

Forum on Regional Cooperation: Developing Quality Infrastructure for Photovoltaic Energy Generation

Santiago, Chile
13-14 September 2017

- a) IEC technical standards for PV systems
- b) IECRE Certification for PV systems

By George Kelly – Sunset Technology Inc.

Standards

Technical Normative Basis

a) IEC technical standards for PV systems



International Electrotechnical Commission
Technical Committee 82 on
Solar photovoltaic energy systems



IEC Technical Standards for PV Systems

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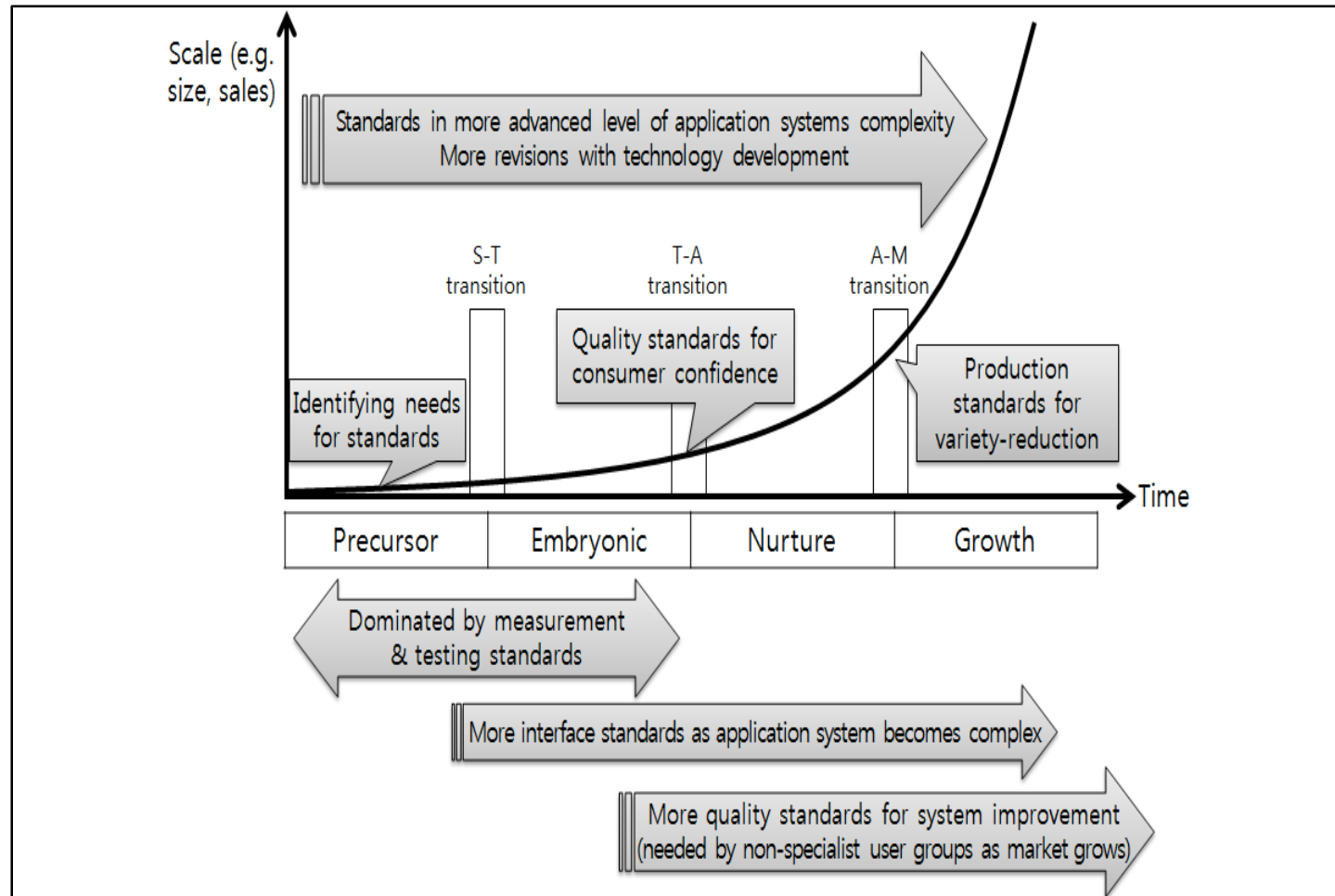
By George Kelly, TC 82 Secretary
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Context and Background



