous carbonaceous materials containing small clusters or single atoms, respectively. We will first investigate TAMOF-1 but different MOFs based such as HKUST-1 (Cu), MIL-100(Fe), MIL-68(Fe), or ZIF-8 (Cu) will be also considered if needed.

As already reported by one of our partners (UPV), the use of alkali or earth-alkali metal species could sensibly promote ammonia desorption and consequently the reaction. These promoters will be thus deposited on the three types of samples by wet impregnation method.[23]

The samples chemical composition will be studied by combustion elemental analysis, ICP-OES and XPS. Crystal structures will be determined by PXRD. The samples morphology will be investigated by HRFESEM and HRTEM. Raman spectroscopy will be also employed. Photo-catalytic performance will be assessed for both N_2 and NO_x through a customized fixed bed photothermal reaction system as reported previous in Prof. H. García's (UPV) group.[23] The produced NH_3 will be trapped by 5mM H_2SO_4 acid and then quantified by indophenol blue method and ^1H NMR. $^{15}N_2$ isotopic experiment will be performed in a closed circulation system modified from the photo-assisted reactor set-up in order to confirm the N source in the produced NH_3. To address the problem of NO_x concentration and purity, we envision the integration (WP1) of a step for separation and purification of NO_x. In particular, NO_x will be first selectively adsorbed on activate carbon.[31] With this process, NO will be mostly oxidized into NO_2. Finally, it will be desorbed, purity addressed and if necessary, a further purification by distillation will be added.[42] NO_2 will be thus our first target reactant, taking into account a) the NO to NO_2 easy conversion during most of the separation process and b) its easier separation and purification. However, NO will be also considered in order to widen the application portfolio of our technology and to allow also alternative NO_x separation and purification methodologies. The prepared catalysts will be tested for the specific reaction and the optimum operating parameters will be investigated such as, T, P, the electrode area/gas, flow ratio, optimum stoichiometry (H_2/N_2, H_2/NO_x), CO, CO_2 and O_2, limit concentrations for the N_2 photo-upgrading reaction, intensity and the wavelength of the solar spectrum will be assessed. DFT modelization will be used to undertand mechanisms, define the key descriptors and to propose optimization strategies for catalysts and working conditions. Molecular simulation will guide the selection of materials for optimal NO/NO_2 separation and purification.

System integration

In the last part of the project (WP5), we will integrate the different modules as develped within the previous WPs into a single lab-scale mini-plant to demonstrate the viability and compatibility of all units into a single installation (Fig. 3). The lab-scale proof-of-concept will be designed to treat in continuous 100 Nmil/min of flue gas with a $10\%CO_2/85\%N_2(85\%)/5\%O_2/1000ppmNO_x$ composition. To match the individual performance we will consider temporary gas storage steps to integrate times and homogenize flows. The integrated device will be thus realised taking into account all the needed components (compressors, vacuum pumps, gas dehydration systems, mass flow controllers, pressure and temperature controllers, tube and fittings). Systems for water and oxygen removal may be integrated.

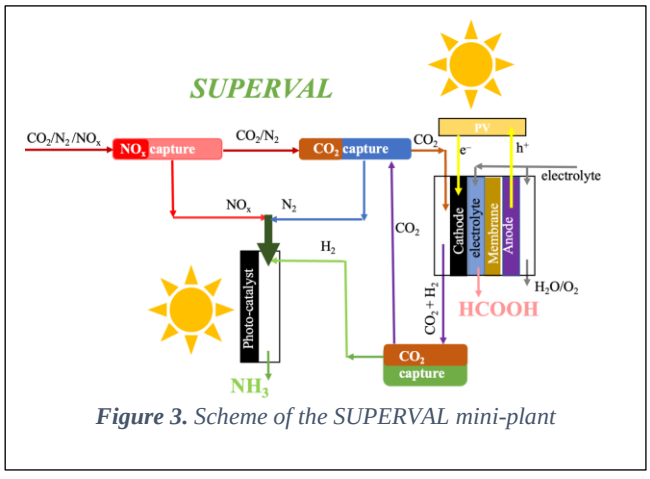


Figure 3. *Scheme of the SUPERVAL mini-plant*

LCA and Technoeconomic Analysis

The modular and integrated design will be subject to a 'cradle-to-grave' LCA study following the ISO standards 14040/14044, in order to quantify the environmental benefits associated to this technology when compared to current industrial production of FA and NH_3. The LCA will not only address the greenhouse-gas mitigation potential by SUPERVAL, but also environmental benefits related to other environmental impacts on human health, ecosystems and natural resources. Besides the comparison of SUPERVAL with current industrial processes, the LCA will also be used as an 'eco-design' tool to identify strategies to improve the environmental performance of this technology. Even if the

final low TRL increases the difficulties and uncertainties in performing a reliable LCA, the results will be very valuable to understand further development, and also to help in the decision making during optimization of each component, module and integration steps.

*SUPERVAL "do no significant harm". Our methodology complies in full with the '*do no significant harm'* principle (Article 17 of EU Taxonomy Regulation):

Climate change mitigation	Our aim is to offer research and development solutions towards sustainability goals (reduction of CO_2 and NO_x emissions). The processes studied will have negligible or positive environmental impact compared to the beneficial knowledge obtained.
Adaptation to climate change	The direct and indirect effects of the project may help industries to adapt to mitigation measures. Besides, all the beneficiaries involved comply with the new European, national, regional or local regulations related to climate change.
Sustainable use and protection of water and marine resources	An environmental impact of SUPEVAL on water and marine resources is not expected.
Circular economy, including waste prevention and recycling	The project follows the beneficiary's internal waste management system that controls traceability and monitors the life cycle of the waste generated to ensure that it does not interfere with the environment or with other people. In addition, our technology will allow for both CO_2 and N_2 recycling through their valorisation, promoting circular economy.
Prevention and control of pollution to the atmosphere, water or the ground	Soil contamination is not foreseen in the development of the project. Waste segregation systems available are isolated from the water supply, avoiding contamination. The emission sources to the atmosphere are duly notified to the competent environmental authorities.
Protection and restoration of biodiversity & ecosystems	No direct environmental impact on any natural area or other ecosystems is foreseen due to the nature of the activity and the control of its environmental vectors.

*SUPERVAL is "Open Science" **SUPERVAL** members are committed to Open Science practices. One of the main goals is ensuring the re-use of data generated in the project and the reproducibility of the research analysis: this includes the documentation on how to set-up experiments, and the necessary tools and data, best practices that support the research results. To this aim, collaborative repositories, such as GitHub/GitLab, GAIA-X/Nextcloud (as Cloud Documental sharing platform), ioChem-BD will be adopted. Research generated within the project will be archived and made available to the EU community through Zenodo and OpenAire, except when there are issues of confidentiality. For research publications, Gold or Green open access models will be used (via archive chemRxiv.org and Open Access journals or Open Research Europe). The Consortium Agreement will also include indications on these aspects and repository protocols for open science. All the identified tools will be designed to operate beyond the lifecycle of the project, so to be used as a long-term solution to foster other valorization initiatives. The creation of virtual dissemination and communication material will support and give visibility to the initiative. This material will be adapted according to the target community and uploaded both in the webpage and the open repositories mentioned above. To enlarge the audience to also reach the general public, social media such as Twitter and LinkedIn will be used. Open Science practices in **SUPERVAL** will be related to the a) involvement of relevant players – including societal stakeholders – in the understanding and uptake of the technology b) integration of information/lessons learnt from the development of the new technology c) ecosystem building/networking for stakeholders.

*SUPERVAL *Data Management Plan* (**DMP**). A data management plan will be developed in month 6, to ensure that data produced by the project are properly managed and stored in accordance with the FAIR (Findable, Accessible, Interoperable, Reusable) principles, to maximize their use for knowledge generation and as a resource to the **SUPERVAL** ecosystem and beyond. It will be updated during the project, as described under WP5 Task 5.2. The DMP will ensure proper management of all data and associated metadata, ensuring IPRs protection. A ***data steward/ess*** will be ensuring that the DMP is successfully implemented. This plan will formalize protocols for data generation, handling, and sharing within and outside the consortium, and how and when data may be made public. The Consortium will identify different target groups and end-users who will produce and benefit of data in the project, how they can share data and to what extent data will be publicly made available. Project data and metadata will be made public, if not confidential, following open access practices. The Consortium will identify several best practices to optimize the findability, accessibility, interoperability, and reusability (FAIR practices) of the data. The DMP will contemplate the following FAIR principles: *(a)* identify the **types of data/research outputs** and formats (text, numerical, images, videos can be anticipated); *(b)* ensure the **findability** by appropriately tagging the data through metadata that follows the standards in the diverse fields and ensures the (*c*) **interoperability** of the different research outcomes; *(d)* setting a platform of the common research area to ensure the **accessibility** to the non-sensitive data; *(e)* all the aspects above ensure that the data will be **reusable** and when possible (not sensitive) open through Creative Commons 4.0 licensing; (f) Curation and storage/preservation costs: person/team responsible for data management and quality assurance. The consortium will make sure that dedicated platforms to store data are set up and that access to these platforms is

coordinated in a proper manner. Project-relevant documents will be collected and managed and, if not in conflict with confidentiality, will be published on the official project website.
*Gender dimension. We do not have identified gender critical issues in addressing project objectives in relation to the R&D planned activites. Institutional and industrial beneficiaries have active politics of *Gender Equality* and a GAP (Gender Action Plan).

2 Impact

2.1 Potential impact

Contribution to the expected outcomes

The European Union set the target to become the first climate-neutral continent by 2050, 'Fit for 55' package,[2] which is the plan against greenhouse emissions with the EU Green Deal[1] as a blueprint. To reach that goal, tougher greenhouse gas reduction targets and a European emissions trading system (ETS) will be applied to the heavy industry and fuel producers. Half of the emission reductions should derive from the direct use of renewable energy and the optimization of the electrification grid. Yet, to cut 95% of the emissions from these large CO_2 emitters by 2050, we should replace fossil fuels by other energy carriers involving technologies that are currently at the demonstration or prototype level, as estimated by the IEA.[43] The latest IPCC Assessment report[44] defines CCU (Carbon Capture&Utilization) for the first time and exposes these technologies as drop-in solutions to decarbonize the emissions and to defosilize the economy. Besides decarbonization, part of the net-zero emissions target is to limit the Nr (reactive nitrogen) losses from agricultural activities or fossil fuel combustion. On the whole, SUPERVAL aims at becoming one of these R&I scalable technologies to manage and valorise the unwanted CO_2 and Nr products from flue gas. Turning this vision into a reality requires resolute action, now. Investments in energy infrastructure typically have an economic life of 20 to 60 years. The steps taken in the next future will be crucial for building an energy system that drives Europe towards climate neutrality in 2050. Due to the early stage of development of this technology, it is complicated to estimate the significance of the benefits of the integrated device. Nonetheless, our consortium includes a partner especialised in the assessment of the technology developed in SUPERVAL (Vareser) and 2LCA who will analyse the sustainability of the technology throughout the project. These studies will contribute to quantify the potential effects that the new modular integrated device for CO_2 reduction into FA and N photofixation will have if our technological targets are achieved.

Outcome 1: Flue gas purification with cost-affordable, efficient, environmentally friendly technology (CRM-free)

SUPERVAL aims to develop and validate at lab-scale a novel technology to manage and valorise flue gas wasted products: carbon dioxide and both reactive (NO_x) and "non-reactive" (N_2) nitrogen. The flue gas purification based on a modular device free of Critical Raw Materials (CRM) has key target impacts: (a) environmental, by reducing the greenhouse emissions from heavy industries set by the EU Green Deal, (b) economic, by overcoming the emission fees set by the ETS, (c) energetic, by avoiding the energy penalty through reducing the energy inputs and using renewable sources (solar power), (d) CRM (Critical Raw Materials) free, which is key for future scalability and implementation. Altogether, SUPERVAL contributes to meet the EU goal for circularity[45] by converting flue gas components into added value products/fuels to be reused. The new technology will impact different industrial sectors producing post-combustion flue gas streams (steel, chemical, cement), with the potential of becoming a centralized solution for them.

