



## **DRAFT**

### **Legal text for Annex [XXX]**

#### **Comfort & Climate Box – Speeding up market development for integrating heat pumps and storage packages**

#### **Combined ECES/HPT Annex on Combined Heat Pump and Storage systems**

***NOTE 1: This legal text gives a summary of the contents of the proposed annex. A larger document containing a full description and elaboration of the chosen scope and work packages is attached to this document. This document should be considered an integral part of this proposal.***

#### **1. Background**

##### **a. General background**

Integrated systems consisting of heat pumps and storage are an important technological option to accelerate the use of renewable energy for heating and cooling. By combining heat pumps and storage, several issues may be tackled, such as

- Balancing & controlling electricity grid loads;
- Capturing a larg(er) share of renewable (local/regional) input (i.e. solar thermal, solar PV);
- Optimizing economics, CO<sub>2</sub>-emissions, fuel use throughout time;
- Providing optimal supply security to buildings.

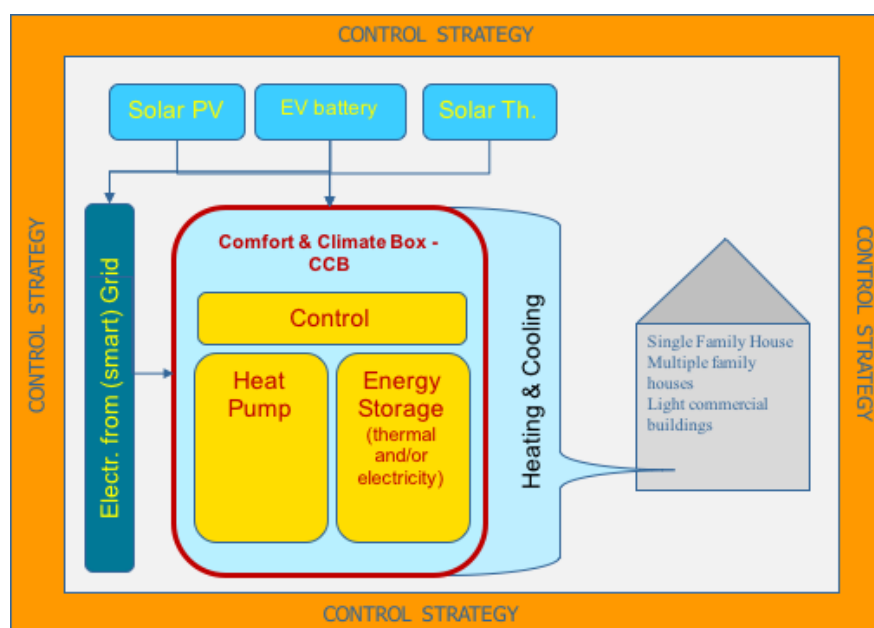
Commercial development of this type of solution is progressing very slowly. This Combined Annex will accelerate market development of combined heat pump / storage packages (working title “Comfort and Climate Box”, or CCB). This will be the first Annex to integrate the work from the HPT and ECES Technology Collaboration Programs (TCP), building upon the earlier work in the fields of Heat Pumps and Storage systems.

##### **b. Definition of concepts**

###### **Comfort & Climate Box (CCB)**

The central concept in this Annex is the Comfort and Climate Box. This concept denotes a combined package, consisting of a Heat Pump, an Energy Storage Module and Controls. This package may form an actual physical unit but can also consist of separate modules that form an integrated ‘virtual pack-age’.

A CCB should not just be a set of components that have been put together. Rather, all components of the CCB should be designed to work together in a modular fashion and should be operated under a dedicated and optimal integrated control strategy.

