



DELIVERABLE

Acronym / Number	WASTE2GRIDS / 826161
Title	Converting <u>WASTE</u> to offer flexible <u>GRID</u> balancing <u>Services</u> with highly-integrated, efficient solid-oxide plants
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Deliverable Number	D4.3
Deliverable Name	Communication, dissemination and exploitation plan and activities (update M10)
Lead beneficiary	DTU
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Summary

The purpose of the deliverable is to summarize the past activities and to update the plans for communication, dissemination and exploitation.



1. Past activities for communication, dissemination and exploitation

The major activities up to mid Feb 2020 are summarized as follows:

1. Olivier Bucheli attended the EU Sustainable Energy Week: Shaping Europe's Energy Future, which was held on 17-21 June 2019. Olivier introduced W2G projects to relevant participants.
2. CEWEP has been contacted to inform them of the W2G projects and W2G will send relevant results at an appropriate time to the association for results exploitation.
3. Publications:
 - Karen Pardos Olsen, Yi Zong, Shi You, Henrik Bindner, Matti Koivisto, Juan Gea-Bermúdez. Data-driven flexibility requirements for current and future scenarios with high penetration of renewables. *International Conference on Applied Energy* 2019, Aug 12-15, 2019, Västerås, Sweden.
This paper has been recommended for APPLIED ENERGY. The extended version of the paper has been submitted to APPLIED ENERGY and is currently under 2nd review.
Karen Olsen, Yi Zong; Shi You; Henrik Bindner; Matti Koivisto; Juan Gea-Bermúdez. Multi-timescale data-driven method identifying flexibility requirements for scenarios with high penetration of renewables. *Applied Energy*, 2020, revised version submitted.
 - Yumeng Zhang, Ligang Wang, Ningling Wang, Liqiang Duan, Yi Zong, Shi You, François Maréchal, Jan Van herle, Yongping Yang. Balancing wind-power fluctuation via onsite storage under uncertainty: power-to-hydrogen-to-power versus lithium battery, *Renewable & Sustainable Energy Reviews*, 2019 (116), 109465 published.
This paper developed the method for optimal selection and operation of many candidate plants to cope with a specific requirement to meet an electricity demand, characterized by typical days.
 - Ligang Wang, Yumeng Zhang, Mar Pérez-Fortes, Philippe Aubin, Tzu-En Lin, Yongping Yang, François Maréchal, Jan Van herle. Reversible solid-oxide cell stack based power-to-fuel-to-power systems: Comparison of thermodynamic performance. *Renewable & Sustainable Energy Reviews*, 2020, under review.
4. Prof. Jan Van herle has given an overview of the W2G project at the workshop of *Power production from biomass: Technological progress, perspective of development*, held in Research Centre ENEA Trisaia, Rotondella (MT), Italy, on 10 October 2019, 8:30 – 13:15, Building R41, Room: Pitagora.
5. Prof. Jan Van herle gave a technical overview of the W2G project at the EPFL-NCEPU workshop on Energy Research held in North China Electric Power University in Beijing, 29 Nov, 2019. The information was received by more than 20 professors and over 100 students on energy research.
6. Dr. Ligang Wang and Dr. Alessandro Agostini gave two presentations of *Techno-economics and Sector Coupling* and *LCA of FCH: latest developments* related to the W2G project at the event of EERA Joint Programmes FCH and Energy Storage with support from the Horizon 2020 project BALANCE entitled *Putting the hydrogen into hybridization: how fuel cells and electrolyzers can support energy storage*, held on November 5, 2019, 11:00-18:30 at ENEA Headquarters, Lungotevere Thaon di Revel 76, Rome, Italy.
7. Dr. Ligang Wang attended Joint EERA – SmiLES Workshop on Hybrid Energy and Energy Storage Systems, held on 7 – 8 November 2019, GSE, Viale Maresciallo Pilsudski, 92, 00197 Roma RM, Italy. In the workshop, he introduced the W2G project to the audience.

2. Updates on the plan for communication, dissemination and exploitation

2.1. Measures to maximise impact

The overall objective of the project is to identify the most promising industrial pathways of waste gasification and solid-oxide cell integrated power balancing plants. The project aims are:



- To perform a preliminary investigation on the long-term techno-economic feasibility of waste-based power-balancing plants from both points of view, long-term available wastes and renewable-dominated (RES) power zones.
- To identify promising business cases.
- To study the feasibility of a large-scale waste-based centralized application.

