D6.1 Report of Kick-off meeting

WP6

Lead Partner: TNO

Partner Contributors: All

Dissemination Level: Public

Deliverable due date: M1 Actual submission date: 2023-02-10

Deliverable Version: V1

Funded by the European Union

Project Acronym	MC2.0
Project Title	Mass customization 2.0 for Integrated PV
Grant Agreement n°	101096139
Call	HORIZON-CL5-2022-D3-01
Topic	HORIZON-CL5-2022-D3-01-03 Advanced manufacturing of Integrated PV
Starting Date	1 January 2023
Duration	38 months

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Abbreviations and Acronyms

BIPV: Building-Integrated Photovoltaics
BIC: Brainport Industry Campus, in Eindhoven (NL), location of TNO MC pilot-line
BOM: Bill of Materials
IPV: Integrated Photovoltaics
IIPV: Infrastructure Integrated Photovoltaics
MC: Mass Customization
VIPV: Vehicle Integrated Photovoltaics

1 Introduction

On January 16th and 17th the project partners of the MC2.0 project gathered together in Eindhoven for the kick-off meeting. Before we start with the meeting report, we will first give a short introduction on the project itself; the reason for this project & our project ambition.

Mass Customization 2.0
In the past 25 years, many integrated photovoltaics (IPV) products have been introduced and demonstrated. Mostly BIPV products, but more recently also IIPV and VIPV products. However, large scale deployment and massive market adoption of these technologies and products have not yet taken place. We are at the brink of a huge scale-up and capacity build-up of PV in Europe, that will have a large effect on our living environment. Therefore, it is now urgent and essential that IPV products become widely available and affordable. This is important (1) to generate solar electricity where the demand is (in the built environment) and (2) to enable multifunctional use of area and space in the built environment.

The overarching ambition of the MC2.0 project is to demonstrate a cost breakthrough for IPV by means of an advanced manufacturing approach, referred to as “mass customization”. In coherence with this approach, we will contribute to solving the other identified barriers.

To realize this ambition, the MC2.0 consortium brings together experts and companies on materials for PV laminates (including PV cells), on manufacturing of PV laminates, on manufacturing of IPV products and on market and application of IPV products.

1.1 Meeting report, 16-17 January Eindhoven

Representatives of all MC 2.0 project partners came together at the High Tech Campus in Eindhoven for the first general assembly of the MC2.0 project. For the meeting agenda and list of participants, please see Appendices 1 and 2.

Meeting day 1, January 16th

After a short introduction of each participant and opening by project coordinator TNO, the project partners further introduced themselves. The research institutes, EURAC, IMEC, PCCL, SUPSI and TNO each prepared a 10-minutes presentation on their institute, their main activities and role in MC 2.0.

Information on each of these institutes and the other partners involved, will be available on our project website mc2dot0.eu.

Next to the institutes, the other 15 partners all prepared a one-slider introducing their company as basis for the interactive partner sessions. These company one-sliders can be found in Appendix 3. The interactive sessions were led by a moderator. During the partner sessions there was plenty of room for questions from partners in the audience and from the moderator. Questions, such as:

- what input would you need to get your activities started?
- when do you consider this project to be an success and
- what are your expectations?

gave good first insights and served as a basis for the parallel work package sessions at day 2 of the meeting.

Next to sharing information between the partners, there was also an informative presentation of the project officer, Ms Maider Machado, with a clear overview of the project guidelines, points of attention, and expectations.

At the start of day 2, Roland Valckenborg, project coordinator on behalf of TNO, gave a project introduction including financial guidelines, project structure, deliverable deadlines and proposed meeting planning for the general assembly and industrial board meetings.

A visit to the Mass Customization (MC) pilot line at the Brainport Industry Campus (BIC) couldn't be missing and was scheduled in the afternoon of January 16th. Via carpool, bike and minivan, the consortium members travelled to BIC in the same town Eindhoven, to have a close look at the Mass Customization line at the TNO lab. Thereafter, the last partner session of the first meeting day was held.

Meeting Day 2, January 17th

During the work package sessions of the second day, the participants were divided into 3 groups. Each group focused on one or two work packages. The main goal was to define a concrete action plan for the coming 8 months for a smooth & quick start right after this first kick off meeting.

These action plans were presented by the work package leads during the second part of day 2. The main actions and agreements are listed below. Soon after the meeting, follow-up sessions per work package had already been planned.

Work package 1:

- Agreements among participants of the WP1 workshop:
  - The WP1 team will start drafting requirements and specs from product owners.
  - TNO will share templates as starting points.
  - WP1-level weekly meetings at the beginning.
- There will be an online meeting with all project partners at the end of January with presentations of IPV end products from the 4 companies involved.

Work package 2:

- Recurring meetings together with WP1, plus once per month specific WP2 meetings.
- Workshop together with WP1 in which the product owners present their products and discuss the main requirements.
- Start making inventories of current manufacturing methods of products.

Work package 3:

- Definition of the cost calculation models for IPV products with initial assumptions (to be confirmed by product technologies from WP1). This action is related to Task 3.1 Cost calculation methodology.
- Initial analysis of reference stakeholders, EU market and archetypes and preliminary meetings with stakeholders and end-users (offer/demand). These actions are related to Task 3.2 Market introduction strategy.
- Workshop preparation:
- First a meeting with technology providers (WP1) for BIPV archetype definition.
- After WP1 design definitions (project month 4-6): applicability of cost models and market strategies to MC2.0 products (reference components, Bill of Materials (BOM), lifetime, etc.)

Work package 4:

- Was not addressed specific during this kick of meeting, because WP4 will start later (from M12 = 1st January 2024).