Outcome 2: Gas streamed CO_2 as building block for the production of formic acid (FA)

Under the EU Strategic Energy Technology Plan (SET Plan),[46] CCU technologies in industrial facilities are key for the decarbonisation of power generation and energy-intensive industries. The SET Plan R&I targets aims to accelerate the rollout of CCU infrastructure in industrial facilities, reduce the cost of CCU value chain and promote the valorisation/storage of CO/CO_2 steams. SUPERVAL aims to: a) capture CO_2 from flue gas streams through a low-energy novel process and b) reduce it into formate/formic acid trough electrocatalytic conversion powered by a photovoltaic solar panel. Not only the reduction of energy penalty, as stated above, but also the valorisation of unwanted CO_2 into formic acid in its easier and safer storage form (formate). Formate can be easily stored and transported as a salt, thus minimizing hazards. Formic acid is extensively utilized as a preservative and antibacterial agent in agriculture, as cleaning agent, in de-icing, in leather tanning, and in several sectors such as, oil & gas, pharmaceutical, rubber and textile. Finally, both formic acid and formate can find applications as liquid fuel to directly power fuel cells or as hydrogen energy carrier with high volumetric capacity (53 g H_2/L).[47] The holistic approach of SUPERVAL lies on the integration across the industrial infrastructure, energy carriers and sectors.

Outcome 3: Reduce the flue gas Nr (NO_x) emissions and sustainable conversion of nitrogen (NO_x/N_2) into NH_3

Anthropogenic activities have also influenced the N-cycle, by providing an excess of Nr (reactive nitrogen) leading to pollution of water, air and soil, affecting human health and the environment. The European Environment Agency (EEA) estimates that the limit for N losses in Europe is exceeded by a factor of 3.3.[48] A lot of the N surplus comes from agricultural activities, yet the combustion of fossil fuels can lead to an increase in NO_x from the oxidation of atmospheric N_2 and organic N (fossil fuels). Our project aims to valorise into NH_3 the wasted Nr products from flue gas steams by a photo-hydrogenation pioneering strategy. Moreover, we will use the same sustainable approach to

upgrade flue gas nitrogen into ammonia marking a cornerstone in the implementation of strategies for the conversion of waste into highly valuable chemicals. Finally, SUPERVAL aims to guarantee the complete sustainability of the nitrogen fixation cycle using the green hydrogen produced during the process.

Contribution to wider impacts

SUPERVAL long-term impacts on science and technology, on the economic market and on society, are aligned with the objectives and destinations of several Horizon Europe Missions: (i) Mission Climate adaptation, by reducing the greenhouse emissions and valorising the waste for added-value products; (ii) Mission Ocean and Mission Soil, by avoiding the release of N-products from fossil combustion, thus contributing to the N cycle management; (iii) Mission Cities, by adding innovation potential and commercial values to the European industry sector and improving air quality.

Scientific & technological

Through its breakthrough approach, SUPERVAL will have several disruptive scientific and technological impacts. Specifically, a) the new state-of-the-art for carbon capture solutions will be defined through the complete and comprehensive development of low-cost adsorption technologies based on a novel MOF for both post-combustion CO_2 capture and hydrogen/CO_2 separation; b) a cornerstone on photo-powered electrolytic cell for CO_2 and water reduction into added value products (formate and hydrogen) will be set. The research efforts will be addressed to the development and theoretical understanding of the main components (electrodes and photovoltaic modules based on non-CRM), as well as to the design and optimisation of the cell, which configuration is expected to reach record current density and solar to chemical conversion efficiency, as the overall solar-to-chemical conversion efficiency targets >12%; c) A pioneering and breakthrough sustainable solution for nitrogen (NO_x and N_2) valorisation by photo-hydrogenation will be developed as alternative to state-of-art Haber-Bosh process. Also in this case the research interest covers both the discover of non-CRM catalysts and the implementation of optimised photo-reactors; d) finally with SUPERVAL will be for the first time integrated and validated at lab-scale a modular technology able to valorise and purify flue gas streams. These actions will set the foundation for future implementation.

Economic

SUPERVAL is expected to have multiple economic impacts. As first, lowering OPEX of carbon capture technology is expected to have significant effects on the CC market. Reductions in operation come both from the materials cost and durability, as TAMOF-1 adsorvent has high thermal and hydro-thermal stability, higher selectivity and also by lower energy needs, i.e. the regeneration step occurs at low temperatures. The actual EU policy foresees ever stricter emission fees to reduce emissions by 2050. Adopting cost-affordable CC solutions would thus result in relevant economic profits. CC market is projected to reach a revised size of US$4.5 billion by 2027, growing at a CAGR of 7.7% over the 2020-2027 period, especifically the growth in the post combustion segment is readjusted to a revised 8.4% CAGR for the next 7-year period. This segment currently accounts for a 11.3% share of the global Carbon Capture and Storage (CCS) market.[49] Moreover, interest expands also to other CO_2 emitting processes. Around 1.9 billion ton/year of industry CO_2 emissions are a biproduct of chemical reactions within the production process, such as production of ammonia/urea and biofuel, iron, steel, and various petrochemical processes that produce chemicals, plastics and fibers, or conversion of limestone ($CaCO_3$) to lime (CaO) in the cement industry. These 'process emissions' cannot be avoided using alternative production technologies. Another possible CC market segment involves hydrogen pre-combustion purification, whose market is projected to grow at a 7.9% CAGR to reach US$3.3 billion by the end of the analysis period. SUPERVAL effect on CC market lies not only in the action of "CO_2 capture" but also in its sustainable conversion into added value formate/formic acid. Formic acid is a high versatile chemical and fuel whose market share is expected to increase by 4.94% CAGR and surpass the formic acid market value of USD 878.7 Million in volume by 2027.[50] Other remarkable economic impacts are foreseen on the ammonia production market, its estimated global production is approximately 150 million metric tonnes and is projected to increase by 2.3% per year.[51] In this case, SUPERVAL economic advantages will be not just related to the reduction of the Haber-Bosh process carbon footprint but also in the proposal of an alternative and more economical and sustainable process. This new approach has the potential to generate interest not only within industrial end-users but also in agriculture and transport areas. Finally, high interest is envisaged on the market of solar modules where non-CRM perovskite is considered the new frontier, so another stakeholders niche will be within the solar energy field.

Societal

The net-zero transition, and its demands in terms of speed and scale, cannot be reached without the societal actors. In the long-term, SUPERVAL will affect citizens in multiple ways: from reduction of CO_2 emissions from the heavy industry, to the increase of the air quality, reduction of wastes, management of the toxic N-products resulting from fuel combustion, among others. Besides, the modular descentralised technology presented by SUPERVAL will increase the energy access for all and the sovereignty of the Member States by providing new added-value products to fossil fuels. Moreover, SUPERVAL offers a surplus to current renewable energies, by providing new energy carriers to supply fuels to sectors and processes difficult to electrify and to create non-fossil carbon feedstock for the chemical industry.

Furthermore, SUPERVAL impacts are linked to 5 of the 17 Sustainable Development Goals (SDGs) set by the UN: a)SDG3 (Good health and well-being) through the production of renewable fuels,. Besides, CO2 capture and valorization would reduce hazardous amounts of GHG in the atmosphere, which contribute to temperature increase, ocean acidification, among others; b) DG7 (Affordable and clean energy) by increasing the knowledge on CCUs and NH_3 conversion. Exploitation of the results will contribute to achieve this goal; c) SDG9 (Industry, innovation and infrastructure) by increasing knowledge and innovation for European industrial competitiveness; d) SDG12 (Responsible consumption and production) enhancing circular economy by increasing atom-economy, resource efficiency, recyclability and promoting sustainable chemistry and e) SDG13 (Climate action) for the transition from fossil-fuel energy systems to more sustainable ones through technology development on clean fuel synthesis and re-valorization of waste products.

Potential barriers

i) Law and regulations remain a critical element of the governments' policy response to support the deployment of CCS. The Insitute's CCS Legal and Regulatory Indicator (CCS-LRI) offers a detailed examination and assessment of national legal and regulatory frameworks in 55 countries and examines a range of legal and regulatory factors likely to be critical for the regulation of the technology. This indicator will be used by the consortium to follow updates.

ii) Effective carbon rates and emissions trading scheme (ETS): The economic costs of carbon pricing can be determinant for the future deployment of CCUS technologies and will become an essential element of technological development strategies. The consortium will closely follow carbon pricing schemes and will take them into account when defining the LCA and techno-economic assessments of the technology.

iii) Lack of private investment in new technological development at low TRLs. The economic&energy crisis is difficulting investments at high risk scientific initiatives. Our initial techno-economic analysis should clarify the actual impact and relevance to up-scaling SUPERVAL technology.

2.2 Innovation potential

SUPERVAL will bring a new modular and integrated device to enable CO_2 and N management/valorisation into formic acid and ammonia through a photovoltaic powered CO_2-water-co-electrolysis coupled with nitrogen photofixation. This ambitious target will also generate additional innovations (research outputs) to be protected through patents:

1	*Research output*: New state-of-the-art CC technology based on MOFs adsorbent
	Impact: New cost efficient and sustainable technology for the separation of CO_2 from flue gases with CO_2 recovery yields>80%
	IPR strategy: Patent filed by Orchestra and ICIQ
2	*Research output*: Advanced photo-powered electrochemical cell for CO_2 valorisation and green hydrogen production
	Impact: This technology will be applied for different processes in different industrial settings such as post combustion CC, hydrogen/N_2 separation, to separate different gasses and eventually valorise them
	IPR strategy: Patent filed by the institutions involved in the development of the cell
3	*Research output*: Novel non-CRM high performing photo-catalysts with high conversion rate for photofixation of NO_x and N_2 into NH_3
	Impact: New photocatalysts made from non-CRM to valorise NO_x and N_2 into one of the most important and used chemicals nowadays (NH_3) in a sustainable and cost-efficient manner
	IPR strategy: Patent filed by UPV
4	*Research output*: Modular integrated technology for complete flue gas purification and valorisation of all its components
	Impact: First integrated technological device validated at laboratory scale to separate and valorise gases from industrial flue pipes, minimizing the GHG emissions and nitrogen losses, CO_2 penalties and converting waste into revenue resulting in a net zero carbon process
	IPR strategy: Patents filed by the institutions involved in the development of the technology.

In this sense, a technology transfer from lab to industry must be follow through a reliable IP management strategy in order to protect the research outputs generated from the project. To do so, ICIQ, along with ORS, will be in charge of identifying sensitive outcomes and data to guarantee a correct technology transfer. Afterwards, the consortium will decide on the public publication and IP protection. The dissemination of results and any project outputs that are considered public by the consortium will follow open science practices. However, those results that may have technological and industrial interest will be protected through patent applications during and straight after the project. Direct exploitation will foster the **idea-to-innovation vision** of the project and potential commercialization in the future, even if optimization steps beyond the lifetime of the project are required. Providing that research and technological targets are achieved, and the LCA and technological assessments of the technology are promising, further development of the technology will be pursued through other funding opportunities such as EIC Transition calls and Accelerator calls, in the case of Orchestra Scientific (ORS). To increase the transfer of knowledge from SUPERVAL

to society and the relevant stakeholders, the consortium will closely work with the EIC Community, EIC Programme Managers and Business Acceleration Services (BAS). We will also use the Innovation Radar tool to connect with deep tech startup ecosystems.

Besides the expertise from scientific partners, SUPERVAL consortium already involves high-tech SMEs such as Orchestra Scientific (ORS) and VARESER. ORS is currently exploiting TAMOF-1 for different applications and has the exclusive license for TAMOF-1 synthesis and exploitation, as filed internationally in European countries, and also in Asia and America. Vareser is a multiservice company, which is part of the Grupo Alenta (Alenta Inversión y Gestión SL). Vareser purpose is to guarantee the sustainability of future generations and is interested in systems for renewable energy exploitation and improvement of energy efficiency. Furthermore, SUPERVAL proposal holds the support of SUNERGY Initiative (letter of support in Page 26), and the SUNER-C Horizon Europe Coordination and Support Action (GA#101058481), in which ICIQ is an active partner, as the research focus aligns with their initiative of accelerating technologies for light-driven chemical production. The consortium will also use this international, intersectoral and interdisciplinary platform and network of contacts to promote SUPERVAL results and contact interested stakeholders.

