

CV 2022-06-05: Peter D. LUND (b. 1957), Professor



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彼得·隆德

Education

1980 M.Sc. in Engineering Physics (Nuclear Engineering and Reactor Physics)
Helsinki University of Technology in Finland (HUT)
1980 18th Graduate Study Programme, United Nations, Geneva
1981 Lic.Sc. in Technology (Engineering Physics) HUT
1984 D.Sc. in Technology (Engineering Physics) HUT
1989 Accelerated Development Programme (ADP1), London Business School

Areas of Specialization

New and renewable energy systems; Energy and innovation; Sustainable energy policy; Multidisciplinary issues in energy; Science-to-policy advice.

Previous Appointments

Professor in Advanced Energy Systems (Eng. Physics) at Aalto University (formerly Helsinki University of Technology, HUT) (1998-); Assoc.Prof.(1992-98); Chair of Aalto Energy Science Initiative (2011-18), Multi-Disciplinary Energy Programme (2013-), Energy Science M.Sc. Major (2019-); Board member Aalto Energy Platform (2013-18). Deputy and Head of Department (1998-2007). Director & coordinator of national new energy R&D for Finnish Funding Agency for Technology and Innovation (Tekes) (1988-98). Founding member & chairman of Energy Institute at HUT. Director of National Graduate School on Energy Science & Technology (2003-08). Part-time Visiting Professor Hubei University (China 2014-), Chutian Chair Professor Hubei University (2015-17). Overseas Teacher Southeast University (China 2015-17). TÜV Guest Professor Technische Universität Dresden, Germany (2015-16). Guest Professor Nanjing Xiaozhuang University (2017-20). Guest Professor (2019-24), Honorary Professor (2019-21) Southeast University.

Professional Experience

EU: Co-Chair European Academies WG on Systemic approach to the energy transition in Europe (2020-21). Chair of Advisory Group of Energy of the European Commission (2002-06). European Academies Science Advisory Council's Energy Panel (Chair 2013-17, member 2009-19). Steering committee member European Platform of Universities in Energy Research (2009-2018) & FP7/UNI_SET (2015-18), Euro-CASE Energy Platform (2013-2016). Advisory roles to European Commission, Co-chair/Vice-Chair of E.C. Call Evaluations, EU Fuel Cell and Hydrogen Joint-Undertaking, European Institute of Innovation and Technology (EIT 2013, 2016-17), ESFRI (2007-11), Core Expert Group for SET-Plan European Energy Education and Training Initiative (2011-14).

Business: Board Member of Ahlstrom Capital Cleantech Management Ltd. (2010-19), Fortum Foundation (2013-18), Gasum Foundation (2004-18), Uniscience Ltd (1997-98). Co-founder Solpros consulting (1994-). Advisor Finnish Innovation Fund SITRA (2015-16). Member of DeTao Masters Academy (2015-). Co-founder (with Dr. X. Zhou) China-Finland Cleantech Business Platform (2017-). Co-founder (with Prof. B. Zhu, BGRIMM Ltd., 2017-) China-EU Open Joint @Lab on Adv. Fuel Cells (中欧燃料电池联合开放实验室合作协议). China-EU New Energy Science Park (共建中欧新能源科技园战略合作框架协议, Qixia, 2019). Economic development advisor, Nanjing-Qixia District (2019-).

National/Nordic: Vice-Chair Finland's Climate Change Panel (2020-23). Team Lead, Nordic Council of Ministers, Prime Ministers' Initiative on Excellence in Research and Innovation on Energy, Environment and Climate (2008); Member of experts Finnish Gov. foresight report on long-term climate and energy policy (2007-09). Member of advisory board Finnish Gov. Str. Programme for Environ. Operations (2011-15), Finnish Gov. Cleantech Str. Programme (2012-15), TEKES Foresight (2006) and Climtech (2000-02). Chair of Science Council of Str. Centre for S,T & I of Finnish Energy and Environ. Cluster (2011-15). Co-chair of Finnish-Russian S&T cooperation on new energy (1996-2000); Chair, Senior Officials energy efficiency group of Baltic Sea Region Cooperation (2004-05).

