Horizon 2020

Call: H2020-SC5-2016-2017
(Greening the Economy)

Topic: SC5-01-2016-2017

Type of action: RIA
(Research and Innovation action)

Proposal number: 776787

Proposal acronym: S2S4E

Deadline Id: H2020-SC5-2017-OneStageB
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How to fill in the forms

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the previous steps in the submission wizard.

Proposal ID **776787** *Acronym* **S2S4E**

1 - General information

Topic	SC5-01-2016-2017
Call Identifier	H2020-SC5-2016-2017
Type of Action	RIA
Deadline Id	H2020-SC5-2017-OneStageB

Acronym: S2S4E

Proposal title*: Sub-seasonal to Seasonal climate forecasting for Energy

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months: *36*

Fixed keyword 1: *Climatology and climate change* Add

Free keywords: *Energy demand and supply, renewable energies, energy management, energy market, climate predictions, sub-seasonal to seasonal forecast, decision support tool, probabilistic information.*

Proposal ID **776787** *Acronym* **S2S4E**

Abstract

Large scale deployment of renewable energy (RE) is key to comply with the GHG emissions reduction set by the COP21 agreement. Despite cost competitive in many settings, RE diffusion remains limited largely due to its variability. This works as a major barrier to RE's integration in electricity networks as knowledge of power output and demand forecasting beyond a few days remains poor. To help solve this problem, S2S4E will offer an innovative service to improve RE variability management by developing new research methods exploring the frontiers of weather conditions for future weeks and months. The main output of S2S4E will be a user co-designed Decision Support Tool (DST) that for the first time integrates sub-seasonal to seasonal (S2S) climate predictions with RE production and electricity demand. To support the dissemination of climate services, a pilot of the DST will be developed in two steps. The first will draw on historical case studies pointed as relevant by energy companies - e.g. periods with an unusual climate behaviour affecting the energy market. The second step will improve probabilistic S2S real-time forecasts built up into the DST and assess their performances in real life decision-making in these companies. This process will be co-designed with consortium's partners which represent different needs and interests in terms of regions, RE sources (wind, solar and hydro) and electricity demand. Besides the partners, S2S4E will engage other users from the energy sector as well as other business areas and research communities to further explore DST application and impact. As a result, DST will enable RE producers and providers, electricity network managers and policy makers to design better informed S2S strategies able to improve RE integration, business profitability, electricity system management, and GHG emissions' reduction. The long-term objective is to make the European energy sector more resilient to climate variability and extreme events.

Remaining characters 9

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

Proposal ID **776787** *Acronym* **S2S4E**

Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him/her and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection
The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database).

Proposal ID **776787** *Acronym* **S2S4E**

List of participants

#	Participant Legal Name	Country
1	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain
2	CICERO SENTER KLIMAFORSKNING STIFTELSE	Norway
3	EDP RENOVAVEIS SA	Spain
4	ENBW ENERGIE BADEN-WURTTEMBERG AG	Germany
5	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE	Italy
6	THE UNIVERSITY OF READING	United Kingdom
7	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Sweden
8	ELECTRICITE DE FRANCE	France
9	CAPGEMINI TECHNOLOGY SERVICES	France
10	LGI CONSULTING SARL	France
11	the climate data factory	France
12	NNERGIX ENERGY MANAGEMENT S.L.	Spain

2 - Administrative data of participating organisations

PIC	***Legal name***
999655520	*BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION*

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 01/03/2005 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Earth Sciences ☐ not applicable

☐ Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **BSC**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Albert** Last name: **Soret**

E-Mail: **albert.soret@bsc.es**

Position in org.: Earth System Services Group Coordinator

Department: Earth Sciences [ ] Same as organisation

[ ] Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona Post code: 08034

Country: Spain

Website: https://www.bsc.es/

Phone 1: +34 934134076 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Dorota	CHMIELEWSKA	dorota.chmielewska@bsc.es	+34 934134082
Isadora	Jimenez	isadora.jimenez@bsc.es	+34 934134076
Mar	Rodriguez	mar.rodriguez@bsc.es	+34 934137566

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **CICERO**

PIC	***Legal name***
998157161	*CICERO SENTER KLIMAFORSKNING STIFTELSE*

Short name: CICERO

Address of the organisation

Street Gaustadallèen 21

Town Oslo

Postcode 0349

Country Norway

Webpage www.cicero.uio.no

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 29/05/2009 - no

SME self-assessment ..... unknown

SME validation sme ..... 29/05/2009 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **CICERO**

Department(s) carrying out the proposed work

No department involved

Department name ☒ not applicable

☐ Same as organisation address

Street *Please enter street name and number.*

Town

Postcode

Country

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **CICERO**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name: **Jana** Last name: **Sillmann**

E-Mail: **jana.sillmann@cicero.oslo.no**

Position in org.: Senior research fellow

Department: CICERO SENTER KLIMAFORSKNING STIFTELSE ☒ Same as organisation

☒ Same as organisation address

Street: Gaustadallèen 21

Town: Oslo Post code: 0349

Country: Norway

Website: http://cicero/no

Phone 1: Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Sigrid	Rian	sigrid.rian.song@cicero.oslo.no	+4791757375

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EDPR SA**

PIC	***Legal name***
921219089	*EDP RENOVAVEIS SA*

Short name: EDPR SA

Address of the organisation

Street PLAZA DE LA GESTA 2

Town OVIEDO

Postcode 33007

Country Spain

Webpage

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no
Non-profit ..... no
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... no
Research organisation ..... no
Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown
SME self-assessment ..... unknown
SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EDPR SA**

Department(s) carrying out the proposed work

Department 1

Department name: Energy Assessment ☐ not applicable

☐ Same as organisation address

Street: Serrano Galvache, 56 - Edificio Encina

Town: Madrid

Postcode: 28033

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EDPR SA**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Daniel** Last name: **Cabezón**

E-Mail: **daniel.cabezon@edpr.com**

Position in org.: Meteorological Models and Special Tasks Manager

Department: Energy Assessment ☐ Same as organisation

☐ Same as organisation address

Street: Serrano Galvache, 56 - Edificio Encina, 5a planta

Town: Madrid Post code: 28033

Country: Spain

Website: www.edpr.com

Phone 1: +34662343428 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EnBW**

PIC	***Legal name***
993419972	*ENBW ENERGIE BADEN-WURTTEMBERG AG*

Short name: EnBW

Address of the organisation

Street DURLACHER ALLEE 93

Town KARLSRUHE

Postcode 76131

Country Germany

Webpage www.enbw.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no
Non-profit ..... no
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... no
Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 22/10/1997 - no
SME self-assessment ..... unknown
SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Energy Markets – Analysis & Evaluation ☐ not applicable

☐ Same as organisation address

Street: Durlacher Allee 93

Town: Karlsruhe

Postcode: 76131

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EnBW**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Matthias** Last name: **Piot**

E-Mail: **m.piot@enbw.com**

Position in org.: Meteorologist / Gas Analyst

Department: Energy Markets – Analysis & Evaluation ☐ Same as organisation

☒ Same as organisation address

Street: DURLACHER ALLEE 93

Town: KARLSRUHE Post code: 76131

Country: Germany

Website: www.enbw.com

Phone 1: +497216316157 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Christoph	Elsaesser	c.elsaesser@enbw.com	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **ENEA**

PIC	***Legal name***
999988521	*AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO*

Short name: ENEA

Address of the organisation

Street Lungotevere Grande Ammiraglio Thaon di Reve

Town ROMA

Postcode 00196

Country Italy

Webpage http://www.enea.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 03/09/2003 - no

SME self-assessment ..... unknown

SME validation sme ..... 03/09/2003 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Department for Sustainability ☐ not applicable

☐ Same as organisation address

Street: Via Anguillarese 301

Town: Rome

Postcode: 00123

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **ENEA**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Matteo** Last name: **De Felice**

E-Mail: **matteo.defelice@enea.it**

Position in org.: Scientist

Department: Department for Sustainability ☐ Same as organisation

☐ Same as organisation address

Street: Via Anguillarese 301

Town: Rome Post code: 00123

Country: Italy

Website:

Phone 1: 00390516098745 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Pierluigi	Fanchin	pierluigi.fanchin@enea.it	0039051 6098194

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **UREAD**

PIC	***Legal name***
999984156	*THE UNIVERSITY OF READING*

Short name: UREAD

Address of the organisation

Street WHITEKNIGHTS CAMPUS WHITEKNIGHTS H

Town READING

Postcode RG6 6AH

Country United Kingdom

Webpage http://www.rdg.ac.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 17/03/1926 - no

SME self-assessment ..... unknown

SME validation sme ..... 17/03/1926 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Department of Meteorology ☐ not applicable

☐ Same as organisation address

Street: Whiteknights Campus

Town: Reading

Postcode: RG6 6BB

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **UREAD**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **David** Last name: **Brayshaw**

E-Mail: **d.j.brayshaw@reading.ac.uk**

Position in org.: Lecturer in Meteorology

Department: Department of Meteorology ☐ Same as organisation

☐ Same as organisation address

Street: Whiteknights Campus

Town: Reading Post code: RG6 6BB

Country: United Kingdom

Website: http://www.met.reading.ac.uk/

Phone 1: +44 (0) 118 378 5585 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Ioanna	Theophanous	i.theophanous@reading.ac.uk	+44 (0) 118 378 4184
EU-Unit	Reading	eu-unit@reading.ac.uk	+44 (0) 118 378 4184

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **SMHI**

PIC	***Legal name***
999507983	*SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT*

Short name: SMHI

Address of the organisation

Street Folkborgsvaegen 1

Town NORRKOEPING

Postcode 601 76

Country Sweden

Webpage www.smhi.se

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Hydrological Research ☐ not applicable

☒ Same as organisation address

Street: Folkborgsvaegen 1

Town: NORRKOEPING

Postcode: 601 76

Country: Sweden

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **SMHI**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Ilias** Last name: **Pechlivanidis**

E-Mail: **ilias.pechlivanidis@smhi.se**

Position in org.: Researcher

Department: Hydrological Research ☐ Same as organisation

☒ Same as organisation address

Street: Folkborgsvaegen 1

Town: NORRKOEPING Post code: 601 76

Country: Sweden

Website: http://www.smhi.se/en/research/research-departments/hydrology/ili

Phone 1: +46114958258 Phone 2: +46114958000 Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Monica	Wallgren	monica.wallgren@smhi.se	+46114958104

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EDF**

PIC	***Legal name***
999926829	*ELECTRICITE DE FRANCE*

Short name: EDF

Address of the organisation

Street AVENUE DE WAGRAM 22

Town PARIS 08

Postcode 75008

Country France

Webpage www.edf.fr

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 12/08/2008 - no

SME self-assessment ..... unknown

SME validation sme ..... 12/08/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research & Development / MFEE ☐ not applicable

☐ Same as organisation address

Street: 6 Quai Watier

Town: CHATOU

Postcode: 78400

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **EDF**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Laurent** Last name: **Dubus**

E-Mail: **laurent.dubus@edf.fr**

Position in org.: Expert Research Engineer

Department: Fluid Mechanics, Energies & Environment ☐ Same as organisation

☐ Same as organisation address

Street: 6 Quai Watier

Town: CHATOU Post code: 78400

Country: France

Website:

Phone 1: +33130877664 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **CAPGEMINI TS**

PIC	***Legal name***
947643150	*CAPGEMINI TECHNOLOGY SERVICES*

Short name: CAPGEMINI TS

Address of the organisation

Street 5-7 RUE FREDERIC CLAVEL

Town SURESNES

Postcode 92287

Country France

Webpage http://www.capgemini.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 07/12/2004 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Aero, Space and Defense Market Unit ☐ not applicable

☐ Same as organisation address

Street: 109 avenue Eisenhower

Town: Toulouse

Postcode: 31036

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **CAPGEMINI TS**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr. Sex: (•) Male ( ) Female

First name: **Roger** Last name: **Rutakaza Maneno**

E-Mail: **roger.rutakaza@capgemini.com**

Position in org.: Chief architect

Department: Customer Service Development / Space Department ☐ Same as organisation

☐ Same as organisation address

Street: 109 Avenue Eisenhower

Town: Toulouse Post code: 31036

Country: France

Website:

Phone 1: +33 5 31 08 91 43 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Carine	Saüt	carine.saut@capgemini.com	+33 5 31 08 91 43

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **LGI**

PIC	***Legal name***
999677733	*LGI CONSULTING SARL*

Short name: LGI

Address of the organisation

Street RUE MARIVAUX 13

Town PARIS

Postcode 75002

Country France

Webpage www.lgi-consulting.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no
Non-profit ..... no
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... no
Research organisation ..... no
Legal person ..... yes

Enterprise Data

SME self-declared status ..... 31/12/2013 - yes
SME self-assessment ..... 31/12/2013 - yes
SME validation sme ..... 17/06/2008 - yes

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Strategy & Innovation ☐ not applicable

☒ Same as organisation address

Street: RUE MARIVAUX 13

Town: PARIS

Postcode: 75002

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **LGI**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mrs Sex: ○ Male ◉ Female

First name: **Camille** Last name: **Auriault**

E-Mail: **camille.auriault@lgi-consulting.com**

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☒ Same as organisation address

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Proposal ID **776787**	*Acronym* **S2S4E**	*Short name* **the climate data factory**

PIC	***Legal name***
920209028	*the climate data factory*

Short name: the climate data factory

Address of the organisation

Street 12 rue de Belzunce

Town Paris

Postcode 75010

Country France

Webpage www.theclimatedatafactory.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 03/03/2016 - yes

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Proposal ID **776787**	*Acronym* **S2S4E**	*Short name* **the climate data factory**

Department(s) carrying out the proposed work

No department involved

Department name		☒ not applicable
	☐ Same as organisation address	
Street	*Please enter street name and number.*	
Town		
Postcode		
Country		

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **the climate data factory**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Harilaos** Last name: **Loukos**

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Proposal ID **776787** *Acronym* **S2S4E** *Short name* **NNERGIX**

PIC	***Legal name***
915372317	*NNERGIX ENERGY MANAGEMENT S.L.*

Short name: NNERGIX

Address of the organisation

Street Avd. Diagonal 534 2º-2

Town Barcelona

Postcode 08006

Country Spain

Webpage http://www.nnergix.com/

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no
Non-profit ..... no
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... no
Research organisation ..... no
Legal person ..... yes

Enterprise Data

SME self-declared status ..... 31/12/2016 - yes
SME self-assessment ..... 31/12/2016 - yes
SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **NNERGIX**

Department(s) carrying out the proposed work

No department involved

Department name ☒ not applicable

☐ Same as organisation address

Street *Please enter street name and number.*

Town

Postcode

Country

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776787** *Acronym* **S2S4E** *Short name* **NNERGIX**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr. Sex: (•) Male ( ) Female

First name: **Joan Miquel** Last name: **Anglès**

E-Mail: **jmangles@nnergix.com**

Position in org.: Sales Manager

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☐ Same as organisation address

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Country: Spain

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Other contact persons

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Proposal ID **776787** *Acronym* **S2S4E**

3 - Budget for the proposal

No	Participant	Country	(A) Direct personnel costs/€	(B) Other direct costs/€	(C) Direct costs of sub-contracting/€	(D) Direct costs of providing financial support to third parties/€	(E) Costs of inkind contributions not used on the beneficiary's premises/€	(F) Indirect Costs / € (=0.25(A+B-E))	(G) Special unit costs covering direct & indirect costs / €	(H) Total estimated eligible costs / € (=A+B+C+D+F+G)	(I) Reimburse-ment rate (%)	(J) Max.EU Contribution / € (=H*I)	(K) Requested EU Contribution/ €
1	Bsc	ES	616500	117000	0	0	0	183375,00	0	916875,00	100	916875,00	916875,00
2	Cicero	NO	483140	76000	0	0	0	139785,00	0	698925,00	100	698925,00	698925,00
3	Edpr Sa	ES	109440	12000	0	0	0	30360,00	0	151800,00	100	151800,00	151800,00
4	Enbw	DE	139657	12000	0	0	0	37914,25	0	189571,25	100	189571,25	189571,25
5	Enea	IT	195504	38000	0	0	0	58376,00	0	291880,00	100	291880,00	291880,00
6	Uread	UK	360795	26880	0	0	0	96918,75	0	484593,75	100	484593,75	484593,75
7	Smhi	SE	333200	40000	0	0	0	93300,00	0	466500,00	100	466500,00	466500,00
8	Edf	FR	152615	12000	0	0	0	41153,75	0	205768,75	100	205768,75	205768,75
9	Capgemini Ts	FR	335500	13500	0	0	0	87250,00	0	436250,00	100	436250,00	436250,00
10	Lgi	FR	330000	17500	0	0	0	86875,00	0	434375,00	100	434375,00	434375,00

11	The Climate Data Factory	FR	217800	18000	0	0	0	58950,00	0	294750,00	100	294750,00	294750,00
12	Nnergix	ES	145000	15000	0	0	0	40000,00	0	200000,00	100	200000,00	200000,00
	Total		3419151	397880	0	0	0	954257,75	0	4771288,75		4771288,75	4771288,75

Proposal ID **776787** *Acronym* **S2S4E**

4 - Ethics issues table

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	○ Yes ◉ No	
5. ANIMALS		**Page**
Does your research involve animals?	○ Yes ◉ No	
6. THIRD COUNTRIES		**Page**
In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	○ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	○ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	○ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	○ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ◉ No	

Proposal ID **776787** *Acronym* **S2S4E**

7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	○ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	○ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	○ Yes ◉ No	
8. DUAL USE		**Page**
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	○ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		**Page**
Could your research raise concerns regarding the exclusive focus on civil applications?	○ Yes ◉ No	
10. MISUSE		**Page**
Does your research have the potential for misuse of research results?	○ Yes ◉ No	
11. OTHER ETHICS ISSUES		**Page**
Are there any other ethics issues that should be taken into consideration? Please specify	○ Yes ◉ No	

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

Proposal ID **776787** *Acronym* **S2S4E**

5 - Call specific questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

S2S4E

Sub-seasonal to Seasonal climate predictions for Energy

List of participants

Participant No	Participant organisation name	Short name	Country	Type
1 (Coordinator)	Barcelona Supercomputing Center - Centro Nacional de Supercomputación	BSC	Spain	Research centre
2	CICERO Senter for Klimaforskning Stiftelse	CICERO	Norway	Research centre
3	EDP Renováveis SA	EDPR	Spain	Industry
4	ENBW Energie Baden-Württemberg AG	EnBW	Germany	Industry
5	Agenzia Nazionale per le Nuove Tecnologie, L'energia e lo Sviluppo Economico Sostenibile	ENEA	Italy	Research centre
6	The University of Reading	UREAD	UK	Research centre
7	Sveriges Meteorologiska Och Hydrologiska Institut	SMHI	Sweden	Research centre
8	Electricité de France	EDF	France	Industry
9	CAPGEMINI Technology Services	CAPGEMINI	France	Industry
10	LGI Consulting SARL	LGI	France	SME
11	The Climate Data Factory	TCDF	France	SME
12	NNERGIX Energy Management S.L	NNERGIX	Spain	SME

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GLOSSARY

C3S	Copernicus Climate Change Services
DSO	Distribution system operator
DST	Decision Support Tool
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential climate variables
EGU	European Geosciences Union
E-HYPE	High-resolution pan-European water model
EMS	European Meteorological Society
ENTSO-E	European Network of Transmission System Operators
GHG	Greenhouse Gas
ICEM	International Conference on Energy & Meteorology
IRENA	International Renewable Energy Agency
NAO	North Atlantic Oscillation
NMME	North American Multi-Model Ensemble
QA	Quality Assurance
RE	Renewable energy
S2S	Sub-seasonal to seasonal
SDG	Strategic Development Goal
SET	Strategic Energy Technology Plan
TRL	Technology Readiness Levels
TSO	Transmission System Operator

1. Excellence

1.1 Objectives

Renewable energy is the fastest growing source of electricity globally and its annual additions in generation capacity met more than 90% of the global increase in 2015 (IEA, 2015a). With the aim of fostering EU leadership in renewable energy, the European Commission is ready to invest over 23 billion euros in projects directed to the creation and improvement of clean energy technologies such as wind, solar, smart grids, and energy storage (EC, 2014). This also has a spillover effect on fostering investment from private companies. For instance, only between 2007 and 2011, the total yearly R&D investment in renewable technologies has more than doubled, going from 2.8 billion euros to 7.1 billion euros, with more than 60% coming from the industry (SET, 2014).

Yet, renewable energy diffusion still faces important challenges related to its large scale integration in the energy system. Due to its variability and possibility of small scale deployment, renewable energy sources are promoting disruptive changes in the energy market. S2S4E aims to foster renewable energy deployment while also maintaining energy security by providing sub-seasonal to seasonal (S2S) climate forecasts. S2S4E aims to enable the energy industry and policy makers to assess how well different renewable energy sources will meet demand over extended time horizons (weeks to months), focusing on the impact of climate variables on energy outputs and needs. **The main objective of S2S4E is to make the European energy sector more resilient to climate variability and high impact events by exploring the frontiers of what can be achieved by using S2S predictions offering a new decision support tool based on S2S climate predictions. In addition, S2S4E will contribute for the expansion of climate services to users and markets as it will base its development on a user-centric framework for co-design and co-development. As a result, S2S4E will advance the goals established by the European Commission's Roadmap for climate services.**

This objective will be achieved through the development of S2S climate predictions tailored to users' requirements and provided as a Decision Support Tool (DST) which will be co-designed and co-developed with relevant users[1] - mainly energy companies. S2S4E will be run upon strong engagement with the users included as partners in the consortium to represent different needs and interests in terms of regions, renewable energy sources and electricity demand, namely: EDPR (Iberian Peninsula/wind, hydro and demand), EDF (Western Europe/hydro, demand, wind and solar) and EnBW (Central Europe/ wind, solar, hydro and demand). Based on a user-centric approach to climate services development, S2S4E will provide access to tailored real-time climate prediction products to optimise decision making across all levels of the energy sector community (e.g. resource and supply management strategies for energy producers and grid operators, anticipation of energy prices for energy traders, planning for operational and maintenance works especially in offshore wind farms and anticipation of cash flow variability to optimize return on investments).

To achieve these goals, S2S4E will address the following six specific objectives (related work packages are given in parentheses):

Objective 1. To explore the scientific and technological frontiers of sub-seasonal predictions and their synthesis with seasonal predictions to provide useful information for decision making processes in the energy sector.

This project brings two novelties, as to the best of our knowledge, it is the first time that services for sub-seasonal predictions and their synthesis with seasonal predictions and user requirements are offered; and that parameters for different energy sources such as wind, solar and hydro and electricity demand are integrated into one tool. This will be achieved by developing methodologies (multi-model approach, bias-correction, statistical downscaling and reconstruction of the essential climate variables (ECV)) to maximize the utility of sub-seasonal and seasonal forecasts for the energy sector with the aim to inform the design of a real-time forecasting system. It will result in the detection of windows of opportunity for S2S time scales, periods in which the Rank Probabilistic Skill Score (RPSS[2]) is higher than 0. (WP4).

[1] For simplicity and readability, throughout the proposal we will use the term *users* to refer to: energy companies (energy producers, energy providers, TSOs, DSOs), weather and climate forecasters, policy makers, as well as research institutions and consultancy companies working with climate and/or energy issues.

[2] RPSS: statistical indicator that computes the cumulative squared error between the categorical forecast probabilities and the observed category in relevance to a reference forecast (Wilks, 1995).

Objective 2. To advance the understanding of observational climate data sets.

Energy companies routinely use observational data sets to understand past climate events and conduct climatological analyses. A specific objective of the project will be to provide an assessment of observational uncertainty by comparing at least five global reanalyses and evaluating reanalyses with point-wise observations. To this end, observational data sets will help to maximize the utility of S2S forecasts for the key climate and energy metrics of value to the energy sector. This will be achieved by developing techniques, methods and models that allow operational S2S climate forecasts to be optimally combined with other geophysical and energy-relevant data as well as process-based hydrological models. (WP3 and WP4)

Objective 3. To develop a framework to assess the economic benefits from using S2S predictions by using historical case studies.

Assess how S2S predictions can help energy companies to improve their operational and investment decisions and therefore improve their economic performance using real cases. Eight case studies will be developed based on the simulation and analysis of real data obtained from past periods with an unusual climate behaviour affecting the energy market. Next, the corresponding S2S simulations will be run and integrated at users' operations. As a result, these case studies will provide in depth understanding of S2S climate service application in the energy sector. (WP2)

Objective 4. Implementation of the Decision Support Tool (DST) and provision of updated real-time forecasts.

Implementation of the Operational Climate Service as a DST that integrates S2S climate predictions and users requirements to provide indicators for wind (capacity factor), solar (capacity factor), hydro (change in water inflow and annual snow maximum anomaly) and electricity demand (consumption rate) capable of fostering the optimisation of power output and electricity demand forecasts. The DST will deliver sub-seasonal forecasts every week and seasonal forecasts every month, during the operational phase (18 months). (WP5)

Objective 5. Build an interactive link with users to promote continuous improvement of the forecasts from the Decision Support Tool (DST)

To foster information exchange with users and promote the continuous improvement of DST, forecast outlooks will be produced and distributed to the industrial partners and any subscribed user every month during the operational phase of the project (18 months). These forecast outlooks will contain both: an assessment of coming forecasts including an analysis of the main weather patterns affecting the different energy indicators; and an evaluation of previous forecasts. In this way, monthly forecast outlooks will work also as a valuable tool to build trust among users on the information provided by DST as well as enhance awareness about climate services benefits. During the project, forecast information will be freely available on the DST and the forecast outlooks will be disseminated through an email list constructed combining information on potential users from all databases of all partners in the consortium and visitors of the DST (WP2 and WP7)

Objective 6. To understand how real-time S2S forecasts can be integrated into the decision making processes of energy market players and assess their potential impacts.

Illustrate how real-time S2S forecasts have been integrated into the decision making processes of different users, namely the energy companies partners in the consortium. To this end, a team combining researchers and energy traders from academic and energy company partners will compare decisions based on current methodologies against the ones based on energy-tailored probabilistic information from the DST to provide an accurate economic evaluation. (WP2).

To achieve the S2S4E objectives, BSC is leading an interdisciplinary and experienced consortium that brings together five research institutes (combining over 4000 researchers with leading positions in the academic community in different research lines, between others: climate services, renewable energies, high performance computing, big data and visualization), three energy companies (accounting for more than 15% of the renewable energy generated in the EU and with energy plants in other continents), three SMEs (relevant companies in their specific field with a versatile and flexible structure to adapt their strategy to new business opportunities) and a large consulting company (with a strong focus and extended experience in energy markets).

1.2 Relation to the work programme

S2S4E responds to the call H2020 SC5-01-2017: "Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept RIA".

The main goal of the S2S4E is well aligned with the overarching challenge of this call, namely "…*the development of climate services concepts that are ready to be used, or show potential for future deployment, demonstrating the added value of using climate information and services by end-users in their operational decision-making.*" Furthermore, all underpinning elements outlined in the specific scope and challenge of the call will be addressed by S2S4E as follows:

To foster "climate-informed decision-making at all levels. The challenge is to minimise risks and costs and to seize opportunities."
S2S4E will achieve this by providing reliable and accurate S2S forecasts, by building up a strong relationship with industrial partners in the project as well as by disseminating the DST within a broader community of potential users. To this end, S2S4E will run experiments with traders from energy companies partners in the consortium to build an accurate economical evaluation of DST performance. The DST will enable users to improve their operational efficiency (e.g. reduce unplanned downtime and maintenance, reduce risks of extreme wear and tear, reduce grid management costs), increase power output (e.g. optimize electricity demand and trade) and reduce risks of power supply interruption (e.g. plan for extended periods of extreme cold/heat). (Objectives 3, 4, 5, 6)
"Bringing climate services to the market requires serving the demand of end-users and developing the business interface between suppliers and users of climate services."
S2S4E will achieve this by establishing a close link with DST users based on information exchange, co-development and co-design of the tool. In practice, S2S4E will conduct participatory activities (e.g. focus groups and interviews) with partners and other potential users, as well as promote and participate in international events to foster awareness of the benefits related to S2S forecasts. Moreover, S2S4E will develop business models co-designed with the business partners involved in the project to ensure an efficient interface is available for the full exploitation of the DST during and beyond the duration of the project. (Objectives 3, 5, 6, 7)
"Matching the demand for (climate) services and the competences in the field. However, the availability of data, information and services does not always correspond to users' needs."
S2S4E will achieve this by co-developing and co-designing the DST with users. Energy companies partners in the consortium as well as a broader audience of users will have access to forecasts produced during the project to validate it. Simultaneously, S2S4E will map user needs through the organisation of workshops and interviews. In this way, the final version of the DST will have incorporated the feedbacks of users during the project and will also remain open to information tailoring following the parameters pointed as most relevant during the validation processes. (Objectives 2, 3, 4, 5)
"Develop future applications in the most promising fields and to mobilise end-user communities"
S2S4E will achieve this by **offering for the first time an integrated S2S forecast for solar, wind, hydro generation and electricity demand which enhances the impact of forecasts on energy companies' global performance.** S2S4E will focus at the energy sector since it is under deep transformation promoted by renewable energy diffusion and climate change. There is an urgent need for energy companies to get accurate forecasts about S2S climate conditions to reduce the impact of variability from renewable energy (e.g. wind and solar), as well as to improve resource planning in the face of strong demand variability (e.g. extreme heat/cold waves). (Objectives 2, 3, 4, 5, 6)
"Development of climate services concepts that are ready to be used, or show potential for future deployment, demonstrating the added value of using climate information and services by end-users in their

operational decision-making."

S2S4E will achieve this by running experiments with traders from energy companies partners in the consortium to build an accurate economical evaluation of the DST performance. The DST will enable users to improve their operational efficiency (e.g. reduce unplanned downtime and maintenance, reduce risks of extreme wear and tear, reduce grid management costs), increase power output (e.g. optimize electricity demand and trade) and reduce risks of power supply interruption (e.g. plan for extended periods of extreme cold/heat). In addition, S2S4E will map business models to maximise the exploitation of DST by business partners thus enhancing its diffusion across energy users (Objectives 2, 3, 4, 6)

"Co-design (involving both suppliers/purveyors and users) pilot applications that support the proof-of-concept phase of climate services with high added-value in potential markets."

S2S4E will achieve this by building an interactive link with users to promote continuous improvement of the forecasts from the DST. During the project, users will have access to a series of forecast outlooks (one per month during the operational phase) enabling their validation in different decision-making processes, as well as the assessment of their economic impacts. In addition, S2S4E puts a strong emphasis on dissemination activities which are opened to audiences from other sectors fostering the possibility of a diversified exploitation of the DST (e.g. agriculture, air quality, urban monitoring, insurance, forestry management). (Objectives 5, 6).

"Create case studies to address methodological issues, develop the user interface, and test the relevance of climate services with a view to co-designing demonstration projects with the end-users at a later stage."

S2S4E will achieve this by developing eight case studies in a joint effort with energy companies' and research centres partners in the project. Within each case study, partners will discuss examples of S2S forecasts with a focus on forecast characteristics (e.g. time resolution, time horizon, and uncertainty). The usefulness of these data and the potential economic benefits will be developed to get a more complete understanding on how to tailor forecasts to enhance their impact on decision making. (Objectives 1, 2, 3, 6)

"Take into account and where possible build upon activities addressed by other initiatives such as the ERA-NET Cofund action on climate services opened in the Horizon 2020 Societal Challenge 5 call of 2015."

S2S4E will achieve this through the strong links with previous (e.g FP7: EUPORIAS-308291 and SPECS-308378) and current projects (e.g. Copernicus CLIM4ENERGY, ECEM and H2020 MARCO-730272) (see Table 2). Regarding the ERA-NET Cofund for Climate Services: *"European Research Area for Climate Services"* (*ERA4CS*-690462), BSC is one of the members of the consortium and WP leader. *ERA4CS* has been designed to boost the development of efficient Climate Services in Europe, by supporting research for developing better tools, methods and standards on how to produce, transfer, communicate and use reliable climate information to cope with current and future climate variability. Besides this, BSC is partner of the New European Wind Atlas (NEWA) project, an ERA-NET PLUS project. The role of BSC is to provide an assessment of the predictability of wind resources at different time horizons. (Objectives 1, 2, 5)

"Foresee activities to cluster with other projects financed under (…) Horizon 2020."

S2S4E will contribute to the ambitious European energy goals defined in the European Strategic Energy Technology Plan (SET-Plan), the European Energy Union, the Europe 2020 strategy for smart, sustainable and inclusive growth and the European Research and Innovation Roadmap for Climate Services. More specifically, under the umbrella of Horizon 2020, S2S4E can be linked to a range projects due to its interdisciplinary framework tackling areas such as renewable energy diffusion, climate services, smart grids, and emergent business models. For instance, S2S4E will join the cluster of projects looking at different forecasting of climate issues such as IMPREX-641811, VISCA-730253, MARCO-730272 and COPERNICUS projects CLIM4ENERGY and ECEM, since they all share not only researchers from S2S4E partners but also work on adjacent topics, thus easily producing synergies. S2S4E will add value to this cluster because of its emphasis on research methods for combining for S2S predictions (Objectives 5, 6)

1.3 Concept and methodology

1.3.1 Concept

1.3.1.1 Background and motivation

Both energy supply and demand are strongly influenced by weather conditions and their evolution over time in terms of climate variability and climate change. The sensitivity of electricity demand to temperature is significant. While in northern Europe, cold spells during winter represent high-risk periods for the energy security of large areas (Ely et al., 2013), in southern Europe hot spells during summer are the source of high risk to the energy network stability (Pardo et al., 2002).

The highest priority for the energy network operators is the balance between electricity demand and supply. Before the introduction of renewable energies, the demand was matched with base-load power plants (coal and nuclear) and generating plants that can be scheduled, usually hydroelectric and fossil-based power plants. This landscape has been changing rapidly with the integration of wind and solar energies into the energy mix over recent years. The increase has been particularly significant in wind energy which had rate of growth of 17% in 2014-2015 (GWEC, 2016), reaching near to 370 GW of installed capacity worldwide in 2014 (WWEA, 2015).This **increase of renewable energy resources implies the introduction of new generation capacity that is dependent on a highly variable weather/climate** (Spiecker and Weber, 2013).

While the energy sector has routinely been using weather forecasts of up to 15 days (Dubus, 2010), beyond this time horizon, climatological data (typically 30-year averages) are used. A common assumption in this method is that future conditions will be similar to past conditions. This assumption entails two inherent shortcomings. The first one is that past conditions can be highly variable, which can make them of limited use to forecast future ones. The second one is that climatology cannot predict events which have never happened before, e.g. extreme events, which can be particularly harmful and whose prediction is of special interest for stakeholders. Our knowledge of climatology is based on a finite sample of past events. This sample is limited in time, and doesn't need to be fully representative of what can happen. Moreover, a climatological approach does not take into account changes in atmospheric dynamics, such as those caused by climate change. Climate change may render past conditions useless for predicting future events, as they may no longer be reproduced.

Climate predictions (Figure 1) including both sub-seasonal (up to one month) and seasonal predictions (for the forthcoming months) have witnessed considerable improvements in the last decade demonstrating that probabilistic forecasting can inform better decision making at some temporal scales and regions (Alessandri et al., 2011, Doblas-Reyes et al., 2013). However, despite this improvement, climate predictions come with a new set of challenges for users: information is often un-tailored and hard to understand or apply in a decision-making context. **Further research is needed to broaden our knowledge of the predictability and usability of S2S predictions and the requirements of energy companies and transmission system operators.**

In particular, understanding and quantifying climatic conditions from several weeks to several months can improve the decision making of renewable energy generation and electricity demand (Figure 1). Operations and Maintenance (O&M) teams of offshore wind farms need to schedule operations during the less windy periods in order to minimize the risk of equipment damaging due to storms and high swell conditions. For grid operators, being aware in advance of the amount of renewable energy that will go into the grid can help schedule traditional power plant operations. For business based on renewable power generation, having a budget of the energy they will produce in the coming months is of crucial importance to anticipate cash flow. For policy makers, information about seasonal variations on renewable energy production provides a prediction of required changes in the energy mix to ensure security of supply.

S2S4E will build up on recent European projects (e.g. EUPORIAS-308291 and SPECS-308378) which brought together a highly skilled group of scientist to address these challenges and further the development of climate services and tools based on climate predictions. The European Commission through the Copernicus Climate Change Service (C3S) has included for the first time seasonal predictions in the portfolio of Service products, and projects such as CLIM4ENERGY and ECEM (Table 2) are promoting the inclusion of climate predictions services based on seasonal forecasts. **However, in these projects the objective is to produce a service but not to conduct research.**

Within this context**, S2S4E will conduct research and contribute to the state of the art in climate predictions exploring the frontiers of what can be achieved by using S2S predictions (Section 1.3.1.2). At the end, the project consortium expects to position the S2S4E project as a starting point for future Copernicus Services.**

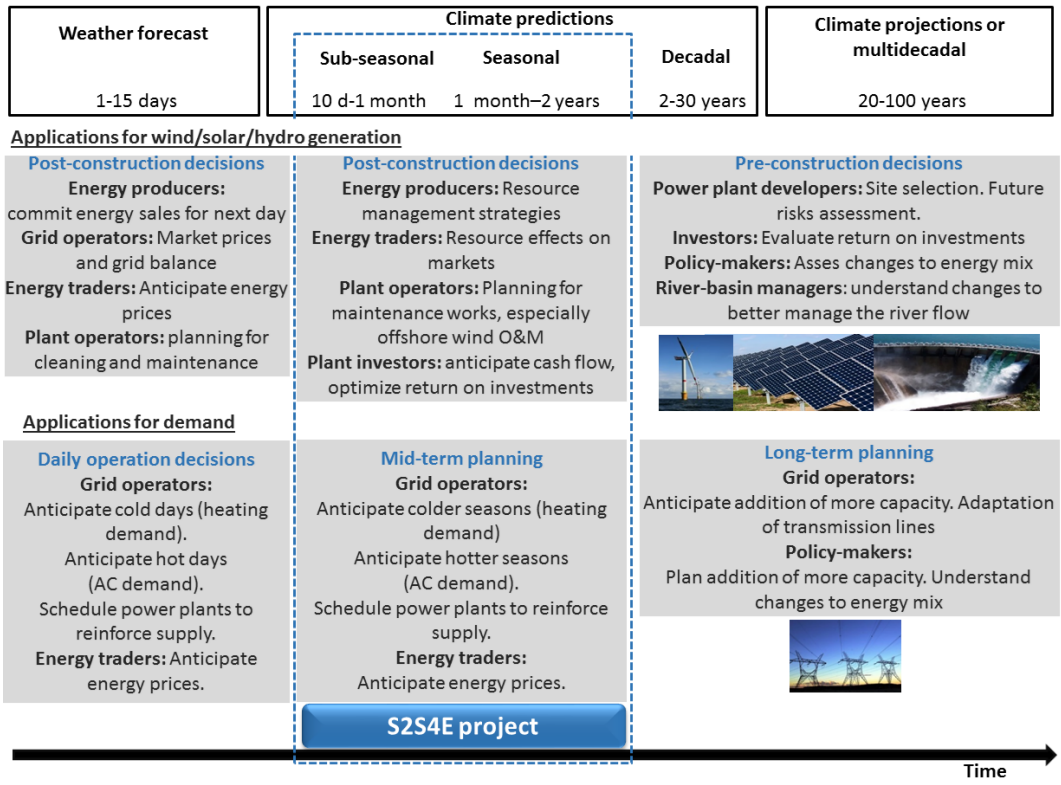


Figure 1: S2S4E project focus and main applications

1.3.1.2 State of the art of climate predictions to better inform decision making

Accurate and reliable information from climate predictions at different time-scales is essential to anticipate climate variability affecting supply and demand of electricity and to stabilize and secure the energy network as a whole. Most previous works in this topic have focused on either short (i.e. daily) or long (i.e. centennial) time-scales, using weather forecasts (Amin 2013, Troccoli et al., 2013) or climate change projections (Ebinger & Vergara 2011, Edenhofer et al., 2012, Koletsis et al. 2016), respectively. However, there are only a few studies focused on the prediction of future evolution of essential climate variables at S2S time-scales in a probabilistic way tailored to the energy sector (Wanders and Wood, 2016; Torralba et al., 2017).

As introduced above, even if the chaotic behaviour of the atmosphere does not allow predicting with accuracy the changing weather beyond a few days, climate predictions are feasible because atmospheric variability on monthly/seasonal time-scales is modulated by slowly-varying boundary conditions and can retain memory from internal processes with very slow damping, such as those in the stratosphere (e.g. Shukla 1998; Folland et al., 2012). These atmospheric fluctuations drive substantial surface climate variability over land. Indeed, covariability between remote regions - often called teleconnections - explain a large part of Earth's climate variations and represent an important source of climate predictability (e.g. North Atlantic Oscilation; Figure 2). Tropospheric and stratospheric pathways have been found to play a key role in connecting internally-generated and radiatively-forced anomalies at mid-latitudes, as well as in settling tropical-extratropical and polar-nonpolar interactions (e.g. Smith et al., 2012, 2016; Scaife et al., 2014). These large-scale atmospheric variability modes are usually described in terms of (low-frequency) teleconnection patterns and/or (high-frequency) weather regimes. Characterizing them in observations (WP3) and assessing their simulation and prediction (WP4), sometimes misled by different metrics and diagnostics, is necessary since advances in understanding these atmospheric linkages could translate into improving climate models and predictions. **S2S4E will additionally tackle, for the first time, the challenge of formulating empirical predictions of local climate variability (relevant for the energy sector) based on the large-scale atmospheric variability modes predicted by the forecast systems**, in order to explore any added-value in grid-point prediction skill.

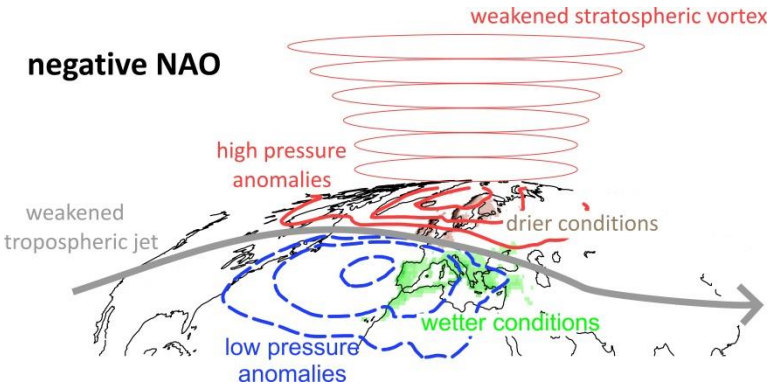


Figure 2: Schematic of key elements in the North Atlantic Oscillation (NAO) teleconnection pattern [in its negative phase]: weakening of the Azores High (low pressure anomalies) and Icelandic Low (high pressure anomalies), associated with weaker (stronger) westerly winds over northern (southern) Europe and weakened stratospheric polar vortex, leading to drier (wetter) than normal conditions over northern (southern) Europe.

