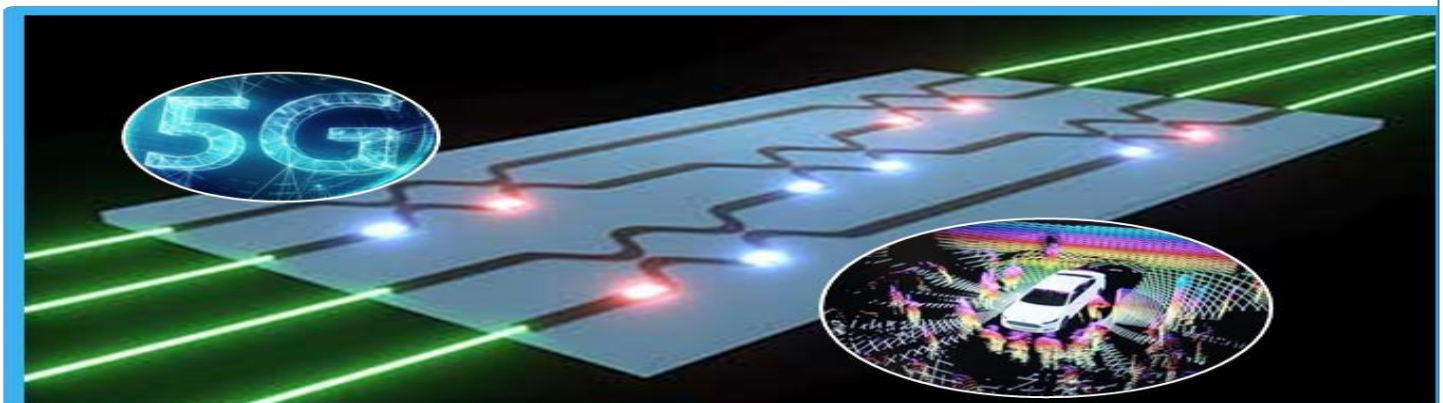**Active Optical Phase-Change Plasmonic Transdimensional Systems Enabling Femtojoule and Femtosecond Extreme Broadband Adaptive Reconfigurable Devices**

**Grant Agreement No: 899598**

## Deliverable D5.2

# Plan for Dissemination and Exploitation

| | |
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| **Project website** | **www.phemtronics.eu** |
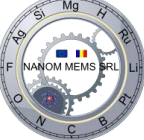
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## Log of changes

Version            V1.0
Changes         Document created

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## About Phemtronics

PHEMTRONICS was launched in June 2020 as a 3-year collaborative project on CMOS-compatible phase-change materials, plasmonic, photonic and electronic integration.

**PHEMTRONICS** aims at replacing "*slow*" electrical or thermal phase change materials with "*ultrafast"* "Optical-Phase-Change Plasmonic Materials"*,* capable of self-reconfiguring and self-adapting as a response to light, shifting from current technology paradigms based on electronic switching to "all-optical  switching" enabling broadband reconfigurability of devices.

**PHEMTRONICS** will enable a new technology paradigm of adaptive optical signal processing with ultrafast network reconfiguration with key metrics of the "femtosecond-scale switching time", "ultralow power of femtojoule/bit" and "microwave-to-optical frequencies" broadband capability required for reliable multibit operations. The exciting outcomes include demonstrations of:

- Ultrafast and low-power switches;
- Adaptive antennas;
- Adaptive switchable multiple-band detection for the future generation of photodetectors;
- All-optical spiking neuron circuit, with integrated all-optical synapses.

# Table of Contents

# Executive Summary

Deliverable D5.2: Plan for Dissemination and Exploitation concerns a detailed and comprehensive dissemination, communication and exploitation strategy.

In PHEMTRONICS dissemination and community engagement as well as exploitation activities are implemented in WP5. As such, this deliverable provides an overview of the activities the project will be pursuing online and offline to ensure that its outcomes are promoted to the right audiences and widely used throughout Europe and worldwide in higher education and commercial training offerings.

From a dissemination and community engagement point of view the focus of this deliverable will be on providing an executive summary of the strategy and plans of the project. Elements like media to be used for dissemination, identification of relevant events, communication channels and tools, exploitation routes and target audience have been defined and included in this plan.

A second component of this deliverable is concerned with the exploitation of the results of the project, be that for educational purposes in academia, or as part of commercial products and services offered by the core and associate industry partners. The consortium has reviewed the training market and potential competitors and engaged in a SWOT analysis to identify those areas in which PHEMTRONICS outcomes offer a competitive advantage to commercial companies involved in the project

# 1. Introduction

## 1.1 Context

The dissemination and communication of the project results is an important objective.

The main objectives of WP5 "Communication, dissemination and exploitation" are to:

- Ensure an effective internal and external communication, as well as maintaining a continuous link with the EC;
- Implement an efficient strategy to disseminate and exploit the project results to create impacts and success stories towards scientific communities, the industry (in particular SMEs) and to EU citizens.

