Programme booklet

LEUVEN 2022 LCE

KU LEUVEN

Welcome to LCE2022

It is our great pleasure to welcome you to LCE2022, the 29th edition of the successful international conference series on Life Cycle Engineering organized under the auspices of the International Academy of Production Engineering CIRP.

Engineering Sustainability. This is our joint challenge and ambition. The evolutions over the past years have shown us once more that addressing this challenge is more urgent than ever. The frequency of extreme weather events around the globe increases and so does the risk for epidemics. Meanwhile our material footprint skyrockets. At the same time, we experience a surge of initiatives from youth, businesses, authorities, civil society and academics to take up the challenge. By joining the LCE2022 conference as a delegate you are joining this worldwide quest for engineering a development that meets the needs of the present while safeguarding the abilities of future generations.

By offering LCE2022 in a hybrid format, we not only aim at increasing robustness with respect to the COVID pandemic, yet also aim at reducing environmental impact of long-distance travel. During the sessions as well as during coffee breaks, opportunities for exchange of visions and experiences with both onsite and online delegates will be offered. We hope these experiences will be a learning environment for all of us to create the sustainable, cyberphysical Conference of the Future.

We wish you a fruitful and enjoyable conference!

Prof. Wim Dewulf

Prof. Joost Duflou

Conference Venue

KU Leuven – Group T Campus
Andreas Vesaliusstraat 13
3000 Leuven, Belgium
+32 16 30 10 30

Registration and Information Desk

Sun 3 April, 17:00 – 19:00
Mon 4 April, 8:00 – 18:00
Tue 5 April, 8:00 – 18:00
Wed 6 April, 8:00 – 18:00

Venues and events

Conference venue

The conference sessions are organized at KU Leuven – Group T Campus, Andreas Vesaliusstraat 13, 3000 Leuven. Online participants are welcome for a virtual visit to this iconic building via https://limel.kuleuven.be/vt/fiiw-groept/?language=en. Registration desk, coffee breaks and the Aula for both plenary sessions and Track 1 technical sessions are situated on the ground floor. Circulating the different building levels (=modules) happens via a spiral pathway, according to the formula: $\alpha = N \cdot 90°$, where *N* represents the Module number and α represents the angle over which you have circulated the spiral pathway. Thus, Mod. 5 (Parallel sessions Track 2) is reached after circulating over 450°; Mod. 6 (Track 3) after 540°; and Mod. 11 (Track 4) after 990° (hence nearly 3 tours). A building designed for engineers. Circular engineers.

Lunch breaks

Lunch breaks are organized in the ALMA restaurant, Tiensestraat 115, 3000 Leuven. This is a 150m walk from the conference venue. Lunch menu can be checked daily via https://www.alma.be/en/alma-1?lang=en. A separate room has been reserved for the conference delegates. Please use the lunch tickets received during registration.

Conference dinner

Monday, 4 April at 07.00 PM. Faculty Club, Groot Begijnhof, Leuven

The Faculty Club is located in the medieval Infirmerie of the Groot Begijnhof. This 'Garden of the Beguines' was founded in the 13th century outside the town walls of that time. The Beguines were female followers of a mystical movement that emerged as a reaction to the growing material and formal aspirations of the regular clergy. They lived like regular nuns, but did not make the same perpetual vows. In March 2000 the Flemish beguinages were included in the UNESCO World Heritage List.

The entrance of the Faculty Club is located at the side of the parking lot.

Guided city tour

A guided city tour is being organized on Monday 4 April, leaving at 6PM from the conference venue. The guide will show you some of Leuven's historic monuments, and will end the tour at the conference dinner venue (Faculty Club). Registration for the tour is not required.

Conference reception

Tuesday, 5 April at 07.00 PM. University Hall, Naamsestraat 22, Leuven

All participants are invited to enjoy the Belgian cheese and beer buffet, offered in the "Jubileumzaal" of the University Halls. Originally built as a Linen Hall for selling cloth, the Halls have been put at the disposal of the university already soon after its foundation in 1425. Today, the Halls house amongst others the rector's offices. The reception takes place in the Jubileumzaal on the first floor. Alternatives for cheese and beer are offered for delegates with dietary constraints.

Platforms

Alfaview (sessions)

Sessions are streamed via the Alfaview platform. Online participants are requested to install the Alfaview software on beforehand and use headsets for optimal sound quality. The following settings are used:

- For plenary sessions: microphone and camera are only enabled for the speakers. Delegates can use the chat functionality for formulating comments and questions.
- For parallel sessions: camera is on by default for all delegates. Microphone can be (de-)activated by the participants: please deactivate unless you have the floor. You can use the chat functionality (typing "Q") to indicate to the chair that you want to ask a question.

Wonder.me (coffee breaks)

Coffee is served throughout the day on the ground floor. Online participants can meet during coffee breaks via Wonder.me using the following link: https://app.wonder.me?spaceId=93a9ce17-04e7-4975-9243-004a315da7e3 and password ***CIRP2022***. On-site (Leuven) participants can join the same Wonder.me session via their personal laptop or in small groups using one of the meeting rooms at Mod. 8. Video conferencing systems in these rooms are connected to the Wonder.me session. Reservations can be made on the schedule attached to the meeting room doors.

To avoid conflicts between Alfaview and Wonder.me, participants must close one platform before opening the second and vice versa!

Proceedings

The contributions accepted by the Scientific Committee are published as open-access proceedings in Procedia CIRP, Volume 105, 2022. Links to individual papers can be found in the digital version of this programme booklet via https://lce2022.eu.

Conference schedule

Monday 4 April – 9:00 – 10:35 – Plenary Session

Leuven	New York	Beijing	Tokyo	Sydney	Plenary (Aula)	Opening session *(chairs: W. Dewulf, J. Duflou)*	ID
9:00	3:00	15:00	16:00	17:00	*Wim Dewulf*	Opening	01_01
9:10	3:10	15:10	16:10	17:10	*Gerard Govers*	Welcome address by KU Leuven vice-rector for Sustainability Policy	01_02
9:20	3:20	15:20	16:20	17:20	*Jan Tytgat*	The road to climate-neutral EV batteries: opportunities and regulatory framework	01_03
9:45	3:45	15:45	16:45	17:45	*Bernhard Steubing*	State-of-the-art of modelling future scenarios in LCA and possible future directions	01_04
10:10	4:10	16:10	17:10	18:10	*Bruno Vermoesen*	The challenges of circular B2C product-as-a-service models for a company normally operating in a B2B mode	01_05

Keynote speakers Monday 4 April

Jan Tytgat (Umicore) - The road to climate-neutral EV batteries: opportunities and regulatory framework

The transition from ICE mobility to electric mobility shifts the CO2 emissions from the tailpipe to the production phase of the batteries. To truly move towards zero-carbon mobility, production must also be C-free. In this contribution, we will discuss the possibilities of reducing the C-footprint of battery production and potentially bringing it to zero. The European legal framework for batteries stimulates this transition and is likely to be a forerunner of future product legislation.