Providing useful, usable and accessible climate forecast information to the energy users implies tailoring the predictions to the users' needs and made them readily available (Cash et al., 2003) (Figure 3). A requisite for that is offering a single reliable probabilistic prediction, instead of a collection of predictions performed by different forecast systems from centres around the world (Doblas-Reyes et al., 2013). This requires a comprehensive assessment of the S2S forecast quality at first stage, where observed and predicted values are compared, and the development of calibration (Schefzik et al., 2013) and combination (Rodrigues et al., 2013) methodologies afterwards. Note that the latter have been barely applied to S2S predictions for the energy sector, being one of the novelties in S2S4E.

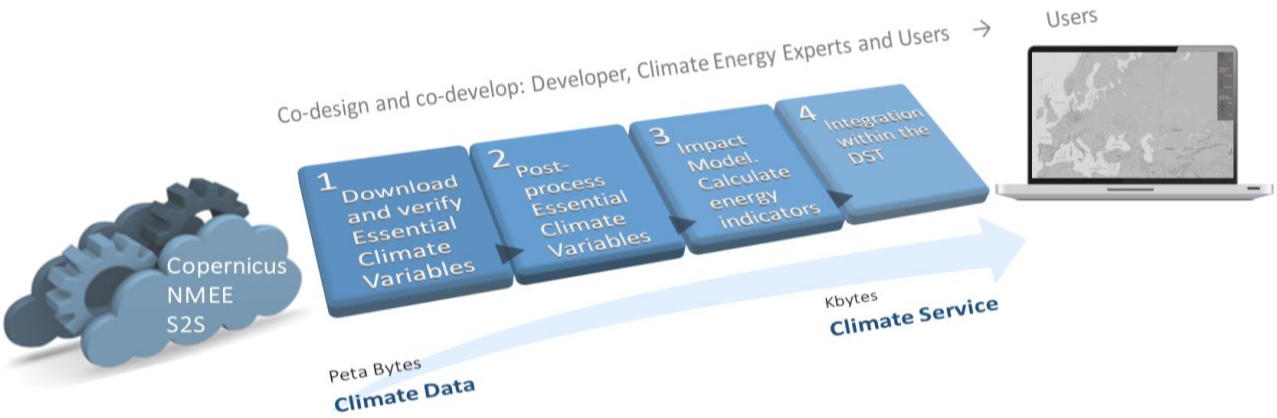


Figure 3: DST development phases

In recent years, the performance of climate predictions has significantly improved but systematic errors, or biases, still remain from the inability of the forecast systems to perfectly reproduce the main processes that drive climate variability (Doblas-Reyes et al., 2013). The predictions are affected by biases in the mean climate and variability and also by the lack of forecast reliability, which has prevent the use of climate predictions by the energy community since end-users need variables with similar statistical properties to those observed (Alessandrini et al., 2013). Several techniques for the bias adjustment of probabilistic climate forecasts have been considered in the literature, such as simple bias correction, quantile-quantile mapping or calibration methods, which are applied to minimise the forecast errors and improve the forecast reliability (Doblas-Reyes et al., 2005; Torralba et al., 2017). S2S4E will pioneeringly address these different aspects of the systematic errors (in the forecast systems) from a point of view of an energy stakeholder, providing the best possible methodology to be implemented in a real-time, operational forecast context by the end of the project.

Another important aspect that prevents the use of climate predictions by the energy sector is the coarse spatial resolution of the forecast systems, which makes difficult the proper usage of their outputs at local energy-farm level. S2S4E will benefit from well-known, robust statistical downscaling methods available in the literature, which empirically refine model outputs' grid into higher-resolution data on particular locations (Gutiérrez et al. 2013, Zorita and Von Storch, 1999), to produce the much-needed predictions of energy-related variables and indicators in target sites.

1.3.1.3 Technology Readiness Levels (TRL) to be achieved by S2S4E tools

To maximize the impact and exploitation of the DST, the tool will be developed at a very high Technology Readiness Level. The target is to end the project with the DST ready for the market trials. S2S4E will advance the technology to TRL7; system prototype demonstration in operational environment. It corresponds to the integration of S2S predictions within the co-developed DST providing for the first time operational real-time S2S forecast for both renewable energy generation and electricity demand indicators.

Table 1: TRL to be achieved by S2S4E tools

Tool	TRL	Advances in S2S4E
Seasonal climate predictions: North American Multi-Model Ensemble (NMME) and Copernicus Climate Change	7	The progress in climate predictions has led to a skill level that is now considered useful for societal applications. Proof of this is the inclusion of seasonal forecasts in the Copernicus Climate Change Service (CLIM4ENERGY, ECEM). Since Copernicus is not a research program, further user oriented research will be conducted in S2S4E to provide refined probabilistic seasonal forecasts by: combining different systems, the assessment of teleconnection patterns and applying conditional predictability, and conducting statistical downscaling techniques (Section 1.3.1.3). According to this, the starting point will be a TRL4-5. As a result of the research and the co-design and co-development with users, we expect to reach a TRL7 by providing a real-time operational forecast within the DST.
Sub-seasonal climate predictions: S2S Project	7	In line with the research performed for seasonal predictions, methodologies for maximizing the utility of sub-seasonal systems will be developed. In this case, due to the novelty of its application for the energy sector and the very large amount of data needed, the starting point for sub-seasonal predictions will be a TRL3 and the aim will be to reach a TRL7.

1.3.1.4 Research and innovation activities linked with the project

Table 2: Main research and innovation activities linked with the project

Programme. Project and description		Outcomes that will feed S2S4E
FP7	EUPORIAS-308291 2012-17 (ENEA, UREAD, BSC): Development of a new realm of climate services and tools using climate predictions with tailored information and easy application in a decision-making context.	Development of project UKKO (Deliverable 42.3), a seasonal wind prediction prototype for the wind energy sector.
	SPECS-308378 2012-17 (BSC-coord, UREAD, ENEA): Produce reliable climate predictions by identifying the main problems in climate prediction and investigate a battery of solutions from a seamless perspective.	Improved estimation of the future frequency of high-impact, extreme climatic events and prediction uncertainty (D53.1).
ERA-NET	NEWA 2012-20 (BSC): Develop the New European Wind Atlas will be developed to be used as a standard for site assessment.	Include for the first time in a wind atlas predictability information at different time horizons (D3.2).
	ERA4CS- 690462 2015-20 (BSC-coord.): Implementation of the ERA-NET and launch of a transnational co-funded call	Awareness about the latest proposals on climate predictions and climate services.
Copernicus	CLIM4ENERGY 2016-18 (EDF, EDPR, SMHI BSC: Demonstrate the value chain from essential climate variables to actionable information in the energy sector.	Develop the science that will feed into the expected seasonal forecasting experiment for the wind and hydro power sector (D3.1 and D3.2).

	Programme. Project and description	Outcomes that will feed S2S4E
	ECEM 2015-18 (EDF, ENEA, UREAD): Developing, in close collaboration with the energy sector, a proof-of-concept model – or demonstrator to enable the energy industry and policy makers to assess how well energy supply will meet demand in Europe over different time horizons.	Observational data to define the energy impact indicators (D2.2).
	QA4SEAS 2016-18 (BSC-Coord): Develops a strategy for the evaluation and quality control of the multi-model seasonal forecasts.	Assessment of forecast quality of illustrative bias-corrected/adjusted seasonal forecasts (D3.1).
H2020	IMPREX-641811 2015-19 (SMHI, UREAD, BSC): Assess forecast skill of meteorological and hydrological extremes in Europe and their impacts, by applying dynamic model ensembles, process studies, new data assimilation techniques and high resolution modelling.	Explore the potential of sub-seasonal forecasting as added value to the seasonal information for water management. Produce a pan-European operational service (D4.4, D4.5, M4.1 and M4.2).
	VISCA- 730253 2017-19 (BSC): Develop a decision support system that integrates seasonal predictions and crop modelling to design climate change adaptation strategies on vineyards.	Implementation of seasonal predictions in an operational real-time forecast system using temperature and precipitation as essential climate variables (D2.6).
	MARCO-730272 2016-18 (LGI, TCDF): Provide a detailed insight into the market for climate services.	Improved insight of Europe's climate services market, with a detailed case study on renewable energy (D5.5)

1.3.2 Methodology

S2S4E consists of seven work packages that can be clustered in two different layers: technological development and market development (Figure 4). The former corresponds to the underlying scientific core involving three strongly interlinked work packages that provide the scientific underpinnings and deployment infrastructure of the Decision Support Tool (DST) (WP 3, 4 and 5). The later refers to the three work packages focused on mapping users' needs, designing business models as well as warranting knowledge dissemination to foster the commercial exploitation of the DST (WP 2, 6 and 7). Both layers of the S2S4E project will unfold simultaneously in a conjoint work of research institutes, energy and consulting companies partners in the consortium, as well as a broader audience of users contacted through a series of dissemination events. In addition, S2S4E will provide a knowledge dissemination platform to facilitate information exchange among partners enhancing the activities of co-design and co-development of the DST.

The technological development is planned to be done based on three pilots. The first pilot will be based on climate modelling derived from case studies of extreme climate events selected by the energy companies partners in the project. From this pilot, an initial S2S forecast will be delivered based on data-intensive analysis of the case studies selected. The second pilot will consist on the implementation of the operational real-time S2S forecast on the DST. The DST will integrate energy indicators (Section 1.3.2.1) at grid point (wind, solar), at basin and sub-basin level (hydro) and at country and cluster level following the guidelines of the e-HIGHWAY 2050 project[3] (electricity demand) for the European domain. **The methodology here planned has been defined to facilitate the replicability of the DST in other continents after the project. To further motive and encourage this geographical replicability, the wind energy indicator will cover a global domain.** The third pilot will refine the initial climate modelling integrating the results of Tasks 4.2, 4.3 and 4.4. It will include an assessment of S2S forecast systems to simulate large-scale drivers of variability and weather regimes identified, as well as the development of methodologies for maximizing the utility of S2S forecast systems through exploitation of conditional predictability and weather regimes.

[3] e-HIGWAY 2050 project. D2.2: European cluster model of the Pan-European transmission grid.

The market development of the DST is structured in three moments reflecting the three DST pilots. As a general rule, market development will be based on the inputs gathered from focus groups[4], interviews and user experience mapping[5] with experts from the partners in the consortium as well as a broader audience of experts on renewable energy generation and electricity markets. First, S2S4E will develop eight case studies of extreme weather events (section: 1.3.2.2 Case studies) which will generate a map of user needs regarding S2S forecasts and will provide data to develop a framework for economic impact assessment. Next, the forecasts from the second DST pilot will be evaluated by energy companies partners in the project upon their implementation on real-time on the business decision making. Third, upon the release of the final version of DST, business model options will be designed in creative workshops using a combination of innovative techniques such as Lego Serious Play[6] with more traditional business model canvas[7]. Furthermore, the broad dissemination of DST forecasts will be strengthened by the release of a series of tools such as fact sheets, policy briefs and a White Report as well as a documentary detailing how S2S4E can benefit the energy sector.

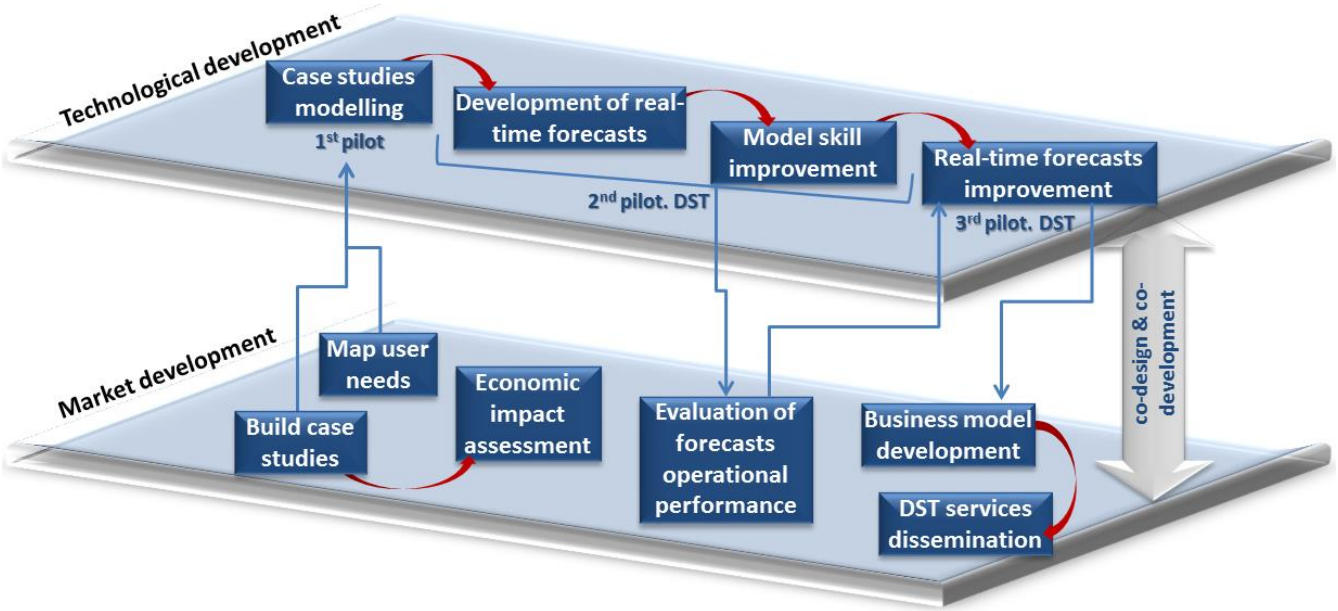


Figure 4: S2S4E development layers

1.3.2.1 Energy indicators

Climate information will be provided by using energy indicators calculated from the essential climate variables. The proposed energy indicators aim to provide robust information on the future variability of wind, solar and hydro power, as well as electricity demand indicators based on probabilistic climate predictions. To estimate the hydro power indicators, S2S predictions will initialize a hydrological model used for understanding large-scale changes of river basin water resources. The service will make use of the SMHI´s pan-European E-HYPE model (Donnelly et al., 2016; Hundecha et al., 2016).

The predictions will be accompanied by skill scores, which numerically illustrate how the performance of future forecasts. This is essential in order to ensure credibility of these forecasts for users, and broaden their spectrum of users. Moreover, skill scores also allow screening the places where the forecasting system can provide more added value than climatological information.

[4] Focus groups is a qualitative research method consisting of interviews in which questions are asked in an interactive group setting about perceptions, opinions, beliefs, and attitudes towards a product, service, concept, idea, etc..

[5] User experience map is a design tool to understand product/service interactions from a users' point of view; it is based on a visual representation that illustrate users' flow (within a product or service) their needs, wants, expectations and the overall experience for a particular goal.

[6] Lego Serious Play is a facilitation methodology used with the aim of fostering creative thinking through team building metaphors of their organizational identities and experiences using Lego bricks.

[7] Business model canvas is a template for developing new or documenting existing business models where a visual chart is used to define elements such as a firm's or product's value proposition, infrastructure, customers, and finances.

Table 3: S2S4E indicators

Sector	Indicator	Description
Wind Solar	Capacity factor	Capacity factor is a widespread indicator in the energy sector that allows fair comparisons between plants of different sizes. It is typical way of assessing the relative performance or usage of any generating power plant. For a given period of time, it is calculated dividing the produced generation by the maximum production that would be achieved if the plant were operating at full capacity during all the time. The generation in wind and solar plants depends almost exclusively on meteorological factors such as wind (wind energy) or irradiation (solar energy).
Hydro	Change in inflow	Change in inflow in relation to a reference period. The information is of most interest in regions where other characteristics are favourable for hydropower, e.g. high inflow, large elevation differences and storage capacity.
	Annual snow max anomaly	Annual snow max anomaly, which reflects the amount of water stored as snow during winter. It is a measure of the natural storage and the seasonal redistribution of precipitation/inflow. A change in the snow storage may affect the need for storage capacity in reservoirs.
Electricity demand	Consumption rate	Electricity demand or load is the amount of electrical power absorbed at a specific time in a transmission or distribution grid. This measure represents all the sectors (industrial, residential, etc.) and then it can be affected by several factors, for example the economic growth, the price of energy, energy efficiency measures. Climatic variables can influence the demand, in fact the use of cooling and heating equipment is strictly related with the temperature and other variables influencing how we perceive the temperature (for example wind speed and humidity. Moreover, demand is also affected by the self-consumption of renewable energy sources, commonly PV panels, that in some sense act like a negative demand: this factor is particularly important in the countries that are experiencing a growth in the penetration of RE sources.

1.3.2.2 Case studies:

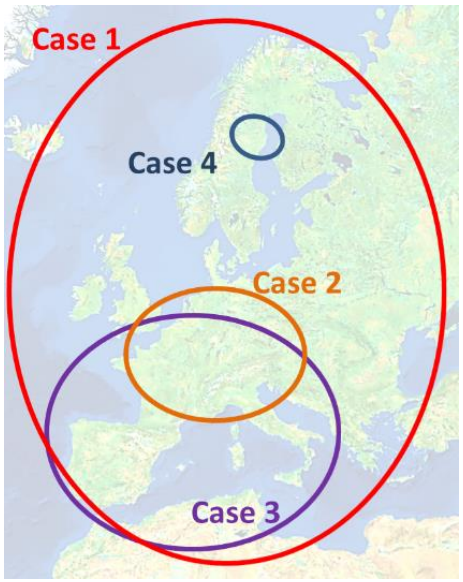


Figure 5: Case studies geographical reach

To support the proof of concept phase historical case studies pointed as the most relevant by industrial partners - e.g. periods with an unusual climate behaviour affecting the energy market will be analysed. This will help to define the DST for its use in real life decision-making in energy companies. This process will be co-designed with the industrial partners of the consortium which represent different needs and interests in terms of regions, renewable energy sources (namely, wind, solar and hydro) and electricity demand.

During the preparation of this proposal, four cases studies have already been defined to exemplify the challenges that S2S4E aims to address. During the project (WP2, T2.2) four additional case studies will be selected. In T4.1 the experiments are going to be run and in WP2 (T2.3) an estimation of the economic value will be performed. The final aim of these case studies is to illustrate with real situations the potential benefits of applying S2S forecasts in the energy sector.

Table 4: Case studies

Case study 1: Winter 2016-2017, in particular December. Interest: The cold wave over Europe created a combination of large increase in electricity demand and lower than usual hydro and wind power generation.	Interest raised by EDF and EnBW to show the real need to the real case
With the increase in the share of electricity generated by RE sources and the rapid reduction of generation capacity from incumbent energy sources, the European energy system has become highly sensitive towards extreme weather events. Cold events in winter have strong impacts on the power system. They are often due to blocking events, combining cold temperatures, no precipitation and low wind speed, then implying large electricity demand, and lower than usual hydro and wind power generation. In France, under the national regulation authority request, EDF had to stop several nuclear reactors to carefully check some components. The total available generation capacity in France was then significantly decreased. Electricity demand and power generation forecasts were then very important to assess the risks on the French and the European systems. Several options can be activated in such situations, but need as accurate as possible forecasts to optimize decision and take the best option(s).	
Case study 2: July 2013. Interest: High pressure system over central Europe: large electricity demand, higher than normal solar generation and low precipitation rates.	Interest raised by EnBW
With nearly 39 GW of installed photovoltaic capacity, periods of high solar radiation during summer in Germany may shift the energy mix considerably. During these periods of elevated solar generation, expensive conventional power plants may be shut down, with a downturn in the energy trading market as a consequence. In this context, coal power plants are typically used as a backup to ensure security of supply. In Germany, coal supply is largely based on hydro transport which is dependent on river navigability associated with precipitation levels. In this specific case, the very low precipitation levels, may, if prolonged, restrict transportation capacity on major waterways like the Rhine and Neckar rivers. This is of particular relevance for EnBW since it transports coal mainly per barge to several power plants along the aforementioned rivers for conventional power supply.	
Case study 3: September 2016 Interest: above normal wind power generation	Interest raised by EDPR and NNERGIX
According to the Spanish TSO, in 2016 the installed wind power capacity represented 22.8% of the total capacity for electricity generation in Spain, and wind energy supplied 19.2% of the demand. This high level of wind power penetration that can have a significant impact on the energy market in periods with lower than normal wind power output. This event was determined by two factors: the increase of the frequency of occurrence of the NAO+ weather regime, with a negative impact on wind speed on southern and central Europe concurrently to the decrease of the frequency of the Atlantic ridge regime, with a positive impact on wind speed. The frequency of the other two regimes (NAO- and blocking) didn't deviate from the climatology value. As a result, a notable decrease of wind speed was observed through all central and southern Europe.	
Case study 4: July 2015 Interest: Spring flood in Sweden	Interest raised by Vattenfall (stakeholders)
In July 2015, a combined snowmelt and rain caused a lot of unproductive release of reservoir water in Umeälven. The reservoir was not managed appropriately without releasing enough water earlier in June/July. This was due to inaccurate hydrological forecasts that predicted a lot of remaining snow for melting. In the first weeks of July, the melting runoff stopped due to low temperatures however snow was still available which flowed to the reservoir later. The lack of accurate information about snow availability resulted in a significant economic loss for hydropower generators. This case study will investigate to which extent improved hydrometeorological forecasts offered from DST could have reduced the water loss during the spill event. The case study will be developed in collaboration with Vattenfall AB, Sweden's largest hydropower producer, owning several power plants in the river studied, and with Vattenregleringsföretagen AB, who coordinates the production and reservoir management in rivers.	

1.3.2.3 Sex and gender analysis

The S2S4E consortium recognizes the importance of the promotion of a fair balance of men and women within the project. In the current structure three of the seven WPs are led by women, two others are co-leaded and approximately 30% of the key personnel involved are female (see Section 4.1). This should be seen as a first step forward to the equal gender balance objectives of the EC and a step towards our goal of a more fair gender balance during the project.

In S2S4E project, the gender aspects will be considered and promoted by all consortium partners and monitored by the BSC as Project Coordinator. Data on gender participation in the project (numbers and roles) will be collected and monitored with a view to benchmarking against employment best practice.

Gender issues will be considered and promoted in every WP by following these actions:

- Encourage the recruitment of women at equal scientific or technical merit, especially in the field of climate prediction and climate services. All job announcements will encourage women to apply by including a statement that demonstrates an "equal opportunities policy"
- Help the participation of women by developing e-conference tools to limit travel, which is more difficult for staff with young children, encouraging a family-friendly organisation of the work;
- Create a good working environment by encouraging working-time flexibility. Communicate within the Consortium the current EU gender legislation.
- Advertise on gender equality on the project website: links to relevant European web pages, highlighting H2020 initiatives.

1.4 Ambition

1.4.1 Advancement beyond the state of the art and ambition

S2S4E will make significant advances in S2S forecasting of renewable energy production. To enhance the integration of renewable power generation into the traditional power network, there is an urgent need to address the vulnerabilities posed to the grid due to the intermittent nature of these energy sources (González-Aparicio and Zucker, 2015; Ssekulima et al., 2016). Variability of demand and supply (e.g. peak demand) are key challenges to the system operators due to their impact on system balancing, reserve capacity and generation capacity allocation. S2S4E will develop state of the art techniques for forecasting wind, solar and hydro resources and electricity demand in a S2S basis over a wide range of geographical scales thereby facilitating renewables integration. In addition, cutting-edge techniques for improving the accuracy of forecasts will be deployed to enhance model skill and forecasts reliability. Moreover, S2S4E will provide combined forecasts for wind, solar and hydro resources in Europe facilitating comparability which is a long lasting demand from the energy industry and research communities (Foley et al., 2012; Widén et al., 2015).

S2S4E will build a community of climate services users thereby fostering the dissemination of climate services. S2S4E will engage in several dissemination activities to gather attention of an even wider community of researchers, practitioners and other stakeholders towards the availability and benefits of climate services such as S2S forecasting for energy. These activities will create a continuous communication link with users, foster trust and therefore facilitate gaining legitimacy in the provision of climate services – normally seen as main barriers for climate services uptake (Soares and Dessai, 2016). Furthermore, based on the contacts database built during the project, further dissemination of climate services can be strengthened and quickly deployed.

S2S4E will reduce risks of renewable energy investment. After decades of public support, renewable energy sources (such as wind and solar) are considered mature in several market settings. As a result, many countries are reducing subsidies to renewable power generation and phasing out priority dispatch (CEER, 2017). These together with high uncertainty regarding future regulation of electricity markets and peak demand behavior (Auffhammer et al., 2017) leads to significant higher investment risks (Glachant, 2016). Investment risks for renewable power rise because future cash flows to cover their high capital expenditures (mostly investment costs) depend to a large extent on uncertain power output, and risky electricity and fuel and carbon prices (Tietjen et al., 2016). The forecasts from S2S4E will enable energy companies to reduce the investment risks of renewable energy by

improving the power output forecasts in the medium and long-runs as well as by improving energy portfolio decisions based on the S2S4E combination of forecasts for solar, wind and hydro.

S2S4E will facilitate the transition towards a consumer centred clean energy transition. Consumers are seen as active players on future energy markets as demand control and decentralized energy generation become increasingly popular (EC, 2016; Parag and Sovacool, 2016). S2S4E forecasts can empower customers to have better control over their electricity demand considering future weather events. This can create opportunities for consumers to develop more flexible responses to price signals thereby reducing overall electricity demand and vulnerability to poor energy access.

S2S4E will foster the integration of the European energy system. The EU 2030 Climate and Energy Policy goals require that renewable energy responds to up to 45% of total electricity generation in the EU (ENTSO-E, 2016). Energy market integration is a key driver to support this evolution as it will enable the necessary flow of electricity across borders thereby raising the share of renewables in the total energy consumption. S2S4E can make a significant contribution to energy market integration by enabling renewable energy producers to correctly forecast their feed-in and hedge their volatility thereby improving system security and economic efficiency.

1.4.2 Innovation potential

Introduction of new S2S forecasting methods combining for the first time information for solar, wind and hydro in a single decision support tool. **S2S4E will bring a novelty, as to the best of our knowledge, it is the first time that: sub-seasonal forecasts and their synthesis with seasonal predictions are produced with the aim to provide a service to the energy sector; and that parameters for different energy sources such as wind, solar and hydro and energy demand are integrated into one tool** (Table 5). A new methodology for a quantitative approach to define and detect weather regimes and to assess their impact on wind, temperature, precipitation and solar radiation will be developed for the different seasons (not only for winter and summer as done in previous studies). In addition, an objective impacts-based methodology for identifying "weather-impact" regimes and modes for the European power sector will be created. This work will identify the meteorological patterns that are associated with the strongest impacts on power-system properties over Europe, rather than focusing on known meteorological modes. The patterns identified will therefore be contingent on the structure of the power system itself (e.g., known or planned deployments of RE technologies), and will be assessed for both individual technologies (e.g., wind, solar, demand, hydro) but also compound phenomena, thereby seeking to better capture the nature of the meteorological impact on the power system as a whole. Moreover, the impact of the leading atmospheric variability modes in the Euro-Atlantic sector (i.e. the NAO, East Atlantic - EA, Scandinavian - SCAND, and East Atlantic/West Russia - EA/WR patterns) on the energy indicators will be examined for the first time, with a particular focus on Europe.

Development of a decision support tool (DST) that is user friendly and highly customizable to a variety of applications. **S2S4E will engage users in co-design and co-development of the DST** from the beginning of the project. To this end, S2S4E will create a framework for information exchange among project partners as well as for the validation of different DST pilots and monthly forecasts (a total of 90 forecasts will be released during the last 18 months of the project: 72 sub-seasonal and 18 seasonal). As a result, DST will reflect user needs while at the same time creating a series of possible set-ups to make forecast data highly customized for each user. With this S2S4E will contribute to fostering the DST exploitation as the difficulty to tailor information to the diverse user needs is known as one of the main barriers for climate services diffusion (Soares and Dessai, 2016; Vaughan and Dessai, 2014).

Creation of a framework for assessing operational and economic impacts of climate services on the production of three renewable energy sources and electricity demand. Climate services are receiving increasing attention for their expected capacity of improving economic performance and reducing risks. However, there is still little evaluation of the actual impacts of climate services (EC, 2015), such as the effects of using S2S forecasts on business performance and social welfare. **S2S4E will create a framework to assess operational and economic impacts of S2S forecasts on the energy companies** partners in the consortium. Initially based on selected case studies, this framework will be then validated by partners based on different forecast outlooks released during the project.

Strengthening the competitiveness and growth of the European energy businesses by enhancing their resilience to increasing exposure to weather and climate risks. While S2S4E focuses in European countries, energy markets and

European energy companies have a global market reach. Indeed, energy markets follow an international dynamics due not only to the influence of commoditization of fossil fuels but also to the global scale of technological and climate developments. S2S4E will provide a broader range of S2S forecasts and co-design platform to access these new climate data suitable to inform better decision-making and minimize risk taking involved in renewable energy operations. In the mid and long-term these newly developed and improved S2S forecasts can lead key European business in the energy sector, as well as in other sectors, to gather competitive advantages at the international level, fostering economic growth and improving global resilience to climate change.

Table 5: Added value to current state of the art

Current Services	Description	Improvements introduced by S2S4E
Short-term forecasting services	Several companies provide short-term forecasts (from hours to 15 days ahead) for wind, solar, hydro or demand. [e.g. NNERGIX, meteologica, meteogroup, aleasoft,...]	• S2S4E will cover longer time scales. • S2S4E will follow an integrated approach for renewable energy supply and electricity demand.
Climatological approaches	Pre-construction resource assessment studies based on past conditions are widely used to build monthly and annual budgets. [e.g. pvsyst, solarGIS pvplanner, AWSTruepower EPRs,...]	• S2S4E will use a dynamical modelling approach. This allows anticipating events that never happened before.
Seasonal forecasting products from private companies	Some wind resource assessment consultancies start to advertise seasonal forecasting products in their websites. As far as we know, they are exploring the market potential. [e.g. AWSTruepower, Vaisala and MetDesk]	• S2S4E will use a dynamical modelling approach. • S2S4E will do extensive skill assessment • S2S4E will provide a multi-model approach integrating sub-seasonal predictions.

2. Impact

This section describes the impacts expected from the project as well as the indicators designed to measure each of these impacts. The impacts are categorized in three levels, namely: project, global and 'other impacts'. The project level entails the impacts as mentioned by the call *SC5-01-2017: Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept (Instrument: Research and Innovation Action)*, whereas the global level refers to impacts that exceed the RIA call's framework related with the work programme, lastly 'other impacts' refer to other additional impacts from the project. The targets of the proposed indicators will be defined in the first general assembly (M12).

2.1. Expected impacts

Expected Impact 1: Providing added-value for the decision-making processes addressed by the project, in terms of effectiveness, value creation, optimised opportunities and minimised risk.
Current practice in supply/demand balance optimization (demand and renewables energies generation forecasts) is based on weather forecasts up to 15 days ahead and climatology for S2S estimations, not taking into account climate variability either extreme events. S2S4E fills this gap by providing climate information that allows to extend forecasts to S2S periods from which several benefits arise such as appropriate medium-term response strategies - e.g. planning to tackle power supply disruptions which can go up to 8% of installed capacity and cost up to US$ 10 billion/year in the US (Brouwer et al., 2014) and minimize costs (e.g. by reducing curtailment and reserve capacity needs, as well as by optimizing maintenance of wind turbines and solar panels by scheduling to low output periods). The market for climate services for the energy sector is expected to grow to $14.6 billion in 2024 in the US and Europe together (Navigant, 2017). In parallel, the impact in terms of revenues for renewable energy generators resulting exclusively from higher production efficiency derived from production forecasts are estimated to be around 22.73 million euros in 2015 (EU, 2016). For instance, higher weather forecast accuracy is estimated to increase the total amount of power traded by at least 10% for solar PV markets in Europe (Silva et al., 2014). For S2S4E industrial partners, a one-month to one-season in advance

skilful prediction could for example help better optimize the management of water resources in dams or modify maintenance plans of generation plants. As a result, S2S4E forecasts can lead to risk reduction of energy generation business thereby improving financial results. For instance, S2S4E forecasts can have an impact on the amount of power traded by energy companies of up to 10% increase by reducing curtailment (NREL, 2016) - please see Figure 6 for market impact examples. More generally, S2S improved predictions could help better anticipating constraining events on power systems, affecting large parts of Europe in winter for instance, as cold waves associated with lower than normal wind speed and precipitation (high demand, low wind and hydro power generation).

Indicators

Indicator 1.1: Number of applications of S2S forecasts by business area (energy generation, transmission, distribution, demand)
Indicator 1.2: Estimation of the economic gains obtained for each of the applications in % of cost reduction.
Indicator 1.3: Number of business areas where the application of S2S forecasts is efficient in the short term.
Indicator 1.4: Assessment of the economic gain to the producer from using the improved forecast in their decision-making in the cases studies defined in the project (D2.3; M36)

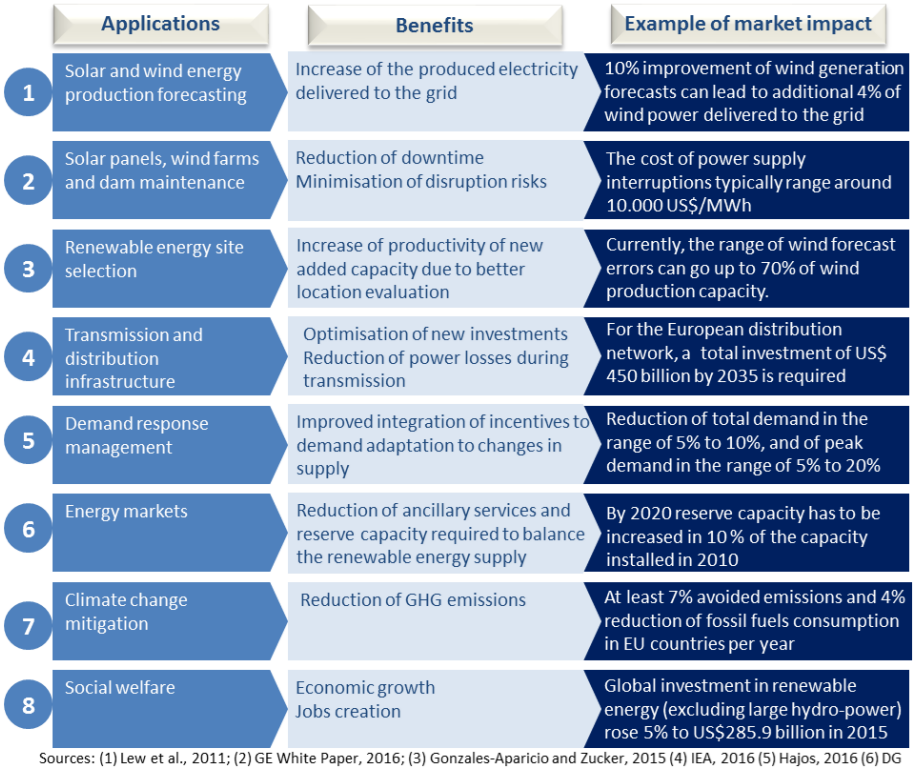


Figure 6: Examples of expected market impacts

Expected Impact 2: Enhancing the potential for market uptake of climate services demonstrated by addressing the added value.

S2S4E is expected to enhance the market uptake of climate services for renewable energies by engaging with users and nurturing a community of users among players from the energy market, policy makers and research organisations. To this end, S2S4E will do a benchmarking and positioning of the Decision Support Tool developed with respect to current solutions on the market that appear as potential competitive solutions. S2S4E will also identify all the marketable results and how the results of the project will be exploited by each partner. The enhancement of potential market uptake is a mid- and long-term capacity impact to the extent the Decision Support Tool will be exploited and create new business opportunities and practices.

Indicators

Indicator 2.1: Benchmark and positioning of the tool (D6.1, M6)
Indicator 2.2: Final Exploitation strategy & Business model options for the tool (D6.4, M36)

Expected Impact 3: Ensuring the replicability of the methodological frameworks for value added climate services in potential end-user markets.
S2S4E will also disseminate its added value not only for the renewable energy industry but also in other sectors by investigating the replicability of the tool. By demonstrating the usefulness of climate services based on S2S predictions private companies specialised in providing consultancy and weather/climate information could see the value of integrating climate predictions to their weather forecasts services in energy as well as other sectors. Among the most prone sectors to benefit from S2S forecasts are agriculture, forestry, urban monitoring and insurance as shown in the Figure 7 below.
Indicators
Indicator 3.1: Number of sectors more prone to the direct replication of the DST Indicator 3.2: Number of registered users of DST from other sectors Indicator 3.3: Number of newsletters produced directed to other sectors Indicator 3.4: Number of meetings and events with stakeholders from other sectors

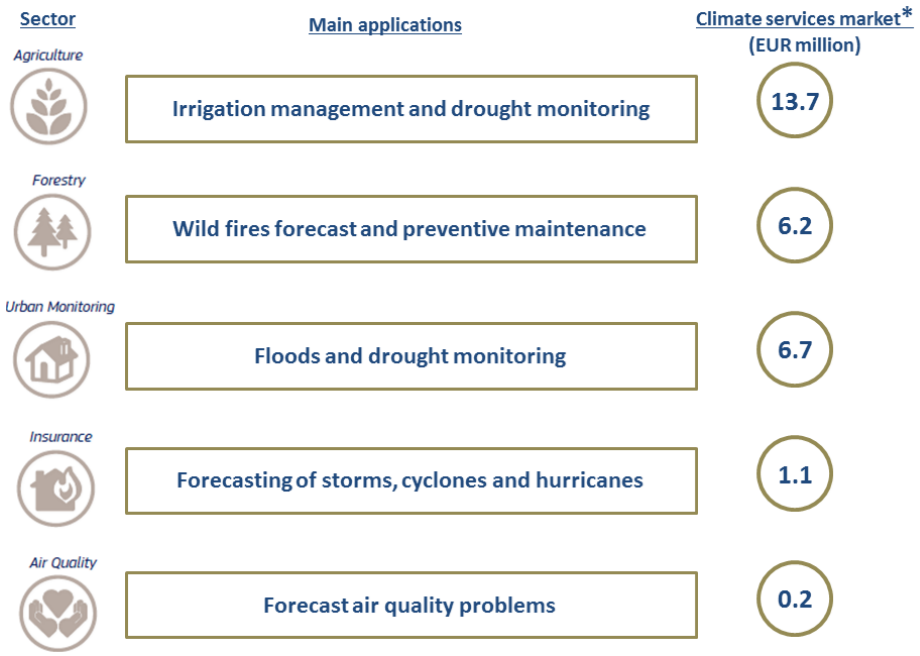


Figure 7: Examples of extension sectors and range of potential market size based on Earth Observation services (EU, 2016)

Expected Impact 4: Promoting a better informed and connected end-user community
S2S4E will stimulate users' engagement in practical and realistic demonstration of the benefits gathered from S2S forecasts. The dissemination plan to be implemented throughout the project brings a series of actions (e.g. workshops, focus groups, interviews, mailing list creation, factsheets distribution) designed to strengthen the ties between the S2S4E project and the end-user community. This will also facilitate the generation of feedback loops between users and DST developers thereby creating a stronger community dynamics.
Indicators
Indicator 4.1: Number of users registered in the project's mailing list. Indicator 4.2: Number of participants in workshops and other public events promoted by the project. Indicator 4.3: Number of users registered to the DST website.

Expected Impact 5: Implementing the Sustainable Development Goals (SDGs), in particular SDG 13 'Take urgent action to combat climate change and its impacts', as well as the conclusions of the COP21 Paris Agreement.
S2S4E will make an important contribution for the achievement of the United Nations Sustainable Development Goals 7, 9 and 13 by improving global renewable energy generation thereby easing energy access and energy security as explained in Figure 8.
Indicators
Indicator 5.1: Number of international fora of relevance (D7.5, M36) Indicator 5.2: Number of international events attended. Indicator 5.3: Number of participants in workshops and other public events promoted by the project from non-OECD countries. Indicator 5.4: Number of visits to the DST website.

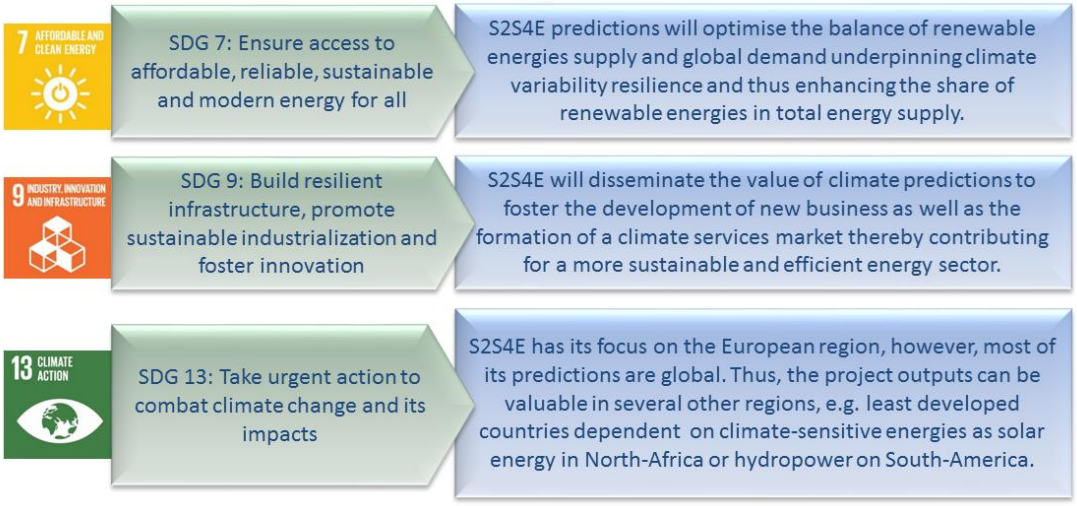


Figure 8: S2S4E impacts on Sustainable Development Goals (SDGs)

Expected global Impact 1: Systemic approach to promote a more resource-efficient, greener and more competitive economy as a key part of smart, inclusive and sustainable growth.
With roughly 75% of total GHG emissions coming from the energy sector (IEA, 2015a), a shift towards renewable energy sources is required to reach the target of 2°C increase in the temperature as predicted in the COP21 Paris Agreement. To this end, the EU's climate policy sets the goal of achieving at least a 27% share of renewable energy consumption by 2030 up from 18.3% in 2016 (EC, 2014; IRENA, 2017). Global renewable electricity capacity is expected to grow by 42% (or 825 GW) by 2021 (IEA, 2016a). Worldwide, this involves huge opportunities for job creation – e.g. the amount of jobs in the renewable energy sector could grow from 9.4 million in 2015 to 24.4 million by 2030 (IRENA, 2017); investment in the power sector which is expected to grow $270 billion in 2014 to $400 billion in 2030; and economies of up to US$ 4.2 trillion annually in avoided expenditures related to climate change and air pollution (IEA, 2015b). S2S4E will enable a more efficient generation of renewable energies and will help understanding and managing climate change risks by providing S2S predictions to a climate-sensitive sector. S2S4E, will therefore promote through research and innovation the transition to a low-carbon and competitive economy.
Indicators
Indicator 5.1: Number of views from unregistered users. Indicator 5.2.: Number of registered users by category (energy companies, policy-makers, etc). Indicator 5.3.: Number of interactions with business agents outside from the consortium. Indicator 5.4.: Dissemination of operational predictions of S2S4E at S2S scales.

