

2014 Inverter Reliability Workshop Survey Results

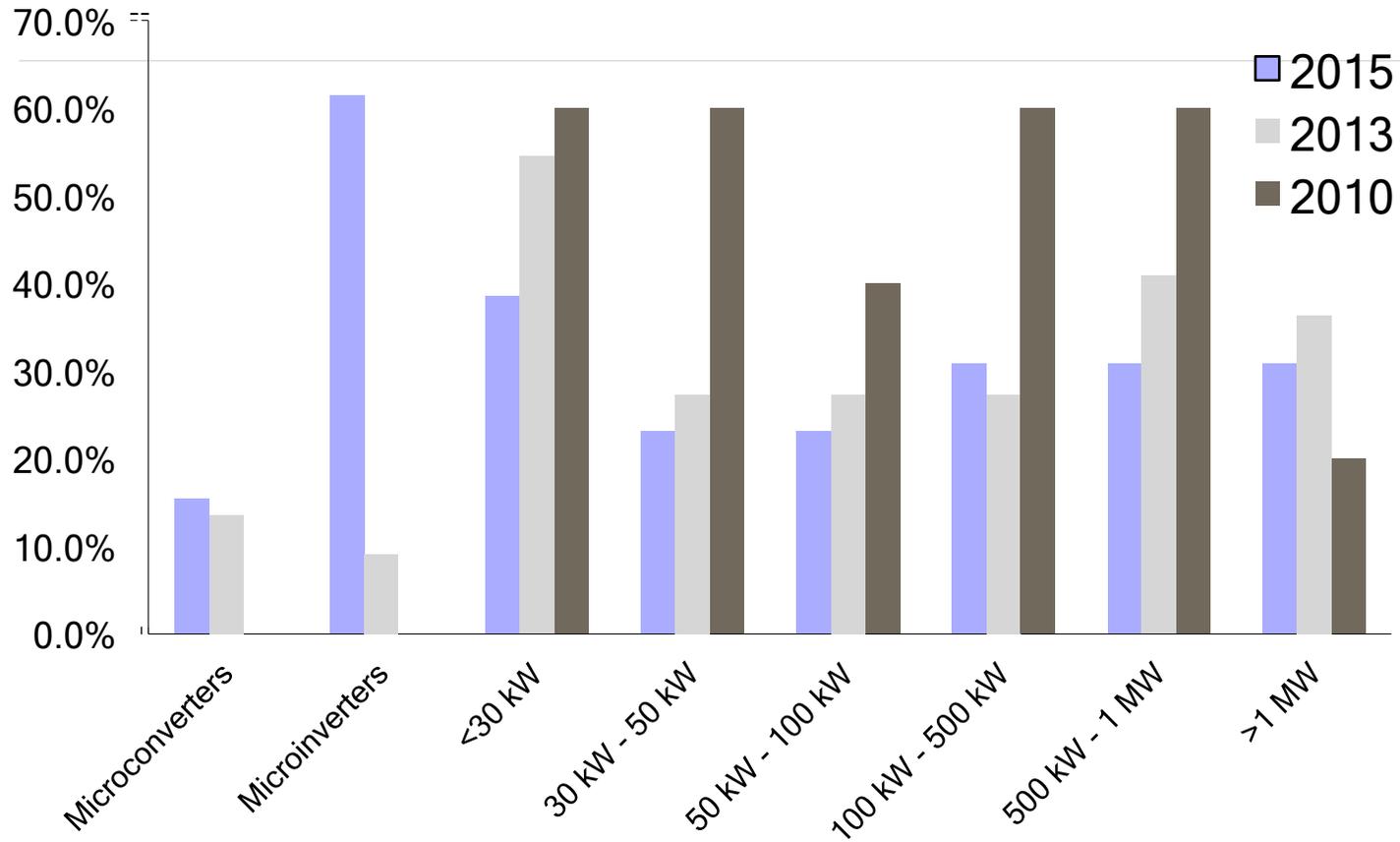
Tuesday, February 24, 2015

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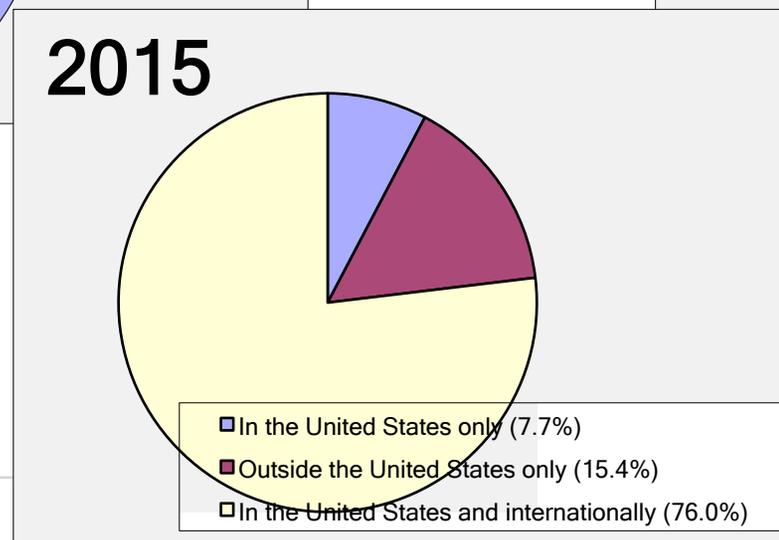