- Industry **growth**
 - Demand increasing 20%+ per year
 - Significant increase in large commercial plants
 - Transfer of manufacturing base to China
- Concern for **quality / bankability**
 - Doubts about adequacy of existing standards
 - Need for improved understanding of reliability
 - Validation of product lifetime for investors
- International PV Quality Assurance Task Force (**PVQAT**)
 - Formed 2011; currently 12 task groups
 - Mainly focused on scientific methods to characterize and predict possible failure modes
 - Work feeding into TC82 for NWIPs

Standardization in Technological Innovation



Source: (J.Y.Ho 2014)

PV Standards Organizations



Standards Development Organization		Membership	Focus of Activities
International Electrotechnical Commission	IEC	National Committees	Performance and Safety of Products, Systems and Services
ASTM International (formerly American Society for Testing and Materials)	ASTM	Individual Experts	Measurement Principles and Specialty Tests
Semiconductor Equipment Manufacturers' Institute	SEMI	Member Companies	Primarily Manufacturing-related (materials and equipment)
Underwriters' Laboratories	UL	Invited Experts	Product Safety
International Code Council	ICC	Invited Experts	Building and Fire Codes
Institute of Electrical and Electronics Engineers	IEEE	Individual Experts	Grid Connection Codes

Conformity Assessment



- Evaluation against **international** standards
 - May use national or regional standards if no international standard is available
- Improved **quality** and **performance**
 - Assurance that PV plant will operate as designed for its expected lifetime
- Increased **confidence** for investors
 - Financial return meets expectations
 - Risk is reduced

Benefits of Certification



- **Independent assurance** of conformance with appropriate international standards
- Evaluation by **accredited inspection bodies** in open and transparent process
- **Objective evidence** of best practices for investors and financial institutions
- Common need in Renewable Energy (RE) systems across **multiple industry sectors**
 - PV Solar, Wind, Marine, and others?