Due to an important involvement of both academic partners and three innovation SMEs, the coordination of dissemination activities will also embrace exploitation, IPRs and IP protection.

The present deliverable will be updated annually (at M12, 24 and 36) in order to describe the implementation of the dissemination, communication and exploitations activities, channels and support material.

## 1.2 Methodology

To increase the effectiveness of dissemination and exploitation activities, the lead of the specific dissemination WP has been assigned to UCC-Tyndall. Dissemination activities performed during the project will be assessed against indicators as:

- Number of publications in journals / proceedings of conferences.
- Number of participation to conferences and trade-shows.
- Website statistics (number of connections to the website; number of downloads; number of individuals / organisations in the newsletter diffusion list).
- Number of external delegates attending the PHEMTRONICS workshops, schools and events.
- Number of "followers" in the social media.
- Number of companies reached By PHEMTRONICS.
- Number of licenses for exploitation of results.

All partners will participate to dissemination activities via publications in journals, presentations at conferences, contributions to the content of the PHEMTRONICS website, newsletters, poster and leaflet.

Specific internal rules governing dissemination activities and the publication policy are set out in the Consortium Agreement and in the Project Handbook Database. These rules comply with the EU Grant Agreement and will ensure smooth flow of results towards the European scientific and industrial communities without violating confidentiality and / or IPRs.

# 2. Dissemination and Communication Strategy

This section will give a high-level, unified view of the dissemination and community building strategy of the project. The associated instruments and communication and engagement channels are part of WPs 1 and WP5.

The aim of the dissemination strategy is to distribute knowledge about the project outputs, innovation potential and business opportunities to all relevant stakeholders. The dissemination strategy is adapted to present relevant information at the right time, right place, and in the correct context to allow the broadest diffusion.

Potential audiences, both internal and external, have been identified in the planning process. Knowing the audience, especially if there are multiple audiences, is important because it may require making a different communication strategy for each audience. PHEMTRONICS has identified and will address for communication the following audiences summarized in Table 1:

**Table 1:** *Audiences addressed by the communication*

| Audience | How to include | How to engage | When to communicate |
|---|---|---|---|
| Internal participants | Mails | Meetings | Updates |
| Current and potential stakeholders | Phone | Meetings | Opportunities |
| Policymakers (regionally and nationwide) | Venues | Meetings | Results |
| Standardisation bodies | Membership | Meetings | Results |
| Entrepreneurs and administrators | Cooperation | Forums | Invitation |
| Technical integrators | Stakeholders | Meetings | Research |
| The media (regionally, nationwide, globally) | Cooperation | Press kit | Results |
| The general public | News | News | Conclusions |
| Other | News | News | Relevance |

Figure 1 presents an overview of PHEMTRONICS tools and channels to be used to disseminate the information to the relevant dissemination target groups.

| Dissemination tools and channels | Policy-makers | Standard-isation bodies | IoT & service-providers | Research & Dev. Community | Private sector | Related projects & initiatives |
|---|---|---|---|---|---|---|
| Visual identity | √ | √ | √ | √ | √ | √ |
| Factsheet | | | √ | √ | √ | |
| Poster | | | √ | √ | √ | |
| Brochure | | | √ | √ | √ | |
| Website | √ | √ | √ | √ | √ | √ |
| Social Networks | √ | √ | √ | √ | √ | √ |
| Videos | √ | √ | √ | √ | √ | √ |
| Newsletter | √ | √ | √ | √ | √ | √ |
| Press releases | √ | √ | √ | √ | √ | √ |
| Web-based user forum | √ | √ | √ | √ | √ | √ |
| Workshops | √ | √ | √ | √ | √ | √ |
| User-forum event | | | √ | √ | √ | |
| Final conference | √ | | √ | √ | √ | √ |
| Publications | √ | √ | √ | √ | | √ |
| Project Public Deliverables | √ | √ | √ | √ | √ | √ |
| Contributions to external events | Contributions to external events | | | | | |

**Figure 1:** *Project Dissemination and Communication tools, channels and target groups*

## 2.1. Project public website

The website contains general information on the project, the consortium and related news and events. The website also discloses continuously updated information on the project (public) results.

The detailed description of the website is provided in the deliverable D1.1 or online at www.phemtronics.eu.

| WEB ACTION PLAN |
| --- |
| • All partners will continue developing and adapting the website, modules and extension based on specifications for website development and target audience (part of the communication strategy) and technology (part of the dissemination strategy). <br> • June 2021 – May 2023 (month 13 – month 36): the website will be enriched with contents, in line with information about project, results, ongoing efforts, open calls etc. that is consistent with dissemination activities. <br> • From June 2023 (month 36); the website will be maintained beyond the end of the project lifetime by CNR |

*\* This action plan will be revised in light of the ongoing COVID-19 Emergency*

## 2.2 Social networks

The online presence will give the project vast exposure on the web, while providing the consortium with an additional channel to share project information and materials and exchange feedback with interested stakeholders via:



Phemtronics has set the following social media accounts:

The PHEMTRONICS LinkedIn group,to mainly reach industrial stakeholders, is accessible at:
https://www.linkedin.com/in/phemtronics-phemtronics-4a01a81aa/?originalSubdomain=it

Phemtronics Twitter, for addressing the general public, can be found at
https://twitter.com/phemtronics

Those tools have been described previously in D1.1 Project website and Logo, and in D5.1: Project COMMUNICATION KIT.