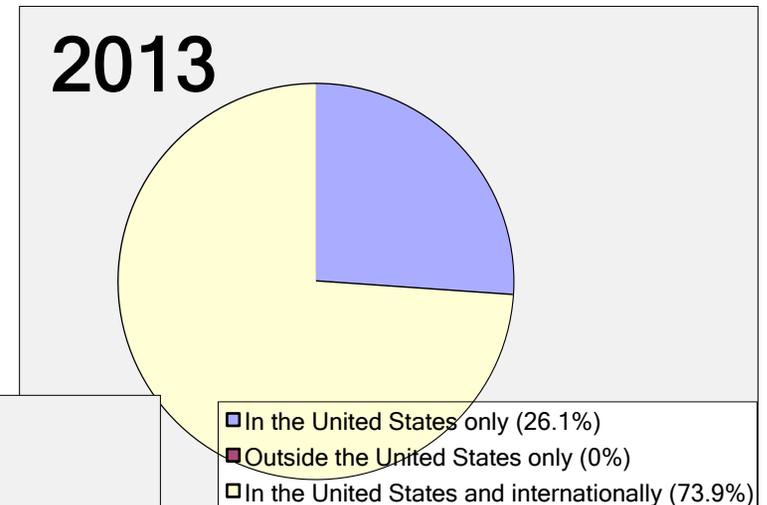
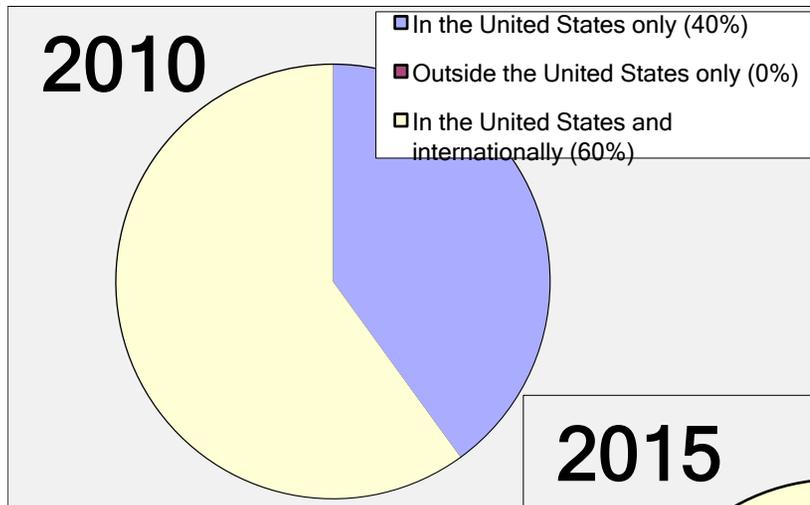
Total Responses

[Survey](#)

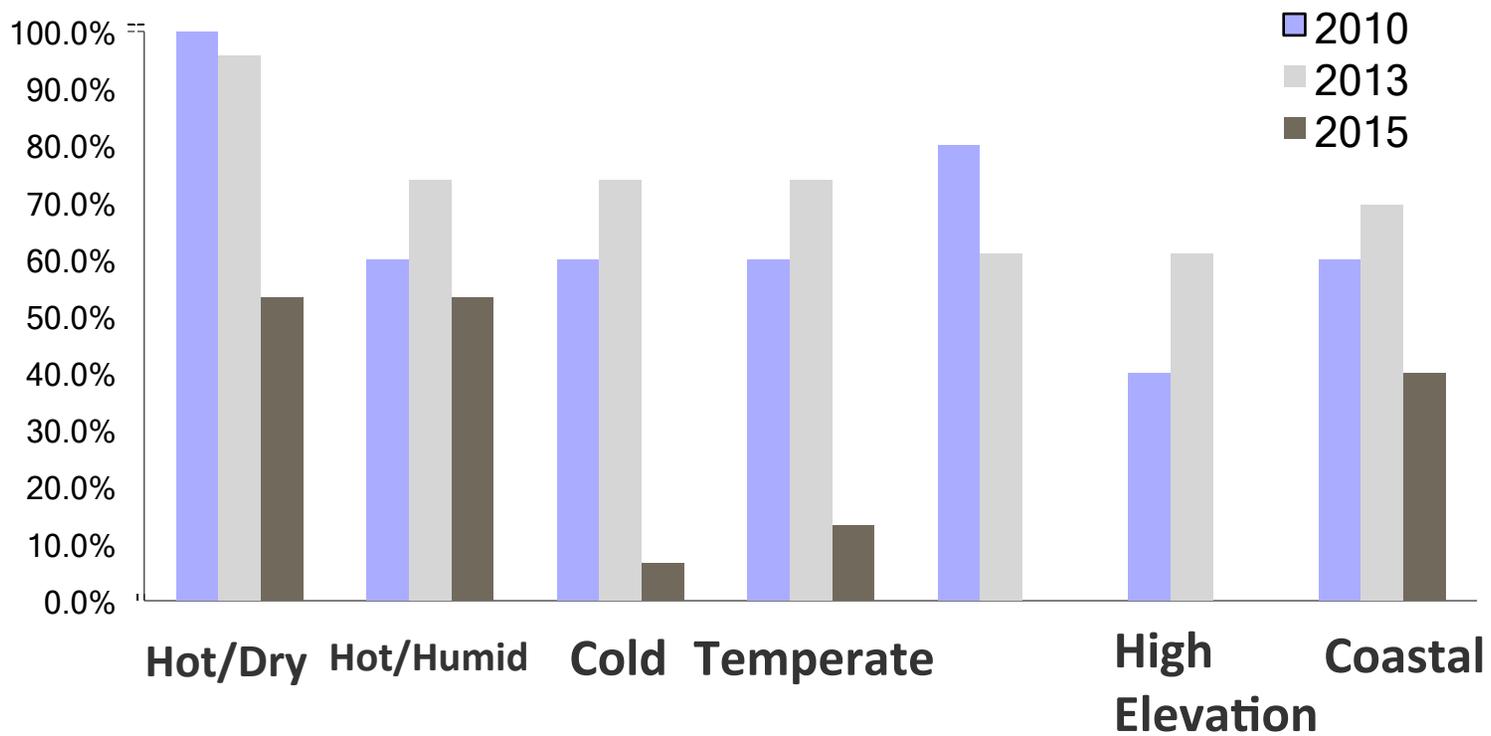
Q1: What size inverters does your company produce?