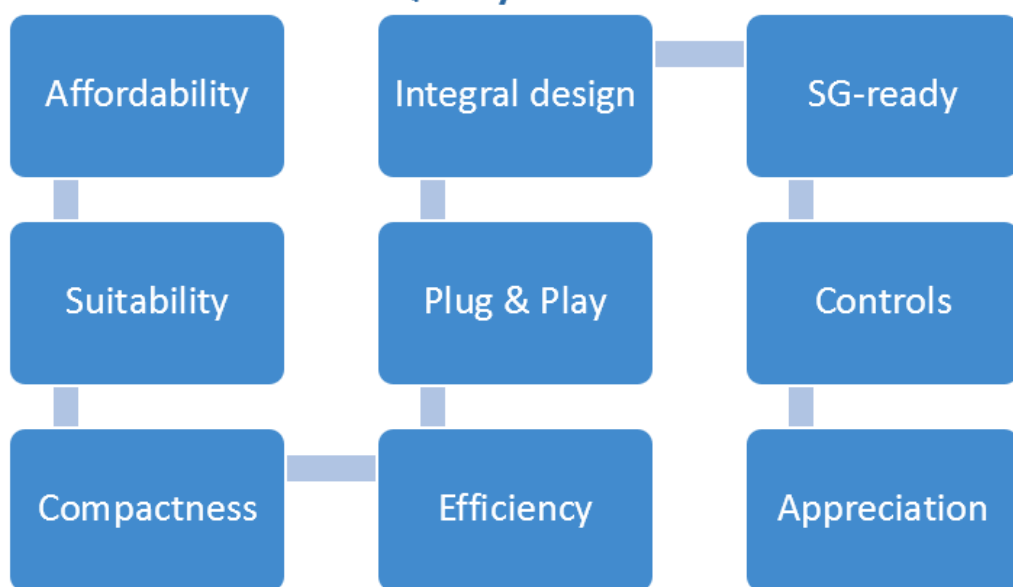


### Quality criteria

There are already several attempts to put CCBs on the market. However, market uptake is still slow and hesitant. We analyze market success by looking at nine design criteria that play a role in developing CCBs.

## Comfort & Climate Box

### Quality criteria



Depending on the local market, available systems may need to improve performance with respect to one or several of these criteria. These criteria form our central reference to describe and measure CCB quality.

### c. Relation to other Annexes

Several international projects have already partially focused on the goals of this Combined Annex. Information exchange to obtain exchange information with these projects is important to guarantee adequate progress. We plan to organize an 'expert meeting' in the start of the Combined Annex to lay the foundation for this information exchange process. Depending on the needs of the Combined Annex, such expert meetings will be organized again during the running time.

The following list IEA Annexes gives a preliminary indication of the available information from earlier or ongoing activities.

#### HPT TCP (Heat pumping technologies)

Annex 30 – Retrofit HPs for buildings	(completed April 2010)
Annex 33 – Compact heat exchangers in HP equipment	(completed April 2010)
Annex 36 – Quality installation / quality maintenance sensitivity studies	(completed Nov. 2014)
Annex 37 – Demonstration of field measurements of HP systems in buildings	(completed April 2016)
Annex 39 – A common method for testing and rating of residential HP and AC Annual/Seasonal Performance	(completed Oct. 2016)
Annex 40 – Heat pump concept for nearly zero-energy buildings	(completed)
Annex 42 – HPs in smart grids	(completed May 2017)
Annex 45 – Hybrid HPs	(ongoing, finalised 2018)
Annex 46 – Domestic hot water HPs	(ongoing)
Annex 49 – Design and integration of heat pumps for NZEBs	(ongoing)
Annex 50 - HPs in multi-family buildings for space heating and DHW	(ongoing)
Annex 51 – Acoustic signature of HPs	(ongoing)
Annex52 - Long term performance measurement of GSHP Systems serving commercial, institutional and multi-family buildings	(ongoing)