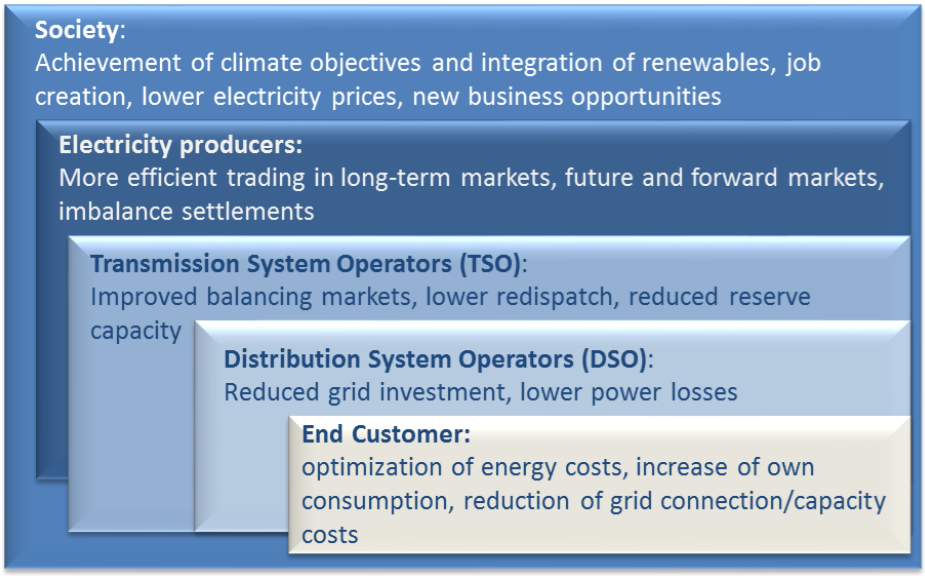


Figure 9: S2S4E global impact overview

Expected global impact 2: Initiatives funded should as far as possible use data resulting from or made available through different initiatives of the European Commission.
S2S Project is a joint initiative of the WWRP/THORPEX/ WCRP to improve forecast skill and understanding on the S2S timescale, and promote its uptake by operational centres and exploitation by the applications community. S2S4E will use real-time forecast information and a continuous communication with the steering group (involved in the External Advisory Board) to promote S2S forecast uptake and exploitation by the energy sector. The Copernicus Climate Change Service (C3S) has energy as a priority area in the development of Sectoral Information Systems (SIS). S2S4E will use real-time forecasts information available from C3S as well as the available reanalysis datasets. Besides, the consortium will build up on the results from knowledge and experience gained through the participation in SIS contracts which have provided case studies and pilot demonstrations for energy (CLIM4ENERGY, ECEM) and water/hydropower (SWICCA). QA4Seas (C3S_5l_LOT3) aims at developing a strategy for the evaluation and quality control (EQC) of the multi-model seasonal forecasts provided by the Copernicus Climate Change Service (C3S). S2S4E will take advantage of the metrics formulated within QA4Seas to apply multi-model methodologies. The previous participation in FP7 projects such as CLIMRUN-265192, EUPORIAS-308291 and SPECS-308378 and the collaboration in currently ongoing H2020 projects, such as IMPREX-641811, will also contribute to maximise the synergies, use and exploitation of results offered by these initiatives. The data generated by S2S4E will be compliant with the INSPIRE directive and the tool produced during the project will be made available for re-use under Pilot and Open Research Data programme. Moreover, all the scientific peer reviewed publications will be made available either through gold open access or green open access (through institutional repository, UPCommons). Together, all these measures will maximise not only the use of results from other European initiatives but also the uptake of S2S4E for following initiatives.
Indicators
Indicator 6.1: Production version of the Operational Climate Service: Decision Support Tool, including developers documentation and user guides (D5.5, M18) Indicator 6.2: Machine-readable electronic copy of the publisher's final version of the scientific papers (or a final peer-reviewed manuscript accepted for publication) made available in green open access in the institutional repository UPCommons

2.1.2 *Impacts not mentioned in the work programme*

The table below summarizes further impacts not mentioned in the work programme, such as the contribution of S2S4E in terms of creation of competitive advantages for the companies in the consortium, nourishment of the climate services market, reduction of air pollution and related benefits to public health, strengthening of European countries leadership in renewable energy and climate services, and facilitation of electric transport.

Table 6: Summary of additional impacts

Other impact 1: Benefits for the companies of the consortium
The private companies of the consortium will gather different benefits from the S2S4E project depending on their background and business area namely: **EDPR, EDF, EnBW (energy companies):** DST can benefit energy companies involved in the project mainly in two ways: by mapping their needs and by offering a solution to S2S forecasting. The former is advantageous as during the S2S4E project energy companies will have the opportunity to engage in several activities of community building, information exchange with experts and designers of the DST. The latter offers advantages to their operational performance as extended climate predictions can enable better decision-making regarding energy production and trade. **NNERGIX (forecaster):** NNERGIX is a forecasting solution provider for renewable energy markets. Forecasts based on the DST can create a competitive advantage for NNERGIX as one of the first companies able to provide S2S weather forecasts. Currently, NNERGIX has already received clients' requests for forecasts with longer time horizon: up to several months ahead (i.e. S2S time scales). S2S4E will enable the development of these forecasts as it involves high complexity in terms of scientific knowledge and computational infrastructure. Thus the strategic impact of the S2S4E project to NNERGIX as a mean to increase its commercial services portfolio and create market differentiation from competitors. Moreover, the commercialisation of the DST would also enable NNERGIX to enter a new and innovative market, in which the complexity of the technology would be an important barrier to competition. **TCDF (climatic data provider):** TCDF provides tailored climate projections (long-term climate information; multi-decadal time scales). TCDF role in S2S4E will be to work with large amounts of data involved in S2S climate predictions, as well as to improve the understanding of strengths and weaknesses of climate predictions in order to facilitate the exploitation of S2S forecasts. At the end, this will lead to a strategic differentiation with potential competitors increasing its commercial services portfolio. **LGI (consulting)**: LGI assists its clients in their innovation strategy through ideation workshops, market studies, elaboration of business models or competitive analyses. LGI works in three main sectors: Environment and Climate, Low Carbon Energies and Smart and Sustainable Territories. The S2S4E project will enable a better knowledge of the climate services market and the decision-making processes in the renewable energy sector to be used in subsequent strategic studies. In addition, in the S2S4E project, LGI will use innovative methodologies such as the Lego Serious Play® workshop. This experience will be added to the list of LGI's references when commercialising such workshops. Part of deliverables will be kept confidential to warrant the success of commercial exploitation (Table 3.1c). Indicator: Final Exploitation strategy & Business model options for the tool (D6.4, M36).
Other Impact 2: Strengthening markets for climate services
In the face of rapid demand ramp ups associated with extreme temperatures and large penetration of renewable energy sources, S2S4E forecasts can foster the market for energy services by offering information to enhance flexibility and security of energy supply (MIT Energy Initiative, 2016). **Indicator:** Number of users registered to access the DST.
Other Impact 3: Reduction of air pollution and related benefits to health
The potential increase in renewable energy use derived from S2S forecasts may have a significant impact on reducing air pollution and the related health issues. The energy sector is the most important source of air pollution accounting for 85% of particulate matter and almost all of the sulphur oxides and nitrogen oxides to

which 6.5 million deaths are attributed each year (IEA, 2016b). Currently, around 90% of urban Europeans are exposed to levels of air pollutants exceeding WHO guidelines (WHO, 2016). In the European Union, the value of the health impacts was estimated at US$440 to 1.25 billion in 2010 (EC, 2013). Clean Air Scenario from the IEA estimates an investment of US$2.3 trillion in advanced pollution control technologies by 2030 (IEA, 2016b).
Indicator: Compliance with the Directive 2008/50/EC of the European Union in the regions where DST forecasts are applied. Amount of additional energy expected to be delivered to the grid by energy companies' partners in the project based on DST forecasts.

Other Impact 4: Fostering lead markets formation among EU countries

The market for energy services is expected to grow from US$9 billion in 2015 to $14.6 billion in 2024 in the US and Europe (Navigant, 2017). S2S4E can enhance the chances of European countries of taking the lead as climate service providers unlocking market potential for innovative services, reducing obstacles to innovation, and thereby creating an advantageous position to face international competition.
Indicator: Number of users registered to access the DST.

Other Impact 5: Gender implications

While gender aspects are not explicitly mentioned in the call text of H2020-SC5-2016-2017, they are nevertheless an important aspect to be considered. The nature of the work within the core scientific work of S2S4E is mostly gender neutral. The activities carried out in S2S4E are grounded in computational and earth science, subjects that generally have a large bias towards male scientists at all levels, although the situation is slowly improving with more females entering the field.
S2S4E can make a difference by employing a recruitment policy and working environment that is welcoming for female candidates (Section 1.3.2.3). S2S4E endorses the principles of the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers. S2S4E partners will whenever possible implement actions (such as organising predictable working times and travel, stimulating use of electronic meetings) to support male and female researchers with children or other dependants.
Indicator: Percentage of women involved in the project.

2.1.3 Barriers and obstacles to overcome

The S2S4E project is aware of possible difficulties in achieving the objectives provided in section 1.1. External factors of the market or any other conditions might affect the success of the results. The following table considers some of these factors tackled by S2S4E project and the measures to face them.

Table 7: Barriers and proposed measures to overcome them

Barriers	Proposed measures to overcome it
Slow adaptation of energy companies to new tools and systems	The presence of three energy companies in the core consortium (which account for over 15% of renewable energy generation in Europe) and the involvement of 6 energy companies as stakeholders ensure at least a trial deployment of the DST which will contribute to facilitate its market uptake. Moreover, the presence of an SME as NNERGIX, with experience in providing forecast products to a number of clients in the energy sector will be important to rapidly adapt the tool to respond to user needs. Finally, if by the end of the project, the commercial exploitation of the DST remains too limited to be maintained by the companies partners in the project, the service will be maintained free of cost for 6 additional months and user engagement will be further promoted.
Diversity of users' needs and conservative attitude towards new weather and climate forecasting	Initially, the exploitation strategy of S2S4E will focus on the energy companies involved in the consortium. These companies will make a contribution to design strategies to assure the market uptake of DST since they are relevant and prestigious players in the energy market. Moreover, the close interaction with

Barriers	Proposed measures to overcome it
technologies	these companies will facilitate the development of DST to attend a diversity of needs and interests in terms of regions, renewable energy sources and electricity demand. Moreover, these energy companies have a tradition of working in close connection with several research centres therefore demonstrate a higher wiliness to become early adopters of new technologies and thus to pay for higher quality and more innovative technologies.
Confusion between weather and climate predictions and users' limited knowledge about climate predictions functionalities	S2S4E has a comprehensive dissemination plan for the DST where users will be able to learn about its benefits and functionalities when applied specifically to their business. Moreover, S2S4E dissemination plan also seeks to foster the formation of a user community which has been found to be a key factor for the dissemination of innovations and climate services uptake (EU, 2016; Soares and Dessai, 2016).
Data access related problems to real-time S2S forecast	S2S will collect data operational forecast from three external sources. The project tasks have been defined according to the plans of the Copernicus Climate Change Services to provide real-time operational seasonal forecast. The North American Multi-Model Ensemble which is freely available will be also used. Regarding sub-seasonal predictions, Andrew W. Robertson (IRI) and Frederic Vitart (ECMWF) co-chairs of the S2S Project have been involved in the EAB and provided a support letter emphasising their interest in the project and their commitment to provide "access to the S2S archive forecast archive".
Policy uncertainty	The constant changes in regulatory frameworks in European countries as well as worldwide may affect the diffusion of renewable energy sources and therefore the market uptake of the DST. The flexibility of set-ups for the forecasts generated by the DST will warrant its usability in a variety of market settings, including sectors other than energy.
Too high implementation costs of the tool may hinder its adoption by the market	The development of business models based on focus groups with energy experts currently active in the market will improve the view of desirable costs and optimal pricing strategies for the DST.

2.2 Measures to maximise impact

To maximise the impact of the project activities and outcomes, S2S4E places a strong emphasis on dissemination through user engagement, exploitation and communication to the energy sector as well as other interested audiences.

The measures to maximize impact aim, on an overall level, to:

- help enhance the potential for market uptake of climate services;
- help maintain the practical and market relevance of project efforts;
- help position the DST among the top EU climate innovations;
- help foster buy-in and mutual learning within the user community and forecast providers.

The dissemination, exploitation, and communication strategies are briefly discussed in this section as three distinct but complementary approaches:

- **Dissemination strategy** aims to position the DST among the top EU climate innovations and highlight the added value to users and partners by way of an effective user engagement strategy.
- **Exploitation strategy** aims to provide a preliminary business and exploitation plan to the DST given its high TRL and the presence in the consortium of SMEs with potential to commercialize and exploit the outcomes of the project.

- **Communication strategy** aims to raise awareness, increase visibility and support dissemination and exploitation by providing a strong visual identity, media tools and channels, as well as fostering linkages with other projects and programmes.

The dissemination and exploitation activities are mainly coordinated in WP7 and WP6 respectively besides a strong linkage to user engagement activities in WP2. These activities are led by two highly-experienced organizations with extensive experience in user engagement, dissemination and exploitation: Center for International Climate Research (CICERO, WP7 and WP2 leader) and LGI consulting (LGI, WP 6 leader). User engagement and dissemination will be supported by BSC (the project coordinator) that has a dedicated team of Knowledge Transfer for climate services. In total 43.8% of the S2S4E efforts is allocated to these WPs together with a budget of 80,000€ for pro-active user engagement activities.

2.2.1 Dissemination

The Project has an ambitious dissemination and exploitation strategy where engagement with users is a central part of the suggested activities. In addition, our External Advisory Board Members (see section 3.2 and section 4) have been identified, in part, on the basis of their access and opportunity to help bring forward dissemination and exploitation of S2S4E results.

Since the main result of the Project is the DST, our dissemination efforts will focus on making sure that the tool and its co-design process facilitates its later commercialization and exploitation as a succinct result of the Project.

In addition to this, we will link our dissemination efforts to three Project outcomes:

1)The increased knowledge of user needs and the existing market of climate service targeting user groups.

2)The increased knowledge on the likely replicability of the methodological framework for users in other sectors. In this regard, the planned forecast outlooks and how we seek to involve users in improving these will have the potential to deliver a high indirect dissemination impact (see figure for types of impact).

3)The increased knowledge on the scientific improvements on S2S predictions by building on previous experiences and thus providing an improved basis for ongoing projects and initiatives related to renewable energies.

A prerequisite step to maximizing the dissemination and impact of DST is to substantiate the added-value for our energy companies (EDF, EDPR, ENBW) and their decision-making processes and to actively foster and support a well-informed and better connected community of energy stakeholders which includes energy companies (energy users, energy providers, TSOs and DSOs) and energy policymakers. This requires a strong and well-thought through user engagement strategy.

The S2S4E consortium incorporates both scientific and industrial partners, enabling a close collaboration between climate information providers and users. This will make understanding of user needs and the tailoring of information in accordance with those user needs more efficient and accurate, and as such will enable us to maximise the impact of this Project.

Based on our stakeholder typology for users, we will organize and execute workshops, meeting and interviews with those users that are in the typology category “perceived high value of the interaction”. These user engagement activities will be done by WP2, WP6 and WP7. We will also produce webinars, forecast outlooks and the DST itself with those same users, in addition to a wider user community. In this we will use methods such as interactive forecasting, to name one. This work will be done under WP6 and WP7. Finally, we also plan to produce factsheets, a policy brief and a White Report with the involvement of a wide variety of users from the whole spectrum of the interaction value chain. Further details are detailed in WP7 description and will be fully developed in the Communication, Dissemination and User Engagement Plan (CDUEP, D7.2). The CDUEP will be a live document that will be revised twice during the Project’s lifetime.

2.2.2 Exploitation

2.2.2.1 Main exploitable results and IPR management

The main exploitable results of S2S4E besides the DST and how the project partner intend to exploit them are summarised in the table below (along the project lifetime this table will be updated upon partner’s request according to management procedures; see Section 3.2):

Table 8: Results and partners involved by exploitation strategies

Results	Partners involved	Exploitation strategies
Decision Support Tool	EDPR	Use the tool to elaborate climate strategies
	EDF	
	EnBW	
	NNERGIX	Commercialise the tool
	TCDF	Extend its services to sub-seasonal forecast and provide the climate forecast data to the DST.
	CAPGEMINI	CAPGEMINI will support NNERGIX in charge of the exploitation plan in its definition phase. CAPGEMINI's focus being the development of collaborative environment and the development of Digital applications and science algorithm (software), the company endorses his role of integrator in the project S2S4E, enabling at the same time to reach end users platforms and new ecosystems.
	BSC	Showcase the tool to present the latest methodologies on S2S predictions and implement further methodologies. User the DST as a success story to promote the creation of S2S services in other sectors such as agriculture or insurance.
Increased knowledge of user needs & existing offer on the market	TCDF	Adjust its offer based on a better knowledge of the market and competitors.
	NNERGIX	
	CICERO	Gain extensive expertise on the Climate services market and most advanced solutions to be used in subsequent strategic studies.
	LGI	
	BSC	
	UREAD	
	ENEA	
	SMHI	
Economic assessment	CICERO	Develop new methodologies to be used in other sectors.
	TCDF	Enrich its offer by extending the provision of the climate forecast service to providers in other sectors.

IP rules, in particular access rights to results and background knowledge, will be addressed in the Consortium Agreement, which will be based on the DESCA 2020 Model Consortium Agreement (www.desca-2020.eu) and will be in complete accord with the Horizon 2020 Rules for participation. The basic rule for IPR management is that knowledge belongs to the partner generating it. Results shall be owned by the project partner carrying out the work generating such results. If any results are created jointly by at least two project partners and it is not possible to distinguish between the contributions of each of the project partners, such work will be jointly owned by the contributing project partners.

2.2.2.2 Exploitation Strategy for the main result: Decision Support Tool

Organisation between the partners:

NNERGIX will be the main partner for commercialisation. NNERGIX already provides weather forecasts to its existing customers in various energy sectors. Its customers are located across Europe, as well as in Mexico, India and a few countries in Africa. NNERGIX will integrate the DST into their portfolio.

To reach other potential customers, **CAPGEMINI** will assist NNERGIX in the commercialisation by bringing in new users and accounts. NNERGIX also hopes to sign a partnership with other forecasters / solution providers, who would act as distributors of the tool. These distributors will be given a license to sell the tool to additional customers.

TCDF will act as a provider of NNERGIX by processing climate data. Its revenues will be calculated as a fraction of the revenue NNERGIX earns from the sale of S2S forecasts. In a second stage of the commercialisation phase, TCDF could commercialise the same type of climate data to other forecasters in high-potential markets, such as agriculture and the built industry.

To process climate data, TCDF will use methodologies, scripts and indicators developed by **BSC** for the solar, wind and distribution applications. If TCDF wants to use the intellectual property generated by BSC for commercial purposes, an agreement must be found between the two partners. This will be discussed in WP6 – Positioning, exploitation and business models, although some options that are currently being explored include:

1-BSC works on Open Access. TCDF then uses its IP

2-TCDF pays royalties to BSC for each sale using their IP

3-TCDF and BSC create a spin-off between themselves, commercializing the processed data to forecasters

For the hydropower application, TCDF will have to use data run in real-time by **SMHI**. In exchange of this work, SMHI will receive a fraction of revenues from TCDF. Finally, **EDF**, **ENBW** and **EDPR** will be the first customers of the DST. The exploitation strategy is represented by the graphic below:

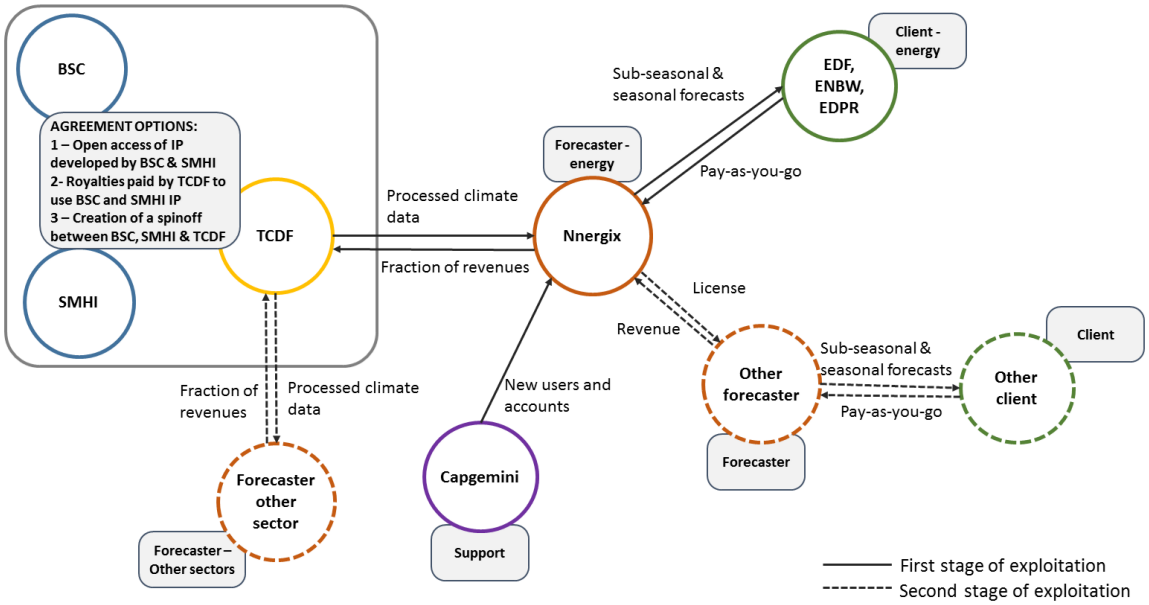


Figure 10: DST exploitation strategy

Business model for the DST for NNERGIX

A first version of the business model is elaborated below, although it will be further developed in WP6. The business model was created using the business model canvas developed by Osterwalder. As shown in the figure below, the canvas includes 9 boxes:

- **Value Proposition:** The tool carries three strong value propositions. First, it enables users to reduce climate data uncertainties while taking into account extremes in climate patterns. This is important as climate is dynamic and past climate records do not provide accurate representations of the future. Second, the tool applies a consistent approach to both renewable energy supply (wind, solar and hydro) and electricity demand. Breaking away from conventional methods of climate services, the tool offers high-quality information for energy supply and electricity demand together. Third, the tool fills a much-needed gap on the market, extending climate data by up to months in advance. While short-term weather data is easy to find, there are few providers that offer S2S information (Table 5).
- **Customer segments:** Customers include different trades in the energy sector, such as energy producers, energy traders, maintenance providers of infrastructure, and Distribution System Operators. The DST might also be interesting for other indirect trades, such as insurance.
- **Customer relationships:** Using the tool, customers will be able to select the S2S forecasts they want, and ask for help if needed.
- **Customer channels:** The DST will be available online through the NNERGIX platform.
- **Key partners**: TCDF will serve as a provider of data to NNERGIX, while CAPGEMINI will assist in bringing potential customers to NNERGIX. Other forecasters acting as distributors will be key partners for NNERGIX to reach more customers.

- **Key activities:** NNERGIX will operate and update the tool, as well as find new customers.
- **Key resources:** To operate the DST, NNERGIX needs processed climate data and a datacentre.
- **Revenue streams:** Revenue will largely stem from clients, in the pay-as-you-go method, with revenue volume a factor of the number of forecasts downloaded. A fraction of the revenues will also stem from other distributors of the tool.
- **Cost structure:** The largest cost envisioned is the operating license. Beyond that, it is expected that there will be some technology costs involved, and that a fraction of the revenues will go to TCDF for the provision of data.

<table>
<tr><th>KEY PARTNERS</th><th>KEY ACTIVITIES</th><th>VALUE PROPOSITION</th><th>CUSTOMER RELATIONSHIPS</th><th>CUSTOMER SEGMENTS</th></tr>
<tr><td>- TCDF, as a provider of data
- Capgemini to bring new users
- Other forecasters</td><td>- Operate the tool
- Updating the tool
KEY RESOURCES
- Climate data
- Software
- Datacenter</td><td>- Reduces uncertainty & takes into account extremes in climate patterns
- Climate predictions for the forthcoming months
- Applies a consistent approach for different sources of renewable energy and electricity demand</td><td>- Self-service
- Personal assistance
CHANNELS
- Online platform</td><td>- Energy producers
- Energy traders
- Maintenance providers
- Distribution System Operators
- Virtual power plants
- Insurance companies</td></tr>
<tr><td>COST STRUCTURE</td><td colspan="2">- Technology costs to operate the tool
- Fraction of revenues to TCDF</td><td colspan="2">- Pay-as-you-go from clients (volume of revenue depending upon volume of forecast downloads)
- Revenues from the sale of licenses to other distributors</td><td>REVENUE STREAMS</td></tr>
</table>

Figure 11: Business model for the DST for NNERGIX

User needs' analysis & alternatives

Short-term weather forecasts currently flood the market, although many in the renewable energy field find that they need medium- to long-term forecasts. Not only are these harder to come by, but they have high uncertainties. Users need reliable forecasts that are consistent with one another, both in their approach and in their data.

The DST that will be developed in this project will meet these needs, filling market gaps (Table 5), and proposing for the first time S2S forecasts for the solar, wind, hydropower and distribution systems at the same time. Alternatives to the tool currently cost about 10,000€/year to use, with seasonal forecasts for a single power plant costing around 4,000€ - 6,000€.

Timeline for commercialisation

At the end of the project, energy companies will have already used the tool for one year and a half. Following the project, NNERGIX will begin to commercialise the tool. This will take one year to integrate it into its existing platform, and to develop marketing material to promote the tool.

Targeted countries

Target countries will be those located on the European continent, although the tool could work worldwide. As NNERGIX has international clients, it can easily target the respective markets of its clients. Such countries include Mexico, India and a few countries in Africa.

Market size

Global energy consumption is expected to grow by 14.5% by 2020 and renewable energy sources are expected to keep growing at the world's fastest-rate – an average of 2.6% per year (EIA, 2017). As a result, weather forecasts become increasingly important to ensure security of energy supply due to renewable energy variability of power generation. Usually seen as a type of climate services, weather and climate forecasts are another rapidly growing market in the US and in Europe (EC, 2014).

The global market for various types of climate information services was estimated in €16.5bn in 2011, with an expected rate of growth of 9.8% per year between 2016 and 2030 (Brook et al., 2016). The market for climate services for the energy sector specifically is expected to reach €13.8 billion in 2024 combining transactions in both the US and Europe (Navigant, 2017).

These figures show that demand is increasing in the renewable sector, and that there is a need for medium- to long-term forecasts as provided by the DST. The DST addresses two specific types of services in the market of climate services for Renewable Energy: Modelling and Data Management. Based on the data above, and assuming that the market share of NNERGIX will remain at a steady 2%, **the potential market for the DST in 2023 is estimated at 2.7 million euros.**

Research data and knowledge management

As part of the Open Research Data Pilot the S2S4E project will be aimed "to make the research data accessible with as few restrictions as possible and protecting sensitive data from inappropriate access". Following this principle, the research data are managing according to these measures:

- Data generated and collected: S2S4E will collect atmosphere S2S data from three external sources (ECMWF Mars, NMME, C3S) and data from on-going projects (e.g. ECEM; see WP3) according to their sharing policies. All collected data will be pre-processed and quality-controlled before being ingested into a reputed data repository.
- Data standards: A roadmap during the proposal phase and the upcoming work is the compliance to the data standards to the data standards established in the community. The data will be formatted in NetCDF following the INSPIRE Directive standards. As the proposal aims at using data from existing platforms (Copernicus, etc.) the data standards implemented in the input data will be preserved.
- Data sharing: We'll select the appropriate data repository (according to the Registry of Research Data Repositories provides by European Commission) to preserve the data, metadata and possibly tools, in the long term.
- Data sharing: following the EC recommendations on data sharing, the data generated within S2S4E (energy indicators, derived variables, diagnostics, etc.) will be freely accessible thought the DST (Open data policy) following the same policies as the input data from the sources Copernicus Climate Change, NMME, S2S Project and other sources.
- Curation and preservation: The project consortium will select the appropriate data repository (according to the Registry of Research Data Repositories provides by European Commission) to preserve the data, metadata and possibly tools, in the long term.

A Data Management Plan (DMP) will be submitted as a deliverable in WP5 (D5.1) by using the *"Guidelines on FAIR Data Management in Horizon 2020"* and the web-based tool *DMPonline*, and involving all work packages and partners to get a coherent plan. The DMP will define the items related to the research data lifecycle (what data will be created and how it will be managed) and will address the items aforementioned. It is a regular project deliverable that will be handled during and after the research project, coming back to it to periodically review the observance of the goals.

Regarding the knowledge management, the project guarantees open access to scientific peer reviewed publications by depositing a machine-readable electronic copy of the publisher's final version of the paper or a final peer-reviewed manuscript accepted for publication. The consortium partners will be encouraged to provide open access (free on-line access, such as the 'green' or 'gold' model) to peer-reviewed scientific publications, which might result from the project. Following the Openair Guidelines (www.openaire.eu) the consortium foresees to combine both options, the associated costs are foreseen in the consortium budget.

As an example the coordinator will use the institutional repository UPCommons (http://upcommons.upc.edu/), respecting always the embargo period. Each publication will be accompanied by bibliographic information, publication date, metadata about project funding (name of the action, acronym and grant number), date of release in open access, and a persistent identifier.

The S2S4E project also foresees to protect the Intellectual Property generated by the project in an early stage of the project as mentioned at the beginning of this section.

2.2.3. Communication activities

Our communication activities aim to increase visibility of S2S4E and enhance the European and global market for climate services. By and large, our external communication strategy will draw on the principles outlined in the H2020 Guidance Document 'Communicating EU research and innovation guidance for project participants'.

S2S4E will update the outline provided below in the Communication, Dissemination and User Engagement Plan (CDUEP, D7.2) to define the goals and objectives of communication, and to provide a full framework for the development of communication tasks along the lifetime of the project detailing target audiences, communication tools and channels, key messages and practical information such as branding project style, logo, guide, templates, etc. This plan will be a life document revised and updated twice during the project lifetime.

Target audiences include the general public in EU/EEA countries, EU policy-makers and in particular DG Energy of the European Commission, EU-based energy companies, forecasters and consultancies. In this work, we will seek to highlight cases which provide documentation of added-value, compile media-friendly statistics, develop infographics for wide distribution and produce a documentary. In addition we will actively seek to promote the Project at specific events chosen for their potential to deliver high impact on public policy-making and business decision-making.

To reach our target audiences we will mainly use our own platforms (website, Twitter, Facebook, YouTube). As part of our public engagement strategy we will develop communication products designed for easy sharing on social media. Use of social media is increasingly recognised as an important and low-cost way of public engagement (House of Commons: Public Engagement in Policy-Making, 2013). Where relevant, research findings will be communicated to mainstream media and journalists, either through press releases or by pitching stories to specific news outlets. Researchers will also write minimum three opinion pieces for specific news outlets across Europe with the support and guidance of WP7 or in co-authorship with WP7.

User engagement is not only central to our dissemination and exploitation strategy, it is also central to the success of our communication activities. We have therefore planned for communication activities that will help us cater to user needs and keep them close as to ensure market relevance of project output. In this we will seek to reach a wider audience of users in the energy sector (both policy-making and business).

We will produce a webinar series for the energy community with the aim to reach a broader user group than those immediately within the Project Consortium. In addition, we will produce a policy brief for the benefit in particular to DG Energy, as well as fact sheets and a White Report aimed for both policy-makers and EU-based energy businesses.

In addition to the above mentioned communication activities specifically planned towards our user groups we will also facilitate direct contact with users through one-to-one meetings with users when needed and in conjunction with specific tasks such as in-depth interviews and focus group workshops. The focus group workshops will allow us to reach a common and consensus-orientated understanding and definition of user needs that will reflect the targeted sub-sectors, whereas the interviews will build on the focus groups and previous projects with the aim of uncovering tacit knowledge and forging trusted relationships.

We will actively encourage the Consortium to seek further opportunities for engagement with users through their professional capacities, and will actively advise the Consortium on issues related to user engagement and public relations. Please see Table 2 for details on National and international research and innovation activities linked with the Project. In addition we will seek to foster networking and joint activities with the wider research community and other initiatives and projects related to energy such as C3S and Climate Services initiatives funded under H2020 and ERANet. Table 10 summarizes relevant conferences, workshops related with S2S4E where the consortium plans to participate

Table 9: Communication and user engagement activities by target audience

Target audience	Activities	Objective	WP Task
S2S4E consortium	· Focus-group discussions at the kick-off meeting · Individual and/or focus group interviews · Survey · Workshop: "Rapid Design Visualization" (RDV) methodology · Creative workshop to establish the business model of the DST · Email updates · Webinar series . Monthly internal conferences . Project portal · General Assembly	· Ensure co-design and co-development · Validate DST pilots · Assess operational and economic impacts · Maximise impact and exploitation · Ensure maximum societal benefit · Ensure project design delivers useful results · Facilitate internal communication	1.3 2.1 5.3 6.2 7.5.1 7.5.2 7.5.3
Scientific community and intergovernmental organisations	· Forecast outlooks · Seminars and workshops · Email updates · Webinar series · Stakeholder Event . Research papers . Public lectures and presentations	· Knowledge sharing and clustering among projects · Maximise impact and exploitation · Ensure maximum societal benefit · Disseminate scientific outcomes	7.4.2 7.4.3 7.5.1 7.5.3
Energy users	. Forecast outlooks · Email updates · Seminars and workshops · Documentary · Webinars series · Wiki and forum to share information about the development, integration and deployment of the final version of the DST . Ticket management system	· Share knowledge · Maximise impact and exploitation · Integration with other projects · Gather user's feedback to the DST	5.4 7.4.1 7.4.2 7.4.3 7.5.1 7.5.3
Public sector stakeholders	· Workshop: "Rapid Design Visualization" (RDV) methodology · Participate at conferences, exhibitions and workshops ant national, EEA, EU, and international level · Webinar series · Stakeholder Event	· Share knowledge · Maximise impact and exploitation · Integration with other projects	5.3 7.4.3 7.5.3 7.5.4
General public/society	· Documentary	· Ensure project is visible to public · Ensure project is reliably communicated	7.4.1
Media	· Public website · Press releases and media contacts · Documentary · Public lectures and presentations · Project newsletters/flyers	· Ensure project is visible to public · Ensure project is reliably communicated	7.3.1 7.3.2 7.3.3 7.4.1
International fora of relevance	· Documentary · Fact sheet · Participate at conferences, exhibitions and workshops ant national, EEA, EU, and international level	· Ensure project is visible to public · Ensure project is reliably communicated	7.4.1 7.4.4

Target audience	Activities	Objective	WP Task
EC Project Officer	· Fact sheet · Policy Brief · White Report · Stakeholder Event · General Assembly · Periodic reports	· Ensure EC is fully informed of overall project progress	1.3 7.4.4 7.5.4
Other EU bodies and projects	· Fact sheet · Policy Brief · White Report · Stakeholder Event	· Share knowledge · Maximise impact and exploitation · Integration with other projects	7.4.4 7.5.4

Table 10: Participation at dedicated events such as conferences and workshops

Event	Dates and venues	About the event	Targeted audience
ICEM	2019, TBC	Bi-annual conference of the World Energy and Meteorology Council. It is a link between users, providers and researchers in the arena of meteorology and climate services for the energy sector.	Energy users, service providers and academy
EGU General Assembly	8-13 April 2018,Vienna, Austria	Annual meeting of the European Geosciences Union where scientists can present their work and discuss their ideas with experts in all fields of geoscience, including Earth Sciences.	Scientific audience
EMS Annual Meeting	3-7 September 2018, Budapest, Hungary	Annual meeting of the European Meteorological Society. The main topic is: serving society with better weather and climate information.	Scientific audience
E-world energy & water	February 2018, Essen, Germany	A conference to showcase innovative solutions for the energy supply of the future, from generation, through distribution and storage to retail, efficiency and green technologies A whole day is devoted to weather impacts on energy.	Trading companies, asset owners, O&M teams, grid operators
WindEurope Conference	28-30 November 2017, Amsterdam, Nederlands	The largest conference on wind power in Europe, gathering experts from industry and academy. It holds sessions on forecasting, resource assessment and O&M strategies.	Wind power industry
IEEE PES General Meeting	5-10 August 2018, Portland, Oregon, USA	Institute of Electrical and Electronics Engineers Power & Energy Society organizes this annual meeting with a strong emphasis on planification of transmission systems.	Transmission and grid operators
Intersolar Europe	20-22 Jun 2018, Munich, Germany	The largest conference on solar power in Europe. It has a specific session on forecasting technologies.	Solar power industry
World Hydropower Congress	2018, TBC	The international hydropower association organizes his annual meeting to gather professionals and decision-makers in the hydropower sector. One of the main goals is to ensure reliable and resilient water and energy systems for everybody.	Hydropower industry Water management and hydrology national agencies

3. Implementation

3.1 Work plan — Work packages, deliverables

3.1.1 Brief presentation of the structure of the work plan

The work plan builds on the dynamic interaction between the different work packages centred on the idea of advancing S2S climate predictions tailored to users' requirements and provided as a Decision Support Tool (DST) for the energy sector. To this end, the project is structured in seven work packages with the aim to: ensure a smooth task management and coordination among partners (WP1); gather a deeper understanding of how and to what extent S2S forecasts can improve decision-making of renewable energy companies and thus create economic value (WP2); investigate the relationship between climate variables and energy indicators and to exploit those links to improve the predictability at S2S time-scales (WP3); develop methodologies for maximizing the utility of S2S forecast systems for both climate and energy variables (WP4); define data protocols, formats, integration and processing for the implementation of the Decision Support Tool (DST) (WP5); design a plan for the commercial exploitation of the DST, for its replicability to other sectors, and for policymaking information (WP6); and finally to maximise the dissemination, communication and user engagement of the project results (WP7).

The dependencies and timings of the different work packages are presented in Figures 12 and 13, the project work packages are detailed in Table 3.1b, the work packages are described in Table 3.1a (section 3.1.3), and all deliverables are listed in Table 3.1c. The major project milestones are listed in Table 3.2a.

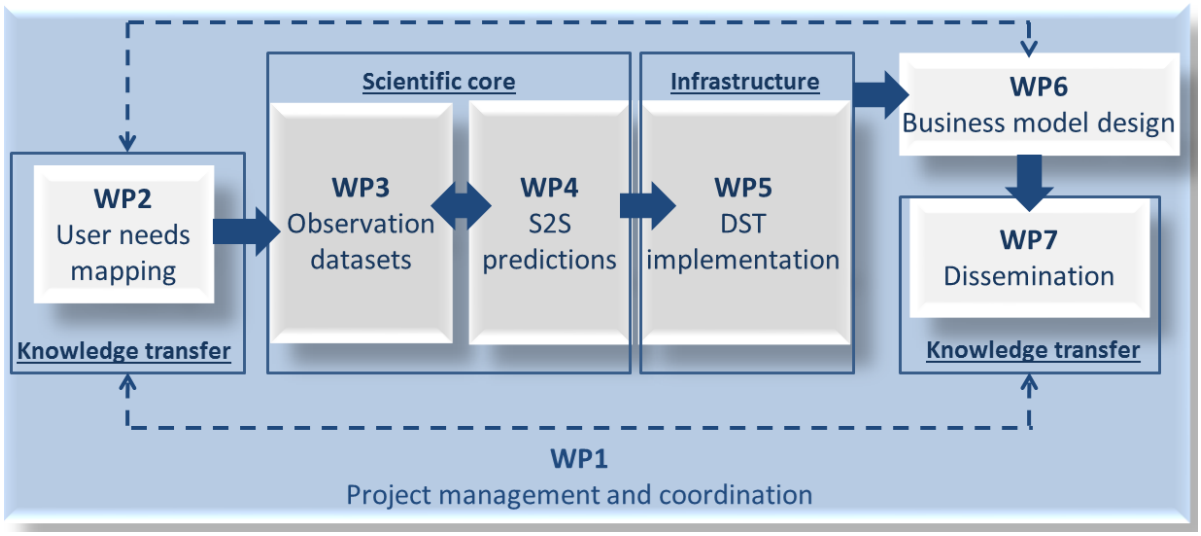


Figure 12: Project work packages' interactions

3.1.2 Timing of the different work packages

Figure 13 shows the Gantt chart of S2S4E where the main features in every task are stressed, including deliverables and milestones. Main meetings are already planned: including kick-off, general assemblies and the final conference.