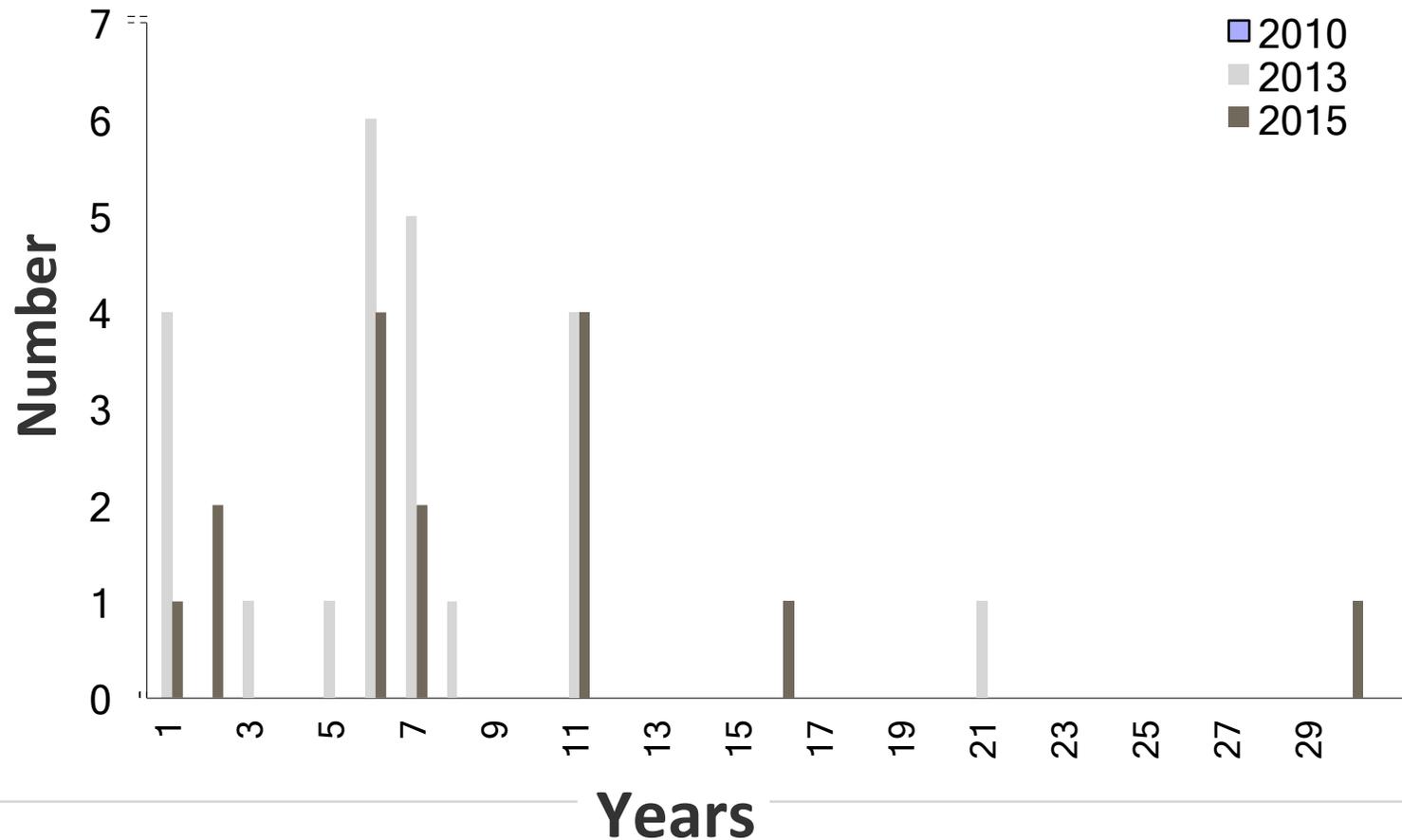
Q2: Where has your company sold inverters for PV systems?



