



ENERGY EFFICIENCY UPSKILLING PROGRAMME

Sustainable and Resilient Data Centres

16-20 September 2024

70% - 90% SkillsFuture funding is available to eligible Singaporeans and PRs*

SIT@Dover, 10 Dover Drive S138683

OVERVIEW

Escalating energy costs and limited power availability in key data centre marketplaces have brought increasing pressure to meet sustainability legislation and reduce enterprises' carbon footprints.

This 5-day course aims to equip learners with an in-depth understanding of sustainable and resilient data centres, including design, construction, and operation. The course will cover key sustainability principles, energy efficiency strategies, green building standards, and emerging cooling technologies. Learners will also learn how innovative power infrastructure and computing solutions can be used to improve the sustainability of data centres.

The course will explore resilience in data centres, with a focus on business continuity and minimising downtime. Learners will discover how resilient data centres are designed and operated to withstand various disruptions, such as power outages, natural disasters, and hardware failures, without compromising the availability of services.

WHO SHOULD ATTEND?

Professionals working in the data centre industry, including:

- Data centre managers
- Facility managers
- Engineers
- Architects
- Sustainability professionals

This course is also suitable for professionals seeking to enhance their knowledge and skills in sustainable data centres.

WHAT YOU WILL LEARN

- Understand key sustainability principles and how they apply to data centres
- Design and construct sustainable data centres using best practices and emerging technologies
- Evaluate and optimise the energy efficiency of data centres, including the calculation of performance metrics
- Identify critical deficiencies and potential downtime risks
- Conduct a data centre health check and maintain it for operational efficiency and resiliency
- Implement green building standards and certifications for data centres
- Address environmental challenges associated with data centre operation

COURSE INSTRUCTORS



Er. Dr. Lock Kai Sang

Professor, Engineering, Singapore Institute of Technology

Dr. Lock is a Professor (Engineering) at the Singapore Institute of Technology (SIT) and the Head of its Energy Efficiency Technology Centre. He plays an active role in energy efficiency and sustainability, being the Chairman of Accreditation Committee for Energy Service Companies (ESCOs) and the Co-Chair of Steering Committee of Singapore Certified Energy Managers (SCEM) Scheme. He is an Accredited Tier Designer awarded by the Uptime Institute.

He is a specialist consulting engineer in the areas of mission-critical electrical design, power quality, EMC, and safety. He conducted many power failure investigations of data centres.

Professor Lock has a unique blend of practicing and academic experience acquired through a career which is equally split between the industry and the academia. He received both his B.Sc. (1975) and Ph.D. (1979) degrees in Electrical Engineering from the University of Strathclyde, UK. He was a faculty at the Department of Electrical Engineering, National University of Singapore for 17 years when he left to set up his consulting practice in 1997. He returned to the academia as a professor at SIT in 2016 after 20 years in the industry.

He is a registered Professional Engineer (Electrical) and served as a Board Member of the Professional Engineers Board, Singapore for 14 years. He is a Fellow of Academy of Engineering Singapore and an Honorary Fellow of the ASEAN Federation of Engineering Organizations.

He is the co-Laureate of the 2021 WFEO Medal for Excellence in Engineering Education awarded by the World Federation of Engineering Organisations. He received the Public Service Medal (2015) and the Public Service Star (2020).

COURSE INSTRUCTORS**Lee Poh Seng**

Executive Director, Energy Studies Institute (ESI), NUS

Dr. Lee Poh Seng (PS) is the Dean's Chair Associate Professor in Mechanical Engineering at the National University of Singapore (NUS), where he combines his deep expertise in energy-efficient cooling technologies and sustainable data centre design with a commitment to academic and research excellence. With a PhD from Purdue University, Prof. Lee has built a career that spans both innovative research and practical applications in the field of

mechanical engineering, particularly focusing on liquid and two-phase cooling systems, green data centre technologies, and alternative cooling solutions.

At NUS, Prof. Lee holds several key positions that allow him to influence energy policy and research direction. He serves as the Executive Director of the Energy Studies Institute (ESI), Co-Director of the Singapore Energy Centre (SEC), and Director of the Centre for Energy Research & Technology (CERT), roles through which he promotes the development and adoption of sustainable energy technologies.

