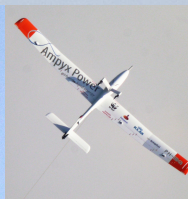
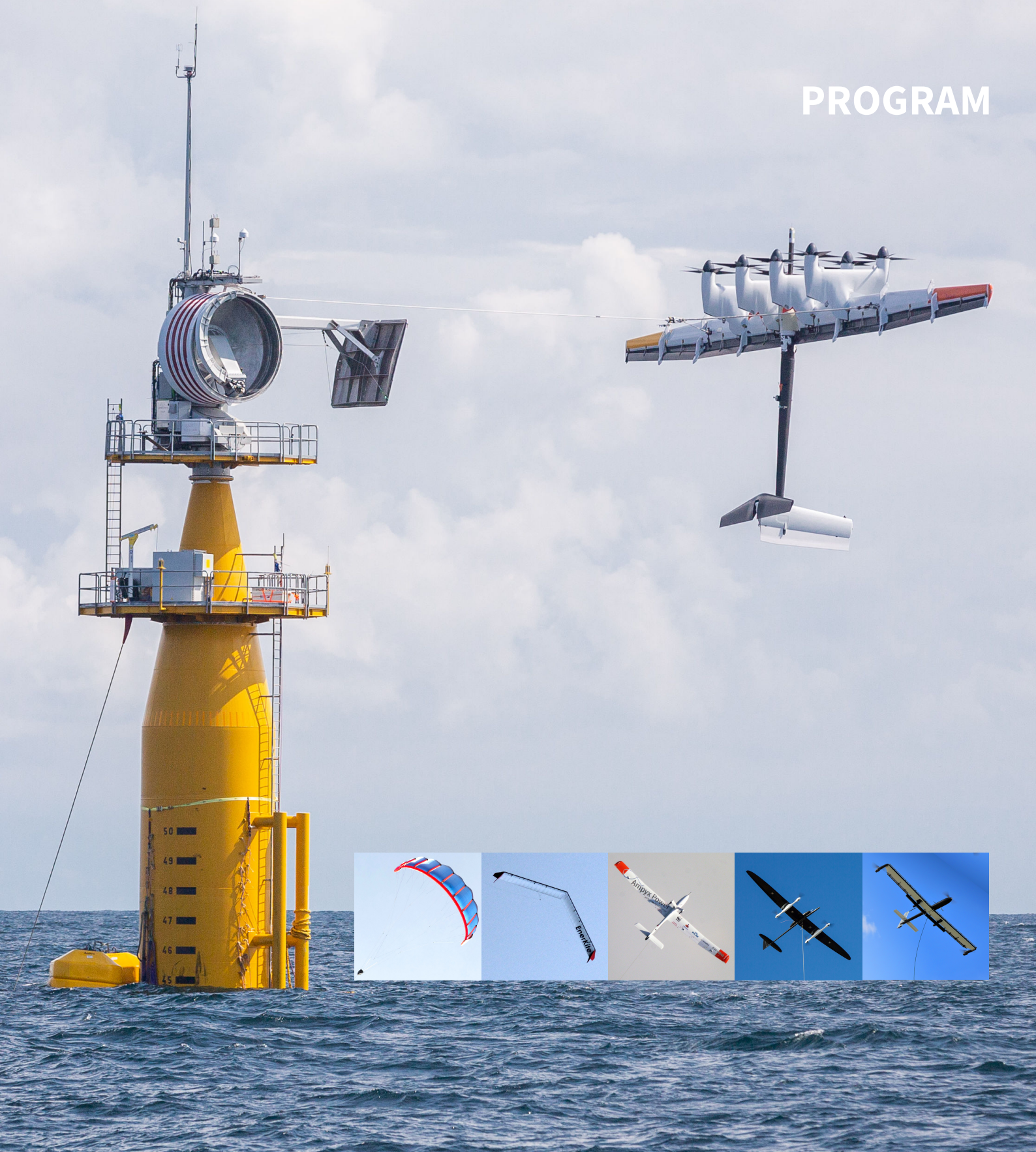


AIRBORNE WIND ENERGY 2019 CONFERENCE

15-16 OCTOBER
UNIVERSITY OF
STRATHCLYDE
UNITED KINGDOM
awec2019.com

PROGRAM





About the conference

The 8th international Airborne Wind Energy Conference (AWEc 2019) is jointly organized by the University of Strathclyde, Delft University of Technology and Airborne Wind Europe. The event will take place on 14, 15 and 16 October 2019 in Glasgow, hosted by the Wind Energy and Control Centre of the University of Strathclyde.