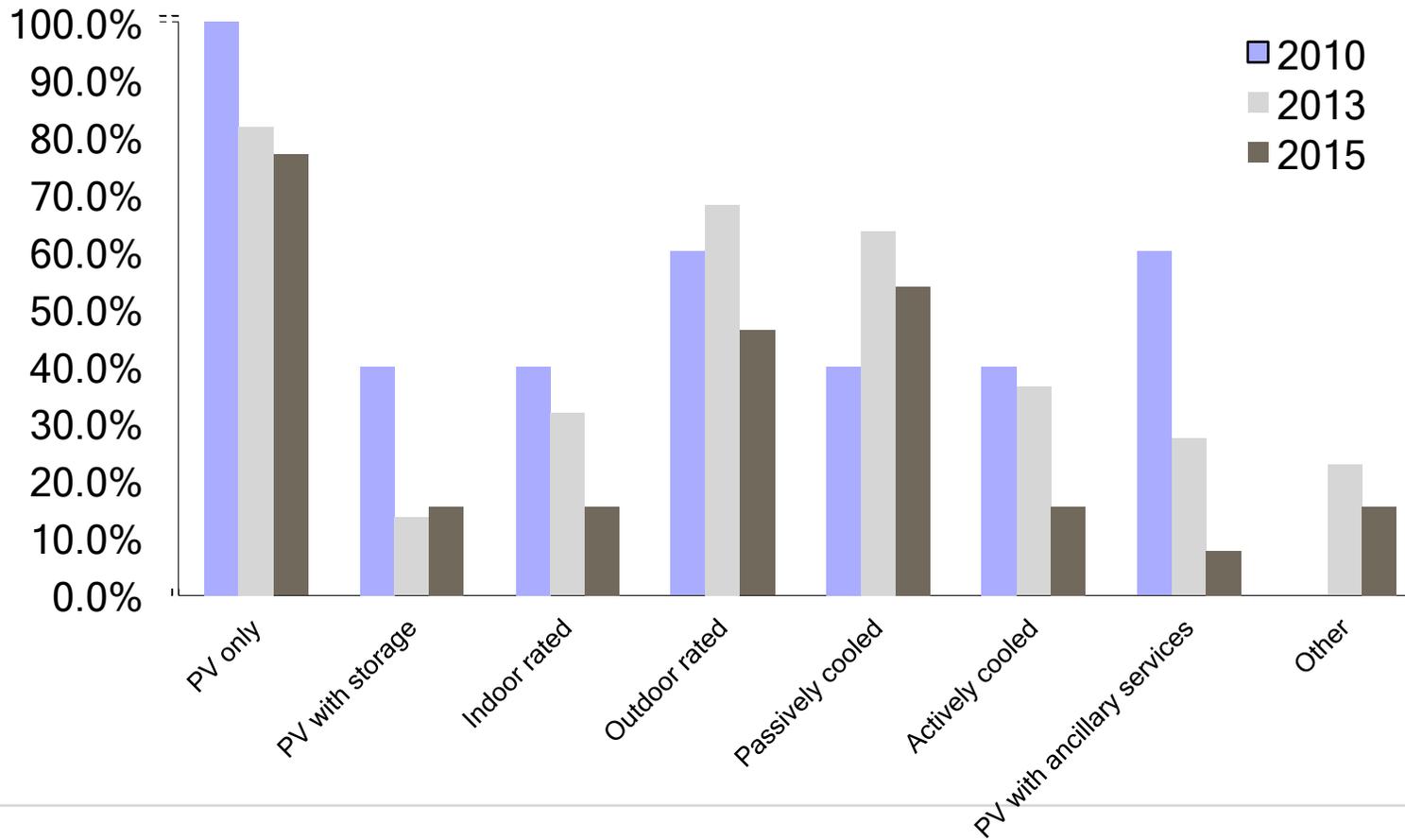
Q3: Which climate zone is most severe in terms of field failure or system stress?



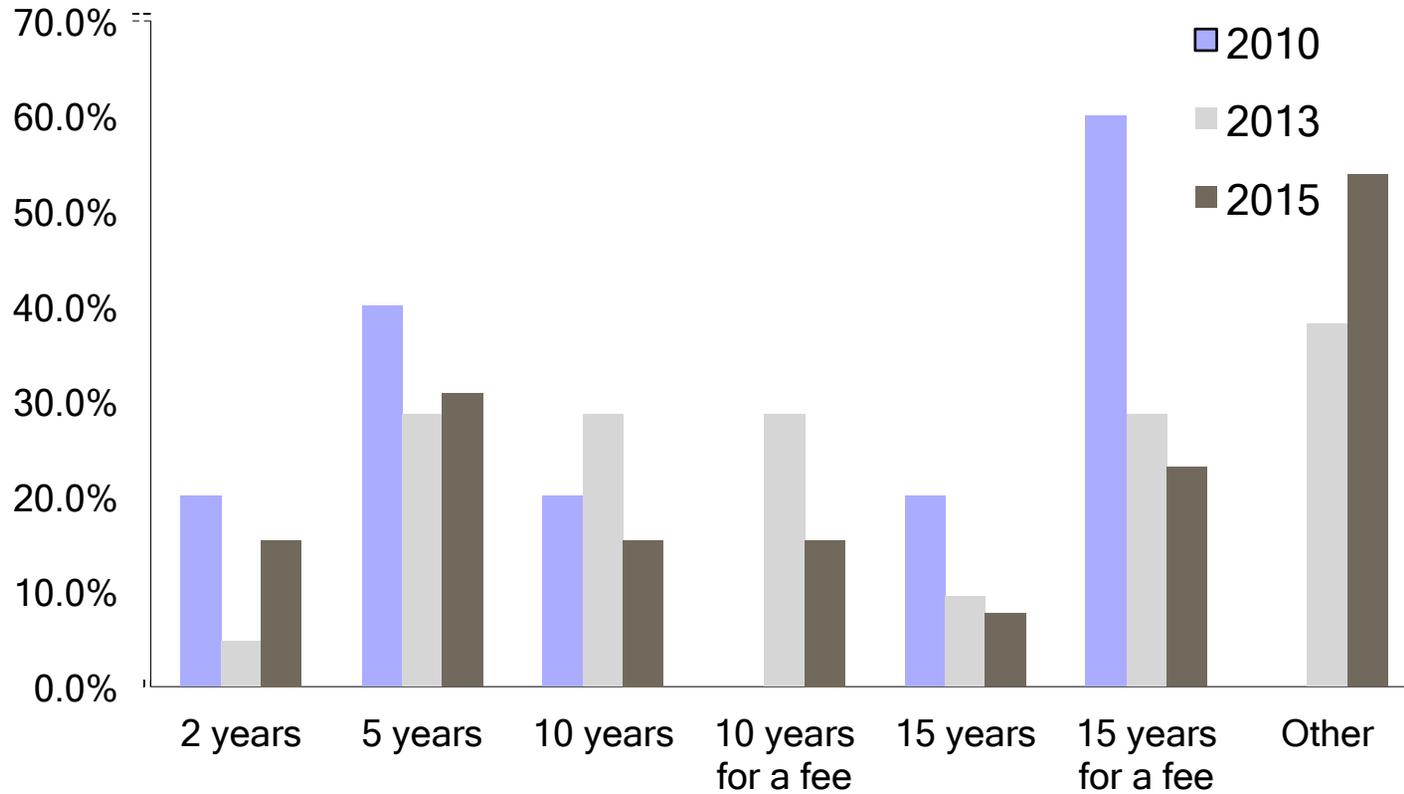
Q4: How many years has your company been in the PV inverter business (rounded up to whole number)?