In addition to his academic and leadership roles, Prof. Lee is also the founder of CoolestDC Pte Ltd, a startup aimed at commercializing innovative liquid cooling solutions for data centres, particularly in tropical climates. This endeavour reflects his passion for translating research findings into practical, market-ready products that can contribute to environmental sustainability.

Prof. Lee's contributions to the field have been recognized with awards and fellowships from esteemed organizations such as the American Society of Mechanical Engineers (ASME), the Energy Institute (EI), and the Institution of Engineers Singapore (IES). His work not only advances the state of mechanical engineering and sustainable technology research but also inspires the next generation of engineers to pursue innovations that address global energy and environmental challenges.

COURSE INSTRUCTORS



Derek William

Principal, De Vie Works

Derek William is a Consulting Engineer based in Singapore, with experience in data centre works in many countries across the Asia-Pacific region. Derek has been in the data centre industry since 1998. As a professional engineer, he has been the founder and principal of a Mechanical & Electrical Engineering Consultancy company since 2000, now semi-retired but still active in the Data Center industry.

Apart from being a registered Professional Engineer, Derek holds globally-recognised qualifications as data centre specialist (in design engineering) and an accredited tier designer. The projects include LEED certified data center, GreenMark Platinum data center, and Free Cooling (in Singapore), ranging in size from small server rooms, through colocation, to hyperscale.

His contributions to the industry include seminar/webinar presentations such as GreenMark for Data Centers committee, Singapore Computer Society committee, and contribution to STDCT. Derek has been a regular trainer for DCD Academy (formerly DC Pro) since 2012, specialising in Data Center cooling.



Wong Tew Kiat

Managing Director and Founder, Organisation Resilience Management Pte Ltd and Chairman, Data Centre Chapter of the Singapore Computer Society

Wong Tew Kiat is a seasoned industry practitioner with 30 years of working experience in data centre and system infrastructure and operations management of a 100,000 sq. ft data centre space. His work experience includes IT Infrastructure, data centre infrastructure & operations management, Business Continuity Management (BCM) for pandemic preparedness planning, crisis response management, incident response, IT Disaster Recovery (DR) management, emergency management and data centre risk and health check management.

He is currently appointed as the Data Centre Chapter (DCC) chairman by the Singapore Computer Society, with responsibility on national platform development for Data Centre professionals to network and share research and innovative ideas. He is a Certified Business Continuity Professional (CBCP), has a Certification by the Disaster Recovery Institute International (USA) and is also a Fellow of the Business Continuity Institute (FBCI, UK). He is also a Certified IT Project Manager, Senior (CITPM), Certified Outsourcing IT Manager, Senior (COMIT) and Certified IT BCM Manager, Senior (CITBCM) by the Singapore Computer Society (SCS) Singapore.

He was the President of the Business Continuity Chapter, an industry chapter in SCS between 2005 and 2008 and between 2010 and 2011. He also chaired the CITBCM Resource Panel to develop the Body of Knowledge for the CITBCM. He currently chairs the CITBCM Board of Assessors. He is also currently the Chairman, Technical Committee with Institute of Technical Education for its Diploma in Data Centre Operations. He has also conducted numerous trainings in the modules of Data Centre and Business Continuity Management for SMU. He is also an experienced public speaker in many data centre and business continuity seminars and conferences in Singapore and the region.

COURSE INSTRUCTORS



Jin Guang Yu

Senior Manager, Green Mark Department Building and Construction Authority

Dr. Jin Guang Yu is Senior Manager at the Building and Construction Authority, where he leads the development and operation of the SLEB Smart Hub. This innovative digital service platform empowers real estate owners and developers to implement energy-efficient solutions, thereby reducing energy consumption and carbon emissions. Additionally, the platform streamlines the green financing process for real estates, utilising advanced AI-powered tools for online assessment and verification.



Li Xiaorong

Assistant Professor, Infocomm Technology, Singapore Institute of Technology

Dr. Li Xiaorong is an Assistant Professor in the Infocomm Technology Cluster at the Singapore Institute of Technology (SIT). Dr Li works on the frontiers of distributed computing systems and large-scale artificial intelligence. She has taught courses such as mobile and cloud computing, database systems, etc.

