COURSE OVERVIEW EE1113
Advanced PV and BESS

Course Title
Advanced PV and BESS

Course Date/Venue
Session 1: July 28-August 01, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: November 24-28, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
EE1113

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

This course is designed to provide participants with a detailed and up-to-date overview on Asdvanced Photovoltaics (PV) and Battery Energy Storage Systems (BESS). It covers the advanced PV technologies, PV cell, module and array design; the solar radiation measurement methods, tools for site selection, shading analysis and performance ratio and yield estimation; the PV system components and architecture, system sizing and design considerations; and the difference between grid-connected and off-grid systems.

Further, the course will also discuss the energy storage technologies, battery management system (BMS), sizing of BESS for PV systems and BESS system architecture and topologies; the control strategies for PV + BESS, thermal management, passive and active cooling techniques and fire detection and suppression systems; the advanced inverter capabilities, hybrid energy systems, SCADA and remote monitoring systems; and the grid code requirements and compliance.

During this interactive course, participants will learn the pre-commissioning checklist, performance testing for PV and BESS, grounding, insulation and continuity tests, safety verifications and energization procedures; the cyber risks in grid-connected assets, securing SCADA and control systems; the operation strategies for optimal performance, performance monitoring and KPIs and preventive and predictive maintenance; troubleshooting PV systems and BESS systems and implementing safety practices; the emergency response procedures and lockout/tagout (LOTO) and hazard mitigation; the financial analysis and business models, regulations, incentives and market trends; and the innovations and emerging trends.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an advanced knowledge on photovoltaics (PV) and battery energy storage systems (BESS)
- Discuss advanced PV technologies, PV cell, module and array design
- Carryout solar radiation measurement methods, tools for site selection and shading analysis and performance ratio and yield estimation
- Identify PV system components and architecture, system sizing and design considerations and the difference between grid-connected and off-grid systems
- Recognize energy storage technologies, battery management system (BMS), sizing of BESS for PV systems and BESS system architecture and topologies
- Apply control strategies for PV + BESS, thermal management, passive and active cooling techniques and fire detection and suppression systems
- Discuss advanced inverter capabilities, hybrid energy systems, SCADA and remote monitoring systems and grid code requirements and compliance
- Develop pre-commissioning checklist and apply performance testing for PV and BESS, grounding, insulation and continuity tests, safety verifications and energization procedures
- Identify cyber risks in grid-connected assets, secure SCADA and control systems and apply access control and encryption
- Employ operation strategies for optimal performance, performance monitoring and KPIs and preventive and predictive maintenance
- Troubleshoot PV systems covering inverter fault codes and diagnostics, string voltage and current mismatch, arc faults and ground faults and I-V curve tracing and insulation resistance
- Troubleshoot BESS systems and implement safety practices, emergency response procedures and lockout/tagout (LOTO) and hazard mitigation
- Describe financial analysis and business models, regulations, incentives and market trends and innovations and emerging trends

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of advanced photovoltaics (PV) and battery energy storage systems (BESS) for engineers and technicians in the energy sector, renewable energy professionals, utility operators, energy analysts, regulatory professionals, energy consultants and other technical staff.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Dr. Ahmed El-Sayed, PhD, MSc, BSc, is a **Senior Electromechanical Engineer** with over **30 years** of extensive experience in the **Power**, **Petroleum**, **Petrochemical** and **Utilities**. He specializes in **HV/LV Equipment**, **High Voltage Electrical Safety**, **LV & HV Electrical System**, **HV Equipments Inspection & Maintenance**, **HV Switchgear Operation & Maintenance**, **LV Distribution Switchgear & Equipment**, **HV Switchgear Maintenance**, **HV/LV Electrical** Authorisation, **Hazardous Area Classification, Power Quality**, **Disturbance Analysis**, **Blackout**, **Power Network**, **Power Distribution**, **Power Systems Control**, **Power Systems Security**, Power **Electronics**, **ETAP**, Electrical **Substations**, Tariff Design & Structure Analysis, **Engineering Drawings, Codes & Standards**, **P&ID Reading, Interpretation & Developing**, **PLC**, **SCADA**, **DCS**, **Process Control**, **Instrumentation**, **Automation**, Power **Generation**, **Process Control Instrumentation**, **SIS**, **SIL**, **ESD**, **Alarm Management Systems**, **Fieldbus Systems** and **Fiber Optics** as well as the service pricing of these. Further, he is also well versed in **Pumps**, **Valves**, **Boilers**, **Pressure Vessels**, **Heat Recovery Steam Generators** (**HRSG**), **Bearings**, **Compressors**, **Motors**, **Turbines**, **Actuators**, **Carbon Footprint**, **Energy Efficiency**, **Power Plant Performance & Efficiency**, **P&ID**, **Engineering Drawing**, **Codes & Standards** and **Hydraulic Systems** He is currently the **Systems Control Manager** of **Siemens** where he is in-charge of Security & Control of Power **Transmission Distribution** & **High Voltage** Systems and he further takes part in the Load Records Evaluation & Transmission Services Pricing.