Bio - Jan Tytgat obtained a PhD in Chemistry from KU Leuven (Belgium). He joined Umicore in 1987 and has assumed several managerial positions (laboratories, purchasing and battery recycling) before joining Umicore's Government Affairs department in 2012. In his current position as director Government Affairs EU, he is in charge of the relation with public authorities on sustainable mobility, energy, trade and recycling. He is Member of the Board of Recharge (the European Association for Advanced Rechargeable and Lithium Batteries) and of EBRA (the European Battery Recycling Association) and is chairman of the Trade Committee of Eurometaux.

Bernhard Steubing (CML – Leiden University) - State-of-the-art of modelling future scenarios in LCA and possible future directions

One of the big dilemmas in LCA is that we typically want to model future systems, but need to rely on background databases that cover current, if not past, technologies. This presentation summarizes recent progress to generate future background databases for LCA, representing future scenarios up to, theoretically, 2100. Important sectoral scenarios have been developed this way, e.g. for electricity, a few selected metals, transport, etc. However, huge gaps remain, such as the coverage of bulk materials, the bioeconomy, agriculture and food, and a wider coverage of resources (e.g. metals) for the energy transition, and of course the transition to a circular economy. The keynote moreover presents ideas on how this could be made a more joint effort with the aim that average LCA practitioners could access such data in the near future.

Bio - Bernhard Steubing did his PhD in Switzerland at EPFL and Empa. He then joined ETH Zurich, where he contributed, among others, to the development of the ecoinvent database. Since 2015, Bernhard works as assistant professor at the Institute of Environmental Sciences (CML) at Leiden University, where he focuses on the sustainability of electric vehicles and batteries, offshore wind power, the built environment, and plastics. One of his core interests is the development of future background scenarios for prospective LCA and innovative modeling LCA approaches such as modular LCA. He is also the founder of the open source LCA software Activity Browser.

Bruno Vermoesen (BSH Appliances) - The challenges of circular B2C product-as-a-service models for a company normally operating in a B2B mode

Switching to a B2C product-as-a-service model is not an evidence for a company that normally works in a B2B context. The company has to step out of its comfort zone and has to face numerous challenges. New customer types, different logistics, recurring revenues versus one-off invoicing, reverse logistics, making the model circular,… BSH Home Appliances, the company behind Appliance brands such as Bosch and Siemens, wants to share its experiences.

Bio - Bruno Vermoesen obtained an engineering degree from Sint-Lieven University College, today part of KU Leuven. He joined BSH Home Appliances (with a brand portfolio including among others Bosch and Siemens appliances) in 1995, where he is currently Head of Office Governmental Affairs for Circular Economy. He is chairman of the Board of Directors of Recupel (the Belgian association responsible for collection and processing of WEEE), president of ANStEC and board member of Stichting Open (the Dutch equivalent of Recupel).

Monday 4 April – 10:55 – 12:15 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Life Cycle Assessment – 1 *(chair: E. Crenna)*	ID
10:55	4:55	16:55	17:55	18:55	*Noel Ullrich*	Estimating the resource intensity of the internet: A meta-model to account for cloud-based services in LCA	02_01
11:15	5:15	17:15	18:15	19:15	*Asela K. Kumudu Kulatunga*	Life Cycle Assessment of Food Loss Impacts: Case of Banana Postharvest Losses in Sri Lanka	02_02
11:35	5:35	17:35	18:35	19:35	*Jasmin Cooper*	Life cycle assessment of negative emission technologies for effectiveness in carbon sequestration	02_03
11:55	5:55	17:55	18:55	19:55	*Simone Cornago*	Temporal Hotspot Identification using Dynamic Life Cycle Inventory: Which are the Critical Time-spans within the Product Life Cycle?	02_04
					Track 2 (Mod.5)	Business Models – 1 *(chair: T. Sakao)*	
10:55	4:55	16:55	17:55	18:55	*Gonçalo Cardeal*	Designing Sustainable Business Models to Reduce Spare Part Inventory	03_01
11:15	5:15	17:15	18:15	19:15	*Fuwei Tao*	Designing a Sustainable Circulation System of Second-life Traction Batteries: A Scenario-based Simulation Approach	03_02
11:35	5:35	17:35	18:35	19:35	*Erik Sundin*	Scaling up Repair Workshops to Remanufacturing Facilities for Household Appliances as a Service	03_03
11:55	5:55	17:55	18:55	19:55	*Chalaka Fernando*	Life Cycle Environmental Impact of Mobility Servitization: The Effect of Fleet Technology Changes	03_04
					Track 3 (Mod.6)	Circular Economy – 1 *(chair: A. Di Maria)*	
10:55	4:55	16:55	17:55	18:55	*Simon Schaubroeck*	Circularity of building stocks: modelling building joints and their disassembly in a 3D city model	04_01
11:15	5:15	17:15	18:15	19:15	*Christiane Plociennik*	Towards a Digital Lifecycle Passport for the Circular Economy	04_02
11:35	5:35	17:35	18:35	19:35	*Laura Talens Peiró*	Advancing in the analysis of materials in electr(on)ic equipment	04_03
11:55	5:55	17:55	18:55	19:55	*Lukas Neugebauer*	Increasing Acceptance for Refurbished Products at the Example of E-Cargo Bikes	04_04
					Track 4 (Mod.11)	Transport & Mobility – 1 *(chair: B. Bras)*	
10:55	4:55	16:55	17:55	18:55	*Frederick Adjei*	Electrically powered micro mobility vehicles in Ghana: transition process with focus on social acceptance	05_01
11:15	5:15	17:15	18:15	19:15	*Sofia Pinheiro Melo*	Life Cycle Engineering Modelling Framework for batteries powering electric aircrafts – the contribution of eVTOLs towards a more sustainable urban mobility	05_02
11:35	5:35	17:35	18:35	19:35	*Luisa Reichsthaler*	An AI-enhanced Approach for optimizing life cycle costing of military logistic vehicles	05_03
11:55	5:55	17:55	18:55	19:55	*Seyed Mojib Zahraee*	Palm oil biomass global supply chain: environmental emissions vs. technology development of maritime transportation	05_04