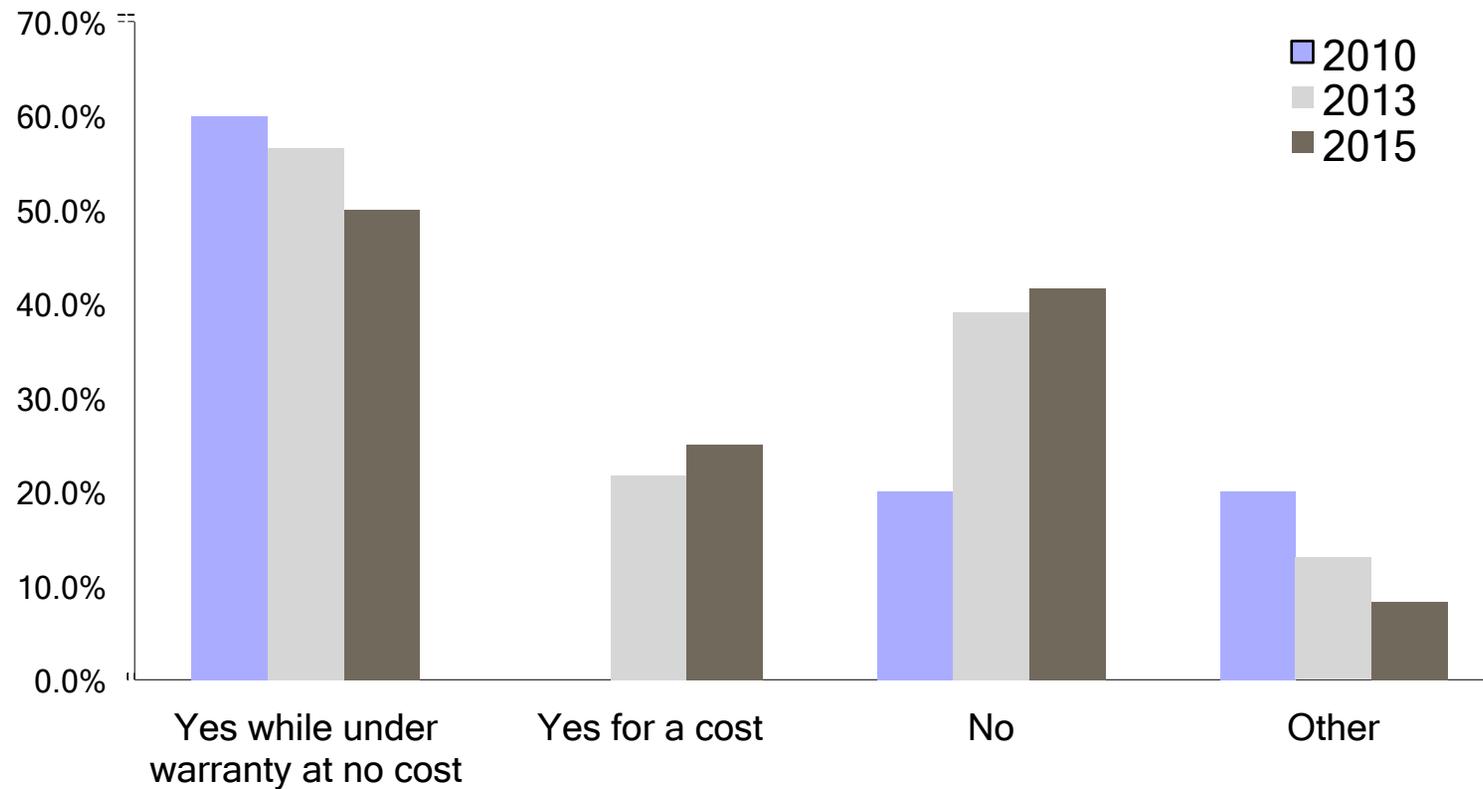
Q5: What different types of inverters has/does your company design and market?



Q6: What is the warranty offered by your company?



Q7: Does your company service your inverters?



Q8: How long do you believe your inverters will last in the field (expected lifetime vs. warranty)?