Benefits of IEC Systems

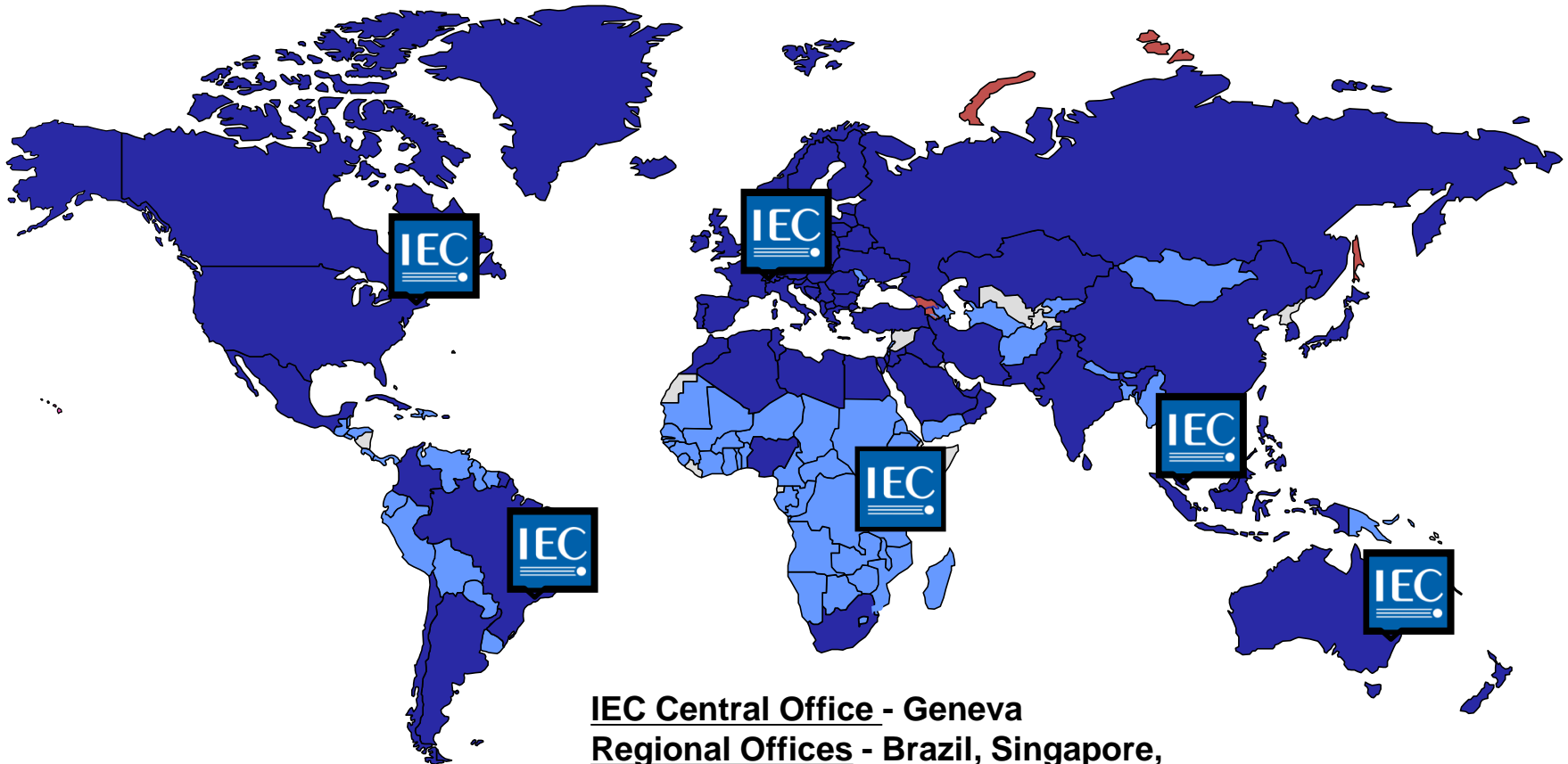


- IEC **Brand**
 - Global recognition – multiple industries
 - International recognition (e.g. WTO + UN)
 - IEC Reports and Certificates used nationally
- Open and Transparent **Process**
 - Clear Rules in process and results
 - Consistency in processes among participating Certification Bodies & Test Labs
- Industry and market provide **direct input**
 - CA systems driven by market demand

IEC Global Reach



83 Members 87 Affiliates



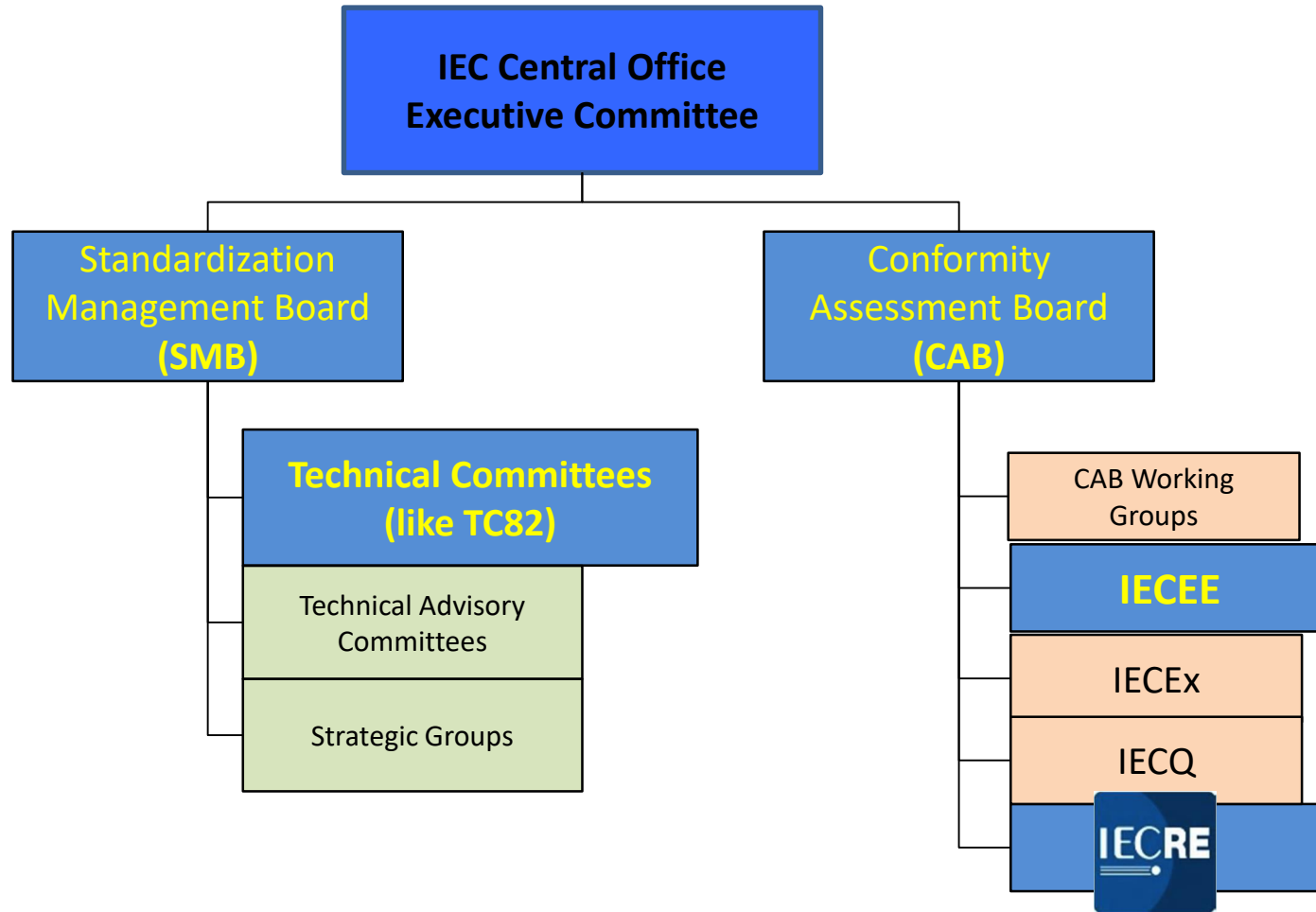
IEC Central Office - Geneva
**Regional Offices - Brazil, Singapore,
Kenya, US and Australia**