During his career life, Dr. Ahmed has been actively involved in different Power System Activities including Roles in Power System Planning, Analysis, Engineering, **HV Substation** Design, Electrical Service Pricing, Evaluations & Tariffs, Project Management and also in Teaching and Consulting. His vast industrial experience was honed greatly when he joined many International and National Companies such as **Siemens**, **Electricity Authority** and **ACETO** industries where he focused more on dealing with Technology Transfer, System Integration Process and Improving Localization. He was further greatly involved in manufacturing some of **Power System** and **Control & Instrumentation Components** such as Series of Digital Protection **Relays**, MV **VFD**, **PLC** and **SCADA** System with intelligent features.

Dr. Ahmed is well-versed in different electrical and instrumentation fields like Load Management Concepts, **PLC** Programming, Installation, Operation and Troubleshooting, **AC Drives** Theory, Application and Troubleshooting, Industrial Power Systems Analysis, AC & DC **Motors**, Electric Motor **Protection**, **DCS SCADA**, **Control** and Maintenance Techniques, Industrial Intelligent Control System, **Power Quality** Standards, Power Generators and Voltage Regulators, Circuit Breaker and Switchgear Application and Testing Techniques, **Transformer** and **Switchgear** Application, Grounding for Industrial and Commercial Assets, Power Quality and **Harmonics**, **Protective Relays** (O/C Protection, Line Differential, Bus Bar Protection and **Breaker Failure Relay**) and Project Management Basics (PMB).

Dr. Ahmed has **PhD**, **Master's** & **Bachelor's** degree in **Electrical** and **Instrumentation Engineering** from the **University of Wisconsin Madison**, **USA**. Further, he has numerous papers published internationally in the areas of Power Quality, Superconductive Magnetic Energy Storage, SMES role in Power Systems, Power System **Blackout** Analysis, and Intelligent Load Shedding Techniques for preventing Power System Blackouts, HV **Substation Automation** and Power System Stability.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Advanced PV Technologies*** *Evolution from Traditional to Advanced PV • Monocrystalline versus Polycrystalline versus Thin Film • Bifacial & Tandem Solar Cells • Emerging Technologies: Perovskite, Organic PV*
0930 – 0945	*Break*
0945 – 1030	***PV Cell, Module & Array Design*** *PV Cell Structure & Function • Module Assembly & Encapsulation • Series & Parallel Configuration • Temperature & Irradiance Effects*
1030 – 1130	***Solar Resource Assessment & Site Analysis*** *Solar Radiation Measurement Methods • Use of Pyranometers & Satellite Data • Tools for Site Selection & Shading Analysis • Performance Ratio & Yield Estimation*
1130 – 1215	***PV System Components & Architecture*** *PV Modules & Inverters • Mounting Systems & Trackers • Wiring, Combiner Boxes & Junction Boxes • AC/DC Disconnects & Protections*
1215 – 1230	*Break*
1230 – 1330	***System Sizing & Design Considerations*** *Load Estimation & Energy Demand Analysis • Sizing PV Capacity to Match Load Profiles • Tilt Angle, Azimuth & Orientation Effects • Impact of Derating Factors*