Monday 4 April – 13:45 – 15:20 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Life Cycle Assessment – 2 *(chair: J. Van Caneghem)*	ID
13:45	7:45	19:45	20:45	21:45	*Isadora Correa Hackenhaar*	A critical review of criticality methods for a European Life Cycle Sustainability Assessment	06_01
14:05	8:05	20:05	21:05	22:05	*Mauro Cordella*	Assessing impacts to biodiversity and ecosystems: understanding and exploiting synergies between Life Cycle Assessment and Natural Capital Accounting	06_02
14:25	8:25	20:25	21:25	22:25	*Matthias Rapf*	Entropy Life Cycle Assessment – practical application and further development	06_03
14:45	8:45	20:45	21:45	22:45	*Andrea Mio*	Multiscale modelling techniques in Life Cycle Assessment: application to product design	06_04
15:05	9:05	21:05	22:05	23:05	*Tao Peng*	A Knowledge-enriched Framework for Life Cycle Assessment in Manufacturing	06_05
					Track 2 (Mod.5)	Sustainable Manufacturing – 1 *(chair: P. Mativenga)*	
13:45	7:45	19:45	20:45	21:45	*Marco Marconi*	Comparing the environmental and economic performances of different substrate pre-treatment processes for diamond coating deposition	07_01
14:05	8:05	20:05	21:05	22:05	*Ilesanmi Afolabi Daniyan*	Life cycle assessment for the milling operation of titanium alloy (Ti6Al4V)	07_02
14:25	8:25	20:25	21:25	22:25	*Christina Wulf*	Analyzing the future potential of defossilizing industrial specialty glass production with hydrogen by LCA	07_03
14:45	8:45	20:45	21:45	22:45	*Stefan Scharf*	Sustainability potentials of an innovative technology and plant system in non-ferrous foundries	07_04
15:05	9:05	21:05	22:05	23:05	*Tufan Chandra Bera*	An Investigation on Reduction of Cutting Energy Consumption Using High Efficiency Machining Strategy	07_05
					Track 3 (Mod.6)	Circular Economy – 2 *(chair: M. Despeisse)*	
13:45	7:45	19:45	20:45	21:45	*Theodoros Dimas*	Development and Validation of a Computational Fluid Dynamics Model for the optimization of a sink-float separator for plastics recycling	08_01
14:05	8:05	20:05	21:05	22:05	*Takamitsu Hirota*	Developing Architecture for Platform-based Circular Economy Business: An Exploratory Study	08_02
14:25	8:25	20:25	21:25	22:25	*Maria Victoria Hernandez Marquina*	Sustainable performance of circular supply chains: A literature review	08_03
14:45	8:45	20:45	21:45	22:45	*Maya Reslan*	Circular Economy: A Product Life Cycle Perspective on Engineering and Manufacturing Practices	08_04
15:05	9:05	21:05	22:05	23:05	*Emma Lindahl*	How could a SME supplier's value chain be evaluated by circular production principles?	08_05
					Track 4 (Mod.11)	Transport & Mobility – 2 *(chair: C. Thies)*	
13:45	7:45	19:45	20:45	21:45	*Alexander Barke*	Comparison of conventional and electric passenger aircraft for short-haul flights – A life cycle sustainability assessment	09_01
14:05	8:05	20:05	21:05	22:05	*Julian Grenz*	LCA based analysis of product portfolios - towards decarbonization	09_02
14:25	8:25	20:25	21:25	22:25	*Wakyo Terazumi*	System dynamics model for changing transportation demand during the pandemic in Japan	09_03
14:45	8:45	20:45	21:45	22:45	*Jaron Schünemann*	Life Cycle Assessment on Electric Cargo Bikes for the Use-Case of Urban Freight Transportation in Ghana	09_04
15:05	9:05	21:05	22:05	23:05	*Francis Fish*	Sustainable Design of Advanced Driver Assistance Systems Based on Optimization and Empirical Studies on Full-Size Light-Duty Pickup Trucks	09_05

Monday 4 April – 15:45 – 17:05 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Ecodesign – 1 *(chair: D. Brissaud)*	ID
15:45	9:45	21:45	22:45	23:45	*Erik Sundin*	Systematic Design for Recycling Approach – Automotive Exterior Plastics	10_01
16:05	10:05	22:05	23:05	0:05	*Federica Cappelletti*	Design for environmental sustainability: collect and use company information to design green products	10_02
16:25	10:25	22:25	23:25	0:25	*Ye Wang*	Towards a Digital Knowledge Base of Circular Design Examples through Product Teardowns	10_03
16:45	10:45	22:45	23:45	0:45	*Anna-Sophia Wilde*	Ontology-based approach to support life cycle engineering: Development of a data and knowledge structure	10_04
					Track 2 (Mod.5)	Sustainable Manufacturing – 2 *(chair: S. Thiede)*	
15:45	9:45	21:45	22:45	23:45	*Angioletta Rita Catalano*	An appraisal of the cradle-to-gate energy demand and carbon footprint of high-speed steel cutting tools	11_01
16:05	10:05	22:05	23:05	0:05	*Yufeng Li*	A process scenario oriented Life Cycle Assessment framework for machining processes	11_02
16:25	10:25	22:25	23:25	0:25	*Yannik Graupner*	Designing the technological transformation toward sustainable steelmaking: A framework to provide decision support to industrial practitioners	11_03
16:45	10:45	22:45	23:45	0:45	*Padmakumar Muthuswamy*	Investigation on sustainable machining characteristics of tools with serrated cutting edges in face milling of AISI 304 Stainless Steel	11_04
					Track 3 (Mod.6)	Circular Economy – 3 *(chair: S. Salhofer)*	
15:45	9:45	21:45	22:45	23:45	*Reyn Joseph O'Born*	Realizing the potential of humic acid recovery in Norway through chitosan treatment of drinking water	12_01
16:05	10:05	22:05	23:05	0:05	*Pedro Lopez-Garcia*	Compounding process optimization for recycled materials using machine learning algorithms	12_02
16:25	10:25	22:25	23:25	0:25	*Lucie Domingo*	Designing out waste: which levelers for local authorities?	12_03
16:45	10:45	22:45	23:45	0:45	*Jorge Luis Amaya Rivas*	Quantification and mapping of domestic plastic waste using GIS/GPS approach at the city of Guayaquil	12_04
					Track 4 (Mod.11)	Energy Systems – 1 *(chair: J. Duflou)*	
15:45	9:45	21:45	22:45	23:45	*Jonas Wendt*	Development of a modular calculation and analysis tool for the planning process of energy efficient industrial cooling supply systems	13_01
16:05	10:05	22:05	23:05	0:05	*Bert Bras*	Analysis of financial and carbon savings of grid-tied home energy systems in conjunction with photo-voltaic solar generation and electric vehicle use	13_02
16:25	10:25	22:25	23:25	0:25	*Lukas Theisinger*	Modeling approach and simulation study to assess the utilization potential of industrial waste heat in district heating systems	13_03
16:45	10:45	22:45	23:45	0:45	*Manbir Singh Sodhi*	Economic Lifetimes of Solar Panels	13_04