Exploitation measures

To guarantee freedom to operate and secure potential exploitation, the following actions will be taken: (i) determination of processes for the release of publications, (ii) definition of trade secrets, (iii) IPR issues within the consortium (regulated in Consortium Agreement (CA)). **Intellectual property rights** (IPR) issues during and after the project will be governed by the CA based on the DESCA model for collaborative projects (www.DESCA-FPt.eu). Intellectual property and technology transfer guidelines will be agreed by all consortium partners prior to project launch. The CA will cover settlements of ownerships of foreground knowledge, exploitation of foreground knowledge and the use of background knowledge during the project. As guiding principle, new IP will be property of the partner(s) responsible of its development, with access freely granted to the other beneficiaries. The CA will also deal with confidentiality issues and the publication strategy of the consortium.

The exploitation activities will start with the identification of all key exploitable results and assess their initial exploitation pathways. To do so, ORS will lead an **exploitation committee** (EC) formed by the partner's KTT (Knowledge and Technology Transfer) offices, who will appoint an IP manager. IPR issues will be reviewed throughout the life of the project, and at the end of the project a final plan for the Use and Dissemination of Foreground will be developed. The final agreement will include a joint ownership agreement that defines the IP share of each party, settles management and operational issues concerning the joint results, as well as utilisation and commercialisation of the results following project termination. Potential stakeholders will be strategically identified through targeted activities and key messages will be disseminated after analyzing their affinity and interest with the project. The EC will provide a strategy and guidelines for the management of innovation and for the regulation of exploitation activities. The plans for exploitation will include an exploitation agreement between beneficiaries formalizing the exploitation strategy, licensing agreements, protection of results, etc.

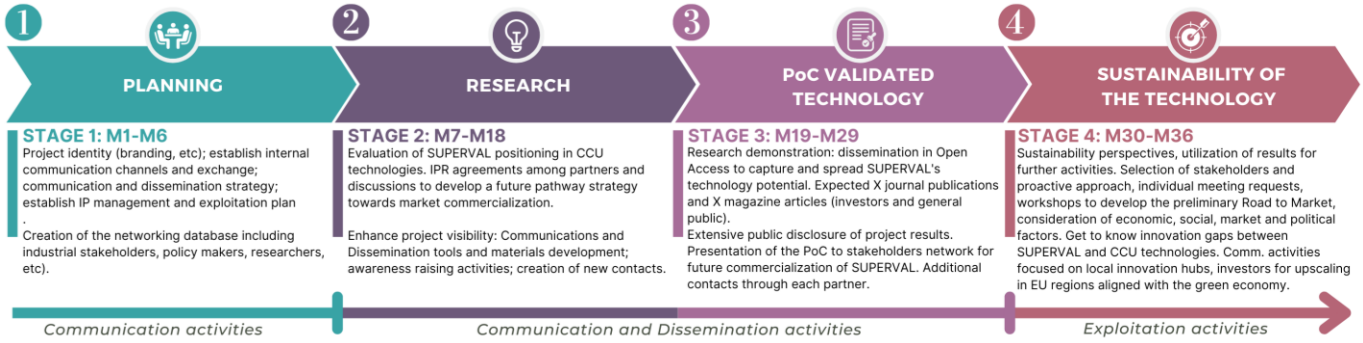
2.3 Communication and Dissemination

In order to maximize SUPERVAL's visibility, the project's outcomes will be disseminated through different channels according to the different audiences. A full 'Plan for dissemination and exploitation including communication activities' (M6) will be designed and periodically updated in alignment with the project's progress to line up SUPERVAL's objectives within a strategic innovation context. SUPERVAL technology is expected to be validated at lab-scale by the end of the project (TRL 4 is expected). However, further testing and validation of the technology in a relevant environment will be pursued after the project. For that reason, an ambitious strategy will be designed for the communication, dissemination and exploitation (CDE) of the project to deliver a technology that can be attractive and sustainable for a long-term upscaling. CDE will be shared with all the partners involved in order to get the maximum level of engagement and participation on the activities with the main objective of bringing additional stakeholders and interested parties, arising scientific interest and industrial participation to reach critical mass needed for the future exploitation of the technology. WP4 and WP5 will cooperate to deliver activities that go beyond the project with a clear focus on the transfer, exploitation and financial viability. Potential partnerships will be evaluated at different exploitation models such as through spin-offs or licensing. Networking activities (see table below) will be organized by ICIQ&ORS and an active participation of the partners in workshops, B2B or Matching events by the EIC, etc. will be encouraged within the project to create contacts with new stakeholders. The adoption of the life cycle analysis (LCA) and conducting a techno-economic analysis in WP4 will allow us to monitor the market requirements and interest and completing the exploitation strategy based on the project's progress. All this together will drive the communication actions when targeting local and public authorities and policymakers in order to support the future application of SUPERVAL technology. An Innovation Manager from ORS (WP5, exploitation, IPR, value proposition) will support the activities to effectively deliver the impacts of SUPERVAL and will actively recommend actions, specially, in the late stage of the project (see diagram below). The identification of each stakeholder group will enrich the CDE strategy and it is designed bearing in mind the benefits and contributions each of them may bring

to SUPERVAL:

1	***Targeted stakeholders*****:** *Multidisciplinary scientific community*
	Dissemination strategy: To ensure technology commercialization and sustainability of the technology, industrially relevant research outcomes will be protected. Non-confidential results will be shared with the scientific community using an Open Science approach through: (a) Open Research Europe; (b) Gold/Green open access publications in high impact journals (*Nature* family, *ACS*); (c) presentations in international scientific conferences (E-MRS, EIC-events); (d) creating collaborations with other National/EU funded projects in the field. Platforms such as Horizon Results will be used.
	KPIs**:** >10 publications in high-impact factor journals;15 events/conferences attended; >5 synergies with related projects (*e.g.* LICROX, SUN2CHEM, DECADE, FlowPhotoChem, SunCOChem)
2	***Targeted stakeholders*****:** *Universities, research centres, students and researchers*
	Dissemination strategy Workshops or summer school organized by the consortium (synergy with RASPA workshops). Critical discussions on current technologies. Brainstorming sessions. Involvement of students and early career researchers in the field of sustainability. Generate interest and possible synergies.
	KPIs**:** 2 SUPERVAL-workshops. Participation in RASPA, iraspa.org/workshops/, organized by TU/e.
3	***Targeted stakeholders*****:** *Industrial community and potential end-users*
	Dissemination strategy: SUPERVAL will have a huge impact on the chemical industry. Project outcomes will be used to generate *renewable fuels* that have a broad number of end-users in the chemical industry as chemical feedstock. Indeed, formamide is being used for the manufacture of sulfa drugs and other pharmaceuticals, herbicides and pesticides, which also gives us the opportunity to connect with pharma- and agroindustry. Key message to communicate: sustainability, critical-raw material free, net-zero technology, long-term stability, low-cost. Actions: (i) participation in specialized industrial fairs (VARESER); (ii) create contacts with industry stakeholders through our participation in events (iii) engage with technology platforms, such as Enterprise Europe Network (EEN), SUNER-C, Cefic, SusChem, etc. and help on the formulation on roadmaps towards the exploitation of processes that involves net-zero carbon technologies.
	KPIs**:** 1 contract with an SME to implement SUPERVAL's technology for validation in a relevant environment is expected
4	***Targeted stakeholders*****:** *Local authorities and Policy makers*
	Dissemination strategy: SUPERVAL will contribute to support a European policy framework to ensure the leadership of European companies in CO_2 valorization and sustainable ammonia production technologies that contribute to the development of a circular and low-carbon economy. Clustering events (webinars, workshops or in common outreach activities) with the objective to exchange news and ideas, providing an overview of all key technical results and methodologies concisely. Some events will be done together with the CCU community such as CO_2Value Europe, where ICIQ is an associate member.
	KPIs**:** 5 policymakers reached
5	***Targeted stakeholders*****:** *General public*
	Dissemination strategy: SUPERVAL's improvements on developing a new viable, sustainable initiative for flue gas CCU solution will be communicated to the general public to get a wider support and acceptance of the technology, highlighting its promising role in carbon-emissions remediation with renewable energy. This will generate an interest in the technology and might create future qualified jobs, which enables the participation of the society in the transition to target climate neutrality. Citizen engagement activities through the invitation of civil society to our open-events.
	KPIs**:** At least 1 representative per each partner's country

Communication, dissemination and exploitation are strongly connected to each other. In order to deliver a highly impactful project, SUPERVAL's strategy is envisioned in four different stages corresponding to different periods of the project (see the stages below). In this way, the entire consortium will be engaged to participate in maximizing project's outcomes and knowledge, which will provide strong connections with different stakeholders:



Communication activities: the main objective will focus on reaching out a wider audience with the aim of increasing awareness about SUPERVAL's scientific and technological outcomes, its implications and how citizens will benefit from them. In this sense, the planned activities will be carried out throughout the 3 years of the project.

GENERAL PUBLIC	***1***	***Tools and channels:*** Website. Ensure the use of analytic tools and key indicators to measure and adapt the webpage to our audience needs.
		Main message: It will include key project information (reports, publications, news, events, contacts and public documents) and last updates on the research outputs. The website will be maintained for at least 2 years after project closure.
		KPIs: 200 visits/month
	2	***Tools and channels:*** Social media: Twitter, Instagram, LinkedIn
		Main message: Social media strategy will be established to raise awareness of the project progress and its results. Two-way communication
		KPIs: >500 followers at the end of the project
	3	***Tools and channels:*** Press releases (PR) (in addition to English, they will be prepared in other European languages for distribution) and audiovisual materials
		Main message: Presentation and important updates on the progress of the project and important technological achievements in each beneficiary's country. Informational videos of the project for the general public: an initial one presenting the project, one release at mid-tern to highlight the impacts of the project and a final one showcasing the results.
		KPIs: 2PR/partner and 3 videos
	4	***Tools and channels:*** Outreach activities
		Main message: SUPERVAL will be incorporated in the outreach activities in which the partners are already involved (*e.g.* Science open days by ICIQ, Science week by INSTM, Pint of Science and EU Researcher's Night by ICIQ, UPV, TU/e, etc.).
		KPIs: >10 outreach activities organized throughout the project

SCIENTIFIC & INDUSTRIAL COMMUNITY	***1***	***Tools and channels:*** Mailing lists with scientific and industrial community.
		Main message: Dissemination about new findings
		KPIs: 1000 people reached
	2	***Tools and channels:*** e-Newsletter
		Main message: Last updates and results on the project, upcoming events related to the project
		KPIs: 2/year
	3	***Tools and channels:*** Leaflets to be distributed in events, fairs, workshops, mailing lists…
		Main message: Description of the project, objectives and consortia
		KPIs: 1000 users reached
POLICY MAKERS	***Tools and channels:*** Events, stakeholder workshops, participation in SUNER-C/SUNERGY	
	Main message: Scientific, societal, industrial and political stakeholders' meetings to discuss how to overcome the limitations of the technology	
	KPIs: >5 relevant events attended by members of the consortium	

