

HR2 Preliminary Data & 2012 OSU Round Robin

2012 June Materials Meeting Toulouse

Materials Working Group

Michael Burns, FAA Tech Center

June, 2012



Federal Aviation
Administration



FAA TECH. CENTER HR2 PROTOTYPE



- New Thermopile System
- Split-Airflow Measurement and Control (REF 0°C,760 mmHg, 60 SCFM (Cooling) / 20 SCFM)
- New Second Stage Plate incorporating new hole pattern / seal
- Software changes incorporating new equation
- Holding chamber preheat position established
- Insulation within specification
- Overlap areas within specification
- Mass Flow Meter used for gas calibration (REF 0°C,760 mmHg)
- Schmidt-Boelter HFG's (3.65 W/cm²)
NIST as Standard Reference

AGENDA

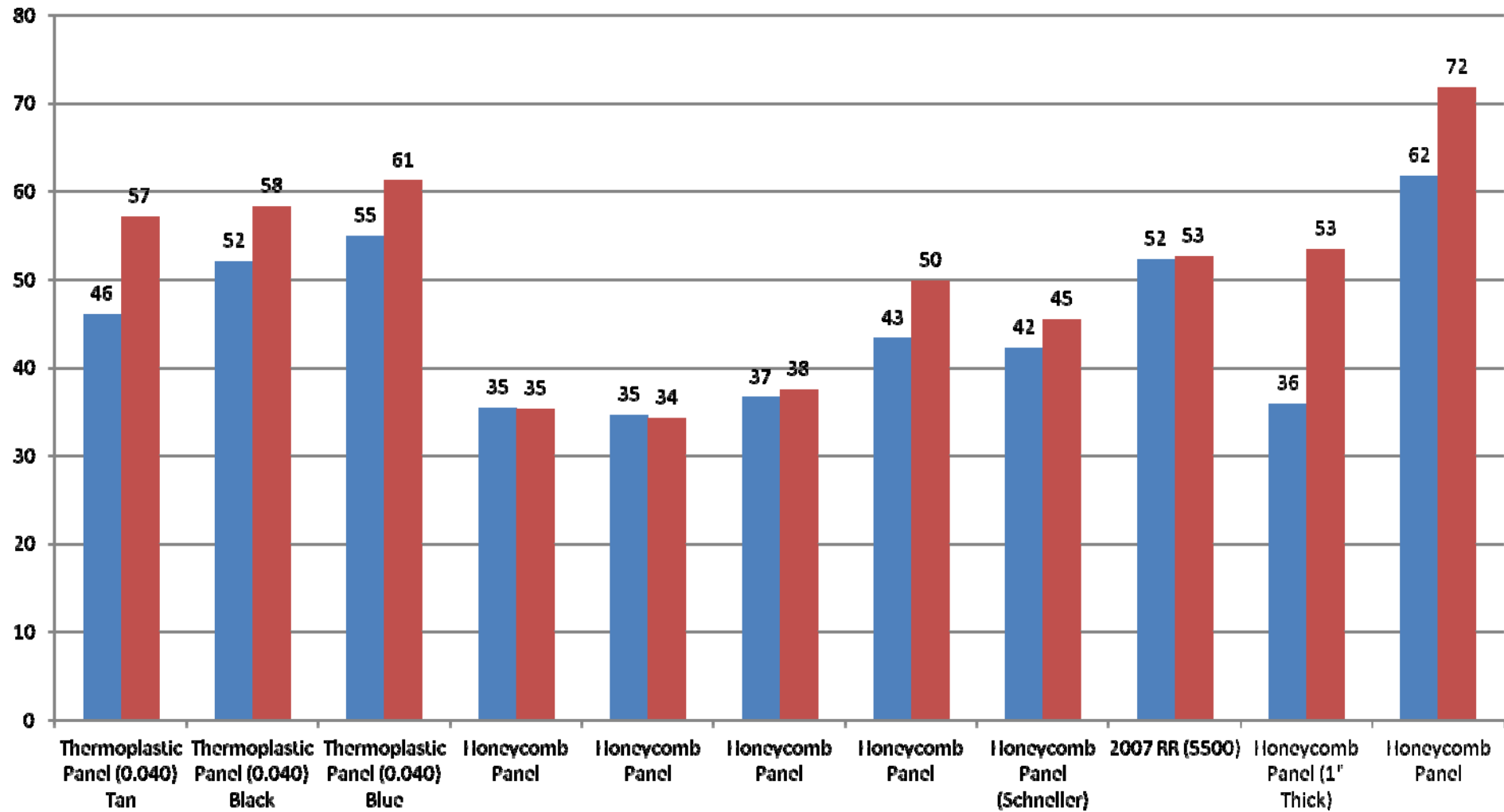
- HR2 Prototype Comparison Data
- 2012 International Heat Release Round Data
 - Peak
 - Total
 - Time to Peak / Total
 - Thermopile mV Data
 - Calibration Factor Data
- Next