Tuesday 5 April – 9:00 – 10:40 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Ecodesign – 2 *(chair: C. Spirinckx)*	ID
9:00	3:00	15:00	16:00	17:00	*Simon Mörsdorf*	Beyond Sustainable Products – Concept for a Positive Impact Product Engineering (PIPE)	14_01
9:20	3:20	15:20	16:20	17:20	*Helmi Ben Rejeb*	From Innovation to Eco-Innovation: Co-Created Training Materials as a Change Driver for Research and Technology Organisations	14_02
9:40	3:40	15:40	16:40	17:40	*Chengcheng Hu*	Life Cycle Eco-design of Biodegradable Packaging Material	14_03
10:00	4:00	16:00	17:00	18:00	*Karsten Schischke*	Durability, reparability and recyclability: Applying material efficiency standards EN 4555x to mobile phones and tablet computers	14_04
10:20	4:20	16:20	17:20	18:20	*Yasushi Umeda*	Evaluation of circularity of components for life cycle design: A toner bottle case study	14_05
					Track 2 (Mod.5)	Sustainable Manufacturing – 3 *(chair: C. Herrmann)*	
9:00	3:00	15:00	16:00	17:00	*Marija Glisic*	A Systematic Framework for Quantifying Production System-Specific Challenges in Life Cycle Inventory Data Collection	15_01
9:20	3:20	15:20	16:20	17:20	*Tufan Chandra Bera*	Modelling of spindle energy consumption in CNC milling	15_02
9:40	3:40	15:40	16:40	17:40	*Di He*	Reducing down-cycling of carbon fibre by fibre architecture preservation: Multi-layer fibre surface quality investigation	15_03
10:00	4:00	16:00	17:00	18:00	*Eric Riedel*	MQTT protocol for SME foundries: potential as an entry point into industry 4.0, process transparency and sustainability	15_04
10:20	4:20	16:20	17:20	18:20	*Trixi Meier*	Investigation of the influence of the additivation of a biological metalworking oil in cryogenic machining	15_05
					Track 3 (Mod.6)	Circular Economy – 4 *(chair: E. Sundin)*	
9:00	3:00	15:00	16:00	17:00	*Hampus Korhan André*	Towards a Conceptual Framework for Analyzing Circular Product-User Life cycles: Learnings from the Sport and Outdoor Sector	16_01
9:20	3:20	15:20	16:20	17:20	*Brian Baldassarre*	Drivers and Barriers to the Circular Economy Transition: the Case of Recycled Plastics in the Automotive Sector in the European Union	16_02
9:40	3:40	15:40	16:40	17:40	*Sven Forte*	Towards Sustainable Systems Reconfiguration by an IoT-driven System of Systems Engineering Lifecycle Approach	16_03
10:00	4:00	16:00	17:00	18:00	*Thomas Hofmann*	Sustainability of battery-operated products	16_04
10:20	4:20	16:20	17:20	18:20	*Mathias Nippraschk*	The impact of Information Flow in the Circular Economy of Lithium-Ion- Batteries and how to measure it	16_05

Tuesday 5 April – 11:00 – 12:40 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Life Cycle Assessment – 3 *(chair: K. Van Acker)*	ID
11:00	5:00	17:00	18:00	19:00	*Jo Van Caneghem*	Comparative life cycle analysis of drinking water supply on a filmset: the case study of 'Binti'	17_01
11:20	5:20	17:20	18:20	19:20	*Claudio Favi*	Life cycle analysis of engineering polymer joining methods using adhesive bonding: fatigue performance and environmental implications	17_02
11:40	5:40	17:40	18:40	19:40	*Davide Rovelli*	Plastic packaging substitution in industry: variability of LCA due to manufacturing countries	17_03
12:00	6:00	18:00	19:00	20:00	*Hazem Eltohamy*	Scoping the life cycle assessment of Fine Future flotation technology-towards more sustainable mining	17_04
12:20	6:20	18:20	19:20	20:20	*Niels Lasse Martin*	LCA-based framework to support planning of centralized vs. decentralized production of solid pharmaceuticals	17_05
					Track 2 (Mod.5)	Additive Manufacturing – 1 *(chair: K. Kellens)*	
11:00	5:00	17:00	18:00	19:00	*Sakinah Zakaria*	Energy Consumption and Scope 2 Emissions for Fused Deposition Modelling	18_01
11:20	5:20	17:20	18:20	19:20	*Rishi Kumar*	Live Life Cycle Assessment Implementation using Cyber Physical Production System Framework for 3D Printed Products	18_02
11:40	5:40	17:40	18:40	19:40	*Johanna Wurst*	Sustainability Assessment of Products manufactured by the Laser Powder Bed Fusion (LPBF) Process	18_03
12:00	6:00	18:00	19:00	20:00	*Daniele Landi*	Comparative life cycle assessment of two different manufacturing technologies: laser additive manufacturing and traditional technique	18_04
12:20	6:20	18:20	19:20	20:20	*Mathias Wiese*	Environmental and technical evaluation of additive manufacturing: Enabling process chain perspective by energy value stream mapping	18_05
					Track 3 (Mod.6)	Circular Economy – 5 *(chair: C. Fitzpatrick)*	
11:00	5:00	17:00	18:00	19:00	*Anja Cudok*	Circular Economy Driven Communities – Sustainable Behavior driven by Mobile Applications	19_01
11:20	5:20	17:20	18:20	19:20	*Joost Duflou*	Implementation of circularity indicators in a household product manufacturing company	19_02
11:40	5:40	17:40	18:40	19:40	*Donal Rambau*	A framework to assess circularity of potable water through its lifecycle	19_03
12:00	6:00	18:00	19:00	20:00	*Marten Toxopeus*	Analysis of environmental transitions for tool development	19_04
12:20	6:20	18:20	19:20	20:20	*Mélanie Despeisse*	Usability and Usefulness of Circularity Indicators for Manufacturing Performance Management	19_05

Tuesday 5 April – 14:00 – 15:40 – Parallel sessions

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Life Cycle Assessment – 4 *(chair: M. Hauschild)*	ID
14:00	8:00	20:00	21:00	22:00	*Marco Marconi*	Environmental assessment and eco-design of a surgical face mask	20_01
14:20	8:20	20:20	21:20	22:20	*Xiaoju Chen*	The Impacts on Greenhouse Gases Emission during the COVID-19 lockdown in the US: An Economic Input-Output Life Cycle Assessment	20_02
14:40	8:40	20:40	21:40	22:40	*Saeed Rahimpour Golroudbary*	Magnesium Life Cycle in Automotive Industry	20_03
15:00	9:00	21:00	22:00	23:00	*Jorge Luis Amaya Rivas*	Carbon and water footprint for the recycling process of expanded polystyrene (EPS) post-consumer waste	20_04
15:20	9:20	21:20	22:20	23:20	*Michael Dieterle*	Life Cycle (gap) Analysis for advanced material recycling of PLA cups	20_05
					Track 2 (Mod.5)	Additive Manufacturing – 2 *(chair: W. Dewulf)*	
14:00	8:00	20:00	21:00	22:00	*Devarajan Ramanujan*	An Empirical Benchmark for Resource Use in Fused Deposition Modelling 3D Printing of Isovolumetric Mechanical Components	21_01
14:20	8:20	20:20	21:20	22:20	*Alessio Vita*	Environmental impacts assessment of Bound Metal Deposition 3D printing process for stainless steel	21_02
14:40	8:40	20:40	21:40	22:40	*Li Yi*	Energy performance evaluation of selective laser melting	21_03
15:00	9:00	21:00	22:00	23:00	*Iacopo Bianchi*	Comparison between the mechanical properties and environmental impacts of 3D printed synthetic and bio-based composites	21_04
15:20	9:20	21:20	22:20	23:20	*Hao Zhang*	Compressive Strength Assessment of 3D Printing Infill Patterns	21_05
					Track 3 (Mod.6)	Maintenance & Repair *(chair: P. Zwolinski)*	
14:00	8:00	20:00	21:00	22:00	*Carola Wurmbach*	Life Cycle Assessment for Adaptive Remanufacturing: incorporating ecological considerations into the planning of maintenance activities – a case study in the German heavy machinery industry	22_01
14:20	8:20	20:20	21:20	22:20	*Florian Bröhl*	Adaptive Remanufacturing – Decision Model for the Intelligent Maintenance of Production Resources	22_02
14:40	8:40	20:40	21:40	22:40	*Nadja Henningsen*	Multi-level Framework for the Assessment of Additive Manufacturing for Spare Parts Supply	22_03
15:00	9:00	21:00	22:00	23:00	*Laura Talens Peiró*	Repair of electr(on)ic products: current practices in Barcelona	22_04
15:20	9:20	21:20	22:20	23:20	*Tine Van Moeseke*	Remote diagnosis for large household appliances: A case study into repair facilitating strategies	22_05