To achieve these aims, an interdisciplinary team has been formed, with know-how and knowledge on each one of the relevant fields of the project: (i) reversible solid-oxide cell (RSOC) (SOLIDpower), (ii) waste identification (ENEA), (iii) gasification and gas cleaning (ENEA), (iv) grid operation (DTU) and, (v) energy/process systems engineering (EPFL). The work performed in Waste2GridS is conceptual engineering work; already developed models and tools will be adapted and improved for the purposes of the project. More specifically, for (i) the identification long-term RES dominated power generation zones and of grid balancing needs (DTU), (ii) the identification of long-term available organic waste streams (ENEA), (iii) the plant modelling and optimal conceptual plant design with plant-wide heat and mass integration (EPFL and ENEA), (iv) the plant sizing and scheduling (EPFL), (v) the waste supply chain design and optimization (EPFL), and the (vi) RSOC development path and upscale strategy (SP SA).

Dissemination, exploitation and communication tasks will be performed in WP4. A comprehensive Data Management Plan (DMP), to manage intellectual property (IP), data and results, has been finalized by month 6 of the project. Dissemination, exploitation and communication parallel actions towards different audiences will be described and performed along the overall length of the project.

Table 1 Overview of the dissemination, exploitation and communication actions related to the expected impacts from Waste2GridS project. Note that publications and conferences' content will include more than one expected impact.

	Expected impact	Dissemination	Exploitation	Communication
1	Techno-economic viability	1-3 scientific publications. Workshop together with members from on-going relevant projects: W2W, BLAZE, others. <i>The workshop will not be organized by W2G but by BLAZE. W2G will be a participant to disseminate the results. Apart from this, we will also have a direct interaction with TSO members, in different contexts, so as to check different assumptions along the project and join several other conferences covering different fields, particularly the grid-service field.</i>	Use of: (i) waste availability data, (ii) RES scenarios, (iii) grid strategies and (iv) the adapted optimization tool for (i) other areas of study (i.e. other countries), (ii) other technologies, and (iii) other projects.	2-3 conferences. Invited talk in workshops.
2	Plant design	1-3 scientific	Use of the developed	2-3 conferences.



		publications.	models to study other types of waste.	Invited talk in workshops.
3	Operating strategy	1-3 scientific publications.	<i>The expected impact is intrinsically a result's exploitation purpose.</i>	2-3 conferences. 1 article in a magazine/website. Researchgate account. Project website. Invited talk in workshops.
4	Technology roadmap	1 technology roadmap.	<i>The expected impact is intrinsically a result's exploitation purpose.</i>	1 article in a magazine/website. Researchgate account. Project website.
5	CO ₂ and methane supply	1 technology roadmap.	<i>The expected impact is intrinsically a result's exploitation purpose.</i>	1 article in a magazine/website. Researchgate account. Project website.

The results of Waste2GridS project are relevant to different priorities of the Horizon 2020 Work Programme from 2018-2020: Energy Union and Circular Economy. In particular, to the Focus Areas “Building a low-carbon, climate resilient future” and “Connecting economic and environmental gains – The Circular Economy”. The relevant EU Directives that can benefit from the results of Waste2GridS project are: (i) the Renewable Energy Directive (RED) (Directive 2009/28/EC¹), setting a market share of 20 % of the total energy needs provided by renewables by 2020, and a 10 % of renewables in transport fuels, (ii) the Waste Framework Directive (Directive 2008/98/EC²), and (iii) the Fuel Quality Directive (FQD) (Directive 2009/30/EC³), as for the synthesized methane.

Two target groups are particularly important for W2G project: (i) the bioenergy community, regarding the best way of using biowaste, and (ii) the transmission system operator’s (TSO), regarding the accommodation of electricity storage plants in their electricity grid planning. Specific actions below are targeted towards the direct dissemination and discussion among both groups.