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The scientific program will take place at the University of Strathclyde at the Technology and Innovation Center (TIC) and include

- five plenary talks by selected experts from international agencies, industry and academia, and
- eleven contributed talk sessions in two parallel tracks, comprising a total of 42 presentations, and
- five panel discussions covering all aspects of airborne wind energy, including a further 10 presentations, and
- two poster sessions, each preceded by plenary spotlight presentations, with altogether 21 poster presentations.

Organizing committee

- David Ainsworth, KPS, UK
- Navi Rajan, TU Delft, Netherlands
- Roland Schmehl, TU Delft, Netherlands
- Stefanie Thoms (chair), Airborne Wind Europe, Belgium
- Oliver Tulloch, University of Strathclyde, UK
- Hong Yue, University of Strathclyde, UK

- Ahmad Hably, Grenoble INP, France
- Christoph M. Hackl, MUAS, Germany
- Colin Jones, EPFL, Switzerland
- Michiel Kruijff, Ampyx Power, Netherlands
- Rolf Luchsinger, TwingTec, Switzerland
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- Espen Oland, Kitemill & UiT, Norway
- Johannes Peschel, Kitepower, Netherlands
- Kristian Petrick, Airborne Wind Europe, Belgium
- Gonzalo Sanchez-Arriaga, UC3 Madrid, Spain
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- Roy Smith, ETHZ, Switzerland
- Alexandre Trofino Neto, UF Santa Catarina, Brazil
- Axelle Viré, TU Delft, Netherlands
- Chris Vermillion, NC State University, USA
- Hong Yue, University of Strathclyde, UK
- Udo Zillmann, Airborne Wind Europe, Belgium

Program committee

- David Ainsworth, KPS, UK
- Philip Bechtle, University of Bonn, Germany
- Alexander Bormann, EnerKite, Germany
- Moritz Diehl, University of Freiburg, Germany
- Lorenzo Fagiano, Politecnico di Milano, Italy
- Fort Felker, Makani, USA
- Sebastien Gros, NTNU, Norway

The book of abstracts is edited by Roland Schmehl and Oliver Tulloch and distributed to registered conference attendees.

The book of abstracts and this program are available in open access from
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Conference sponsors



Program - Monday, 14 October 2019

Time		
16:00	REGISTRATION	[FOYER]
18:00	WELCOME RECEPTION	[GLASGOW CITY CHAMBERS]