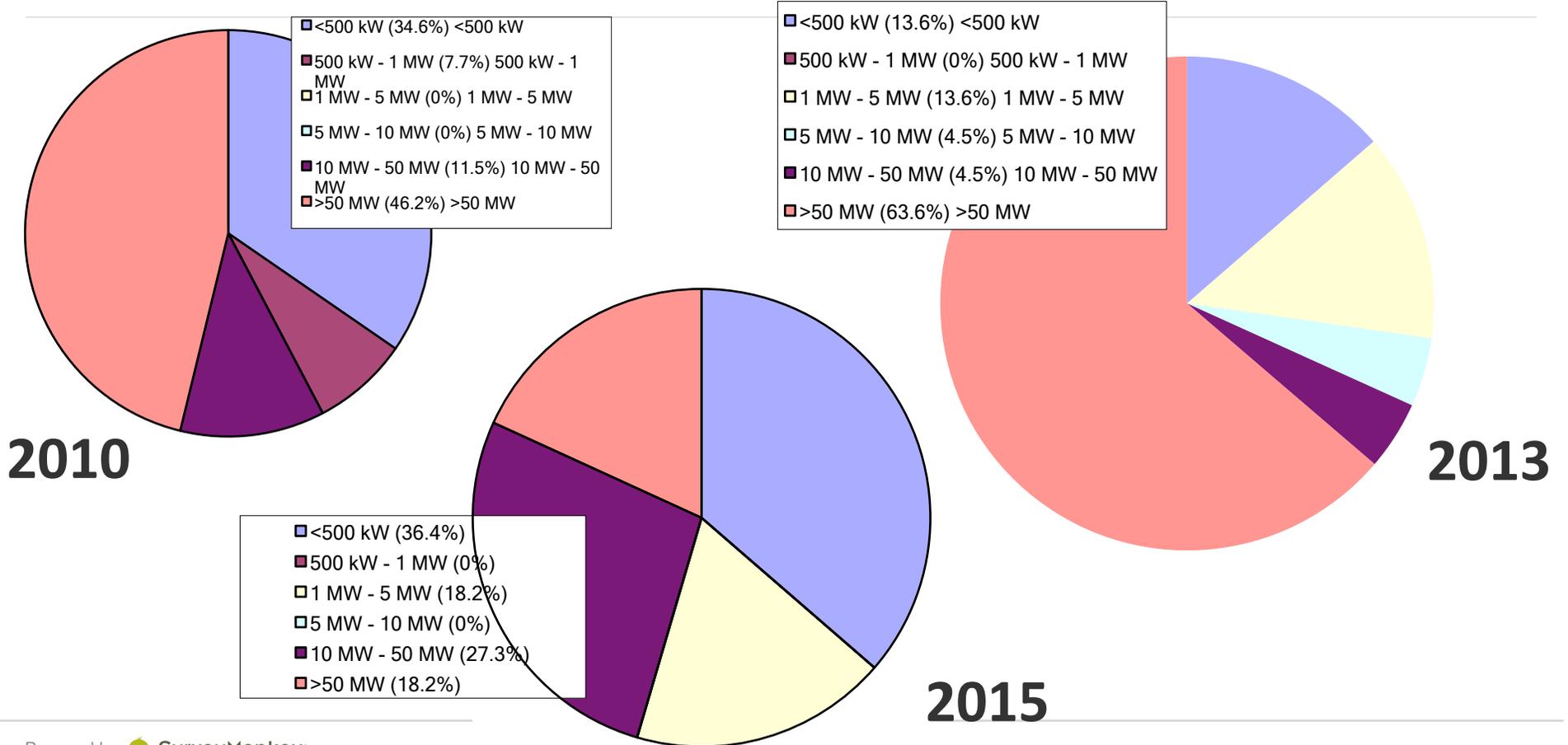
2013

- unknown
- 10 years (4)
- 12 -15 years (2)
- 15 years (5)
- 16 years
- 20 years (8)
- 25 years (2)
- >25 years
- 30 years
- >30 years

2015

- 5 years (2 year warranty)
- 7 years
- 10 years
- >10yrs **(2)**
- 10-20 years
- 12 years
- 12-25 years
- 15years
- 20 years
- > 25
- >40 years
- 50 years

Q9: To date, what is your company's cumulative capacity of PV inverters sold?



Q10: How does your company define inverter failure? (e.g. x% efficiency loss, loss of communication, no power output)

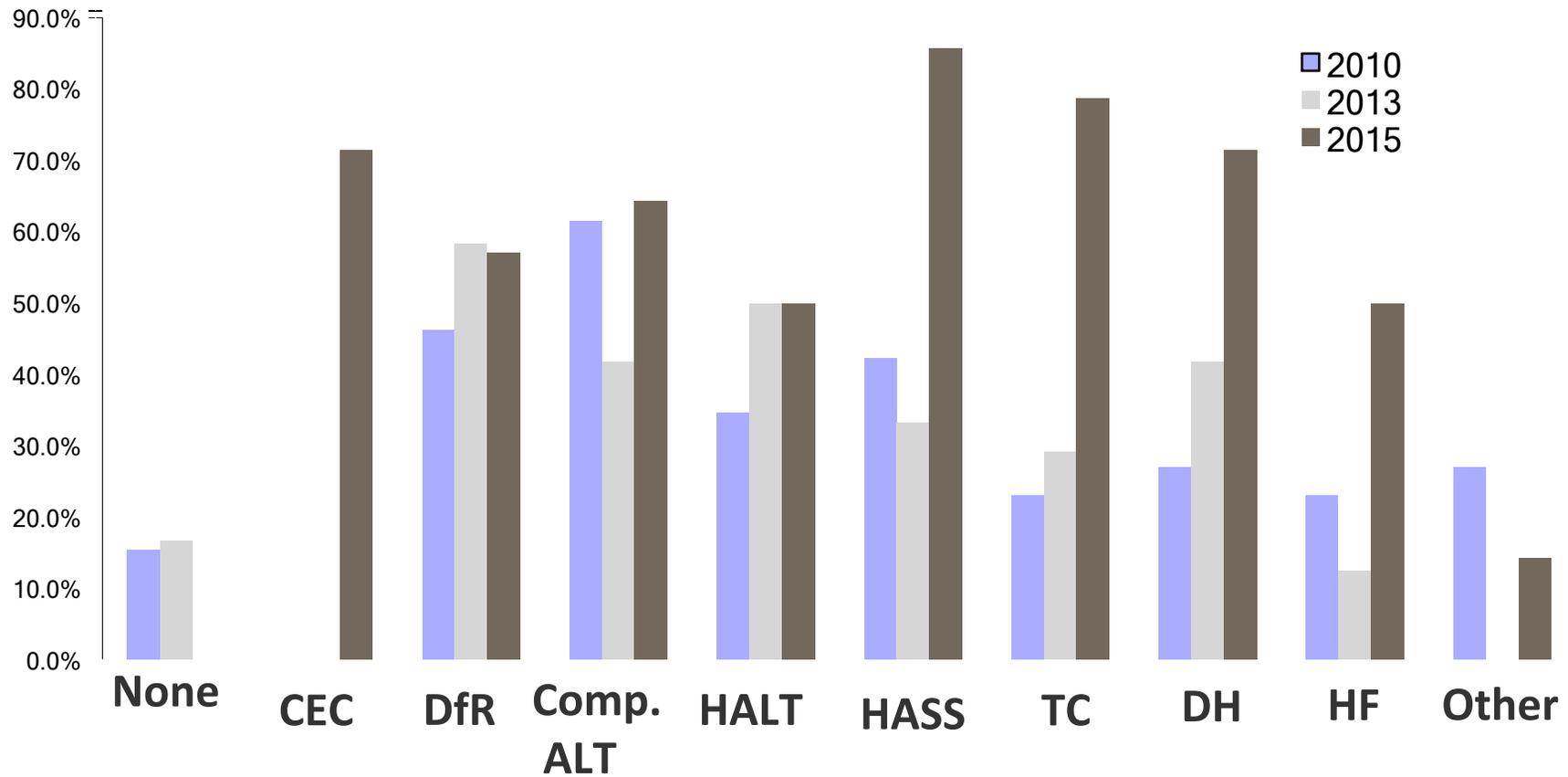
- Any customer dissatisfaction (5)
 - Any issue that requires service visit or return of inverter
 - Power down/no power output (7)
 - downtime in excess of warranty provision
 - Degraded power output (3)
 - <70% power output
 - >5% loss in energy harvest d
 - Loss of communication (4)
 - Loss of major functionalities (3)
 - Physical damage
-