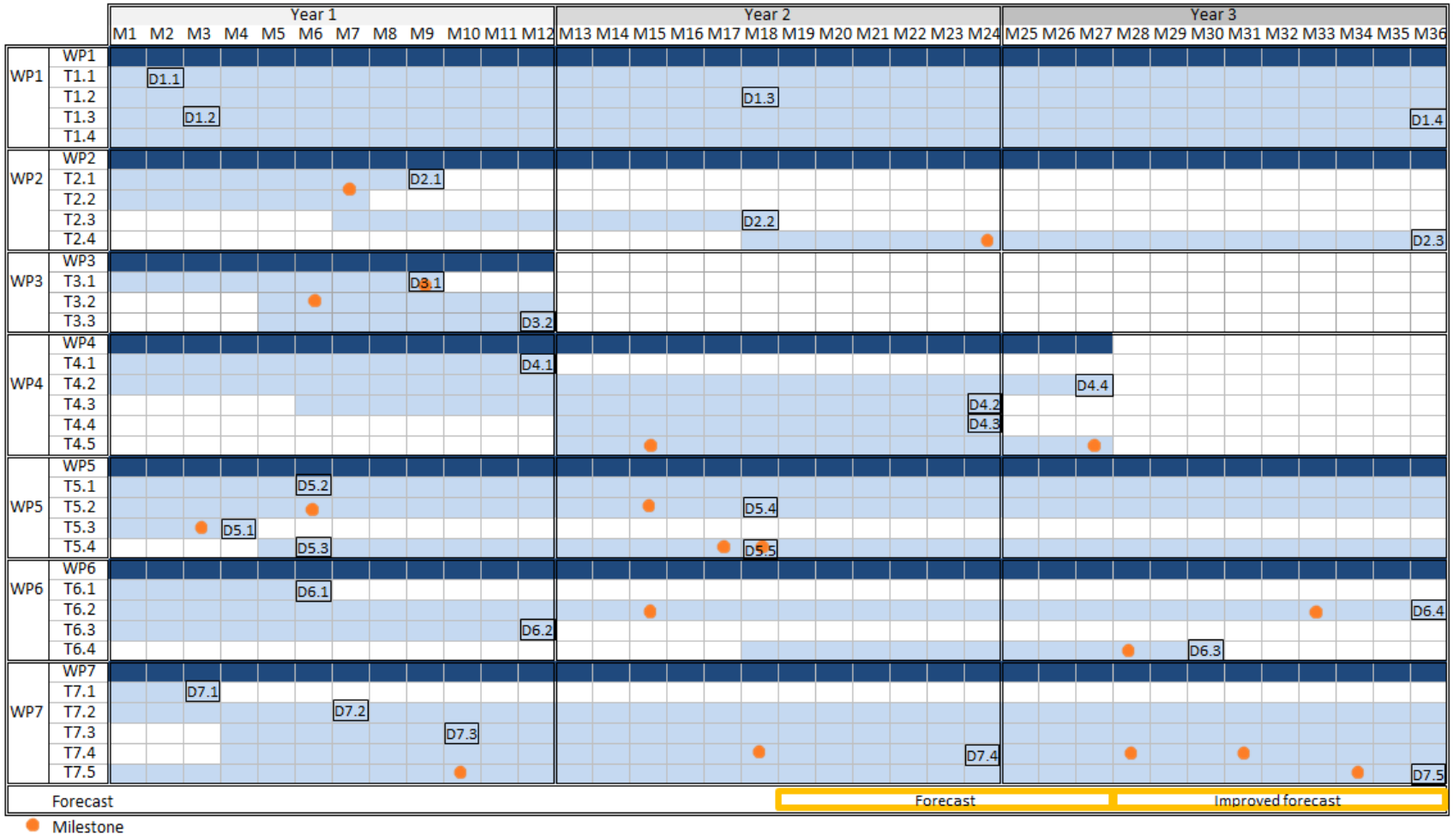


Figure 13: Gantt chart of S2S4E

3.1.3 Detailed work description

Tables 3.1a: Work package description

Work package number	1	Lead beneficiary				BSC	
Work package title	**Project management**						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	30	0	0	0	0	0	0
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	0	0		0	0	0	
Start month	M1		**End month**		M36		

Objectives

The main objective of this work package is to provide timely and efficient coordination of the S2S4E project in the following activities:

- Provide effective administrative, financial and contractual management to achieve the project objectives on time, to cost and at the highest quality level.
- Ensure that the project submits all results and deliverables in due time and good quality.
- Ensure an efficient interaction with the European Commission (EC), facilitate the consultation with the External Advisory Board and the internal communication within the consortium.

Description of work

This work package is led by: Albert Soret and Mar Rodriguez (BSC)

This work package will be led by Barcelona Supercomputing Center - Centro Nacional de Supercomputación (hereafter BSC), which will be responsible for all contractual, administrative and legal aspects of the project. The following is a list of the tasks required to achieve the objectives of this Work Package. The high level Management Structure as well as the individual roles and responsibilities within this structure are explained in Section 3.2 of the proposal. It also includes a brief overview of the most important management procedures of the project, which will be further defined in the early months.

Task 1.1: Administrative, contractual and financial coordination of the activities.

Duration: M1-M36 Participant: BSC (9 PM)

Lead by the experienced BSC Project Management Officer this task will establish the corresponding procedures, tools and methodologies to enable an effective project management, including administrative and financial management. It will also coordinate the timely production of deliverables, organize the kick-off meeting and reviews, and organize and manage audits requested by the European Commission. On a 6-month basis, the project coordinator will monitor resources usage, producing internal use of resources reports to ensure the project resources expenditure is in track with the work progress. Given the key role of project management in the success of the S2S4E project, the Project Manager will be backed up by BSC Project Management Office who will follow closely the project activities and will be available to take over the project management tasks at any time should a problem occur or additional human resources will be needed at some specific point to manage the S2S4E project.

Task 1.2 Technical coordination

Duration: M1-M36 Participant: BSC (9 PM)

Lead by the Technical Manager, this task will perform the technical coordination of the project by monitoring the progress of the Work Packages, technical coordination of meetings, appointing reviewers to assess the quality of the deliverables before their delivery to the EC, and solving technical conflicts. The Technical Manager role will be appointed once the S2S4E proposal is selected for funding.

Task 1.3 Internal communication, Quality and Risk Management

Duration: M1 - M36 Participant: BSC (9 PM)

In this task, we will determine the appropriate strategy to ensure clear communication channels between all partners and the EC in order to facilitate the exchange of critical project documentation and news and to encourage participation in the decision-making process. The task will require defining and maintaining internal collaborative tools for sharing documentation and communicating work status. One of the outcomes of this task will be a Project Portal or intranet (shared workspace) as well as a series of distribution lists along with the organization of a monthly teleconference for the S2S4E Consortium.

The Coordinator will be the single contact point for the EC and for strategic issues outside the project. This task will ensure the appropriate follow-up of specific obligations deriving from the EC contract, in terms of reporting (financial and scientific results), communication and general management procedures. The coordinator will inform the EC of project achievements and of any deviations from the agreed plans. In case of major difficulty, the coordinator will undertake a dialogue with the EC in order to find appropriate solutions

In this task, we will also define and implement the appropriate quality assurance processes that ensure accurate documentation, reporting and justification of the work being carried out. A process will be developed (and tools if applicable) to ensure that the deliverables have been reviewed by a broad spectrum of individuals against a well-defined set of criteria. Moreover, we will determine the minimum level of quality required for presentation of the official outcomes of the project to the EC. The high level principles guiding these procedures will be agreed to at the start of the project at the Kick-off Meeting. The administrative project management procedures defined in Task 1.1, quality assurance and risk management processes will be defined in D1.1.

Task 1.4 Innovation Management

Duration: M1-M36 Participant: BSC (3 PM)

In order to ensure that the results of S2S4E will not remain confined in academia of research labs but will find their path towards the market, a proper innovation management plan is of paramount importance. The Innovation Management Board (IMB) will work closely with the project coordinator and the consortium exploitation team to ensure a proper exploitation path as explained in section 2.2 and defined in WP6. Innovation management processes include both day-to-day management of knowledge and IPR issues and the iterative creation of exploitation plan and technology roadmaps. Being more precise, that will include: (1) Creation of an IPR repository; (2) monitor IPR compliance with H2020 and Consortium Agreement rules; (3) facilitate any related conflict; (4) facilitate the creation of commercial agreements between partners leading to joint exploitation after the end of the project; (5) monitor the project to guarantee consistency between technical and marketing choices; (6) monitor the market during the whole duration of the project, particularly concerning evolution of the technology, potential customers and existing and emerging competitors; (7) alert the Executive Board in case of inconsistencies with the exploitation goals; and (8) plan initiatives that combine technical and exploitation objectives to create business models for defining and exploitation path of most relevant innovations within the project.

Deliverables

D 1.1: Project information brochure/ booklet for participants and Project Portal. **(Lead: BSC, M2)**
D 1.2: Kick-off meeting report. **(Lead: BSC, M3)**
D 1.3: Follow up of Key Performance Indicators (KPIs). **(Lead: BSC, M18)**
D 1.4: Final Public Report. **(Lead: BSC, M36)**

Work package number	2	Lead beneficiary				CICERO	
Work package title	Definition of user needs and the role of S2S forecasts in decision-making						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	22	16	6	6	6	4	4
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	6	6		11	0	8	
Start month	M1		**End month**		M36		

Objectives

In work package 2, we examine how and to what extent S2S forecasts can improve decision-making of energy companies and thus create economic value. S2S variability in wind, solar radiation, precipitation and temperature affects the supply of energy produced by wind, solar and hydropower installations as well as electricity demand. Climate conditions affect cash flows and risks of renewable-energy producers, thereby their economic value. To ensure the added-value of the S2S forecasts for decision-making, it is key to understand which decisions benefit the most from such forecasts and how S2S forecasts should be tailored to support decision-making processes. Main objectives:

- Gain a better understanding of decisions that can benefit from S2S forecasts. (T2.1)
- Analyse the potential use of S2S forecasts in specific case studies. (T2.2)
- Assess the economic value of the use of S2S forecasts in energy decision-making. (T2.3)
- Provide best practice examples of the use of S2S forecasts in energy companies. (T2.4)

Description of Work

This work package is led by: Jana Sillmann (CICERO)

Task 2.1: Map user needs and decision-making processes

Duration: M1-M9 Participants: BSC (leader), CICERO, LGI, ENBW, EDF, EDPR, NNERGIX, SMHI

We will review knowledge gained in previous projects (e.g., SPECS-308378, EUPORIAS-308291, CLIM4ENERGY, ECEM and MARCO-730272) on how S2S forecasts are perceived and currently used to support decision-making. This knowledge will be presented and discussed with the industrial partners and SMEs in focus-group discussions at the kick-off meeting and later followed up in individual and/or focus group interviews. Specifically, an initial understanding of the users' needs will be obtained in the focus group discussion, and an in-depth understanding will be achieved from the interviews and the case studies in the second focus group discussion with the key stakeholders (T2.2.). Based on this information CICERO will develop an interview guide to assist the case studies in T2.2. CICERO and LGI will perform a gap analysis to identify discrepancies and opportunities between user needs and what current S2S forecasts can provide to support decision-making, assisting the work in subsequent WPs, in particular WP4 and WP5. Based on this analysis, LGI will visualize the current use and needs of S2S forecasts in each energy sector. Engagement with a wider range of users will be done as part of WP7 (for more see section 2.2.2.).

Partner (PMs)	Description
BSC (4)	Review existing knowledge; Take part in individual and/or focus group interviews; Perform a gap analysis
CICERO (4)	Organize the focus group discussions and interviews; Support interview guide development; Perform a gap analysis
LGI (4) CAPGEMINI (2)	Engage with users through participatory methods; Develop an interview guide; Create user experience maps; Perform a gap analysis
SMHI (1)	Engage hydropower stakeholders (Vattenfall and Vattenreglering)
EnBW (1), EDF (1), EDPR (1), NNERGIX (2)	Share experience and perceptions on the use of S2S forecasts; Identify decisions that may benefit from S2S forecasts; Participate in focus group and interviews

Task 2.2: Case studies

Duration: M1-M7 Participants: CICERO (leader), BSC, LGI, SMHI, ENBW, EDF, EDPR, NNERGIX

In consultation with the industrial partners, we defined four initial case studies as listed in Table 4. Other case studies of interest will be identified and discussed in the interviews and focus group discussions as part of T2.1. Based on the outcome, up to four additional case studies will be analysed in T2.2. The selected case studies will be simulated and analysed in WP4.

Within each case study, LGI and several academic partners will conduct in-depth interviews with a limited number of key persons from the relevant industrial partner or SME, using the interview guide developed in T2.1. In the interviews, examples of S2S forecasts will be presented with the help of researchers from WP3 and WP4 focusing on the forecast characteristics such as time resolution, time horizon, and uncertainty. The usefulness of these data and the potential economic benefits will be discussed together with the energy companies to get a more complete understanding of the way decisions could be improved by tailored forecasts. After completion of the interviews, CICERO and BSC will identify and analyse synergies between case studies in order to generalize findings to provide input for T2.3 and to bring the findings in a broader context. CICERO will, in particular, identify the relevance of the tailored forecasts for different kinds of operational and investment decisions, and reflect on the differences in the decision-making processes.

Partner (PMs)	Description
CICERO (6)	Conduct in-depth interviews; Collect and generalize findings from case studies
BSC (2), LGI (2), SMHI (2)	Conduct in-depth interviews
ENBW (0.5), EDF (0.5), EDPR (0.5), NNERGIX (1)	Participate in in-depth interviews and suggest case studies.

Task 2.3: Economic analysis of the value of using climate predictions

Duration: M7-M18 Participants: CICERO (leader), ENBW, EDF, EDPR, NNERGIX , BSC

This task aims at estimating economic value created by using S2S forecasts in energy companies. We will examine operative and investment decisions (e.g., optimization of hydro-power production, investments in multiple-fuel district heating) identified in T2.1 and T2.2. The economic value estimations will be based on stylized decisions, drawing from knowledge gained in T2.1 and T2.2 and T4.1. Because uncertainties in the forecasts can be understood and modelled in different ways, economists and natural scientists within the project will agree on a set of approaches to identify and quantify them. Next, these uncertainties will be translated to company risks, taking into account correlations between the various uncertain factors. Using real options theory for decisions under uncertainty, CICERO will derive decision rules based on S2S forecasts and risk estimates for the identified decisions. These decision rules will be compared and contrasted with rules based on the traditional net present value approach which does not explicitly model uncertainty.

Partner (PMs)	Description
CICERO (8)	Derive optimal decision rules; Calculate the economic value and optimal use of S2S forecasts; Examine how uncertainty can be modelled
ENBW (0.5), EDF (0.5), EDPR (0.5), NNERGIX (2)	Validate the results with energy experts; Evaluate the value added of S2S forecasts as compared to existing practices
BSC (2)	Validate the results with climate services experts

Task 2.4: Operational impact evaluation of real-time S2S forecasting

Duration: M18-M36 Participants: BSC (leader), LGI, EDF, NNERGIX, UREAD, ENEA, SMHI, CICERO

Task 2.4 will build a continuous link with energy companies involved in the consortium to feed the deployment of the forecast system within the Decision Support Tool (DST). This task will be closely connected to the activities in WP5, which will define the requirements of the data input needed to build the DST prototype. BSC will introduce the DST to industrial partners enabling them to take advantage of the strong connection with the academic partners and to start the integration of climate predictions in their operational activities. At the same

time, NNERGIX will start sharing the DST with its client networks to expand the number of initial pilot tests. BSC will closely follow the deployment of the DST at partners' operations and decision making and evaluate the operational performance of the DST by establishing a process of dynamic information exchange which will foster service co-design. After 6 months of the pilot deployment, users will make an assessment of the service performance of DST with the aim to validate its design. As a result, this task will clearly illustrate the impacts of integrating S2S forecasts in the decision-making processes of the energy companies, thus providing the basis for the development of best practices. In addition, BSC will coordinate the creation of a framework for assessment of information tailored to partners' operations that will be used to develop forecast outlooks in T7.4, including the evaluation of the forecast performance from previous periods and the description of current forecasts.

Partner (PMs)	Description
BSC (14)	Formulate and interpret forecasts to provide the required information to release forecast bulletins; Illustrate how the forecast have been included in the decision making process of the energy companies; Monitor DST deployment and assess its operational impact
UREAD (4), ENEA (6), SMHI (1)	Formulate and interpret the forecasts to provide the required information to release forecast bulletins
LGI (5)	Collaborate with energy companies; Gather necessary data to build monthly reports; Analyse the global economic impact of the tool
ENBW (4), EDF (4), EDPR (4)	Integrate the real-time operational forecasting system in their decision making process; Economically evaluate the performances of this forecasting system
NNERGIX (3) CAPGEMINI (4)	Share the DST with its client networks and work with them to implement the DST

Deliverables

D2.1: User needs and decision-making processes that can benefit from S2S forecasts. (**Lead: BSC, M9**)

D2.2: Economic gains from using S2S forecasts in energy producers' decision-making by analysing relevant case studies. (**Lead: CICERO, M18**)

D2.3: The impact of operational real-time forecasts for decision-making processes and best practice examples. (**Lead: BSC, M36**)

Milestones

M2.1: Information available from the participatory activities (focus group discussions and interviews). **(M7)**

M2.2: Validation from users of service performance of DST prototype. **(M24)**

Key Performance Indicators

KPI 2.1 Number of stakeholders involved in participatory activities (interviews and focus groups). **(20)**

KPI 2.2 Number of analysed case studies for obtaining the value of using S2S. **(8)**

KPI 2.3 Number of energy companies that integrate climate prediction forecast in their operations. **(5)**

KPI 2.4 Number of subscriptions to the forecast outlooks. **(30)**

Work package number	3	Lead beneficiary			ENEA	
Work package title	**Observational datasets**					
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	10	4	0	0	20	15	12
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	0	0		0	3	0	
Start month	M1		**End month**		M12		

Objectives

WP3 aims to lay the foundation for the data-intensive analysis needed to investigate the relationship between the essential climate variables and key energy indicators and to exploit those links to improve the predictability at S2S time-scales. In this WP we analyse tendencies and assess the mechanisms driving the identified energy indicators. Main objectives:

- To dissect the available datasets (observational, both in-situ and satellite, and reanalyses) building a knowledge-base about their characteristics and limitations (e.g. usage caveats). (T3.1)
- To assess the main climatic drivers of the energy indicators (e.g. teleconnections) in order to better understand how to exploit the available climate information to improve forecast utility. (T3.2, T3.3).

Description of Work

This work package is led by: Matteo De Felice, Alessandro Dell'Aquila (ENEA)

Task 3.1: Analysis and verification of observational data sets

Duration: M1-M9 Participants: ENEA (leader), BSC, TCDF

A comparison among the observational datasets will be carried out in order to establish the main differences between them for all the essential climate variables, as well as their accuracy when compared with point-wise observations. Datasets will be selected according to their availability for the variables that will be needed for the generation and analysis of energy indicators. These datasets include: ECMWF ERA-Interim and, when available, ERA5 reanalysis, as well as JMA JRA-55, NCEP/NCAR reanalysis, MERRA-2 reanalysis and satellite products from CM SAF initiative.

Inter-comparison of reanalysis products for the essential climate variables (including temperature, solar irradiation, 10m wind speed) will be performed (BSC, ENEA). The quality of the reanalyses will also be assessed with on-site observational datasets where available. The characteristics of the climatologies, trends and inter- and intra-annual variability will be analysed and assessments of the observational uncertainty will be made (ENEA). Methods for remapping observational and reanalysis datasets will be investigated to determine the most appropriate techniques for allowing post-processing of the operational forecasts (TCDF). These techniques may vary according to the variable (e.g. bicubic for temperature, conservative for precipitation) or the post-processing applied (bias correction, weather regimes classification) in order to maximise the utility of the operational forecast products.

Particular attention will also be paid to the co-variability of the essential climate variables with an aim to understanding the predictability of simultaneous, compound, phenomena that can impact the energy sector (e.g. low wind and high-demand in areas with a high-penetration of wind power).

Partner	Description
ENEA (6)	Analyse the inter- and intra-annual variability of all the datasets; Comparison of reanalyses with observations; Analysis of the co-variability between the essential climate variables
BSC (2)	Intercomparison of 10-meter wind from different reanalyses including a characterisation of the differences in climatology, trends and variability.
TCDF (3)	Evaluation of remapping techniques to be used in the post-processing chain

Task 3.2: Classification of weather regimes

Duration: M5-M12 Participants: SMHI (leader), BSC, ENEA, UREAD

This task is concerned with identifying and classifying the weather regimes that have an impact on the energy sector. Methodologies such as machine learning to dynamically cluster and classify weather patterns in the Euro-Atlantic region will be used and the impact of those regimes on the variability of the essential climate variables (including surface wind speed, temperature, solar radiation, precipitation, etc.) and energy indicators (capacity factor of solar and wind energy, electricity demand, change inflow) will be analysed (ENEA, BSC, SMHI), as well as on snow-driven flooding events (SMHI). Statistical models will be used to better understand the relationship between the weather patterns or large-scale models of variability and the energy indicators obtained from the C3S SIS ECEM project (ENEA) and to identify predictable signals at S2S timescales to help improve the utility of S2S forecasts. This task has strong links to T4.3.

In contrast to this, a repeatable impacts-based methodology for identifying "weather-impact" regimes and modes for the European power sector will be developed (UREAD). This work will identify the meteorological patterns that are associated with the strongest impacts on power-system properties over Europe, rather than focussing on known meteorological modes, and will build on existing work (Bloomfield et al, PhD thesis, in prep). The patterns identified will therefore be contingent on the structure of the power system itself (e.g., known or planned deployments of RE technologies), and will be assessed for both individual technologies (e.g., wind, solar, demand, hydro) but also compound phenomena (e.g. low renewables, high demand events), thereby seeking to better capture the nature of the meteorological impact on the power system as a whole. Compound phenomena will include: "residual load"- the demand remaining once renewable resources have been removed – and "load duration curves" – see e.g., Bloomfield et al, in press). The power systems structure will be informed by the eHighway2050 scenarios (both present and near-future) and the RE targets of individual nations and regions. Analysis will be performed both on the essential climate variables (e.g., appropriately sited and weighted combinations) and energy impact indicators (i.e., national-aggregate wind, solar, and demand). The patterns – and the power system models used to derive them – will be made available to WP3 and WP4.

Partner	Description
SMHI (8)	Analysis of large-scale variability and its connection to ECVs
BSC (4)	Development of a methodology to classify and analyse weather regimes; Analysis on the impact of weather regimes on wind speed
ENEA (6)	Development of a machine-learning based methodology to cluster the weather regimes; Statistical analysis of the connection between weather regimes and energy indicators
UREAD (7)	Analysis of the patterns with the strongest impact on the European power system, also considering the compound phenomena

Task 3.3: Characterization of the main modes of variability affecting Europe and their impact on the essential climate variables

Duration: M5-M12 Participants: UREAD (leader), BSC, ENEA, CICERO, SMHI

In this task the influence of the leading atmospheric variability modes in the Euro-Atlantic sector (i.e. the NAO, East Atlantic - EA, Scandinavian - SCAND, and East Atlantic/West Russia - EA/WR patterns) on the essential climate and local hydrological variables will be revisited, and their impact on the energy indicators examined for the first time, with a particular focus on Europe (BSC, ENEA, SMHI). The remote teleconnection of ENSO in the tropical Pacific and the surface signature of the stratospheric polar vortex variability will be analysed in terms of their impact on wind speed (BSC, UREAD). Metrics such as correlation and mutual information will be used to evaluate the links between global climate indices representing the large-scale modes of variability and the essential climate variables. Web-based visualisation tools will be developed to help users explore the datasets (ENEA).

The relationship between the "weather-impact" modes derived in T3.2 and well-established teleconnection indices and climate modes, will be assessed to identify state-dependent (or conditional) predictability (UREAD). The characteristics of the "weather-impact" modes will be quantified through metrics such as return periods (UREAD). The ASF-20C seasonal hindcast ensemble (Weisheimer et al., 2016) will also be used to investigate

the main modes of climate variability and their link to the energy-relevant essential climate variables, including extremes (CICERO). This dataset is a new large ensemble of atmospheric seasonal hindcasts covering the period 1900 to 2009 and constitutes a unique tool to explore modes of variability in atmospheric seasonal climate prediction, which is not possible with current seasonal hindcasts that cover the past 20 to 30 years. Data for the energy sector impact indicators will also be obtained from the C3S SIS ECEM project.

Partner (PMs)	Description
UREAD (8)	Analysis of the relationship between weather-impact modes and teleconnection indices
BSC (4)	Detection of the main modes of variability in the Euro-Atlantic region; Analysis of the impact of main modes of variability on wind speed
ENEA (8)	Exploration of the link between global climate indices and the modes of variability of ECVs; Development of an interactive application to explore the results
SMHI (4)	Investigation of the connection between modes of variability in Europe and local hydrology
CICERO (4)	Investigation of modes of variability and surface climate based on the hindcast simulations to identify robust relationships

Deliverables:

D3.1: Validation of observational datasets and recommendations to energy users on the choice of observational/reanalysis products. **(Lead: ENEA, M9)**

D3.2: Modes of variability in Europe and their impact on the energy indicators. **(Lead: SMHI, M12)**

Milestones:

M3.1: Compilation and distribution of common methodologies/scripts with the consortium. **(M6)**

M3.2: Assessment of reliability and uncertainty in the reanalyses. **(M9)**

Key Performance Indicator

KPI 3.1 Number of reanalyses analysed. **(5)**

Work package number	4	Lead beneficiary				UREAD	
Work package title	S2S climate predictions						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	25	6	0	0	18	40	24
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	0	0		0	16	0	
Start month	M1		End month		M27		

Objectives

- Support the proof-of-concept phase of the climate service through simulation and evaluation of the stakeholder identified case studies (T4.1).
- Performance assessment of sub-seasonal and seasonal forecast systems for both climate and energy variables (T4.2).
- Assessment of sub-seasonal and seasonal forecast systems to simulate large-scale drivers of variability and weather regimes identified in WP3 (T4.3).
- Development of methodologies for maximizing the utility of sub-seasonal and seasonal forecast systems through exploitation of conditional predictability and weather regimes (T4.4).
- Provision of knowledge, tools and indicators for the implementation of real-time forecasts (T4.5).

Description of Work

This work package is led by: David Brayshaw, Andrew Charlton-Perez & Emma Suckling (UREAD)

WP4 aims to develop a framework for maximizing the utility of sub-seasonal and seasonal forecasts for the key climate and energy metrics of value to the energy sector. It will do this by developing techniques, methods and models that allow operational S2S climate forecasts to be optimally combined with other geophysical and

energy-relevant data as well as process-based hydrological models. The activities in this WP will not only focus on the impacts for individual technologies (i.e. wind, solar or hydro power), but will take a broader view of risk and the impact of variability and predictability across the whole power system. This is particularly necessary when a single climate driver has impacts across different sectors and regions, i.e. large-scale cold and still conditions associated with atmospheric blocking during winter. Such an approach will build on the case studies identified in projects such as ECEM as well as in WP2.

Task 4.1: Benchmark assessment of the case studies using hindcast data

Duration: M1-M12 Participants: SMHI (leader), BSC, TCDF, ENEA, UREAD

The objective of this task is to analyse the case studies defined by the industrial partners in WP2 (T2.2) providing a first, preliminary assessment of the forecast capability to reproduce the observed anomalies and their impact on the relevant energy indicators. Initially, a single system approach (i.e. taking individual models from the S2S sub-seasonal, and the Copernicus and NMME seasonal forecast products) will be employed. Simple bias adjustments will be applied using the case studies identified for wind, solar and hydropower as well as demand. Statistical downscaling techniques, understood as a way of bias adjustment, will also be applied whenever wind and solar energy users require local information to the specific sites of study. Case studies taking a cross-sectoral approach (e.g. involving multiple sectors/risks, such as high demand, low renewables events) will also be identified and examined. The outcomes of this task will allow the users to have a first vision of the potential application of S2S climate predictions for decision-making (T2.3). In turn, the feedback provided in WP2 will help to refine WP4 activities (T4.2, 4.3, 4.4 and 4.5).

Partner (PMs)	Description
SMHI (3)	Calculate the hydro energy indicators for the case studies, including an assessment of the seasonal forecasts that are used as input to the dynamical hydropower model, as well as the end-user oriented seasonal impact indicators.
BSC (2)	Calculate the wind energy indicators for the case studies; Provide (including downscaled) information relevant for wind and solar energy.
ENEA (2)	Calculate the solar energy and demand indicators for the case studies.
UREAD (3)	Evaluate case studies taking a cross-sectoral approach, including high demand, low renewables events.

Task 4.2: Comprehensive forecast quality assessment

Duration: M1-M27 Participants: SMHI (leader), UREAD, BSC, ENEA, CICERO, TCDF

An assessment of the forecasting capabilities of current sub-seasonal and seasonal forecast systems will be made in terms of the essential climate variables that drive the energy system (temperature, precipitation, wind speed, solar radiation, snow), and the key energy indicators (river flow volumes, demand, renewables supply). These assessments will use hindcasts from the S2S, Copernicus and NMME systems. A comparison of skill and predictability across the different lead times will be made, including high frequency (daily) data, as well as weekly, bi-weekly, monthly and seasonal means.

This task will also focus on the assessment of enhanced bias adjustment, statistical downscaling and model combination techniques, with the aim of maximizing the utility of sub-seasonal and seasonal forecast systems for the essential climate variables and energy indicators. Methods for combining information across the sub-seasonal and seasonal timescale will also be investigated, in particular the use of sub-seasonal forecast information to constrain seasonal forecasts (i.e. following a 'seamless' approach).

Partner (PMs)	Description
SMHI (9)	Assessment of the improvement of a multi-model hydrological forecasting system over Europe; Evaluation of skill for river inflows, snow storage, and extreme seasonal events in hydropower modelling; Development of a combined statistical-dynamical approach to produce prototype forecasts of accumulated volume of the spring floods in Sweden; Test of the multi-model hydro-power forecasts under operational conditions for the 2012-2016 floods in Sweden.
BSC (8)	Implementation and assessment of several approaches to multi-model ensemble forecasting with a focus on forecast uncertainty assessment for wind speed. These approaches will be generalizable and applied by other partners to climate and energy indicators for solar power and demand;

	Comparison of statistical downscaling approaches.
ENEA (6)	Evaluation of the predictability of extreme events for solar radiation and solar power generation.
UREAD (12)	Skill assessment of current sub-seasonal and seasonal forecast systems for the key energy indicators; Assessment of the value of the high frequency (daily) data; Assessment of skill for the multi-model ensemble forecasts solar and demand variable.
CICERO (2.5)	Skill assessment of current sub-seasonal and seasonal forecast systems for the essential climate variables.
TCDF (7)	Comparison of different bias adjustment techniques for the essential climate variables; Provision of the most appropriate bias adjustment method to other partners.

Task 4.3: Predictability of energy-relevant climate variability

Duration: M6-M24 Participants: UREAD (leader), BSC, SMHI, ENEA, CICERO

This task will focus on the predictability of the weather regimes and large-scale teleconnection patterns identified in WP3 (T3.2) on sub-seasonal and seasonal timescales. The ability of current S2S systems to simulate and predict the relevant modes of variability modes will be assessed, focusing on impacts for particular sectors (i.e. wind, solar and hydro power), as well as compound phenomena that impact the power system as a whole. A common methodology will be employed across the different partners to ensure robustness and reproducibility.

Partner (PMs)	Description
UREAD (9)	Assessment of skill in S2S systems in terms of "weather impact regimes" and modes of variability with a focus on compound phenomena that lead to risks on the power system as a whole.
BSC (6)	Assessment of S2S prediction systems to reproduce the impact of weather regimes and large-scale teleconnection patterns on wind speed.
ENEA (5)	Assessment of S2S prediction systems to reproduce the impact of weather regimes and large-scale teleconnection patterns relevant for solar power and demand.
SMHI (5)	Assessment of predictability of weather regimes and teleconnections relevant for hydro power; Development of the statistical-dynamical multi-model approach to hydrological forecasting incorporating insights of relevant weather regimes from WP3.
CICERO (3.5)	Skill of the essential climate variables will be assessed against the ASF-20 (atmospheric seasonal forecasts of the 20th Century) dataset conditioned on the regimes and modes of variability.

Task 4.4: Conditional predictability and weather regimes

Duration: M12-M24 Participants: UREAD (leader), BSC, SMHI, ENEA

On sub-seasonal timescales it is very likely (and has already been demonstrated for some regimes) that predictability is different for different climate regimes. Additionally, predictability on the local scale can often be enhanced by making use of synoptic-scale predictions of weather regimes and then downscaling these predictions to the local scale. It is therefore important that any real-time forecast system has the ability to make use of both of these ideas, rather than simply relying on standard local scale (i.e. grid-point) output from climate models.

This task will develop methodologies to reconstruct the energy-related essential climate variables from the teleconnection indices analysed in WP3. The aim is to improve the utility of forecasts by incorporating skillful information of the large-scale teleconnection patterns at different time scales. In particular, statistical methodologies for identifying and utilising conditional predictability from the large-scale modes of variability will be assessed, focusing on the energy-relevant climate variables, as well as the energy impact indicators.

Sub-seasonal forecast information will also be used to condition the seasonal impact model for hydrological forecasting over Europe, including a focus on Swedish hydropower. This will involve using the sub-seasonal forecasts to initialize the hydrological impact model and also to constrain the seasonal forecast signal.

Partner (PMs)	Description
UREAD (14)	Identification and utilization of conditional predictability and skill with a focus on impacts from a whole power system perspective
BSC (5)	Construction of wind speed and wind power forecasts directly from the large-scale modes of

	variability and assessment of its forecast quality in comparison with the quality of the wind speed forecasts itself
ENEA (3)	Construction of solar power generation and demand from large-scale modes of variability
SMHI (5)	Use of sub-seasonal forecast information to condition the seasonal impact model for hydrological forecasting over Europe

Task 4.5: Provision of methodologies for real-time operational forecasting

Duration: M13-M27 Participants: TCDF (leader), SMHI, BSC, ENEA, UREAD

This task is concerned with transferring knowledge and targeted methodologies developed in this work package to inform the design of a real-time operational forecast system (Figure 3). In the first version of the DST, the essential climate variables and energy impact indicators will be implemented in the operational system based on data-intensive analysis. In the improved version, the recommendations from users after 6 months of operational use (M2.2) will be integrated and the multi-model and calibration approaches developed in T4.2, and T4.4 will be tested under operational conditions. Software for post-processing the sub-seasonal and seasonal forecasts will be developed and provided to WP5. This task will involve collaboration with WP5 so that the science developed in WP4 can be implemented into the DST framework. This work package is not concerned with the generation of the operational products themselves.

Partner	Description
TCDF (9)	Application and provision of bias adjustment and multi-model combination methodologies for the climate and energy variables based on the methods identified in T4.2; Assemble software for the methods developed in WP4 to post-process the sub-seasonal and seasonal forecasts needed for the operational phase.
SMHI (2)	Provision of data for the coming spring floods in Sweden and for seasonal hydrological impact indicators over Europe.
BSC (4)	Selection of metrics and impact indicators to be implemented in the DST; Systematic assessment of previous operational forecasts against observations/reanalysis for wind power
ENEA (2)	Transfer of knowledge on key metrics and impact indicators for demand and solar power provided to WP5; Provision of methodologies for the processing of sub-seasonal and seasonal forecasts into the climate metrics and energy impact indicators.
UREAD (2)	Transfer of knowledge on key metrics and impact indicators for demand net renewables and relevant weather regimes provided to WP5.

Deliverables

D4.1: Benchmarking skill assessment of current sub-seasonal and seasonal forecast systems for the users' selected case studies. (**Lead: SMHI, M12)**

D4.2: Impact and assessment of weather regimes on the energy sector. (**Lead: UREAD, M24**)

D4.3: Assessment of conditional predictability and use weather regimes to construct energy-relevant variables. (**Lead: UREAD, M24**)

D4.4: Skill assessment and comparison of methods for sub-seasonal and seasonal forecast systems for the energy sector. (**Lead: SMHI, M27**)

Milestones:

M4.1 Delivery methodologies for real-time operational forecasting. **(M15)**

M4.2 Delivery methodologies for the improved version of the real-time operational forecasting. **(M27)**

Key Performance Indicators:

KPI 4.1: Number of scientific papers published within the project **(8)**

KPI 4.2: Number of multi-model climate forecasting systems analysed **(3)**

Work package number	5	Lead beneficiary				CAPGEMINI	
Work package title	Operational Climate Service: Decision Support Tool (DST) implementation						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	23.5	0	2	2	0	0	4
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	2	27		0	8	6	
Start month	M1		**End month**		M36		

Objectives

- Definition of data protocols and formats
- Data integration and processing
- Co-development and co-design of the DST providing a climate service for energy

Description of work

This work package is led by: Roger Rutakaza (CAPGEMINI)

Task 5.1: Data Management Plan - definition of data protocols and formats.

Duration: M1-M36 Participants: BSC (leader), CAPGEMINI, TCDF

This task will define the requirements of the input data files needed to build the prototype, in terms of format (NetCDF4 compressed), metadata and file and directory structure. This definition will follow international standards such as the INSPIRE data specifications[8] and the Climate and Forecast conventions. Both, the filenames, directory structure and file attributes will need to be clearly defined to be able to identify the data provenance (institute, variables names, forecast dates, etc.). This task will also define the hardware requirements to store and preserve the data for the forecast system during and after the end of the project and will design the protocols to download the input data from external sources (ECMWF Mars, NMME, C3S) to the BSC local storage. All these definitions and conventions will be gathered and summarized in the Data Management Plan (DMP) that will be updated along the project.

Partner (PMs)	Description
BSC (3)	Define the protocols for the input data (essential climate variables) and the energy indicators.
TCDF (1)	Define the format and conventions for the metrics to combine and post-process the essential climate variables
CAPGEMINI (3)	Define data protocols and formats to be used by the DST

Task 5.2: Processing climate forecast and data integration in DST

Duration: M1-M36 Participants: TCDF (leader)**,** CAPGEMINI, BSC

As defined in section 2.2.2 input data will come from different remote servers (ECMWF, C3S, etc.) and are stored in different formats (grib1, grib2, NetCDF3, NetCDF4), following different standards and accesses procedures (e.g. ftp, http). Therefore, the data will have to be automatically downloaded, quality controlled and converted to fulfil the requirements defined in T5.1 and integrated in the DST. The download, formatting and quality control of the data will be made using Python and the ECMWF software suite called ecaccess that gives access to the MARS servers. The relevant reanalysis and observations used to compare the models and to compute energy indicators will also be downloaded from the Copernicus data store (C3S) and formatted in a similar way to the model outputs. Some of the observational data sets will also come from some industrial partners and will be shared among the partners following a non-disclosure agreement. Once the input files database has been built, TCDF will operationally implement the methodologies developed in T4.5 (Figure 3). Then the energy indicators required for renewable energy supply and demand will be computed according the user's needs, with as much data pre-processed as possible. Finally, CAPGEMINI will integrate the forecast information within the DST. Deliverable 5.4 will need the availability of M4.1 and M5.3.

[8] http://inspire.ec.europa.eu/data-specifications/2892

Partner (PMs)	Description
TCDF (7)	Perform the bias correction and compute improved forecast; Post-process essential climate variables to ensure the integration of the data within the DST
CAPGEMINI (6)	Integration of the real-time forecast data within the DST
BSC (12)	Host the data and take care of the technical infrastructure to host the data (security, remote access,…); Quality check and formatting the data downloaded; Compute wind, solar and demand indicators by applying impact models
SMHI (4)	Compute hydropower indicators by applying impact model (E-HYPE)

Task 5.3: Conceptualization, requirements, and testing of the DST

Duration: M1-M4 Participants: CAPGEMINI (leader)**,** BSC, EDF, EnBW, EDPR, NNERGIX

CAPGEMINI will use UX (User eXperience) in order to design user interfaces which fit their expectations in coordination with the participatory activities of WP2 (focus groups and interviews; see T2.1 and T2.2). The first step of our methodology will be to understanding users' needs according to several hypotheses and then develop a Minimum Viable Product (MVP). The MVP will be created with the principles of User eXperience (UX) Design and quickly tested in real conditions with a panel of future users to improve the product with their feedback. The principle of the UX Design is to create a product with a positive user digital experience at its heart. The aim is to remove all functional and emotional frictions that users may encounter.

According to this philosophy, we will create our MVP's user interface using CAPGEMINI's "Rapid Design Visualization" (RDV) methodology. The RDV method is a rapid, collaborative and iterative process that is used to develop Users Interfaces (UI) that are adapted to the intended usage of the system. This method will include one workshop with all the WP2 T2.1 contributors and policy makers from the External Advisory Board. The workshop will be held with participatory activities: A kick-off meeting in M1, followed by a series of interviews to be conducted up to M4. To begin, we will identify user needs, elaborate the first workflow of our solution and sketch the first draft of our UI in the form of "storyboards". Then, we will create the wireframes of the user interfaces. This step will allow us to refine and animate the displays to illustrate and validate their interactions. It also allows us to refine what information we will need (including when and how) from the backend systems, notably from WP2. Finally, we will create the definitive visual displays to make sense of the interfaces and animate them with a design prototype to be tested by real users including an eye tracker test. It is worth noting that in the methodology, the starting point will be project UKKO (http://www.project-ukko.net/; co-designed and co-developed in the EUPORIAS project which is now being currently updated by the visualization group of the BSC within the CLIM4ENERGY project).

Partner	Description	(PMs)
CAPGEMINI (12)	Carry out a workshop in order to collect users' needs; Create the visual displays	12
BSC (0.5)	Perform an eye tracking test	0.5
EDF (1), EnBW (1), EDPR (1), NNERGIX (2)	Conceptualization of the prototype, providing an industrial viewpoint on how the data should be put together	1 (each), 2 NNERGIX

Task 5.4: Development, integration and deployment of the final version of the DST

Duration: M5-M36 Participants: BSC (leader), CAPGEMINI, EDF, EnBW, EDPR, NNERGIX

Once the prototype is validated and the design of T5.3 is complete, BSC will start the implementation phase combining lean development techniques, inside the agile methodology, thus warranting that the software will adjust to the requirements and the users' needs.

During the process BSC will use incremental development cycles, dividing up the full design into layers that will let us develop the interface elements by stages, from the most general to the most specific ones. By the end of each cycle BSC will perform user tests and benchmarks involving the industrial partners of the consortium to follow up and have a continuous validation of the results. Of particular interest will be the usability of the data visualization component of the interface, which will need close collaboration between programmers, UX designers, graphic designers, and data visualization experts. This division of the development process in cycles allows us early detection of integration problems and critical defects, which improves the quality of the final

product and increases productivity during the development process.