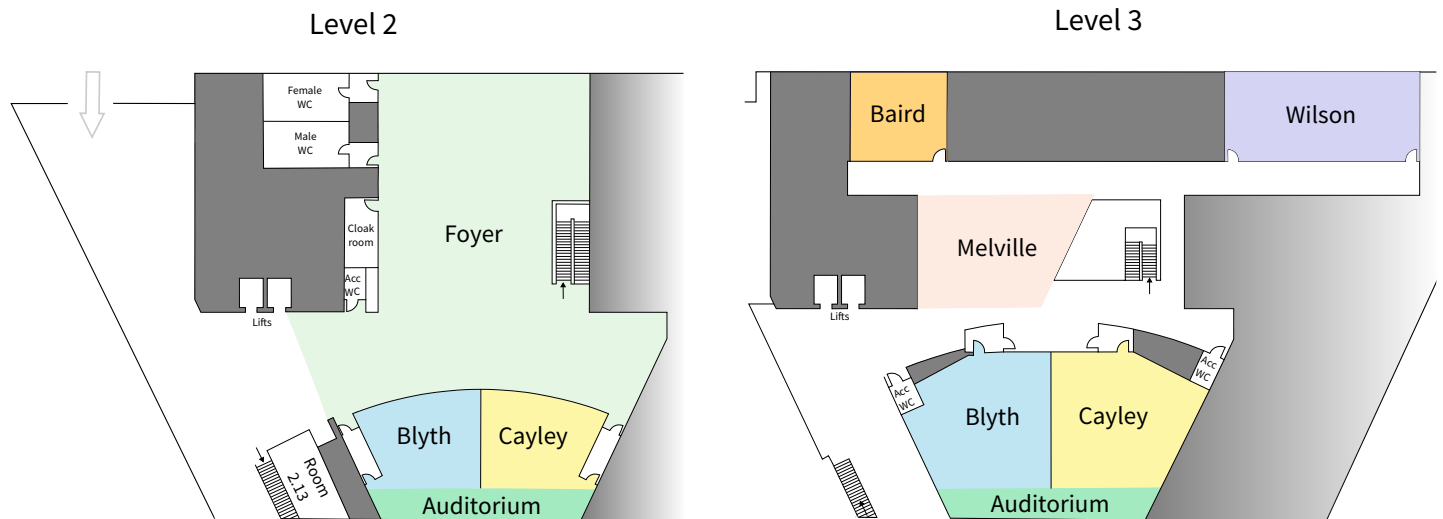
Program - Tuesday, 15 October 2019

Time			
8:30	REGISTRATION		[FOYER]
9:00	CONFERENCE OPENING	Roland Schmehl, <i>TU Delft</i> Stefanie Thoms, <i>Airborne Wind Europe</i> Bill Leithead, <i>University of Strathclyde</i>	[AUDITORIUM]
9:20	INTRODUCTION	Giles Dickson, <i>WindEurope</i> Challenges and Learnings to Progress Wind Energy as an Industry	
9:40	PLENARY 1 TALK	Sören Sieberling, <i>Ampyx Power</i> Status Update and Review of the AP-3 Development	
10:10	PLENARY 2 TALK	Doug McLeod, <i>Makani</i> Lessons Learned from Testing Makani's Energy Kite Offshore	
10:40	COFFEE		[FOYER]
11:10	AWES DEVELOPMENT [BLYTH]	CONTROL CROSSWIND [WILSON]	R&D PANEL [CAYLEY]
	Joep Breuer, <i>Kitepower</i> REACH: a H2020 FTI Project to Develop a 100 kW AWE System	Eva Ahbe, <i>ETH Zurich</i> Experimental Validation of Path-Tracking Model Predictive Control for Fixed-Wing Power Kites	Jochem Weber, <i>NREL</i> AirborneMax - Scaling as the Key Issue for Airborne Wind Energy Roderick Read, <i>Windswept</i> Practical Tests of Rotary Network AWES Kristian Petrick, <i>Airborne Wind Europe</i> Developing a European Roadmap for AWE
11:30	Lode Cernel, <i>Kitemill</i> From Minutes to Hours of Autonomous Operation	Hironori A. Fujii, <i>TMIT</i> Three-Dimensional Flight Trajectories of Tethered UAV for Optimal Energy Generation	PANEL DISCUSSION Roland Schmehl, <i>TU Delft</i> (moderator) Stephanie Mann, <i>ORE Catapult</i> Dominik von Terzi, <i>TU Delft</i> David McMillan, <i>Uni Strathclyde</i> Philip Bechtle, <i>Uni Bonn</i>
11:50	Michiel Kruijff, <i>Ampyx Power</i> Challenges and Opportunities of AWES Market Entry at Utility Scale	Ignacio Oficialdegui, <i>Acciona Energy</i> WINDSLED: Alternative Model to Conventional Logistics in Polar Regions Based on AWE	
12:10	Andy Stough, <i>Windlift</i> What is the Right Size for an AWE System?	Manfred Quack, <i>SkySails Power</i> Extended Periods of Automated Tethered Flight at SkySails	
12:30	LUNCH		[FOYER]
13:40	PLENARY 3 TALK	Cédric Philibert, <i>International Energy Agency</i> Wind Power in the Energy Transition	[AUDITORIUM]
13:50	OEM 1 PANEL	Johannes Peschel, <i>Kitepower</i> Kitepower and the Journey Towards 24/7 Operation	
14:00		Thomas Hårklau, <i>Kitemill</i> Kitemill: Past, Present and Future	
14:10		PANEL DISCUSSION Udo Zillmann, <i>Airborne Wind Europe</i> (moderator) Richard Ruiterkamp, <i>Ampyx Power</i> Cédric Philibert, <i>IEA</i> Poster 1 Presenters	Stephan Brabeck, <i>Skysails</i> Doug McLeod, <i>Makani</i> Giles Dickson, <i>WindEurope</i>
15:10	POSTER 1 SPOTLIGHTS		
15:30	COFFEE		[FOYER]
16:00	POSTER 1 SESSION		[MELVILLE]