Roles & Responsibilities



- Standards Management Board (**SMB**)
 - Technical Committees => Write the standards
 - Manage nomination of experts and voting by National Committees (Member Bodies)
- Conformity Assessment Board (**CAB**)
 - Assessment Schemes => Evaluate implementation of standards in specific situations
 - Manage accreditation of Certifying Bodies

IEC Organization



IEC Standards Process



- **170** countries represented
 - 83 “member” and 87 “affiliate” countries
 - One vote per country (national committee)
- **203** Technical Committees / Subcommittees
 - Scope and Work Programme for each TC approved by vote of participating national committees
 - National committees appoint experts to participate in each project
 - Minimum 5 participating countries for a new project
- Rules defined under ISO/IEC Directives

Standards Development Fundamental Principles



- Established by World Trade Organization
 - Common to ISO, IEC, ITU
- IEC procedures are intended to ensure:
 1. [Transparency](#)
 2. [Openness](#)
 3. [Impartiality and consensus](#)
 4. [Effectiveness and relevance](#)
 5. [Coherence](#)
- And to address the concerns of developing countries

Development Tools



- IEC website: www.iec.ch
 - Up-to-date information on all projects
 - Access to all working documents
 - Electronic voting / commenting
 - Templates for drafting standards
 - Web-conferencing & collaboration tools
- Experts Management System (EMS)
 - Administered by national committees
 - Online registration for TC meetings



TC 82 Scope



- To prepare international standards for systems of photovoltaic conversion of solar energy into electrical energy and for all the elements in the **entire photovoltaic energy system**.
- In this context, the "photovoltaic energy system" includes the entire field **from light input to** a photovoltaic cell to and including the interface with **the electrical system(s)** to which energy is supplied.

TC 82 Structure



- Established **1981**
- 51 countries represented
 - 40 “participating” and 11 “observing” member countries with 350+ experts
 - 10 active working groups
- TC82 has the **LARGEST** work programme of all IEC committees
 - 68 projects underway (46 new, 22 revisions)
 - This is good – if they get finished !!

TC 82 Working Groups



- WG 1: Glossary
- WG 2: Modules, non-concentrating
- WG 3: Systems
- WG 6: BOS components
- WG 7: Concentrator modules
- WG 8: Cells



- JWG 1: Off-grid PV systems
- JWG 4: Grid Code Compliance (SC 8A)
- JWG 32: Electrical safety of PV system installations (TC 64)
- JWG 82: Secondary cells and batteries for renewable energy storage (TC 21)

