1. PUBLISHABLE SUMMARY

Summary of the context and overall objectives of the project (For the final period, include the conclusions of the action)

In modern greenhouses as well as in indoor and urban farms tomatoes, cucumbers, strawberries but also salads and herbs have to be irradiated with artificial light when sunlight irradiance does not suffice for a healthy and timely cropping cycle. High Intensity Discharge (HID)-luminaires like Metal halide or Sodium vapour lamps still offer an economic feasible solution with comparable high ratios of photon output to electricity input. However, the development in LEDs with peaks in different spectral ranges result in increasingly efficient ultra violet, violet, deeb blue, blue, green, red, far red and broader-spectrum-white diodes.

While an increasing number of horticulture projects is now being equipped with LEDs, they often only use red and blue light since respective photons can be produced with the lowest electricity input resulting in lower running costs than comparable photon flux of best available HID-luminaires. Growing evidence from science and practice illustrates that the combination of these wavelengths alone is not enough to meet the strict requirements to produce healthy vegetables and fruits especially under the light of consumers' tastes. For this reason, most producers still opt for hybrid solutions using HID & LED lights. The way forward is either to develop white LEDs with an efficient broad spectrum. Ponix Systems GmbH is following a different and more basic research oriented path:

Its LED-luminaire "Malina" includes diodes with eight different peak wavelengths and an additional broad-spectrum-white light. While the superposition of all wavelengths results in white light including all photon types that are needed to excite the plant receptors under different conditions, the overall efficiency drops to a value slightly beneath HID-lamps. However, with Malina it is possible to control each diode individually. Now the exact amount and type of photons can be delivered to the plants. These amounts and necessary compositions vary not only between species but also during the growing cycle from germination over vegetative and reproductive phases and even during day and night times and also depend on the incident direct and diffuse sunlight. Based on this knowledge and the Malina luminaires the farmer is capable of precisely optimising electricity input while taking best and individual care of the each plant. Furthermore, other goals including overall nutrient contents for better taste but also for individual adjusted nourishment, harvesting schedules, natural pest control and prevention as well as luminaire longevity can be pursued.

With this technology Ponix Systems GmbH contributes to opening a broad field of innovations for sustainable and competitive agriculture, agri-food and bio-based sectors. Resource-efficient eco-innovative food production and processing and the reduction of food losses (and wastes) on farm and along the value chain are main drivers with this regard. By reducing energy- and labour costs also for vertical urban farms, Malina furthermore supports the market diffusion of this upcoming and promising food production methodology based on minimised land, water, time and energy input.

Within the EASME Phase 1 flexiLED project overall objective was to facilitate a successful and sustainable market entry of the dynamic precision lighting solution Malina from Ponix Systems GmbH as a B2B-product for large-scale greenhouses and indoor, urban farms. Therefore, the feasibility of the business regarding technological- and economic viability had to be assessed while the markets and their participants needed to be analysed.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far (For the final period please include an overview of the results and their exploitation and dissemination)

For the technical feasibility study we queried requirements for horticulture lighting from potential customers and relevant competitors. We upgraded the design of the Malina prototype and commercially manufactured a couple of 1st generation Malinas. These luminaires have been tested, photo-optical and electro-technical specifications have been measured and simulated. Furthermore, they have been installed at potential costumers to collect practical feedback. We used the test results for a techno-economic comparison with best available and comparable technology. Based on these findings and a state-of-the-art analysis we outlined performance parameters for the 2nd generation Malinas as well as additional development & research needs.

In the commercial feasibility study we performed a market analysis re-defining not only target countries and their market potentials but also resulting in a list of potential customer contacts. Market penetration of competitors was revealed and regulatory requirements for the product and services have been determined. We critically examined patents and utility models related to the product and services and intellectual property rights- and elaborated contingency strategies. Through the establishment of academic partnerships further research was initiated including a medium-sized national interdisciplinary research project.

In the financial feasibility study we outline a business strategy discussions based on the findings from the technical and the commercial feasibility work. Therefore, we refined investment requirements and different development timelines, and simulated the integration into Ponix Systems GmbH core business resulting in an updated business plan.

We summarised the flexiLED project in an innovation strategy including a discussion on how to meet EASME Phase 2 requirements. In addition, partners, expertise and other support needed for the growth of the company have been identified. We elaborated in greater detail changes in the objectives, the concept and approach as well as changes in the expected impact of the Ponix Systems GmbH lighting division.

Progress beyond the state of the art, expected results until the end of the project and potential impacts (including the socio-economic impact and the wider societal implications of the project so far)

Through the EASME Phase 1 flexiLED project we could extend the internal knowledge and know-how on horticultural lighting within the Ponix Systems team. Clear research and development needs for our company could be identified in order to position ourselves as relevant players in the greenhouse and vertical farming market. Therefore, and for the market introduction of our innovative lighting solution Malina, the economic added value of photons with distinct wavelengths has to be quantified. In the innovation-strategy-finding-process we staked out the way including the redesigning and testing of a 2nd generation Malina. With additional and focused research actions in the upcoming years we calculated investment requirements of about €500.000 to introduce the innovation to the market. This includes two additional skilled full time equivalent employees in 2019-2020 and significantly augmented growth potentials until 2021 when compared to the initial core business of the company. Wider societal implications of this project can be outlined regarding the potential of Malina to provide resource efficient lighting for vertical and urban farms thus minimising land, water, time and energy

dependencies of healthy food production as demonstrated in a small-scale micro-greens production facility and regarding expected results from basic research performed in two universities.

Address (URL) of the project's public website

www.ponix-systems.at

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