#### ECES (Energy conservation through energy storage)

Annex 28 – Distributed Energy Storage for the Integration of renewable Energy	(completed 2018)
Annex 29 (SHC task 42) – Compact thermal energy storage	(completed 2016)
Annex 30 – Thermal energy storage for cost-effective energy management & CO2 Mitigation	(ongoing)
Annex 33 (SHC task 58) – Material and component development for thermal energy storage	(ongoing)

#### EBC (Energy in buildings and communities)

Annex 67 – Energy flexible buildings	(ongoing)
--------------------------------------	-----------

#### SHC (Solar cooling and heating)

Task 42 (ECES Annex 29) – Compact thermal energy storage	(completed 2016)
Task 58 (ECES Annex 33) – Material and component development for thermal energy storage	(ongoing)

#### DSM (Demand Side Management)

Task 17 – Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources	(completed 2016)
Task 24 – Closing the Loop - Behaviour Change in DSM, From Theory to Policies and Practice	(ongoing)
Task 25 – Business Models for a more effective market uptake of DSM energy services	(ongoing)

#### ISGAN (International Smart Grid Action Network)

Several reports, annexes, expert input.

#### Energy Efficient End-Use Equipment

Several reports, annexes, expert input.

#### **d. Relation to HPT long-term strategy**

In line with the strategic goals of HPT, this Annex will contribute to accelerating the market development of heat pumps:

##### Energy security

Demonstration of the promising combination of heat pumping and energy storage technologies; working towards affordable solutions;

##### Economic development

Decreasing the “lab-to-market” time for combined heat pump / storage packages; demonstrating cost-effectiveness of these packages.

##### Engagement

Forging ties between research and industry to develop this new market opportunity.

## **2. Description of technical sector; definitions**

We will work on ‘package’ solutions (BCCs) providing domestic hot water (always) and heating and/or cooling, depending on the climate zone of the participant. The package solution could but will not automatically take the shape of a single physical ‘box’ providing all functions. Rather, the package may also consist of a set of ‘modules’ that have been designed to work together and are run by a dedicated and optimized control strategy as a ‘virtual package’. With this approach, easy integration into existing heating systems is also kept in mind, which helps to reduce retrofitting costs.

Policy development will not be included in the scope, other than as a set of policy recommendations for accelerated market development.

We include external sinks and sources of heat and electricity, such as solar PV, solar thermal and electrical vehicles. These external appliances are regarded as ‘fixed’ boundaries for the system. We will not yet try to optimize interaction with external appliances to arrive at a fully matured smart grid concept.

For this project, storage can be thermal and/or electrical in nature. The typical capacity to aim for will be approximately single-day use for space heating. For example, to maximize self-use of renewable production or to enable within-day peak shaving.

Building stock will be limited to existing single-family houses and light commercial use with a similar demand profile as domestic use (e.g. notary office, dentist etc.).

##### Not included in the project

Explicitly not addressed in this project are:

- Seasonal storage
- Connection to district heating
- Regulatory frameworks and their impact on this technology development (policy recommendations will be part of the annex)
- Direct electrical heating

### 3. Objectives and scope

This project is not meant to be a theoretical 'research Annex'. All contributing projects in the participating countries should aim to focus on developments that are 'almost market ready'.

#### Main goal

The goal of this Combined Annex is to develop improved CCBs in existing buildings to speed up market development. We will strongly focus on systems that will be close to commercial realization (i.e. technology readiness level upwards from 7/9) and have a high quality, adopted to their local market.

The work will be oriented around the nine quality criteria discussed above to define the concept of improved quality. The underlying drive is to accelerate the market development for CCBs to enable rapid growth of the application of these promising heating systems in differing climate zones.

By exchanging the lessons learned from the separate developments in each participating country, we will enable the participants to help each other to speed up their local market development.

#### Annex tasks

This goal can be translated into the following explicit Annex tasks for each participant country.

#### **Investigate the present market status**

- Which CCBs, or CCB-like systems are already available on the market?
- Which systems/manufacturers are likely to enter the market within the next years?
- What does the market need: e.g. which of the nine quality criteria discussed above are most important for further market development?
- Which of the identified quality criteria need improvement?