3 Quality and efficiency of the implementation

3.1 Consortium

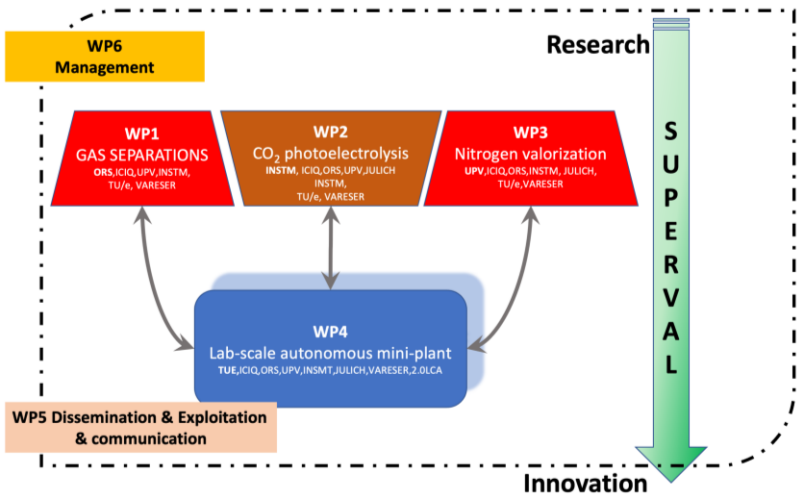
SUPERVAL consortium is a multidisciplinary team of partners with cross-sectorial and integrated competences specifically set up to achieve the project objectives. The Institute of Chemical Research of Catalonia (**ICIQ**) is the leader of project and will coordinate CDE activities (WP5 and WP6). ICIQ has a long-time expertise coordinating large European projects such as the EU-funded MEMCARB project and the collaborative A-LEAF, LICROX, NOAH and VIROFLOW. The ICIQ, through Prof. Galán-Mascarós research group, will also take part in the development of TAMOF-1 based CC technologies and of non-CRM electrocatalysts for water oxidation. The Prof. Galán-Mascarós team is at the forefront for research in smart materials for energy and environmental applications and laid the groundwork on the discovery TAMOF-1. Moreover, the team will exploit and share their expertise in OER catalysis, electrochemical cell design and optimisation, acquired during years of research activity but in particular during the A-LEAF project. ICIQ will share its facilities for material characterisation (TAMOF-1, electrocatalysts, electrochemical cells). Finally, ICIQ's Núria López research team will support the experimental research activity performed within the project understanding at fundamental level catalytical mechanisms for water oxidation, CO_2 reduction and nitrogen photo-fixation. Núria López's research team is a worldwide leader in modelling mechanisms that govern chemical processes in heterogeneous catalysis. This modeling will offer optimization strategies, discovered *in silico*, as to boost the catalyst implementation onto electrodes and devices. Orchestra Scientific S. L. (**ORS**) will develop the new TAMOF-1 based separation technologies proposed within this project and will implement the NO_x separation and purification module. **ORS** is a start-up company founded in 2017 and participated by the ICIQ and ICREA, both public institutions. Since its birth, ORS is committed to bring the knowledge generated in ICIQ related to the TAMOF-1 material and its applications to the market. Their members are committed to revert the funding spent on research to society, providing clean and affordable solutions to critical environmental issues. ORS R&D team has deep knowledge of TAMOF-1 material and solid technical and engineering expertise on adsorption CC solutions and separation technology. The National Interuniversity Consortium of Materials Science and Technology (**INSTM**) with the University of Messina (**UNIME**) as an affiliated entity, leader of the WP2, will develop cathodes for CO_2 reduction and hydrogen production and will be involved in the design, construction and optimization of the electrochemical and photo-electrochemical CO_2 valorisation cells. INSTM is the largest consortium of its kind in Italy, researching advanced materials and technologies and drawing on the expertise of no less than 50 universities. The activities will be led by Prof. Siglinda Perathoner, with profound research expertise in electrocatalysis for CO_2 reduction and on full cell devices, and Prof. Claudio Ampelli, with wide experience in design and engineering of electrocatalytic devices and related materials. The unit of research (UdR) involved in this project is located at the University of Messina (UdR-ME), specifically, CASPE (Laboratory of catalysis for sustainable energy) located at the Dept. of Chemical, Biological, Pharmaceutical and Environmental Sciences. The activities of UdR ME will be centred on the supervision of the hired personnel involved in the development of a photo-electrochemical cell for the reduction of CO2 and water into formate and hydrogen, as well as in the advanced characterization of the prepared electrodes to evaluate their morphological and structural properties (by SEM-EDX, X-ray diffraction, XPS, Raman) and electrochemical aspects (by LSV, CV, EIS). UdR-Me will also be involved in the dissemination of the project results. The research group of Hermenegildo Garcia of the Polytechnic University of Valencia (**UPV**) will be in charge of the development of non-CRM catalysts for the "N" photo-hydrogenation. The Garcia team is at forefront of research in photo-assisted catalytic reactions including N_2 upgrading. **JULICH** is one of the largest center of competence in Germany. The Institute of Energy and Climate Research, and specifically the IEK-5 Photovoltaics, is among the world leader institutes in the development of solar cells, including their integration in devices. Their research is oriented to industry and application and has large interest in the development of low cost perovskite and silicon heterojunction solar cells and their integration in solar modules to produce photovoltaic-electrochemical devices. JULICH will be in charge of the light handling and absorption to power the SUPERVAL device. The research group of Prof. Dr. S. Calero of the Eindhoven University (**TU/e**) will be in charge of molecular dynamic simulations. These studies are fundamental to understand and predict the diffusion of fluids through porous beds or pipes. The Calero team is a worldwide leader in force fields, algorithms and simulations to reverse engineer the properties of materials. An important part of their research activity is carried out in close collaboration with large and small industries that benefit from the knowledge and scientific transfer that the group develops to modules, system and plant design. **VARESER**, is a SME with expertise in renewable energy solutions and sustainable optimization of industrial processes. Among other tasks, **VARESER** will lead the techno-economic analysis of the SUPERVAL technology, bringing an industrial vision to our project. Finally, 2.-0 LCA (**2LCA**) consultants is a European leader in life cycle analysis. Despite the low target TRL of this call and of the SUPERVAL project, it is clear that an early LCA will benefit the progress of the proposal, guiding the decision making, and technology vision to fullfill the minimun carbon-footprint upon scaling-up.

3.2 Work plan and resources

SUPERVAL is a **three year project** aimed to demonstrate the feasibility at lab-scale of a sustainable, autonomous, sun-powered installation for the full valorisation of both CO_2 and nitrogen (N_2/NO_x) components from a flue gas stream

into respectively formate/formic acid and ammonia. SUPERVAL has a well-defined and focused workplan with activities (and WPs/Tasks structure) aligned to the project objectives, as shown in the **Pert chart** below.

- WP1: gas separation. WP1 consist of two sub-WPs. One (WP1.1) will be addressed to the development of two low-energy carbon capture technologies for respectively CO_2/N_2 and CO_2/H_2 separation. The second (WP1.2), will aim to implement a NO/NO_2 capture and purification process.
- WP2: CO_2/water-photo-electrolysis: development of a PEC cell where CO_2 and protons are reduced at the cathode to respectively formate and hydrogen and water is oxidised to oxygen at the anode. The cell will be then integrated and powered by a non-CRM photovoltaic panel.
- WP3: Photo-hydrogenation of N_2/NO_x to NH_3. Development of a reactor for the joint photo-hydrogenation of N_2 and NO_x to ammonia with solar light irradiation.
- WP4: Device integration, SUPERVAL technology performance validation and feasibility assessment.



In the WP4, the single devices developed, built and optimised during the previous WPs will be integrated in a single technology and its performance will be validated at lab-scale. SUPERVAL feasibility will be assessed by both techno-economic and life cycle analysis.

- WP5: Definition, planning and execution of 'Dissemination, Communication and Exploitation: activities'.
- WP6: management: Organization and monitoring of the project.

The **Gantt chart** shows the expected progress for this project, with the time schedule that will be devoted to each task in the corresponding Work Packages. This schedule will be the guide to monitor the progress of the project, allowing to identify any delays. The deliverables & milestones are indicated in the Gantt chart.

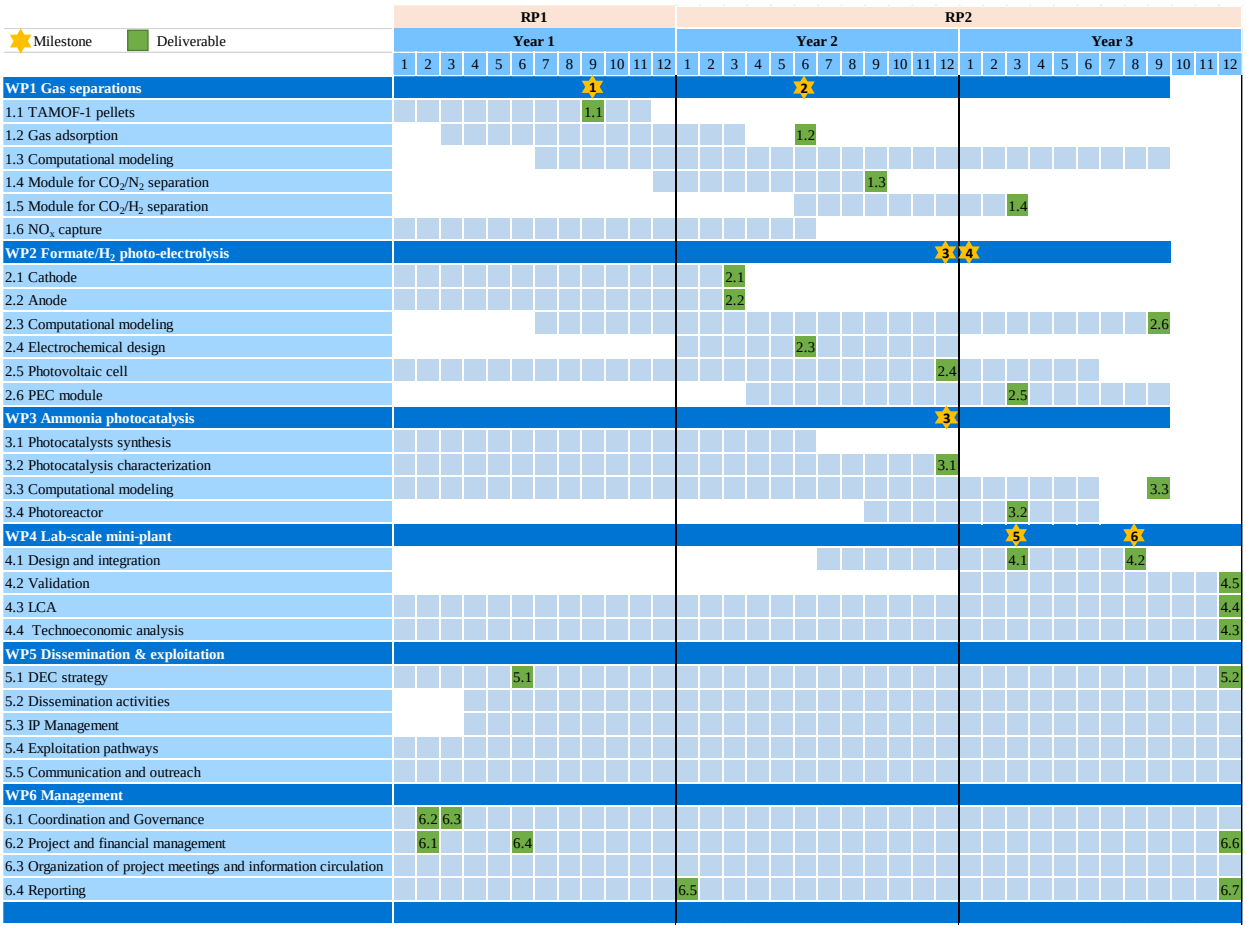


Table 3.2g: 'Subcontracting costs' items : Not applicable

Table 3.2h: 'Purchase costs' items (travel and subsistence, equipment and other goods, works and services)