1330 – 1420	***Grid-Connected versus Off-Grid Systems*** *Differences in Configuration & Controls • Inverter & Battery Interactions • Islanding Detection & Anti-Islanding • Compliance with Grid Codes*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0830	***Basics of Energy Storage Technologies*** *Types: Lithium-Ion, Lead-Acid, Flow Batteries • Comparison of Chemistries: LFP, NMC, LCO • Flywheels, Supercapacitors & Thermal Storage • Application Matrix & Technology Maturity*
0830 – 0930	***Battery Management System (BMS)*** *Functions & Components of BMS • Voltage & Temperature Monitoring • State of Charge (SoC) & State of Health (SoH) • Cell Balancing & Fault Handling*
0930 – 0945	*Break*
0945 – 1100	***Sizing of BESS for PV Systems*** *Load Profile & Autonomy Requirements • Depth of Discharge & Cycle Life • Peak Shaving & Load Shifting Scenarios • Sizing Tools & Software*
1100 – 1215	***BESS System Architecture & Topologies*** *DC-Coupled versus AC-Coupled Systems • Modular versus Containerized BESS • Integration with Hybrid Systems • Role of Inverters & PCS*
1215 – 1230	*Break*
1230 – 1330	***Control Strategies for PV + BESS*** *Frequency & Voltage Support • Peak Demand Shaving & Arbitrage • Self-Consumption Optimization • Backup & Black Start Functions*
1330 – 1420	***Thermal Management & Fire Protection*** *Thermal Runaway Risks & Causes • Passive & Active Cooling Techniques • Fire Detection & Suppression Systems • International Standards & Certifications*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0830	***Advanced Inverter Capabilities*** *Smart Inverter Functionalities • Reactive Power Support & Voltage Ride-Through • Frequency-Watt & Volt-Watt Controls • Communication Protocols (Modbus, IEC 61850)*
0830 – 0930	***Hybrid Energy Systems*** *PV + BESS + Diesel Integration • Load Prioritization & Controller Logic • Role of Energy Management System (EMS) • Microgrid Applications & Examples*

0930 – 0945	*Break*
0945 – 1100	***SCADA & Remote Monitoring Systems*** *Real-Time Data Acquisition • Dashboard & Visualization Tools • Alarms & Performance Metrics • Integration with Grid Operator Control Centers*
1100 – 1215	***Grid Code Requirements & Compliance*** *IEEE 1547, IEC 61727, DEWA/TRANSCO Standards • Voltage & Frequency Regulation Requirements • Power Quality & Harmonic Limits • Anti-Islanding & Protection Coordination*
1215 – 1230	*Break*
1230 – 1330	***Commissioning & Functional Testing*** *Pre-Commissioning Checklist • Performance Testing for PV & BESS • Grounding, Insulation & Continuity Tests • Safety Verifications & Energization Procedures*
1330 – 1420	***Cybersecurity & Data Integrity*** *Cyber Risks in Grid-Connected Assets • Securing SCADA & Control Systems • Access Control & Encryption • NIST & IEC Standards for Cyber Resilience*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