Q12:How does your company define inverter reliability?

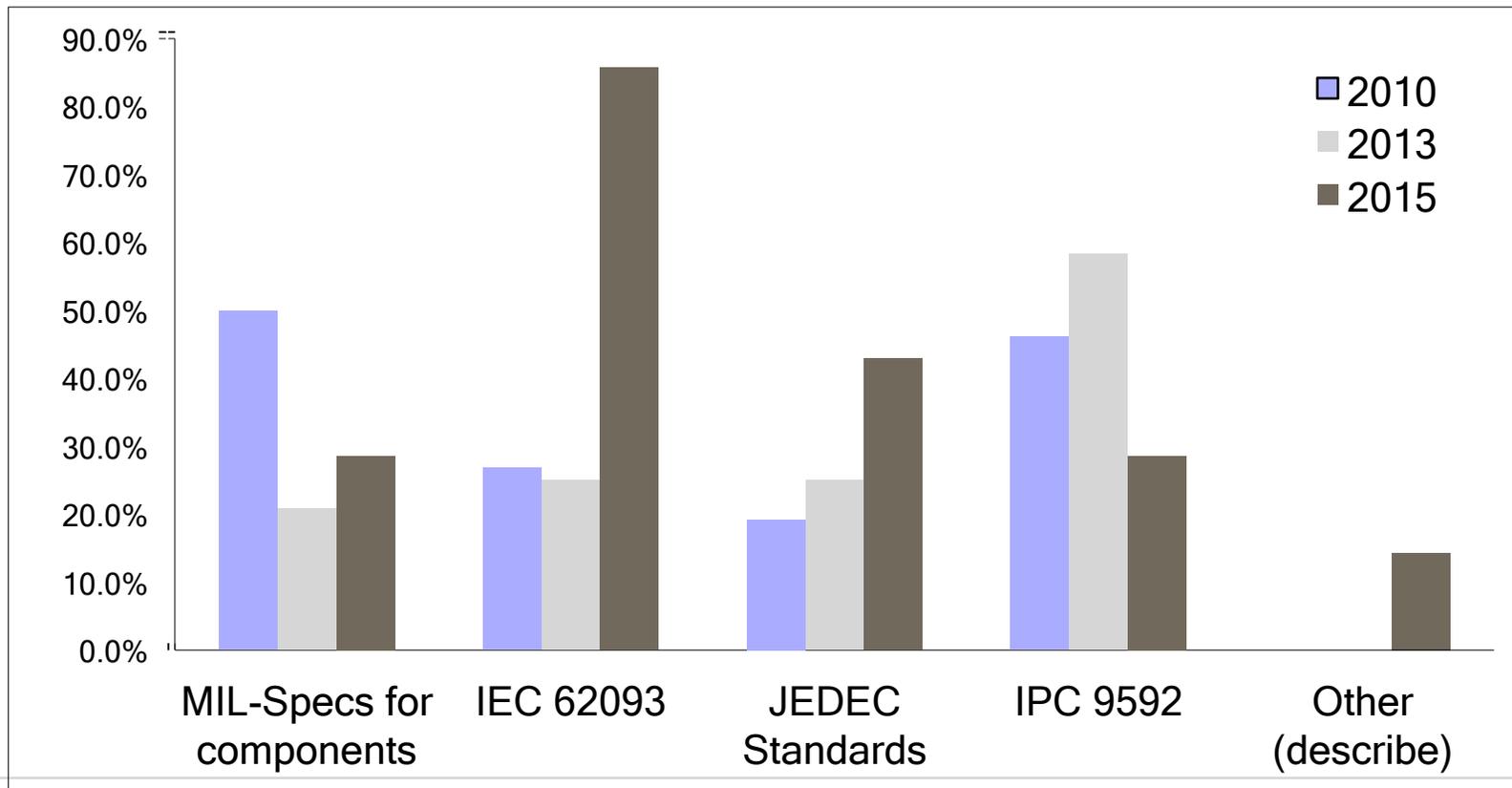
- Probability of failure within a certain time period in given condition
 - Meeting stated efficiency, communication, and specifications (7)
 - No unscheduled service calls within warranty period (2)
 - Annual loss in efficiency lower than minimum threshold

- Statistical Analysis
 - Annualized Failure Rate / Useful life
 - Failures in Time (FIT)
 - Mean Time Before Failure (MTBF)
 - $R(t)=\exp(-t/MTBF)$

Q13: What reliability testing does your company currently perform?