1./ICIQ		
	Cost (€)	**Justification**
Travel and subsistence	27600	Project meetings (15.000 €), visits/stays in other Institutions (5.600 €), attendance to conferences (7.000 €)
Other goods, works and services	122500	Reagents, solvents and gases (52.000 €); processing and shaping (agglomerants and small lab parts for cutting/handling of pellets) (35.000 €), IP protection (10.000 €), audit certificate (5.000 €), communication activities: including webpage, visual ID, materials (leaflets, videos, posters, etc) (20.500 €)
Total	150100	
2./ORS		
	Cost (€)	**Justification**
Travel and subsistence	19800	Project meetings (6.600 €), attendance to conferences (6.600 €), visits/stays in other institutions (6.600 €)
Other goods, works and services	178125	Modules components (75.125 €), materials and parts to build the gas separation modules: piping, tubing, valves, flow controllers, columns (80.000 €). IP protection (15.000 €), audit (8.000 €).
Total	197925	
3./UPV		
	Cost (€)	**Justification**
Travel and subsistence	15000	Project meetings (9.000 €), organization of consortium meeting (3.000 €), attendance to conferences (3.000 €)
Other goods, works and services	117900	Chemicals, solvents, reagents and glassware for photocatalyst preparation and photoreactosr consumables (62.900 €); Access to electron microscopy, cost of XPS and analytical techniques (32.000 €); financial audit (1.000 €); open access publications (22.000 €)
Total	132900	
4./INSTM		
	Cost (€)	**Justification**
Travel and subsistence	19200	Project meetings (12.200 €), visits/stays in other Institutions (3.000 €), attendance to conferences (4.000 €)
Equipment	33000	Analytical instrumentation for gas analysis, potentiostat/galvanostat, peristaltic pum, flow mass controllers (30.000 €), computer hardware (3.000 €). Only depretiation costs are considered except from purchases aimed to build a prototype
Other goods, works and services	52000	Reagents (5.000 €), membranes and gas-difussion substrates (10.000 €), materials to build the PEC device (15.000 €), piping, valves and connectors (5.000 €), spare parts for analytical instrumentation (3.000 €). Costs for open access publication (9.000 €), audit certificate (5.000 €)
Total	104200	
5./FZJ		
	Cost (€)	**Justification**
Travel and subsistence	25000	Project meetings (14.000 €), visits/stays in other Institutions (3.000 €), attendance to conferences (8.000 €)
Other goods, works and services	73000	Materials to prepare solar cells and modules (20.000 €), TCO targets and spare parts (20.000 €), chemicals (10.000 €), components for electrochemical cell and for solar simulator (20.000 €), audit (3.000 €)
Total	98000	
6./TU/e		
	Cost (€)	**Justification**
Travel and	12000	Project meetings (6.000 €), attendance to conferences (6.000 €)

subsistence		
Other goods, works and services	22000	Access to cluster nodes (15.000 €); Dissemination costs (3.000 €); Software and hardware licenses (4.000 €); audit certificate
Total	34000	
7./VARESER		
	Cost (€)	**Justification**
Travel and subsistence	8500	Project meetings (3.500 €), participation in sectoral networks (2.000 €), Visits/stays in other insitutions (1.500 €), events and platforms (1.500 €)
Total	8500	
8./2LCA		
	Cost (€)	**Justification**
Travel and subsistence	6000	Project/consortium meetings (6.000 €)
Total	6000	

Table 3.2i: 'Other costs categories' items (e.g. internally invoiced goods and services) Not applicable

Table 3.2j: 'In-kind contributions' provided by third parties:

Partner	Third party	Cost (€)	Justification
1./ICIQ	ICREA	48.000 €	ICREA will be the third party making resources available to the beneficiary ICIQ free of charge. ICREA is a Foundation supported by the Catalan Government and guided by a Board of Trustees. Although the salary cost of JR Galán-Mascarós will be paid by ICREA, the PI will be assigned to physically work at ICIQ and considered a member of ICIQ. These costs are therefore assimilated as "own resources" of ICIQ, and will be charged to the project without being considered as a receipt. The cost will be declared by the beneficiary and it will be recorded in the accounts of the third party.

4 Ethics self-assessment

No ethics issue

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Letter of Support for the proposed SUPERVAL project from the SUNERGY Initiative through funding of the SUNER-C Action

SUNERGY
Princetonlaan 8a, 3584 CB Utrecht, Netherlands
contact@sunergy-initiative.eu

Subject: Letter of Support for the proposed "Sustainable Photo-ElectRochemical VALorization of flue gases" (SUPERVAL) project, submitted to the EIC Pathfinder Challenges 2022 (Horizon Europe)
Date: Universiteit Utrecht, October 5th 2022

To whom it may concern,

On behalf of the SUNERGY Initiative, and the SUNER-C Horizon Europe-funded Coordination and Support Action (Grant n° 101058481) we hereby declare our support for the SUPERVAL proposal. The research focus and scope align with our initiative of accelerating technologies for light-driven chemicals production.

The SUNERGY initiative, recently mandated by the European Union through funding of the SUNER-C Coordination and Support Action, aims to develop a pan-European platform on sustainable fuels and base chemicals, gathering academia, industry and other stakeholders working towards a long-term partnership in Horizon Europe. Our overall vision is to replace fossil intrants in the synthesis of fuels and commodity chemicals for industry and agriculture by molecules made from abundant feedstocks (H_2O, CO_2, O_2…) using solar energy. We also aim to develop negative carbon dioxide emission technologies using renewable energy and abundant resources to enable a circular economy. In this mission, we are supported by more than 300 stakeholders across the EU, including universities, heavy industries, SMEs, NGOs, research organizations, etc.

We strongly support the SUPERVAL proposal, as its objectives are well-aligned with the SUNERGY vision that aims to achieve the sustainable production of fossil-free fuels and chemicals for a circular economy. Delivering sustainable solar chemicals and fuels is a global challenge, and will be essential towards a sustainable, sovereign and resilient European energy supply.

Yours sincerely,

Prof. Dr. ir. Bert Weckhuysen
Utrecht University
SUNER-C Coordinator

Dr. Frederic Chandezon
CEA
SUNER-C Co-Coordinator

Funded by
The European Union,
Grant Agreement No. 101058481

ANNEX 2

ESTIMATED BUDGET FOR THE ACTION

	Estimated eligible[1] costs (per budget category)										Estimated EU contribution[2]			
	Direct costs								Indirect costs	Total costs	EU contribution to eligible costs			Maximum grant amount[6]
	A. Personnel costs			B. Subcontracting costs	C. Purchase costs			D. Other cost categories	E. Indirect costs[3]		Funding rate %[4]	Maximum EU contribution[5]	Requested EU contribution	
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons		A.4 SME owners and natural person beneficiaries	B. Subcontracting	C.1 Travel and subsistence	C.2 Equipment	C.3 Other goods, works and services	D.2 Internally invoiced goods and services	E. Indirect costs					
Forms of funding	Actual costs	Unit costs (usual accounting practices)	Unit costs[7]	Actual costs	Actual costs	Actual costs	Actual costs	Unit costs (usual accounting practices)	Flat-rate costs[8]					
	a1	a2	a3	b	c1	c2	c3	d2	e = 0,25 * (a1 + a2 + a3 + c1 + c2 + c3)	f = a + b + c + d + e	U	g = f * U%	h	m
1 - ICIQ-CERCA	370 500.00	0.00	0.00	0.00	27 600.00	0.00	122 500.00	0.00	130 150.00	650 750.00	100	650 750.00	650 750.00	650 750.00
2 - ORS	261 000.00	0.00	0.00	0.00	19 800.00	0.00	178 125.00	0.00	114 731.25	573 656.25	100	573 656.25	573 656.25	573 656.25
3 - UPV	259 000.00	0.00	0.00	0.00	15 000.00	0.00	117 900.00	0.00	97 975.00	489 875.00	100	489 875.00	489 875.00	489 875.00
4 - INSTM	212 000.00	0.00	0.00	0.00	19 200.00	33 000.00	52 000.00	0.00	79 050.00	395 250.00	100	395 250.00	395 250.00	395 250.00
4.1 - UniME	120 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30 000.00	150 000.00	100	150 000.00	150 000.00	150 000.00
5 - FZJ	322 747.00	0.00	0.00	0.00	25 000.00	0.00	73 000.00	0.00	105 186.75	525 933.75	100	525 933.75	525 933.75	525 933.75
6 - TU/e	0.00	324 895.00	0.00	0.00	12 000.00	0.00	22 000.00	0.00	89 723.75	448 618.75	100	448 618.75	448 618.75	448 618.75
7 - VARESER	151 600.00	0.00	0.00	0.00	8 500.00	0.00	0.00	0.00	40 025.00	200 125.00	100	200 125.00	200 125.00	200 125.00
8 - 2.-O LCA	104 000.00	0.00	0.00	0.00	6 000.00	0.00	0.00	0.00	27 500.00	137 500.00	100	137 500.00	137 500.00	137 500.00
Σ consortium	1 800 847.00	324 895.00	0.00	0.00	133 100.00	33 000.00	565 525.00	0.00	714 341.75	3 571 708.75		3 571 708.75	3 571 708.75	3 571 708.75

[1] See Article 6 for the eligibility conditions. All amounts must be expressed in EUR (see Article 21 for the conversion rules).
[2] The consortium remains free to decide on a different internal distribution of the EU funding (via the consortium agreement; see Article 7).
[3] Indirect costs already covered by an operating grant (received under any EU funding programme) are ineligible (see Article 6.3). Therefore, a beneficiary/affiliated entity that receives an operating grant during the action duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant, unless they can demonstrate that the operating grant does not cover any costs of the action. This requires specific accounting tools. Please immediately contact us via the EU Funding & Tenders Portal for details.
[4] See Data Sheet for the funding rate(s).
[5] This is the theoretical amount of the EU contribution to costs, if the reimbursement rate is applied to all the budgeted costs. This theoretical amount is then capped by the 'maximum grant amount'.
[6] The 'maximum grant amount' is the maximum grant amount decided by the EU. It normally corresponds to the requested grant, but may be lower.
[7] See Annex 2a 'Additional information on the estimated budget' for the details (units, cost per unit).
[8] See Data Sheet for the flat-rate.

ANNEX 2a

ADDITIONAL INFORMATION ON UNIT COSTS AND CONTRIBUTIONS

SME owners/natural person beneficiaries without salary (Decision C(2020) 7115[1])

Type: unit costs

Units: days spent working on the action (rounded up or down to the nearest half-day)

Amount per unit (daily rate): calculated according to the following formula:

{EUR 5 080 / 18 days = **282,22**}
multiplied by
{country-specific correction coefficient of the country where the beneficiary is established}

The country-specific correction coefficients used are those set out in the Horizon Europe Work Programme (section Marie Skłodowska-Curie actions) in force at the time of the call (see Portal Reference Documents).

HE and Euratom Research Infrastructure actions[2]

Type: unit costs

Units[3]: see (for each access provider and installation) the unit cost table in Annex 2b

Amount per unit*: see (for each access provider and installation) the unit cost table in Annex 2b

* Amount calculated as follows:

For trans-national access:

$$\frac{\text{average annual total trans-national access costs to the installation (over past two years[4])}}{\text{average annual total quantity of trans-national access to the installation (over past two years[5])}}$$

For virtual access:

$$\frac{\text{total virtual access costs to the installation (over the last year[6])}}{\text{total quantity of virtual access to the installation (over the last year[7])}}$$

Euratom staff mobility costs[8]

Monthly living allowance

Type: unit costs

---

1 Commission Decision of 20 October 2020 authorising the use of unit costs for the personnel costs of the owners of small and medium-sized enterprises and beneficiaries that are natural persons not receiving a salary for the work carried out by themselves under an action or work programme (C(2020)7715).

2 Decision of 19 April 2021 authorising the use of unit costs for the costs of providing trans-national and virtual access in Research Infrastructure actions under the Horizon Europe Programme (2021-2027) and the Research and Training Programme of the European Atomic Energy Community (2021-2025).

3 Unit of access (e.g. beam hours, weeks of access, sample analysis) fixed by the access provider in proposal.

4 In exceptional and duly justified cases, the granting authority may agree to a different reference period.

5 In exceptional and duly justified cases, the granting authority may agree to a different reference period.

6 In exceptional and duly justified cases, the granting authority may agree to a different reference period.

7 In exceptional and duly justified cases, the granting authority may agree to a different reference period.

8 Decision of 15 March 2021 authorising the use of unit costs for mobility in co-fund actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025).

Units: months spent by the seconded staff member(s) on research and training in fission and fusion activities (person-month)

Amount per unit*: see (for each beneficiary/affiliated entity and secondment) the unit cost table in Annex 2b

* Amount calculated as follows from 1 January 2021:
{**EUR 4 300** multiplied by
country-specific correction coefficient** of the country where the staff member is seconded}[9]

**Country-specific correction coefficients as from 1 January 2021[10]

EU-Member States[11]

Country / Place	Coefficient (%)
Bulgaria	59,1
Czech Rep.	85,2
Denmark	131,3
Germany Bonn Karlsruhe Munich	101,9 95,8 98 113,9
Estonia	82,3
Ireland	129
Greece	81,4
Spain	94,2
France	120,5
Croatia	75,8
Italy Varese	95 90,7
Cyprus	78,2
Latvia	77,5
Lithuania	76,6
Hungary	71,9
Malta	94,7
Netherlands	113,9
Austria	107,9
Poland	70,9
Portugal	91,1
Romania	66,6
Slovenia	86,1

[9] Unit costs for living allowances are calculated by using a method of calculation similar to that applied for the secondment to the European Commission of seconded national experts (SNEs).