CAPGEMINI will formalize the definition of the integration strategy in a System Validation and Verification Plan with collaboration from BSC. During the development process BSC and CAPGEMINI will use a ticket management system (Redmine, http://www.redmine.org/) for issue tracking, Gantt charts, files and documents management, and a wiki and forum for internal communication.

At the end of the development stage, CAPGEMINI will validate the integration of all DST components.

Once the DST is running in an operational mode, the system will be maintained until the end of the project. Besides this, a ticket management system, a wiki and a forum will be established for external communication to engage a wider audience.

Partner (PMs)	Description
BSC (8)	Develop and implement the DST following the design by T5.3
CAPGEMINI (6)	Contribute in the integration strategy definition that will be formalized in the SVVP (System Validation and Verification Plan); System Validation and Verification Plan Validate the integration of all DST components
EDF (1), EnBW (1), EDPR (1), NNERGIX (4)	Test functionalities, accessibility and integration.

Deliverables:

D5.1: Conceptualization, requirements, and testing the DST. **(Lead: CAPGEMINI, M4)**

D5.2: Data Management Plan (DMP). **(Lead: BSC, M6)**

D5.3 System Validation Verification Plan (SVVP) including test suite documents. **(Lead: CAPGEMINI, M6)**

D5.4 Architecture Design Document including a Data integration strategy and the Interface Control Definition. **(Lead: CAPGEMINI, M18)**

D5.5: Production version of the Operational Climate Service: Decision Support Tool, including developers documentation and user guides. **(Lead: BSC, M18)**

Milestones:

M5.1: User testing report available (prototype and wireframes) and design of the visualization tool. **(M3)**
M5.2 Server deployed and running. **(M6)**
M5.3: Software available to download, transform and format the data for real-time forecast. **(M15)**
M5.4: Release candidate version of the DST ready for validation. **(M17)**
M5.5: Operational forecast products including an external wiki and forum available. **(M18)**

Key Performance Indicators

KPI 5.1: Number of visits to the DST. **(>1000)**

KPI 5.2: Level of responsiveness to support request on the ticket system. **(Less than 5 working days for an initial response)**

Work package number	6	Lead beneficiary				LGI	
Work package title	**Positioning, exploitation and business models**						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	1.5	8	2	2	1	0	2
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	2	5		28	3	11	
Start month	M1		**End month**		M36		

Objectives

Work package 6 will explore the prerequisites to ensure the best possible exploitation of S2S4E results by the partners. First, WP6 will **clarify how the S2S4E partners will use the results of the project after the end of the project**: In accordance with the Data Management Plan (DMP) developed in the WP5, results and data that can

be further exploited and commercialised will be identified. The different options for commercialisation will be investigated (T6.2), one of these results being the tool to be developed in WP5. Specific business model options will be elaborated to enable its commercialisation. To maximise the exploitation, a replicability study will be conducted to assess the applicability of the tool in other sectors (T6.4). Then, WP6 will **study the external elements that may impact the use of the tool:** T6.1 will present other systems available on the market and define the positioning of the S2S4E tool compared to other competitive solutions. T6.3 will assess the policies in key countries to be defined, and at European level that may slow down or enhance the use of the tool. The main outputs of this WP are listed below:

- Identification of potential competitive solutions (T6.1)
- Partners' exploitation of the forecasts (T6.2)
- Business models for the DST (T6.2)
- Policy intervention to facilitate adequate usage (T6.3)
- Potential use of S2S in other sectors (T6.4)

Description of work

This work package is led by: Eva Boo (LGI)

Task 6.1: Benchmark and positioning

Duration: M1-M6 Participants: NNERGIX (leader), LGI, CICERO, EDF, EnBW, EDPR

This task aims to study the current solutions on the market that appear as potential competitive solutions. The main characteristics of the different tools will be detailed. A matrix with the different solutions will be created to represent the positioning of the tool compared to its competitors. To identify such competitors, interviews with potential clients will be conducted.

Partner (PMs)	Description
NNERGIX (6)	Lead the task and establish a structure for the description of the different tools; Name several competitive solutions
LGI (7)	Describe up to 7 competitive tools; Write the section dedicated on positioning
EDF (1), EnBW (1), EDPR (1)	Name several competitive solutions; Help positioning the different competitive solutions

Task 6.2: Business models and exploitation

Duration: M1 - M36 Participants: LGI (leader), NNERGIX, CAPGEMINI, TCDF, BSC, EDPR, EnBW, EDF, ENEA, SMHI

The purpose of this task is to describe how the results of the project will be exploited by each partner. Based on the Data Management Plan developed in WP5, the exploitation section will identify all the marketable results and develop a strategic plan to promote and deploy them. Intellectual property rights will also be treated in this task (see section 2.2). As the main outcome of the project will be the tool, business model options will be developed to ensure the further commercialisation. Questions such as "Which partner will commercialise the tool? What will be sold (license, information, subscription)? At what price?" will be answered. Creative workshops will be organised in this task using innovative techniques such as Lego Serious Play® combined with a more traditional business model canvas. Monetisation of the different solutions and services will be analysed to ensure profit for partners. To foster the commercialisation of the tool after the end of the project, a commercialisation agreement to be signed by the S2S4E partners will be prepared in this task 3 months before the end of the project (see list of milestones).

Partner (PMs)	• Description
LGI (12.5)	Lead the creative workshop with the S2S4E partners to establish the business model of the DST; Discuss with all the partners on their exploitation strategy via interviews and questionnaires; Develop IP strategy for the main results of the project
NNERGIX (5), TCDF (2.5), CAPGEMINI (3)	Provide input and feedback on the business model options of the DST; Identify IP issues for the commercialisation of the DST
BSC (1), EDPR (1), EnBW (1), EDF (1), ENEA (0.5), SMHI (1.5)	Provide input and feedback on their business models and their exploitation strategy of their results to LGI; Participate in the creative workshops to precise the business models

Task 6.3: Assessment of policies and recommendations

Duration: M1 - M12 Participants: CICERO (leader), LGI

This task assesses possible policy interventions to enhance the economic value of S2S. Interventions are warranted if there are market failures. These are likely to occur if climate services are provided free, while the scope of the services are limited by public budgets, or if the services are delivered as a private good, but with a potential benefit to the public. CICERO will identify possible market failures in providing S2S forecasts, drawing on economic theory and lessons from WP2, WP5, and Tasks 6.1, 6.2 and 6.4. Then, possible policy interventions will be discussed with the partners in the project, if possible as a part of the interviews conducted in WP2. To support the broad perspective of S2S usage in this work package, LGI will do a separate study to map existing policy instruments and their usage. The final recommendations to policy interventions and measures aimed at facilitating use of S2S will done by striking a balance between the theoretical messages and the practical challenges.

Partner (PMs)	Description
CICERO (7.5)	Carry out a theoretical analysis of market failures; Complement theoretical analysis with partner discussions; Identify policy interventions/instruments that may further enhance the economic value of S2S forecasts.
LGI (3.5)	Describe policy instruments in use that influence the economic value of S2S forecasts; Identify policy interventions/instruments that may further enhance the economic value of S2S forecasts

Task 6.4: Replicability

Duration: M18 - M30 Participants: LGI (leader), CAPGEMINI, BSC, ENEA, SMHI, TCDF, CICERO

This task, will investigate the applicability of the tool in other sectors, based on the key success factors and main added value of the tool for the utilities in the energy sector. By identifying synergies with other sectors, the marketability of the tool could be maximised. An innovation camp will be organised with the partners of the project as well as external actors during one day to make them work together and identify opportunities to replicate the tool for other applications.

Partner (PMs)	Description
LGI (5)	Lead the innovation camp to identify synergies with other sectors
CAPGENIMI (2), BSC (0.5), ENEA (0.5), SMHI (0.5), TCDF (0.5), CICERO (0.5)	Participate in the innovation camp

Deliverables

D 6.1: Benchmark and positioning of the tool. **(Lead: NNERGIX, M6)**

D 6.2: Assessment of policies and recommendations. **(Lead: CICERO, M12)**

D 6.3: Replicability of the platform. **(Lead: LGI, M30)**

D 6.4: Final Exploitation strategy & Business model options for the tool. **(Lead: LGI, M36)**

Milestones

M 6.1: Creative workshop restricted to the S2S4E partners to elaborate business models options for the DST. **(M15)**

M 6.2: Innovation camp with the partners and stakeholders of the climate services sector to identify opportunities for the DST in sectors others than energy. **(M28)**

M 6.3: First version of a commercialisation agreement for the DST. **(M33)**

Key Performance Indicators

KPI 6.1: Number of competitive solutions analysed. **(7)**

KPI 6.2: Number of policy instruments analysed. **(6)**

Work package number	7	Lead beneficiary				CICERO	
Work package title	Dissemination, communication and user engagement						
Participant number	1	2	3	4	5	6	7
Short name of participant	BSC	CICERO	EDPR	EnBW	ENEA	UREAD	SMHI
Person months per participant	25	15	2	2	3	2	3
Participant number	8	9		10	11	12	
Short name of participant	EDF	CAPGEMINI		LGI	TCDF	NNERGIX	
Person months per participant	2	6		5	3	4	
Start month	M1		End month		M36		

Objectives

This WP coordinates the dissemination and communication and outreach activities of the project, as well as facilitates user engagement. Key outcomes and outputs from the other WPs will form the basis for the preparation of activities and materials under WP7. WP activities will be structured into three main lines of activities with specific objectives:

1) Communication: the timely communication of project outputs, outcomes and research milestones.

- Increase visibility of S2S4E and its outcomes in the European arena and beyond.
- Enhance the European and global market for climate services.

2) Dissemination: the effective dissemination of project outputs with the aim to boost the commercial exploitation strategy and market uptake of S2S4E's results and the Decision Support System.

- Operational predictions are disseminated with the potential of adding value to the project through further commercialization of outputs.
- Position S2S4E Decision Support System among the top EU climate-related innovations.

3) User engagement: to ensure the appropriate engagement of users.

- Exchange lessons learnt and results at regional, national and global levels to contribute to the further development of climate services for energy.
- Raise awareness of all the relevant energy stakeholders about S2S4E to demonstrate how S2S relate to their current and future needs.

Description of work

This work package is led by: Tiina Ruohonen (CICERO)

Task 7.1: Brand Development and External Platforms

Duration: M1-M3 Participants: LGI (lead), CICERO

A coherent and recognizable visual identity will be designed to be used in all project materials (D7.1). This task includes the following work: Design of visual identity (including design elements, logo, colours and fonts), design of templates for letters, presentations, reports and newsletters, design and setup of website and social media platforms.

Partner (PMs)	Description
LGI (2)	Design a coherent and recognizable visual to be used in all project materials.
CICERO (0.5)	Support the above activity

Task 7.2: Communication, Dissemination and User Engagement Plan

Duration: M1-M36 Participants: CICERO (lead), BSC

An outline of the Communication, Dissemination and User Engagement Plan (CDUEP) is provided in section 2.2 and will be further developed in D7.2. The document will provide detailed information about the activities planned along the lifetime of the project. The document will provide an overview of key messages, detailed target audiences, communication platforms and activities, as well as practical information such as branding of the project, logo, templates, etc. The document will also provide a full framework for user engagement activities detailing target stakeholders, effective mechanisms for engaging users and temporal implementation plan of the user engagement activities. Key performance Indicators (KPI) for each dissemination and user engagement activity will be defined. This plan will be revised and updated twice during the project's lifetime

and a final report will be delivered in M36.

Partner (PMs)	Description
CICERO (1.5)	Develop and revise CDUEP
BSC (0.5)	Support the above activity

Task 7.3: Communication and Media work

Duration: M3-M36

Participants: CICERO (lead), all partners

Communication activities will be carried out during the entire project period as specified in D7.2. Some activities have already been identified, these are:

Subtask 7.3.1: Media work - M3-M36 - CICERO (lead), BSC (support), all (contribute)

Mapping of relevant media actors to the project, both international and national media, and specialized trade press and mainstream media. Establishment of media monitoring and a proprietary media list which will be built on existing contacts in Consortium, as well as media liaison for the project. Define media-friendly content and messages, in collaboration with other WPs, particularly towards the end of the project period or once we have relevant research results and a prototype. Support consortium partners, where necessary, in their media work, including drafting of press releases and writing of op-eds.

Subtask 7.3.2: Communications content for platforms - M3-M36 - CICERO (lead), LGI, BSC (support), all (contribute)

Ongoing communication activity of producing and creating attractive content for the different project platforms such as website, quarterly newsletter, Twitter, Facebook and YouTube. This will be done in close collaboration with the other WPs for the duration of the project, and WP7 will set up a small editorial team consisting of communications staff from partner organisations that will have monthly meetings. Examples of content: scientific publications (open access), data sets (open data), events, research news, news articles, op-eds, interviews, reports, articles based on research but in popularized format.

Subtask 7.3.3: Communications and PR materials - M3-M36 - BSC (lead), CAPGEMINI, CICERO (support), all (contribute)

We will produce roll-ups and brochures in physical formats (D7.3). We will also produce, in cooperation with other WPs, final summaries of project findings for various types of stakeholders in a format as described in D7.2.

Partner (PMs)	Description (PMs)
CICERO (5.5)	T7.3.1 Map media actors, establish media monitoring, develop media list, define content, draft press releases and op-eds (2); T7.3.2 Host (rotates) editorial team, plan content for all platforms, produce and order content, update platforms (3); T7.3.3 Support (0.5)
BSC (4)	T7.3.1 Define content, help draft press releases and op-eds. (0.5); T7.3.2 Host (rotates) editorial team, plan content for all platforms, produce and order content, update platforms (2); T7.3.3 Produce physical PR materials and project findings (1.5)
LGI (1.5)	T7.3.1 Map media actors, develop media list, define content, draft press releases and op-eds (0.5); T7.3.2 Host (rotates) editorial team, plan content for all platforms, produce and order content, update platforms (1)
CAPGEMINI (3.5)	T7.3.2 contribute content (0.5); T7.3.3 Support (3)
ENEA (1.5), SMHI (1.5)	T7.3.2 contribute content (1.5)
all others	T7.3.2 contribute content (0.5)

Task 7.4: Dissemination Activities

Duration: M3-M36 Participants: CICERO (lead), all partners

Dissemination activities will be carried out during the entire project period as specified in D7.2. Some activities have already been identified, these are:

Subtask 7.4.1: Documentary - M12-M24 - BSC (lead), CICERO (support)

Production of a documentary shortfilm (D7.4) that explains the motivation, purpose and market potential of the DST through animations and simulation data from WP2. The main target audience are potential users of

the DST. However, the video will be made under a *multilayer* approach, so it can be enjoyed by a broad audience, but has deeper layers of information to satisfy and engage an expert audience as well.

Subtask 7.4.2: Forecast Outlooks – M18-M36 - BSC (lead), CICERO (support)

We will produce forecast outlooks that will be distributed through our mailing list. In producing these we will actively ask for feedback from users on the forecasts in order to improve them. We plan to do this both ex-ante (aiming to improve usefulness) and ex-post (looking into accuracy and performance of the outlook forecasts). We will produce an outlook per month in the period PM18-PM36 (total 18). In this we will align ourselves closely to the work streams under user engagement and more specifically tasks 7.5.1 and 7.5.2. The forecasts will be distributed through our online platforms, mainly our website and the DST.

Subtask 7.4.3: Events - M20-M34 - BSC (lead), CAPGEMINI, NNERGIX, all (support)

We will organize (or co-organize, if opportune) two events between M28 and M31 with the aim to position the DST in the wider energy community. In this we will work closely with WP2 (see tasks 2.1 and 2.2) and WP6 (see tasks 6.1, 6.2 and 6.4). We will also seek to foster networking and joint activities with research community and other initiatives and projects related to energy such as C3S and Climate Services initiatives funded under H2020 and ERANet. In addition we will seek to participate at conferences, exhibitions and workshops at national, EEA and EU, and international levels in order to disseminate the results and illustrating the benefits of the Decision Support System (see Table 10, Section 2.2.3).

Subtask 7.4.4: Fact sheet, Policy Brief and White Report - M20-M36 -CICERO (lead), BSC (support), all (contribute)

We will produce one fact sheet, one policy brief and one White Report that detail how S2S4E can make the European energy sector more resilient to climate variability, how energy stakeholders can benefit from the tool, and the economic opportunities of improved decision-making processes together with policy recommendations to the European Commission. In this we will work closely with WP2 (see tasks 2.1 and 2.2) and WP6 (see tasks 6.1, 6.2 and 6.4). In addition we will produce a White Report on S2S for a wider group of stakeholders at the end of the project period in coordination with subtask 7.5.4 and in close collaboration with all other WPs.

Partner	Description (PMs)
CICERO (3.5)	T7.4.1 Support (0,5); T7.4.2 Support (1); T7.4.4 Produce policy brief and White Report (2)
BSC (12)	T7.4.1 Produce documentary (5); T7.4.2 Produce forecast outlooks (3); T7.4.3 Organise events (2); T7.4.4 Produce fact sheets (2)
CAPGEMINI (2)	T7.4.1 Support (1); T7.4.3 Support (0,5); T7.4.4 Contribute and promote (0,5)
NNERGIX (2.5)	T7.4.3 Support (2); T7.4.4 Contribute and promote (0,5)
all others (1)	T7.4.3 Support (0,5); T7.4.4 Contribute and promote (0,5)

Task 7.5: User Engagement Activities

Duration: M1-M36 Participants: CICERO (lead), BSC (support), all partners (contribute)

Active engagement with the energy community within and outside the EU, including energy companies and intermediary SMEs, consultancy companies and international organisations relevant for energy stakeholders (EWEA, WEMC) is crucial for maximising S2S4E impact beyond the industrial partners of the consortium. We will actively seek to engage a wider user community through a variety of activities.

Subtask 7.5.1: User Engagement Management - M1-M36 - CICERO (lead), BSC (support), all (contribute)

We will setup and maintain a proprietary list of stakeholders and users in order to create impact and build audience for all of our outreach activities. In this work we will use APSIS as our tool. We will facilitate or assist the facilitation of meetings by using participatory methodologies (co-production of knowledge) as described in the project. We will also seek to facilitate feedback from users, such as during the production of forecast outlooks as detailed in task 7.4.2. In this we will work closely with WP2 (see tasks 2.1 and 2.2) and WP6 (see tasks 6.1, 6.2 and 6.4). We will develop and employ a stakeholder typology to assist stakeholder work and engagement with user groups across the consortium.

Subtask 7.5.2: Interviews and stakeholder survey - M2-M36 - CICERO (lead), all (contribute)

We will seek to interview a small, core group of users in order to establish preferred formats of engagements. We will also send out a stakeholder and user survey to a larger group with the overall purpose of finding the most effective way for helping to: 1) maintain the practical relevance of the conducted research, 2) foster buy-in and support and thereby facilitate the research, and 3) foster mutual learning between stakeholders, users

and the project. In this we will work closely with WP2 (see tasks 2.1 and 2.2).

Subtask 7.5.3: Webinar series - M24-36 - BSC (lead), CICERO (support), all (contribute)

We will produce a free and open access webinar series for the energy community. The aim is to present the operational forecast for each season and analyze the performance of the predictions for the previous season. The webinars (6) will be recorded and provided as an open resource on our website.

Subtask 7.5.4: Final Stakeholder Event - M34 - BSC (lead), CICERO (support), all (contribute)

A final event (potentially organized as a high-level roundtable or a matchmaking workshop) will present the results and outcomes of the complete project to energy stakeholders and the wider energy community and specific stakeholders in the European Commission and DGs. The conclusions of this event will feed into a sectoral synthesis report (White Report on S2S, see subtask 7.4.4) that assesses the implications of S2S climate predictions on i) improved decision making ii) risk management and adaptation strategies and iii) climate services market development for energy.

Partner	Description (PMs)
CICERO (4)	T7.5.1 Facilitate user engagement and maintain appropriate tools (1,5); T7.5.2 Conduct survey and interviews (1.5); T7.5.3 Support (0,5); T7.5.4 Support the organisation of the final event (0,5)
BSC (8.5)	T7.5.1 Support (0,5); T7.5.3 Organise the webinar series (5); T7.5.4 Organise the final Stakeholder Event (3)
TCDF, NNERGIX	T7.5.4 support and contribute (1)
all others	T7.5.4 support and contribute (0,5)

Deliverables

D7.1: Website and social media platforms up and running, visual identity (design elements), templates and logo available. **(Lead: LGI, M3)**

D7.2: Communication, Dissemination and User Engagement Plan (CDUEP). **(Lead: CICERO, M7)**

D7.3: Communication and PR materials (roll-up and brochure). **(Lead: BSC, M10)**

D7.4: Documentary on the DST. **(Lead: BSC, M24)**

D7.5: Summary report on the impact of dissemination, communication and user engagement activities. **(Lead: CICERO, M36)**

Milestones

M7.1: Launch of stakeholder survey. **(Lead: CICERO, M10)**

M7.2: Start of dissemination of monthly Forecast Outlooks. **(Lead: BSC, M18)**

M7.3: Event in Southern/Central Europe. **(Lead: CICERO, M28)**

M7.4: Event in Northern Europe. **(Lead: CICERO, M31)**

M7.5: Final Stakeholder Event. **(Lead: BSC, M34)**

Key Performance Indicators

All dissemination and user engagement activitites will have associated KPIs that will be defined in the CDUEP and tracked in the two revisions of the CDUEP and D7.5 Some examples of KPIs will include:

KPI 7.1: Number of visits to the project website. **(>1000)**

KPI 7.2: Number of subscribers to our mailing list. **(>30 subscribers)**

KPI 7.3: Number of attendees in events and seminars. **(> 40 participants)**

KPI 7.4: Number of media mentions. **(>20)**

Table 3.1b: List of work packages

Work package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
WP1	Project management	1	BSC	30	M1	M36
WP2	Definition of user needs and the role of S2S forecasts in decision-making processes	2	CICERO	95	M1	M36
WP3	Observational datasets	3	ENEA	64	M1	M12
WP4	S2S climate predictions	6	UREAD	129	M4	M36
WP5	Operational Climate Service: Decision Support Tool (DST) implementation	9	CAPGEMINI	74.5	M1	M36
WP6	Positioning, exploitation and business models	10	LGI	65.5	M1	M36
WP7	Dissemination, communication and user engagement	2	CICERO	72	M1	M36
				530		

Table 3.1c: List of Deliverables

Deliverable (No.)	Deliverable name	WP No.	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D 1.1	Project information brochure/ booklet for participants and Project Portal	WP1	BSC	Report	CO	M2
D 1.2	Kick-off meeting report	WP1	BSC	Report	CO	M3
D 1.3	Follow up of Key Performance Indicators (KPIs)	WP1	BSC	Report	CO	M18
D 1.4	Final Public Report (M36)	WP1	BSC	Report	CO	M36
D2.1	User needs and decision-making processes that can benefit from S2S forecasts	WP2	BSC	Report	PU	M9
D2.2	Economic gains from using S2S forecasts in energy producers' decision-making by analysing relevant case studies	WP2	CICERO	Report	PU	M18
D2.3	The impact of operational real-time forecasts for decision-making processes and best practice examples	WP2	BSC	Report	CO	M36
D3.1	Validation of observational datasets and recommendations to energy users on the choice of observational/reanalysis products	WP3	ENEA	Report	PU	M9
D3.2	Modes of variability in Europe and their impact on the energy indicators	WP3	SMHI	Report	PU	M12

Deliverable (No.)	Deliverable name	WP No.	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D4.1	Benchmarking skill assessment of current sub-seasonal and seasonal forecast systems for the users' selected case studies	WP4	SMHI	Report	PU	M12
D4.2	Impact and assessment of weather regimes on the energy sector	WP4	UREAD	Report	PU	M24
D4.3	Assessment of conditional predictability and use weather regimes to construct energy-relevant variables	WP4	UREAD	Report	PU	M24
D4.4	Skill assessment and comparison of methods for sub-seasonal and seasonal forecast systems for the energy sector	WP4	SMHI	Report	PU	M27
D5.1	Conceptualization, requirements, and testing of the DST	WP5	CAPGEMINI	Report	CO	M4
D5.2	Data Management Plan (DMP)	WP5	BSC	Report	PU	M6
D5.3	System Validation Verification Plan (SVVP) including test suite documents	WP5	CAPGEMINI	Demonstrator	CO	M6
D5.4	Architecture Design Document including a Data integration strategy and the Interface Control Definition	WP5	CAPGEMINI	Demonstrator	CO	M18
D5.5	Production version of the Operational Climate Service: Decision Support Tool, including developers documentation and user guides	WP5	BSC	Demostrator	CO	M18
D6.1	Benchmark and positioning of the tool	WP6	NNERGIX	Report	CO	M6
D6.2	Assessment of policies and recommendations	WP6	CICERO	Report	CO	M12
D6.3	Replicability of the platform	WP6	LGI	Report	PU	M30
D6.4	Final Exploitation strategy & Business model options for the tool	WP6	LGI	Report	CO	M36
D7.1	Website and social media platforms up and running, visual identity (design elements), templates and logo available	WP7	LGI	DEC	PU	M3
D7.2	Communication, Dissemination and User Engagement Plan (CDUEP)	WP7	CICERO	Report	PU	M7
D7.3	Communication and PR materials (roll-up and brochure)	WP7	CICERO	DEC	PU	M10
D7.4	Documentary on the DST	WP7	BSC	Report	PU	M24

Deliverable (No.)	Deliverable name	WP No.	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D7.5	Summary report on the impact of dissemination, communication and user engagement activities	WP7	CICERO	Report	PU	M36

3.2 Management structure, milestones and procedures

3.2.1 Management structure

The management structure for this project builds up on previous successful models used by BSC in foregoing FP7 and Horizon 2020 projects, taking into account the specific needs derived from the goal of deploying a complex integrated system in a short timeframe as well as the contractual restrictions of the Horizon 2020 Framework Programme. The S2S4E consortium is formed by 12 partners from different fields (namely, research centres, supercomputing facilities, energy companies and SMEs) which combined make a positive contribution to the project by bringing complementary areas of expertise. It is important to note that most of the project partners have been working together in previous European projects thus establishing a strong foundation for further collaboration within S2S4E project. The management structure for the project is designed to provide an appropriate level of professional organisation (based on the structure proposed in DESCA model) to mediate efficiently between the different interests and cultures of the partners, and it is based on well-known best practice methodologies (e.g. PRINCE2, PMI, etc). The general organizational structure and decision-making process have been presented below (Figure 14).

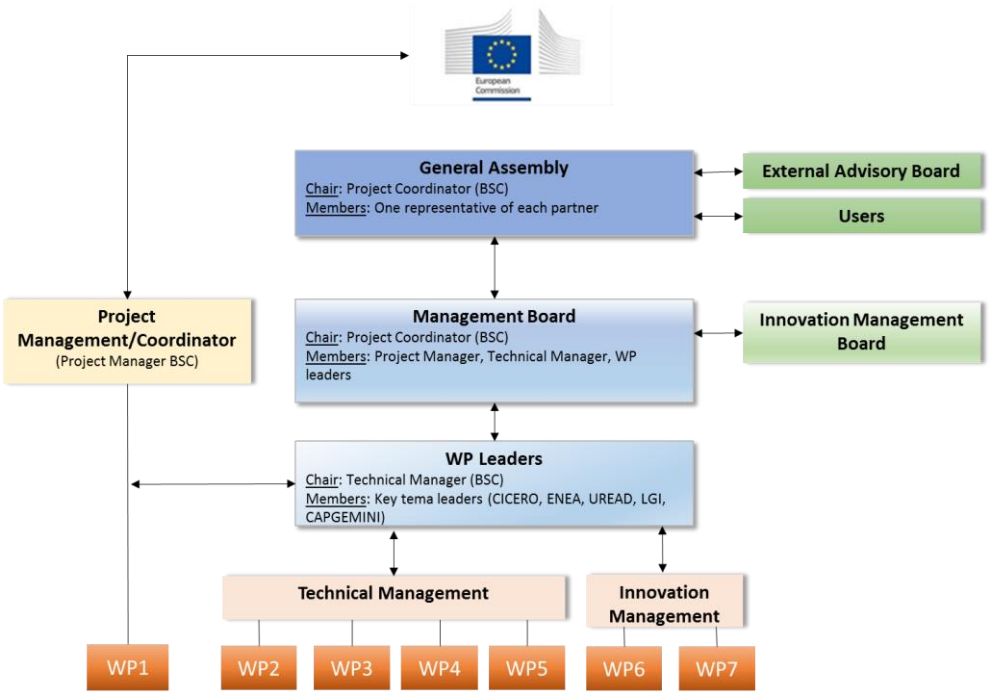


Figure 14: Management structure of S2S4E Consortium

General management bodies

The project organization structure includes the following key components:

Management Board

The Management Board is chaired by the Project Coordinator, Project and Technical Managers and includes one representative from each Work Package. The Management Board is an executive body that reviews the project progress on a regular basis; it has full power to make decisions on day-to-day issues. It is also responsible for

resource allocation, the review/approval of Periodic Reports and Deliverables, the preparation of project reviews, and the coordination of exploitation plans. The Management Board holds monthly conference calls and host decision making by consensus among its members. In the case that the Management Board cannot obtain consensus to make a decision, the issue is escalated to the General Assembly and brought to a vote if required.

Innovation Management Board (IMB)

The Innovation Management Board (chaired by TCDF) has the task to understand and assess innovations and innovators in a project, as well as **commercialization opportunities and related strategies**. For a given innovation the IMB should identify the project partner best suited to take it to market and provide advice on exploiting the full commercial potential of an innovation. Through the conjoint work among its partners, the IMB assembles the expertise to provide guidance on identifying market opportunities and overcoming commercialization hurdles.

IMB's key task is to analyse the documentation of the outputs generated along the project to collect relevant information on potential marketable products. These analyses will then be discussed with project partners at the review meeting. By doing so, and depending on the stage of the project (just started, progressed or nearly finished), the IMB assesses how ready the consortium/innovator is for e**ntering the market and how they intend to anticipate changing market conditions**. At the same time the interaction between the IMB and innovators in the consortium is meant to raise their awareness of the issues at hand and to help them develop a more compelling exploitation attitude. The IMB will also support the partners in dealing with **IPR issues** as well as in **negotiating joint exploitation agreements**. S2S4E consortium will take advantage of the services offered by European Commission IPR Helpdesk.

Coordinator

The Barcelona Supercomputing Center will serve as Coordinator of the S2S4E project. The responsibilities involved in this role will be shared between the Technical Manager (TM), and the Project Manager (PM) or the individuals assigned to these roles during any interim absences from the project.

Work Package Leaders

Work Package Leaders (WPL) are responsible for the scientific and technical work of their respective Work Packages. This includes the planning and control of all activities within the Work Package, the preparation of deliverables and the collection of the contributions from other partners participating in the respective Work Packages for internal and external reports. Work Package leaders regularly talk via teleconference or face-to-face as part of the General Assembly (GA) and arrange for additional technical meetings when necessary. They are expected to raise critical issues in the GA and to support the Technical Manager in coordinating cross-work package relationships within the appropriate activity area. They are required to actively participate in the regular project-related meetings as well as prepare technical and status presentations as required.

Technical Manager

The Technical Manager (TM), Prof. Francisco J. Doblas-Reyes, ensures that the scientific and technical objectives of the project are met. The TM leads the definition of the high level technical strategy and coordinates the team project to implement it. In implementing this strategy, the TM also ensures that the project maintains its relevance to the H2020 Work Programme 2016-2017 and its strategic objectives. Moreover, the TM organizes technical presentations of project progress to external parties and ensures the appropriate involvement and visibility of the members of the project. The Technical Manager is supported by the Project Manager (PM) who is responsible for the day-to-day execution of the project. The TM collaborates closely with the PM to provide clear and accurate Periodic Reports. Key Performance Indicators (KPI) have been defined in each WP to monitoring the progress of the tasks. A list of the KPI is available in Annex 1.

Project Manager

The Project Manager (PM), Mar Rodriguez, is responsible for the day-to-day execution of the project. This role will be allocated to BSC Project Management Office (PMO), which has a vast experience in the field of the Horizon 2020 (25 projects since the beginning of the programme in 2014) and Seventh Framework Programme projects (42 projects since the beginning of the programme).

The PM will ensure the timely achievement of project objectives and deliverables by continuously monitoring the project progress against the plan of record. The Project Manager identifies and tracks issues as well as proposes

suitable corrective actions (i.e. resource reallocation, task force creation, etc.) that might require a formal decision by the General Assembly. The PM is also responsible for calling the General Assembly meetings, as well as reviewing, compiling and distributing Minutes and Actions. The PM defines the procedures for change management (proposed changes to the plan of record), risk management, quality assurance and IPR management. The administrative and financial management of the project is also responsibility of the PM, including internal use of resources monitoring on a 6-month basis, the provisioning of Periodic Reports and Financial Statements, and ensuring an efficient distribution of EU funding. The Project Manager will also act as the official point of contact between the Commission and the Beneficiaries.

External Advisory Board (EAB)

The External Advisory Board will be composed by three distinguished experts responsible for: ensuring the external evaluation of the project progress, providing recommendations of new actions and activities in the area by liaison with the MB and by participating in the general assemblies, increasing the project visibility and strengthening its links to international programmes and other activities outside Europe. The EAB will meet at least once per year, either in person or by teleconference; if necessary extraordinary meetings will be scheduled. S2S4E has reserved within WP1 funds to support the participation of the EAB in the project general assemblies. The EAB is composed by three institutions which are listed in section 4-5 of this proposal.

3.2.2 Management Team and Experience

The BSC is a large organisation that performs research and provides computing and training services with expertise in climate and computational research. The coordination will be done by Dr. Albert Soret, as Principal Investigator, TM and a PM supported by the PMO and the BSC Financial Officer. S2S4E follows the strategy of appointing two project managers to ensure the administrative and organisation supervision of the project under any circumstance. Both managers will closely follow the evolution of the project although only one of them will be acting at a time. The acting PM will conduct all management tasks under an agile methodology: administrative, contracting and financial matters, all stages of reporting, links with the EC Project Officer and the Consortium, teleconferences minutes and meeting organisations, and assist in progress reporting. The managers have vast experience in international business and European projects. A communication officer based at the BSC, Isadora Jiménez, will also be involved to implement the communication and documentation strategy. She will support WP7 leader (CICERO) in linking technical and scientific issues and subcontractors and users, prepare all sorts of information material (videos, fact sheets, tutorials) based on both the project and other information sources, develop the project web site (and its link to social media if considered relevant), events and press releases.

3.2.3 Management Procedures and Tools

General Assembly

The General Assembly (GA) is the formal decision-making body and holds the highest level of authority in the project. It will be chaired by Dr. Albert Soret, Project Coordinator, and will consist of one representative from each partner. The GA is formally responsible for successful project completion. The GA makes decisions by consensus when possible. In the case that consensual decisions cannot be reached, the GA puts decisions to a vote that is decided by simple majority. In the event of a tie vote, the Coordinator casts the deciding vote. The governance structure and decision-making process will be consistent with the terms agreed between partners in the Consortium Agreement. The GA will hold monthly teleconferences in order to review the project progress on a regular basis; it has full power to make decisions on day-to-day issues. It is also responsible for resource allocation, the review and approval of the Periodic Reports and Deliverables, the preparation of project reviews and the coordination of exploitation plans. The GA will meet annually face-to-face, with the meetings location rotating among partners' locations.

Internal communication tools

In order to support the cooperation among all partners and encourage participation in the decision-making process, a set of internal collaboration tools will be set up in M2. BSC, as the leader of WP1 will be responsible for providing the project with the necessary internal collaborative tools, including: a Project Portal (shared workspace) to facilitate the exchange of critical project documentation and news, an issue tracking system and a set of distribution mailing lists for working sub-groups as appropriate (for instance by WP). The Coordinator of the project plans to hold monthly/ quarterly teleconferences with the partners.

Progress monitoring

Progress monitoring will be performed through the set of milestones defined in Section 3.1.1 as part as the work plan structure, and summarized in the List of Milestones in Section 3.2.4. The S2S4E work plan structure has been defined in order to facilitate charting the progress of the project. The Coordinator will ensure that monitoring the work progress and use of resources is done on a 6-month basis in order to ensure the detection of errors and deviations as early as possible in the project's life cycle. This will enable the consortium to apply systematically corrective actions or contingency plans, if necessary. WPLs will report to the Coordinator the effort spent by their work packages, status of achievement of milestones, production of deliverables and completion of tasks within their respective WP. It is foreseen technical meetings every six months between the coordinator and the consortium to better monitoring the scientific activities.

Consortium Agreement

The Consortium Agreement will define more specifically the project general administrative and legal aspects: management structure, decision process, liabilities of the Contractors, defaults and remedies, confidentiality, disputes, intellectual property rights, etc. It will address the specific technical and financial content of the project (list of partners, work plan, resource allocation and background). BSC Legal Advisor will be involved in the drafting and negotiation of the Consortium Agreement. The BSC legal advisor will also assist in the implementation follow-up and compliance with the terms of the consortium agreement.

Quality Control Assurance and Risk management

A Quality assurance process will be defined in order to ensure accurate documentation, reporting and justification of the work being carried out. An internal peer-review process will be set up, including a well-defined set of criteria, to assure the project deliverables meet the minimum quality standards before being sent to the European Commission as official outcomes of the project. The high level principles guiding these procedures will be agreed upon at the start of the project at the Kick-off Meeting. The quality assurance process will be also documented in D1.1.

In the Table 3.2b the risks for implementation are identified as well as the mitigation measures to be applied. The aim of risk management is to identify the project risks and then to keep them continuously under control with dedicated mitigation actions. A set of Key Performance Indicators (KPI) has been defined in each WPs in order to better monitor the project progress and if results achieved follow the quality requirements and objectives defined by the project. The KPI list is available in the annex of this document. The Coordinator will regularly monitor progress and budgetary issues, notifying Management Board (MB) of any potential problems as early as possible. Early engagement of the EC to assist in resolving management problems will be made as required.

Although the resources for the project have been assessed as accurately as possible, it will be necessary to closely monitor the progress of the project and to control the resources spent. To review the project progress and the related resources at least once a year and to reallocate resources whenever necessary will be a key task of the management subject to approval by the MB. If any deviation is found, adequate corrective actions or contingency plans will be put in place.

Emergency and Conflict Resolution

Any event that may jeopardize the overall completion date of the Project should be reported immediately to the Project Manager. The PM will call an emergency GA meeting or teleconference as required. Each party involved in the issue must present a short document describing their respective understanding of the conflict that includes at least one proposed solution. The GA reviews the conflict documents and following the procedures of the GA, each member votes for one of the proposed solutions. The solution receiving the simple majority of votes is implemented with the chairperson casting the tie-breaking vote as necessary.

3.2.4 Milestones

Table 3.2a: List of milestones

Milestone no	Milestone name	Related WP	Due date (month)	Means of verification
M 2.1	Information available from the participatory activities (focus group discussions and interviews)	WP2	M7	Access to the project website
M 2.2	Validation from users of service performance of DST prototype	WP2	M24	Users writing confirmation
M3.1	Compilation and distribution of common methodologies/scripts with the consortium	WP3	M6	Report distributed to the consortium
M3.2	Assessment of reliability and uncertainty in the reanalyses	WP3	M9	Report distributed to the consortium
M4.1	Delivery methodologies for real-time operational forecasting	WP4	M15	Report distributed and data available in central repository
M4.2	Delivery methodologies for the improved version of the real-time operational forecasting	WP4	M27	Report distributed and data available in central repository
M5.1	User testing report available (prototype and wireframes) and design of the visualization tool	WP5	M3	Report distributed and data available in central repository
M5.2	Server deployed and running	WP5	M6	Report distributed and data available
M 5.3	Software available to download, transform and format the data for real-time forecast.	WP5	M15	Report distributed and software available in project website
M5.4	Release candidate version of the DST ready for validation	WP5	M17	Version available in the project website
M5.5	Operational forecast products including an external wiki and forum available	WP5	M18	Product available in the project website
M6.1	Creative workshop restricted to the S2S4E partners to elaborate business models options for the DST	WP6	M15	Workshop report distributed to the consortium
M6.2	Innovation camp with the partners and stakeholders of the climate services sector to identify opportunities for the DST in sectors others than energy	WP6	M28	Camp report distributed to the consortium
M6.3	First version of a commercialisation agreement for the DST	WP6	M33	Agreement
M7.1	Launch of stakeholder survey	WP7	M10	Survey available in the project website
M7.2	Start of dissemination of monthly Forecast Outlooks	WP7	M18	Report distributed to the users
M7.3	Event in Southern/Central Europe	WP7	M28	Event report distributed to the consortium
M7.4	Event in Northern Europe	WP7	M31	Event report distributed to the consortium
M7.5	Final Stakeholder Event	WP7	M34	Event report distributed to the consortium

3.2.5 Risk Assessment

Table 3.2b: Critical risks for implementation

Description of risk (indicate level of likelihood: Low/Medium/High)	WP	Proposed risk-mitigation measures
Delay on deliverable and milestone achievements (Low)	1	Although the resources for the project have been assessed as accurately as possible, it will be necessary to closely monitor the progress of the project and to control the resources spent. Revising the project progress and the related resources at least each year and to reallocate resources whenever necessary will be a key task of the PO subject to approval by the MB
Recruitment: difficulties to attract suitably qualified personnel to fill the available positions (Medium)	2, 3, 4, 5	To manage this risk the coordinator will actively ensure that partners can support each other in tasks during the early stages of the project
Operational risks: information and data not shared effectively within consortium (Medium)	All	The Data Management plan will provide the instructions to follow to avoid sharing problems.
Scientific risks: not reaching user requirements from scientific and tools usability for exploration and visualization (Low)	2, 3, 4, 5	Before the preparation of the proposal, several face to face meetings were organized with industrial partners to: 1) explain the idea of the project highlighting strengths and weaknesses of the proposed tool; and 2) ensure their direct involvement in the project. This preliminary communication has been maintained during the preparation phase and will be further encouraged during the project. The iterative development mode enables to collect feedback along the project life and to adjust and then mitigates the risk of failing to meet the expected requirements.
Technical risk: availability of S2S forecast on time for the operational real-time operational forecast and disruption in data procurement. (Medium)	5	A data availability schedule will be established to identify the due date and data needed along the project.