#### **Develop or assemble market prototypes**

- Build working CCB package(s), focusing on the specific improvement of specific quality criteria.
- Prototypes should be 'close to market', i.e. no fundamental research, but using available components where possible.
- Prototype packages can be physically integrated but may also establish a 'virtual package'.

#### **Testing prototypes**

- Measure performance of the prototypes, either in a test bench setting or in field trials.
- Develop suggestions for performance metrics best suited for CCB packages.

#### **Provide input for the roadmap**

- What are the lessons learned in each local market?
- Which development areas need most attention?
- What is needed to further develop the local markets?
  - Government
  - Builders
  - HP / Storage industry
  - Installers
  - Etc.
- Recommendations for HP/Storage combined testing standards.

#### 4. Means

To reach our proposed goals, the following work packages have been defined. For most work package, a prospective work package leader has stepped forward already. Precise scope and deliverables of each work package will be written in cooperation with the (prospective) package leaders. A tentative interest in a WP leadership is naturally not yet binding in any formal or informal manner for that country.

##### WP 1 – Present state of the market and system types

For each participating country separately:

- Overview of systems presently on the market or close to commercialization
- Use cases CCBs for participating countries, taking the Annex' scope into account
- Functional conditions and requirements for further improvement of CCBs for the local market

##### WP 2 – Prototyping

The scope and scale for this task is wholly dependent on the national support achieved by the individual countries.

- System specification building on the country-specific output from WP 1
- Control strategy development
- Building or assembling prototypes

##### WP 3 – Testing and pre-standardization

- Develop comparison metrics
  - i.e. Critical performance indicators of packages, benchmarks for qualifying and quantifying packages
- Carry out measurements under lab conditions
  - for smaller and/or cheaper components
  - optimization for climate zones and use cases 'in vitro'
- Deployment of prototypes in field trials
  - Separate trials for each participating country.
  - Mix of use cases
  - First results → focus on basic functionality, ease of installation, size, user interaction, etc

*Note: Extensive measurements of applied systems in the field are not realizable within the timeframe of this Combined Annex but will be initiated.*

- Recommendations for testing standards
  - Present ISO standards and local standards for participating countries
  - What's missing in present standards?
  - How should we make a fair assessment of CCB quality, including control strategy

##### WP 4 – Roadmap / Conditions for successful implementation

- Identify boundary conditions for optimal market development
  - Building constraints: sound, space, insulation, infiltration
  - Customer needs and acceptance: health, safety, comfort
  - Ease of installation, robustness, longevity
  - Power delivery and sizing
- Overviews of barriers and stakeholder interests
- Overview of life cycle analysis (LCA) of CO<sub>2</sub> and costs

- Recommendations for control interfaces:
  - HP/Storage package ↔ heat/cold load ↔ HP ↔ Storage ↔ Renewables ↔ (Smart) grid
- Recommendations for industrial manufacturers
- Recommendations for policy makers
- Recommendations for standardization

#### WP 5 – Organization and dissemination

- Information exchange / input from other sources  
(i.e. other IEA Annexes, Horizon 2020 projects, European Heat Pump Association (EHPA) other international stakeholder platforms, etc.)
- Outcomes expert workshops
- Annex meetings, communication, coordination
- Reporting
- Planning

### **5. Target audience and Benefits**

This Annex proposes to help develop the knowledge base on these topics and to initiate, support and evaluate prototypes, field trials and ready-to-market systems with integrated heatpump/storage packages. We specifically aim to mitigate the building blocks mentioned above.

