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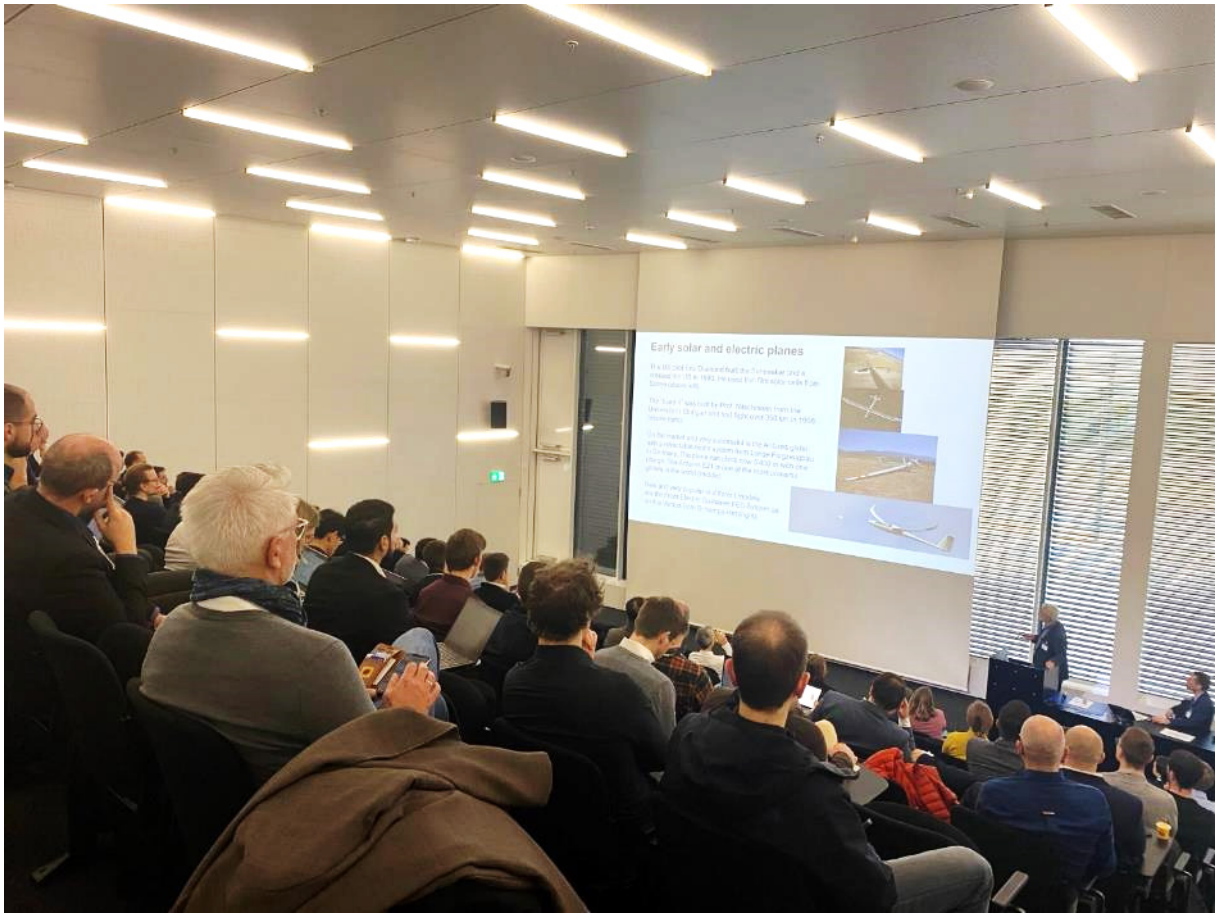
PVinMotion 2024

PV IN MOTION 2024

Conference & Exhibition on
Vehicle Integrated PV
March 6-8 | Neuchâtel, Switzerland