## 2.3 Project communication and dissemination Kit

Offline printed dissemination and communication tools open for a more visual engaging way of raising awareness about the project, its aims, activities and results.

PHEMTRONICS will be offline communicating and disseminating through a number of media outlets:

- Booth to be exhibited at conferences, workshops, schools and events;
- Two posters, one to address general public and one to address the scientific community;
- Two leaflets, one to communicate mainly with scientific communities and one to communicate with stakeholders and general public;
- POWERPOINT TEMPLATE Project templates to facilitate the work of partners and improve consistency and impact;
- Press Releases;
- At least 2 explanatory videos of the project content on YOUTUBE and Project web site
- Newsletter;

Newsletter issues are foreseen every 6 months. They will be provided to the consortium, EC and to the PHEMTRONICS stakeholders list, LinkedIn page, website subscribers and contacts identified and communicated by the consortium partners. It will also be uploaded on the project and partners' websites.

The communication kit has been described in detail in deliverable D5.1.

## 2.4 Newsletters

PHEMTRONICS is releasing newsletters on a 6 months basis. This will enable the consortium to update the project community with latest project activities and results.

The content of the newsletters is coordinated with the content on the websites. The information presented is extracted from one-to-one interviews, discussions about how the participants and stakeholders see themselves and their role in the project, as well as reach out to get insights from technical partners and business partners.

The project coordinator provides an editorial for every issue as well as delivers more material on progress of the project and relevance to other ongoing efforts.

An approach will be implemented where stakeholders and participants are challenged to present good use cases and stories. Finding material and popularize their findings is considered an important contribution to the communication efforts of both the project and the open calls.

| NEWSLETTER ACTION PLAN |
| --- |
| • An editorial team with young researchers' members from all PHEMTRONICS partners has been set and will be implemented in the course of the project. |
| • The Editorial Team will prepare a new edition of the newsletter every 6 months based on partners' inputs. |
| • Partners provide content for the newsletters and invite additional contacts to subscribe to the newsletter. |
| • CNR releases the newsletters through e-mail blast to registered community members. Activities will be upheld to increase the number of subscribers. |
| • TEOX uploads each newsletter edition on the website, for the general public to access. |

## 2.5 Infographic videos and Educational Game on phase change

Easily shared on the web and displayed on wide screens at events, infographic videos are also a very effective way to communicate. Two short PHEMTRONICS videos will be produced to promote the projects objectives and challenges. More will be prepared as the project proceeds. At least, one video will be prepared to promote and explain the new phase change materials approach. Finally, a video will be produced at the end of the project to summarize the main outcomes. They will be shared and used as much as possible by all partners.

Additionally, partner TEOX will deliver (D5.4 at M24) an educational game to explain to non-specialists and schools the main concept of phase change materials and devices.

| VIDEOS ACTION PLAN |
| --- |
| • UC produced a video in June 2020 (month 1) containing visually engaging infographics in order to simplify complex messages to viewers and to announce the PHEMTRONICS project. |
| • The Consortium will prepare a video at M18 in the various laboratories to explain the approaches taken to produce new phase change materials and devices |
| • TEOX will prepare a video at M30 to address the industry for exploitation |
| • Partners promote these videos through their respective channels. |

### 2.6 Project public deliverables

A major expression of external dissemination is the production of deliverables. Over the entire project duration, the PHEMTRONICS consortium will produce a wide range of official and public deliverables. All of them will be made available on the project website resources area in order to spread the project excellence and disseminate knowledge as widely as possible.

| DELIVERABLE ACTION PLAN |
|---|
| • Project deliverables are drafted using the Word template designed at the beginning of the project. This, and future, templates is available on the PHEMTRONICS project password protected fileserver.<br>• A list of key deliverables to be reviewed by the Partners and Advisory Board before final submission to the EC is created.<br>• The final compressed PDF version of public deliverables is uploaded on the project website in the public access section, or on the restricted page, depending on the dissemination level of the deliverable |

## 3. Trainings, Seminars and Webinars

Practical training courses, open to end-users will be organised preferably face-to-face (with a target number of 10-20 attendees) or as videos posted on the project's webpage.