Tuesday 5 April – 16:00 – 17:40 – Workshops (on-site only)

Leuven	Workshops		ID
16:00	*Mod. 11*	Workshop on sustainable engineering education	23_01
16:00	*Mod. 5*	Workshop on industrial symbiosis	24_01
16:00	*Mod. 6*	Workshop on Product Passports	25_01

Three parallel workshops will be organized for interactive knowledge exchange. Due to the interactive format, the workshops are restricted to on-site participation:

- **Product passports**: Actors along the product value chain are still confronted with substantial information gaps on the origin, composition, repair and dismantling options of products. The "European Green Deal" therefore proposes the introduction of electronic product passports. As an information carrier, it would not only offer potential for resource conservation and better recycling, but also be an enabler for circular business models. The workshop will therefore initially establish a common understanding with the participants by providing an introduction on the current status on global digital product passport developments. Findings will be presented on the information and technical demands, barriers and conflicts that exist throughout the value chain stakeholders which is collected via literature review, interviews and a workshop series. The goal of the workshop is to discuss relevant issues concerning e.g. data privacy, environmental efforts for the technical implementation and liabilities of a digital product passport, as well as related to data quality, potential information needs, accessibility and usability for research.
- **Industrial symbiosis**: While Industrial Symbiosis as a concept to optimize the (re)use of material resources between different industrial players is rather common in the context of process industry, it is a rare strategy in discrete manufacturing environments. However, research on systematic recycling strategies based on well optimized process combinations has demonstrated that high quality parts can be manufactured directly from production scrap, without the need for remelting and the typical long and costly logistical chains required for conventional recycling. In this workshop a number of cases will be presented demonstrating the industrial relevance and feasibility of this concept as implemented in well optimized processes. There will be opportunity for discussing the pros and cons with experienced industrial partners. Furthermore we will jointly work on some pending questions and obstacles contributing to the next step in implementing this promising strategy for resource efficient, low impact manufacturing.
- **Sustainable engineering education**: Engineering students must be trained to develop long-term thinking, and to become aware of the complex social environment and planetary boundaries within which they will be operating. Hence, sustainable engineering and system thinking become increasingly important competences to be developed throughout engineering programmes. The objective of this workshop is to inspire the participants on the concepts, topics, competences etc. that can be addressed, as well as to exchange best practices on pedagogical approaches while fostering international and intercultural collaboration in new learning formats for sustainable engineering education.

Wednesday 6 April – 09:00 – 10:40 – Plenary Session – joint LCE2022 & CATS2022

Leuven	New York	Beijing	Tokyo	Sydney	Plenary	Joint plenary session for LCE2022 and CATS2022 *(chairs: K. Kellens, W. Dewulf)*	ID
9:00	3:00	15:00	16:00	17:00	*M. Röhrig (Airbus)*	Paving the way towards Sustainable Aircraft Production	26_01
9:20	3:20	15:20	16:20	17:20	*C. Herrmann (TU Braunschweig)*	Positive Impact Factories for Sustainable Cities: Overview, Insights and Future Directions	26_02
9:40	3:40	15:40	16:40	17:40	*J. Peeters (KU Leuven)*	Towards demanufacturing 4.0	26_03
10:00	4:00	16:00	17:00	18:00	*J.M. Rödger (Umlaut)*	Panel discussion: The sustainable Factory of the Future	26_04

Keynote speakers Wednesday 6 April

Martin Röhrig (Airbus) - Paving the way towards Sustainable Aircraft Production

Airbus production is strongly striving to fulfil the green deal targets while ramping up simultaneously. All this has to follow a stringent and transparent logic along the whole value chain. The same logic will form the measures for sustainability of the future ZeroE Aircraft industrial system to enable End2End Green Aviation with a game-changing production.

Bio - Martin Röhrig obtained a PhD in engineering from University of Hanover. Since 2004 he has been assuming different managerial positions within the Airbus group related to development, manufacturing, operations, and strategy. Since 2017 he is Head of Factory of the Future and Demonstrators.

Jef Peeters (KU Leuven) – Towards demanufacturing 4.0

To accelerate the transition towards a circular economy, the successful integration of industry 4.0 technologies will be crucial to increase the economic viability of reuse, repair, refurbishing, remanufacturing and recycling. Since these end-of-(first)-life treatment processes typically need to deal with a huge variation in product models and conditions various opportunities were identified for the development of smarter systems adopting and integrating various learning approaches.

Bio - Jef Peeters holds a MSc in industrial design, a MSc in industrial management and a PhD in Engineering Science. Since 2020 he is co-chairing the Life Cycle Engineering research group at KU Leuven and as Assistant Professor. His research focuses on the development of innovative products and processes for a circular economy via (eco)design and reuse, repair, refurbishing, remanufacturing and demanufacturing.

Christoph Herrmann (TU Braunschweig) - Positive Impact Factories for Sustainable Cities: Overview, Insights and Future Directions

Urbanization, deglobalization and decentralization increase the interest in the urban factory concept. Urban factories are production systems located in an urban environment that make use of the unique resources and characteristics of their surroundings to create products locally with a potentially high degree of customer involvement. Furthermore, absolute sustainability asks for a new generation of factories that are more than mere production sites, are able to create positive impacts, and become a building block for sustainable cities.

Bio - Christoph Herrmann has studied mechanical engineering/production engineering. After his doctor degree in 2003 he habilitated in production engineering in 2008. As a company's founder, he has transferred tools and services to support design for environment into the electric/electronic and automotive industry. From 2005 to 2008 he was also scientific director of KERP Center of Excellence Environment & Electronics, Vienna. From 2009 to 2013 he was scientific director and member of the Automotive Research Center Niedersachsen (NFF), Germany. He currently is university professor for Sustainable Manufacturing & Life Cycle Engineering and co-director of IWF, Institute of Machine Tools and Production Technology, Technische Universität Braunschweig as well as director of the Fraunhofer Institute for Surface Engineering and Thin Films IST since November 2018.