Work package 5:

- Task 5.1: Establishing environmental impact. For this task there's a need for product data. WP5 will align with WP1 to use same data of different designs.
- Measurement of environmental impact: collect existing data and new data from partners involved.

General meetings:

- Kick-off meeting of Industrial Board, for now proposed at BAU Messe in München on April 20th, 2023. A related Horizon 2020 project, BIPVBoost is organizing a project meeting on that same day. The Industrial Board meeting of MC2.0 will be linked to that event, to create synergy.
- General Assembly M6 (online) in June 2023.
- General Assembly M12 preferably in-person at one of the project partners in December 2023.

This project involves quite a large number of Public deliverables that will be shared via mc2dot0.eu during the project duration.

Appendix 1 Meeting agenda

AGENDA Kick-off meeting MC 2.0

January 16th and 17th 2023
Conference Centre The Strip
High Tech Campus 1C; 5656 AE, Eindhoven, the Netherlands

Monday January 16th, 2023

09:00 – 09:30 Arrival with coffee & tea

09:30 – 09:40 Welcome and introduction

09:40 – 10:50 Partner presentations (PowerPoint): EURAC, IMEC, PCCL, SUPSI, TNO

10:50 – 11:15 *Short Break*

11:15 – 12:00 Interactive partner presentations: AMAT, Focchi, Glass to Power, Sunplugged, Vitronic
Moderator: Atse Louwen

12:00 – 12:40 EC Project Officer Maider Machado: welcome and guidelines (incl Q&A)

12:40 – 13:40 *Lunch*

13:40 – 14:25 Interactive partner presentations: Bouwhulp, ERNST Schweitzer, I40MC, IWIN, VDL EGT
Moderator: Francesco Frontini

14:25 – 15:00 travel to the Brainport Industries Campus (BIC) (see appendix for travel directions)

15:00 – 15:45 visit to the MC line

15:45 – 16:30 Interactive partner presentations: Duflex, ENFOIL, Maan, Monier, Roartis
Moderator: Wiep Folkerts

16:30 – 17:00 travel (by carpool) from the Brainport Industries Campus (BIC) to Eindhoven Centre

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Tuesday January 17th, 2023

Conference Centre The Strip
High Tech Campus 1C; 5656 AE, Eindhoven, the Netherlands

08.30 – 09.15	Welcome and introduction Project Management
09:15 – 11:00	Work package sessions (4 groups, in parallel). Focus on WP activities for the coming 8 months. - WP1, including reliability part of WP2 - WP2 (excl. reliability) - WP3 - WP5
11:00 – 11:30	*Short Break*
11:30 – 12:00	Plenary presentation per WP1 and 2 (15 minutes each) lead on the outcome of the parallel sessions. Including planning and actions for the coming 8 months.
12:00 – 13:00	*Lunch*
13:00 – 13:30	Plenary presentation per WP3 and 5 (15 minutes each) lead on the outcome of the parallel sessions. Including planning and actions for the coming 8 months.
13:30 – 14:00	Closing of the meeting (TNO)

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Appendix 2 Attendance list

Attendance List:

Partner	Attendant
AMAT	Davide Colla
Bouwhulp	Yuri van Bergen
Bouwhulp	Haico van Nunen
Duflex	Marton Berkers
Duflex	Arno Dumoré
ENFOIL	Marc Meuris
ERNST Schweitzer	Andreas Haller
ERNST Schweitzer	Alexia Voser
EURAC	Jennifer Adami (2nd day)
EURAC	Martino Gubert (2nd day)
EURAC	Atse Louwen
EURAC	Laura Maturi (2nd day)
EURAC	David Moser (2nd day)
EURAC	Martina Pelle (2nd day)
Focchi	Alessandro Pracucci
Focchi	Laura Vandi
Glass to Power	Claudio Castellan
Glass to Power	Marcello La Rosa
I40MC	Jacques Engländer
I40MC	Julian Witowski
IMEC	Michaël Daenen
IMEC	Jonathan Govaerts
IMEC	Nikoleta Kyranaki
IWIN	Paolo Frigeri
Maan	Jan Teunis
Maan	Suzanne Westerdijk
Monier	Jan Mussche
PCCL	Gernot Oreski
Roartis	Jochen Schuermans
Sunplugged	Andreas Zimmermann
SUPSI	Pierluigi Bonomo
SUPSI	Mauro Caccivio
SUPSI	Francesco Frontini
VDL ETG	Sorin Stan
VDL ETG	Filip Uyttenhove
Vitronic	Udo Bürgel
Vitronic	Jens Schöbel
CINEA (project officer)	Maider Machado (1st day)
CINEA	Ioannis Retsoulis (1st day)
TNO	Wiep Folkerts
TNO	Aldo Kingma (2nd day)
TNO	Marc Koetse
TNO	Niels van Loon
TNO	Nienke Riezebos

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TNO	Dorrit Roosen-Melsen
TNO	Mirjam Theelen
TNO	Peter Toonssen
TNO	Roland Valckenborg
TNO	Simona Villa

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Appendix 3 introduction slides partner companies

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Introducing all partners

Institutes:

information on the website www.mc2dot0.eu

Other partners: one pager in this brochure

And more information on the website www.mc2dot0.eu

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Introduction to Applied Materials Italia

History of Applied Materials Italia

Applied Materials Italia, formerly Baccini™, is a leading equipment supplier to the solar industry.

Founded in 1967 in Treviso, Italy by Gisulfo Baccini, Baccini™ pioneered the advancement of solar-cell manufacturing and became an industry benchmark for screen-printing production lines.

Baccini introduced the first fully automated c-Si solar screen-printing line "Twin" in 1996, followed by the Rotary Line™ in 2004 and the Softline™ in 2007. With its high-performing 20-MW-scale production lines, Baccini rapidly established a worldwide presence in the market by supplying its products and services to nearly every solar-cell manufacturing company.