Those will be also given in form of webseminars organised by means of virtual platforms. These will include:

| Topic | Partner | Tentative Schedule |
|---|---|---|
| Thermodynamicsof Phase change materials | JKU | February-March 2021 |
| Training course on DFT | UC | Summer  2021 |
| Training course on phase-change materials theory and their practical application | UCC-Tyndall | December 2021 |
| Optic for Surface analysis | JKU | Jan-Feb 2022 |
| Training course on designing and modeling of plasmonic nanostructures with electromagnetic computation tools | UC | March 2022 |
| Nanofabrication routes of phase-change materials devices | WWU | Winter 2022 |
| Training course on *in-line* metrology for phase change materials | CNR | May 2022 |
| Training course on  photonics and microelectronics fabrication | TEOX | December 2022 |
| PIC Design and Characterization training | VLC | Winter 2023 |

Partners will include PHEMTRONICS results in the teaching courses for both BSc and MSc/PhD level in the following courses:

| CNR | Phase Change Materials | MSc in Materials Engineering  at University of Bari |
|---|---|---|
| UC | Light-matter interaction | Electromagnetic waves-PCM interaction topic included in MSc "Science and Engineering of light" |
| JKU | Optics for Surface Science | MINT Didactics of Physics, Linz School of Education |

# 4. Publications

The PHEMTRONICS consortium commits to release tailored publications showcasing project outputs, in open access peer-reviewed journals or specialised magazines. Some of these will be tailored for specific events. Other publications will be prepared each time the project has key findings to disseminate. In addition, project partners will possibly contribute to e-Journals, blogs and newsletters targeting a larger public with shorter articles and news, as well as to policy-oriented publications to enhance project outreach to policymakers. Those publications will be based on the results of the activities, including but not limited to development guides, study reports, recommendations, lessons learned, and event outcomes:

- Guides;
- Monitoring reports with recommendations;
- Outcomes of the web-based user forum;
- Experiences: lessons learnt on the phase-change materials and devices related activities;
- Open Access Repositories;
- Event reports showing event outcomes.

The publication process is governed by the rules described in the Data Management Plan (D1.3) and the Consortium Agreement.

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**PUBLICATION ACTION PLAN**

- Over the project duration: project partners commit to release at least 10 publications in peer-reviewed journals, 10 conferences proceedings, and 5 workshops proceedings, preferably joined ones among consortium partners.
- Each time they identify one interesting Call for papers/articles they wish to apply to, the partners are invited to complete the internal online table to provide information on.
- Before submitting a scientific publication, partners are invited to send a draft version to the consortium members according to Art. 29 of the Annotated Model Grant Agreement of the European Commission. "A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of - unless agreed otherwise — at least 30 days, together with sufficient information on the results it will disseminate".
- Therefore, "Any other beneficiary may object within — unless agreed otherwise — 15 days of receiving notification if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests ».
- According to Art. 29 of the Annotated Model Grant Agreement of the European Commission «Each beneficiary must ensure open access (free of charge, online access for any user) to all peer-reviewed scientific publications relating to its results".
- Publication that are open to the public will be designed into an eBook for dissemination in both internal and external channels.
- All partners contribute to the promotion and dissemination of the various publications.

The consortium partners plan on publishing the PHEMTRONICS results in the following journals:

| TOPIC | Journals |
|---|---|
| **Phase Change Materials** | Nature Communications, Nature Materials, Nanomaterials, Advanced Materials, Advanced Functional Materials, Journal of Material Chemistry. |
| **Plasmonics and Plasmonic devices** | Nature Photonics, Nanophotonics, Journal of Applied Physics, Applied Physics Letters, Nano Letters. |
| **Optical properties of phase change materials** | Optics Express, Optical Materials Express Nanotechnology, ACS Photonics, Advanced Optical Materials |
| **DeviceDesign** | SPIE Proceedings. |
| **Trade journals** | Laser World Congress, Photonics West, Photonics Europe. |

**Open access**
Concerning the obligation of the partners to provide open access to all peer-reviewed publications related to the project, accoding to the article "Open access to scientific publications" (29.2) of the Grant Agreement, the consortium is adopting two main) routes towards Open Access:
- Open access publishing (also called "gold" open access): the article is immediately provided in open access mode by the publisher. The associated costs are shifted to the PHEMTRONICS partners/authors.
- Self-archiving (also called "green" open access): the published article or the final peer-reviewed manuscript is uploaded by the partner/author in an online repository. Access is often delayed ("embargo period").
- The partners will provide open access (free of charge, online access for any user) to all publications by depositing them in the following repositories:
- Institutional;
- Zenodo (www.zenodo.org)

The partners will ensure open access to the deposited publication – via the repository – at the latest:
- On publication in case of the "gold" OA;
- Within six months in case of the "green" OA.

**Visibility of the EU funding**
Concerning the obligation of the partners to promote the project and its results, PHEMTRONICS obeys the main provisions of the articles "Information on EU funding — Obligation and right to use the EU emblem" (29.4; 38.1.2) of the Grant Agreement.
Results will display the EU emblem and include the acknowledgment of the EU funding.