Panel discussion

Wednesday 6 April 2022, 10:00 – 10:40

Panel discussion on the sustainable factory of the future as a joint initiative of LCE2022 (29th CIRP Conference on Life Cycle Engineering) and CATS2022 (9th CIRP Conference on Assembly Technologies and Systems). Panel members are Martin Röhrig (Airbus), Jef Peeters (KU Leuven), Christoph Herrmann (TU Braunschweig), and Dirk Torfs (Flanders Make). The panel discussion will be moderated by Jan-Markus Rödger (Umlaut).

Dirk Torfs

Bio - Dirk Torfs obtained MSc and PhD degrees in mechanical engineering from KU Leuven and an MBA degree from Flanders Business School. He was managing director in several industrial companies (TRASYS, GLE, ABB and IMTECH) before taking up his current position as CEO of Flanders Make, the Flemish strategic research center for manufacturing industry. He serves on the board of several innovation cluster organizations and is an executive professor in the MBA program of Flanders Business School.

Jan-Markus Rödger

Bio – Jan-Markus Rödger holds a degree in Industrial Engineering and a PhD in Sustainable Manufacturing. He has taken up sustainability management roles in different companies and is currently acting as Director Sustainability of Umlaut.

Wednesday 6 April – 11:00 – 12:40 – Parallel sessions – joint LCE2022 & CATS2022

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Disassembly & recycling 4.0 – 1 *(chair: I. Zaplana)*	ID
11:00	5:00	17:00	18:00	19:00	*Simon Mangold*	Vision-Based Screw Head Detection for Automated Disassembly for Remanufacturing	27_01
11:20	5:20	17:20	18:20	19:20	*Fengfu Yin*	Waste smartphone disassembly fault detection based on fuzzy set fault tree analysis	27_02
11:40	5:40	17:40	18:40	19:40	*Chuangchuang Zhou*	Design of a robotic system for battery dismantling from tablets	27_03
12:00	6:00	18:00	19:00	20:00	*Wouter Sterkens*	Computer vision and optical character recognition for the classification of batteries from WEEE	27_04
12:20	6:20	18:20	19:20	20:20	*Gwendolyn Foo*	Challenges of robotic disassembly in practice	27_05
					Track 2 (Mod.5)	Energy Systems – 2 *(chair: B. Sprecher)*	
11:00	5:00	17:00	18:00	19:00	*Benjamin Jacobsen*	Transition of energy system by regulating of Power Quality for efficiency improvements	28_01
11:20	5:20	17:20	18:20	19:20	*Kuldip Singh Sangwan*	Comparative Life Cycle Assessments of Photovoltaic Thermal Systems with Earth Water Heat Exchanger Cooling	28_02
11:40	5:40	17:40	18:40	19:40	*Guangling Zhao*	Environmental Analysis of Integrating Photovoltaics and Energy Storage in Building	28_03
12:00	6:00	18:00	19:00	20:00	*Marc Münnich*	Identifying efficiency and flexibility measures for energy-oriented factory management	28_04
12:20	6:20	18:20	19:20	20:20	*Elke Schropp*	Prospective Life Cycle Assessment: a Case Study of Hydrogen Production with Water Electrolysis	28_05
					Track 3 (Mod.6)	Batteries – 1 *(chair: T. Spengler)*	
11:00	5:00	17:00	18:00	19:00	*Narjes Fallah*	Techno-financial investigation of second-life of Electric Vehicle batteries for energy imbalance services in the Irish electricity market	29_01
11:20	5:20	17:20	18:20	19:20	*Jan-Linus Popien*	Exploring recycling options in battery supply chains – a life cycle sustainability assessment	29_02
11:40	5:40	17:40	18:40	19:40	*Wei-wei Liu*	State of health estimation of retired battery for echelon utilization based on charging curve	29_03
12:00	6:00	18:00	19:00	20:00	*Daniela Wohlschlager*	Comparative environmental impact assessment of ICT for smart charging of electric vehicles in Germany	29_04
12:20	6:20	18:20	19:20	20:20	*Bernhard Faessler*	Hybrid energy storage systems of energy- and power-dense batteries: a survey on modelling techniques and control methods	29_05
					Track 4 (Mod.11)	Manufacturing Systems – 1 *(chair: J. Duflou)*	
11:00	5:00	17:00	18:00	19:00	*Marian Süße*	Framework for increasing sustainability of factory systems by generative layout design	30_01
11:20	5:20	17:20	18:20	19:20	*Lukas Siemon*	Multi-scale Simulation for Energy Flexible Factories and Factory Networks: A System of Systems Perspective	30_02
11:40	5:40	17:40	18:40	19:40	*Marco Spaltini*	Defining the Roadmap towards Industry 4.0: The 6Ps Maturity Model for Manufacturing SMEs	30_03
12:00	6:00	18:00	19:00	20:00	*Alberto Loffredo*	Energy-Efficient Control of Parallel and Identical Machines: Impact on the Overall Production System	30_04
12:20	6:20	18:20	19:20	20:20	*Nicla Frigerio*	Energy monitoring of manufacturing plants: a real case application	30_05

Wednesday 6 April – 14:00 – 15:40 – Parallel sessions – joint LCE2022 & CATS2022

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Disassembly & recycling 4.0 – 2 *(chair: J. Peeters)*	ID
14:00	8:00	20:00	21:00	22:00	*Jan-Philipp Kaiser*	A Concept for Autonomous Quality Control for Core Inspection in Remanufacturing	31_01
14:20	8:20	20:20	21:20	22:20	*Núria Boix Rodríguez*	Eco-design guidelines takeaways from the analysis of product repairability and ease of disassembly: a case study for electric ovens	31_02
14:40	8:40	20:40	21:40	22:40	*Lin Li*	An efficient disassembly process generation method for large quantities of waste smartphones	31_03
15:00	9:00	21:00	22:00	23:00	*Christian Wandji*	Characterization of the state of health of a complex system at the end of use	31_04
15:20	9:20	21:20	22:20	23:20	*Bart Engelen*	Techno-Economic Assessment of Robotic Sorting of Aluminium Scrap	31_05
					Track 2 (Mod.5)	Energy Systems – 3 *(chair: E. Shittu)*	
14:00	8:00	20:00	21:00	22:00	*Adrian von Hayn*	Demand side management in the cooling supply of brewing processes	32_01
14:20	8:20	20:20	21:20	22:20	*Gabriel Naumann*	Life Cycle Assessment of an Air-Source Heat Pump and a Condensing Gas Boiler Using an Attributional and a Consequential Approach	32_02
14:40	8:40	20:40	21:40	22:40	*Nora Schelte*	A generic GHG-LCA model of a smart mini grid for decision making using the example of the Don Bosco mini grid in Tema, Ghana	32_03
15:00	9:00	21:00	22:00	23:00	*Benjamin Jacobsen*	Green flexibility Market – Platform development for system services using fuel cells	32_04
15:20	9:20	21:20	22:20	23:20	*Alexa Rea*	User perceptions of a range-based thermostat	32_05
					Track 3 (Mod.6)	Batteries – 2 *(chair: K. Schischke)*	
14:00	8:00	20:00	21:00	22:00	*Philipp Engels*	Methodology for a combined uncertainty analysis and data quality rating of existing graphite datasets in context of battery LCAs	33_01
14:20	8:20	20:20	21:20	22:20	*Daniele Landi*	Comparative life cycle assessment of two different battery technologies: lithium iron phosphate and sodium-sulfur	33_02
14:40	8:40	20:40	21:40	22:40	*Chris Yuan*	An Environmental Sustainability Analysis Tool for Next Generation Lithium Ion Batteries of Electric Vehicles	33_03
15:00	9:00	21:00	22:00	23:00	*Andrea Di Maria*	Environmental Assessment of an Innovative Lithium Production Process	33_04
15:20	9:20	21:20	22:20	23:20	*Mohammad Abdelbaky*	A comparative assessment of resource-use criticality in advanced lithium-ion battery technologies	33_05
					Track 4 (Mod.11)	Manufacturing Systems – 2 *(chair: F. Cerdas)*	
14:00	8:00	20:00	21:00	22:00	*Benjamin Röhm*	Simulation Data Management in the Digital Twin (SDM-DT) – Evolution of Simulation Data Management along the Product Life Cycle	34_01
14:20	8:20	20:20	21:20	22:20	*Bryan C Watson*	Connections Between System of System Sustainability and Resilience in an Electric Motor Manufacturing Supply Chain	34_02
14:40	8:40	20:40	21:40	22:40	*Sebastian Thiede*	Mixed reality towards environmentally sustainable manufacturing – overview, barriers and design recommendations	34_03
15:00	9:00	21:00	22:00	23:00	*Marcus Vogt*	Model-based energy flexibility analysis of a dry room HVAC system in battery cell production	34_04
15:20	9:20	21:20	22:20	23:20	*Haiyue Wu*	Condition-Based Monitoring and Novel Fault Detection Based on Incremental Learning Applied to Rotary Systems	34_05