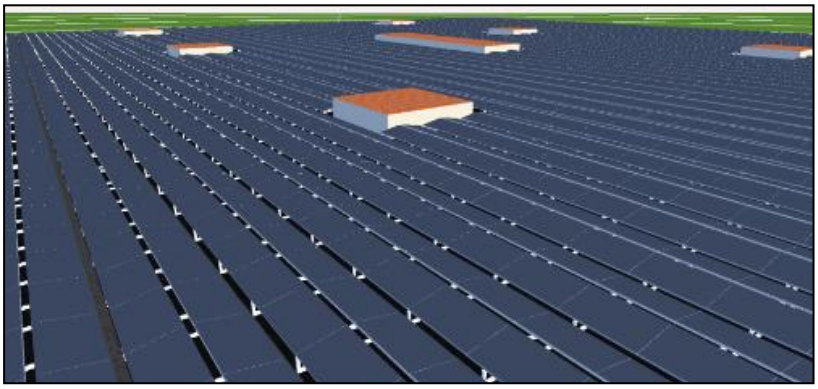
0730 – 0830	***Operation Strategies for Optimal Performance*** *Forecasting Solar Generation & Load • Curtailment & Grid Interaction • Operating Modes (Grid-Forming/Grid-Following) • EMS Optimization Algorithms*
0830 – 0930	***Performance Monitoring & KPIs*** *Yield analysis & Degradation Tracking • SoC/SoH Tracking for BESS • Fault Detection & Diagnostics • Energy Losses & Performance Ratio*
0930 – 0945	*Break*
0945 – 1100	***Preventive & Predictive Maintenance*** *Visual Inspections & Thermography • Battery Maintenance Protocols • Inverter & Tracker Servicing • Use of AI/ML for Predictive Analytics*
1100 – 1215	***Troubleshooting PV Systems*** *Inverter Fault Codes & Diagnostics • String Voltage & Current Mismatch • Arc Faults & Ground Faults • I-V curve Tracing & Insulation Resistance*
1215 – 1230	*Break*
1230 – 1330	***Troubleshooting BESS Systems*** *Common Battery Errors & Alarms • BMS Fault Handling & Reset Procedures • Thermal Management System Faults • Communication & Data Logging Issues*
1330 – 1420	***Safety Practices & Emergency Response*** *Electrical Safety & PPE Requirements • Arc Flash & Fire Risks • Emergency Shutdown Procedures • Lockout/Tagout (LOTO) & Hazard Mitigation*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