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Zusammenfassung

Die 3. Ausgabe der PVinMotion-Konferenz fand am 6., 7. und 8. März 2024 in Neuchâtel in den Gebäuden der Microcity [1] statt. Das Programm umfasste 44 mündliche Vorträge, 13 Poster, 2 Podiumsdiskussionen, eine Labortour und einen externen Besuch am Flughafen Payerne, um SolarStratos fliegen zu sehen (siehe das vollständige Programm in Anhang 1). Für die Abschlussveranstaltung am Freitag hielt Prof. Christophe Ballif Becquerel Preis 2016 einen sehr inspirierenden Vortrag über die mögliche glänzende Zukunft der PV. Mehr als 110 Teilnehmer meldeten sich vor Ort an, darunter 10% der Studenten. Fünf Stände und zwei Solarfahrzeuge wurden während der Konferenz ausgestellt. Der gesellige Teil des Workshops umfasste ein Abendessen am Neuenburgersee, den Besuch der Einrichtungen des CSEM und der EPFL-Mikrostadt für Photovoltaik-Forschung und -Entwicklung sowie das einzigartige Ereignis.

Résumé

La 3ème édition de la conférence PVinMotion s'est déroulée les 6, 7 et 8 mars 2024 à Neuchâtel dans les bâtiments de Microcity [1]. Au programme, 44 présentations orales, 13 posters, 2 tables rondes, une visite de laboratoire et une visite externe à l'aéroport de Payerne pour voir SolarStratos voler. Pour la séance de clôture du vendredi, le Prof. Christophe Ballif, prix Becquerel 2016, a fait une présentation très inspirante sur l'avenir prometteur possible du photovoltaïque. Plus de 110 participants se sont inscrits sur place dont 10% d'étudiants. Cinq stands et deux véhicules solaires ont été exposés lors de la conférence. La partie sociale de l'atelier comprenait un dîner au bord du lac de Neuchâtel, la visite des installations du CSEM et de l'EPFL-Microcity pour la recherche.

Summary

The 3rd edition of PVinMotion Conference took place on March 6, 7 & 8, 2024 in Neuchâtel in the buildings of Microcity [1]. The program included including 44 oral presentations 13 posters, 2 panel discussions, one lab tour and one external visit at Payerne airport to see SolarStratos flying. For the closure session on Friday, Prof. Christophe Ballif Becquerel price 2016, gave a very inspiring presentation on the possible bright future of PV. More than 110 participants registered onsite including 10% of students. Five booths and two solar vehicles were exposed during the conference. The social part of the workshop included a diner by the lake of Neuchatel, the visit of the CSEM and EPFL-Microcity facilities for photovoltaics research and development.

Contents

Abbreviations

CTE	Coefficient of thermal expansion
MBB	Multi busbars
MPPT	Maximal power point tracker
POE	Poly-olefin elastomer
PV	Photovoltaics
VIPV	Vehicle Integrated PV

1 Introduction

1.1 Description of the PVinMotion

PVinMotion is the world's first scientific conference dedicated to vehicle-integrated photovoltaics. The conference brings together renowned experts from both the PV and the automotive world to showcase innovative work and accelerate the progress toward solar powered transportation:

- Researchers from all VIPV-related areas
- Module and material producers
- Technology and electronics suppliers
- Designers, advisors, finance & business

VIPV research and industry are at the start of an exciting ride, with unprecedented momentum for technical advances and market growth. Come explore the cutting-edge technologies, concepts, and examples for integrating PV into different vehicles.

PVinMotion Conference is the first of its kind platform for scientists and researchers in PV and materials, vehicle manufacturers, module producers, electronics and materials suppliers, consultants, advisers and designers to meet, to network and to exchange ideas.

- The first edition of the conference - PVinMotion 2021 - was held online from December 6-8, 2021.
- The second edition of the conference - PVinMotion 2023 - took place, in-person in 's-Hertogenbosch, the Netherlands, and online, from February 15-17, 2023.
- The third edition of the conference - PVinMotion 2024 - was held in Neuchâtel, Switzerland, from March 6-8, 2024.

The edition 2024 from PVinMotion was different from previous one, we focused on Vehicle Integrated PV (VIPV) for day 1 and day 2 were Antonin Faes (from CSEM/EPFL) was chairing these initial two days with Martin Heinrich (Fraunhofer-ISE) and Lenneke Slooff (TNO), the day 3 was reserved for Electrical Vehicle (EV) usage in combination with PV and renewable source like bidirectional charging and grid stabilization. Nicolas Wyrsch from EPFL was chairing the day 3.

Globally, the workshop can be considered a success. It has also permit to showcase many Swiss solutions/products/R&D activities, and has allowed Swiss actors to establish multiple contacts.