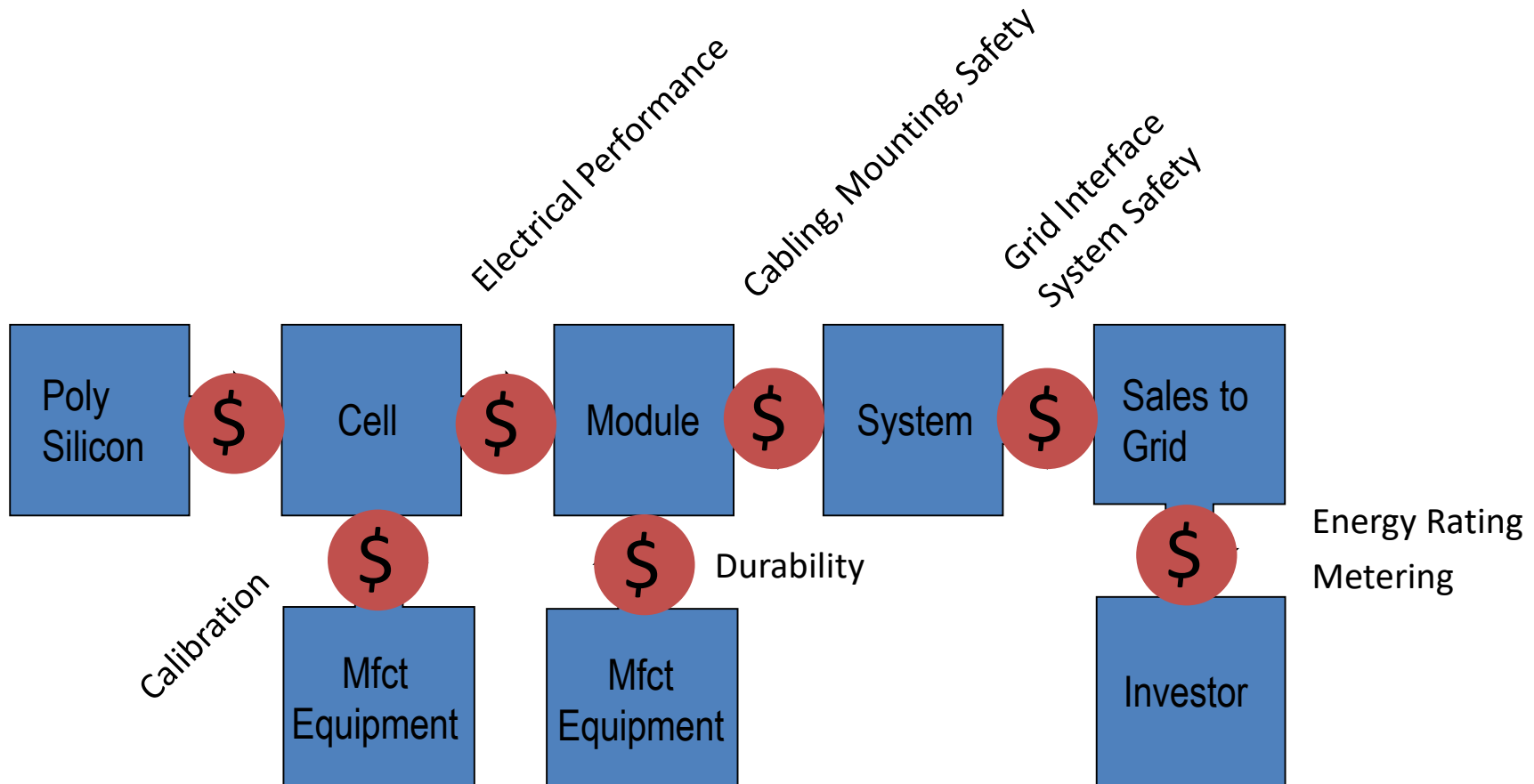
TC 82 Impact



IEC TC 82 standards, implemented in all major markets, have contributed in the last 35 years to:

- ✓ High quality and reliability systems
- ✓ Cost Reduction
- ✓ Innovation
- ✓ Transparent markets and trade
- ✓ Safety