Table 1 summarizes the main impact points discussed in Section 2 of the project proposal, together with the suggested actions for dissemination, exploitation and communication of results. The innovation of the current project remains on (i) the application of the “multi-layer” methodology to such a waste-RSOC integrated system, and (ii) the evaluation of the waste-based power-balancing plant under realistic conditions of waste production and grid balancing strategies, in two specific European countries. The business cases, and concepts for RSOC commercialization, will be pointed out in the expected impact number 4. The CO₂ and synthetic methane markets will be discussed in expected impact number 5.

a) Dissemination and exploitation of results

Waste2GridS project is expected to contribute mainly in the areas of circular economy and RES integration. Realistic input conditions will be kept, focusing in two well-defined geographical areas: Denmark (high penetration of wind energy) and Italy (high penetration of solar photovoltaic energy). The expected project results can be mainly classified as “knowledge, know-how and experience” that will be shared among the scientific community, population and policy-makers through scientific publications, conferences, magazines and roadmaps, respectively.

¹ <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0028>

² <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098>

³ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0030&from=EN>



The potential users of the results of the project are professional stakeholders (industry, manufacturers, research institutions, etc), policy-makers, public bodies (government, standardization bodies, etc) and general public. Since the European society as a whole will ultimately benefit from the results of the project, specific measures are planned to increase awareness on circular economy and RES penetration, and on waste/RSOC technology combination in particular. Taking into account the results to be achieved by the consortium during the project execution, a tailored communication action will address each target group in the best way possible to demonstrate the advantages and possible strategies of the Waste2GridS system and particularly, in comparison with the state-of-the-art and with competing electricity storage systems. The communication, exploitation and dissemination channels proposed to reach the targeted audiences mentioned above are 1 to 3 scientific publications, 2 to 3 conferences, 1 article in a magazine/website and one technology roadmap on feasible and optimal conditions for waste-based power-balancing plants.

- Up to date, we have assisted the International Conference on Applied Energy 2019, Aug 12-15, 2019, Västerås, Sweden; the work by Karen Pardos Olsen, Yi Zong, Shi You, Henrik Bindner, Matti Koivisto, Juan Gea-Bermúdez, “Data-driven flexibility requirements for current and future scenarios with high penetration of renewables” will be accepted a full paper in Applied Energy (lead by DTU).
- Ligang Wang, Yumeng Zhang, Mar Pérez-Fortes, Philippe Aubin, Tzu-En Lin, Yongping Yang, François Maréchal, Jan Van herle. Reversible solid-oxide cell stack based power-to-fuel-to-power systems: Comparison of thermodynamic performance. *Renewable & Sustainable Energy Reviews*, 2020, under review.
- Ligang Wang, Yumeng Zhang, Mar Pérez-Fortes, François Maréchal, Jan Van herle. Design database of reversible solid-oxide cell based power-to-methane-to-power integrated with waste gasification. *Applied Energy*, under prepare. It is expected to be submitted by end Feb 2020.
- Other publications envisaged are on waste characterization (lead by ENEA) and on the whole project (lead by EFPL), in journals like Biomass and Bioenergy, Energy, Applied Energy, from Elsevier, respectively.

Three conferences and one workshop are foreseen in the upcoming months:

- The 28th European Biomass Conference and Exhibition (EUBCE 2020, <http://www.eubce.com/>), targeting biomass-based audience. Two works have been submitted, summarizing the work developed in WP1 (grid balancing needs) and the overall project.
- The workshop initiated by W2G as a side-event of the 28th European Biomass Conference and Exhibition (EUBCE 2020, <http://www.eubce.com/>) will be taken over by the EU H2020 project BLAZE. W2G project will be a participant to disseminate the potential of combing waste and solid-oxide for grid balancing services.
- The 14th European SOFC & SOE Forum (EFCF2020 <https://www.efcf.com/2020>), targeting the RSOC community. A work, disseminated the optimal plant design with RSOC integrated with waste gasification.
- The Grid Service Markets Symposium (GSM 2020 <https://grid servicemarket.com/>), where a work describing the project grid balancing results and data compiled/generated has been submitted.

The technology roadmap will be written at the end of the project.

Focused on the TSO feedback regarding the results and the hypotheses considered, two actions are anticipated:

- The Grid Service Markets Symposium (GSM 2020 <https://grid servicemarket.com/>), where a work describing the project grid balancing results and data compiled/generated has been submitted.



- A questionnaire will be prepared first with the brief numbers and figures obtained currently by the WT1.1 will be distributed to the Danish and Italian TSO contacts. With their reply, potential bi-lateral discussions are expected to follow face-to-face or by phone.