1.2 Sponsors 2024

The PVinMotion2024 Conference had 5 sponsors, 3 media partners, 2 board members and 2 hosts for the 2024 edition (see bellow). Without these sponsors it would not have been possible to hold the conference with the same budget.

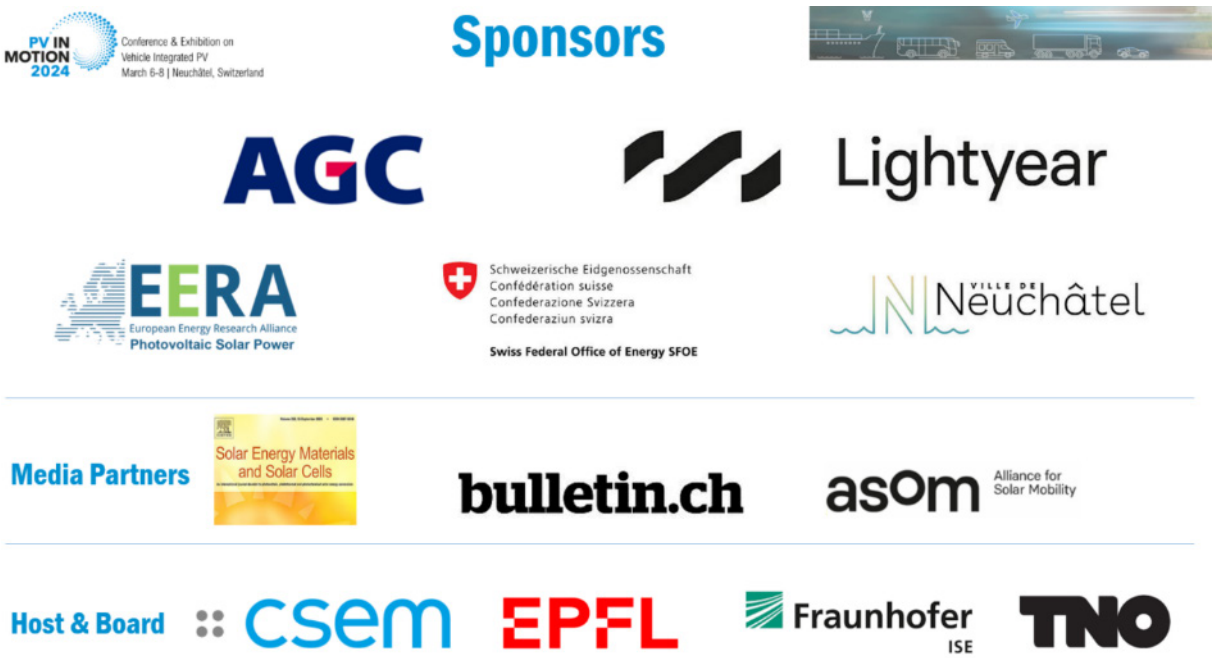


Fig. 1.1 : Intermediate slides during presentation shift and during coffee and lunch breaks which include sponsors, media partners and host and board partners.

1.3 Program and summary of PVinMotion 2024

The program duration of the PVinMotion 2024 was 3 days including 44 oral presentations 13 posters, 2 panel discussions, one lab tour and one external visit at Payerne airport to see SolarStratos flying (please see the full program in annex 1). For the closure session on Friday, Prof. Christophe Ballif Becquerel price 2016, gave a very inspiring presentation on the possible bright future of PV.

The summary and highlights of the Wednesday 6th of March 2024 includes:

- Session 1: VIPV worldwide
    - >110 participants, first solar car 1960
    - EU incentive for passenger cars & trucks
    - DoE: OnRoad 1. Heavy-duty vehicles 2. Passenger cars
- Session 2: Yield modelling and dynamic shading
    - VIPV can reduce the need for investment in the electricity grid
    - 1 kW VIPV covers 30% of the traveling distance in Portugal, 80% time parked
    - LIDAR, GIS-3D, image analysis, monitoring, modelling of shading for VIPV
    - Loss in VIPV: 1. Partial shading 2. Curvature 3. Dynamic shading (orientation?)
- Poster Session
    - Power losses in electrical car system can consume a large part of the VIPV power
    - Design for solar hood
    - Fabrication + Mechanical modelling of rigid PV fixed on a Soleva electric van.