The PV Value Chain and Added Value through Standards

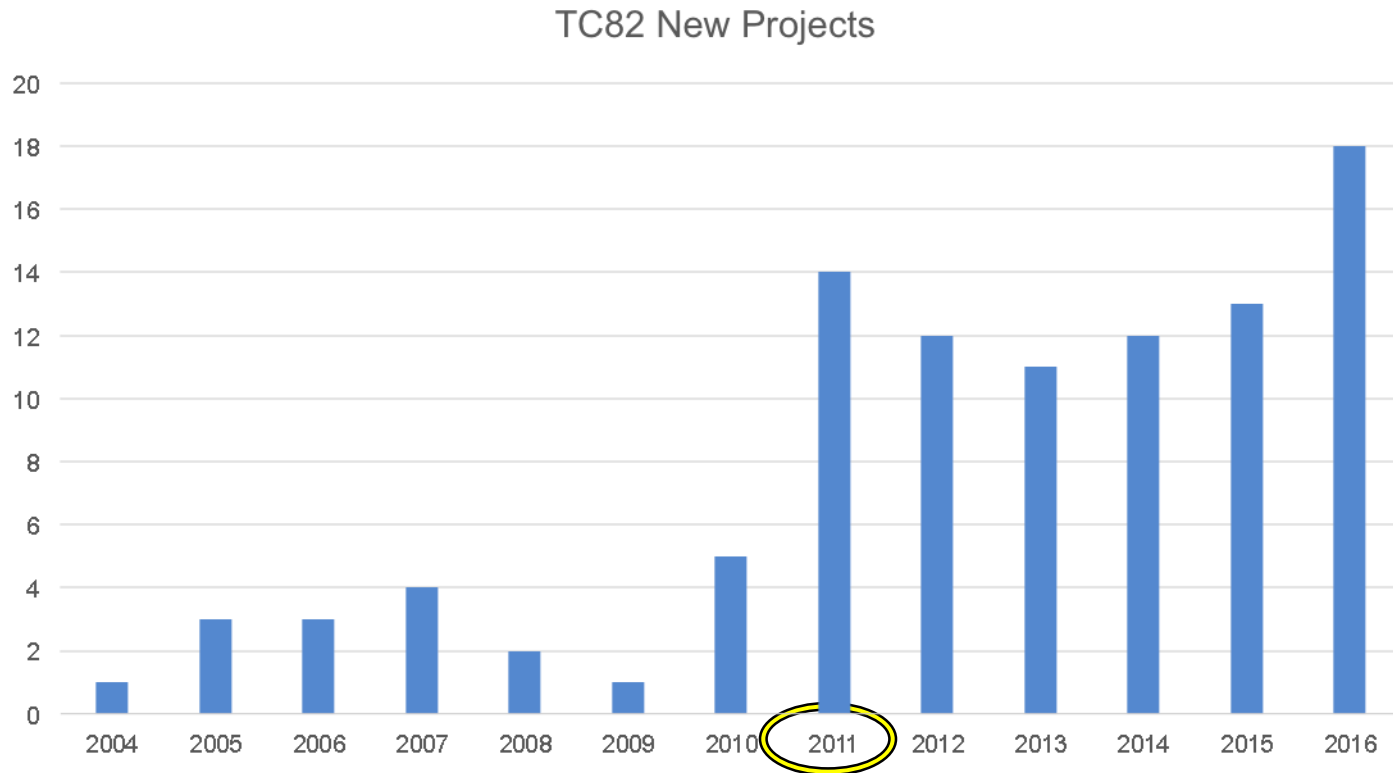


Standards Development



- Comprehensive review of existing international and national standards conducted by TC82 experts in 2014
- Determination of which standards would most likely be **required to conduct** conformity assessments
- Consideration of all IEC standards and others where appropriate (ASTM, UL, VDE, etc.)
- Used to **prioritize** the work of TC82 and supporting efforts by PVQAT
- Results presented at IEEE PVSC in Denver June 2014

“PVQAT Effect” on TC82



Remarkable development, demonstrating importance and visibility of IEC standards in PV

“Certifiable” Standards



- **Design**
 - 62548 Array Design (or 62738 Power Plant)
 - 61724-1 Performance Monitoring
- **Commissioning**
 - 62446-1 Documentation, Test & Inspection
 - 61724-2 Capacity Evaluation
- **Operation**
 - 62446-2 System Maintenance
 - 61724-3 Energy Evaluation
- **Quality Management**
 - 62941 PV Module Manufacturing
 - 63049 PV System Installation

Anticipated areas of activity



- **WG2 Modules**
 - Module component specs & tests
 - Quality system
 - Reliability & comparative testing
 - Closely tied to PVQA Task Force efforts
- **WG3/6 Systems/BOS**
 - Safety standards for specific components
 - System design & installation
 - System commissioning and O&M
 - Coordination with work in other SDOs
- **WG7 Concentrators**
 - Power & energy rating; solar simulator