Acquisition by Applied Materials

Applied Materials, Inc. was founded in 1967 and today it is the world's largest semiconductor and display equipment company. In fiscal year 2022, Applied Materials reported revenue of $25.79 billion, R&D investment of $2.8 billion and had approximately 33,000 employees worldwide. Applied Materials has the industry's broadest portfolio of materials engineering products and technologies to improve power, performance, area, cost and time-to-market (PPACt).

Applied Materials acquired Baccini in 2008 and helped to sustain its rapidly growing business. As part of Applied Materials, Baccini was able to provide the hundreds of production lines necessary to support the expansion plans of its growing network of customers. Together, they effectively contributed to the evolution of solar-cell technology throughout the world.

Applied Materials Italia's engagements

Applied Materials Italia continues to be a leading equipment supplier to the solar industry and engages in multiple projects funded by the European Community.

As a key, longstanding member of the solar ecosystem, Applied Materials Italia leverages its unique expertise and capabilities in Treviso to support R&D activities for the industry.

What would make the MC-2.0 project a success for Applied Materials Italia

Applied Materials Italia aims to demonstrate the performance of a high-efficiency solar cell architecture and support its integration into an integrated photovoltaics product.

Bouwhulp Group, (BHG), Eindhoven, NL

Description of organisation:

BouwhulpGroep (BHG) was established in 1978, and since then has dealt with over 500.000 buildings, in the role of architect, consultant or researcher. For more than 25 years BHG has been completing assignments of (semi-) government agencies, conducting research on the existing housing stock, energy efficiency, and affordability of buildings.

BouwhulpGroep always has been active in the existing housing stock: in the past decades we have worked for more than 200 housing associations. As architects, we did projects ranging from painting and colouring advise, through maintenance plans, towards deep renovation or even demolishing and designing new buildings, but always within an existing context. As consultants, we often operate at the boundary of project and people. We look at the broad perspective of housing, including aspects of affordability, sustainability, and market perspectives. Our assignments include evaluating energy efficiency of renovations considering technical aspects and people's behaviour, but also developing models to help housing associations to plan maintenance and implement changes as well. Because of our knowledge on the housing stock, and the combination of consultant and architecture expertise, we are often hired for complicated assignments, or as a second opinion, e.g. to bring jammed projects into life again, or to get support from occupants in cases where the housing association got stuck.
Research has always been an important part of the company's vision. 10-15% of the revenues has always been put into research on relevant topics. Besides that, several articles, publications, and books were published, and conventions about refurbishments were organized. Currently one employee is placed via BouwhulpGroep at Rotterdam University of Applied Science as a professor on sustainable renovation. BouwhulpGroep consists of fifteen employees, with different backgrounds.

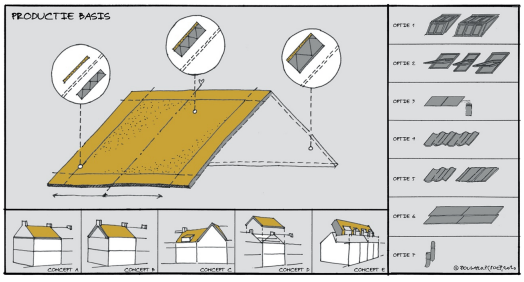
Tasks in the project:

Far-reaching sustainability of existing neighbourhoods and homes is necessary to achieve the objectives of the climate agreement in 2050. For far-reaching sustainability, our housing stock must be renovated on a large scale. The plans per municipality and per district for organizing more efficient and sustainable energy are a socially new and challenging part of the municipal tasks.

Our answer to this challenge is the initiative for a 'Mobiele Buurtfabriek' (Mobile Neighbourhood Factory) with energy-producing roofs and facades. An idea that BouwhulpGroep, together with TNO-Solliance, first presented in December 2020 to the Director of Building and Housing of the Ministry of Internal Affairs. We do this by directly facilitating energy-producing roofs and facades to all homeowners in the Netherlands and neighbouring European countries. Our aim in this project is to facilitate the route to market of renovation solutions, based on the principles of Component Renovation, the concept Mobile Neighbourhood Factory and application Ikwoon.

The 'Mobiele Buurtfabriek' is the name of a process in which demand development, supply development, upscaling and knowledge transfer are successively organized from one and the same division: the component. Working in components creates a platform (hub) in which repetition of product/process, education and collaboration can be organized in the daily practice of sustainable innovation and thus become the starting point for scaling up. We look at the Roof and Facade component groups, the target group owner of house (rent and owned) and the quality level of renovation, including integrated solar solutions. For several predefined component family roof and facades, several mass customization solutions for IPV will be developed for the relevant product market combination (PMC) be identified as such in the application. By preparing the renovation package consisting of the materials for the roof and/or facade at the relevant house, the renovation can be demonstrated and immediately scaled up in the neighbourhood.

Our expectations for the MC2.0 project lie within the scope of the renovation stream which will be (further) developed, implemented, and demonstrated.



Duflex

- Specializes in the design and development of innovative industrial automations
- Based in Elst (Gelderland), the Netherlands
- Exists 25 years
- 26 employees
- Portfolio of 900 + different machines & solutions
- Customers in 14 countries

Duflex Mechatronics is a cutting-edge company specializing in the design and development of innovative robotics technology. Founded in 1997, the company has quickly established itself as one of the leaders in the field, with a team of highly skilled engineers and technicians who are dedicated to pushing the boundaries of what is possible with robotics.