The acknowledgment of the EU-funding in all dissemination,communication activities and publications reads:
"This project has received funding from the European Union's Horizon 2020 research and innovation programme under PHEMTRONICS grant agreement No 899598".

# 5. Conferences and Workshops

## 5.1 Project events

Project events will come as a dissemination support to WP2, WP3, and WP4's objectives. They will help spreading the project outputs to the respective target audiences, facilitate valuable feedback from respective stakeholders, and provide ground for discussion and brainstorming.

### PROJECT EVENTS ACTION PLAN

- The consortium will organise 1 major international *European* school on plasmonic PCM technologies at M18 (D5.3).
- The consortium will organise 1 major international *workshop* on phase change materials and devices at M30 (D5.5).
- The consortium will organise at least four preferably face-to-face workshops (free to attend) and tutorials, in connection with large-audience events (E-MRS meetings, IS-TCM, European Microwave Week, etc.. ) to present intermediate research results and interact with interested stakeholders. Target audience expected of 20-30 attendees and typical duration will be one day or two half-days. Consortium will aim to have a mixture of contributions from both the project partners and from stakeholders. Possibly of combining these events with existing annual international conferences and/or consortium meetings to increase the attendance will be investigated.
- The Consortium will organize 1 "Demonstration Day" for industry, SMEs, and scientific community.
- At least 6 visits to strategic stakeholders, including innovative SMEs and start-ups.
- At least 10 visits to schools with educational kits (video, games).

## 5.2 Participation in external events

The consortium partners plan to disseminate and communicate the PHEMTRONICS results at the following scientific conferences, workshops and outreach events:

This channel of dissemination will be used to facilitate knowledge sharing, personal interaction, and community building with targeted audiences from the EU during related science and technology events, trade fairs and exhibitions. PHEMTRONICS partners will use their participation in external events as an additional opportunity to establish synergies with other initiatives having similar scope in order to avoid duplication of effort and save resources.

All partners will look for major events in the field to contribute to.

CNR and UCC-Tyndall will track and record the characteristics of the audience participating to the events: type of audience (scientific community (higher education, research), industry, civil society, policy makers, medias, other), size of audience and countries addressed.

In order to share maximum visibility on potential events of interest for the PHEMTRONICS community, UCC-Tyndall will set up a list of dissemination events. It will be updated every three months by UCC-Tyndall in consultation with the partners. It will be shared on the project website.

### EXTERNAL CONFERENCES ACTION PLAN

- CNR will draft an indicative list of target events and circulate it among partners.
- Project partners complete the table with inputs on additional interesting.
- Partners propose outreach events that will be planned and organized with WP5 leader
- Partners inform and provide details on their planned participation to future events.
- After each external event they contributed to, partners send CNR and UCC-Tyndall a short news providing info on their participation, to be posted on the project website
- Web Meeting and Conferences will be attended during the COVID19 Emergency

The PHEMTRONICS Consortium has already identified the following Conferences and Trade Events:

| Type of conference | Type of Contribution and expected outcome |
|---|---|
| **Photonics, integrated optics, PCMs**<br>CLEO conference and CLEO Europe conference<br>SPIE Photonics West<br>Optical Fiber Communication Conference – OFC<br>MRS Spring and Fall meetings<br>European Conference on Optical Communication ECOC<br>Asia Communications and Photonics Conference<br>European Phase-Change and Ovonic Symposium<br>European Conference on Integrated Optics (ECIO)<br>Conference International of Optics and Electronics (CIOE)<br>International Conferance On Metamaterials, photonic crystal and plasmonics (META)<br>International Conferenceon Antennas and Electromagnetic Systems (AES) | 2 focus sessions, 1 special symposium, 2 industrial expositions, 4 posters, 2 workshops and 4 tutorials<br><br>Disseminate project results to broad and international audience in optical computing, communication and applications, industrial leaders and policy makers |
| **Microwave circuits, radar, antennas**<br>EuMW, European Microwave Week<br>IMS, International Microwave Symposium<br>IEEE International Symposium on Antennas and Propagation & European Conference on Antennas and Propagation, EUCAP | 3 industrial papers, 3 posters;<br>Disseminate our results to the microwave communications community. |
| **Electron devices, circuits and systems**<br>IEEE ECTC Electronic Components and Technology Conference<br>IEEE Electronics System Integration Conference (ESTC)<br>IEEE IEDM – IEEE International Electron Devices Meeting<br>IEEE MWSCAS, International Midwest Symposium on Circuits and Systems<br>IEEE DDECS Design and diagnostics of electronic circuits<br>IEEE DDECS Design and diagnostics of electronic circuits and systems | 4 papers,<br>Disseminate our results to the electronic devices community and learning about emerging electronic devices |

Considering the existing COVID-19 Pandemic emergency, whenever possible those conferences will be attended in person by a project representative; otherwise webconferences will be attended.