The summary and highlights of the Thursday 7th of March 2024 includes:

- Module technology with lightweight modules
    - Presentation by PXP Corporation, Simoldes, CSEM, Fraunhofer ISE and imec.
    - Lightweight and ageing stable is possible!
- Temperature simulations for cars and trucks:
    - Truck: increase by approx. 2 °C max. (Fraunhofer ISE)
    - Cars: PV integration no disadvantage to Thermal Comfort Roof (AGC)
- Industry Session and panel discussion: Survey: 40% of vehicles will be equipped with solar in 2034

The summary and highlights of the Friday 8th of March 2024 about vehicle to grid connection includes:

- Mobility has to (will) be electric (including heavy-duty vehicles)
- PV can provide the needed energy (stand-alone or VIPV)
- Buildings should be seen as «energy hubs» integrating PV and EVs and key for a resilient energy system
- Large electrification rate of mobility will require adequate strategies to avoid grid congestions (VIPV may not help) → smart charging strategies, charge at work rather than at home
- V2X could be helpful as flexibility asset for the grid. Can provide ancillary service to the grid or even help in case of black-start
- V2X deployment hindered by lack of standards and limited market offers.
  Grid operators not yet ready (at least in Switzerland)

More information about the conference can be found under: History | PVinMotion Conference (pvinmotion-conference.com).

Special Issue of the 3rd PVinMotion Conference will be published in Solar Energy Materials and Solar Cells (SolMat). Nowadays, 11 papers have been accepted, 2 papers are under revision and 1 paper was withdrawn after review. Which shows already the very positive impact of the workshop on the scientific community.

1.4 Social event and Networking

The social part of the workshop included first an evening diner at “le Café des Amis” near the lake of Neuchatel was organised to present to the international participant the beauty of the Lake-region. On Thursday evening a special event was organised at the airbase of Solarstratos in Payerne with a flight of the plane and a conference from the eco-explorer Raphael Domjan. On the Wednesday afternoon the visit of the CSEM and EPFL-Microcity facilities for photovoltaics research and development was organised. 3 master and 2 PhD students from EPFL could help the conference and follow the presentations and the networking event to make some scientific contact for their future work and research opportunities. 2 solar vehicles were exposed during the conference, first the Dutch Lightyear 0 solar car and the electrified Soleva solar van. 5 booths were mounted in Microcity buildings including 3 solar roofs and various roll-ups.

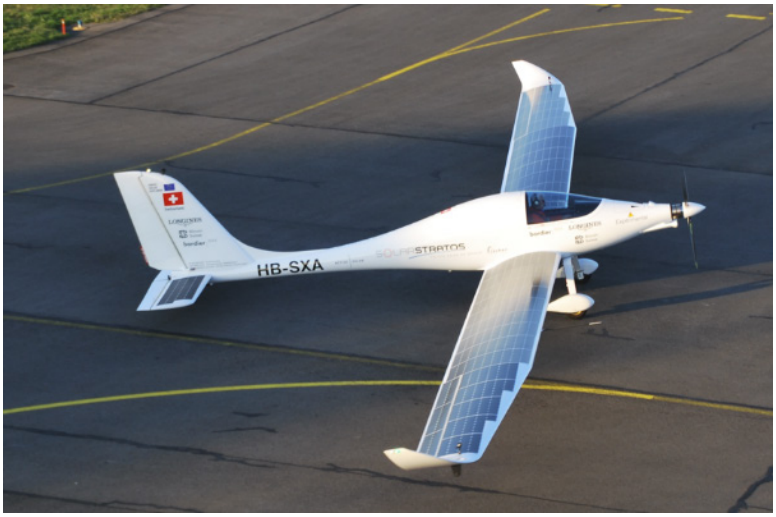
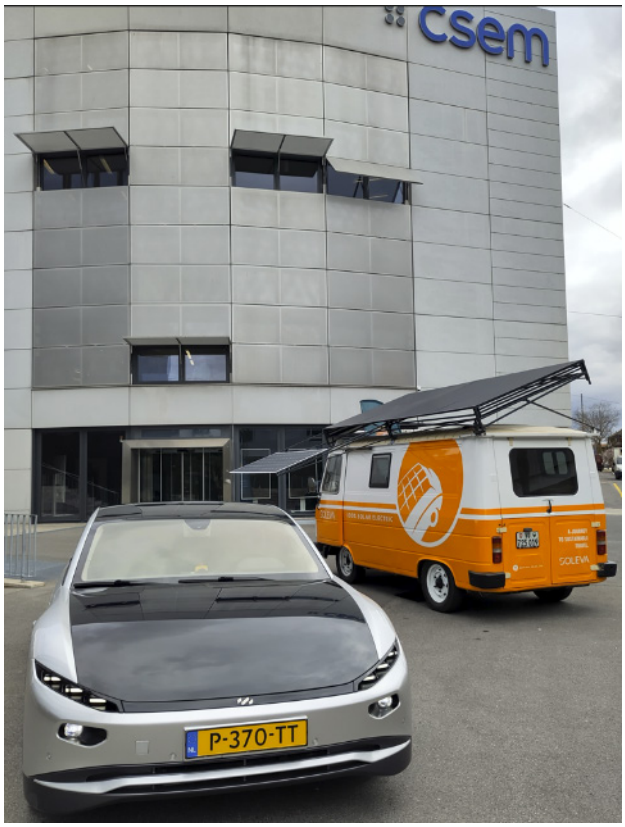