[10] For the financial statements, the amount must be adjusted according to the actual place of secondment.
The revised coefficients were adopted in the Decision authorising the use of unit costs for the Fusion Programme co-fund action under the Research and training Programme of the European Atomic Energy Community 2021-2025. They are based on the 2020 Annual update of the remuneration and pensions of the officials and other servants of the European Union and the correction coefficients applied thereto (OJ C 428, 11.12.2020) to ensure purchasing power parity. The revised coefficient are applied as from 1 January 2021 through an amendment to the grant agreement.

[11] No correction coefficient shall be applicable in Belgium and Luxembourg.

Slovakia	80,6
Finland	118,4
Sweden	124,3

Third countries

Country/place	Coefficient (%)
China	82,2
India	72,3
Japan	111,8
Russia	92,7
South Korea	92,3
Switzerland	129.2
Ukraine	82.3
United Kingdom	97.6
United States	101,4 (New-York) 90,5 (Washington)

Mobility allowance

Type: Unit costs

Units: months spent by the seconded staff member(s) on research and training in fission and fusion activities (person-month)

Amount per unit: **EUR 600** per person-month; see (for each beneficiary/affiliated entity and secondment) the unit cost table in Annex 2b

Family allowance

Type: unit costs

Units: months spent by the seconded staff member(s) on research and training in fission and fusion activities (person-month)

Amount per unit: **EUR 660** per person-month; see (for each beneficiary/affiliated entity and secondment) the unit cost table in Annex 2b

Education allowance

Type: Unit costs

Units: months spent by the seconded staff member(s) on research and training in fission and fusion activities (person-month)

Amount per unit*: see (for each beneficiary/affiliated entity and secondment) the unit cost table in Annex 2b

*Amount calculated as follows from 1 January 2021:
{EUR 283.82 x number of dependent children[12]**}**

[12] For the estimated budget (Annex 2): an average should be used. (⚠ For the financial statements, the number of children (and months) must be adjusted according to the actual family status at the moment the secondment starts.)

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ORCHESTRA SCIENTIFIC SOCIEDAD LIMITADA (ORS), PIC 905329810, established in AVDA PAISOS CATALANS, 16, TARRAGONA 43007, Spain,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Elías Daura Oller with ECAS id n003d8fo signed in the Participant Portal on 14/06/2023 at 17:12:13 (transaction id SigId-296497-ABFW v6YoqmldzIoLKK9zGCddGBxksnZuMsFfWFU4Lj9ybzdeOGHzadous2A oRzsFxxtm1RvVnPmZFYbmK8zZfPIm-yntOf97TTHqJXwStD2tm9a-SiG Bb1XFVVoIQGDpxJivzqCbVRzkZJEQzc7W4qg0sTCd0YzmF7BbXKkwfS mdncjeGxHEI714RhRSZNGq3qzLhm2). Timestamp by third party at 2023.06.14 17:12:18 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITAT POLITECNICA DE VALENCIA (UPV), PIC 999864846, established in CAMINO DE VERA SN EDIFICIO 3A, VALENCIA 46022, Spain,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

María Belén PICÓ-SIRVENT with ECAS id n0075tgw signed in the Participant Portal on 15/06/2023 at 09:57:03 (transaction id SigId-301705-YhxUDxqnYqCzKAYw7nh2iWqED8LjeVlXLLS5r485rHP6uzNycf LHFQns4whST2GL0e5lfdubR46qUPMjMzleLl0-yntOf97TTHqJXwStD2tm9a-XWipMK6f61fzn3OpP3rOScZYPZFCk4iauzX PSnPydECQuCy41e6xMbAT0da7wqhYO4Lk1gbY0eUnNqggtnVzNS0). Timestamp by third party at 2023.06.15 09:57:23 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI (INSTM), PIC 999991237, established in VIA GIUSTI 9, FIRENZE 50121, Italy,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Federica Bondioli with ECAS id n005b5rp signed in the Participant Portal on 15/06/2023 at 09:20:52 (transaction id SigId-300982-FDMA izuiZGOEhdfafUZccFZyTDHyiP3UVuXNcFAsLoON5IqlYDb5y8OJPqR4 t3VvnxnZcDWzx9LzGh8AsNxkOFm-yntOf97TTHqJXwStD2tm9a-OKfS gcopdr3aoXJRnFJ2Vw6ERtZivsQGSzMZqNPrsBi1mzbko1aXsOhbI6N HHYZyfs3Umm5wpzT1IHkl9zPERCK). Timestamp by third party at 2023.06.15 09:20:58 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

FORSCHUNGSZENTRUM JULICH GMBH (FZJ), PIC 999980470, established in WILHELM JOHNEN STRASSE, JULICH 52428, Germany,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Anne BOSCH with ECAS id nboschan signed in the Participant Portal on 20/06/2023 at 11:08:40 (transaction id SigId-36943-IPx8U21ykdf WrS3iFP0SMREzNSvePRQsSn38ZMrXFQyzXjvzxDZMHktAzRvy62h9Hj 7WyNTRzqozK1lIfUUGLDY0-jpJZscgsw0K4epxy2XYw0y-5dhg78Ky9f Ke7CEV8TdoP8J22PN0HaSOJtFzitHZvmp5qSMyG6AZoo9zjsb74rvLg MzVWRv0YOcnWXSV7OLCngW). Timestamp by third party at 2023.06.20 11:08:45 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

TECHNISCHE UNIVERSITEIT EINDHOVEN (TU/e), PIC 999977269, established in GROENE LOPER 3, EINDHOVEN 5612 AE, Netherlands,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Nicole Fouchier with ECAS id n009qoc6 signed in the Participant Portal on 19/06/2023 at 12:46:02 (transaction id SigId-24669-cpO6Z zSofTwTHjXd3XLV54VUcIEJszf5czjJdabL5TmZ6Q2y4zdaAg4qxJM1ILx sIq7feDorEHSIEHUNK7MNMfe-jpJZscgsw0K4epxy2XYw0y-Gou3IUH C9KJ8OBjINZVl09aRFzSbPQMxa0h7xnlSAu7hzLVYzW2kS6MECOqv9 CODOmYE43ToTQQZ9U0NfbDuInW). Timestamp by third party at 2023.06.19 12:46:09 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

VARESER 96 SL (VARESER), PIC 884906751, established in AVENIDA AMADO GRANELL MESADO N 75-6, VALENCIA 46013, Spain,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Fernando Huet Grondona with ECAS id n00chbrv signed in the Participant Portal on 16/06/2023 at 13:31:30 (transaction id SigId-12221-j2u3zlOaAsgvvyFylzWnOo23HssZ5UAofmv8FYhWmsQnxDqPQSmMxxKDVUTBTY4rYY8TzsV5lePWIiffRH3zS08-jpJZscgsw0K4epxy2XYw0y-L1Ewn18eT8Qx4RYzmkj0QX3sfiHCadztvqSuWqOXgmdP6MCczdR37S0Ykvh10K1zLuaSXkZonKxGJ3bhTbVHzgG). Timestamp by third party at 2023.06.16 13:31:35 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

2.-O LCA CONSULTANTS APS (2.-O LCA), PIC 986412401, established in RENDSBURGGARDE 14 4 315B, AALBORG 9000, Denmark,

hereby agrees

to become beneficiary

in Agreement No 101115456 — SUPERVAL ('the Agreement')

between FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA (ICIQ-CERCA) **and** the **European Innovation Council and SMEs Executive Agency (EISMEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Jannick Hoejrup SCHMIDT with ECAS id nschmijp signed in the Participant Portal on 15/06/2023 at 08:57:28 (transaction id SigId-300581-lFlWXDJVmmyqzpHLZMqS7mhcdv2cC5zt4MFdEqyMBYQE2dXuXXskYRSxhlKm7zgcS0S76FtL8NhB6zkzNnxRDQF-yntOf97TTHqJXwStD2tm9a-uBwL85TwExQgMtFkhAAWCEKxJASBWDj24q41zhVnIfb1ebbsRYHmM8K19wy9aYcBcTTs250sjfeRlafIkB1rkm). Timestamp by third party at 2023.06.15 08:57:33 CEST

FINANCIAL STATEMENT FOR [PARTICIPANT NAME] FOR REPORTING PERIOD [NUMBER]

	Eligible[1] costs (per budget category)																EU contribution[2]				Revenues
	Direct costs															Indirect costs	Total costs	EU contribution to eligible costs			Total requested EU contribution	Income generated by the action
	A. Personnel costs			B. Subcontracting costs	C. Purchase costs			D. Other cost categories								E. Indirect costs[2]		Funding rate %[3]	Maximum EU contribution[4]	Requested EU contribution		
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons		A.4 SME owners and natural person beneficiaries	B. Subcontracting	C.1 Travel and subsistence	C.2 Equipment	C.3 Other goods, works and services	[D.1 Financial support to third parties]	D.2 Internally invoiced goods and services	[D.3 Transnational access to research infrastructure unit costs]	[D.4 Virtual access to research infrastructure unit costs]	*[OPTION for HE PCP/PPI:* D.5 PCP/PPI procurement costs*]*	*[OPTION for Euratom Programme Cofund Actions:* D.6 Euratom Cofund staff mobility costs*]*	*[OPTION for HE ERC Grants:* D.7 ERC additional funding*]*	*[OPTION for HE ERC Grants:* D.8 ERC additional funding (subcontracting, FSTP and internally invoiced goods and services)*]*	E. Indirect costs						
Forms of funding	Actual costs	Unit costs (usual accounting practices)	Unit costs[5]	Actual costs	Actual costs	Actual costs	Actual costs	[Actual costs]	Unit costs (usual accounting practices)	[Unit costs[5]]	[Unit costs[5]]	[Actual costs]	[Unit costs[5]]	[Actual costs]	[Actual costs]	Flat-rate costs[6]						
	a1	a2	a3	b	c1	c2	c3	[d1a]	d2	[d3]	[d4]	[d5]	[d6]	[d7]	[d8]	e = 0,25 * (a1 + a2 + a3 ~~+b~~+ c1 +c2 + c3 ~~+ d1a + d2 + d3 + d4 (+ d5][+ d6]~~ [+d7] ~~[+ d8]~~)	f = a+b+c+d+e	U	g = f*U%	h	m	n
XX – [short name beneficiary/affiliated entity]																						

The beneficiary/affiliated entity hereby confirms that:

The information provided is complete, reliable and true.

The costs and contributions declared are eligible (see Article 6).

The costs and contributions can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 19, 20 and 25).

For the last reporting period: that all the revenues have been declared (see Article 22).

① Please declare all eligible costs and contributions, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Only amounts that were declared in your individual financial statements can be taken into account lateron, in order to replace costs/contributions that are found to be ineligible.

[1] See Article 6 for the eligibility conditions. All amounts must be expressed in EUR (see Article 21 for the conversion rules).

[2] If you have also received an EU operating grant during this reporting period, you cannot claim indirect costs - unless you can demonstrate that the operating grant does not cover any costs of the action. This requires specific accounting tools. Please contact us immediately via the Funding & Tenders Portal for details.

[3] See Data Sheet for the reimbursement rate(s).

[4] This is the *theoretical* amount of EU contribution to costs that the system calculates automatically (by multiplying the reimbursement rates by the costs declared). The amount you request (in the column 'requested EU contribution') may be less.

[5] See Annex 2a 'Additional information on the estimated budget' for the details (units, cost per unit).

[6] See Data Sheet for the flat-rate.

ANNEX 5

SPECIFIC RULES

CONFIDENTIALITY AND SECURITY (— ARTICLE 13)

Sensitive information with security recommendation

Sensitive information with a security recommendation must comply with the additional requirements imposed by the granting authority.

Before starting the action tasks concerned, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task. The documents must be kept on file and be submitted upon request by the coordinator to the granting authority. If they are not in English, they must be submitted together with an English summary.

For requirements restricting disclosure or dissemination, the information must be handled in accordance with the recommendation and may be disclosed or disseminated only after written approval from the granting authority.

EU classified information

If EU classified information is used or generated by the action, it must be treated in accordance with the security classification guide (SCG) and security aspect letter (SAL) set out in Annex 1 and Decision 2015/444[1] and its implementing rules — until it is declassified.

Deliverables which contain EU classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving EU classified information may be subcontracted only with prior explicit written approval from the granting authority and only to entities established in an EU Member State or in a non-EU country with a security of information agreement with the EU (or an administrative arrangement with the Commission).