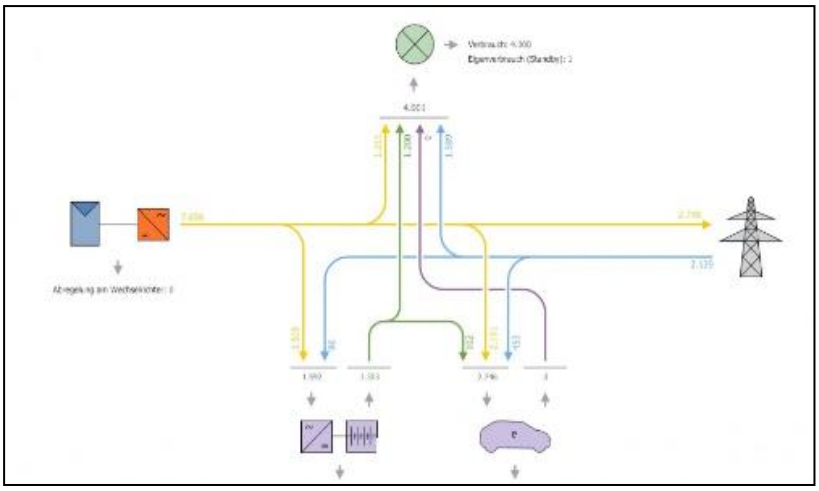
Day 5

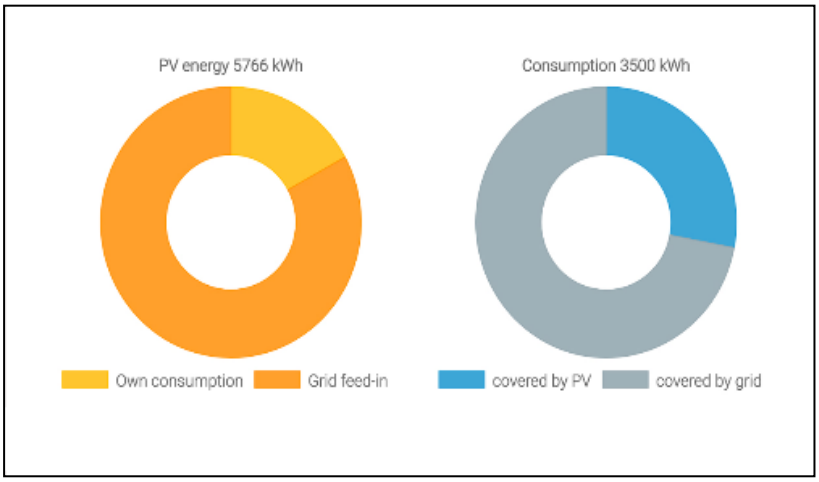
0730 – 0830	***Financial Analysis & Business Models*** *LCOE & LCOS Calculations • CAPEX/OPEX Modeling for PV+BESS • Payback Period & ROI Metrics • PPA & Leasing Models*
0830 – 0930	***Regulations, Incentives & Market Trends*** *Regulatory Frameworks in UAE & GCC • Feed-in Tariffs & Net Metering • Ancillary Service Markets • Carbon Credits & Sustainability Policies*
0930 – 0945	*Break*
0945 – 1030	***Case Studies: Utility-Scale Projects*** *EWEC Noor Abu Dhabi Solar Plant • Shams 1 CSP with Storage • International BESS Case Studies • Lessons Learned & Best Practices*
1030 – 1130	***Advanced Software Tools & Simulations*** *PVSyst, HOMER, SAM, ETAP for BESS • EMS Simulation & Forecasting Tools • SCADA Integration with GIS • Digital Twins for O&M Optimization*
1130 – 1230	***Innovations & Emerging Trends*** *Second-Life Batteries & Recycling • Floating PV & Agri-Voltaics • Hydrogen Integration & Long-Duration Storage • AI/ML for Grid Optimization*
1230 – 1245	*Break*
1245 – 1345	***Workshop: Designing a PV+BESS System*** *Load Profile & Energy Audit • Sizing PV & BESS Using Software • Cost-Benefit Analysis • Presentation of Group Results*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulators (Hands-on Practical Sessions)

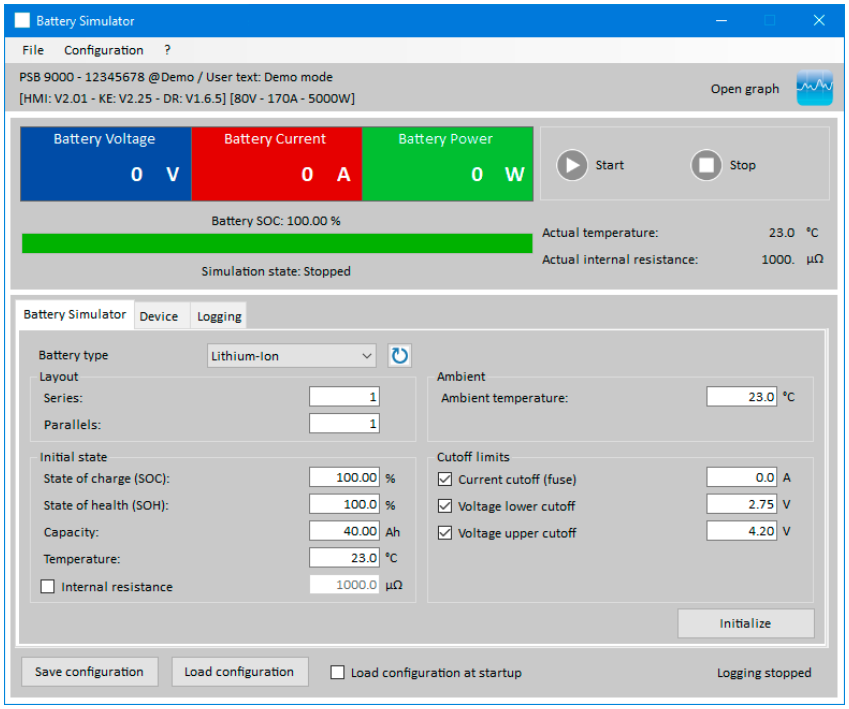
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art simulator "PV*SOL Premium" and "Battery simulator".







PV*SOL Premium



Battery simulator

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