	Eiji Itakura, <i>Toyota Motor Corporation</i> Save from Future Japan Social Crises! "Mother-ship" Project Uwe Fechner, <i>Aenarete</i> Open Data Project: Flight Data Analysis of Kite-power Systems Alex Rementeria, <i>Cranfield University</i> Wind Tunnel Parametric Study of Kite Performance for Power Generation Solenn Le Pense, <i>KPS</i> Effect of Wind Variations on Tether Load Transfer from Kite to Winch Antoine Morvan, <i>ENSTA-Bretagne</i> A Fast Simulation Tool for Ships Towed by Kites: Assessment of Propulsion Efficiency	Peter Listov, <i>EPFL</i> PolyMPC: An Efficient Tool for Embedded Model Predictive Control for Fast Mechatronic Systems Mahdi Ebrahimi Salari, <i>Uni Limerick</i> A Study on Power Transmission Techniques for Marine Airborne Wind Energy Farms Jonathan Dumon, <i>Gipsa-lab</i> Power Curve Analysis Of Airborne Wind Energy Tallak Tveide, <i>Kitemill</i> The Second, Most Important, Law of Tether Scaling Hiroshi Okubo, <i>Kanagawa IT</i> Airborne Wind Power Generation Employing Straight-Bladed Wind Turbines	Rachel Leuthold, <i>Uni Freiburg</i> Comparison of Engineering Induction Models in a Multi-Kite Optimal Control Problem Alan Mortimer, <i>Wood Clean Energy</i> Complex Wind Profiles Measured Offshore and Their Relevance to Airborne Systems Manuel C.R.M. Fernandes, <i>Uni Porto</i> Heading Angle Control for Path-following Guidance in a Pumping Kite Generator Rigo Bosman, <i>DSM</i> Engineering With a Bending-Optimized HMPE AWE Tether Jochem De Schutter ¹ , <i>Uni Freiburg</i> OpenOCL - Optimal Control Library for Airborne Wind Energy
16:30	WIND RESOURCE & ENERGY PROD. [BLYTH]	PERFORMANCE MODELING [WILSON]	AIRSPACE & REGULATION PANEL [CAYLEY]
	Mark Schelbergen, <i>TU Delft</i> Airborne Wind Energy Production Estimation using Wind Profile Shape Statistics	Thomas Haas, <i>KU Leuven</i> Investigation of Airborne Wind Energy Farm Performance for Different Operation Modes Using Large Eddy Simulation	Kristian Petrick, <i>Airborne Wind Europe</i> Developing Airborne Wind Energy Safety and Technical Guidelines PANEL DISCUSSION Corey Houle ³ , <i>TwingTec</i> (moderator) Dieter Moormann, <i>RWTH Aachen</i> Nathanel Apter, <i>FOCA</i> Amanda Boekholt, <i>FOCA</i> Patrick Junge, <i>Skysails</i> Neal Rickner, <i>Makani</i> Michiel Kruijff, <i>Ampyx Power</i>
16:50	Philip Bechtle, <i>Uni Bonn</i> Airborne Wind Energy Resource Analysis: From Wind Potential to Power Output	Tim Brodrick, <i>KPS</i> Effect of Mass on Airborne Wind Energy Performance	
17:10	Markus Sommerfeld ² , <i>Uni Victoria</i> Wind Inflow Profile Impacts on Optimal AWE System Sizing	Vincent Bonnin, <i>Ampyx Power</i> An Analytical Performance Model for AP-4 Conceptual Design Phase	
17:30	END-OF-DAY		
18:30	BUSSES DEPARTURE FOR DINNER		[FOYER]
19:00	CONFERENCE DINNER		[TALL SHIP]