Before that, she was a senior research scientist and capability group manager, focusing on cloud/edge computing for big data analysis, AI/Machine Learning, modelling and simulation in A*STAR Institute of High Performance Computing (IHPC). Dr Li was also an Executive Manager and a technologist working on various topics such as green data centres, AI and technology roadmap at Infocomm Media Development Authority, Singapore. She received her PhD in Electrical and Computing Engineering from the National University of Singapore in 2006 and her B.E. from the Beijing University of Posts and Telecommunications in 1998.

Her interests include parallel and distributed/high-performance computing, big data analysis, AI/ML, modelling and simulation, green computing, etc. Dr Li is a senior member of IEEE and she has published more than 50 papers in prestigious international journals and conferences.



Zhang Wei

Associate Professor / Prog Leader, Infocomm Technology, Singapore Institute of Technology

Dr. Wei ZHANG received the B.Sc. degree in electronic information science and technology from the School of Science, Xidian University, Xi'an, China, in 2008, the M.Eng. degree in circuits and system from the School of Electronic Engineering, Xidian University in 2011, and the Ph.D. degree in computer science from the School of Computer Science and Engineering, Nanyang Technological University (NTU), Singapore, in 2015. He

is currently an Assistant Professor with the Information and Communications Technology Cluster, Singapore Institute of Technology (SIT). Before joining SIT, he was a Scientist at the Agency for Science, Technology, and Research (A*STAR), Singapore. From 2015 to 2017, he was a Research Fellow at NTU, Singapore. His current research interests include energy optimization for the information and communication technology area, as well as smart buildings and smart cities.

COURSE SCHEDULE

Day 1	
Morning session	<p>Introduction to Sustainable and Resilient Data Centres</p> <ul style="list-style-type: none"> • Defining sustainability in the context of data centres • Environmental impact assessment • Key concepts in data centre resilience • Uptime operation of data centres • Identifying potential threats and risks for resilient operation • Learning from data centre outage analysis <p>Standards and Guidelines</p> <ul style="list-style-type: none"> • Green data centre standards • Requirements of SS 564: Sustainable data centres • BCA-IDA Green Mark for data centres • Data centre rating system • Data centre tiering system • Environmental benchmarking • Singapore green data centre policies and incentives • Investment allowance scheme
Afternoon session	<p>Energy Optimisation of IT Equipment</p> <ul style="list-style-type: none"> • Energy flow in a computer system • Changes in data centre environments (ASHRAE TC9.9) • Ecodesign requirements for servers and data storage products (Directive 2009/125/EC) • Efficiency of IT equipment • System instrumentation for power management • Hardware aspect of power management • Software aspect of power management • Consolidation and virtualisation: Server virtualisation, storage virtualisation, client virtualisation

	<ul style="list-style-type: none"> • Selection and deployment of new IT equipment for energy efficiency and decarbonisation • Deployment of new IT services • Management of existing IT equipment and services • Data transmission network provision • Data management <p>Case Study – Energy Optimisation of IT Equipment</p>
Day 2	
<p>Morning session</p>	<p>Energy Sustainability</p> <ul style="list-style-type: none"> • Energy use in data centres • Data centre energy usage in Singapore • Energy breakdown in data centres • Mechanical PUE • Electrical PUE • Water resources • Energy efficient lighting systems <p>Power Infrastructure 1</p> <ul style="list-style-type: none"> • Requirements for powering • Power reliability and availability • The tier classification of power infrastructure • Electrical power distribution and major power equipment • Uninterruptible power supply • UPS topology for efficient power distribution • Designing power infrastructure for resilience, meeting demand response data centre power equipment • EMC, power quality and power factor improvement
<p>Afternoon session</p>	<p>Power Infrastructure 2</p> <ul style="list-style-type: none"> • Right sizing data centre power equipment • Management of existing power equipment • Selection and deployment of new power equipment • Barycentre method for location of power equipment • Onsite electrical generation • Deployment of renewable energy sources, microgrids and energy storage • Hydrogen for data centres • DC power architecture • Energy efficiency optimisation <p>Case study – Powering Infrastructure</p>
Day 3	
<p>Morning session</p>	<p>Facility Design</p> <ul style="list-style-type: none"> • Site selection and building criteria • Building design criteria • Planning site and space • Building physical layout • Building geographical location • Data centre retrofit/upgrading