# 6. Synergies with Ongoing Initiatives

PHEMTRONICS will not limit its dissemination activities to the goals of awareness and understanding. More than informing, the project will aim at triggering involvement in and endorsement of its activities and results, seeking to enhance links and synergies with similar initiatives. Therefore, many of the initiatives whose channels are used for dissemination purposes will be closely considered in order to create synergies whenever possible.

Alongside with other partners, PHEMTRONICS is creating the framework for projects to cooperate across domains, technologies, pilot sites and stakeholder interest and roles. The main purpose is to coordinate dissemination and communication efforts in order to:

• Foster connections with other communities that would be difficult to reach otherwise;
• Create long-term research collaboration;
• Increase project visibility;

- Maximize project impact;
- Share knowledge on phase change materials and devices  related topics;
- Share experience on technical challenges encountered;
- Avoid work duplication;
- Networking;

| SYNERGY ACTION PLAN |
|---|
| <ul><li>Mutual promotion of events and news by exchange of announcements published on project website or newsletters.</li><li>Mutual invitations to participate in and speak at project workshops and conferences.</li><li>Joint organisation of events.</li><li>Joint applications for external events: booths, networking sessions, workshops, conferences.</li><li>Exchange of feedback on project publications and deliverables.</li></ul> |

# 7. Expected Impact of the Dissemination and Communication Activities

PHEMTRONICS expects to influence and stimulate the scientific and technological collaboration between phase change materials developers and optics and microelectronics devices integrators.
Creating knowledge and material that later on will be included in papers and official documents and be open and influence optoelectronic development and public decisions is yet another goal.
Information and results from dissemination activities will be gathered and analysed in order to identify strengths and weaknesses in the communication. Goals have been defined, and KPIs will represent data the success rate can be measured against and alternative be used to adjusted the dissemination or communication strategies. KPIs have been included in the DoA and are summarized in Table 2. The KPIs only serves as guidelines at this final stage of the project.
In summary, Table 2: Dissemination & Communication Summary Chart matches the Communication and Dissemination Supports and Channels.

**Table 2.** *Plan for Dissemination, Methods and KPIs.*

| Time | Objective | Methods |
|---|---|---|
| Yr 1 | **(i)** Create general awareness<br><br>**(ii)** Dissemination in strategic networks to cross-fertilise | • e-communication through support materials (e.g. explanatory videos(>2)), press releases (>5), flyers(3), leaflets (3) and website (3000 views by M36)<br>• Press coverage in technical/public magazines and social media (Facebook, Twitter LinkedIn; >200 followers, re-tweets, likes, and links shared; 1000 views)<br>• Conference and workshop contributions (>10)<br>• Attendance in seminars(>5) and liaison with industry innovators (>3) |
| Yr 2 | **(i)** Awareness of results in scientific networks<br>**(ii)**involve stakeholders **(iii)** Promote the uptake of methods, technologies & tools | • Publications in top peer-reviewed journals (>10), conferences (8), workshops (8)<br>• Targeted newsletters to the user community (issue every 6 months)<br>• Visits to schools with educational kits (video, games) (>10)<br>• Organisation of scientific events (workshop, tutorials)(>4) in parallel to large-audience events (E-MRS meetings, IS-TCM, European Microwave Week, etc...)<br>• Press/media coverage: 2 press articles, 2 radio appearances and 2 TV appearances<br>• Visits to strategic stakeholders, including innovative SMEs and start-ups (>6)<br>• Organise 1 major international *European* school and 1 workshop<br>• Engage our networking sphere to promote our findings to other companies |

| | | |
|---|---|---|
| **Yr 3** | **(i)** Exploitation of all components<br>**(ii)** Identify new opportunities for the uptake of PHEMTRONICS results in specific domains | • Publications in peer-reviewed journals* (>10), conferences* (>10), workshops (>5)<br>• Liaise with prominent networks and knowledge clusters (>5) for exploitation<br>• 2 webinars for a large audience (posted also on YOUTUBE; >1000 visualizations)<br>• Organisation of 1 "Demonstration Day"<br>• Booklet on description of the innovative components of PHEMTRONICS,<br>• Press coverage in newspapers & magazines (>3); 2 radio & 2 TV appearances<br>• Licensing (>2), Patents (5) and publications 2 years beyond the end of project |

# 8. Exploitation

Exploitation implies strategies to successfully involve target groups, end-users, stakeholders and transferring the results/products for the PHEMTRONICS project into their professional domains. The key objectives for the exploitation of the PHEMTRONICS results are:

- To make the technical developments known to the scientific community for collaborative projects;
- To make the PHEMTRONICS results and benefits of the developed outputs attractive and known to the wider public and investors;
- To concentrate on the key benefits of the research, marketing the project results and creating the basis for further research, development and implementation addressing industry.