Fig. 1.3 : Participants to the special event on Thursday at SolarStratos airbase in Payerne with below the airplane landing just after a test flight.

Fig. 1.4 : Conference given by Raphael Domjan from SolarStratos plane on Thursday 7th of March evening during the visit at Payerne airport.

Fig. 1.5 : Networking time during standing coffee break and standing lunch of Friday 9th of March.

Fig. 1.6 : Group picture on Friday 9th of March in front of Microcity buildings and with Soleva solar van.



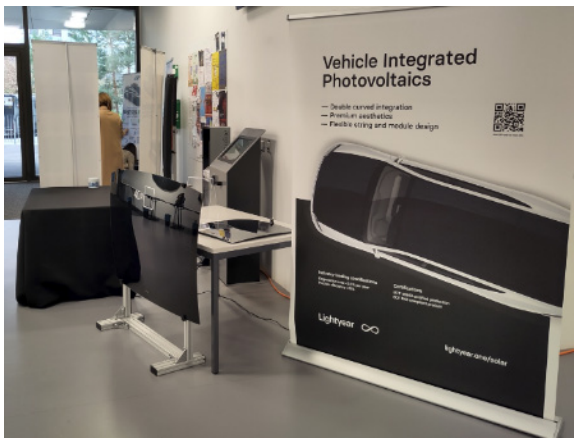


Fig. 1.7 : Lightyear solar car and Soleva solar van in front of the CSEM building and booths placed in Microcity building hall.

1.5 Participants

The subscription to the PVinMotion 2024 included 111 participants from 21 countries with 52 on early bird, 8 on Student early bird, then 2 on regular student and the rest on regular ticket. For the food organisation, 21% was vegetarian. 3 people have food allergies, which is important to take into account.

2 Next steps

Next edition of the PVinMotion will be hold in Japan at Miyazaki University in May 2025.

Special Issue of the 3rd PVinMotion Conference should be published in Solar Energy Materials and Solar Cells (SolMat).