The leverage from this project will come from partly the successful implementation of prototypes and field trials (see below). But also from WP 1, 3,4, 5 where knowledge dissemination is projected. Project funding for participating partners will have a critical impact on the number and diversity of the physical field projects that will be realized. Participating countries are invited to

- Get industry partners involved in the project to help speed up knowledge exchange and field trial execution
- Consider funding industry or research partners to get involved in the national teams for this Combined Annex
- Get policy makers and grid operators involved to act on the recommendations from this Combined Annex

The target audience for this Combined Annex consists of manufacturers, testing institutes and policy makers. The output from this Annex can be of significant help in speeding up the development and market growth for CCBs.

*The ambition level of this annex will strongly depend on participation and funding of research and industry partners. In setting up the final scope, close collaboration between participating countries will be needed to ensure enough industry participation.*

## 6. Deliverables

The compulsory deliverables of the Annex are:

- Final report of the Annex according to template
- A public Annex Website as a subsite to the HPC website
- Progress reports to ExCo meetings according to template, once a year oral for each ExCo (alternating between ExCo meetings of HPT and ECES), focusing on results, achievements and/or success stories) and twice a year management reports prior to the ExCo meetings.
- 3 Short status report to the HPC and ECES secretariat twice annually for publication in the Newsletter/Magazine, focusing on results, achievements and/or success stories
- One article per year, topical or non-topical, to the HPC Newsletter/Magazine and ECES newsletter
- Report to the HPT and ECES Annual report
- Text and pictures to a 2-page popular scientific summary of Annex results to be freely disseminated

Further deliverables of the Annex are:

- Overview of present market status for CCBs
- Setup and first results of field tests with CCBs
- Roadmap with recommendations for market participants as specified in WP 4

## 7. Funding

(a) Working Meetings. The working meetings shall take place in Europe at the location of European participants.

(b) Publications: The cost of publishing the Final Report and summary assessments to the general public as pdf files in the HPT database are born by the HPT TCP and executed by HPC. The cost for communication and dissemination for the respective countries described in paragraph 6 above shall be covered by all the Participants themselves.

(c) Individual Financial Obligations. Each Participant shall bear all the costs incurring in carrying out the Task activities, including reporting and travel expenses.

(d) RVO (Netherlands)<sup>1</sup> supports and funds the work of the Operating Agent to cover co-ordination and summary report preparation expenses and other Annex-related (e.g. Workshop) costs.

## 8. Time schedule

The proposed running time of the Combined Annex will be 2 ½ years (30 months). The Annex definition workshop has taken place in Utrecht (Netherlands) at 17 & 18 January 2019. Formal start of the Annex is expected in March or April 2019, with reception of the formal number for this Annex from the ExCo HPT. The ExCo ECES has already provided a number, ECES Annex # 34.

---

<sup>1</sup> The Dutch consortium of ministry Economic Affairs and Climate, ministry of the Interior and Kingdom Relations and TKI Urban Energy fund the expenses of the Operating Agent.



The time planning is as follows:

		WP 1 Market status	WP 2 Prototyping	WP 3 Testing	WP 4 Roadmap	WP 5 Organization
2019	Q1	Annex definition workshop				
	Q2	Formal start of combined Annex				
	Q3					
	Q4					
2020	Q1					
	Q2					
	Q3					
	Q4					
2021	Q1					
	Q2	Final report, roadmap and prototyping results				

This time schedule is quite ambitious. To enable rapid and efficient progress of the Annex, the goal is to finalize WP 1 within 2019, to enable a ‘head start’ with WP 2 and WP 3 as soon as funding for local projects within the participating countries is obtained.

## 9. Specific obligations and responsibilities of the participants

(a) Each Participant shall nominate a representative to participate in the work under this Annex.

(b) Each Participant shall carry out the equivalent of at least total 3 person months/year of task-sharing work during the programme period unless otherwise agreed by the Participants.

(c) Each Participant shall contribute to the working meetings and to a workshop on the results achieved through the activities conducted under this Annex, including the identification of speakers and participants.

(d) All participating countries are required to contribute to WP 1 and WP 4 and at least deliver partial or preliminary results in WP 2 and WP 3.