EU classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

ETHICS (— ARTICLE 14)

Ethics and research integrity

The beneficiaries must carry out the action in compliance with:

- ethical principles (including the highest standards of research integrity)

[1] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

and

- applicable EU, international and national law, including the EU Charter of Fundamental Rights and the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Supplementary Protocols.

No funding can be granted, within or outside the EU, for activities that are prohibited in all Member States. No funding can be granted in a Member State for an activity which is forbidden in that Member State.

The beneficiaries must pay particular attention to the principle of proportionality, the right to privacy, the right to the protection of personal data, the right to the physical and mental integrity of persons, the right to non-discrimination, the need to ensure protection of the environment and high levels of human health protection.

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

- aim at human cloning for reproductive purposes
- intend to modify the genetic heritage of human beings which could make such modifications heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed)
- intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer, or
- lead to the destruction of human embryos (for example, for obtaining stem cells).

Activities involving research on human embryos or human embryonic stem cells may be carried out only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the granting authority.

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out in the European Code of Conduct for Research Integrity[2].

This implies compliance with the following principles:

- reliability in ensuring the quality of research reflected in the design, the methodology, the analysis and the use of resources
- honesty in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair and unbiased way

[2] European Code of Conduct for Research Integrity of ALLEA (All European Academies).

- respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment

- accountability for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts

and means that beneficiaries must ensure that persons carrying out research tasks follow the good research practices including ensuring, where possible, openness, reproducibility and traceability and refrain from the research integrity violations described in the Code.

Activities raising ethical issues must comply with the additional requirements formulated by the ethics panels (including after checks, reviews or audits; see Article 25).

Before starting an action task raising ethical issues, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task, notably from any (national or local) ethics committee or other bodies such as data protection authorities.

The documents must be kept on file and be submitted upon request by the coordinator to the granting authority. If they are not in English, they must be submitted together with an English summary, which shows that the documents cover the action tasks in question and includes the conclusions of the committee or authority concerned (if any).

VALUES (— ARTICLE 14)

Gender mainstreaming

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action and, where applicable, in line with the gender equality plan. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS — ACCESS RIGHTS AND RIGHTS OF USE (— ARTICLE 16)

Definitions

Access rights — Rights to use results or background.

Dissemination — The public disclosure of the results by appropriate means, other than resulting from protecting or exploiting the results, including by scientific publications in any medium.

Exploit(ation) — The use of results in further research and innovation activities other than those covered by the action concerned, including among other things, commercial exploitation such as developing, creating, manufacturing and marketing a product or process, creating and providing a service, or in standardisation activities.

Fair and reasonable conditions — Appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

FAIR principles — ‘findability’, ‘accessibility’, ‘interoperability’ and ‘reusability’.

Open access — Online access to research outputs provided free of charge to the end-user.

Open science — An approach to the scientific process based on open cooperative work, tools and diffusing knowledge.

Research data management — The process within the research lifecycle that includes the organisation, storage, preservation, security, quality assurance, allocation of persistent identifiers (PIDs) and rules and procedures for sharing of data including licensing.

Research outputs — Results to which access can be given in the form of scientific publications, data or other engineered results and processes such as software, algorithms, protocols, models, workflows and electronic notebooks.

Scope of the obligations

For this section, references to ‘beneficiary’ or ‘beneficiaries’ do not include affiliated entities (if any).

Agreement on background

The beneficiaries must identify in a written agreement the background as needed for implementing the action or for exploiting its results.

Where the call conditions restrict control due to strategic interests reasons, background that is subject to control or other restrictions by a country (or entity from a country) which is not one of the eligible countries or target countries set out in the call conditions and that impact the exploitation of the results (i.e. would make the exploitation of the results subject to control or restrictions) must not be used and must be explicitly excluded from it in the agreement on background — unless otherwise agreed with the granting authority.

Ownership of results

Results are owned by the beneficiaries that generate them.

However, two or more beneficiaries own results jointly if:

- they have jointly generated them and
- it is not possible to:
  - establish the respective contribution of each beneficiary, or
  - separate them for the purpose of applying for, obtaining or maintaining their protection.

The joint owners must agree — in writing — on the allocation and terms of exercise of their joint ownership (‘**joint ownership agreement**’), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement or consortium agreement, each joint owner may grant non-exclusive licences to third parties to exploit the jointly-owned results (without any right to sub-license), if the other joint owners are given:

- at least 45 days advance notice and
- fair and reasonable compensation.

The joint owners may agree — in writing — to apply another regime than joint ownership.

If third parties (including employees and other personnel) may claim rights to the results, the beneficiary concerned must ensure that those rights can be exercised in a manner compatible with its obligations under the Agreement.

The beneficiaries must indicate the owner(s) of the results (results ownership list) in the final periodic report.

Protection of results

Beneficiaries which have received funding under the grant must adequately protect their results — for an appropriate period and with appropriate territorial coverage — if protection is possible and justified, taking into account all relevant considerations, including the prospects for commercial exploitation, the legitimate interests of the other beneficiaries and any other legitimate interests.

Exploitation of results

Beneficiaries which have received funding under the grant must — up to four years after the end of the action (see Data Sheet, Point 1) — use their best efforts to exploit their results directly or to have them exploited indirectly by another entity, in particular through transfer or licensing.

If, despite a beneficiary's best efforts, the results are not exploited within one year after the end of the action, the beneficiaries must (unless otherwise agreed in writing with the granting authority) use the Horizon Results Platform to find interested parties to exploit the results.

If results are incorporated in a standard, the beneficiaries must (unless otherwise agreed with the granting authority or unless it is impossible) ask the standardisation body to include the funding statement (see Article 17) in (information related to) the standard.

Additional exploitation obligations

Where the call conditions impose additional exploitation obligations (including obligations linked to the restriction of participation or control due to strategic assets, interests, autonomy or security reasons), the beneficiaries must comply with them — up to four years after the end of the action (see Data Sheet, Point 1).

Where the call conditions impose additional exploitation obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) grant for a limited period of time specified in the request, non-exclusive licences — under fair and reasonable conditions — to their results to legal entities that need the results to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Additional information obligation relating to standards

Where the call conditions impose additional information obligations relating to possible standardisation, the beneficiaries must — up to four years after the end of the action (see Data Sheet, Point 1) — inform the granting authority, if the results could reasonably be expected to contribute to European or international standards.

Transfer and licensing of results

Transfer of ownership

The beneficiaries may transfer ownership of their results, provided this does not affect compliance with their obligations under the Agreement.

The beneficiaries must ensure that their obligations under the Agreement regarding their results are passed on to the new owner and that this new owner has the obligation to pass them on in any subsequent transfer.

Moreover, they must inform the other beneficiaries with access rights of the transfer at least 45 days in advance (or less if agreed in writing), unless agreed otherwise in writing for specifically identified third parties including affiliated entities or unless impossible under the applicable law. This notification must include sufficient information on the new owner to enable the beneficiaries concerned to assess the effects on their access rights. The beneficiaries may object within 30 days of receiving notification (or less if agreed in writing), if they can show that the transfer would adversely affect their access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

Granting licences

The beneficiaries may grant licences to their results (or otherwise give the right to exploit them), including on an exclusive basis, provided this does not affect compliance with their obligations.

Exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights.

Granting authority right to object to transfers or licensing — Horizon Europe actions

Where the call conditions in Horizon Europe actions provide for the right to object to transfers or licensing, the granting authority may — up to four years after the end of the action (see Data Sheet, Point 1) — object to a transfer of ownership or the exclusive licensing of results, if:

- the beneficiaries which generated the results have received funding under the grant
- it is to a legal entity established in a non-EU country not associated with Horizon Europe, and
- the granting authority considers that the transfer or licence is not in line with EU interests.

Beneficiaries that intend to transfer ownership or grant an exclusive licence must formally notify the granting authority before the intended transfer or licensing takes place and:

- identify the specific results concerned
- describe in detail the new owner or licensee and the planned or potential exploitation of the results, and
- include a reasoned assessment of the likely impact of the transfer or licence on EU interests, in particular regarding competitiveness as well as consistency with ethical principles and security considerations.

The granting authority may request additional information.

If the granting authority decides to object to a transfer or exclusive licence, it must formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information it has requested).

No transfer or licensing may take place in the following cases:

- pending the granting authority decision, within the period set out above
- if the granting authority objects
- until the conditions are complied with, if the granting authority objection comes with conditions.

A beneficiary may formally notify a request to waive the right to object regarding intended transfers or grants to a specifically identified third party, if measures safeguarding EU interests are in place. If the granting authority agrees, it will formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information requested).

Limitations to transfers and licensing due to strategic assets, interests, autonomy or security reasons of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security reasons, the beneficiaries may not transfer ownership of their results or grant licences to third parties which are established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless they have requested and received prior approval by the granting authority.

The request must:

- identify the specific results concerned
- describe in detail the new owner and the planned or potential exploitation of the results, and
- include a reasoned assessment of the likely impact of the transfer or license on the strategic assets, interests, autonomy or security of the EU and its Member States.

The granting authority may request additional information.

Access rights to results and background

Exercise of access rights — Waiving of access rights — No sub-licensing

Requests to exercise access rights and the waiver of access rights must be in writing.

Unless agreed otherwise in writing with the beneficiary granting access, access rights do not include the right to sub-license.

If a beneficiary is no longer involved in the action, this does not affect its obligations to grant access.

If a beneficiary defaults on its obligations, the beneficiaries may agree that that beneficiary no longer has access rights.

Access rights for implementing the action

The beneficiaries must grant each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

- informed the other beneficiaries that access to its background is subject to restrictions, or

- agreed with the other beneficiaries that access would not be on a royalty-free basis.

The beneficiaries must grant each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

Access rights for exploiting the results

The beneficiaries must grant each other access — under fair and reasonable conditions — to results needed for exploiting their results.

The beneficiaries must grant each other access — under fair and reasonable conditions — to background needed for exploiting their results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its background is subject to restrictions.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for entities under the same control

Unless agreed otherwise in writing by the beneficiaries, access to results and, subject to the restrictions referred to above (if any), background must also be granted — under fair and reasonable conditions — to entities that:

- are established in an EU Member State or Horizon Europe associated country

- are under the direct or indirect control of another beneficiary, or under the same direct or indirect control as that beneficiary, or directly or indirectly controlling that beneficiary and

- need the access to exploit the results of that beneficiary.

Unless agreed otherwise in writing, such requests for access must be made by the entity directly to the beneficiary concerned.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for the granting authority, EU institutions, bodies, offices or agencies and national authorities to results for policy purposes — Horizon Europe actions

In Horizon Europe actions, the beneficiaries which have received funding under the grant must grant access to their results — on a royalty-free basis — to the granting authority, EU institutions, bodies, offices or agencies for developing, implementing and monitoring EU policies or programmes. Such access rights do not extend to beneficiaries' background.

Such access rights are limited to non-commercial and non-competitive use.

For actions under the cluster 'Civil Security for Society', such access rights also extend to national authorities of EU Member States for developing, implementing and monitoring their policies or programmes in this area. In this case, access is subject to a bilateral agreement to define specific conditions ensuring that:

- the access rights will be used only for the intended purpose and
- appropriate confidentiality obligations are in place.

Moreover, the requesting national authority or EU institution, body, office or agency (including the granting authority) must inform all other national authorities of such a request.

Additional access rights

Where the call conditions impose additional access rights, the beneficiaries must comply with them.

COMMUNICATION, DISSEMINATION, OPEN SCIENCE AND VISIBILITY (— ARTICLE 17)

Dissemination

Dissemination of results

The beneficiaries must disseminate their results as soon as feasible, in a publicly available format, subject to any restrictions due to the protection of intellectual property, security rules or legitimate interests.

A beneficiary that intends to disseminate its results must give at least 15 days advance notice to the other beneficiaries (unless agreed otherwise), together with sufficient information on the results it will disseminate.

Any other beneficiary may object within (unless agreed otherwise) 15 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the results may not be disseminated unless appropriate steps are taken to safeguard those interests.

Additional dissemination obligations

Where the call conditions impose additional dissemination obligations, the beneficiaries must also comply with those.