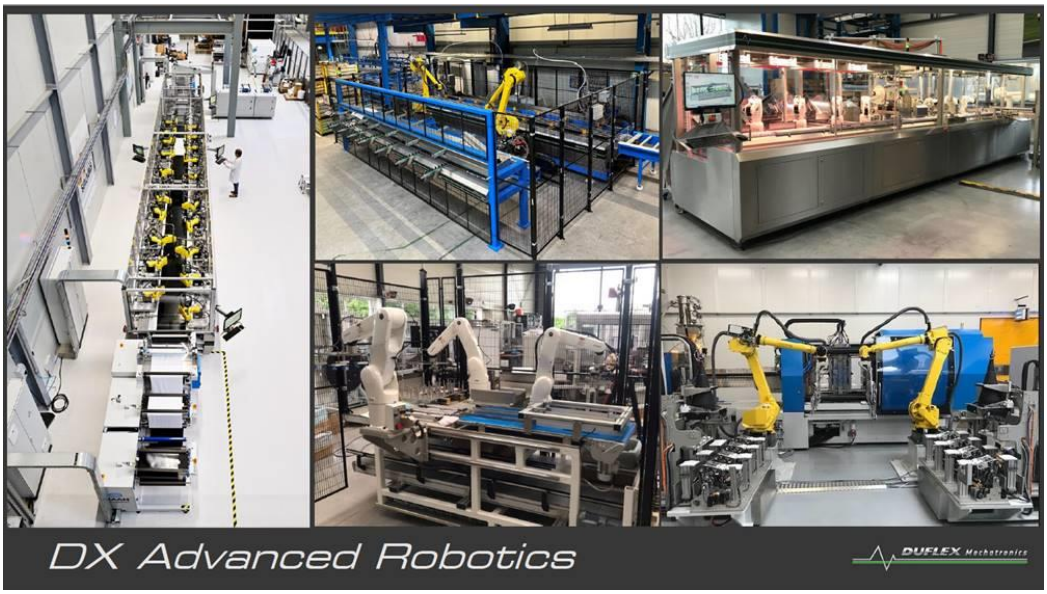
In 2023 Duflex Mechatronics works with 26 permanent employees. The company is located in Elst (Gld) the Netherlands and has facilities for engineering mechanical / electrical, software development, assembling, testing, and also has an advanced toolshop in which Duflex manufactures its own parts. The building is equipped with solar panels, with which their own energy is fully provided 5 months per Year.

In addition to their industrial robots in the manufacturing-industry, Duflex has also made significant contributions to the field of pharmaceutical-, medical- and food- & packaging-industry. Duflex developed a lot of knowledge of 'industry 4.0' and is able to connect shop floor to any top floor (ERP-system) with smart technology. This makes the company highly versatile. Projects vary from relatively simple pick & place units to the complete setup of automated and robotized production lines.

One of Duflex's most impressive achievements is the development of the mass customization line, an innovative research line with 20 robots to produce flexible solar laminates that can be incorporated into components for buildings, infrastructure and vehicles. Since 2020 Duflex has been working closely together with TNO and Maan Group on this project and a fully operating pilot line is the result.

What would make the MC2.0-project a success for us:

Taking the mass customization line to the next level, and thereby the development of new and innovative solar energy products, would make this project a success for us. By eventually developing new, more efficient solar cells, and more versatile solar products, we could bring back a market to Europe that we can serve with our technology. We are proud to be part of the development of solar energy products and to contribute to the energy transition.



EnFoil is a Belgian-Dutch start-up company, based on the flexible PV interconnection technology of imec, TNO and Hasselt University (Solliance). **The goal of EnFoil is to enable material and product manufacturers to activate their surfaces with integrated PV** to produce green energy at a competitive cost.

The product of EnFoil is a PV generating foil, based on a Thin Film PV material (CIGS), deposited on a thin metal substrate, encapsulated in a protective sheet. The PV active material is multi-crystalline and will not crack, when bended. **It results in a light weight (1-2 kg/m^2), flexible, durable and impact resistant foil, that can adapt to any surface** (curved, vibration stressed, mechanically stressed) with a PV efficiency of 150 Wp/m^2.
CO_2 footprint is 1/3rd and water consumption is 1/10th of traditional PV panels.

EnFoil is a BtB company, looking for large material and product manufacturers. **EnFoil designs and produces a PV foil, specifically adapted to the needs and requirements of our customers.** The foil is tailored made in any dimensions, shape, cabling and electrical output, conformal to the 'look and feel' of the product of our customers.



Participation in the MC2.0 project:
T1.2 Design of semi-fabricates: EnFoil and TNO will make a generic design for the CIGS based semi-fabricate for the roof and façade applications using a scalable concept (size and shape).
T2.1 Equipment for semi-fabricate manufacturing: The generic design for the semi-fabricate, developed in 1.2 will be integrated in the mass-customization line.
T3.1 Cost calculation methodology: the change through the cost of the semi-fabricates using MC technologies and the change through the cost of the integration using automated manufacturing.

The main interest and purpose of EnFoil is to look for solutions for upscaling the semi-fabricate manufacturing, i.e., increasing throughput, reducing cost and scrap. A success would be to enable semi fabricate manufacturing at a speed of about 30 m^2/h with good quality.