	<ul style="list-style-type: none"> • M&E, ITC facilities <p>Cooling</p> <ul style="list-style-type: none"> • Heat transfer mechanism in data centre environment • Thermal management strategies for high-density server deployments • Hybrid cooling approaches for maximum efficiency • Equipment manufacturers' heat load computation • Cooling management • Temperature and humidity settings • Free cooling/economized cooling • Computer room air conditioners • Best practices for reducing energy consumption in cooling systems
<p>Afternoon session</p>	<p>Air Management</p> <ul style="list-style-type: none"> • Basic airflow principles • Airflow management and design • Impact of equipment placement, rack layout and server configurations on airflow • Computational fluid dynamics modelling • Computer room air handlers <p>Thermal Guidelines for Data Processing Environments</p> <ul style="list-style-type: none"> • Environmental guidelines for air-cooled equipment • New environmental guidelines for high-density air-cooled equipment • ASHRAE thermal guideline classes for IT equipment • Environmental guidelines for liquid-cooled equipment • Increasing use of economisation in IT equipment spaces • Rising exhaust temperature of IT equipment • Air temperature trends in IT support equipment spaces • Thermal transients and excursions in IT equipment spaces <p>Case Study – Cooling Infrastructure</p>
<p>Day 4</p>	
<p>Morning session</p>	<p>Technical Visit to NUS Sustainable Tropical Data Centre Testbed</p> <ul style="list-style-type: none"> • Advanced cooling solutions • Direct liquid cooling • Liquid-cooled server rack • High efficiency cooling plant • Reuse of data centre waste heat
<p>Afternoon session</p>	<p>Risk Assessment, Sustainable & Resilient Operation & Maintenance</p> <ul style="list-style-type: none"> • Risk assessment • Data centre health check and maintenance • Discussion on risk management and mitigation plan • Case studies of identified risks and outages • Disaster recovery

	<ul style="list-style-type: none"> • Next generation data centre <p>Day 4 Case studies</p>
Day 5	
Morning session	<p>Monitoring, Measurement, Analysis, and Evaluation of Data Centre Sustainability Performance</p> <ul style="list-style-type: none"> • Energy use and environmental measurement, collection, logging and reporting • Data centre sustainability indicators and baseline • Sustainability targets and planning to achieve them • Energy/sustainability audit and performance evaluation • Regular preventive maintenance • Life cycle management • Master list of energy efficiency/sustainability actions • Energy strategy • Best practices applied to a sustainable data centre • Calculation of performance metrics with case study authentic data
Afternoon session	<p>Future Trends & Class Assessment</p> <ul style="list-style-type: none"> • Future trends of data centres • AI data centres • Cybersecurity issues • Balancing sustainability and resilience • Rounding up <p>Class Assessment</p>

CERTIFICATE AND CONTINUING PROFESSIONAL DEVELOPMENT

A Certificate of Participation will be issued to participants who:

- Undertake non-credit bearing assessment during the course
- Attend at least 75% of the course

This workshop is eligible for the following continuing professional development units:

- **40 SCEM PDUs to be awarded**
- **TBC PDUs awarded by PEB Singapore**

COURSE FEES

SkillsFuture funding is available for eligible Singaporeans and Singapore PRs. Terms and Conditions apply.

Category	Full Fee	After SF Funding
Singapore Citizen (Below 40)	\$5,450.00	\$1,635.00
Singapore Citizen (40 & above)	\$5,450.00	\$635.00
Singapore PR/LTVP+ Holder	\$5,450.00	\$1,635.00
Non-Singaporeans	\$5,450.00	Not Eligible

Note:

- All figures include GST. GST applies to individuals and Singapore-registered companies.
- You can opt for either SF Series Funding or Mid-Career Enhanced Subsidy. Both cannot be combine.

SCAN QR CODE TO REGISTER & FIND OUT MORE ABOUT THE COURSE



SIT reserves the right to make changes to published course information, including dates, times, venues, fees and instructors without prior notice