3.3 Consortium as a whole

The S2S4E consortium consists of twelve partners from seven countries (Spain, France, Norway, Germany, Italy, United Kingdom and Sweden). It is a balanced mix of experts in the various domains linked to climate as well as energy companies and SMEs. This combination of different expertise and profiles makes possible to address these main issues of the call, namely:

- To minimise risks and costs and to seize opportunities.
- To match the demand for services and the competences in the field.
- To develop future applications in the most promising fields and
- To mobilise end-user communities where demonstration projects are not yet feasible.

The consortium involves three well balanced profiles to cover the pillars of the project activities: user needs/case studies, Data integration and processing, Data Support Tool and Forecast.

- **5 Research centres: BSC, CICERO, UREAD, SMHI** and **ENEA**. Leading climate scientist from research institutes with proved experience on co-developing climate services to ensure the transfer of state of the art scientific

knowledge into the energy sector and the society in general. Each of them will be the main responsible for an area: wind power (BSC), solar power (UREAD), hydropower (SMHI), electricity demand (ENEA) and users' needs (CICERO). Besides this, UREAD will coordinate the different activities to provide a broader view of risk and the impact of variability and predictability across the whole energy sector.

- **3 energy companies: EDF, EDPR** and **ENBW.** Energy managers and traders with experience in collaborating in research and innovation projects to ensure the adaptation of scientific research into decision management processes. These energy companies have been selected because they represent different needs and interests in terms of regions, renewable energy sources and electricity demand with a wider vision of the whole energy system and with the capacity of integrating the needs of other users (e.g. TSO). TSOs have not been included in the core consortium of the project due to the time requirements to be involved as a partner which TSOs' organizations (normally highly linked with public administrations) and strategic plans (provision of daily operational services) would found difficult to guarantee. Yet, considering the relevance of their point of view, TSOs are included as stakeholders, represented by the French (RTE) and the Macedonian (MEMCO) organisations (see Annex 2).
- **CAPGEMINI:** One of the world's foremost providers of consulting, technology and outsourcing services with experience on developing Decision Support Tools and a network of stakeholders that will foster the exploitation of S2S4E after the project.
  - **3 SMEs:**
    - **TCDF**: A SME with experience in distributing climate data to the industry to facilitate the definition of mitigation strategies to ensure the generation of user-tailored information in a comprehensive way.
    - **LGI**: A SME with experience designing business models to enhance innovation diffusion so that the impacts of the project are addressed accordingly to the plan.
    - **NNERGIX**: A SME forecaster that provides short term forecast products for solar, wind and electricity demand to its clients.

Each partner's profile play a key role in the process of the project lifetime as it is shown in Figure 15. Indeed the selection of work package leaders has been made based on the competences in each part of the process.

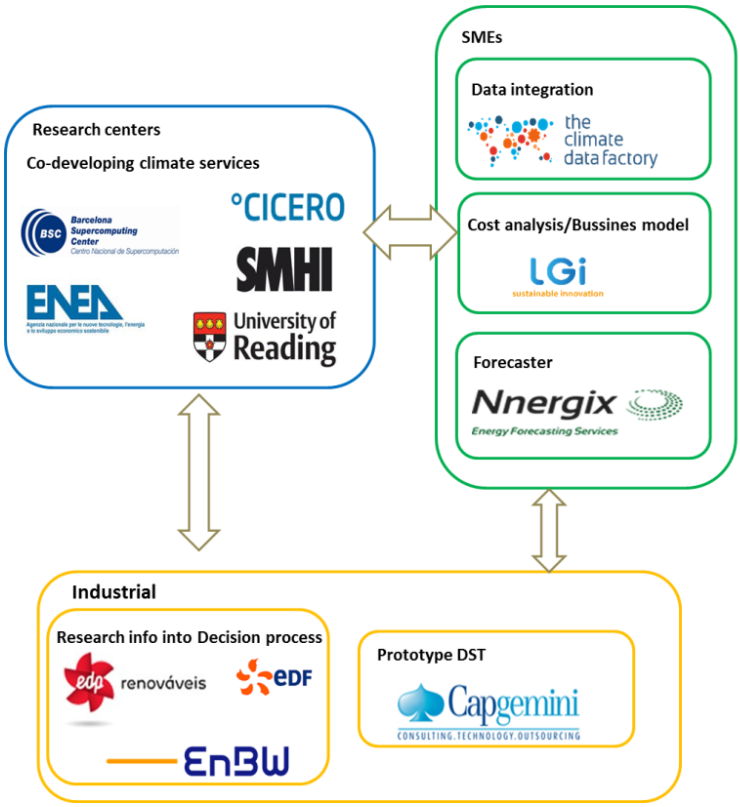


Figure 15: S2S4E consortium

The consortium is also supported by a broader audience, whose profile within the project is defined as follows:

- **Users:** energy companies (energy producers, energy providers, TSOs, DSOs), weather and climate forecasters, policy makers, as well as research institutions and consultancy companies working with climate and/or energy issues.

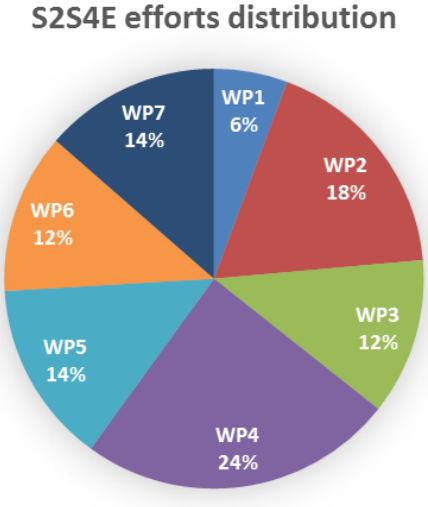
TheS24E project has received sixteen letters of support from the main type of users considered (society: two; academia: three; and industry: eleven) which sets a good base and it is expected a rapidly increase in the number of users along the project lifetime. The list of support letters is available in the Annex of section 4 as a support document.

These users will take part in the project as co-designers and co-developers of the decision support tool (DST) so that the forecasts can be tailored to user-centric needs. Users will play a key role by providing detailed information regarding the applicability of forecasts (WP2), the key features required for the development of the tool (WP5) and the most suitable business models to the commercial exploitation of the DST (WP6). Meetings and interviews will be arranged with users from the starting date of the project in order to ensure that the data collected by the S2S4E Consortium will be useful in their decision making process.

3.4 Resources to be committed

Table 3.4a: Summary of staff effort

No	Short name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	Total PMs per Participant
1	BSC	30	22	10	25	23.5	1.5	25	137
2	CICERO	0	16	4	6	0	8	15	49
3	EDPR	0	6	0	0	2	2	2	12
4	EnBW	0	6	0	0	2	2	2	12
5	ENEA	0	6	20	18	0	1	3	48
6	UREAD	0	4	15	40	0	0	2	61
7	SMHI	0	4	12	24	4	2	3	49
8	EDF	0	6	0	0	2	2	2	12
9	CAPGEMINI	0	6	0	0	27	5	6	44
10	LGI	0	11	0	0	0	28	5	44
11	TCDF	0	0	3	16	8	3	3	33
12	NNERGIX	0	8	0	0	6	11	4	29
Total Person Months		**30**	**95**	**64**	**129**	**74.5**	**65.5**	**72**	**530**



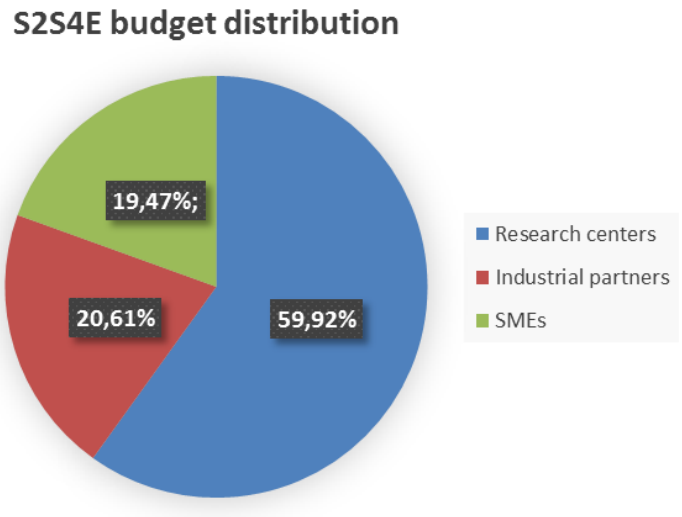
The distribution of person months (PMs) reflects the efforts to address the scientific objectives described in previous sections. The project allocates the highest number of PMs in the S2S climate predictions issues (WP4), the link of the scientific development with the energy decision making (WP2) as well as in the development of the DST (WP5), which is the key product of the project. As for the rest of WPs the efforts are balanced according to the partners involvement and tasks carried out.

Table 3.4b: 'Other direct cost' items (travel, equipment, other goods and services, large research infrastructure)

Participant 1 BSC	Cost (€)	Justification
Travel	50,000€	Travels for general meetings, attending workshops, attending international conferences (WP2, 3, 4, 5, 6) Expenses for the travels of the External Advisory Board and stakeholders invited to workshops (WP2 and 7) and General Assemblies (WP1).
Equipment	20,000€	Fat nodes for data storage (WP4)
Other goods and services	47,000€	Four scientific publications (WP5), disks for data storage (WP4), audit costs and General Assemblies organisation (WP1)
Total	**117,000 €**	

Participant 2 CICERO	Cost (€)	Justification
Travel	25,000€	Travels for project meeting for CICERO staff for 3 years (WP2, WP3, WP4 and WP7).
Equipment	3,000€	Small IT equipment such as tripods. Also need to factor in subscription cost for newsletter provider such as APSIS.
Other goods and services	48,000€	Consumables: organization and/or co-organisation of min three events (WP7), communication and PR materials (roll-ups, brochures) (WP7), forecast outlooks (WP7), fact sheets (WP7), logo and design of all visual elements (WP7), webinar series (WP7), potential of social media sponsored posts (boosts) (WP7). 1 or 2 peer-reviewed publications and 1 White Report (WP2, WP3/4 and WP7).
Total	**76,000€**	

Participant 5 ENEA	Cost (€)	Justification
Travel	26,000€	Travel for general assemblies, WP meetings, stakeholder engagement events and international conferences.
Equipment	12,000€	Disks for data-storage for activities on WP3 and WP4. Fat node for data analysis and access to data.
Other goods and services	0€	N/A
Total	**38,000€**	



From the point of view of the partners' profile, the 60% of the budget is allocated in Research Centres whereas Industrial partners and SMEs have around 20% and 19% of the contribution respectively, which ensures the exploitation of the results.

The project allocates around 71% in personnel and approximately 8% for other direct costs. The reason of this percentage of personnel costs is the differences among the personnel rates in the different institutions.

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Annex List of Key Performance indicators (KPI)

KPI	Name	WP	Target
KPI 2.1	Number of stakeholders involved in participatory activities (interviews and focus groups)	WP2	20
KPI 2.2	Number of analysed case studies for obtaining the value of using S2S	WP2	8
KPI 2.3	Number of energy companies that integrate climate prediction forecast in their operations	WP2	5
KPI 2.4	Number of subscriptions to the forecast outlooks	WP2	30
KPI 3.1	Number of reanalyses analysed	WP3	5
KPI 4.1	Number of scientific papers published within the project	WP4	8
KPI 4.2	Number of S2S forecasting systems being analyse	WP4	3
KPI 5.1	Number of visits to the DST	WP5	>1000
KPI 5.2	Level of responsiveness to support request on the ticket system	WP5	less than 5 working days for an initial response
KPI 6.1	Number of competitive solutions analysed	WP6	7
KPI 6.2	Number of policy instruments analysed	WP6	6
KPI 7.1	Number of visits to the project website	WP7	>1000
KPI 7.2	Number of subscribers to our mailing list	WP7	>30 subscribers
KPI 7.3	Number of participation in events and seminars	WP7	>40 participants
KPI 7.4	Number of media mentions	WP7	20

Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)

Part B: Section 4-5

List of participants

Participant No	Participant organisation name	Short name	Country	Type
1 (Coordinator)	Barcelona Supercomputing Center - Centro Nacional de Supercomputación	BSC	Spain	Research centre
2	CICERO Senter for Klimaforskning Stiftelse	CICERO	Norway	Research centre
3	EDP Renováveis SA	EDPR	Spain	Industry
4	ENBW Energie Baden-Württemberg AG	EnBW	Germany	Industry
5	Agenzia Nazionale per le Nuove Tecnologie, L'energia e lo Sviluppo Economico Sostenibile	ENEA	Italy	Research centre
6	The University of Reading	UREAD	UK	Research centre
7	Sveriges Meteorologiska Och Hydrologiska Institut	SMHI	Sweden	Research centre
8	Electricité de France	EDF	France	Industry
9	CAPGEMINI Technology Services	CAPGEMINI	France	Industry
10	LGI Consulting SARL	LGI	France	SME
11	The Climate Data Factory	TCDF	France	SME
12	NNERGIX Energy Management S.L	NNERGIX	Spain	SME

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Section 4: Members of the consortium

4.1. Participants (applicants)

Participant 1:

Barcelona Supercomputing Center Centro Nacional de Supercomputación	**Barcelona Supercomputing Center- Centro Nacional de Supercomputación (BSC)**

The Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC), created in 2005, has the mission to research, develop and manage information technology in order to facilitate scientific progress. At the BSC, more than 350 people from 40 different countries perform and facilitate research into Computer Sciences, Life Sciences, Earth Sciences and Computational Applications in Science and Engineering. The BSC is one of the four hosting members of the European PRACE Research Infrastructure as well as one of the first eight Spanish "Severo Ochoa Centre of Excellence" awarded by the Spanish Government.

The Earth Sciences Department of the BSC (ES-BSC) was established with the objective of carrying out research in Earth system modelling. The ES-BSC activities are focused on global climate modelling and prediction are based on research, development and predictions with the EC-Earth climate forecast system. It also undertakes research on the development of dynamical and statistical methods for the prediction of global and regional climate on time scales ranging from a few weeks to several years, with a special focus on technologies that allow high-resolution modelling. The formulation of the predictions includes the development and implementation of techniques to statistically downscale, calibrate and combine dynamical ensemble and empirical forecasts to satisfy specific user needs in the framework of the development of a climate service.

The assessment of the sources of predictability and the limitations of current climate prediction systems to exploit them, especially over Europe, inspires many of the publications by the unit. Besides contributing to the 5th phase of the Coupled Model Intercomparison Project (CIMP5) critical for the UN IPCC Fifth Assessment Report (AR5), global climate research activities at ES-BSC enable provision of various historical reconstructions and initial conditions to the EC-Earth community for analysis of climate dynamics and for seasonal to decadal climate predictions. The ES-BSC is already active in the planning and design of the future coupled climate model intercomparison project, CIMP6, and is preparing to make key contributions including the groundbreaking high-resolution climate simulations with EC-Earth. Over the years, the department has been active in numerous European Projects including, in FP7 and H2020 not only as partner but also as coordinator. It is also currently involved in at least five COPERNICUS projects coordinating one of the actions.

Role in the project

BSC is the coordinator of this project and the leader of the WP1 Management. Besides, it is involved in the following WPs:

- WP1: Management of the project
- WP2: Understand user needs to illustrate how forecasts can improve decision making and create value for the energy managers.
- WP3: Assessment of ten-meter wind speed field using different observational data sets and identification of main weather patterns affecting wind speed.
- WP4: Assessment and maximization of the performance of sub-seasonal and seasonal forecast systems for the wind energy indicators.
- WP5: Definition of data protocols and formats for their integration and processing. Development of an operational prototype providing real-time application of sub-seasonal and seasonal forecast.
- WP6: Study the current solutions on the market and identify all the marketable results of the project.
- WP7: Link with other initiatives and projects (Copernicus, etc), dissemination, communication and exploitation activities. Link with the user community.

Key personnel

Dr. Albert Soret (male) holds a PhD in Environmental Engineering from the Polytechnic University of Catalonia (Barcelona). He is the Head of the Services group at BSC-ES with 10 years of research experience in earth sciences, supervises 3 PhD students and numerous postdoctoral scientist. His research focuses on assessing the impact of climate on socio-economic sectors through the development of user-oriented services that ensure the transfer of the technology developed and the adaptation to a rapidly changing

environment. He is the Work Package leader within the VISCA-730253 H2020 project and CLIM4ENERGY and MAGIC COPERNICUS projects. Between others, he is participating in EC-FP7 and H2020 projects: EUPORIAS-308291, SPECS-308378, PRIMAVERA-641727 and IMPREX-641811. He has participated in numerous industrial projects, now he leads two research projects for industry: one with Vodafone and the other Iberdrola, Gas Natural Fenosa and EPRI.

Dr. Isadora Christel Jiménez (female) has a Master's degree in Science communication (IDEC-UPF) and a PhD in offshore wind energy Impact assessment from the University of Barcelona. She has eight years of research experience in direct contact with stakeholders and five years working on science communication. As the science communication specialist of the Earth System Services group at BSC-ES she facilitates knowledge and technology transfer to end users. She is currently involved in EU funded projects in dissemination actions, user-engagement activities and the interaction with stakeholders to promote the integration of seasonal-to-decadal climate predictions in different economic sectors. She is Work Package leader within FP7 and H2020 projects EUPORIAS-308291, PRIMAVERA-641727, IMPREX-641811 and ClimatEurope-689029.

Dr. Nube Gonzalez (female) received a degree in Physics from the University of Salamanca (USAL). She studied a Masters in Meteorology and Climatology at the Complutense University of Madrid (UCM) under a fellowship from "la Caixa" Foundation. She joined the Climate Investigation and Application Group (GICA) of the USAL under a FPI fellowship, where she holds an international PhD in "Research and Development of Geotechnologies" in year 2015. Her Doctoral Thesis, entitled "Evaluación de las teleconexiones climáticas observadas y simuladas con modelos de CMIP en la región Euro-Atlántica" focus on Northern Hemisphere Teleconnections with outputs of Global Climate Models (GCM´s) from CMIP3 and CMIP5 datasets under different emission scenarios and comparison with Re-analysis data. In year 2013 she started to work at Institut Català de Ciències del Clima (IC3) in the Climate Forecasting Unit (CFU) where she was involved in the development and communication of climate services for energy. Currently, Nube is working at BSC, where her research topic is to understand the forecast quality and the predictability sources of the most comprehensive set of sub-seasonal and seasonal probabilistic predictions of wind speed and temperature. She contributed to various national and European projects as RESILIENCE or EUPORIAS among other.

Pierre Antoine Bretonnière (male) holds a Masters Degree in "Mathematical and Mechanical Modelling" from the Matmeca engineer school in Bordeaux (France). Graduated in 2010, he has worked in several climate research institutes (CERFACS - Toulouse - France, Catalan Institute of Climate Sciences - Barcelona - Spain and the Earth Sciences Department of the Barcelona Supercomputing Center). His work focuses on climate models outputs, data management and model coupling. He was the person in charge of the data management plan in the SPECS FP7 project and has participated in several other European projects (PRIMAVERA, QA4SEAS,...). He is also involved in the Research Data Alliance (RDA) framework as chairman of the "Weather, climate and air quality" interest group.

Prof. Francisco Doblas-Reyes (male) is the Director of Earth Science Department at BSC. He is involved in the development of the EC-Earth ESM, and has been since its inception. Prof. Doblas-Reyes is a worldwide expert in the development of seasonal-to-decadal climate prediction systems and has more than 20 years of experience in weather and climate modelling, climate prediction, as well as the development of climate services. For his work in seasonal forecasting, he was awarded the Norbert Gerbier-MUMM International Award from the UN World Meteorological Organization (WMO) in 2006. He serves in several panels of the World Climate Research Programme (WCRP) and the World Weather Research Programme (WWRP) under the UN WMO (among them the steering group of the Polar Prediction Project), is a member of the European Network for Earth System modelling HPC Task Force and has participated in numerous national and European FP4, FP7 and H2020 projects. Currently, Prof. Doblas-Reyes is the principal investigator (PI) or co-investigator in 6 FP7 and H2020 European projects, is coordinator of the FP7 collaborative SPECS project, he is also leading a COPERNICUS action (QA4SEAS) and supervises numerous postdoctoral scientists and software engineers. He has won 50 Million hours of computing time for the High Resolution Ensemble Climate Modeling project through the PRACE network. He is a lead author of the IPCC and member of the steering group of the Polar Prediction Project. Overall, Prof. Doblas-Reyes has authored and co-authored more than 100 peer-reviewed papers on climate modeling and prediction, as well as climate services, and currently has a total of 6103 citations with a h-index of 39.

Dr. Fernando Cucchietti (male) holds a PhD in Physics from the National University of Cordoba (Argentina). He is the Head of the Scientific Visualization group at BSC-ES with 13 years of research experience in data visualization and theoretical physics, with over 30 publications that received more than 1900 citations. His research focuses on data-intensive visualizations for graphical interfaces, images, and videos, as well as data science applied to industrial problems (in particular artificial intelligence). He participates in three European Centers of Excellence (NOMAD, EoCoE, and CompBioMed), and other H2020 projects (GrowSmarter, HPC4e). He leads two research projects for industry.

Relevant Projects

COPERNICUS project *QA4Seas - Quality Assessment Strategies for Multi-model Seasonal Forecasts:* BSC is the leader of this project which is aimed at developing a strategy for the evaluation and quality control (EQC) of the multi-model seasonal forecasts provided by the Copernicus Climate Change Service (C3S) to respond to the needs identified among a wide range of stakeholders. The quality assessment will be user driven and will put at work the best expertise available on the evaluation of the multi-faceted quality aspects of state-of-the-art seasonal forecast systems.

COPERNICUS project: *CLIM4ENERGY* will bring together the complementary expertise of 7 climate research and service centers and 11 energy practitioners to demonstrate, from case studies, the value chain from ECVs to actionable information in the energy sector. It will deliver 9 energy-relevant pan-European indicators of climate trends and variability with a cross sectoral consistency, appropriate documentation and guidance, estimation of uncertainties, and a demonstration of use. It will contribute to other Copernicus services by sharing experience and tools on quality control, data access with distributed systems, visualization of complex multi-dimensional data and their uncertainties.

ERA-NET Cofund for Climate Services: *"European Research Area for Climate Services"* (*ERA4CS* 690462) has been designed to boost the development of efficient Climate Services in Europe, by supporting research for developing better tools, methods and standards on how to produce, transfer, communicate and use reliable climate information to cope with current and future climate variability. BSC is one of the members of the consortium and WP leader.

H2020 project: *Vineyards´ Integrated Smart Climate Application (VISCA-730253)*. The main objective of VISCA is making European wine industries resilient to climate changes, minimizing costs and risks through an improvement of the production management (quality and quantity of final product), while evaluating its replicability to other high-added value agriculture sectors.

H2020 project*: PRocess-based climate sIMulation: AdVances in high resolution modelling and European climate Risk Assessment (PRIMAVERA-641727)* the main objective is to develop a new generation of advanced and well-evaluated high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity, for the benefit of governments, business and society in general.

Relevant publications and products

Year	Products	Technical information
2016	**Seasonal hurricane prediction system**	Barcelona Supercomputing Center and Colorado State University in association with XL Catlin have launched a new website to track seasonal hurricane forecasts and the evolution of hurricane activity. Seasonal Hurricane Predictions brings together forecasts from major centers that specialize in Atlantic hurricane forecasting. It also offers extensive information to promote understanding of the factors that contribute to these meteorological phenomena, which can have devastating consequences, and to help explain why different seasonal forecast models can produce different predictions. **http://www.bsc.es/ESS/seasonalhurricanepredictions/**

2015	**Seasonal Wind Predictions for the Energy Sector**	Developed as part of the Resilience prototype in the EUPORIAS project. Project Ukko is an interactive climate service interface for wind industry users to explore probabilistic wind speed predictions for the coming season provided by the RESILIENCE prototype. The aim is to support users to better understand the future variability in wind power resources and bridge the gap between energy practitioners and the climate science community. **http://www.project-ukko.net/**

Year	Title	Authors	Conference, journal or book
2015	Climate predictions for site selection: a new generation of risk management tools.	Soret, A., Torralba, V., Davis, M., Doblas-Reyes, F., Gonzalez-Reviriego, N.	EWEA Resource Assessment workshop, Helsinki, Finland, 2-3 June 2015.
2015	Impact of land-surface initialization on sub-seasonal to seasonal forecasts over Europe.	Prudhomme, C., F.J. Doblas-Reyes, O. Bellprat and E. Dutra	Climate Dynamics
2013	Retrospective prediction of the global warming slowdown in the past decade.	Guemas, V., F.J. Doblas-Reyes, I. Andreu-Burillo and M. Asif	Nature Climate Change

Infrastructures

BSC is the National Supercomputing Facility of Spain and hosts a range of high-performance computing (HPC) systems including MareNostrum IV the new supercomputer, will be 12.4 times more powerful than the current MareNostrum 3 that will have a performance capacity of 13, 7 Petaflop/s. The general purpose element, will have 48 racks with more than 3,400 nodes with next generation Intel Xeon processors and a central memory of 390 Terabytes. The second element of MareNostrum 4 will be formed of clusters of three different technologies that will be added and updated as they become available. These are technologies currently being developed in the US and Japan to accelerate the arrival of the new generation of pre-exascale supercomputers.

The BSC is a key element of and coordinates the Spanish Supercomputing Network, which is the main framework for granting competitive HPC time to Spanish research institutions. Furthermore, BSC-CNS is one of six hosting nodes in France, Germany, Italy and Spain that form the core of the Partnership for Advanced Computing in Europe (PRACE) network. PRACE provides competitive computing time on world-class supercomputers to researchers in the 25 European member countries.

Participant 2:

°CICERO	**Center for International Climate and Environmental Research, Oslo (CICERO)**

CICERO is Norway's foremost institute for interdisciplinary climate research. We deliver new insights that help solve the climate challenge and strengthen international climate cooperation.

We help to solve the climate problem and strengthen international climate cooperation by predicting and responding to society's climate challenges through research and dissemination of a high international standard. Our researchers collaborate with top researchers from around the world, and publish their work in recognized international journals, reports, books and periodicals. CICERO has garnered particular attention for its research on the effects of manmade emissions on the climate, society's response to climate change, and the formulation of international agreements. We have played an active role in the IPCC since 1995 and eleven of our scientists contributed the IPCC's Fifth Assessment Report.

CICERO delivers important contributions to the design of international agreements, most notably under the UNFCCC, on topics such as burden sharing, and on how different climate gases affect the climate and emissions trading. CICERO helps design effective climate policies and study how different measures should be designed to reach climate goals. CICERO houses some of the world's foremost researchers in atmospheric chemistry and we are at the forefront in understanding how greenhouse gas emissions alter Earth's temperature. CICERO helps local communities and municipalities in Norway and abroad adapt to climate change and in making the green transition to a low carbon society. CICERO helps key stakeholders understand how they can reduce the climate footprint of food production and food waste, and the socioeconomic benefits of reducing deforestation and forest degradation. CICERO has long experience in studying effective measures and strategies for sustainable energy production, feasible renewable policies and the power sector in Europe, and how a changing climate affects global energy production. CICERO is an internationally recognized driving force for innovative climate communication, and are in constant dialogue about the responses to climate change with governments, civil society and private companies.

Role in the project

CICERO is leading and contributing most to two work packages, i.e. WP2 and WP7,CICERO will further contribute to tasks in the following WPs:

- WP2: leader of the WP
- WP3: Characterization of the main modes of variability affecting Europe and their impact on the essential climate variables using a novel ensemble of atmospheric seasonal hindcasts.
- WP4: Assessment of the case studies with retrospective forecast and improve predictability concentrating on cold and heat extremes.
- WP6: Lead Task 6.3 and carry out a theoretical analysis of market failures and complement theoretical analysis.
- WP7: Dissemination activities. Leader of this WP.

Key personnel

Dr. Jana Sillmann (female) received her doctoral degree (Dr.rer.nat) from the University of Hamburg (Germany) for her work on weather and climate extremes at the Max-Planck-Institute for Meteorology. As a postdoctoral researcher, she spent four years at the Canadian Centre for Climate Modeling and Analysis and the University of Victoria (BC, Canada) and contributed with her work to several chapters of the IPCC Fifth Assessment Report. She is an internationally well-recognized expert in the field of climate extremes with highly cited journal articles. Dr. Sillmann is co-leading activities for the World Climate Research Programme (WCRP) Grand Challenges on Extremes and is an appointed member of the World Meteorological Organization (WMO) Commission for Climatology Task Team for Tailored Climate Information. At CICERO, she is the coordinator of the Climate Services platform and she leads three interdisciplinary projects on climate extremes and their impacts funded by the Research Council of Norway (RCN) including a wide range of national and international (worldwide) partners as well as stakeholders.

Ms. Tiina Ruohonen (female) has an Advanced Research Master's Degree in International Relations and Development (M. Phil). She is a Senior Communications Advisor at CICERO and a former Fellow at Massachusetts Institute of Technology (MIT) Center for Collective Intelligence. She has over 10 years of experience from international organisations, research institutions and not-for-profits, and has leadership experience from projects and organisations working on strategic communication, stakeholder engagement, renewable energy deployment, and business ethics. In her previous role as a business consultant Ms. Ruohonen

worked extensively with renewably energy producers in Finland, Germany and Norway and with clients in both the private and public sector. At CICERO, she leads the communication unit's efforts in international research projects and works as a project developer and WP-leader on projects relating to international climate policy and policy coherence for development.

Dr. Kristin Linnerud (female) has a PhD in Economics (Norwegian school of Economics) and a MSc in Finance (London School of Economics and Political Science). She has working experience from the energy sector and has also hold a position as a board member in a vertically integrated power company for 12 years. She has done research on how climate change and climate policy affects decisions in the renewable-electricity sector since 2008. In 2008-2010, she led an interdisciplinary research project on the impacts of climate change on the power sector involving 9 national and international research institutions. In recent years, she has led theoretical and empirical studies on how investors in renewable electricity projects respond to uncertainty under renewable energy support schemes applied in the EU. These studies reflect her competence in economics, econometrics and investment theory as well as her overall good knowledge of the power sector in Norway and the EU. Dr. Linnerud is a coordinator for the energy research at CICERO. She has been project leader or assistant project leader in several research projects funded by the Research Council of Norway on the renewable energy sector. In recent years she has been invited as a visting academic at Oxford University, School of Geography and the Environment and London Business School.

Mr. Asbjørn Aaheim (male) is an economist (cand.oecon) from University of Oslo. He was at Statistics Norway from 1978 to 1992, where he worked primarily on the management of national wealth and income from natural resources. In 1993, he started at CICERO, and did several studies on costs and benefits of climate policies, decision making under uncertainty, and adaptation to increasing frequencies of extreme events. He was a Lead Author of IPCCs Second Assessment report on the applicability of cost-benefit analysis of climate change policies. In later years, most of his work has been focusing on integration of results from other disciplines in economic modelling, with several contributions to projects for the European Commission. Attention has been on the development of tools to combine national policy perspectives with local interests and individual perspectives, including how to incorporate uncertainties and risk. For this work, he was nominated to the ENI award for achievements in environmental and resource economics in 2016.

Dr. Nathalie Schaller (female) has a PhD in Climate Physics from ETH Zurich (Switzerland), where she focussed on evaluating global climate models. She contributed to the nonlinMIP project and has published about the non-linearity of the climate system's response to anthropogenic forcing. During a 3-year postdoctoral position at the University of Oxford (UK), partly funded by an early-career Swiss National Science Foundation fellowship, she gained expertise on probabilistic attribution of extreme events and led a high-profile interdisciplinary study on a recent UK flood. She has also experience with producing and analysing seasonal forecasts. Currently, she works on two RCN projects about large-scale atmospheric circulation and extreme events.

Mr. Erlend Hermansen (male) has recently submitted his PhD thesis in the sociology of science (Science and Technology Studies - STS) at University of Oslo and was a visiting scholar at the University of Edinburgh in fall 2013. His prime research focus is on the climate science-policy nexus, researching how scientific knowledge is produced and used in decision making by different actors. Particularly, he investigated how the knowledge represented in IPCC reports is communicated and taken up in policy- and decision making at various levels. Combined with his previous position as a Communications Advisor at CICERO, Mr. Hermansen has special competence in how scientific knowledge can be made usable, and consequently he has been involved in developing CICERO's work on climate services and earlier been hired part-time as a consultant to the private sector. Mr. Hermansen has worked as deputy project leader on two international research projects and has a wide international network. In Spring 2017, he will kick off a recently granted research project on climate science-policy interfaces, funded by RCN.

Relevant Projects

H2020 project*: SMART* – Sustainable Market Actors for Responsible Trade (2016-2020) analyses the regulatory complexity within which European market actors operate, both the private sector and the public sector in its many market roles. (WP lead Tiina Ruohonen)

Research Council of Norway funded projects:

TWEX (2016-2019): investigates the added-value of the "Tales of future weather" approach for climate services with academic partners and the largest hydropower producer in Norway (Statkraft). (Project lead Jana Sillmann; Nathalie Schaller)

RELEASE (2015-2017): is a strategic research program for Sogn og Fjordane University College to investigate local impacts and sustainability of renewable energy projects (WP lead Kristin Linnerud)

RISKY-RES (2014-2016): investigates how policy risk affects investment decisions under Uncertainty with focus on EU renewable energy and climate policies beyond 2020 with academic partners and a stakeholder group. (Kristin Linnerud)

Dissemination of scientific knowledge as a policy instrument in climate policy (2011-2016): investigates how scientific knowledge should be designed and communicated in order to be useful for decision makers both in the public and private sector. (deputy project lead Erlend Hermansen)

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Atmospheric seasonal forecasts of the 20th Century: multi-decadal variability in predictive skill of the winter North Atlantic Oscillation (NAO) and their potential value for extreme event attribution	Weisheimer, A., N. **Schaller**, C. O'Reilly, D. A. MacLeod and T. Palmer	*QJRMS*, doi: 10.1002/qj.2976.
2015	Investment barriers under a renewable-electricity support scheme: Differences across investor types	**Linnerud, K.** and Holden, E.	Energy, 87, 699-709.
2015	Formalization and separation: A systematic basis for interpreting approaches to summarizing science for climate policy	Sundqvist, G., Bohlin, I., **Hermansen**, E. A. T. and Yearley, S.	).. Social studies of science, 45(3), 416-440.
2011	Extreme cold winter temperatures in Europe under the influence of atmospheric blocking conditions	**Sillmann**, J., M. Kallache, M. Croci-Maspoli and R.W. Katz	J. Climate, 24, 5899–5913, doi: 10.1175/2011JCLI4075.1.
2010	Modelling Economic impacts and adaptation to extreme events. Insights from European case Studies	Mechler R., S. Hochrainer, **A. Aaheim**, H. Sælen, A. Wreford	Mitigation and Adaptation Strategies for Global Change. **15** (7), 763-778.

Infrastructures

N/A

Participant 3:

	EDP Renováveis SA (EDPR)

EDP Renewables (Euronext: EDPR) is a leading, global renewable energy company devoted to value creation, innovation and sustainability. It operates in markets around the globe and is continuously expanding our business to new regions, making the commitment to lead in each market as well as create value for its stakeholders and shareholders.

EDPR has developed wind farms since 1996 and was first listed publicly in June 2008. EDPR's global presence is managed by two regional platforms which oversee the development, construction and operation of assets in their geographic areas. EDPR Europe, headquartered in Madrid, manages assets located in the European Union, and other Regions renewable energy assets of the EDP Group and EDPR North America, headquartered in Houston, manages assets in the United States and Canada.

EDPR is committed to operational excellence through high-quality assets and attractive markets, which provide highly attractive possibilities, principally due to their growth prospects and stable regulatory structure that permit profit generation.

Energias de Portugal, S.A. (EDP), a vertically-integrated utility company, headquartered in Lisbon, Portugal, is the majority shareholder of EDPR. EDP Group is Portugal´s largest industrial group and one of Europe´s primary energy companies. Currently, it is the Iberian Peninsula´s third largest energy operator with business interests in generation, distribution and supply of electricity and gas in Portugal and Spain. Additional to its leadership position in the Iberian Peninsula, EDP Group also holds a significant position in the Brazilian electricity sector.

Role in the project

The role of EDPR at the different WP can be summarized as follows:

- WP2: Provide critical case studies based on wind and/or combined hydro-wind to validate events and illustrate the usability of sub-seasonal forecasts.
- WP5: Provide feedback on usability of prototype and post-processing tools
- WP6: Assistance in identification of competitive tools and the exploitation of the project.
- WP7: Help on the dissemination, communication and exploitation activities. Link with other industrial users.

Key personnel

Dr. Daniel Cabezon (male) has 16 years of experience in the wind energy sector and currently leads the Meteorological Models and Special Tasks Area at the Energy Assessment department in EDPR. Among other tasks, he is involved on the development of short-term and seasonal forecasting models as well as on numerical modelling of wind flow and wind farm wake flow as support to the Wind Resource area. Activities are mostly based on the collaboration with R&D groups and universities in the framework of bi-lateral agreements, national and EU projects.

Relevant Projects

COPERNICUS project: *CLIM4ENERGY* will bring together the complementary expertise of 7 climate research and service centers and 11 energy practitioners to demonstrate, from case studies, the value chain from ECVs to actionable information in the energy sector. It will deliver 9 energy-relevant pan-European indicators of climate trends and variability with a cross sectorial consistency, appropriate documentation and guidance, estimation of uncertainties, and a demonstration of use. It will contribute to other Copernicus services by sharing experience and tools on quality control, data access with distributed systems, visualization of complex multi-dimensional data and their uncertainties.

FP7 project *WindFloat - Floating demonstration platform for offshore wind turbines*: EDPR installed and operated a floating demonstration platform in deep waters (>50m). Successfully executed at Aguçadoura coast (northern of Portugal), for a Vestas V80 wind turbine during the period 2011-2015.

H2020 project *Demogravi3 - new gravity-based concept for offshore wind turbines*. The project has a duration of 4 years (2015-2019) and it will include a demonstration platform at Aguçadoura coast taking advantage of the current WindFloat infrastructure and the submarine cable for inland connection.

UK British Council - EDPR Project - *Advanced analytical wake model for large offshore wind farms*: Collaboration between EDPR and the university of Nottingham for the development of an advanced wake

model that takes into account thermal, meandering and boundary layer effects. Co-funded PhD student during 3 years (2016-2018)

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Corrosion in offshore wind energy: assessment of marine aerosol concentration using the CALIOPE air quality modelling system in Europe	Soret, A., Ortega D., Pay M.T., Lledó Ll, Cabezón D.	Wind Europe Summit proceedings, Hamburg, Germany, 27-29 September 2016
2016	Transient growth of perturbations in a vortex ring	Wacks D., Cabezon D., Mao X.,	Science of Making Torque from Wind, Munich, 2016
2013	A semi-parabolized wake model for big offshore wind farms based on the open source CFD solver OpenFOAM.	Cabezon D., Migoya E., Crespo A.,	Journal of Informatics and Mathematics

Infrastructures:

N/A

Participant 4:

EnBW	**Energie Baden-Württemberg AG (EnBW)**

EnBW Energie Baden-Württemberg AG is the third largest energy company in Germany, with 5.5 million customers, a 13 GW generation portfolio and some 20,000 employees. EnBW generates, trades in, transports and sells energy, focusing on the electricity and gas business as well as energy and environmental services.
It is EnBW's aim to achieve sustainable and profitable growth with a balanced business portfolio and smart energy solutions – to the benefit of its partners, customers, employees and owners. The main focus lies on the German market, especially Baden-Württemberg, but EnBW also operates in other European markets. Striving for the optimum energy mix is the primary objective. In addition to the use of conventional energies, the increase in energy efficiency and expansion of renewable energies play an important role for EnBW. Under this scope, EnBW will provide its expertise in solar and wind energy production.

Role in the project

EnBW is an industrial partner participating in this project and will provide its knowledge and long-term experience in the field of energy meteorology. EnBW will be involved in the following WPs:

- WP2: EnBW will be part of the end-user panel to define the specific needs of energy managers and generate a usable added-value in the commodity markets.
- WP5: Test of the mock-up and regular assessment of the prototype in an operational mode, to be confronted with real-time market information.
- WP6: EnBW will evaluate the usefulness and marketability of the product before the final version of the prototype.
- WP7: Communication and exploitation activities. Link with the energy community.

Key personnel

Dr. Matthias Piot (male) is a Meteorologist and Gas Analyst at EnBW AG, responsible for weather-related activities in commodity trading and weather risk management. He is part of a tight teamwork involving commodity traders and asset/portfolio managers. He has nearly 12 years of experience in the field of meteorology, air quality modelling and oceanography, and he has been involved in multiple international environmental projects. He had a two-year postdoctoral stay at BSC which enhances the cooperation between the two partners. He is author and co-author of 5 JCR-indexed articles in the field of air quality.

Dr. Christoph Elsaesser (male) is a Meteorologist at EnBW AG. Being focused on the German power market, he is involved in all weather-related trading and portfolio management activities at the EnBW trading floor. Besides energy meteorology, he has experiences in forecast modeling of power load/supply as well as skills in data and time series analysis. He earned a PhD in environmental physics at Heidelberg University and has more than 9 years of experience in climate research and applied meteorology.

Relevant Projects

EnBW's research and development activities pave the way for the necessary technological advances. The company has a large history of cooperation and funding between research institutes, universities (e.g. ETH-Zurich; Universität Oldenburg), various German Ministries (e.g. Economics Ministry; Ministry for the Environment, Nature Conservation and Nuclear Safety) and several German municipalities (see, e.g., MeRegio Project; http://www.meregio.de). To date, EnBW counts more than 150 involvements in innovative research programmes dealing with renewable energy, environmental aspects or conversion from one energy source to another. Current projects running:

Project Ukko: Project Ukko allows the development of an interactive climate service interface for wind industry users to better visualize regional wind speed predictions on a seasonal scale. This interface serves users to better understand the future variability in wind power resources and bridges the gap between energy practitioners and the climate science community. As an energy supplier, EnBW AG supported this project in the evaluation of the applicability and relevance of such information on a seasonal scale for energy purposes

(**www.project-ukko.net)**

FP7 project IMPREX: The project aims at improving hydro-meteorological forecast products and at increasing the operating efficiency and strategic management of the European transportation sector. A special focus is given to Inland Waterway Transport. The target areas chosen as case studies (Rhine, Danube and Elbe Rivers) are part of the backbone of Europe's waterway. Therefore, improvements demonstrated will have a direct economic relevance for the transportation sector. As a major stakeholder, EnBW is closely involved in this project to help the development of a high-qualitative, tailor-made hydro-meteorological solution (**www.imprex.eu)**

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Solar power forecasting: application of the NMMB/BSC-CTM on-line chemical weather prediction model in central Europe **http://meetingorganizer.copernicus.org/EMS2016/EMS2016-446.pdf**	Soret A., S. Basart, D. Ortega, M. Piot	16th EMS Annual Meeting
2016	Application and verification of the NMMB/BSC-CTM forecast for solar energy **http://meetingorganizer.copernicus.org/EGU2016/EGU2016-14089.pdf**	Soret A., K. Serradell, M. Piot, D. Ortega, V. Obiso, O. Jorba	EGU 2016

Infrastructures

Onshore, the installed output nationwide has already increased from 28 to around 250 Megawatts since 2009 and Germany's first commercial offshore wind farm "EnBW Baltic 1" has gone online in 2011. EnBW wants to expand installed capacity by 3,000 Megawatts by 2020 not only in wind power, but also in hydro-electric power. In terms of local solutions, it is also planned to expand combined heat and power generation and photovoltaic as well as bioenergy. EnBW built the first photovoltaic installation back in 1984. Since 2003 the company has been realizing rooftop systems and solar parks for municipalities and private investors together with regional partners. With our program "Solar BürgerAktiv" we encourage the financing and construction of photovoltaic installations together with municipalities.