## 8.1 SWOT Analysis

The exploitation strategy has been built considering the following SWOT analysis that will be periodically revised during the GA meetings to update it and readdress exploitation activities accordingly.

| | | **Positive** | **Negative** |
|---|---|---|---|
| **Internal** | | **STRENGTHS**<br>• Strong consortium comprised of leading experts in the area of phase change materials, plasmonics, photonics devices;<br>• Open content for anyone interested to adopt, use and extend;<br>• Good industry contacts of some consortium members with leading media & publishing organisations in Europe<br>• Good SME partners who can establish links with large enterprises; | **WEAKNESSES**<br>• Consortium partners may not be able to easily collaborate on extending the PHEMTRONICS content after the project end (due to differences in priorities or lack of resources); |
| **External** | | **OPPORTUNITIES**<br>• Growing demand of novel 2D materials<br>• Growing demand of reconfigurable fast technologies for communication and mobility<br>• Growing demand for reconfigurable antennas ; | **THREATS**<br>• Fast growing competition by Universities and Research centres worldwide interested in the same field;<br>• Growing competition from companies with more resources to be invested in the field; |

## 8.2 Industry Technology Training
Training is a very important activity also to catch the attention of SMEs and industry due to two reasons:

- Training is required by big customers who are interested in using our technologies and lack in-house expertise.
- Training provides a new channel to promote PHEMTRONICS technologies and materials to new potential customers and adopter.

Educational materials developed within PHEMTRONICS will be reused to extend the commercial training content with new topics.

The commercial-SMEs partners of the consortium will offer training services to companies related to:

| Partner | Training |
|---|---|
| TEOX | **Microwave switches and reconfigurable antennas** |
| NANOM | **New solutions for photodetectors** |
| VLCPHOTONICS | **PIC Design and Characterization** |

## 8.3 Partners preliminary exploitation plan
The exploitation strategy is based on user requirements, the technological objectives, goals and developments of the PHEMTRONICS project, as well as the business cases and objectives of the Partners in the PHEMTRONICS project. The exploitation plan aims at synergizing the exploitation plans for partner-level exploitation as well as a plan for exploitation the results of the project as a whole. Below are reported the exploitation plans identified so far for each partner.

| Partner Involved | Exploitable Result & Means of Exploitation |
|---|---|
| **CNR** | CNR will offer an excellent environment for the further development and exploitation of PHEMTRONICS phase change materials (PCMs) by<br>• will increase its capacity in phase-change-materials and will open its facilities to provide a service of materials growth to companies;<br>• licensing of optimised processes to reactors manufacturers;<br>• joint-adventures with photonic companies on PCMs;<br>• a spin-off on manufacturing PCMs;<br>• service of Ga-chalcogenides deposition and characterization.<br>• Exploitation via publications, conferences, databases on the new materials, and the generation of new research projects.<br>• Promotion of the developed technologies via joined adventures with industry. |
| **UCC-Tyndall** | UCC-Tyndall will utilize its Industry Access Group that focuses on developing and managing the Centers IP portfolio and in promoting the take up and transfer of UCC-Tyndall technology to industry, particularly in the high technology indigenous sector in Ireland. Of particular interest would be the formation of a spin-off company in collaboration with the Technology Transfer Office (TTO). Therefore, as part of exploitation and business plans UCC-TNI plans:<br>• to build a partnership with Enterprise Ireland (the Irish government organization responsible for the development and growth of Irish enterprises in world markets, |

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| | https://www.enterprise-ireland.com/en/); <br> • to increase its capacity and offerings as an academic foundry and will open its facilities to provide a service for European microelectronic and photonics industry; <br> • Exploitation via publications, conferences, patents and licences, and the generation of new research projects. |
| **WWU** | The University of Munster offers an excellent environment for the further development of PHEMTRONICS materials and devices: <br> • WWU will offer phase change materials photonic devices through its broad academic network and industrial partnerships with leading neuromorphic companies. <br> • WWU will provide open-source and open-data access to photonic processing via the Münster Nanofabrication Facility (MNF), in order to enable integration of phase-change building blocks in chip-scale devices. <br> • WWU will embed design and device layouts within its open-source design kit. This design service will be offered to SMEs and other RDO centers. <br> • Exploitation via publications and conferences and the generation of new research projects. <br> • Commercial exploitation of the results will occur through a planned creation of a spin-off company. |
| **JKU** | As a teaching and research institution, the contributions of JKU within the PHEMTRONICS project are targeted more towards academia. Therefore, the exploitation of the developed resources and training materials has no direct commercial focus. Still all the content produced in collaboration with JKU can be reused by other researchers and industrial partners alike, in order to gain knowledge and skills in different areas of expertise related to phase change phenomena in materials and optics. The main line of exploitation activities is the presentation and use of the materials as part of teaching activities and lectures. The work conducted within PHEMTRONICS will be used as part of lectures. Furthermore, JKU plans to reuse the produce modules as part of tutorials, within the scope of university external treating activities such and as part of summer schools for PhD student. JKU will continue the exploitation of PHEMTRONICS results, beyond the end of the projects through reusing the contributions within further projects, through academic activities and individual research, e.g. as part of Ph.D. theses. |
| **UC** | UC plans to: <br> • create a consulting group for the modelling and designing of PCM plasmonic systems. This will include computation on electromagnetic and DFT calculations through SIESTA tool (https:// departments.icmab.es/leem/siesta) <br> • exploit via publications, conferences, database on the new materials, and the generation of new research project. <br> UC will continue the exploitation of PHEMTRONICS results, beyond the end of the projects through reusing the contributions within further projects, through academic activities and individual research, e.g. as part of Ph.D. theses. |
| **NANOM** | NANOM plans to exploit its results from WP2 and WP4 by: <br> • new composite material developing based on phase-change material and conducting polymer. <br> • patent application(s) on "SOI-CMOS compatible wideband plasmonic waveguided photodetector <br> • electro-optically tunable in the visible spectrum using phase-change semiconductor". |