Dissemination of project results will contribute to (i) further and faster technological development of RSOC (professional stakeholders), (ii) faster penetration of RES (policy-makers, transmission system operators – TSO, distribution system operators –DSO, and public bodies), (iii) increasing the usage of waste for energy purposes (policy-makers and public bodies), (iv) increasing the understanding about gasification and RSOC operation (professional stakeholders, scientific community and general public), and (v) increasing public awareness about RES needs, and public acceptance about the proposed solution and its challenges (general public). For the dissemination of results among other EU projects, the members of the consortium have been invited to several workshops (see introductory section).

Data and Knowledge Management

The project will use methodologies and tools that have been already used and developed by the partners of the consortium. It will collect (first three items below) and generate an important amount of data, know-how and knowledge (i.e. the results of the project):

- RES balancing scenarios and balancing profiles for the identified zones in Denmark and Italy.
- Waste identification and location (with relevant resolution) for the identified zones in Denmark and Italy.
- Economic and performance data of the considered technologies (gasification, waste pre-treatment units, syngas cleaning units, RSOC, others).
- Suitable configurations and working conditions of waste-based power-balancing plants.
- Suitable sizes of the waste-based power-balancing plants.
- Appropriate scheduling and storage strategies of the waste-based power-balancing plants.
- Realistic waste supply chains for large-scale power-balancing plants.
- Modelling tool.

We acknowledge the fact that data gathered and used as model input can have an associated uncertainty. The “degree of confidence” of the data will be presented qualitatively via the well-known Pedigree Analysis. The software used for process modelling will be Aspen Plus. The software(s) used for process optimization and energy profiles/waste resources matching will combine Matlab, Lua, GAMS and/or Ampl.

For the DMP and IP agreement in month 6, project partners agreed on data management (for instance, the type of format to be used -.csv, .pdf, .png, final tools to be used, type of data license according to Creative Commons, gold or green OA publications) and handling of intellectual property rights (IPR). The data management of this project will be supported by the Research Data Library Team of the EPFL. The potential intellectual property generated from this project will be fully discussed and exploited with help from the institutional Technology Transfer Office (TTO) from the EPFL.

Data and documents sharing among the members of the consortium is be made via EPFL Google Drive⁴. Publishable data (i.e. all collected data in the project, and the agreed results within the IPR, considering the possibility of patenting), in the framework of the Open Research Data pilot, will be stored on EPFL servers and are/will be published on Zenodo, where there is a specific EPFL community⁵. Zenodo fully supports the

⁴ <https://wiki.epfl.ch/help-gdrive-en>

⁵ <https://zenodo.org/communities/epfl/?page=1&size=20>



FAIR principles. Modelling codes will be appropriately described in the scientific papers. Zenodo will also be used to share our (gold or green) open access (OA) publications. Most of project reports are intended to be public and linked to the project CORDIS webpage (as well as all the OA publications).

The members of the consortium will be free to use the knowledge and tools generated by them during the project for other projects or actions. Ideally, further work in the field to Waste2GridS will imply the study of further European areas or countries, and/or the inclusion and study of other waste-treatment technologies.

b) Communication activities

As pointed out in the first table of the current draft, results' communication activities are targeted to reach science community (via targeted conferences) and society at large:

1. Via our project website: <https://www.waste2grids-project.net/>
2. And Researchgate account: <https://www.researchgate.net/project/WASTE2GRIDS-Converting-WASTE-to-offer-flexible-GRID-balancing-Services-with-highly-integrated-efficient-solid-oxide-plants>
3. Through contributions in our institutions websites (to be published in the upcoming months):
 - a. A news in ENEA's page: <https://www.enea.it/en>
 - b. A news in EPFL's page: <https://news.epfl.ch/>
4. Though specific links on the website of the project partners:
 - a. <https://orbit.dtu.dk/en/projects/converting-waste-to-offer-flexible-grid-balancing-services-with-h>
 - b. <https://www.solidpower.com/en/about-us/projects/>
 - c. <https://www.epfl.ch/labs/gem/research-and-development-projects/>

The consortium has a project logo, and associated templates for reporting and dissemination and communication, that appropriately identify the consortium and project's purpose. We have prepared a project leaflet to be distributed in upcoming events.