Thank You



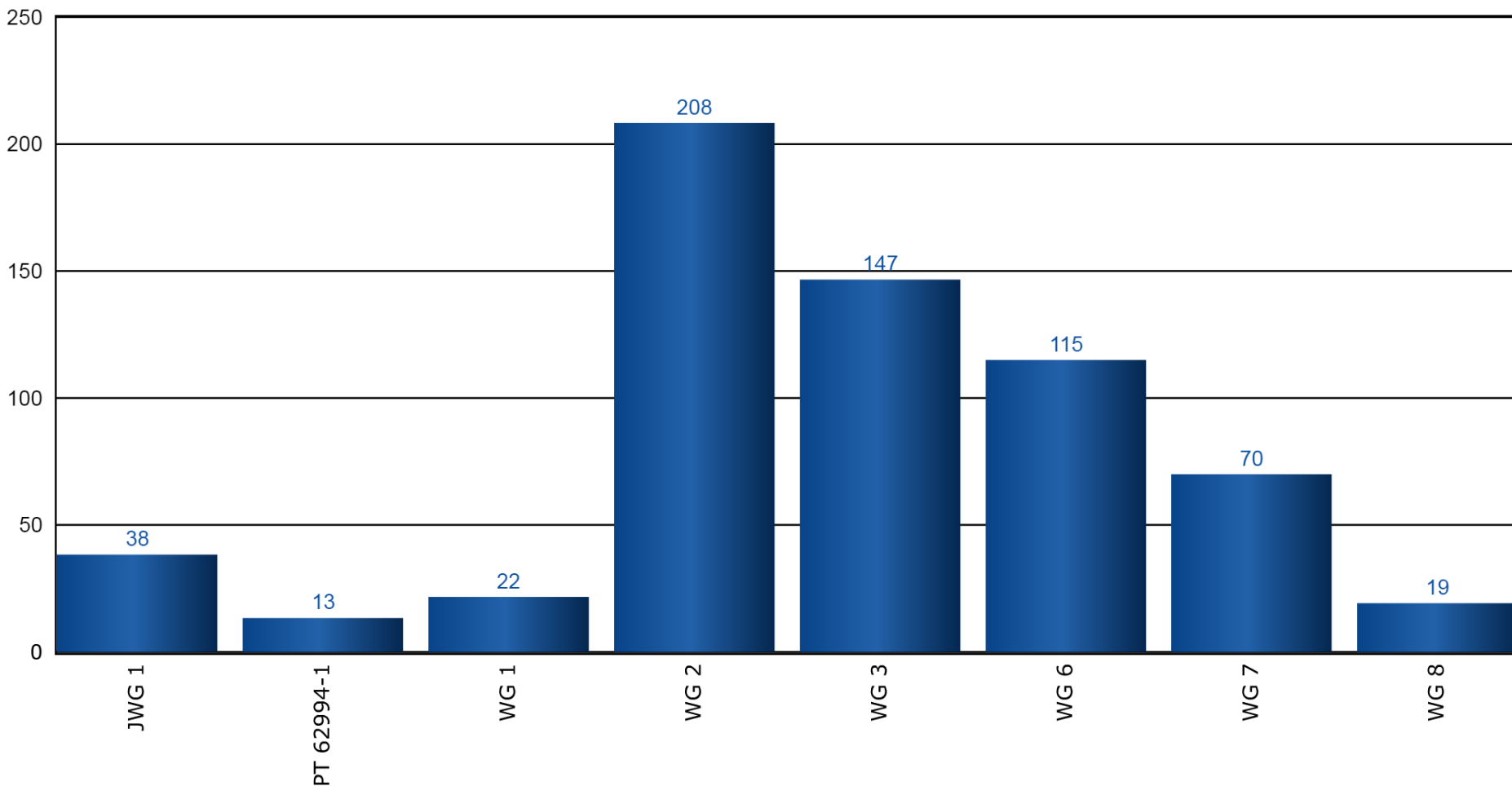
Questions?