## 10. Specific obligations and responsibilities of the Operating Agent

The OA is responsible for a correct execution of the final Workplan as agreed by the ExCos of HPT-TCP and ECES-TCP).

The Operating Agent shall:

(a) Develop, in co-operation with the Participants, a detailed work programme, a framework for the Final Country Report and a timetable for all the activities carried out under this Annex, including methodology.

(b) Provide the Executive Committee with periodic reports describing the progress of the work being accomplished under the Annex, once per year oral for each ExCo (focusing on results, achievements and/or success stories), twice a year a written management report, according to IEA requirements and once a year a contribution to the annual report.

(c) Deliver the results as described in Deliverables.

(d) Provide to the Executive Committee, within six months after completion of all work under the Task, a Final Report for its approval and transmittal to the Agency



(e) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programs and projects implemented by or under the auspices of the Agency or by other competent bodies

(f) Provide the Participants with necessary guidelines for the work they carry out, assuring minimum duplication of effort

(g) Co-ordinate the efforts of all Participants and ensure the flow of information within the Task

(h) Co-ordinate the work to ensure the compulsory deliverables to the HPT and ECES Newsletters/Magazines and to their websites

(i) Provide general administration

Furthermore, it is expected that the OA will develop constructive relationships with dedicated industries in member countries of HPT and ECES TCP in the heat pump and storage domain in order to involve them in work of the Annex.

The IEA Heat Pump Centre (IEA TCP HPT secretary and communication centre) offered to assist in the establishment of the Annex. Thereafter, the Heat Pump Centre will follow the Annex to check that the routines are followed, that the status and progress reports are delivered in due time and the quality of them. They will also assist the operating agent in the publication of the final reports and compilation of the summary in the end of the Annex. Therefore, it is the responsibility of the OA to follow the instructions of Heat Pump Centre in this regard.

It is the responsibility of the operating agent to follow the instructions of the two ExCos (Executive Committees) from HPT TCP and ECES TCP. The instructions will be harmonized between the two ExCos.

## **11. Information and Intellectual property**

(a) *Executive Committee's Powers.* The publication, distribution, handling, protection and ownership of information and intellectual property arising from this Annex shall be determined by the Executive Committees (ECES and HPT), acting by unanimity, in conformity with this Annex.

(b) *Right to Publish.* The Participants shall have the right to publish information provided to or arising from their Task, except for proprietary information, as defined in paragraph (c) below.

(c) *Proprietary Information.* For the purposes of this Annex, proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example, computer programmes, design procedures and techniques, chemical compositions of materials, or manufacturing methods, processes or treatments) which is appropriately marked provided that such information:

- (1) Is not generally known or publicly available from other sources
- (2) Has not previously been made available by its owner(s) to others without obligation concerning its confidentiality; and
- (3) Is not already in the possession of the recipient Participant(s) without obligation concerning its confidentiality.



It shall be the responsibility of each Participant supplying proprietary information, and of the Operating Agent, to identify such information as proprietary and to ensure that it is appropriately marked.

The Participants and the Operating Agent shall take all necessary measures in accordance with this paragraph, the laws of their respective countries and international law to protect the proprietary information provided to or arising from this Task.

(d) *Production of Relevant Information by Governments.* The Operating Agent should encourage the governments of all Agency Participating Countries to make available or identify to the Operating Agent all published, or otherwise freely available information known to them that is relevant to the Task.

(e) *Production of Relevant Information by Participants.* Each participant agrees to provide to the Operating Agent all previously existing information, and information developed independently of the Task, which can assist or is needed by the Operating Agent to carry out its functions in this Task, which is freely at the disposal of the Participants, and the transmission of which is not subject to any contractual and/or legal limitations, under the following conditions:

- (1) The Participant will make such information available, at its own costs, provided that such costs are not substantial
- (2) If substantial costs are necessary for the Participant to make such information available, the Operating Agent and all Participants will determine the charge of the costs for each participant, upon approval of the Executive Committee.