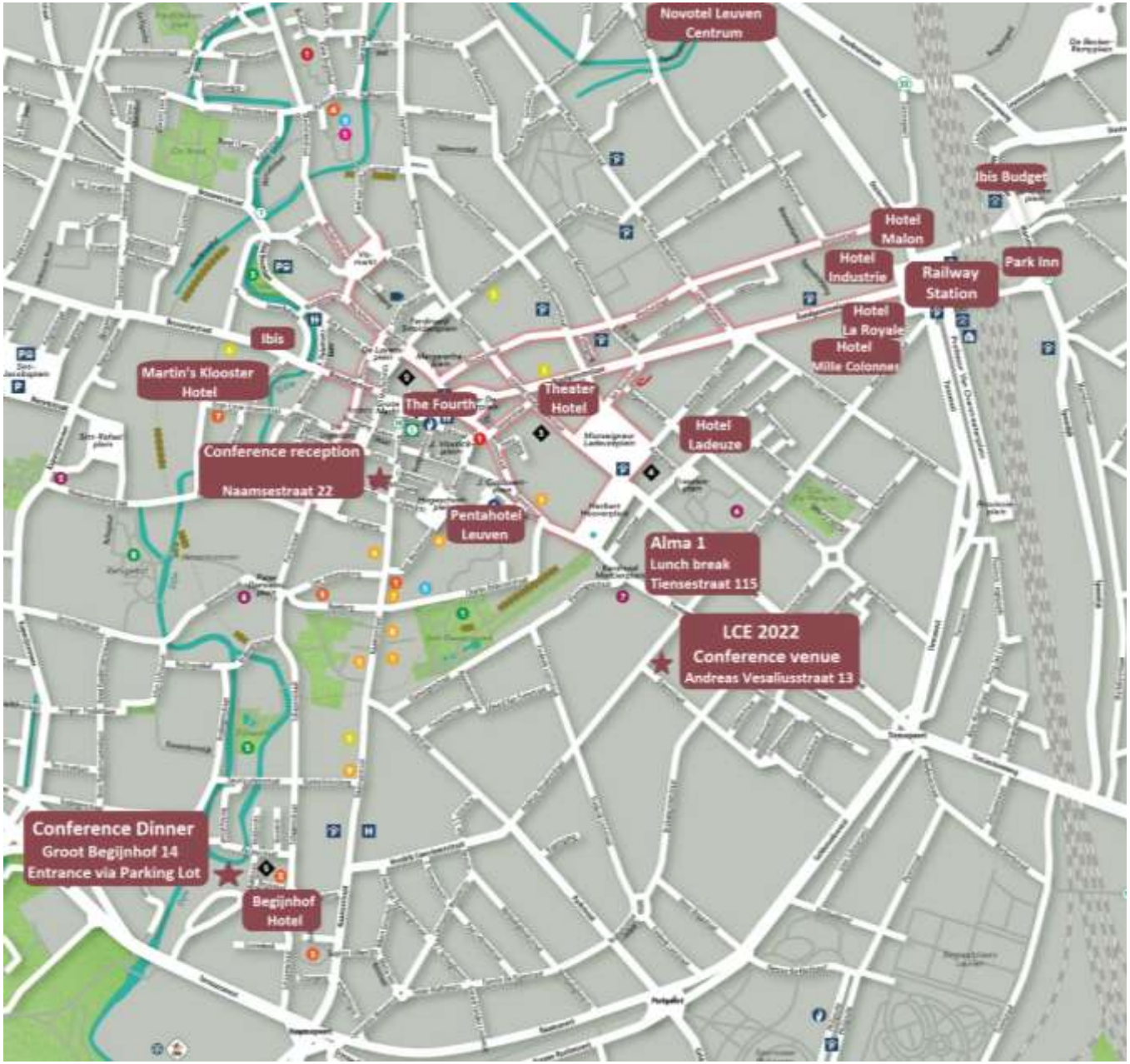
Wednesday 6 April – 16:00 – 17:20 – Parallel sessions – joint LCE2022 & CATS2022

Leuven	New York	Beijing	Tokyo	Sydney	Track 1 (Aula)	Disassembly & recycling 4.0 – 3 *(chair: C. Favi)*	ID
16:00	10:00	22:00	23:00	0:00	*Simon Van den Eynde*	Assessing the efficiency of Laser-Induced Breakdown Spectroscopy (LIBS) based sorting of post-consumer aluminium scrap	35_01
16:20	10:20	22:20	23:20	0:20	*Fengfu Yin*	Research on an intelligent disassembling method for multi-type mobile phones based on rough set theory	35_02
16:40	10:40	22:40	23:40	0:40	*Felix Klenk*	Potential assessment of an increased exchange of core information for remanufacturing in automotive reverse supply chains	35_03
17:00	11:00	23:00	0:00	1:00	*Richard Blümel*	Research on Gentle Loosening of Solidified Bolted Joints for Complex Capital Goods	35_04
					Track 2 (Mod.5)	Business models – 2 *(chair: D. Evrard)*	
16:00	10:00	22:00	23:00	0:00	*Walid Ijassi*	Characterizing urban factories by their value chain: a first step towards more sustainability in production	36_01
16:20	10:20	22:20	23:20	0:20	*Jan Felix Niemeyer*	A creativity-driven Case-Based Reasoning Approach for the systematic Engineering of Sustainable Business Models	36_02
16:40	10:40	22:40	23:40	0:40	*Jannik Alexander Schneider*	Life cycle cost impact of maintenance networks for product-service system fleets	36_03
17:00	11:00	23:00	0:00	1:00	*Daniel Guzzo*	A pricing system for machine tools offered as result-oriented Product-Service System	36_04
					Track 3 (Mod.6)	Lean production and assembly (*chair: E. Demeester*)	
16:00	10:00	22:00	23:00	0:00	*Fabian Dillinger*	Competence Requirements in Manufacturing Companies in the Context of Lean 4.0	37_01
16:20	10:20	22:20	23:20	0:20	*Lucas Bretz*	The ECO Maturity Model – A human-centered Industry 4.0 maturity model	37_02
16:40	10:40	22:40	23:40	0:40	*Fabian Sippl*	Approach for stakeholder identification in Manufacturing Change Management	37_03
17:00	11:00	23:00	0:00	1:00	*Konrad Jagusch*	Process control measures in reaction to assembly adjustments in one-off production	37_04