3 References

[1] https://www.pvinmotion-conference.com/conference-topics, on 13.08.2024

4 Annex 1: PVinMotion 2024 Program

PVinMotion 2024 Program

From 6th to 8th of March in Neuchatel, Switzerland

	Wednesday 6th of March			
	Session	**Affiliation**	**Speaker**	**title**
Session am1 : 09h00-10h30	**Session 1 : VIPV worldwide (chair: Antonin Faes)**	Chairs	Antonin Faes, Nicolas Wyrsch, Lenneke Slooff, Martin Heinrich	Opening
			Urs Muntwyler	40 Years of Solar Cars
		Lightyear	Bonna Newmann	A VIPV Roadtrip
		DoE	Scott McCalmont	Challenges and Opportunities for VIPV: A Perspective from the U.S. Department of Energy
		Mizuho R&T	Keiichi Komoto	VIPV in Japan
Session am2 : 11h00-12h20	**Session 2 : Yield modeling (chair: Kenji Araki)**	TNO	Anna Carr	Solar Moves: Part 1, Modelling the impact of VIPV
		Uni Lisboa	Leonardo Ferreira	Citizen-science experimental campaign to assess the potential of solar cars
		Mizuho R&T	Keiichi Komoto	Possible contribution to reduction of CO2 emission by PV-Powered Passenger Vehicle in Japan
		AIST	Hidenori Mizuno	A Case Study of PV-Integrated EVs Applied in a Merchandise Delivery Service in Japan: Part 2 - Challenges in Actual Operation
		IES-UPM	Rubén Núñez Júdez	On the validation of a modelling tool for Vehicle Integrated PhotoVoltaics: reflected irradiance in urban environments
Session pm 1 : 13h30-14h50	**Session 3 : Dynamic shading (chair: Rubén Núñez Júdez)**	Uni Miyazaki	Kenji Araki	Testing and rating of VIPV: Scientific background
		IES-UPM	Luis Javier San José Gallego	Image Processing-based Methodology for Dynamic Shading Analysis & VIPV Performance Estimation
		LIST	Christian Braun	Assessment of local albedo impacts on the solar potential for VIPV applications: A simplified high-resolution GIS approach using 3D City Models in complex urban environments.
		Uni Ljubjiana	Marko Jankovec	Solar Irradiance and PV Module Monitoring in Dynamic Environments
		PKNU	Jimin Hong	An Innovative 360 VR Camera-Based System for Advanced Parking Space Analysis of Solar Electric Vehicles
Session pm 2 : 15h15-16h15	**Session 4 - Poster session**		More than 13 posters to be presented (see below)	
Visits : 16h30-18h30	**Visit CSEM/EPFL facilities**			
Social Event : 19h00	**Conference Diner at Café des Amis (Quai Robert-Comtesse 4, 2000 Neuchâtel)**			

PV IN MOTION 2024 Conference & Exhibition on Vehicle Integrated PV March 6-8 | Neuchâtel, Switzerland

PVinMotion 2024 Program

	Thursday 7th of March			
	Session	**Affiliation**	**Speaker**	**title**
Session am1 : 09h00-10h35	**Session 5 : Cell & Module Technologies for VIPV (chair: Martin Heinrich)**	PXP Corporation	Hiroki Sugimoto	Light-Weight and Smart VIPV Modules via Thin-Film Technology
		Fraunhofer-ISE	Marc Andre Schüler	Towards Fiber-Reinforced Front Sheets for Lightweight PV Modules in VIPV
		CSEM	Bénédicte Bonnet-Eymard	Tuning PV modules for vehicles
		Fraunhofer-ISE	Luis Eduardo Alanis	Thermal Effect of VIPV Modules in Refrigerated Trucks
		KU-Leuven	Bin Luo	Interconnection and Encapsulation Strategies for Reliability Improvement of Lightweight Photovoltaic Modules Towards Vehicleintegrated Applications
		Infinite Mobility	Moez Jomâa	Potential of Solar PV in Powering Cargo Bikes by Infinite Mobility
Session am2 : 11h00-12h20	**Session 6 : VIPV Performance and Energy Yield measurements (chair: Ned Ekins-Daukes)**	IES-UPM	F. Martín	Relative angular response characterization in VIPV for energy rating
		IES-UPM	Ricardo Moruno	Effect of diffuse irradiance on curved modules.
		CEA-INES	Bertrand Chambion	Experimental study of irradiance and temperature uniformity on passenger car roof
		Uni Miyazaki	Yasuyuki Ota	Outdoor evaluation of total cross tied Si module under driving conditions
		Jülich	Evgenii Sovetkin	Light distribution on vehicles' bodies
Session pm 1 : 13h30-14h50	**Session 7 : Indutrial Session (chair: Bonna Newman)**	AGC	Loic Tous	VIPV production from the point of view of a glass roof manufacturer
		Toyota	Lenneke Slooff	Challenges of Perovskite solar cells (PSC) Technology for Mobility
		Simoldes	Julien Robin	PhotoVoltaic Automotive Body (PVAB) Project Outcome of 3 years of VIPV R&D industrial project
		Lightyear	Philippe Nivelle	Towards the development of a glass-free, cost-effective, reliable and impact compliant vehicle-integrated PV module packaging
		OPES	Robert Händel	How to build a competitive VIPV production facility in Europe
Session pm 2 : 15h15-16h15	**Session 8 - Panel discussion**	Moderator: Prof. Christophe Ballif	Panel including the top ranked professors and industrial speakers Is solar mobility only a dream or the real future?	
Visits 16h15 & Social Event	**Visit SolarStratos in Payerne + Aperitif**			