Program - Wednesday, 16 October 2019

Time						
8:30	REGISTRATION					[FOYER]
9:00	KEYNOTE Lorenzo Fagiano, <i>Politecnico di Milano</i> Automation Challenges in AWE Systems and the Role of Academic Research Alexander Bormann, <i>Enerkite</i> Latest Achievements Towards Next Generation Renewables 9:40 OEM 2 PANEL Rolf H. Luchsinger, <i>TwingTec</i> TwingTec's Roadmap to Wind Energy 2.0: From Full Proof of Concept to the First Commercial Product 9:50 PANEL DISCUSSION Udo Zillmann, <i>Airborne Wind Europe</i> (moderator) David Ainsworth, <i>KPS</i> Max Ter Horst, <i>e-kite</i> Reinhart Paelinck, <i>Kiteswarms</i> Robert Creighton, <i>Windlift</i> Fort Felker, <i>Makani</i> 10:00 POSTER 2 SPOTLIGHTS Poster 2 Presenters					[AUDITORIUM]
10:45	COFFEE					[FOYER]
11:15	POSTER 2 SESSION Michael Perlberger, <i>Brainwhere</i> Brainwhere's AWE System for Harvesting High Altitude Wind Energy Daniel Zywiets, <i>Enerwhere</i> What Will it Take for AWE to be Successful in Remote & Mini-Grid Applications? 11:30 SYSTEM OPT. & COST MODELING [BLYTH] Mitchell Cobb, <i>NC State University</i> Development of Iterative Learning Strategies for Optimal Crosswind Flight of AWE Systems 11:50 Elena Malz, <i>Chalmers</i> The Value of Airborne Wind Energy in a Zero-Emission Electricity System 12:10 Filippo Trevisi, <i>DTU</i> Configuration Optimisation of a Generic Crosswind Wind Energy System 12:30 Mark Aull, <i>Windlift</i> Airborne Wind Energy System Optimizer (AWESOpt) for Fly-Gen Analysis and Optimization 12:50 LUNCH					[MELVILLE]
13:50	Hiroki T. Endo, <i>Niihama-Kosen</i> R&D of Airborne Wind Power Generation at Niihama National College of Technology Espen Oland, <i>Kitemill</i> A Solution to the Pose Estimation Problem for Airborne Wind Energy Systems using Multiple Bluetooth 5.1 Devices 13:50 AWES RESEARCH [WILSON] Max Rüger, <i>Uni Bonn</i> AWESome: An AWE Learning Platform using Open Science and Open Hardware 14:10 Gonzalo Sánchez-Arriaga, <i>UC3 Madrid</i> Flight Testing, Aerodynamic Parameter Identification and Dynamic Simulation of Rigid and Flexible Kites Applied to AWE Systems 14:30 Tarek N. Dief, <i>Kyushu University</i> Hardware-in-the-Loop (HIL) and System Identification of a Pumping Kite Power System 14:50 Rik Bättig, <i>ftero, ETH Zurich</i> Fast Prototyping of Morphing Wings for Airborne Wind Energy 15:10 UTILITY & PROJECT DEV. PANEL [CAYLEY] Kester Gunn, <i>RWE Renewables</i> Investigating Offshore Markets for AWE Technologies Ciaran Frost, <i>BVG Associates</i> Global Prospects for Airborne Wind Onshore PANEL DISCUSSION Udo Zillmann, <i>Airborne Wind Europe</i> (mod) Henk Hutting, <i>NuCapital</i> Fabian Wendt, <i>Ramboll</i> Carlos Llopis, <i>Siemens Gamesa</i>					[CAYLEY]