International R&D: IAB of National Center of Excellence at King Fahd Univ. of Petroleum and Materials/Ministry of Education, Saudi Arabia (2011-13). Steering committee of Research Council of Norway Energy Programme (2000-08), European Strategy Forum on Research Infrastructures, Energy (2007-11), Scientific Adv. Board of Austrian Arsenal Research Centre (2005-08), Instituto Madrileño de Estudios Avanzados Energia Spain (2007-11), Swedish Fuel Cell Programme (STEM 2002-5). Executive Committee of IEA solar R&D programmes (1987-2004), vice-chair (1989-93).

Academic/NGO: Member, Finnish Academy of Science and Letters (2018-), Swedish Engineering Academy in Finland (1998-). Member of advisory board Finland Futures Research Centre (2011-15), Johns Hopkins University ISEP (2017-). Board member Helsinki Institute of Physics (1999-06), Finnish Physical Society (1997-99), International Solar Energy Society (1996-99), Swedish Engineering Academy in Finland (2008-13), Finnish Solar Energy Society (1980-84) chairman (1984-85), WWF Finland vice-chair (2004-10) & board of trustees (2000-05). International Council for Thermal Energy Storage, chairman (1994-97); IEEE Technical Committee on Intelligent Green Production Systems, member (2006-); European Renewable Energy Research Centers EEIG, member (1995-2016).

Research/Programme Evaluations: Participated in 80 international evaluations, 20 countries (1992-). Austria (BMNT), Belgium (VITO), Canada (NRC, ORF), Denmark (Energistyrelsen, IRF, H.C. Ørsted, DFF, DTU/Risø), Estonia (ERC, Enterprise Estonia), Finland (Ministry of Trade and Industry), France (ANR), Germany, Hong Kong (RGC), Ireland (SFI), Israel (ISF), Kazakhstan (Ministry of Education and Science), Norway (Research Council of Norway, VISTA), Poland (NSC), Portugal (FCT), Saudi-Arabia (Ministry of Higher Education), Singapore (Agency for STR), Sweden (STEM, Formas, NUTEK), Switzerland (Federal Office of Energy), USA (NSF), IEA, European Commission (many: FP4-FP7, EIT/KIC, JU FCH, Horizon 2020, FET-Flagship, FET, Era-Net, Erasmus+ (3), EU Future Batteries (3), ICT, EU Green Deal, Horizon Europe (2), foundations.

Academic evaluations: Austria, Australia, Belgium, Denmark, Estonia, Finland, France, Germany, India, Ireland, Israel, Jordan, Latvia, Netherlands, Norway, Pakistan, Poland, Qatar, Sweden, Turkey, UK.

Scientific Journals: Editor-in-Chief Oxford Open Energy (Oxford University Press, 2021-); Founding Co-Editor Global Challenges (Wiley, 2015-6, Exc. Adv. Committee 2017-); Co-Editor-in-Chief Interdisciplinary Reviews: Energy and Environment (Wiley, 2010-); Editor-Europe Energy Research (Wiley, 2004-2018); Associate Editor Nano Energy (Elsevier, 2014-5), Solar Energy (2001-5); Editorial board Applied Energy (Elsevier), Energy Sci. & Eng. (Wiley), Int. J. Low-Carbon Technologies (Oxford Univ. Press), Energies (MDPI), Nanomaterials (MDPI), Adv. Board of SCI (MDPI), Energy Materials (OAE). Guest Editor of many special issues. Reviewer 45 journals.