EnFoil

"Opportunity, evolution and innovation", this is the formula of the Focchi family, in the service of architecture since 1914

Partner	**Focchi Spa Unipersonale**
Type	Large company
Country	Italy (IT)
Website	www.focchi.it
Core business	Architectural building envelope
Market	UK (80%) USA (10%) ITA (10%)
Contact	Alessandro Pracucci a.pracucci@focchi.it

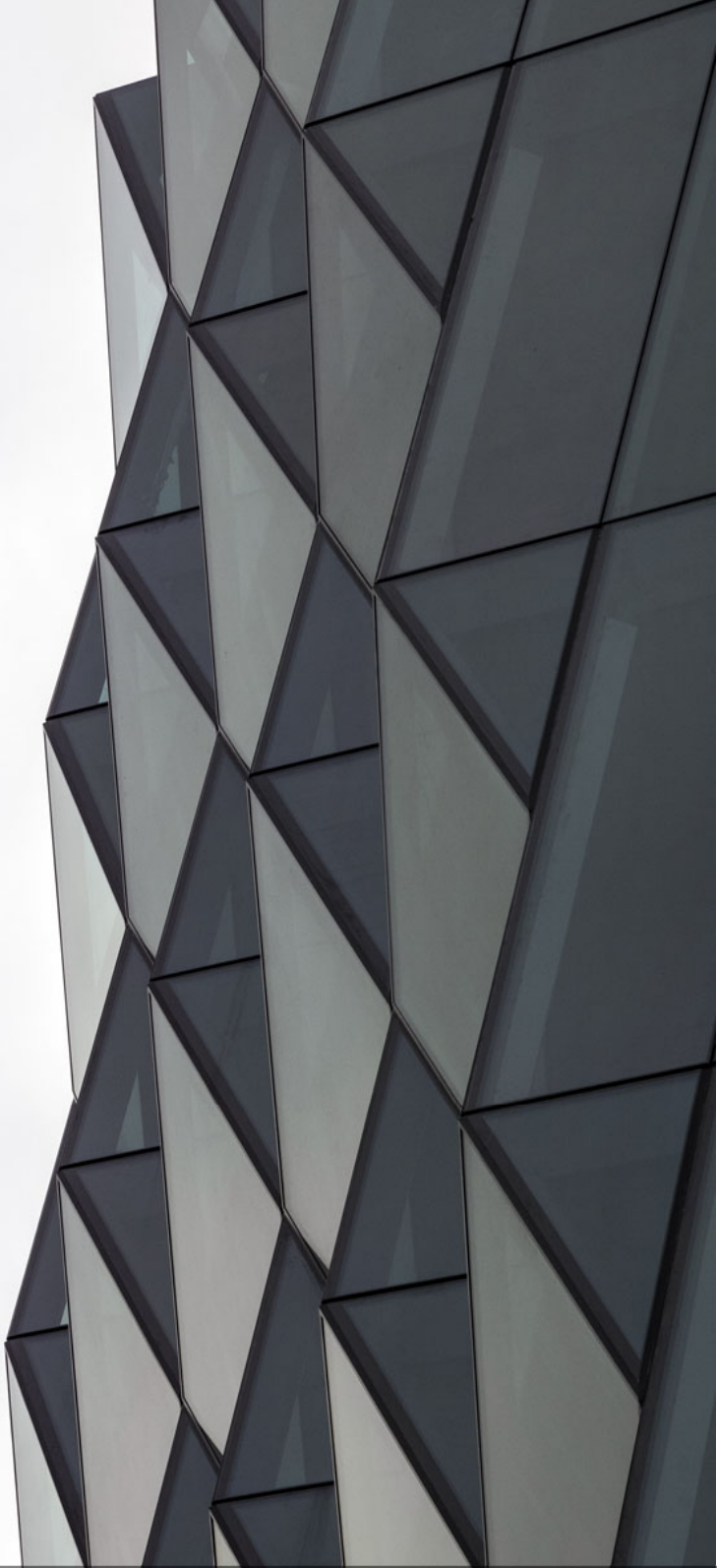
Large italian company with specific know-how in **high technological building envelope**

Bespoke **designing, manufacturing, and installation** of prefabricated façade units

R&D office to engineer architectural concept desing with façade specs

Mock-ups Team for prototipying and testing of façade solutions, according to European/UK/USA façade standard

Experiences in **European Projects** as WP and Task Leader



What would make the MC2.0-project a success for you?

- To support partners for the development of MC2.0 **products** for façade market
- To design and demonstrate the **integration** of MC2.0 products in façade
- To supply a **demonstration** environment for MC2.0 products test
- To disseminate the results achieved by MC2.0 project within **façade sector**
- To develope a strong **network** and collaboration among the consortium

The role of Glass to Power in the MC2.0 Consortium

Glass to Power S.p.A. (G2P) operates in the BIPV market, dealing with the integration of suitable PV technologies into the roof or the façade of a building. Such technologies simultaneously play as building envelope and electrical power generator, thus providing material and energy saving, reducing fossil fuels consumption and ozone depleting greenhouse gases emission.

G2P's product is an innovative transparent photovoltaic insulating glass unit (PV-IGU) based on Quantum Dot-Luminescent Solar Concentrator (QD-LSC) technology (see Figure 1): tailor-made semiconductor nanoparticles (quantum dots, QDs) of specifically engineered environmentally friendly composition are dispersed in a Plexiglass waveguide. The QDs absorb solar radiation and re-radiate infrared light, which is confined within the waveguide by total internal reflection (as in the case of optical fibers). The light thus propagates to the Plexiglass edges where it is converted into electricity by small PV modules hidden in the IGU frame.

Such a peculiar photonic-based design leads to a transparent PV device without any element placed on its surface (as in common technologies); therefore avoiding any aesthetic impact or visual impediment, while guaranteeing optimal thermal insulation, natural lighting for the internal environment, and reduced overheating from excessive solar radiation. Furthermore, installing G2P's PV-IGUs offers a unique opportunity to convert the energy passive vertical surfaces of buildings into distributed energy generators significantly contributing to architectural sustainability.