Contact george@sunset-technology.com

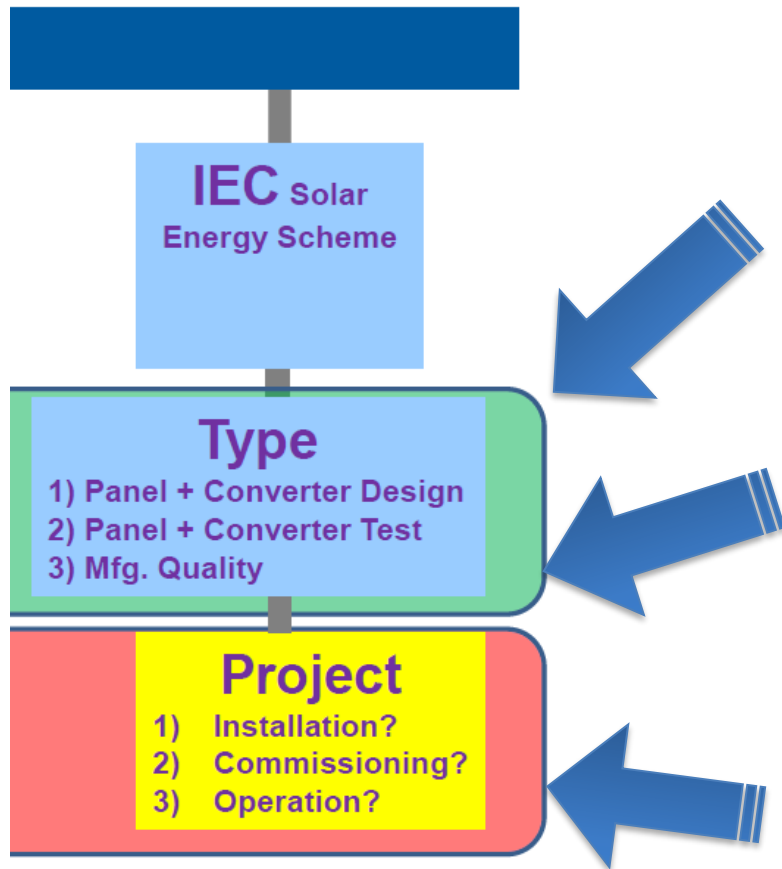
BACKUP SLIDES



TC 82 Experts in WGs



Closing the Gaps



Module - 61215 / 61730
Inverter - 62109 / 62891
Tracker - 62817
BOS - 62093 + others

Module Manufacturing Quality – 62941
BOS Manufacturing Quality – NWIP

System Design - 62548 / 62738
Installation Quality – 63049
Commissioning – 62446-1
Maintenance – 62446-2
Performance – 61724 series

Module Quality



- [IEC/TS 62941](#) Guideline for increased confidence in PV module design qualification and type approval
 - Publication January 2016
 - Collection of [best practices](#) from across the industry
 - Refers to basic requirements of ISO 9001, plus...
- Focus on [PV-specific](#) manufacturing processes and procedures to ensure quality and consistency
 - Key metrics and capabilities needed for PV
 - Modules produced this way will be more likely to perform according to warranty (25+ years)
- Preparations underway for first [factory audits](#) and QMS certificates in Q4 2016

System Design



- IEC [62548](#) PV Array Design Requirements
 - PV system architectures
 - Mechanical design
 - Selection and erection of electrical equipment
 - Safety issues
 - Marking and documentation
 - Coordination with 61724 series (Performance Monitoring)
- IEC/TS [62738](#) PV Power Plant Design
 - Specific to utility-scale plants; special techniques allowed
 - CD2 in process; publication in 2017

Installation Quality



- [IEC/TS 63049](#) Guideline for increased confidence in PV system installation
 - Fast track project in TC82 WG3
 - Describing known best practices for managing quality and avoiding problems
 - Includes many basic requirements of ISO 9001
- Focus on [PV-specific](#) construction processes and procedures to ensure consistency of installation
 - Key metrics and capabilities needed for PV
 - Systems constructed this way will be more likely to perform according to warranty (25+ years)

Commissioning & Operations



- IEC [62446-1](#) Ed. 2
 - Minimum commissioning tests and inspection criteria
 - Minimum documentation to verify safe installation and correct operation
 - Additions to address different categories of systems
 - Test regimes differentiated as appropriate for the system type, scale, and complexity
 - Coordination with 61829 On-site I-V measurement
 - Grid connected systems only
 - Can also be used for periodic re-testing, re-inspection, maintenance, or modifications
- System Maintenance [62446-2](#)
 - At CD stage; publication in 2017
 - Includes preventative and corrective maintenance
 - Both safety-related and performance-related
 - Troubleshooting and documentation of results

Performance Monitoring



- Expanded series of standards
 - 61724-1 System performance **monitoring**
 - 61724-2 **Capacity** evaluation method
 - 62724-3 **Energy** evaluation method
- Future - standardized reporting of performance
 - **Information model** for system availability (63019)
 - Based on wind turbine document 61400-26
 - Ongoing work in Sandia O&M subteam
 - SunSpec Alliance **data protocols**
 - Common basis to allow aggregation of data
 - Enables benchmarking and trend identification



US PV Standards



- Voluntary
 - ANSI process
 - IEC Standards Adopted
 - National differences
 - Regulatory
 - National Electrical Code
 - Listing requirements
 - Building Codes
-
- Key SDOs for PV in the US



Building Codes



- Published by International Code Council (ICC)
 - International Building Code (IBC)
 - International Residential Code (IRC)
- **Regulatory** (Legal) requirement
 - One or both may be required
 - Varies by **State, County or City** regulations
 - Enforced by local inspectors representing “Authority Having Jurisdiction” (AHJ)