Q14: What reliability-related standards or guidelines does your company currently use?



Q15: What are your top three (3) vulnerabilities or reliability issues for your inverters?

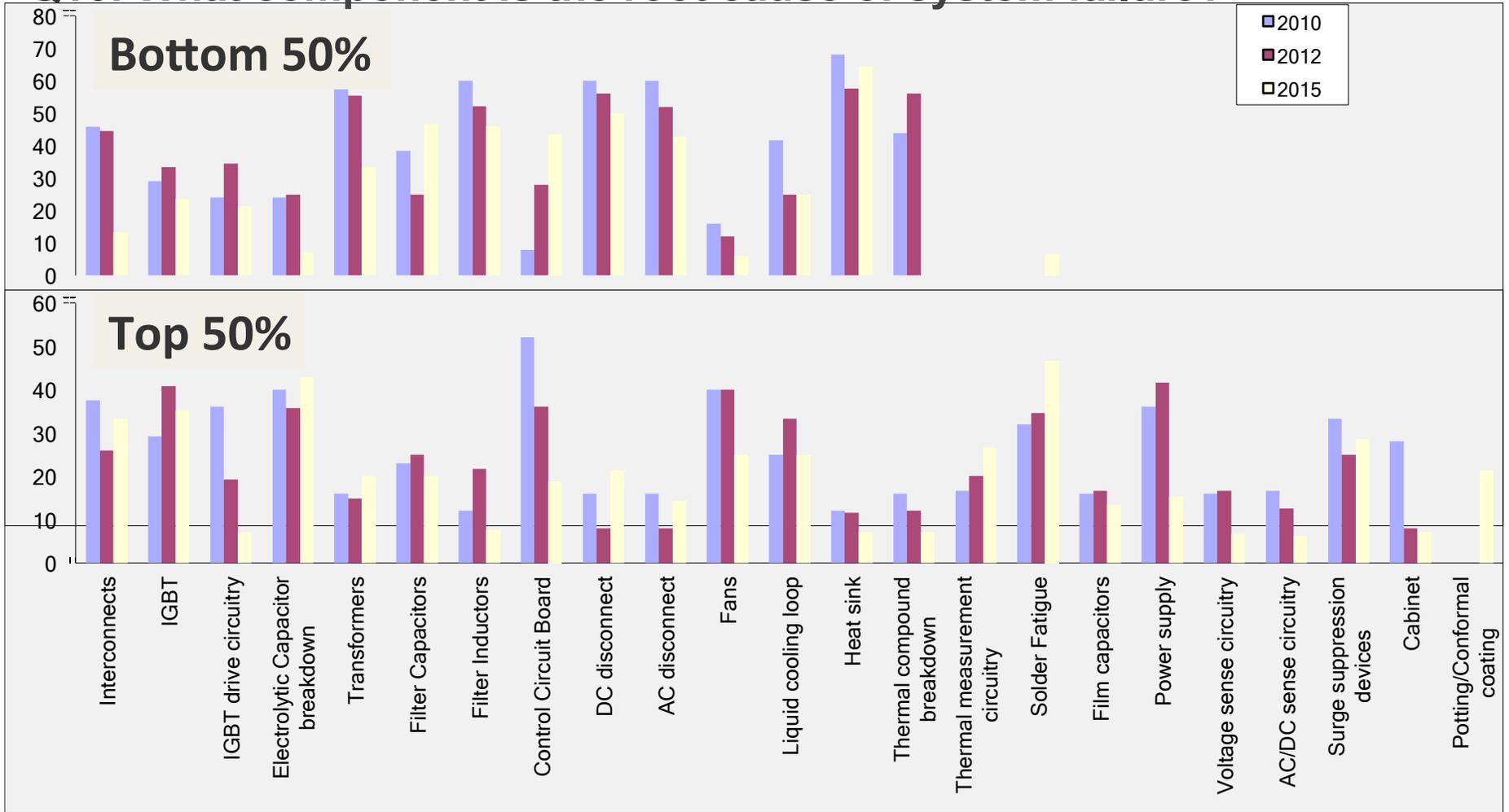
2010

2013

2013

-
- Electrical Transients/Grid events **(21) (12) (8)**
 - Environmental **(5) (10) (3)**
 - Dust, Corrosion, Moisture
 - Temperature **(17) (4) (2)**
 - Excursions, Cycling, Cooling
 - Component failure/degradation **(4) (1)**
 - IGBT **(4) (1) (2)**
 - DC Capacitors **(3) (4) (1)**
 - Boards/Control **(5) (4) (1)**
 - Solder Joints **(1) (1) (1)**
 - Software **(2) (2) (0)**
 - Interconnects/Contactors **(3) (1) (0)**
 - Fans **(1) (1) (0)**
 - Protection **(2) (0) (2)**
 - Inductors **(0) (1) (0)**
 - Sensors **(0) (1) (0)**
 - Communications **(5) (10) (3)**
 - Installer / third party errors **(2) (5) (0)**
 - Site Issues
 - High DC/AC Ratio **(0) (1) (0)**
 - Grounding/Leakage **(0) (1) (1)**
-

Q16: What component is the root cause of system failure?



Q19: From OEM perspective what you would like DOE, national laboratories, standard development organizations, and utilities to do to help increase inverter reliability?

- Long term, outdoor testing (4)
- Real world simulation and Reliability Testing
 - ALT testing with correlation (5)
 - Research into higher reliability components (2)
 - Program on collecting field failures and analyze & model the results for future design (6)
 - BOM cost analysis, market analysis/reports
- Spell out clear performance criteria and acceptable degradation levels for spec
- Standards development (15)
 - PV Sites, reliability testing, qualification testing, component reliability
- Prognostics and Health Management (2)

Q18: Order of interest Of the following session topics (1- of most interest to me, 6 - of least interest to me):