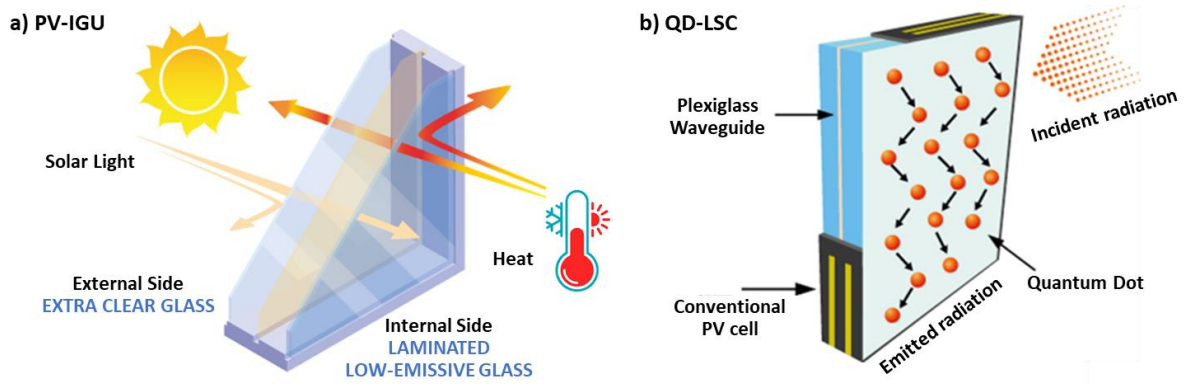


Fig. 1: Schematic representation of G2P's product (a) and technology (b).

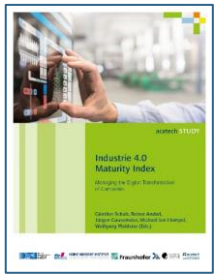
Since its first patent in 2016, G2P has achieved TRL 8 and is now building several industrial lines for the production of QDs and Plexiglass nanocomposite waveguides with the highest standards of sustainability, safety and circularity, as well as for the complete PV-IGU assembly.

Therefore, in agreement with the project goals and by sharing within the MC2.0 Consortium its experience in the value chain management/supply of PV-IGU design and production (according to BIPV market demand), G2P aims at improving its production chain and product properties.

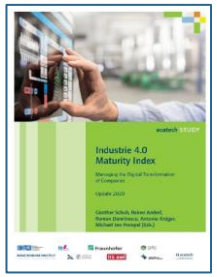
The Industrie 4.0 Maturity Index is a management framework that helps organizations to build and execute robust transformation programs – **We use and further develop it**

acatech Study

Broad consortium from science & industry defined a **standard framework** for Industrie 4.0



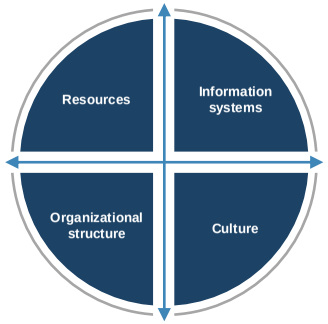
2017

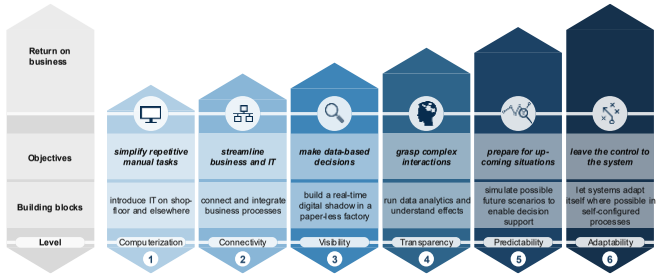


2020

Industrie 4.0 Maturity Index

The I4.0MI provides a **holistic and technology-agnostic** view on relevant I4.0 capabilities in 4 dimensions to be developed along 6 levels of maturity





Application in industry

The I4.0MI can be used as **blueprint** to structure the digital transformation of producing companies

BASF We create chemistry · HARTING · REHAU Unlimited Polymer Solutions · ZF · Mondelēz International · MARS · covestro

The Industrie 4.0 Maturity center as part of the RWTH Aachen Campus serves as a central contact point for application and development of the Maturity Index

Services		Platform		Community		Research & Development	
I4.0 Experience	I4.0 Roadmap	Surveys	Analytics	Training	Industry Practice	Releases	Benchmarks
I4.0 Program	I4.0 Transform.	Knowledge		Workshops	Networking	Studies	

iWin Sagl
Via Cantonale 18
6928 Manno, Switzerland
www.iwin.ch - info@iwin.ch

iWin – Innovative Windows

iWin – innovative Windows Sagl is a startup and spin-off of SUPSI (University of Applied Sciences and Arts of Southern Switzerland) founded in 2019 and based in Manno (Ticino).

iWin produces photovoltaic modules in the form of compact and multi-functional windows that offers sustainable shading and controls glare to optimize the incoming natural sunlight and the solar heat gain. Our final product is a photovoltaic Venetian blinds sealed inside an insulating glass.

The technology reduces the carbon footprint in the building industry by saving up to 30% of energy consumption and producing up to 120kWh/m2 of renewable energy.

Role in MC2.0: IPV product manufacturer

Expectations from the MC2.0 project:

WP1 Design

- To define the design of the semi-fabricate for iWin application

WP2 Manufacturing

- Establish a quality control procedure for the acceptance of the semi-fabricate specifications at the reception in iWin. The procedure should aligns the semi-fabricate performance results obtained at the MC line and the ones measured at the material reception in iWin.
- Establish a procedure to control the quality of the IPV product at iWin. The procedure should correlate the performance of the IPV product with the specifications of the semi-fabricate.

WP3 Economy & Market

- At least 20% of cost reduction determined by marginal cost analysis

WP4 Renovation wave

- Analysis of existing standards and norms from T4.2 to certify the solar windows.