Awards: Honors in Silver by the Swedish Engineering Academy in Finland (2021). Best research article award of 2020 at Tallinn University of Technology in Technics and Technology (coauthored Nano Energy 67(2020)104183) (Estonia 2021). Jiangsu Province International Science and Technology Cooperation Award (China 2021), Tutoring of 1st Prize Entry for the Nat. College New Energy Vehicle Big Data Application Innovation Competition (China, Dec 2020). Jiangsu Friendship Award and Medal 2020 (China). Paper Renewable & Sustainable Energy Reviews 101(2019) selected as paper of the month at Riga Technical University (May 2019). World Society of Sustainable Energy Technologies Innovation Award 2018 (Power Generation Technologies, with Prof. B. Zhu), Jinling Friendship Award (Nanjing, China) 2016, Finnish Solar Industry Life-Work Award 2016, Poster Recognition Award (Nanoenergy 2017, Espoo; with M. Lin and group), Best Paper Award (World Society of Sustainable Energy Technologies, Geneva, 2014; with J. Lindgren), Finnish Nature League Award, 2014, Fortum Prize 2008, Lyceum Award of Pori City, 2006, Finnish Nature Conservation Society's Prize in 2004, ISES Löf-Duffie Award 1991, Imatran Voima Utility Foundation Best PhD Thesis in Energy Award 1987. Knight, First Class, of the Order of the White Rose of Finland 2007.

Conferences: Chairman (10), session chair (37), international committee (60), invited talks (>100). General Chairman of Nano Energy Conference (2014-). Co-organizer Jiangsu-EU Conference on New Energy.

Societal: Frequently asked expert in parliamentary hearings, talks, and public/social media (@LUND_ENERGY). Public and private sector consulting (1995-).

Teaching: Supervised > 150 doctoral and master students. He has guided/supervised 50 doctoral dissertations. Five former Ph.D. students are professors. University courses for 40 years (basics & advances in new energy, energy systems, thermodynamics, fuel cells & H₂, solar, wind, multidisciplinary), visiting lectures. Executive education.

Research Activities

Recent projects: EU 2020: Innovation pathways, strategies and policies for the Low-Carbon Transition in Europe, SURFIT Sustainable solutions for affordable retrofit of buildings; Strategic Research Council: Creative adaptation to wicked socio-environmental disruptions; Nordic Flagship: Flexibility for Variable Renewable Energy Integration in the Nordic Energy System; Academy of Finland: A novel single component fuel cell based on engineered nanocomposites, China-Finland collaboration; ASPIRE: novel integrated approach for highly reproducible and stable perovskite solar cells; Ministry of Environment: Importance of electrification for decarbonization.

Active research collaboration: Southeast University, China University of Geosciences, Hubei University, Nanjing Institute of Technology, Northeastern University, Xi'an University, Tinjian University, Hongkong Polytechnic University, Johns Hopkins University, University of Delaware, Indian Institute of Technology (Delhi), Comsat-Islamabad, Royal Institute of Technology (KTH), Danish Technical University (DTU), Riga University of Technology, Technical University of Dresden, Skolkovo Institute of Science and Technology, Finnish universities.

Research Interests

Future and multidisciplinary energy issues: Energy transition, clean energy systems, nanoenergy, multidisciplinary energy science.

Keywords: solar energy, fuel cells and hydrogen, nanomaterials, energy systems analysis, modelling, scenarios, innovations

Resume of Experience

Peter Lund has more than 40 years of experience in energy and science. He has a rich track-record from research and academia, working across disciplines and bridging sectors. He also applies science to useful human ends, putting experience and insight to lecturing, innovations, science-to-policy advice, and consultancy. His expertise comprises many sustainable energy systems. His academic interest is on energy materials and systems, with a multidisciplinary link to policies, energy transition, and businesses. He is fluent in Finnish, Swedish, English, German, beginner in Chinese.

He has served in different capacities; e.g. board memberships, evaluation of R&D programmes, coordination of RTD, involvement with breakthrough programmes world-wide, which together have resulted in profound insight on research and innovation. EU and China are in his special focus of international work.

Main Achievements

Dr. Lund has made original contributions in clean energy, in particular advanced fuel cells, 3rd generation solar cells, energy storage, energy system flexibility, but also in large R&D initiatives. He pioneered solar energy and energy storage research in Finland in late 1970. His achievements have been recognized with the Finnish Solar Industry Life-Work Award, Imatran Voima and Fortum Foundation Awards, among others.