15:10	REGULATION & SAFETY [BLYTH] Corey Houle ⁴ , <i>TwingTec</i> Safe Testing of AWE Systems 15:30 Sebastian Rapp, <i>TU Delft</i> Rare Event Prediction for Enhanced Control System Reliability of AWE Systems 15:50 Gillian Vallejo, <i>Natural Power</i> Avian Collision Risk Modelling: A Comparison of Methods for AWE Devices 16:10 Neal Rickner, <i>Makani</i> AWE Systems as an Obstruction: Makani's Journey with the FAA 16:30 CONTROL LAUNCH & LANDING [WILSON] Lorenzo Fagiano, <i>Politecnico Milano</i> Control of Vertical Take Off, Pumping Operation and Vertical Landing of Hybrid Drones for AWE Audrey Schanen, <i>Gipsa-lab</i> On Using Drones for the Take-Off and Landing Phases of an AWE System Espen Oland, <i>Kitemill</i> Kitemill's Vertical Take-off and Landing System for the KM1 Model Paul Williams, <i>Ampyx Power</i> Autonomous Automatic Takeoff and Landing of Rigid Wind Airborne Wind Energy Systems 16:50 MODELING & SIMULATION [CAYLEY] Frédéric Bourgault, <i>New Leaf Mgmt</i> Coupled Kite-Ground Station Simulink Model for Optimal Flight Path Following Assessment Mikko Folkersma, <i>TU Delft</i> Fluid-Structure Interaction of Inflatable Wing Sections Oliver Tulloch, <i>Uni Strathclyde</i> Modelling Studies on Tensile Rotary Power Transmission for AWE Systems Mac Gaunaa, <i>DTU</i> Investigation of the Effect of Modelling Different Degrees of Detail in the Key Elements in a Crosswind Kite Wind Energy System					[FOYER]
15:10	COFFEE					[FOYER]
15:40	AERODYN./STRUCT. MODELING [BLYTH] Mojtaba Kheiri, <i>Concordia University</i> Advances in Aerodynamic Modelling of Crosswind Kite Power Systems 16:00 Urban Fasel, <i>ETH Zurich</i> Aeroservoelastic Analysis and Optimization Framework for Morphing AWE Wings 16:20 Ashwin A. Candade, <i>Enerkite / TU Delft</i> Development of a Toolchain for Aero-structural Design of Composite AWE Kites 16:40 Paul Thedens, <i>SkySails Power</i> Steady-State Solver for a Ram-Air Kite Aeroelastic Model Based on Dynamic Relaxation 17:00 CONCEPT DESIGN [WILSON] Christof Beaupoil, <i>someAWE Labs</i> Practical Experiences With a Torsion Based Rigid Blade Rotary AWE System With Ground Based Power Generation Florian Bauer, <i>TU Munich</i> Power Electronic Topologies of Drag Power Kites Jochem De Schutter ⁵ , <i>Uni Freiburg</i> Towards a Modular Upscaling Strategy for Utility-Scale Airborne Wind Energy Paul Williams, <i>Ampyx Power</i> Model-Based Development and Verification of Ampyx Power's Airborne Wind Energy System 17:40 AIRBORNE WIND EUROPE [BAIRD] Members (only) meeting, with: Ampyx Power, e-kite, Enerkite, FEcreate, Kitepower, Kiteswarms, Kitemill, KPS, Makani, Politecnico di Milano, Skypull, Skysails, TU Delft, TwingTec					[BAIRD]
17:00	CONFERENCE CLOSING PANEL TALK Roland Schmehl, <i>TU Delft</i> Udo Zillmann, <i>Airborne Wind Europe</i> and invited guests • What are the key take-aways from the conference? • What are the key opportunities for AWE in the next years? • What should the industry focus on and how can academia help most effectively? • What are the key messages to the non-AWE world?					[AUDITORIUM]
17:40	END-OF-DAY					