PVinMotion 2024 Program

	Friday 8th of March			
	Session	**Affiliation**	**Speaker**	**title**
Session am1 : 09h00-10h35	**Session 9 : V2X (chair: Nicolas Wyrsch)**	Mobility Cooperative	Marco Piffaretti	Self consumption optimization vs. other flexibility uses in the "V2X Suisse" pilot project
		Virtual Vehicle Research	Judy Jalkh	Energy harvesting potential for 3 EVs equipped with PV for the area of Graz in Austria
		EPFL PV-Lab	Noémie Jeannin	Mapping the potential of electric vehicles as flexibility set for solar energy Europe
		Planair	Mathieu Boccard	SunnYparc - Harmonious integration of renewable energies and electric mobility
		Soleva	Curdin Wuethrich	Soleva – A journey to sustainable travel
		FreeSuns	John Morello	User feedback about E-mobility, Solar roof and battery storage for an individual house
Session am2 : 11h00-12h35	**Session 10 : V2X & Grid Support (chair: Lenneke Slooff)**	SFOE	Luca Castiglioni	The convergence of PV and electric mobility: V2G
		TNO	Omar Usmani	Local grid congestion reduction from Vehicle-Integrated Photovoltaics
		UAS - HES-SO	David Wannier	How could the electrification of the mobility, and V2X in particular, mitigate the electricity shortage?
		tiko Energy Solutions	Aby Chacko	Experience with flexibility in the V2X Suisse project
		Group E	Peter Cuony	A DSO strategy for EV integration
		SENE	Marc-H. Schaffner	Buildings as energy hubs : a vision for the canton of Neuchâtel
Session pm 1 : 13h45-14h45	**Session 11 - Panel discussion**	Moderator: Andreas Hutter	Panel including the full value chain for V2X and Grid support How to make V2X helping the energy transition ?	
Session pm 2 : 15h15-16h00	**Session 12 : Conference Closure**	CSEM & EPFL	Prof Christophe Ballif	Bright Perspective for Solar Energy
		Conference chairs	Antonin Faes, Nicolas Wyrsch, Lenneke Slooff, Martin Heinrich	Wrap-up, Closure & Announcement of the next PVinMotion

PVinMotion 2024 Poster Session

Wed 6th at 15h15

	Affiliation	Presenter	Title
List of Posters	CEA-INES	Bertrand Chambion	Influence of electrical architecture losses on VIPV solutions performances for passenger cars
	Uni Miyazaki	Kensuke Nishioka	PV on HAPS (High Altitude Platform Station): PV modeling
	Uni Miyazaki	Kenji Araki	Optimum Clustering of VIPV Strings: Statistical and Probability Approach
		Urs Muntwyler	VIPV Business Plan Task 17
	Uni Lisboa	Miguel Centeno Brito	Assessment of the potential of solar urban buses in different geographies
	PCCL	Nikolina Pervan	Honeycomb structures as backsheets for light weight PV modules
	TNO	Oguzhan Apaydin	Next Steps in Manufacturing High-Yield, Low-Cost, Lightweight VIPV Components
	Lightyear	Philippe Nivelle	Solar-based replacement for car hoods: design principles and optimization
	Uni Miyazaki	Kenji Araki	PV on Heavy Duty Vehicles (HDVs) project in Japan
	EPFL	Pauline Boillat	Fabrication, Characterization and Simulation of Lightweight Composite Sandwich PV Modules Integrated to an Electrical Solar Van
	TNO	Sanne van den Broek	Shading model for VIPV
	HSLU	Roger Buser	E-Ducato with PV
	UNSW	Ned Ekins-Daukes	Pathways to low-cost III-V photovoltaic solar cells

PVinMotion 2024 Social Events

Book the weekend after the conference: https://www.pvinmotion-conference.com/program/social-event

PV IN MOTION 2024 Conference & Exhibition on Vehicle Integrated PV March 6-8 | Neuchâtel, Switzerland