He pioneered seasonal storage for solar energy. He was PI for world's 2nd large-scale solar storage pilot project; he did ground-breaking work in their optimization and design for which work he received the International Solar Energy Society's Löf-Duffie Award. Dr. Lund pioneered H₂ technology for energy storage (Power-to-H₂-to-Power), and piloted world's 2nd PV-H₂ seasonal storage system also serving as one of the first solar-to-fuel systems. Later on, he took on photochemical hydrogen production (PEC), in which his group was able to radically reduce catalyst demand. He co-pioneered international cooperation on zero-energy houses and PV in buildings with the IEA. This contributed to first commercial BIPV panels. Using carbon nanomaterials, his team produced one of the best non-platinized counter electrode and world-record efficiency of metallic flexible dye solar cells. They found key ageing factors for DSC and co-developed pivotal DSC ageing tests. This work continues on perovskite solar cells.

In fuel cells, his team innovated 2D current density measurements for PEM fuel cells to optimize flow, also first open-cathode PEMFC with high power density inspiring both portable and aerial use. His group developed tertiary compounds with nanostructures yielding highest ever measured ionic conductivity at intermediate temperature for high-power ceramic fuel cells (>1Wcm⁻²). With Chinese groups lead by Prof. Zhu he co-established a new field on ionic-semi-conductors. This work was recognized with the World Society of Sustainable Energy Technologies Innovation Award.

Dr. Lund's work has helped to integrate PV and wind into energy systems and develop flexibility measures. He showed that through power-to-thermal measures the self-consumption share of variable renewable power could be 2-3-folded almost anywhere globally. His work on market penetration of new renewable energy technologies presented at pre-COP13 conference in Copenhagen in 2006 received global coverage, and foresaw the coming development trends in clean energy.

Dr. Lund has contributed to multi-disciplinary energy science by combining socio-economic and technical disciplines, which he has applied to energy poverty, inclusion, regime issues in sustainable energy transitions.

He has contributed to key energy initiatives in EU (SET-Plan, EIT/KIC, FET Flagship), science-to-policy advice (EASAC, SAM), and Nordic collaboration. He chaired the Advisory Group of Energy of the European Commission 2002-06, which provided among the first input to the European Strategic Energy Technology Plan (SET-Plan), now the largest energy R&D effort in Europe. He was member of the European Commission's High-Level Group for Peer-Review on economic, social and environmental impacts of the Joint Technology Initiative on Fuel Cell and Hydrogen Technologies in 2007, which evolved to the 1billion €+ Joint-Undertaking on Fuel Cells and Hydrogen (JU FCH). He has also had several evaluator assignments to the European Institute for Innovation and Technology (EIT) and EU Future Emerging Technologies (FET) Flagship initiatives, which are major breakthrough initiatives in Europe. He is past Chair of the Energy Steering Panel of the European Academies Science Advisory Council, which provided science-to-policy advice to EU's decision-makers, e.g., on biofuels and bioenergy sustainability, shale gas, energy storage, nuclear waste. He co-chaired (2020-2021) a group of top scientists under Science Advice for Policy by European Academies on evidence-based policy options for the European Commission's Scientific Advice Mechanism on the energy transition in Europe (correspondence in *Nature* 596, 486 (2021), doi: <https://doi.org/10.1038/d41586-021-02311-1>).

He was the Chairman (2012-2015) of the Science Council for the Strategic Centre for Science, Technology and Innovation of the Finnish Energy and Environment Cluster, which was a major public-private effort to combine excellence and relevance for breakthroughs and commercialization of new energy technologies. He was team lead of Nordic Prime Minister's Research Excellence initiative in Energy and Climate (2008), the largest project in Nordic cooperation. He coordinated Finnish advanced energy R&D (TEKES) for 10 years, with unique industry-academia innovation ecosystems leading to ground-breaking innovations in arctic wind energy, BIPV, superconductive motors, among others. He has participated in 100 strategic reviews & evaluations in 20 countries with a R&D value of over \$3B.

Domestically he has actively contributed to science-to-policy advice to climate and energy policy; he is vice-chair of the Finnish Climate Panel, mandated by the Government to provide scientific advice to Finnish climate policy-making, e.g., Ministries; he has participated in many parliamentary hearings. For his societal contributions, he was awarded the Finnish Nature League Award in 2014 and the Finnish Nature Conservation Society's Prize in 2004. He is member of the Finnish Academy of Science and Letters and Swedish Engineering Academy in Finland (former board member), receiving the Honors in Silver for his contributions..