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| | • patent application(s) on "Wideband tunable Mid IR plasmonic photodetector using  phase-change semiconductor".<br>• patent application(s) on "Wideband tunable UV-VIS plasmonic photodetector using phase-change semiconductor".<br>• collaboration with PHEMTRONICS partners in new projects. |
| **TEOX** | TEOX designs and develop its components and patents its technologies; the small-medium scale production is executed with joint agreement with major foundries and/or licensing the developed technology.<br>Actions planned by TE-OX to exploit the results of the project are:<br>• for the new devices developed during  the project  by TE-OX such as double wavelength switches proposed in WP4, TE-OX plan to fabricate some demonstrators that will be proposed to potential clients to be integrated in subsystems of communications. Two demonstrations will be done in the two years  following the end of the project i) a first one with a department of Defense in the frame of a specific project ii) and a second one in collaboration with an industrial partner of TE-OX in France developing communication Reception/Transmission electronic modules.<br>• TE-OX is also developing new Reflect Array antennas in collaboration with industrial partners. Phase shifters based on the new technology will be integrated on these microwave sensors in the 4-5 years following the end of the project.<br>• all devices will be proposed for sale in partnership with distributors like Radiospares, NewTech, Venture PTE and MRC Gigacomp. |
| **VLC** | VLC will compile design libraries with its own designs (and the designs of other partners, if required), in order to facilitate their use during and after the project by expert and novice designers, and ease the exploitation by having them packaged and licensed under the same library. Designs can also be black boxed, in order to protect intellectual property.<br>VLC Photonics intends to exploit its results from the project in different ways:<br>VLC can reinforce their design services towards telecom/datacom fields with the offering of application specific design libraries, including generic and foundry-specific building blocks that implement selected functionalities (e.g. wavelength filters, interferometers, couplers, etc.). These libraries can then be embedded into foundry or customer process design kits (PDKs), and can be further validated with real fabrication and characterization data, compact models based on simulations and measurement data. The libraries can be licensed by external users. Moreover, VLC can be used by academic partners as a way to easily commercialize their design IP on commercial libraries through a fee-based revenue model, strengthening thus the collaboration among project partners on common exploitation goals and providing researchers with an industrial platform to easily publicize and monetize their outcomes.<br>Design libraries can be commercialized just after the project ends, as the designed building blocks will be validated by then in different levels of maturity and will be ready for use by other designers. These will be then commercialized directly by VLC. |

As a further step of implementation of the exploitation step the goal for year-2 is to gather feedback about the use and deployment potential of the PHEMTRONICS applications by external stakeholders and to transfer this feedback into the methodological and technological further development of the project. On the basis of this users' feedback, we will implement the exploitation plan.

# 9. Summary and Outlook

In this deliverable we presented and discussed the cornerstones of our dissemination and community building strategy, and provided an exploitation plan.

This Dissemination, Communication and Exploitation Plan aims at capturing all dissemination, communication and exploitation activities of the project which will support the widening of the user base and will increase public awareness of the new possibilities that are being created by the PHEMTRONICS project. This plan has strategies for how to apply content, tools and resource indicators. It explains contexts, defines roles and assigns responsibilities.

All the project results will demand updated brochures and folders, the video needs to be updated to reflect that the project has matured, and both website and news mails will enter a new phase where it is expected that more stakeholders will be more aware of PHEMTRONICS.

It is expected that dissemination efforts also will generate more feedback from the public, stakeholders and integrators. The project will therefore have to consider best practise for streamlining support questions and request for material.

The key tangible outcomes of the project (methodology, learning materials, materials and proof-of-concept devices) will be reused and further developed by core partners as part of other collaborative projects and as a commercial service.

The new phase will also require re-thinking some communication and dissemination action to adapt to the COVID-19 and post-COVID-19 Emergency time.