OSU / HR2 Comparison Data

Peak Heat Release Rate

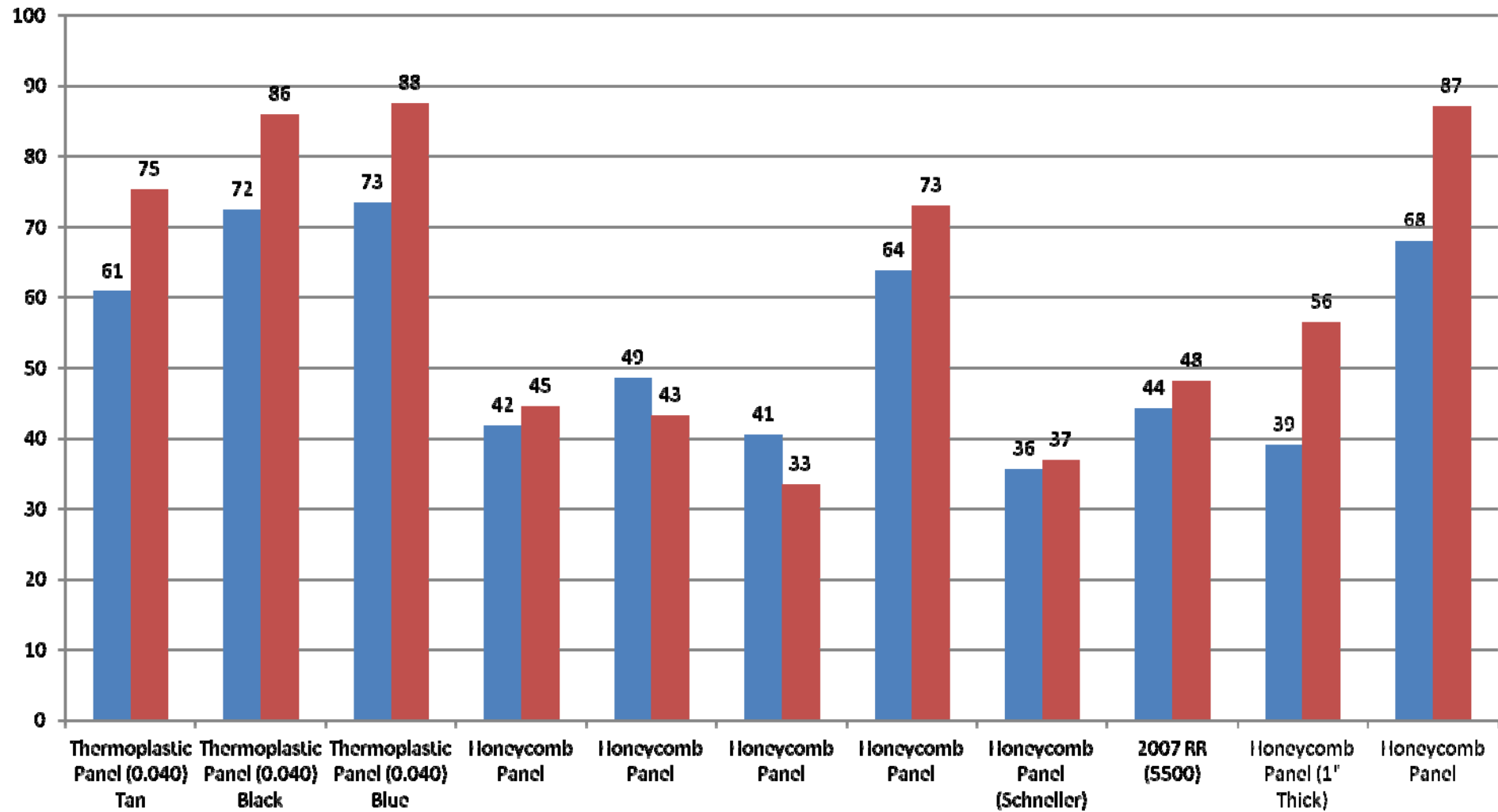
OSU HR2



OSU / HR2 Comparison Data