He has actively collaborated with China on solar energy and fuel cells since 2008, including establishment of two EU-China collaboration platforms, visiting scholar in 3 universities, several keynotes, advisor, co-authored 20+ journal articles with scientists from 7 universities. His work with China has resulted in major science outcomes and new business initiatives. He is recipient of the prestigious Jinling Award (Nanjing) in 2016 and the Jiangsu Friendship Award and Medal in 2020.

Selected publications

380 peer-reviewed journal articles, 500+ research papers. 24 chapters & edited books. Google-Scholar h-index 65; 16,780 cit.

Energy materials:

M.I. Aghar, S. Jouttijärvi, R. Jokiranta, A.-M. Valtavirta, P. D. Lund. Wide bandgap oxides for low-temperature single-layered nanocomposite fuel cell. *Nano Energy* 53 (2018) 391-397. (Impact Factor=17.8)

A Tiihonen, K Miettunen, J Halme, P Lund, Perovskite solar cell ageing standards need reproducible data on failure mechanisms *Science eLetter* 14.3.2018 <http://science.sciencemag.org/content/359/6374/388/tab-e-letters>

Jianbing Huang, Shunquan Tan, Peter Lund and Huanping Zhou. Impact of H₂O on organic-inorganic hybrid perovskite solar cells. *Energy & Environmental Science* 10 (2017) 2284-2311 (IF=38.5)

P.D. Lund et al. Standardized Procedures Important for Improving Single-Component Ceramic Fuel Cell Technology. *ACS Energy Letters* 2 (2017) 2752-2755. (IF=19)

B. Zhu, P. D. Lund, et al. Schottky junction effect on high performance fuel cells based on nanocomposite materials. *Adv. Energy Mater.* (2015). (IF=29.4)

Kemppainen, A. Bodin, B. Sebok, T. Pedersen, B. Seger, B. Mei, D. Bae, P. C. K. Vesborg, J. Halme, O. Hansen, P.D. Lund and I. Chorkendorff. Scalability and feasibility of photoelectrochemical H₂ evolution: The ultimate limit of Pt nanoparticle as an catalyst. *Energy & Environmental Science* 8(2015), 2991-2999. (IF=38.5)

Energy systems:

- P.D. Lund. Improving economics of battery storage. *Joule* (2020) 4, 2543-2545. (IF=41.2)
- S.Yun, W, Fang, T. Du, X. Hu, X. Huang, X. Li, C- Zhang, P.D. Lund. Use of bio-based carbon materials for improving biogas yield and digestate stability. *Energy* 164(2018) 898-909. (IF=7.5)
- J. Salpakari, T. Rasku, J. Lindgren, P. D. Lund. Flexibility of electric vehicles and space heating in net zero energy houses: an optimal control model with thermal dynamics and battery degradation. *Applied Energy* (2017)190, 800-812. (IF=9.7)
- J Wang, S Yang, C Jiang, Q Yan, P Lund. A novel 2-stage dish concentrator with improved optical performance for concentrating power plants. *Ren Energy* 108 (2017) 92-97. (IF=8)
- Lindgren, J., Lund, P. D., Effect of extreme temperatures on battery charging and performance of electric vehicles. *J Power Sources* 2016, 328, 37-45. (IF=9.1)
- Lund, P., Mikkola, J., Ypyä, J., Smart energy system design for large clean power schemes in urban areas. *J Clean Prod.* 103, 437-445 (2015). (IF=9.3)

Energy policy:

- N. Nakicenovic, P.D.Lund. Could Europe become the first climate-neutral continent? Correspondence, *Nature* 596,486 (2021) (IF=49.96)
- Bolwig, S., Bazbauers, G., Klitkou, A., Lund, P.D., et al. Review of modelling energy transitions pathways with application to energy system flexibility, *Renewable & Sustainable Energy Reviews* 101 (2019) 440-452. (IF=14.98)
- P.D. Lund. Implications of Finland's plan to ban coal and cutting oil use. *Energy Policy* 108 (2017) 78-80. (IF=6.1)
- P. Lund. How fast can businesses in the new energy sector grow? *Ren. Energy* 66 (2014) 33-40. (IF=8)
- P.D. Lund. Energy policy planning near grid parity using a price-driven technology penetration model. *Technol Forecast Soc Change* 90 (2015) 389-399. (IF=8.6)
- P.D. Lund: Effects of energy policies on industry expansion in renewable energy. *Ren Energy* 34 (2009)53-64(IF=8)
- P.D. Lund. Impacts of EU carbon emission trade directive on energy-intensive industries – indicative micro-economic analyses. *Ecol. Econ.* 63 (2007) 799-806. (IF=5.3)

Books:

- Peter Lund et al. (Eds.) *Advances in Bioenergy. The Sustainability Challenge.* Wiley, 2016.
- P.D. Lund et al. (Eds.) *Advances in Energy Systems: The Large-scale Renewable Energy Integration Challenge.* Wiley, 2019.

Keynote and invited talks

>120 invited talks 2001-; examples of talks:

- Market transformation perspective and stakeholder aspects in IEA cases;* IEA Technology Needs Markets, Paris, Nov 2001
- Creating effective innovation and research approaches to meet society's megachallenges – examples from energy;* Nordic Council of Ministers Conference on Investing in Research and Innovation, Copenhagen, Oct 2006
- New technologies for clean air;* EU-USA Transatlantic Cooperation in Clean Air, Brussels, Apr 2007
- Modelling and effective use of LT SOFC for polygeneration applications;* Hong Kong Polytechnic University, Feb 2010
- Bridging energy and climate gap—can science and innovations provide mainstream solutions?* Univ. Rovira i Virgili, June 2011
- Major energy impacts and emission reductions through integrated green energy approaches in urban scale – lessons learned and way forward;* International Green Energy Economy Conference, Washington DC, Jul 2011
- Large-scale urban renewable electricity schemes - integration and interfacing aspects;* SET-2011, Turkey, Sept 2011
- Scaling-up of Nanotechnology Enabled Electrochemical Energy Conversion;* World Resources Forum, Beijing, Oct 2012
- Leapfrogging Energy System Flexibility for Integrating High Shares of Renewable Electricity;* IEEE International Conference on Smart Energy Grid Engineering (SEGE'13), Oshawa, Canada, Aug 2013
- Emerging energy technologies;* ESOF 2014, Copenhagen, Denmark, Jun 2014
- Energy in transition in EU - the role of new and renewable energy technologies;* 2nd Jiangsu-Europe International Conference on Energy (JSSUN2015), Nanjing, China, Nov 2015
- How to bridge old and new in energy? Importance of system integration;* 8th International Exergy, Energy and Environment Symposium (IEEEES-8), Antalya, Turkey, May 2016
- Moving single-component fuel cell technology towards practical applications;* H₂& Fuel Cell Forum Wuhan, Dec 2017
- Policies on energy system flexibility accelerating clean energy transition;* Nordic Clean Energy Week, Copenhagen, May 2018
- Moving to a new phase in sustainable energy through advanced flexibility;* SET 2018, Wuhan Aug 2018
- Generic storage strategies for PV-intensive systems;* 3. Herbstworkshop Energiespeichersysteme, TUD Dresden, Nov 2018
- Deep decarbonization pathways - importance of framing;* CONECT'19, Riga, Latvia, May 2019
- Role of advanced thermal energy technologies in deep decarbonization of energy systems;* 1st Int Conf on Energy and Environment, Nanjing, Sept 2019
- Systemic issues with the energy transition towards carbon neutrality.* Conf. of Env.&Climate Technologies,Riga,Latvia,May 2020
- Early experiences from deep decarbonization pathways in the Nordics.* Meet the Energy Leaders, TU Delft (NL), November 2020
- Systems-embedded clean energy pathways supporting accelerated decarbonization.* 14th China Bioindustry Convention, 06/2021
- Can Europe become the first carbon-neutral continent in the world?*14th Int.Conf. on Applied Energy, Bangkok,Thailand, 11/2021
- The European energy transition with reflection to energy security;* CONECT'22, Riga, Latvia, May 2022