Floorplan of conference building



Short notice program changes

1. Jochem De Schutter will be replaced by co-author Rachel Leuthold, Uni Freiburg.
2. Markus Sommerfeld will be replaced by co-author Frédéric Bourgault, New Leaf Management Ltd.
3. Corey Houle will be replaced by co-moderator Kristian Petrick, Airborne Wind Europe.
4. Corey Houle will be replaced by Natanel Apter, Swiss Federal Office of Civil Aviation (FOCA), presenting “An Operational-Centric Approach to Safety”.
5. Jochem De Schutter will be replaced by co-author Rachel Leuthold, Uni Freiburg.

Session chairs

AWES DEVELOPMENT: Rolf Luchsinger, TwingTec, [E rolf.luchsinger@twingtec.ch](mailto:rolf.luchsinger@twingtec.ch)
CONTROL CROSSWIND: Lorenzo Fagiano, Politecnico di Milano, [E lorenzo.fagiano@polimi.it](mailto:lorenzo.fagiano@polimi.it)
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POSTER 1 & 2 SESSIONS: Oliver Tulloch, University of Strathclyde, [E oliver.tulloch@strath.ac.uk](mailto:oliver.tulloch@strath.ac.uk)

Information for presenters and session chairs

Slide presenters should contact their session chair before the start of their session, towards the end of a preceding lunch/coffee break or poster session. All presentation rooms are equipped with a beamer and a connected PC/Laptop, running MS Powerpoint, Acrobat Reader and a common webbrowser with internet access. Presentations should be copied to this PC/Laptop via USB stick. If absolutely required external Laptops can be connected to the beamer via HDMI/VGA ports. In the tradition of the last AWECs all presentations will be videorecorded for the purpose of posting the presentations online in open access, free of charge, to increase the reach of the conference especially also for audience that can not afford participation in the event. This has been communicated to all abstract authors / presenters well ahead of the conference. It is assumed that by registering and participating in the conference, presenters implicitly allow the conference organizers to publish the recorded presentation videos for above non-commercial purpose. Also posters will be made available for download from the conference website.

EAWE Technical Committee “Airborne Wind Energy” Meeting

During the Wind Energy Science Conference (WESC) in Cork, 16–20 June 2019, the General Assembly of the European Academy of Wind Energy (EAWE) approved the establishment of a Technical Committee “Airborne Wind Energy” (EAWE-TC-AWE). The kick-off meeting for this committee will be held during the AWEC 2019, on Wednesday 16 October from 10:45–11:30, parallel to the Poster 2 Spotlight, Coffee Break and following Poster 2 Session, in room 2.13. The meeting will be chaired by Roland Schmehl, TU Delft. Invited are the committee members Tim Hagemann (replacing Po Wen Cheng), University of Stuttgart; Mac Gaunaa, DTU; Philip Bechtle, University of Bonn; Moritz Diehl, University of Freiburg; Lorenzo Fagiano, Politecnico di Milano and Florian Bauer (replacing Filippo Campagnolo), TU Munich.

Public transportation

SPT Travel Centres provide information about all types of travel in Glasgow and Strathclyde area. The Glasgow subway system is the easiest way to get around the City Centre and West End. A single journey costs £1.75, a return £3.30 and a day ticket £4.20. Services run every 5 minutes at peak times. Alternatively Nextbike Glasgow has 700 bikes for hire in 70 locations available 24/7. You can rent a bike via nextbike’s Android/iPhone App, by the on-bike computer, or by phoning +44 (0)20 816 69851. Rental starts at £1 for the first 30 minutes.

Internet

Wifi in the conference building is available through the network eduroam, which can be accessed with a host university account. Alternatively you can use the network TIC conferences, which can be accessed with the password *DearGreenPlace*.

Map of Glasgow and conference locations