Participant 5:

	Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA)

ENEA is the Italian government agency responsible for the areas of new technology, energy and the sustainable economy. Its two fundamental tasks are to conduct research in these areas and to diffuse the results nationally. ENEA's activities in the Environmental sector involve: Environmental surveying and monitoring; Climate modelling and analysis at global and regional scale; Global change assessment; Research and assessment of the impact of productive activities on the human and natural environments; Development of advanced technologies and new products with low environmental impact. The Agency has around 3000 staff throughout Italy, operating at nine major Research Centres and a number of smaller facilities.

ENEA has a special laboratory devoted to Climate Modelling and Impacts (SSPT-MET-CLIM) with a staff of 15 employees. This laboratory combines long standing expertise both in the area of oceanic and atmospheric modelling (regional and global) and impact evaluation in relevant sectors (energy, infrastructure, agriculture, ecosystems). Its major fields of research are Mediterranean and African climate, the analysis of the regional hydrological cycle and related teleconnections, energy and environmental modelling, forecasting applications for renewable energy, electric grid, infrastructure maintenance and planning.

ENEA participates in the many large international networks/ initiatives, e.g. EERA (European Energy Research Alliance), ECRA (European Climate Research Alliance), European Energy Network, MEDENER (Mediterranean Association of the National Agencies for Energy Conservation), TAFTIE (The Association For Technology Implementation in Europe), Enterprise Europe Network.

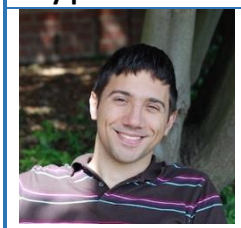
In the last five years, the SSPT-MET-CLIM laboratory coordinated the EU-FP7 CLIM-RUN project on climate services, and it has contributed to IMPACT2C, SPECS and EUPORIAS, SINGULAR, PERSEUS EU-FP7 projects. It is now participating to CRESCENDO H2020 initiative and to the national program Next-Data to build a national system for the retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas. The laboratory is currently involved in the Copernicus SIS ECEM project, on the two first proof-of-concepts for an European operational climate service in the energy sector

Role in the project

ENEA is the partner of this project and the leader of the WP3. Besides, it is involved in the following WPs:

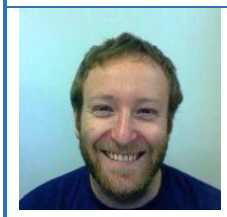
- WP2: Formulation and interpretation of the forecasts to provide the required information to release forecast bulletins.
- WP3: Observational Datasets.
- WP4: evaluation of the predictability of extreme events for solar radiation and solar power generation at S2S scales. Analysis of the link between weather regimes and solar power production. Exploration on the possibility to reconstruct solar power generation from large-scale modes.
- WP6: Business models and exploitation and in replicability tasks.
- WP7: Communication and dissemination activities. Preparation of fact-sheets, user engagement activities. Interaction with stakeholders.

Key personnel



Dr. Matteo De Felice (male) he is currently staff scientist at the Climate Impacts and Modelling laboratory in the ENEA Research Centre in Bologna. He has a Ph.D. in Informatics and Automation, which revolved around the application of nature-inspired optimisation and modelling methods (namely evolutionary algorithms or ensemble of neural networks) to energy-related problems. In 2011, he moved to his current laboratory, and since then he has been taking advantage of my background in data-driven modelling and machine learning to deal with several real-world applications where weather and climate play an important role. He was the supervisor of the ENEA service for the Dispatching Office of TERNA, the Italian TSO, and he is the ENEA supervisor for the C3S ECEM project. He was also involved in CLIM-RUN, SPECS and EUPORIAS FP7 projects.

Dr. Alessandro Dell'Aquila (male) PhD in Geophysics, is a Permanent ENEA Researcher since 2009 (previously temporary staff researcher with similar duties). In charge of analysis and validation of the regional climate model employed at ENEA for the Euro-Mediterranean area. Current research interests are focused on the assessment of uncertainty of state-of–the-art climate models in reproducing climate processes at both global and local scales. Particular attention is also paid in providing climate information tailored on the end-users needs in the energy, tourism, agriculture sectors. He has participated to several EU projects (CIRCE, AMMA, CLIM-RUN, IMPACT2C, SINGULAR, and PERSEUS SPECS, EUPORIAS (as ENEA PI and WP leader in the vulnerability assessment framework wp), CRESCENDO and NEXTDATA projects. Involved in the coordinated modelling experiment for the Euro-Mediterranean region Med-CORDEX (ENEA Contact point) , in the European Climate Research Alliance (ECRA) and in European Climate Service Partnership (ECSP) initiatives. Author of 29 peer reviewed papers (up to 2015), and more than 30 international conference contributions. H-index Scopus 2015 : 14. Member of WMO Joint CBS/CCl Expert Team on Operational Predictions from Sub-seasonal to Longer-time Scales (ET-OPSLS).



Dr. Marcello Petitta (male) is currently researcher at ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development. His research fields are atmospheric physics, climate change, energy meteorology, drought, remote sensing, extreme events statistics, air quality, GPS Radio Occultation, data integration and assimilation. He obtained the Ph.D. in Aerospace Engineering at the University of Rome 'La Sapienza' (April 2004) with a thesis on: "Atmospheric application of the GPS radio occultation.", before, he got his Degree in Physics at the same university in 2000 with a thesis on Atmospehric Physics: "Measurement of meteorological variables from space: a prototype of a mission". From 2008 to 2012 he was the head of the Air and Atmosphere group in the Institute for Applied Remote Sensing at the European Academy, EURAC, leading the projects on Air Quality monitoring and assessing in South Tyrol. He is one of the national experts of the Alpine Convention for the Italian Ministry of the Environment. He is author and co-author of several peer reviewed publications on atmospheric general circulation, drought, extreme events, GPS radio occultation, radiative models and air quality.

Relevant Projects

COPERNICUS project *ECEM – European Climatic Energy Mixes* ENEA is partner of this project which objective is to enable the energy industry and policy makers to assess how well energy supply will meet demand in Europe over different time horizons, focusing on the role climate has on energy supply and demand. It will develop, in close collaboration with the energy sectors, a demonstrator that will offer a coherent approach for the climate variables/indicators used in power demand/supply balance, an added value with respect to current practice in the sector, where climate data and derived ESCIIs are not always physically homogeneous and/or in balance.

FP7 project SPECS – *Seasonal to decadal climate prediction for the improvement of European Climate Services (GA 308378):* ENEA was partner of this project and coordinator of the pilot activities. The project analysed the impact of improved climate information, provided by climate forecasts, on the energy and agriculture sectors.

Service contract with the Dispatching Office of TERNA S.p.A.: ENEA worked in tight collaboration with the Italian transmission system operator, TERNA, to assess the benefit due to the use of meteorological information, provided by reanalyses and forecasts, to the management of power grids and renewable energy sources in Italy.

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Benchmarking Northern Hemisphere midlatitude atmospheric synoptic variability in centennial reanalysis and numerical simulations	Dell'Aquila, A., S. Corti, A. Weisheimer, H. Hersbach, C. Peubey, P. Poli, P. Berrisford, D. Dee, and A. Simmons	Geophysical Research Letters

2016	Evaluation of simulated decadal variations over the Euro-Mediterranean region from ENSEMBLES to Med-CORDEX	Dell'Aquila, A., Mariotti, A.	Climate Dynamics
2015	Seasonal climate forecasts for medium-term electricity demand forecasting	De Felice M., Alessandri A., and F. Catalano	Applied Energy
2015	Short-term predictability of photovoltaic production over Italy	M. De Felice, M. Petitta, and P. M. Ruti	Renewable Energy
2013	Electricity Demand Forecasting over Italy: Potential Benefits using Numerical Weather Prediction models	M. De Felice, A. Alessandri, and P. M. Ruti	Electric Power Systems Research

Infrastructures

N/A

Participant 6:

University of Reading	**University of Reading- Department of Meteorology (UREAD)**

The Department of Meteorology at Reading is the largest of its kind in Europe and has a thriving community of over 200 academic and research scientists. In the most recent Research Excellence Framework results (REF 2014), 86% of our research was graded as world leading or internationally excellent. Our weighted score places us third in the UK in the "Earth Systems & Environmental Science" category, and makes us the highest-graded department focusing on the fundamental science of weather and climate: we were rated particularly strongly on the new "Impact" metric, and on "research environment". The department hosts around 25 Met Office scientists, the Climate directorate and the Models and Data division of NCAS (National Centre for Atmospheric Science), and major elements of NCEO (National Centre for Earth Observation). The Institute for Environmental Analytics (IEA - www.the-iea.org) is a new venture hosted from Reading to engage industry and government in deriving maximum impact from environmental expertise and information.

Research within the energy-meteorology field at the University of Reading has played a leading role in demonstrating the impacts of weather and climate variations on the European energy sector and in understanding forecast skill and the drivers of predictability for meteorological and energy relevant variables. This work has led to several projects and collaborations with businesses across the energy sector, such as National Grid and energy trading companies to support their understanding and uptake of sub-seasonal to seasonal forecasts. We have also been involved in a consortium Project aimed at developing a prototype operational climate service for energy (EU Copernicus, ECEM project). More broadly, our expertise in climate research has led to a number of collaborations with industry and involvement in consortium projects seeking to understand weather and climate risks in industry.

Role in the project

UREAD will lead WP4 on sub-seasonal to seasonal climate predictions, as well as provide contributions to the following WPs:

- WP2: Formulate and interpret the forecasts to provide the required information to release forecast bulletins.
- WP3: Development of impacts-based methodologies for identifying weather-impact regimes and modes for the European power sector.
- WP4: Assessment and maximization of the performance of sub-seasonal and seasonal forecast systems for wind, solar and demand over Europe. Leader of this WP.
- WP7: Communication and dissemination activities. Preparation of contents for the platform.

Key personnel

Dr. Emma Suckling (female) is a postdoctoral research scientist within NCAS-Climate at the Department of Meteorology, University of Reading (UK). She has five years of postdoctoral experience, with research interests centred on understanding climate variability and predictability using statistical analysis, empirical models and forecast evaluation techniques. She has been involved with several interdisciplinary consortium projects (including NERC-funded EQUIP and EU FP7 funded SPECS) with the aim of improving near-term climate prediction for decision-making. She also has experience of collaborating with industry partners including in the insurance (Munich Re and Lloyd's) and energy (Rubykon AG) sectors, as well as being involved in the COPERNICUS Project ECEM. Dr Emma Suckling has a background in theoretical physics and, after completing her PhD, made a transition into climate science, taking up a postdoctoral position within the Centre for the Analysis of Time Series at the London School of Economics, before joining the Meteorology Department at Reading in 2014.

Dr. David Brayshaw (male) is the Associate Professor of Climate Science and Energy Meteorology at the University of Reading, and a Principal Investigator for the National Centre for Atmospheric Science (UK). The Energy-Meteorology research group, which he founded in 2012 and continues to lead, is a pioneer in the application of advanced climate science in the energy sector, working with a range of industrial partners (e.g., National Grid, Centrica, EDF, BP, UK Crown Estate, IEA). Dr David Brayshaw is a lead investigator for the COPERNICUS ECEM project, a WP lead for the H2020 PRIMAVERA and NERC ODYSEA, and a consultant for the UK Space Agency RE-SAT project. Overall, he has been involved in leading 16 research projects (11 as PI) and has supervised 6 PhD students and 8 postdocs. He has 31 peer reviewed publications (714 citations; h-index 14)

and is a member of the RCUK Energy Strategy Advisory Committee, the NERC peer review college, and the International Conference on Energy Meteorology Science Steering Committee.

Dr. Andrew Charlton-Perez (male) is Associate Professor of Meteorology and leader of a research group in Stratospheric Dynamics and Climate. He has 59 peer reviewed publications with more than 2600 citations and an h-index of 26. He is a co-author of Chapter 2 of forthcoming 2015 World Meteorological Organisation/United Nations Environment Program Scientific Assessment of Ozone Depletion He serves the scientific community as an associate editor of the *Journal of Climate* and was an elected council member of the Royal Meteorological Society from 2007-2010. He is a WP leader on the current H2020 grant, ARISE2 and has total grant income of more than £2m to his home University with 14 successful grant proposal managed.

Hannah Bloomfield (**female**) is a final year PhD student, supervised by Brayshaw and co-sponsored and supported by the UK Met Office Hadley Centre. With a background in mathematics and environmental physics, her research has investigated the impact of climate variability and climate change on the European power system with high levels of renewable energy installation (particularly wind power in the UK), using data from reanalysis and the HiGEM climate model. A key focus is identifying the patterns of weather and climate variability that impact the power system as a whole rather than as individually isolated ingredients in order to inform system planning. She has successfully published one paper in a high-profile journal, with two more planned. It is anticiapated that her PhD thesis will be submitted in March 2017.

Relevant Projects

COPERNICUS project: *ECEM – European Climatic Energy Mixes (2016-present)* The European Climatic Energy Mixes (ECEM) project is an EU Copernicus Climate Change Services Project (C3S) seeking to develop a proof-of-concept climate service for energy applications. Working closely with sectoral stakeholders, its purpose is to enable the energy industry and policy makers to assess how well energy supply will meet demand in Europe over different time horizons, focusing on the role climate has on energy supply and demand. The energy-meteorology group is developing a series 'case studies' to demonstrate the value and use of this service. ECEM is one of the COPERNICUS Sectoral Information System projects.

Rubykon project: *Sub-seasonal predictability for energy trading across Europe (2015-2016)* Power market prices across Europe are often highly affected by weather. Having skilful forecasts of these variables from days to weeks ahead is therefore of great value to the power market sector, for example in renewable energy trading. In collaboration with Rubykon AG, UREAD performed a probabilistic calibration and skill evaluation of operational ensemble forecasts for meteorological properties over several regions in Europe. This project was funded by Rubykon AG.

NERC PURE project and PhDs with Centrica Energy and UK Met Office: *Subseasonal forecasting for the energy sector (2012- 2016); Future climate – future energy (2013-present)* Two PhD projects, both supervised by Brayshaw, explore the utility of climate forecast and simulation data in the energy sector. The first PhD investigated the potential for subseasonal weather forecasts to provide useful information for the energy trading, quantifying and demonstrating that they can be utilised to 'add economic value' in real forecasting for month-ahead energy pricing and trading. This lead to a subsequent follow-up project whereby UREAD assisted one of the largest electricity companies in the UK (Centrica) to operationalize the use of probabilistic month-ahead wind power forecasts. The second PhD, working with the UK Met Office, addresses the implications of year-to-year climate variability and long-term climate change for planning and operations in the electricity sector as a whole under the assumption of high-levels of installed renewable generation capacity.

H2020 project*: PRocess-based climate sIMulation: AdVances in high resolution modelling and European climate Risk Assessment (PRIMAVERA-641727)* PRIMAVERA aims to develop a new generation of advanced and well-evaluated high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity, for the benefit of governments, business and society in general. UREAD investigator Brayshaw is leading a WP within PRIMAVERA focusing on the use of climate information in the energy sector.

National Grid projects: *Understanding and predicting extreme wind power generation events (2012-2015; NIA_NGET0016 and NIA_NGET0085)* This project investigated extreme wind power generation events in Great Britain and their predictability at lead times 1-10 days ahead. In collaboration with stakeholders at National Grid (the UK electricity system TSO), this work informed new strategies for setting system reserve and maintaining supply security in GB, and is part of a wider series of ongoing projects funded at UREAD through

National Grid's Network Innovation Allowance (this ongoing research includes solar PV as well as wind power).

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Quantifying the increasing sensitivity of power systems to climate variability	Bloomfield, H. C., Brayshaw, D., Shaffrey, L., Coker, P. and Thornton, H.E.	Environmental Research Letters. ISSN 1748-9326 (In Press)
2015	Using reanalysis data to quantify extreme wind power generation statistics : a 33 year case study in Great Britain	Cannon, D.J., Brayshaw, D.J., Methven, J., Coker, P.J. and Lenaghan, D.	Renewable Energy, 75. pp. 767-778. ISSN 0960-1481 doi: 10.1016/j.renene.2014.10.024
2014	Verification of European subseasonal wind speed forecasts.	Lynch, K. J., Brayshaw, D. J. and Charlton-Perez, A.	Monthly Weather Review, 142 (8). pp. 2978-2990. ISSN 1520-0493 doi: 10.1175/MWR-D-13-00341.1
2011	The impact of large scale atmospheric circulation patterns on wind power generation and its potential predictability: a case study over the UK.	Brayshaw, D. J., Troccoli, A., Fordham, R. and Methven, J.	Renewable Energy, 36 (8). pp. 2087-2096. ISSN 0960-1481 doi: 10.1016/j.renene.2011.01.025

Year	Products	Technical information
2014-2016	**Reconstructed 'artificial' wind-power records for Great Britain (model code and data).**	Hourly time series of GB-aggregated wind power generation from 1980-present, reconstructed from MERRA reanalysis, assuming 'fixed' amounts of installed wind-power. Originally developed under the National Grid project (NIA_NGET0016), this has now been downloaded for use by a range of industry, policy-support and academic users. The basic technology in the system has also been used by National Grid / OfGEM in the UK's electicity "capacity assessment" reports (2012, 2013, and 2014) and by the Crown Estate.

Infrastructures

The University of Reading has access to the UK's National Supercomputing Facility (ARCHER), which it uses extensively for climate modeling. ARCHER comprises of a Cray XC30 MPP supercomputer with 4920 compute nodes with two 12-core Intel Ivy Bridge series processors giving a total of 118,080 processing cores. The University of Reading also has access to the UK's JASMIN super-data cluster, which offers 15 Petabytes of disk storage.

Participant 7:

SMHI	**Swedish Meteorological and Hydrological Institute (SMHI)**

SMHI is a public body with some 670 employees under the Swedish Ministry of Environment, running both governmental services and commercial businesses. SMHI is providing decision support to a broad range of end-users, based on meteorology, hydrology, oceanography and climatology information. The institute is responsible for national monitoring and modelling in these fields, data archives and refinement of information for societal needs. SMHI has a long tradition in developing customized products and services (today mostly as web applications), as well as 24/7 production of forecasts with early warnings, and operates the dissemination of flood alerts to other EU member states in the EFAS system for EU Copernicus. It has a strong R&D focus with 110 full time scientists and just as many in IT. The institute represents Sweden in the World Meteorological Organisation (WMO) and is the national data provider in its working domains. Currently, it is adapting according to EU open data strategy and the INSPIRE directive, is active in GEOSS and a partner in three on-going major GMES projects. The institute is involved in many national and international projects and is currently coordinating some collaborative FP7 and Horizon2020 projects. The SMHI management system has been certified under the quality standards ISO 9001 and ISO 14001. SMHI has a long tradition in operational hydrological modelling of river discharge. The hydrological development at SMHI is focused on improvements of the complete chain in forecast production, tools for climate change impact assessment, and environmental modeling of nutrient fluxes in catchments, rivers, lakes and wetlands The Hydrological Research unit consists of 20 scientists, including 3 associate professors and 13 PhDs.

Major efforts are being made on improving precipitation estimates, both for intensities and spatial patterns. Numerical calculations of water discharge were originally made using the HBV model, first developed at SMHI in the 1970s, and now applied in more than 50 countries worldwide. Over the last decade, the main hydrological tool has been the in-house HYPE model, which makes better use of existing spatial information and includes soil processes. The HYPE model is applied with a high resolution over large areas, such as the whole of Sweden, the Baltic Sea drainage basin, discharge to the Arctic, and for India, the Middle east-North Africa region, and La Plata and Niger River basins, as well as for the European continent. SMHI therefore already has several years of experience with using open data for continental hydrological modelling and is one of the few international actors capable of linking recent scientific progress with operational forecast systems for long-term institutional maintenance.

The Hydrological Research unit is involved in working groups within global communities such as WMO, Unesco-IHP and ICSU-IAHS and is an active partner in the research communities of EGU and AGU. The unit has participated in several collaborative EU-funded projects relevant to for instance water resource management, hydrological and water quality modelling, climate change impact studies, flood forecasting. Several of these project have involved integration of EO data in hydrological modelling, see table below for more details.

Role in the project

SMHI will contribute in a number of WPs and lead the activities of seasonal hydrological forecasts related to the hydropower sector. Besides, it is involved in the following WPs:

- WP2: Understand the hydropower user needs to illustrate how forecasts can improve decision-making and create value for the energy managers.
- WP3: Detection of representative weather types and analysis of their connections with climate variables (wind, temperature, precipitation and solar radiation). Objective classification of different weather types using local climate information.
- WP4: Assessment and maximization of the performance of sub-seasonal and seasonal hydrological forecast systems (dynamic, statistical and multi-model approaches) for the hydropower indicators at the pan-European scale and national Swedish domain.
- WP5: Definition of data protocols and formats for the integration and processing of identified seasonal impact indicators. Development of an operational prototype providing real-time application of sub-seasonal and seasonal hydrological forecasts.
- Business model, exploitation and replicability
- WP7: Organise workshops/webinars for the hydropower sector. Link with other initiatives and projects (Copernicus, Horizon 2020 etc), dissemination, communication and exploitation activities. Link with the user and scientific community.

Key personnel

Ilias Pechlivanidis, PhD (Male): He is a senior researcher at SMHI and expert in identification and evaluation of hydrological models under uncertainty. He has about 10 years of experience in hydrologic/hydraulic research. He is the Associate Editor in Hydrology and Water Resources in the Global NEST journal, a Guest Editor at two special issues in the Hydrology and Earth System Sciences (HESS) journal, and has organised and convened international workshops and conferences (>10). He has been the project leader in European and international projects at SMHI, focusing on short to medium-range and seasonal hydrological forecasting, calibration of large scale multi-basin hydrological models, and assessment of environmental change on hydrology and water resources. He has been leading the development/improvement of the application of the HYPE hydrological model in the Indian subcontinent.

Berit Arheimer, PhD, Assoc. Prof (female): She is the head of the hydrology research at SMHI, and interested in modelling and operationalization of tools for environmental analysis in various scales. She has been in charge of about 20 scientists the last 12 years, and has 20 years of experience in interdisciplinary research with 40 peer-reviewed papers in international journals. She is the national representative of IAHS, IHP and experienced with several international scientific assignments, e.g. in WMO and HELCOM and OSPAR commissions. She has been involved in several national and international projects and has experience as project coordinator, work package leader, steering committees, convener of international workshops and chair of regular international working groups.

David Gustafsson, PhD, Assoc. Prof. (male): He is a Senior Researcher and SMHI project leader within the EU FP7 CryoLand and ESA NorthHydrology project – both focusing on development and integration of EO data and services in hydrological modelling. Through these projects he has developed a strong connection to both the EO community and the hydrology modelling and end-user communities. He is leading the development of the SMHI Pan-Arctic application of the HYPE model (HYdrological Predictions for the Environment) assimilating EO snow data, and has contributed to the development of a model for the Niger River inland delta flooding in the Niger River HYPE application.

Jonas Olsson, PhD, Assoc. Prof. (male): He is a Senior Researcher, SMHI's scientific theme leader and an Associate Professor at Lund University. His work comprises rainfall modelling and downscaling, development and evaluation of rainfall-runoff models and forecasts and hydrological climate change assessment. He has published over 60 peer-reviewed papers and has had a range of scientific commitments including EU-project coordinator and WP leader, scientific committee member and faculty opponent. Besides research, he works as operational "hydrologist on duty" for Sweden.

Relevant Projects

H2020 project *IMPREX (IMproving PRedictions and management of hydrological Extremes)*, ***2015-2019***. IMPREX will improve forecast skill of meteorological and hydrological extremes in Europe and their impacts, by applying dynamic model ensembles, process studies, new data assimilation techniques and high resolution modeling.

Copernicus action *SWICCA (Service for Water Indicators in Climate Change Adaption), Copernicus,* ***2015-2018****.* The SWICCA service will provide data and guidance for climate impact assessments in the water sector. The main target group is consulting engineers working with climate change adaptation in the water sector. By using indicators, climate impact assessments can be done without having to run a full production chain from raw climate model results – instead the indicators can be included in the local workflow with local methods applied, to facilitate decision-making and strategies to meet the future. Working with real users will ensure that useful data is inserted into the Climate Data Store (CDS).

FP7 project *EUPORIAS,* ***2012-2016***. Develop and deliver reliable predictions of the impacts of future climatic conditions on a number of key sectors (to include water, energy, health, transport, agriculture and tourism), on timescales from seasons to years ahead. Develop climate services and tools targeted to the needs of the end-users, and improve the users' understanding of their vulnerability to varying climatic conditions.

ESA project *Hydrology TEP, ,* **2015-2017.** Provide scientific and institutional stakeholders and practitioners with a flexible web-based platform to access, explore, and exploit EO-based data and products related to IWRM, to support hydrological science, and streamline exchange of geospatial information and knowledge within the relevant user community. This platform will enable EO information products most relevant for Water Productivity and Vulnerability.

FP7 project *Cryoland,* ***2011-2015***. Development of EO products (snow, glaciers, ice on lakes and rivers) and services tailored to user needs, with a strong representation of hydrology in the user community (i.e.

hydropower, flood forecasting, spring floods). SMHI coordinates the user community interaction and development of EO data integration in hydrological modeling

FP7 project *SWITCH-ON (Sharing Water-related Information to Tackle Changes in the Hydrosphere – for Operational Needs),* ***2014-2017***. SWITCH-ON aims to take advantage of the large sources of open data related to water (from GEOSS, Copernicus, etc), and repurpose them with a focus on usability and value-adding for end-users, both within government and business as well as within civil society.

Relevant publications

Year	Title	Authors	Conference, journal or book
2016	Technical Note: Initial assessment of a multi-method approach to spring-flood forecasting in Sweden	**Olsson, J.**, Uvo, C. B., Foster, K., and Yang, W.:,	Hydrol. Earth Syst. Sci., 20, 659-667, doi:10.5194/hess-20-659-2016,
2016	A regional parameter estimation scheme for a pan-European multi-basin model	Hundecha, Y., **B. Arheimer**, C. Donnelly, and **I.G. Pechlivanidis**	*Hydrol. Reg. Stud.*, *6*, 90–111, doi:10.1016/j.ejrh.2016.04.002.
2015	Climate impact on floods: changes in high flows in Sweden in the past and the future (1911–2100)	**Arheimer, B.** and Lindström, G	Hydrol. Earth Syst. Sci., 19:771-784, doi:10.5194/hess-19-771-2015.
2014	Uncertainty in the Swedish operational hydrological forecasting systems,	**Pechlivanidis, I.G.**, T. Bosshard, H. Spångmyr, G. Lindström, **D. Gustafsson**, and **B. Arheimer**	*Vulnerability, Uncertainty, and Risk: Quantification, Mitigation and Management*, edited by M. Beer, S. K. Au, and J. M. Hall, pp. 253–262, Liverpool, UK.
2011	A systematic review of sensitivities in the Swedish flood-forecasting system	**Arheimer, B.,** Lindström, G. and Olsson, J.	Atmospheric Research 100:275–284.

Infrastructures

SMHI is responsible (setup, improvement and management) for the E-HYPE model, a pan-European hydrological model, which calculates hydrological and nutrient variables on a daily time-step. SMHI provides necessary means to execute day-to-day R&D activities (desks with high-speed internet connection, multiple OS computers, printers, private audio & video conference room, high-capacity repository and processing server cluster, etc.). The institute offers several multi-sized meeting and training rooms, a fully equipped auditorium.

Participant 8:

	Electricité de France (EDF)

EDF Group is the world's leading electricity company and it is particularly well established in Europe, especially France, the United Kingdom, Italy and Belgium. Its business covers all electricity-related activities, from generation to distribution and including energy transmission and trading activities to continuously balance supply with demand. A marked increase in the use of renewables is bringing change to its power generation operations, which are underpinned by a diversified low-carbon energy mix founded on nuclear power capacity. With activities across the entire electricity value chain, EDF is reinventing the products and services it offers to help residential customers manage their electricity consumption, to support the energy and financial performance of business customers and to support local authorities in finding sustainable solutions for the cities of the future. As today's increasingly digital world dramatically changes the way we produce and consume, research into electricity generation, transmission and consumption is of decisive importance. To succeed in the energy transition, the 2,100 EDF's R&D division staff (representing 29 nationalities) are currently working on many different projects designed simultaneously to deliver low-carbon power generation, smarter energy transmission grids and more responsible energy consumption.

The missions of EDF's R&D are structured around 3 key priorities.

Priority 1: consolidating and developing competitive, low-carbon energy generation mixes. One of the major challenges presented by the energy transition is to ensure the efficient coexistence of traditional generating methods – particularly in terms of improving nuclear plant safety, efficiency and operating life even further – with the development of renewables.

Priority 2: developing new energy services for customers. Responding to customer expectations means thinking about new solutions that respond effectively to variable energy demand while also limiting carbon emissions.

Priority 3: preparing the electrical systems of tomorrow. This involves developing smart management tools that will make electrical systems more flexible and adaptable, encouraging the injection of intermittent energy sources into the grid, and designing new sustainable energy solutions at local and regional level.

Role in the project

EDF will be involved in the following WPs:

- WP2: Assistance in identifying relevant literature for the review and in defining the interview questions.
- WP6: Assistance in users' needs assessment / priorization; tests of the mock-up + feedback to developers in terms of functionalities, ergonomy, ease of access, integration in end users' tools, etc.
- WP6: Assistance in identification of competitive tools.
- WP7: Assistance in reaching the energy community, through our network (EDF Group + other companies / energy organizations), and more generally link with WEMC (World Energy and Meteorology Council); provide a bridge for other projects, in particular COPERNICUS SIS (ECEM & CLIM4ENERGY) + expected Energy oriented H2020 project (grid integration of RE for instance).

Key personnel

Dr. Laurent Dubus (male) is an expert researcher in Energy Meteorology. He's been working for EDF R&D since 2001. He has skills and experience in climate system modelling, weather and climate forecasts and power systems management. His activities are dedicated to improving the effective integration of high-quality weather, climate and other environmental information into energy sector policy formulation, planning, risk management and operational activities, to better manage power systems on all time scales from a few days to several decades. He is involved in different French and international activities and organizations at the nexus between energy and meteorology, including WMO, the Superior Council of Meteorology in France and the ICEM conference series. He is also one the founders of the World Energy and Meteorology Council (www.wemcouncil.org). Laurent holds an engineering degree in Marine Environment and a PhD in Physical Oceanography. As an expert researcher, his duties currently cover research activities, scientific and technical advice to project leaders, end-users and R&D program managers, training and

young scientists' supervision at master and PhD level.

Relevant Projects

COPERNICUS project: *ECEM*. The ECEM service aims to produce, in close collaboration with prospective users, a proof-of-concept climate service – or demonstrator – whose purpose is to enable the energy industry and policy makers to assess how well different energy supply mixes in Europe will meet demand, over different time horizons (from seasonal to long-term decadal planning), focusing on the role climate has on the mixes. ECEM is one of the COPERNICUS Sectoral Information System projects.

COPERNICUS project: *CLIM4ENERGY* brings together the complementary expertise of 7 climate research and service centers and 11 energy practitioners to demonstrate, from case studies, the value chain from ECVs to actionable information in the energy sector. It will deliver 9 energy-relevant pan-European indicators of climate trends and variability with a cross sectoral consistency, appropriate documentation and guidance, estimation of uncertainties, and a demonstration of use. It will contribute to other Copernicus services by sharing experience and tools on quality control, data access with distributed systems, visualization of complex multi-dimensional data and their uncertainties.

FP7 project*: EUPORIAS* (GA 308291) is a four-year collaborative project funded by the European commission under the seventh framework programme, which will end in January 2017. It intended to improve our ability to maximise the societal benefit of seasonal to decadal predictions of environmental conditions. Working in close relation with a number of European stakeholders this project developed a few fully working prototypes of climate services addressing the need of specific users. The time horizon is set between a month and a year ahead. Over the 4 years the 24 project-partners, representing a diverse community ranging from UN organisations to small enterprises, aimed at increasing the resilience of the European Society to climate change by demonstrating how climate information can become directly usable by decision makers in different sectors.

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2015	Aerosols attenuating the solar radiation collected by Solar Tower Plants: the horizontal pathway at surface level	Elias, T., D. Ramon, L. Dubus, C. Bourdil, E. Cuevas-Agullo, T. Zaidouni and P. Formenti	AIP Conference Proceedings, **Vol. 1734**(1). DOI: 10.1063/1.4949236
2014	Weather Matters for Energy	Troccoli, A., L. Dubus and S.E. Haupt, editors	Book, Springer, ISBN: 978-1-4614-9220-7 (Print) 978-1-4614-9221-4 (Online).
2014	Weather and climate and the power sector: needs, recent developments and challenges.	Dubus, L.	In Weather matters for energy, A. Troccoli, L. Dubus and S.E. Haupt, Ed., Springer, 2014, XVII, 528 p. ISBN 978-1-4614-9220-7.
2010	Practises, needs and impediments in the use of weather/climate information in the electricity sector.	Dubus, L.	In: Troccoli A (ed) Management of weather and climate risk for the energy sector. NATO Science Series, Springer Academic Publisher. ISBN 978-90-481-3691-9

Infrastructure

EDF R&D's participation in the project will not necessitate any specific infrastructure. However, in case of need, many computing facilities are available internally, including a HPC cluster with 1 PetaFlops capacity.

Participant 9:

Capgemini CONSULTING.TECHNOLOGY.OUTSOURCING	**Capgemini Technology Services**

Capgemini Technology Services France, in particular, the sector Capgemini Aerospace & Defense, with the two practices Custom Software Development and Insights & Data dedicated to the Space domain, are involved in the execution of the project. Capgemini is a guiding force in shaping the Aerospace and Defense market by serving 7 out of 10 of the top companies in Aerospace & Defense (A&D). Capgemini aims to define, design, build and run applications and information systems. Capgemini has developed Aerospace & Defense Centres of Excellence (CoE) applied to the four sectors of Defense, Air Traffic Management and Space & Navigation with more than 4,000 engineers working on engineering services across main locations in France, Germany, UK, Italy, USA, Canada, Sweden, Netherlands, India and China. The Capgemini Aerospace & Defense CoE can rely on a highly talented group of specialists with varied skill sets from different disciplines in the AeroSpace domain and an average of seven years of experience. Some of our key customers in the sector include: ADS, Thales, ESA, CNES, TOTAL and ERDF among others. Capgemini has been involved in several proofs of concept to demonstrate the benefits of space data valorization and related technologies in terms of performance, scalability and flexibility of the solution. Capgemini has accumulated a strong expertise in the data valorization process, which includes Earth Observation data collection (Sentinels constellation; Landsat, Spot among others), processing and dissemination. An internal initiative is being industrializing (ESA GEORICE project) and will bring to the market soon: Insights and Big Data as a service. This platform establishes strong links with experts of analytics and with the innovative big data technologies. Capgemini has strong skills about software development and integration. It encompasses all kind of software: Image Production Center (data processing chains), Mission Center and Ground Segment center -critical systems and “Digital Customer Experience” websites for collaborative systems, portals, social networks, mobiles applications.

In addition, as IT and data services leader, Capgemini has a robust expertise in delivering big data projects. Here below are listed the more relevant experiences:

- Regarding Image Production Center, mandated by CNES, Capgemini has design and set up a Multi-satellite, Multi-sensor Ground Segment for Multi-temporal Data (MUSCATE). MUSCATE aims to provide imagery products to the scientific community.
- Regarding the scientific aspect, Capgemini has a good knowledge of the science issues through the Scientific Office (SO), a pool of 20 PhD researchers on physics, mathematics and engineers. The SO ensures the operational implementation of scientific results in close collaborations with research centres. The innovation goal relies on the improvement of Big Data technologies and the framework to integrate scientific algorithms, in a Cloud infrastructure. The Scientific Office develops data processing algorithms for Earth Observation (radar, optics, with Sentinel-1, Landsat, Radarsat, Envisat, SPOT, Pléiades, MERIS, SWOT, etc.) and carry out data analysis from other domain (industry, aeronautic, etc.), define models to discover and extract added value from huge datasets;
- Regarding data science, Capgemini has accumulated an expertise both with “basic” machine learning algorithms (classification, clustering, regression, recommender systems, etc.) and with advanced algorithms (e.g.: neural networks, advanced optimization, descriptive and predictive analysis) that are designed by the mathematicians from the Scientific Office;
- Since 2015, Capgemini has been invested in its own Big Data platform dedicated to Earth Observation named Tech4Earth.This platform is the first step of the platform Insights & Data as a service for the applications handled space data.
- Regarding Big data and Cloud technologies, Capgemini assets could be grouped according to the following categories:
    - Data hub and processing engines: several project and benchmarks have been performed, especially around the Hadoop ecosystem. Capgemini has been experimenting these solutions for spatial and more generally science applications since 2011
    - Cloud administration to manage central and local (VMs) environments for operational services or collaborative development environment sharing resources.
    - Common services: Capgemini team has implemented several projects by using streamed events or Data Hub Software (DHuS) Sentinel ingestion, scheduled batch data fetching, ElasticSearch and SolR indexing and querying, noSQL dedicated storage to optimize user requests response time

(column-based, document-based or graph based).

Role in the project

CAPGEMINI will lead WP5 on the development of the tool (DST), as well as provide contributions to the following WPs:

- WP2: Share the DST with its client networks and work with them to implement the DST.
- WP5: Capgemini will lead the activities to implement the Decision Support Tool.
- WP6: CAPGEMINI will participate providing information for developing business models and the exploitation of the results.
- WP7: Contribute content to platforms and dissemination activities among their clients and users.

Key personnel

Roger Rutakaza (male): Roger is a senior IT Architect accumulated 20 years of experience on Industries, Space and Aeronautic domains. He masters JEE (Java), RDBMS, SOA, and distributed systems and Micro services technologies. His experience comes from projects implemented for CNES, ESA, Airbus, Snecma and other major actors of industries, space and aeronautic domains. He will be in charge of leading the design and implementation of WP5

Emmanuelle Capdevielle (female): Emmanuelle is an IT Engineer with 9 years of experience on Space domain dealing with Earth Observation systems. She worked in particular on ground segment and mission center for CNES and Airbus DS GEO (Spot Image). She is an expert on JEE (Java), Hadoop, ESB, web services and Business Intelligence (BI) technologies which were used on several projects related to Earth Observation systems during these last 9 years.

Relevant Projects

MUSCATE platform is designed to provide users with products coming from time series of images acquired over large territories. Sentinel-2 is the production module's flagship, but until the constellation is launched, MUSCATE has been already started producing data coming from Spot 4 (Take5) experiment. At the same time the processing of all the Landsat data acquired over continental France from 2009 to 2011 is included in the ground segment. MUSCATE is divided in two modules:

- Production module to generate the imagery products:Data Acquisition, Data Processing (with product quality control): ortho-rectification, calibration, tiling, space re-sampling, fusion and atmospheric correction, Data IQ (Image Quality) expertise
- Distribution module for the dissemination of the imagery products: Sentinel-2; Landsat 5, 7 et 8 ; Spot World Heritage; Kalideos

ESA project: *Fully Automated Aqua Processing Service (FAAPS)* is a service in near real time for the flooding monitoring using space data and crowdsourcing information. FAAPS service is in charge of collecting and processing the huge volume of data acquired by radar satellites during a flooding event. An additional flood risk prediction service crossing some soil moisture measured by the satellite SMOS and precipitation forecasts has been added in collaboration with a French research laboratory (CESBIO),

GEORICE, as an instantiation of the TECH4EARTH platform, is a dedicated service providing to the rice monitoring stakeholder's information and products developed using Copernicus Sentinel-1 4 data. The target products include rice crop grown area at a given time of the year, rice crop area estimates per season and per year, early warning of yield shortage, and indicators of rice production. The platform services and products has been tailored to user's needs.

In parallel, Capgemini has developed various **demonstrators**

- for the marine and coastal pollution monitoring using optical satellite images using Copernicus Sentinel-2 data;
- For grouping several types of data for the data management: data collected on the field, satellite data, GNSS information.

For all these applications, relevant technologies have been implemented to enable the dissemination of results **in real or near real time to the final end-users**

Relevant publications and products

N/A

Infrastructures

N/A

Participant 10:

LGI sustainable innovation	**LGI Consulting SARL**

Founded in 2005, LGI is a French consultancy that offers the following services: project development and management, in particular for EU projects; communication and dissemination; IT development; and strategy and innovation studies.
LGI has a strategic position in high-tech sectors, most notably in energy, transport, security and environment. Its approach is both multidisciplinary and European—consultants have competences in law, finance, engineering and IT, and are fluent in French, English, German, Italian, Spanish, Portuguese and Czech.
LGI offers a wide range of consulting services to support its clients' decision-making. The firm's strategic marketing approach is based on insight into advanced technological developments and novel business models, with innovation at the heart of the process. Our services include market research and forecasts, global industry analysis, and stakeholder mapping. These services enable our clients to address their key challenges while also exploiting their strategic opportunities. LGI has developed a recognised expertise on business modelling and technologies and market assessments. It has a strong background in leading work packages within EU projects in its areas of expertise.