WP5 Sustainability

- LCA assessment obtained from T5.1.2

Company Information
Maan Glueing Technologies

Different divisions, different expertises: one group

Specialist Coating Equipment

Specialist Adhesion Techniques

Specialist Biopolymers

Facilitating R&D activities

Blueprint of assembly line for semi-fabricates of IPV panels

TNO innovation for life

Focus on laminating solution

MAAN GROUP

- Partner for lamination solutions
- Roll-to-Roll production line
- Production line tests
- Material tests
- Lab facilities
- Material knowledge

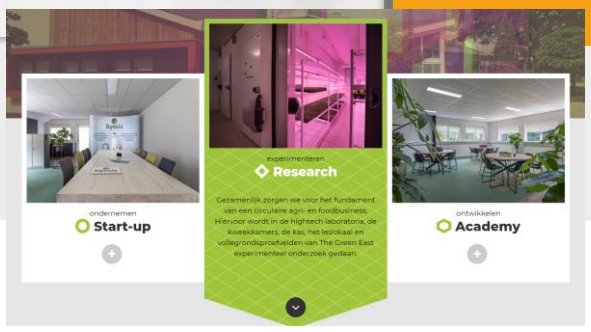
Innovation driven

As **Maan** we invest in sustainable solutions, because we have a duty of care. To ourselves and to future generations.

With our knowledge and expertise in lamination, cutting and coating combined with our material knowledge, we can test and research different production methods in order to create the best lamination solution for IPV panels.

Smart biodegradable products

Sustainable linerless labelling



Visionairs of the future at the Green East

Ultra thin stickers
(thinner than human hair)

Pattern coating

- Founded in 2008, with labs and production unit in Genk, Belgium
- R&D, manufacturing and sales of ***"Adhesives, coatings, inks and resins for electronic & industrial applications"***
- Experts in "custom development work", also for small(er) volume projects
- "Game-changer with regards service and flexibility": MOQ's, speed of response, lead times, R&D turn-around,
- Brands: ***IQ-BOND®*** ***IQ-CAST®*** ***IQ-GREASE®*** ***IQ-SINTER®***
- Portfolio includes:
    - Electrically conductive adhesives and inks
    - Thermally conductive adhesives, gapfillers, greases and casting resins
    - (Hybrid-) sintering materials for power applications
    - Dielectric adhesives and coatings, including UV-curable materials
    - Micro-encapsulants such as underfills, edgefills, cornerbonds, globtops, dam & fills
    - Casting resins
    - Surface Mount adhesives
    - Structural bonding adhesives (1 komponent , 2 komponent, UV-curable)
- Lab-facilities with state-of-the-art equipment including TMA, DMA, DSC, FTIR, rheology, resistivity, …

- Production facilities enabling (very) small batch productions, up to large volume capabities
- End-customer packages from as small as 3cc , 5 cc , 10 cc syringes, up to drums of 200 liter

- Core technology: epoxy and epoxy-hybrids, but also offering other chemistries such as silicones, UV-acrylates, UV-urethanes, MS polymers, cyanate esters, … all REACH, ROHS, SVHC-compliant

- **<u>What would make the MC2.0 a success for Roartis:</u>**
    - Currently already offering and commercialising conductive adhesives for some solar applications, the objective in this project is to to develop "high speed, fast curable" electrically conductive interconnect materials, enabling reliable, fast, economically, roll-to-roll solar module assemblies
    - Identify, and in-house develop / manufacture chemistries enabling these challenges
    - Demonstrate (fast) processability and long-term reliability: achieve proof of concept demonstrators
    - Demonstrate our capabilities to be included in future new possible collaboration projects
- **<u>Contacts for MC2.0. project :</u>**

Jochen Schuermans, Founder & CEO - jochen.schuermans@roartis.com
Dr. Anja Henckens, CTO - anja.henckens@roartis.com

More information: www.ROARTIS.com - www.IQ-BOND.com

Ernst Schweizer AG

Building today for tomorrow's generation!

Building Envelopes

Façades
+ PV façades (glass-glass)

Wood/Metal Window Systems
+ Innovation leader wood/metal window systems

Folding and Sliding Walls
+ Market cultivation close to decision maker

Mail Boxes and Parcel Boxes

+ Innovation and market leader mail and parcel boxes including smart home connections

Solar Systems

MSP Mounting System
+ Low ballast, easy installation
+ Europeanisation and scaling

Solrif (BIPV Roof System)
+ Reliability, aesthetics

Solar Thermal Collector
+ Partnership, reliability

Goals for the MC2.0 Project

- Design of glasless PV façade systems
- Bonding of the semi-fabricates to powder coated metal sheets
- Compatibility with standard powder coating colouring process
- Improved cost effectiveness of BIPV
- Low additional fire load
- Equipment for production and testing of glasless IPV façade elements
- Push industry 4.0 forward → digitalization & automatization

Sunplugged

Made-to-Measure thin-film Photovoltaics for devices, buildings and vehicles

The company

Sunplugged´s goal is to provide a **fully customisable PV materia**l that can be easily integrated into self-powered devices, vehicles and buildings. Sunplugged has developed its own **CIGS** solar cell process and a production concept that allows to produce flexible PV modules with **varying shapes, sizes and voltages „on-the-fly".**

Sunplugged is currently upscaling its set of technologies to full market readiness. Sunplugged employees 9 high-skilled R+D workers and the next major target milestone is to produce of tailor-made, flexible PV fully automated in its pilot production located in Tyrol/Austria.