Open Science

Open science: open access to scientific publications

The beneficiaries must ensure open access to peer-reviewed scientific publications relating to their results. In particular, they must ensure that:

- at the latest at the time of publication, a machine-readable electronic copy of the published version or the final peer-reviewed manuscript accepted for publication, is deposited in a trusted repository for scientific publications

- immediate open access is provided to the deposited publication via the repository, under the latest available version of the Creative Commons Attribution International Public Licence (CC BY) or a licence with equivalent rights; for monographs and other long-text formats, the licence may exclude commercial uses and derivative works (e.g. CC BY-NC, CC BY-ND) and

- information is given via the repository about any research output or any other tools and instruments needed to validate the conclusions of the scientific publication.

Beneficiaries (or authors) must retain sufficient intellectual property rights to comply with the open access requirements.

Metadata of deposited publications must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent, in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: publication (author(s), title, date of publication, publication venue); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the publication, the authors involved in the action and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for any research output or any other tools and instruments needed to validate the conclusions of the publication.

Only publication fees in full open access venues for peer-reviewed scientific publications are eligible for reimbursement.

Open science: research data management

The beneficiaries must manage the digital research data generated in the action ('data') responsibly, in line with the FAIR principles and by taking all of the following actions:

- establish a data management plan ('DMP') (and regularly update it)

- as soon as possible and within the deadlines set out in the DMP, deposit the data in a trusted repository; if required in the call conditions, this repository must be federated in the EOSC in compliance with EOSC requirements

- as soon as possible and within the deadlines set out in the DMP, ensure open access — via the repository — to the deposited data, under the latest available version of the Creative Commons Attribution International Public License (CC BY) or Creative Commons Public Domain Dedication (CC 0) or a licence with equivalent rights, following the principle 'as open as possible as closed as necessary', unless providing open access would in particular:

- be against the beneficiary's legitimate interests, including regarding commercial exploitation, or

- be contrary to any other constraints, in particular the EU competitive interests or the beneficiary's obligations under this Agreement; if open access is not provided (to some or all data), this must be justified in the DMP

- provide information via the repository about any research output or any other tools and instruments needed to re-use or validate the data.

Metadata of deposited data must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: datasets (description, date of deposit, author(s), venue and embargo); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the dataset, the authors involved in the action, and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for related publications and other research outputs.

Open science: additional practices

Where the call conditions impose additional obligations regarding open science practices, the beneficiaries must also comply with those.

Where the call conditions impose additional obligations regarding the validation of scientific publications, the beneficiaries must provide (digital or physical) access to data or other results needed for validation of the conclusions of scientific publications, to the extent that their legitimate interests or constraints are safeguarded (and unless they already provided the (open) access at publication).

Where the call conditions impose additional open science obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) immediately deposit any research output in a repository and provide open access to it under a CC BY licence, a Public Domain Dedication (CC 0) or equivalent. As an exception, if the access would be against the beneficiaries' legitimate interests, the beneficiaries must grant non-exclusive licenses — under fair and reasonable conditions — to legal entities that need the research output to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Plan for the exploitation and dissemination of results including communication activities

Unless excluded by the call conditions, the beneficiaries must provide and regularly update a plan for the exploitation and dissemination of results including communication activities.

SPECIFIC RULES FOR CARRYING OUT THE ACTION (— ARTICLE 18)

Implementation in case of restrictions due to strategic assets, interests, autonomy or security of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security, the beneficiaries must ensure that none of the entities that participate as affiliated entities, associated partners, subcontractors or recipients of financial support to third

parties are established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless otherwise agreed with the granting authority.

The beneficiaries must moreover ensure that any cooperation with entities established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) does not affect the strategic assets, interests, autonomy or security of the EU and its Member States.

Recruitment and working conditions for researchers

The beneficiaries must take all measures to implement the principles set out in the Commission Recommendation on the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers[3], in particular regarding:

- working conditions
- transparent recruitment processes based on merit, and
- career development.

The beneficiaries must ensure that researchers and all participants involved in the action are aware of them.

Specific rules for EIC actions

All EIC actions (EIC Pathfinder actions, EIC Transition actions and EIC Accelerator actions) are subject to the call conditions. They will be managed proactively by the granting authority and the EIC Programme Manager it has appointed. When implementing them, the beneficiaries must closely cooperate and follow their instructions and provide requested information and data in a timely, helpful and constructive manner. Communication between EIC Programme Managers and beneficiaries must take place via the EIC Market Place.

When implementing EIC actions, the beneficiaries acknowledge and accept that they must attend regular (normally six-monthly) progress meetings, if organised by the granting authority.

In addition, the beneficiaries must provide the granting authority with regular data and information on the implementation of the action (normally every three months), if requested by the granting authority and via the EIC Market Place.

The beneficiaries acknowledge and accept that EIC actions are part of (one or more) EIC Portfolio(s) managed by the granting authority and the EIC Programme Managers and therefore subject to the following specific portfolio-related conditions:

- the granting authority may:

[3] Commission Recommendation 2005/251/EC of 11 March 2005 on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers (OJ L 75, 22.3.2005, p. 67).

- move the action to another EIC Portfolio or add additional EIC Portfolios during the action — with 30 days prior notice via the EIC Market Place

- adjustments: change EIC Challenge Portfolio objectives and roadmap during the action and, if needed, request adjustments to the action activities, milestones or deliverables (amendment; see Article 39)

- for challenge-based EIC Pathfinder actions: suspend or terminate the action, if there is no agreement on adjustments needed to ensure relevance with the objectives or roadmap of the Challenge Portfolio for which the action has been selected (see Articles 31.2 and 32.3)

- the Programme Manager may:

  - request participation in EIC Portfolio activities (such as conferences, workshops, EIC Portfolio or networks meetings, experience and data sharing activities, and EIC Business Acceleration Service events, etc.)

  - propose or accept the organisation of EIC additional Portfolio activities (for EIC Pathfinder actions: possibility of additional funding of up to EUR 50 000 to cover the related costs).

The beneficiaries must comply with the additional IPR, dissemination and exploitation obligations set out in the call conditions, in particular:

- use the EIC Market Place platform to exchange information on results (including preliminary findings) and Portfolio activities, in accordance with the Terms and Conditions of that platform

- clarify all intellectual property issues before the grant is signed and cover them in the consortium agreement (including ownership and co-ownership of results, consortium-internal approval processes for the dissemination of results, pre-existing technologies, appropriate licensing agreements for background, etc.) and, if requested, provide a copy to the granting authority

- provide updates to the plan for exploitation and dissemination of the results and information on dissemination or exploitation activities, if requested by the granting authority and for up to four years after the end of the action

- in case of indirect exploitation of the results: give priority to entities established in a Member State or a Horizon Europe associated country to exploit the results

- for beneficiaries that are non-profit legal entities in EIC Pathfinder or EIC Transition actions: EIC Inventors are granted indefinite access rights for exploitation purposes under the following conditions:

  - the access rights are granted on a royalty-free basis, unless the beneficiary provides support to the EIC inventor to exploit the results (in which case the royalties may be shared on mutually beneficial terms, provided this does not make the exploitation by the EIC inventor impossible)

  - the EIC Inventor must inform the beneficiary in due time before any exploitation activity they intend to undertake, and report to the beneficiary on the implementation

  - if the beneficiary considers that the exploitation activity could negatively affect its own exploitation activities (as set out in the plan for exploitation and dissemination), it may request the granting authority to suspend the EIC Inventor's access rights

- comply with dissemination restrictions imposed by the granting authority in the plan for exploitation and dissemination of the results (if any), i.e.:

  - prior protection

  - simultaneous unrestricted dissemination through the EIC Market Place

  - for results that qualify for an EIC Transition action or EIC Business Acceleration Services: prior assessment of the innovation potential

- allow the granting authority to also disseminate and promote the exploitation of the results, if they have already been made public by the beneficiary (or with its consent) or if, despite its best efforts, no exploitation has taken place, no interested party to exploit the results through the Horizon Results Platform has been found and it cannot demonstrate an alternative exploitation opportunity

In addition to the obligations set out in Article 17, communication and dissemination activities as well as infrastructure, equipment or major results funded under EIC actions must also display the following special logo:

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When implementing EIC Accelerator actions, the beneficiaries must moreover comply with the following additional obligations:

- investment component: the pursuit of the action depends on the approval of the investment component by the EIC Fund and its integration into the Agreement (amendment to add the investment component into the Data Sheet, Point 1 and Articles 1 and 3 and to adapt the description of the action in Annex 1 and add the investment agreement as Annex 6) if no agreement can be reached with the EIC Fund on the investment, the action may be terminated

- implementation, monitoring and reporting:

  - the grant and investment components of the action will be interlinked and managed and monitored together and in close coordination with the EIC Fund, in particular:

    - the information, data and documents regarding both components (including sensitive information within the meaning of Article 13) are considered as information, data and documents of the action and may be

mutually exchanged between the granting authority and the EIC Fund and relied on for the management of both components (if needed)

- the investment agreement signed by the EIC Fund will be attached to the Agreement and become an integral part of it (Annex 6)

- the rights and obligations under the investment agreement may be exercised and enforced both by the granting authority or the EIC Fund, interchangeably

- issues regarding either component may impact the other component and lead to the suspension or termination of the entire action (including exit from the investment)

- reorientation: the parties (beneficiary or granting authority) may request an amendment (see Article 39) to reorient the action (including its objectives or substantial changes affecting the objectives), if required by a change of circumstances and provided that the action remains eligible under the call for which it was selected and does not lose its relevance

- progress meetings and reviews:

  - there will be at least one intermediary progress meeting and a final progress meeting at the end of the action, before submission of the final report

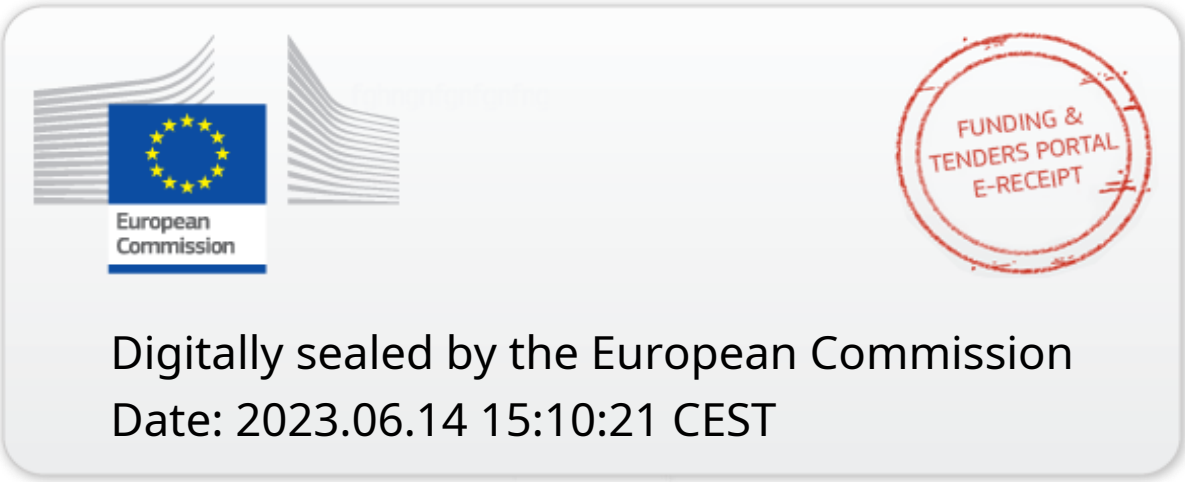
  - the granting authority will be represented by the EIC Project Officers and EIC Programme Managers and may be assisted by other Commission representatives, EIC Fund representatives or independent outside experts; if independent outside experts are used as reviewers, the beneficiaries will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest

  - if a progress meeting confirms grounds for suspension or termination of the action, the notification of the meeting minutes (progress meeting conclusions) will serve as pre-information letter, with a reduced deadline for submitting observations (15 days after receiving the meeting minutes)

  - the final report will be assessed by independent outside reviewers (see Article 25.1.2)

- IPR, dissemination and exploitation:

  - the IPR, dissemination and exploitation obligations set out in the EIC Fund investment agreement (see Annex 6) will apply; the provisions set out in Annex 5 will therefore only apply until the EIC Fund investment agreement is concluded or if the Agreement is terminated early.



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