Role in the project

LGI is the leader of WP6. It is also involved in the following WPs:

- WP2: Work on the French case study to identify users and understand their decision-making processes.
- WP6: Positioning, exploitation and business models. Leader of this WP.
- WP7: Design communication tools, such as the logo and the website; participate in communication and dissemination activities; link with the user community

Key personnel

Mrs. Eva Boo (Female) has an MSc in Industrial Engineering, majoring in Construction and Industrial Systems, as well as a Master in International Business Management and Operations. She has seven years of experience in the infrastructures and energy sectors, working in different companies in Spain, France and the United States. She has worked for the Spanish government on approaching new markets for technologies with high potential; at the engineering company Ayesa; and in the US consulting firm, Accenture. She has carried out several missions on policy, strategy, innovation and techno-economics. She joined LGI in 2012, where she leads the Innovation Strategy Business Unit and coordinates various innovation projects in the energy field.

Mrs. Suzi Maurice (Female) holds a Master of International Development from the University of Pittsburgh and a Master of Business Administration from the University of Geneva. Her studies focused on environmental sustainability and she has been published on the topic of climate change adaptation in the Philippines, as well as on the role of securities commissions in corporate disclosure of environmental and social factors. She has worked with UNCTAD on the Sustainable Stock Exchanges initiative and advised the OECD on its COP21 communication strategy. Prior to her transition to Europe, she was an award-winning journalist in China, where she produced and hosted a business show for the nation's first independent TV network.

Mrs. Chloé Chavardès (Female) is in charge of LGI's public communication activities. She works closely with partners to define, coordinate and implement project communication strategies, plans and activities. Her work covers online, print and multimedia communication, as well as event management and planning. She has a rich background in the aerospace sector. Prior to joining LGI in 2012, she spent five years working in corporate communication at the European Space Agency, both in the Netherlands and in France. She has also conducted communication research in the energy sector in the United States.

Relevant Projects

FP7-EeB NMP – UMBRELLA (2012-2015): UMBRELLA delivered a decision-support tool that provided information regarding buildings' energy consumption, methods for decision implementation, and incentives for solutions. LGI conducted a market analysis to quantify and qualify stakeholders' needs, as well as identified their cost structure and potential revenues. Furthermore, LGI mapped existing financial mechanisms to develop innovative business models. The project's budget was €3.7 million, with 10 partners working together over a period of 36 months.

FP7-SmartCities – READY (2014-2018): The project aims to demonstrate optimised energy systems for high-performance energy districts. The project has two demonstration cities: Aarhus (DK - 300,000 inhabitants) and Växjö (SE - 83,000 inhabitants). LGI is in charge of the market assessment of the different smart cities' solutions

(energy-efficient buildings, transport and ICT), as well as defining green business models for the new, innovative solutions. The project has a budget of €34.6 million, includes 20 partners, and will last for 60 months.

H2020 – Energy - ENTRUST (2015-2018): The project's main outcome is to provide a new understanding of energy-related practices, using an intersectional approach to the socio-demographic factors in energy use. This will effectively enhance stakeholder engagement in Europe's energy transition. As a partner and work package leader for the project, LGI is assessing the energy policy environment and promoting a Europe-wide energy transition that includes contemporary best practice. LGI is also investigating new business models to support the innovative transition pathways proposed within ENTRUST. With a budget of €3.49 million and seven partners, the project will run for 36 months.

H2020 – Climate services – MARCO: MARCO examines the current market for climate services in the EU, while also forecasting future opportunities to propel the market's growth. The needs of the users of climate services play a key role in the project's analysis. LGI is in charge of devising innovation models that address gaps in market demand and supply; is conducting a case study in the field of water and sanitation; and is providing a qualitative analysis of the market's demand. The project has a budget of €1.53 million, with 11 partners working together over a period of 24 months.

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2015	How Innovative Business Models Can Boost The Energy Efficient Buildings Market	Boo et al.	40th IAHS World Congress on Housing - Sustainable Housing Construction, December 2014
2014	Developing A Sustainable Housing Marketplace: New Business Models To Optimise Value Generation From Retrofit	Dunphy, N., Boo, E., Dallamaggiore, E., Morrissey, J.	40th IAHS World Congress on Housing - Sustainable Housing Construction, December 2014
2014	The Role of Innovative Business Models to Kindle Sustainability in the Built Environment.	Morrissey, J., Boo, E., Dallamaggiore, E., Dunphy, N.	Round Table on Sustainable Cities: Research, Business and Local Government. Invited Paper, The Russell Group-China Workshop on Sustainable Cities. Xi'an Jiaotong-Liverpool University (XJTLU), Suzhou, China, 3-5 June.

Infrastructures

N/A

Participant 11:

the climate data factory	**The Climate Data Factory (TCDF)**

The climate data factory (TCDF) is a climate service provider of post-processed climate change model data to the climate change adaptation practitioner community. Indeed impact studies require data that are becoming difficult to access and need correction from systematic errors in order to be used in impact models. The climate change model data that is distributed is the result of a post-processing of climate change projections (mostly CMIP5 and CORDEX model simulations) to make them directly useable by it's clients. This positioning makes TCDF a data provider for adaptation needs for multiple sectorial applications.
The major post-processing levels are:

- Remapping (interpolation on a same spatial grid).
- Bias correction (correction of the model systematic errors on key variables).
- Sub-sampling (selection or representative simulations).
- Formatting (putting the data into most popular professionals data formats).

Role in the project

TCDF will contribute to the following WPs:

- WP3: Observational datasets.
- WP4: Sub-seasonal to Seasonal climate predictions.
- WP5: Decision Support Tool (DST) implementation.
- WP6: Positioning, exploitation and business models.
- WP7: Dissemination, communication and exploitation.

Key personnel

Dr. Harilaos Loukos (male), as founder and CEO, is the legal representative of TCDF in this project. HL is a weather/climate serial entrepreneur with international expertise in the field of weather, climate and adaptation commercial services, climate change innovation, and product and service development. He was involved in several FP7 projects and he is contributing to EIT Climate-KIC's activities related to climate services. His background is in climate and oceanography with a PhD from University Pierre et Marie Curie Paris 6 and a post-Doctorate at the University of Washington and NOAA. During the past 15 years HL was involved in developing business opportunities in the field of weather, climate and adaptation commercial services, climate change innovation. He is also founder and board member of Climpact-Metnext a leading European provider of weather services to the retail and energy sector. He was also co-Chair of the Adaptation Services Platform of the EIT Climate-KIC (www.climate-kic.org) from 2012 to 2015.

Dr. Thomas Noel Pierre (male) holds a PhD in Earth Sciences and Atmosphere from the University of Versailles Saint Quentin en Yvelines performed within LATMOS, one of Institut Pierre Simon Laplace laboratories. Over the past five years, TN served as research engineer in several IPSL laboratories (LMD and LSCE) and specialized in the bias correction and post-processing of climate model databases. He was in charge of correcting the IPSL models for DRIAS project. He also corrected the models SETS E3P basis for the project and finally made data corrections on behalf of Labex L-IPSL. TN has an excellent command of scientific tools and programming languages (shell, Python, R, Fortran), climate data manipulation tools (NCO, CDO, CMOR, QC tool) and excellent knowledge of climate simulations bases CMIP5 and EUROCORDEX. He also mastered algorithms bias corrections for having used extensively during the past five years and is one of the co-authors of the article on the CDFt_SSR correction method.

Relevant Projects

Copernicus Climate Change Service - Evaluation and Quality Control Function for the Climate Data Store: Lot4. Assuring Best practiCes for Climate model Data Evaluation (ABC4CDE) - Implementation August 2016 – September 2018.

H2020 Climate Services Market Research project - MArket Research for a Climate services Observatory (MARCO) - Implementation November 2016- October 2018.

JPI Climate/ERA4CS - Climate-induced Risks in the Energy Sector: Tools for Assessment (CRESTA) – Under evaluation.

Relevant publications and products

Year	Title	Authors	Conference, journal or book
2016	Bias correction of precipitation through Singularity Stochastic Removal: Because occurrences matter.	Vrac, M., Noël, T., & Vautard, R	Journal of Geophysical Research: Atmospheres.
2015	Bias Correction Intercomparison Project (BCIP): an introduction and the first results	Nikulin, G., Bosshard, T., Yang, W., Bärring, L., Wilcke, R., Vrac, M., Noël Thomas, ... & Fernández, J.	EGU General Assembly Conference Abstracts (Vol. 17, p. 2250).
2013	Climate variability and trends in downscaled high-resolution simulations and projections over Metropolitan France.	Vautard, R., Noël, T., Li, L., Vrac, M., Martin, E., Dandin, P., ... & Joussaume, S.	Climate dynamics, 41(5-6), 1419-1437
2009	Probabilistic downscaling approaches: Application to wind cumulative distribution functions	Michelangeli, P. A., Vrac, M., & Loukos, H.	Geophysical Research Letters, 36(11).

A data set of remapped and bias corrected climate model data. The data set is based on 6 daily variables from 2 experiments. The variables are surface mean temperature, surface minimum temperature, Surface maximum temperature, precipitations, surface wind and surface radiation. The experiments are the CMIP5 and Euro CORDEX experiments, including all available models and emissions scenarios (Reference Concentration Pathways) published on the Earth System Grid Federation (ESGF) portal.

Infrastructures

TCDF uses the Amazon Web Services (AWS) for both storage and computing. TCDF is part of the AWS Activate program, a technical support programme for handpicked technological start-ups.

Participant 12:

Nnergix Energy Forecasting Services	**Nnergix Energy Management S.L. (Nnergix)**

NNERGIX Energy Management, S.L. is a technology-based company of recent creation. It was founded in January 2013 with the aim of designing and developing predictive software algorithms for processes and activities related with electric energy production and management. NNERGIX stems from the integration of two concepts, data mining and weather/energy forecasting services. Its business initiative focus in the energy markets and renewable electricity sector.

Nnergix is an innovative company formed by energy industry professionals with a wide range and very solid knowledge based on several years of experience in the energy, electrical market and meteorological field. We look for the continuous improvement of our technology in order to offer the best accuracy and the latest state of the art solutions for fields such as meteorology, renewable energy technologies, resource analysis, etc.

Nnergix' business is mainly focused in the development and commercialization of predictive products for the energy industry and the electrical markets always linked to meteorological parameters.

Our platform uses cutting-edge technologies such as Artificial Intelligence algorithms to get profit from big data generated through different players of the industry and generate very high scalable predictive products using a SaaS business model. Nnergix is able to predict how much energy will be produced in a selected power facility for the next hours until 15 days ahead with an hourly resolution.

Role in the project

During the project Nnergix's will be involved in the following WPs:

- WP2: To identify users' needs and evaluation of the added value of the S2S forecasts.
- WP5: Test functionalities, accessibility and integration
- WP6: Positioning, exploitation and business models. Exploitation of the DST.
- WP7: To be the link between the research project and the industry pointing out the seasonal forecast demands coming from the market.

Key personnel

Ramón Molera (male) holds an MSc in Industrial Engineering from **IQS** (Chemical Institute of Sarrià), specialising in energy. In 2014 he was recognized as an Inspiring Young Entrepreneur (IYE) by the ESADE Entrepreneurship Institute (EEI) and awarded with a scholarship for executive education at ESADE Business School. He has wide experience in the energy sector as technical and financial project analysis manager as well as executive experience in energy technologies, Data Analytics and IT. Before co-founding Nnergix Ramón was part of Engy Holding AB (Technical & Financial office manager), Finland Futures Research Centre (Energy Researcher), Deenma Finland (Energy Consultant) and Deenma Barcelona (Project Engineer).

Joan Miquel Anglès (male) graduated as Industrial Engineer at Polytechnic University of Catalonia, specialized in energy. Afterwards he continued studying in ESADE Business & Law School and Grenoble Ecole de Management in 2013 and 2014, respectively. He has much expertise in solar photovoltaic energy and technical advice in wind energy, also being part of international projects. His work experience includes been Project Engineer at Ecostream, Project Manager at Prestige Energías Renovables and Project Manager & Energy Consultant at DEENMA. After that he became one of Nnergix's co-founder where he worked as Technical Manager. With more than 10 years of experience in the renewable energy sector, and knowing very well its international ecosystem, now he serves as Business Development Manager.

Karla Hernández (female) is Industrial Engineer (Universidad Nacional Autónoma de México), has Master`s Degree in Business Administration and Business Innovation from Universitat de Barcelona and is Doctor of Business (Phd), Entrepreneurship, at the same university. Karla worked for Procter & Gamble in Consumer & Market Knowledge before joining Nnergix in 2013; her goal was to implement business intelligence for the sales department through different processes; first collecting appropriate information for a defined goals. Second evaluate the data and extract valuable information; and third build decision-making tools for marketing and sales area. She has also experience and has been involved in corporate communication activities.

Relevant projects

Agreement to develop "Nnergix PVSat" in partnership with ESA (European Space Agency)

Contract with ESA-BIC (European Space Agency Bussines Incubation Centre) "Nnergix PVSat" Is an advanced very-short-term Forecast System based on real-time assimilation of Satellite Images.
In the context of massive application of solar PV power as source to produce energy for the electric system, it apears the challenge of grid integration because weather uncertanty. Therefore, Grid Operators, Producers and Electricity traders require accurate irradiance and power forecasts.
The goal of the project is to build a predictive technology able to produce solar irradiance forecasts for a very short term range (6 hours) and frequently updated (every 15 minutes). Using satellite imagery coming from METEOSAT, specifically visible spectrum, Nnergix is developing a irradiance model that can correlate cloud cover and density to surface irradiance, during a certain time interval.

Contract to supply wind power forecasts to Mexican TSO (Transmission System Operator)

The National Energy Control Centre (CENACE) is a public and decentralized institution that holds the Operational Control of the National Electricity System, the operation of the Wholesaler Electricity Market and guarantees the equality of opportunities when accessing the National Grid of Transmission and the General Grid of Distribution.
Nnergix is currently serving a 2 years long Services Contract for daily supply of weather and power forecasts for all the wind farms over the country. The portfolio is composed by 10 different regions adding all together a total of 1400 MW of power capacity. The service includes:
- Intra-day forecasting with hourly resolution
- Short-term and Mid-term forecasting up to 15 days ahead
- Power forecasting for single locations

Contract to supply power Multi-technology forecasts for MEPSO to ensure grid stability

MEPSO is the Transmission System Operator of the Republic of Macedonia. Its core activity is a smooth electricity transmission via the high voltage network, electric power system control and regular and duly electricity flow to its clients. MEPSO arranges and dispatches the electricity transport throughout Macedonia, as well as takes care of balancing the power system.
Nnergix is currently serving power forecasts for all MEPSO's renewable portfolio at country level. This portfolio is made of 3 different technologies: Solar PV with 18 MW of power capacity installed through 110 single locations, wind with 36 MW power capacity and Small-Hydro power with more of 60 MW by 62 locations over the country. The supply is for Short-term and Mid-term forecasting up to 15 days ahead, with real-tie data assimilation and monitoring software.The duration of the contract is 1 year, extendible up to 3 years.

Contract to supply solar PV power forecasts at Country level in Spain

Two years long commercial contract to supply solar power forecasts to the company Nexus Energía, which is the main solar PV wholesaler in the Spanish electricity market. Nexus' portfolio is made of more than 18.000 solar production units, adding a total capacity of 1750 MW of power. The service includes:
- Intra-day forecasting with hourly resolution
- Short-term and Mid-term forecasting up to 15 days ahead
- Solar irradiance and temperature power forecasts

Contract to supply Nowcasting service in South Africa for an IPP (Independent Power Producer)

Contract for supplying very short-term power (active and reactive) forecasting service, for a ground based solar PV facility of 65 MW of power capacity. The service involves real time data assimilation from the meters of the plant to achieve high accuracy on the predictions. The objective of the service is to ensure stability and balance to the high voltage transmission grid

Relevant Products/Services

Nnergix has developed a variety of solutions in order to help managing renewable energies behaviour in the short-term. Transmission System Operators (TSO), Independent Power Producers (IPP), and electricity traders, they want to know in advance how much electricity will produce their renewable facilities linked to weather forecasts.

- Solar PV & CSP forecast: Solar PV production forecast since next coming hours up to 14 days. This technology is based on short-term numerical weather forecast prediction and it is combined with data

coming from facilities' meters. Artificial intelligence methods such as machine learning algorithms are the key to take maximum advantage of the available data and to achieve high accuracy and reliability.

- EO forecast: Accurate wind power forecast since the next few hours to the next coming days. Technology based on a combination of high-resolution weather forecast models and non-linear machine learning techniques.
- HY forecast: Run of River Power Station energy forecast. This technology is based on weather forecast models predictions and machine learning algorithms that take into account the particular capacity behaviour depending on kind, duration and intensity of rains within the catchment basin.
- WE forecast: Advanced weather forecasts for parameters linked to wind & solar power (global/direct/diffuse irradiance, wind speed and direction at different hub heights, wind gusts)
- See more information at http://www.nnergix.com/products

Infrastructures

Nnergix will contribute to the project its commercial network and capabilities, Nnergix will attend with its own booth several events/fairs worldwide which will help the consortium to check the industry feeling regarding on the research project. Nnergix will also contribute with its social network spread all over the world at different types of companies within the renewable energy sector.

4.2. Third parties involved in the project

For the partners except those listed below, there are no third parties involved.

Participant 1: BSC Third parties

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	No
Does the participant envisage that part of its work is performed by linked third parties	No
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Yes

BSC applies a Third Party modality with the Institut Català de Recerca i Estudis Avançats (ICREA), where the third party is making its resources available to the beneficiary under Article12 of the Grant Agreement - Use of in-kind contributions provided by third parties free of charge. According to this situation, ICREA will not carry out any part of the work and just lends resources to the beneficiary. These resources are directly used by the beneficiary, the work is performed in its premises and there is no reimbursement by the beneficiary to the third party. The third party makes available resources (dedicated time of Prof. Francisco J. Doblas-Reyes, who is employed by ICREA) to the beneficiary, which does not reimburse the cost to the third party, but which charges the costs of the third party as an eligible cost of the project. Its costs will be declared by the beneficiary in its Form C but must be recorded in the accounts of the third party. ICREA resources will be available for the whole duration of the project, mainly for RTD activities. Main activities are on WP3 and WP4.

External Advisory Board (EAB)

	**COPERNICUS Porgramme**
The Copernicus Climate Change Service (C3S) is still in the development phase and will combine observations of the climate system with the latest science to develop authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide. ECMWF operates the Copernicus Climate Change Service on behalf of the European Union and will bring together expertise from across Europe to deliver the service. C3S will provide key indicators on climate change drivers such as carbon dioxide and impacts, for example, reducing glaciers. The aim of these indicators will be to support European adaptation and mitigation policies in a number of sectors. (https://climate.copernicus.eu/about-c3s)	
Expert **Dr Carlo Buontempo** currently manages the Sectoral Information System (SIS) of the Copernicus Climate Change Service (C3S) at the European Centre for Medium-Range Weather Forecasts (ECMWF). He coordinates the activities of 7 projects working on the interface between climate science and decision making in sectors ranging from energy to city planning.	
	**The Subseasonal to seasonal prediction project (S2S project)**
The Subseasonal to Seasonal Prediction (S2S) Project is a proposed WWRP/THORPEX/ WCRP joint research project.The main goal of the S2S project is to improve forecast skill and understanding on the subseasonal to seasonal timescale, and promote its uptake by operational centres and exploitation by the applications community. Specific attention will be paid to the risk of extreme weather, including tropical cyclones, droughts, floods, heat waves and the waxing and waning of monsoon precipitation. (http://s2sprediction.net/)	
Expert Dr Andrew Robertson currently leads the Climate Group at the International Research Institute for Climate and Society (IRI). His research interests include regional climate variability and change, probabilistic daily rainfall modelling, predictability of weather-within-climate, and climate downscaling methodologies. His work at IRI spans all aspects of tailoring of climate information for use in conjunction with sectoral models for improved “climate risk management,” through targeted research, tool development, and training/outreach. He has worked on diverse tropical regions, including most recently India and SE Asia. He co-chairs the Steering Group of the S2S project.	
	**KIC Innoenergy**
InnoEnergy is the European company dedicated to promoting innovation, entrepreneurship and education in the sustainable energy field by bringing together academics, businesses and research institutes. Our goal is to make a positive impact on sustainable energy in Europe. InnoEnergy is one of the first Knowledge and Innovation Communities fostered by the European Institute of Innovation and Technology (EIT). It is a commercial company with 27 shareholders that include top ranking industries, research centres and universities, all of which are key players in the energy field. (http://www.innoenergy.com/)	
Expert **Mr Mikel Lasa**, CEO of InnoEnergy Iberia, has an extensive experience in bridging research, business and education within the renewable energy sector. Before joining KIC InnoEnergy, Mikel was head of the wind turbine technology division of the Spanish engineering company Apia XXI, and head of analysis and design of wind turbines at the Spanish National Centre for Renewable Energy. Prior to that, he worked in Germany and France as research engineer at Robert Bosch and as quality engineer at Valeo.	

Section 5: Ethics and Security

5.1 Ethics

Research activities proposed under S2S4E do not involve any Ethics issues mentioned in the tables.

Consideration has been given to the end-users who will be involved in the research, and only organisational data will be collected as opposed to any personal data. Where commercially sensitive data is concerned, this will be identified and the relevant information will be withheld accordingly. All research information will be gathered in accordance with guidelines laid down by the European Commission, and in accordance with the guidelines of the partner conducting the research (BSC).

5.2 Security

The S2S4E project does not involve activities or results raising security issues nor 'EU-classified information' as background or results.

Annex Support letters

		Supporter name	Signatories	Description
Academic	Programme	COPERNICUS Climate Change Services (C3S)	Carlo Bountempo, Sectoral Information System Manager	The Copernicus Climate Change service will give access to information for monitoring and predicting climate change and will, therefore, help to support adaptation and mitigation. It benefits from a sustained network of in situ and satellite-based observations, re-analysis of the Earth climate and modelling scenarios, based on a variety of climate projections.
	International project	S2S project	Andrew W. Robertson, Co-chair of S2S (IRI, USA) Frederic Vitart, Co-chair of S2S (ECMWF, UK)	The Subseasonal to Seasonal Prediction (S2S) Project is a proposed WWRP/THORPEX/ WCRP joint research project.The main goal of the S2S project is to improve forecast skill and understanding on the subseasonal to seasonal timescale, and promote its uptake by operational centres and exploitation by the applications community.
	KIC	KIC Innoenergy	Mikel Lasa, CEO of InnoEnergy Iberia	InnoEnergy is the European company dedicated to promoting innovation, entrepreneurship and education in the sustainable energy field by bringing together academics, businesses and research institutes. Our goal is to make a positive impact on sustainable energy in Europe. InnoEnergy is one of the first Knowledge and Innovation Communities fostered by the European Institute of Innovation and Technology (EIT).
Society	Public administrator	Institut Català d'Energia (Spain)	Joan Esteve i Reyner, Head of Division of Energy Planning	The Institut Català d'Energia is the entity responsible for developing and implementing the energy policy of the Government of Catalonia, mainly in the field of the energy efficiency and the development of renewable energy sources.
	Renewable energy cooperative	Som Energia S. Coop. C. L. (Spain)	Gisbert Huijink, co-founder and member of management team	The main goal of the company is to offer green electricity to domestic users and to invest in renewable energies.
Energy companies	TSO	RTE Réseau de transport d'électricité (France)	M. Vincent Lefieux, Head of the Data science group	French Transmission System Operator which delivers an unhindered flow of electricity across the grid, second by second.

		Supporter name	Signatories	Description
	DSO	AD MEPSO (Republic of Macedonia)	Kiril Ackoski, Director	Transmission System Operator. The core MEPSO activity is a smooth electricity transmission via the high voltage network, electric power system control and regular and duly electricity flow to its clients
	Energy products providers	Vattenfall AB (Sweden)	Per Larsson, Director Planning and Optimisation Nordic	Vattenfall is the largest hydropower producer in Sweden. It's main products are electricity, heat and gas. In electricity and heat, Vattenfall works in all parts of the value chain: generation, distribution and sales.
		Vattenregleringsforetagen (Germany)	Peter Calla, Chief Water Managment Department	It is responsible for seasonal regulations in about 130 dams in six rivers in mid Sweden. VRF is a joint unit of regulation enterprises, one in each river, owned by the power companies in the river respectively. The duty includes water management, river forecasting, juridical issues, dam safety and coordination of the interests of the power companies.
		Iberdrola Renovables Energías, S.A.U.	Henar Estévez Marín, Head of Energy Resource Department	It is a head of business company of the Iberdrola Group headquartered in Spain which performs deregulated activities in generation and commercialization of electric power using renewable energy sources and whose aim, consequently, is to perform all kinds of activities, work and services related to the business of producing and commercializing electricity through facilities that use renewable energy sources.
		Gas Natural Fenosa (Spain)	Ramón Jane, Technology Programmes Unit	Gas Natural Fenosa is a multinational energy services group operating in 23 countries whose activities include generation, supplying, distributing, commercialization of natural gas and electricity business. Subsidiaries of our Group as Gas Natural Fenosa Renovables is devoted to development and generation of renewable energy, mainly focused on wind and hydro, and co-generation.
	Traders	Wind to Market S.A (Spain)	José Salmerón, Managing Director	Wholesale electricity management company dedicated to provide representation and electricity sale management services for renewable and conventional electricity generators and independent suppliers in the electricity market and provide access to CO2 trading at wholesale market prices for compliant industries.
		FENIE ENERGIA S.A (Spain)	Rodrigo López, Deputy Director of Energy Management	Wholesale electricity and gas management company dedicated to provide representation and management services for renewable and conventional electricity generators and independent suppliers in the electricity market.
	Forecaster	ConWx Aps	Jester Thiesen, CEO of	ConWx is a privately owned knowledge-based company which supplies a range of

		Supporter name	Signatories	Description
		(Denmark)	ConWx Aps	advanced weather and energy forecasting services to companies all over the world.It is an independent service provider with a reputation for delivering highly reliable forecasts and outstanding service.
	Other	ESA Renewables LLC (USA)	Javier Latre-Gorbe, Chief Technical Officer	A renewable energy-focused firm develops, constructs, owns, and operates renewable energy assets in Europe and North America.
		DNV GL Group Technology and Research (Germany)	Asuncion Lera St. Clair, Senior Principal Scientist, Climate Change Programme	provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas, and energy industries

Date 28/02/2017

Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29; 08908, Barcelona

Subject: Letter in support to the CSI4EU project

Topic of the Call: Exploiting the added value of climate services

Topic identifier: SC5-01-2017

Dear Albert,

With this letter I, Carlo Buontempo, Sectoral Information System Manager of Copernicus Climate Change Service at ECMWF, would like to express my interest for all the projects that will be submitted in response to the call ***SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept*** **(Instrument: Research and Innovation Action).**

Developing sectoral impact indicators able to provide useful input into decision-making process is of high importance and in line with the operational agenda of C3S.

We would be happy to collaborate with, and wherever possible support (through membership of Advisory Board or otherwise) the **S2S4E** project, should this be funded.

We wish you all the best with your proposal.

Yours sincerely,

Dr. Carlo Buontempo
Sectoral Information System Manager
Copernicus Climate Change Service
E-mail: carlo.buontempol@ecmwf.int

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ Jordi Girona 29; 08908, Barcelona

March 3, 2017

Letter of Support, H2020 proposal S2S4E

We, the co-chairs of the WWRP/WCRP Sub-Seasonal to Seasonal Prediction Project (S2S) express our support for your project proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)*, which you have prepared in response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

The S2S Project is a joint research project of the World Weather and World Climate Research Programs (WWRP and WCRP), whose goals are to improve forecast skill and understanding on the sub-seasonal to seasonal timescale (2 weeks to 2 months), and promote its uptake by operational centres and exploitation by the applications community.

We consider the outcome of the S2S4E proposal could make a substantial difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks and months. We believe that the energy sector has great potential to benefit from improved S2S weather and climate forecasts. Indeed, we consider that S2S4E, if funded, will help to promote the WWRP/WCRP S2S project by providing an important demonstration of the societal value of S2S forecasts. We thus express our full encouragement of your proposal.

If funded, we look forward to working with you to maximize your project's success through offering feedback (through membership of Advisory Board or otherwise) and through access to the S2S archive forecast archive.

Sincerely,

Andrew W. Robertson, Co-chair of S2S

Senior Research Scientist, International Research Institute for Climate and Society (IRI, Columbia University, New York, USA

Frederic Vitart, Co-chair of S2S

ECMWF, Reading, UK

Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29; 08908, Barcelona

Barcelona, 02nd of March, 2017

Expression of interest in H2020 proposal S2S4E

With this letter, I express our interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

InnoEnergy supports the high TRL development and commercialisation of technological innovations that lead to new products and services for a sustainable energy future.

InnoEnergy considers that the outcomes derived from the S2S4E project could make a difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply and anticipate colder and hotter events.

We welcome the opportunity follow the development of this project and will contribute with feedback and advice on how to market and exploit the Decision Support Tool.

For all the reasons above, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever climate services for sub-seasonal and seasonal time scales.

Sincerely,

Mikel Lasa
Iberia CEO
InnoEnergy

Generalitat de Catalunya
Institut Català d'Energia

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Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29
08908 Barcelona

Barcelona, 23 February 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

The Institut Català d'Energia is the entity responsible for developing and implementing the energy policy of the Government of Catalonia, mainly in the field of the energy efficiency and the development of renewable energy sources.

The Institut Català d'Energia considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

The Institut Català d'Energia will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

Generalitat de Catalunya
Institut Català d'Energia

C.Pamplona 113, 3ª Planta
08018 Barcelona
Tel.:93 622 05 00
Fax.:93 622 05 01
www.icaen.net

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Joan Esteve I Reyner
Head of Division of Energy Planning

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ Jordi Girona 29; 08908, Barcelona

Girona, February 14th, 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

Som Energia sccl is a Spanish renewable energy cooperative with currently more than 32.000 members. We were set up to facilitate a quick transition towards a 100% renewable energy system owned by and managed in the best long term interest of citizens. We aim at having a 100% self production via a variety of wind, solar and hydro projects.

Som Energia considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

Som Energia will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales. Sincerely,

Gijsbert Huijink (co-founder and member of management team)

SOM ENERGIA, S.C.C.L.
CIF: F-55091367
C/ Pic de Peguera, 15,
B, Planta 1, Porta 16
17003-GIRONA

Réseau de transport d'électricité

M. Vincent Lefieux
RTE
Head of the Data science group
Email: vincent.lefieux@rte-france.com
Phone: +33 1 41 02 14 35

Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29; 08908, Barcelona

La Défense, 17th February 2017

Expression of interest in H2020 proposal S2S4E

Dear Dr. Albert Soret Miravet,

With this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

To maintain a real-time balance between supply and demand, the French Transmission System Operator, RTE, delivers an unhindered flow of electricity across the grid, second by second. As our activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector. RTE will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

Sincerely,

МЕПСО
МАКЕДОНСКИ ЕЛЕКТРОПРЕНОСЕН СИСТЕМ ОПЕРАТОР

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ Jordi Girona 29; 08908, Barcelona

Skopje, 16th of February of 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

MEPSO is the Transmission System Operator of the Republic of Macedonia. The core MEPSO activity is a smooth electricity transmission via the high voltage network, electric power system control and regular and duly electricity flow to its clients. MEPSO arranges and dispatches the electricity transport throughout Macedonia, as well as takes care of balancing the power system.

MEPSO considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, schedule power plants to reinforce electricity power supply, anticipate colder and hotter events.

As our market activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

MEPSO will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Kiril Ackoski M.Sc. El.Eng.

Director
Electricity Market Operator

VATTENFALL

Dr. Ilias Pechlivanidis

Swedish Meteorological and Hydrological Institute (SMHI)

Folkborgsvägen 17, 60176, Norrköping

Stockholm 15 February 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

Vattenfall AB is a big energy company in Europe with around 20.000 employees. Vattenfall's main products are electricity, heat and gas. In electricity and heat, Vattenfall works in all parts of the value chain: generation, distribution and sales. Our operations are based on the following energy sources: biomass, hydro, natural gas, nuclear, wind, coal and solar. Vattenfall is the largest hydropower producer in Sweden and among the largest in Scandinavia

Vattenfall AB considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate hydro management strategies, resource effects on markets, anticipate energy prices, optimize return on investments, schedule power plants to reinforce supply.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector. Vattenfall AB will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Per Larsson

Director Planning and Optimisation Nordic

Vattenfall AB
Markets / Assets

Evenemangsgatan 13
SE-169 56 Solna

D: + 46 8 739 57 97
M: +46 70 559 57 97

VATTENREGLERINGSFÖRETAGEN
UMEÄLVEN • ÅNGERMANÄLVEN • INDALSÄLVEN • LJUNGAN • LJUSNAN • DALÄLVEN

Dr. Ilias Pechlivanidis

Swedish Meteorological and Hydrological Institute (SMHI)

Folkborgsvägen 17, 60176, Norrköping

Östersund / 15 Februari 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

Vattenregleringsföretagen (VRF) is responsible for seasonal regulations in about 130 dams in six rivers in mid Sweden. VRF is a joint unit of regulation enterprises, one in each river, owned by the power companies in the river respectively. The duty includes water management, river forecasting, juridical issues, dam safety and coordination of the interests of the power companies.

VRF considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate water management strategies, which includes optimization of the total power production, juridical responsibility regarding water levels and discharges, and management of the water when facing floods and draughts.

As the water management is highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are. We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We are also willing to advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector, and to contribute with data on river discharge and water levels for case studies provided that the data will only be kept inside this project.

VRF will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Peter Calla
Chief Water Managment Department
Vattenregleringsföretagen

IBERDROLA

IBERDROLA RENOVABLES ENERGÍA
c\ Tomás Redondo 1
28033 MADRID

Barcelona Supercomputing Center (BSC)
Centro Nacional de Supercomputación (CNS)
C/ Jordi Girona 29
08908 BARCELONA
ATT: Dr. Albert Soret Miravet

Madrid, February 8th, 2017

SUBJECT: Expression of interest in H2020 proposal S2S4E

From IBERDROLA RENOVABLES ENERGÍA we would like to express our interest in the proposal: *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* that will be submitted to the H2020 call topic SC5-01-2017 (RIA). Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept.

IBERDROLA RENOVABLES ENERGÍA considers that the outcomes from the S2S4E project could improve climate information. It might allow better evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons.

The company will be pleased to follow the development of the project and, when feasible, will study review the material and prototypes prepared for the users of the climate information and the discussion that might be convened.

Sincerely,

Henar

Ms. Henar Estevez Martín
Head of Energy Resource Department

Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29; 08908, Barcelona

Barcelona, 17th February 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

Gas Natural Fenosa is a multinational energy services group operating in 23 countries whose activities include generation, supplying, distributing, commercialization of natural gas and electricity business. Subsidiaries of our Group as Gas Natural Fenosa Renovables is devoted to development and generation of renewable energy, mainly focused on wind and hydro, and co-generation. It has installed power of more than 2,187MW just in Spain.

Gas Natural Fenosa considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

Gas Natural Fenosa will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Ramon Jane
Technology Programs Unit
Engineering and Technology Innovation Division
Gas Natural Fenosa

gasNatural fenosa
Dirección Innovación Tecnológica

w2m wind to market
valor y gestión para su energía

Att. Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29.
08908 Barcelona

Madrid, February 16th 2017

Expression of interest in H2020 proposal S2S4E

Hereby I would like to express a positive interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

WIND TO MARKET (hereinafter W2M) is a wholesale electricity management company dedicated to provide representation and electricity sale management services for renewable and conventional electricity generators and independent suppliers in the electricity market, and provide access to CO_2 trading at wholesale market prices for compliant industries. W2M also has started a power retail business in 2016, with a remarkable growth among SME in its first year of activity.

W2M considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate market price evolution, resource management strategies, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and warmer events.

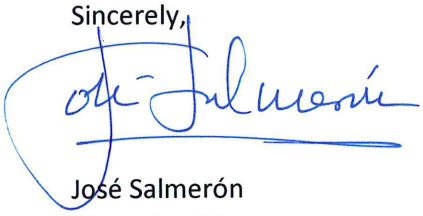
As our energy market activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also interested in participating in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

W2M will follow the development of this project and, to the best of our availability, will contribute with feedback to research activity.

On the above mentioned grounds, I would like to offer my strong support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,



José Salmerón
Managing Director

fenie energia

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ JordiGirona 29; 08908, Barcelona

Madrid, 16th of February of 2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

FENIE ENERGIA is a wholesale electricity and gas management company dedicated to provide representation and management services for renewable and conventional electricity generators and independent suppliers in the electricity market. Also providing electricity to residential and industrial consumers in Spain.

FENIE ENERGIA considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

FENIE ENERGIA will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Rodrigo Lopez
Deputy Director of Energy Management (FENIE ENERGÍA S.A.)

CONWX APS

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ Jordi Girona 29; 08908, Barcelona

Copenhagen 21/02/2017

Expression of interest in H2020 proposal S2S4E

Whit this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

ConWx is a privately owned knowledge-based company. Founded in 2008, located in Copenhagen, we supply a range of advanced weather and energy forecasting services to companies all over the world.

ConWx ApS considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate planning for maintenance works in offshore wind and anticipate colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

ConWx ApS will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Jesper Thiesen, CEO ConWx

Dr. Albert Soret Miravet
Barcelona Supercomputing Center (BSC)
C/ Jordi Girona 29; 08908, Barcelona
February 9th, 2017

Expression of interest in H2020 proposal S2S4E

On behalf of ESA Renewables, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy (S2S4E)* and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic *SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept* (Instrument: Research and Innovation Action).

The ESA Group is a renewable energy-focused firm that develops, constructs, owns, and operates renewable energy assets in Europe and North America. ESA Renewables considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for a full evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate energy production, site performance and operation and management.

This project will have a positive effect on the management activities of the company including resource management strategies, resource effects on markets, anticipating energy prices, planning for maintenance works, anticipating cash flow, optimizing return on investments, scheduling power plants to reinforce supply, and anticipating colder and hotter events.

As our production activities are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are. We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

ESA Renewables will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

Javier Latre-Gorbe
Chief Technical Officer

DNV·GL

Dr. Albert Soret Miravet

Barcelona Supercomputing Center (BSC)

C/ Jordi Girona 29; 08908, Barcelona

Oslo-10 February 2017

Expression of interest in H2020 proposal S2S4E

With this letter, I express a strong interest in the proposal *Sub-seasonal to Seasonal climate predictions for Energy* (S2S4E) and in the forthcoming project, in case the EC awards the contract to the consortium throughout the full duration (i.e. 36 months). The proposal has been prepared as a response to the EC Horizon 2020 Programme call topic SC5-01-2017 Exploiting the added value of climate services; from climate service concepts to piloting and proof-of-concept (Instrument: Research and Innovation Action).

Driven by its purpose of safeguarding life, property and the environment, DNV GL enables organisations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas, and energy industries. We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight

DNV GL Group Technology and Research considers that the outcomes derived from the S2S4E project could make difference in the generation of a new class of climate information, allowing for improved evaluation of the impact of energy indicators over the forthcoming weeks, months and seasons to better anticipate resource management strategies, resource effects on markets, anticipate energy prices, planning for maintenance works in offshore wind, anticipate cash flow, optimize return on investments, schedule power plants to reinforce supply, anticipate colder and hotter events.

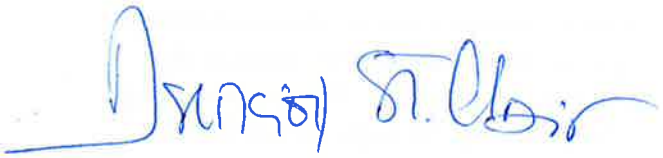
Complementing our in-house research capacities given we know many of our customers are highly dependent on weather and climate, we are keen to keep abreast on ongoing developments that can affect our operations. We welcome the opportunity to participate in as end users/stakeholders in the discussions and help to identify what the specific needs of our sector are.

We are also willing to participate in international workshops that explore and demonstrate the usefulness of the project outcomes. We will advise on the feasibility and relevance of current and potential climate data, relevant to the energy sector.

DNV GL Group Technology and Research will follow the development of this project and will contribute with feedback to research activity, accepting to check the material and prototypes prepared for the users of the climate information.

For these reasons, I would like to offer my enthusiastic support to the S2S4E project where the consortium will provide for the first time ever this kind of services for sub-seasonal and seasonal time scales.

Sincerely,

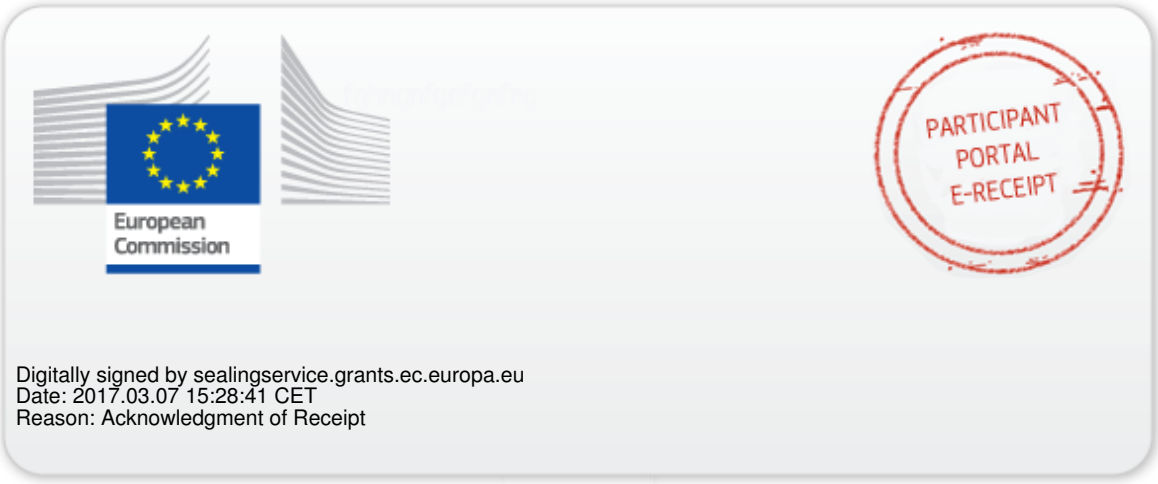


Asuncion Lera St. Clair

Senior Principal Scientist, Climate Change Programme

DNV GL Group Technology and Research

asun.lera.st.clair@dnvgl.com



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