Main tasks in MC2.0 project

- Development of **handling and supply of semifinished CIGS to the MC line**
- **Digitise the cell interconnection process** at SUNP to **allow customisation on cell level**
- Improvement of **reliability of semi-finished flexible CIGS f**rom the roll

What we expect from the project

- Closing the gap between lab and fab
- System for **supplying semi-fininished PV material to „integrators"** from the roll
- **Robust and easy to handle semi-finished, CIGS-based PV foils** for further processing

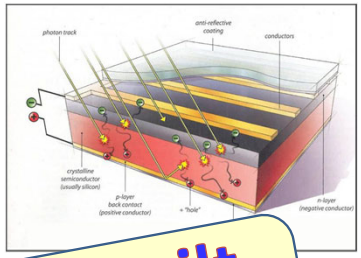
Equipment for Solar Technologies VDL ETG (c-Si, a-Si, OPV, CIGS, perovskite)

Vacuum chambers

Lab equipment

Fully-integrated production equipment

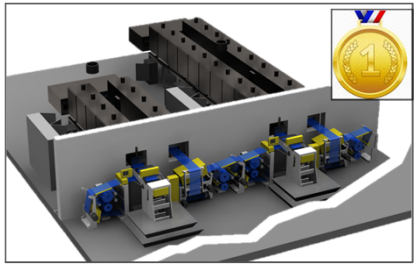
1990-2005



Customized PV equipment

2010-2023

Designed and Built at VDL ETG




DYESOL

VDL ETG Appointed as Major Area Demo Expert

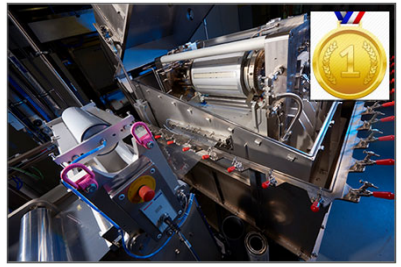
Queanbeyan, 5 February 2016 – Dyesol Limited, global leader in the development and commercialisation of Perovskite Solar Cells (PSC), is delighted to announce that it has appointed VDL Enabling Technologies Group (VDL ETG) to assist in the development of a Major Area Demonstration Prototype.

2015 2016 2017 2018 2019

Silicon: R&D → Prototype (Major Area) → Pilot (Continuous Process) → Production

Metal: R&D → Prototype (Major Area) → Pilot (Continuous Process) → Production

The 1st Phase contract involves a specialist engineering study resulting in the preparation of a Feasibility & Functional Specification for Perovskite Major Area Demonstrator development. This phase will be



VITRONIC in a Nutshell

- Image processing experts since 1984
- 1,300 employees in 80 countries, 184 million € total turnover
- Solar development and projects since 2005
- Hardware and software solutions for all steps of production

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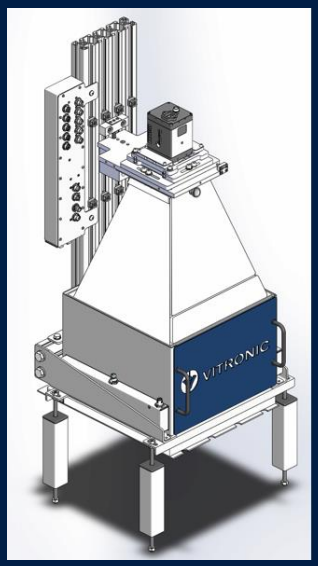
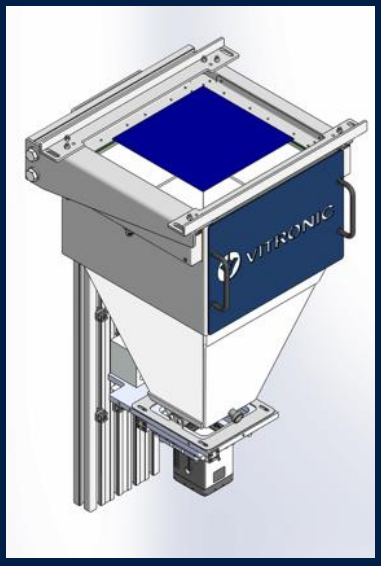
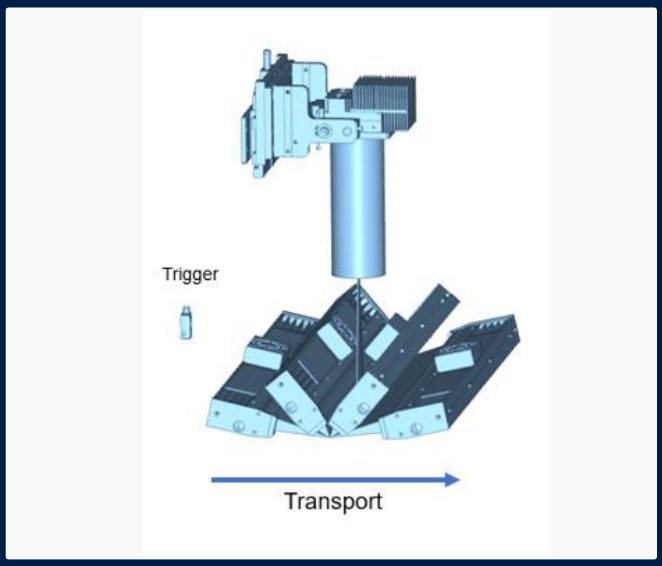
FUSION matrix systems





Linescan
(with 3D defect detection)



Product features/benefits

✓ Detection and classification of 2D/3D and material deviations/failures
✓ Industry 4.0 – benefits:
- predictive maintenance, trend analysis, feedback to optimize process parameters → yield optimization, opex-reduction

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Our key goals

✓ Bring in our expertise in 3D and surface inspection
✓ Evaluate innovative approaches for surface inspection
✓ Access to new market of mass customized IPV production

VITRONIC
the machine vision people