Wednesday 6 April – 17:20 – 17:40 – LCE2022 Closing session

Leuven	New York	Beijing	Tokyo	Sydney	Plenary (Aula)	LCE2022 Closing session *(chairs: W. Dewulf, J. Duflou)*	ID
17:20	11:20	23:20	0:20	1:20	*Closing session*		38_01

Map


Novotel Leuven Centrum
Ibis Budget
Hotel Malon
Park Inn
Hotel Industrie
Railway Station
Hotel La Royale
Hotel Millie Colonnes
Ibis
Martin's Klooster Hotel
The Fourth
Theater Hotel
Hotel Ladeuze
Conference reception
Naamsestraat 22
Pentahotel Leuven
Alma 1
Lunch break
Tiensestraat 115
LCE 2022
Conference venue
Andreas Vesaliusstraat 13
Conference Dinner
Groot Begijnhof 14
Entrance via Parking Lot
Begijnhof Hotel

Overview

Europe (CET)	New York (USA)	Beijing (CN)	Tokyo (JP)	Sydney (AUS)	CONFERENCE DAY 1 | April 4th			
08:00 - 09:00	02:00 - 03:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	Registration			
09:00 - 10:35	03:00 - 04:35	15:00 - 16:35	16:00 - 17:35	17:00 - 18:35	Plenary session (Aula)			
10:35	04:35	16:35	17:35	18:35	Coffee break			
10:55 - 12:15	04:55 - 06:15	16:55 - 18:15	17:55 - 19:15	18:55 - 20:15	Life Cycle Assessment - 1 (Aula)	Business Models - 1 (Module 5)	Circular Economy - 1 (Module 6)	Transport & Mobility - 1 (Module 11)
12:15	06:15	18:15	19:15	20:15	Lunch break			
13:45 - 15:25	07:45 - 09:25	19:45 - 21:25	20:45 - 22:25	21:45 - 23:25	Life Cycle Assessment - 2 (Aula)	Sustainable Manufacturing - 1 (Module 5)	Circular Economy - 2 (Module 6)	Transport & Mobility - 2 (Module 11)
15:25	09:25	21:25	22:25	23:25	Coffee break			
15:45 - 17:05	09:45 - 11:05	21:45 - 23:05	22:45 - 00:05	23:45 - 01:05	Ecodesign - 1 (Aula)	Sustainable Manufacturing - 2 (Module 5)	Circular Economy - 3 (Module 6)	Energy Systems - 1 (Module 11)
17:05	11:05	23:05	00:05	01:05	End of day 1			
18:00					Guided city tour			
19:00					Conference dinner			

Europe (CET)	New York (USA)	Beijing (CN)	Tokyo (JP)	Sydney (AUS)	CONFERENCE DAY 2 | April 5th		
09:00	03:00	15:00	16:00	17:00	Welcome		
09:00 - 10:35	03:00 - 04:35	15:00 - 16:35	16:00 - 17:35	17:00 - 18:35	Ecodesign - 2 (Aula)	Sustainable Manufacturing - 3 (Module 5)	Circular Economy - 4 (Module 6)
10:40	04:40	16:40	17:40	18:40	Coffee break		
11:00 - 12:40	05:00 - 06:40	17:00 - 18:40	18:00 - 19:40	19:00 - 20:40	Life Cycle Assessment - 3 (Aula)	Additive Manufacturing - 1 (Module 5)	Circular Economy - 5 (Module 6)
12:40	06:40	18:40	19:40	20:40	Lunch break		
14:00 - 15:40	08:00 - 09:40	20:00 - 21:40	21:00 - 22:40	22:00 - 23:40	Life Cycle Assessment - 4 (Aula)	Additive Manufacturing - 2 (Module 5)	Maintenance & Repair (Module 6)
15:40	09:40	21:40	22:40	23:40	Coffee break		
16:00 - 17:40	10:00 - 11:40	22:00 - 23:40	23:00 - 00:40	00:00 - 01:40	Workshop on sustainable engineering education (Module 11)	Workshop on industrial symbiosis (Module 5)	Workshop on Product Passports (Module 6)
17:40	11:40	23:40	00:40	01:40	End of day 2		
19:00					Conference reception		

Europe (CET)	New York (USA)	Beijing (CN)	Tokyo (JP)	Sydney (AUS)	CONFERENCE DAY 3 | April 6th			
08:30 - 08:50	02:30 - 02:50	14:30 - 14:50	15:30 - 15:50	16:30 - 16:50	Welcome and opening session for CATS delegates (Aula)			
08:50 - 09:00	02:50 - 03:00	14:50 - 15:00	15:50 - 16:00	16:50 - 17:00	Short break - LCE delegates joining			
09:00 - 10:40	03:00 - 04:40	15:00 - 16:40	16:00 - 17:40	17:00 - 18:40	Plenary session [LCE+CATS] (Aula)			
10:40	04:40	16:40	17:40	18:40	Coffee break			
11:00 - 12:40	05:00 - 06:40	17:00 - 18:40	18:00 - 19:40	19:00 - 20:40	Disassembly & Recycling 4.0 - 1 (Aula)	Energy Systems - 2 (Module 5)	Batteries - 1 (Module 6)	Manufacturing Systems - 1 (Module 11)
12:40	06:40	18:40	19:40	20:40	Lunch break			
14:00 - 15:40	08:00 - 09:40	20:00 - 21:40	21:00 - 22:40	22:00 - 23:40	Disassembly & Recycling 4.0 - 2 (Aula)	Energy Systems - 3 (Module 5)	Batteries - 2 (Module 6)	Manufacturing Systems - 2 (Module 11)
15:40	09:40	21:40	22:40	23:40	Coffee break			
16:00 - 17:20	10:00 - 11:20	21:00 - 23:20	22:00 - 00:20	23:00 - 01:20	Disassembly & Recycling 4.0 - 3 (Aula)	Business Models - 2 (Module 5)	Lean Production and Assembly (Module 6)	
17:20	11:20	23:20	00:20	01:20	LCE2022 Closing session (Aula)			
17:40	11:40	23:40	00:40	01:40				