(f) *Use of Confidential Information.* If a Participant has access to confidential information which would be useful to the Operating Agent at an aggregated level in carrying out the studies, assessments, analysis or evaluations described in this Annex, such information may be communicated to the Operating Agent but shall not become part of any report or other form of documentation issued as part of this Task, nor shall it be communicated to the other Participants, except as may be agreed between the Operating Agent and the Participant who supplies such information. This information between the Participant and the OA has to be marked clearly as “confidential”.

(g) *Acquisition of Information for the Task.* Each Participant shall inform the Operating Agent of the existence of information that can be of value to the Task, but which is not freely available, and each Participant shall endeavour to make such information available to the Task under reasonable conditions, in which event the Executive Committees may, acting unanimity, decide to acquire each information.

(h) *Reports on Work Performed under the Task.* The Operating Agent shall prepare reports on all work performed under the Task and the result thereof, including studies, assessments, analysis, evaluations and other documentation, but excluding proprietary information, in accordance with paragraph 11(c) above.

(i) *Copyright.* The Operating Agent, or each Participant for its own results, may take appropriate measures necessary to protect copyrightable material generated under this Task. Copyright obtained shall be the property of the Operating Agent, for the benefit of the Participants provided, however, that Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise provided by the Executive Committee.



The Contracting Parties understand and agree that the name, acronym and emblem of the IEA has been notified to the World Intellectual Property Organisation (WIPO) Secretariat according to Article 6 of the Paris Convention for the Protection of Industrial Property, as amended on 28 September 1979. The Contracting Parties further understand and agree that the OECD/IEA shall retain the copyright to all IEA deliverables, materials or publications published or to be published by the IEA or jointly by the IEA and a third party to this Annex. Should the Contracting Parties use any such deliverables, materials or publications they shall give full acknowledgement to the OECD/IEA as being the source of the material with a copyright notice in the following form: © OECD/IEA, (year of publication).

(j) Authors. Each Participant shall, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation from its authors required to carry out the provisions in this paragraph. Each Participant shall assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

## 12. Operating Agent

The Netherlands has designated the Operating Agent and provides funding for the duration of the project.

Contact information for the Operating Agent:

Name	Peter Wagener & Paul Friedel
Affiliation	Business Development Holland B.V.
Postal address	Stationsplein 128 3844 KR Harderwijk Netherlands
Telephone number	+31 341 707 462
E-mail address	<a href="mailto:wagener@bdho.nl">wagener@bdho.nl</a> (mobile +31 651 335 966), <a href="mailto:friedel@bdho.nl">friedel@bdho.nl</a> (mobile +31 644 542 224)

## 13. Preliminary list of participants in this Annex

The following countries were represented at the Annex definition workshop in Utrecht (Netherlands) at 17 & 18 January 2019:

1. The Netherlands
2. Austria
3. Canada
4. Germany
5. Sweden
6. Switzerland
7. United Kingdom

## 14. Research organisations participating in this Annex

Participation is open for 6 months after this legal text has been approved and confirmed by the ExCo's of TCP HPT and TCP ECES.



## **15. Cooperation with other IEA TCPs**

The Proposed Annex is well suited for collaboration between HPT and ECES TCPs. Both TCPs will benefit from the work and outcomes from the Proposed Annex.

The Combined Annex is lead by HPT and ECES TCPs together, the cooperation will be organized as follows:

- (a) the Annex shall follow both HPT and ECES TCP's regulations. In case of contradictions, these shall be handled by the ExCos.
- (b) Status and progress of the Proposed Annex will be regularly reported to the ExCos of HPT and ECES TCPs.
- (c) Countries that are members of HPT or ECES TCP are welcome to participate in the Annex on the same conditions, as stated in this Legal Text.