Total Heat Release

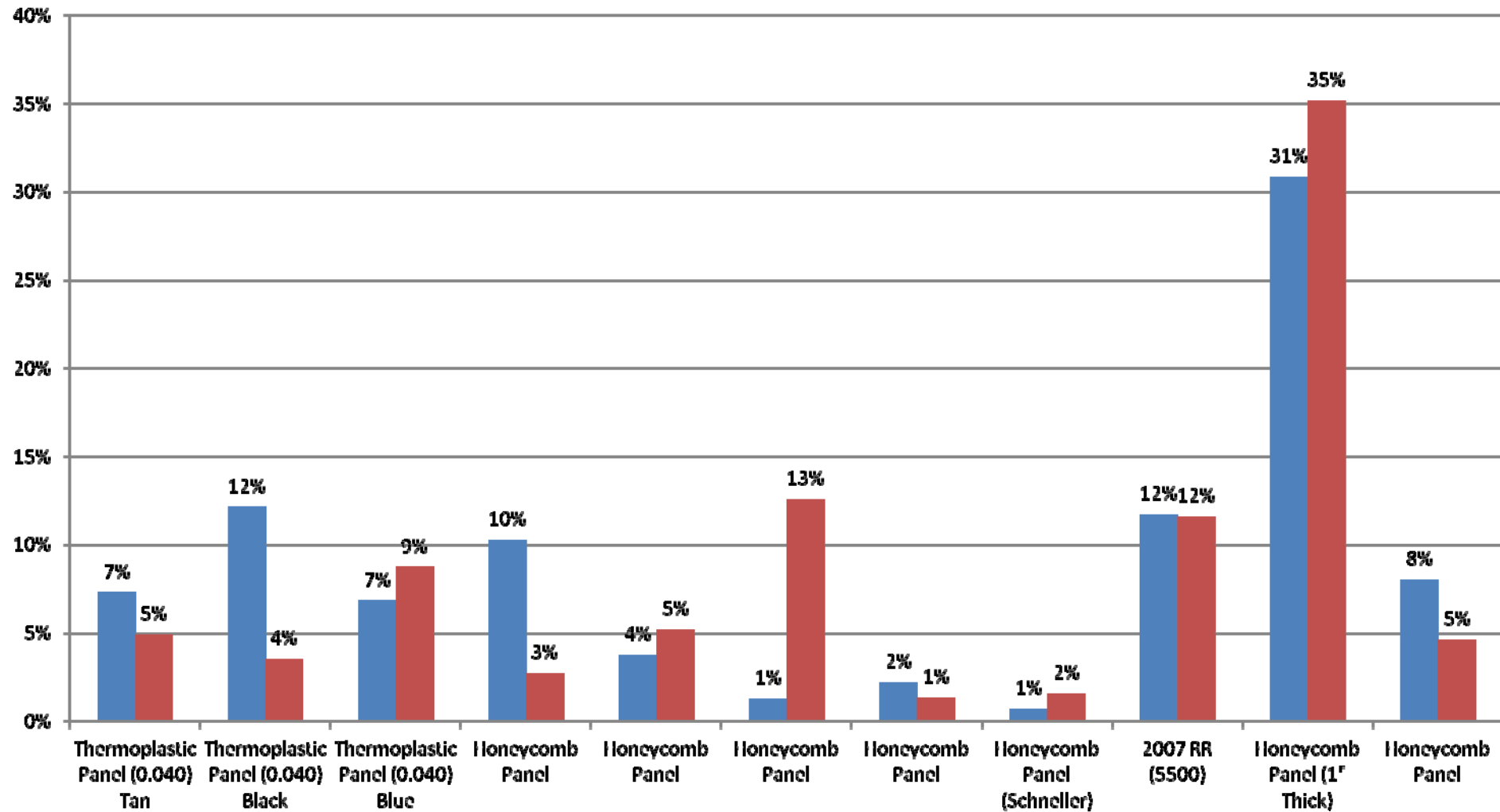
■ OSU ■ HR2



OSU / HR2 Comparison Data

Peak HRR Repeatability (% STDEV)

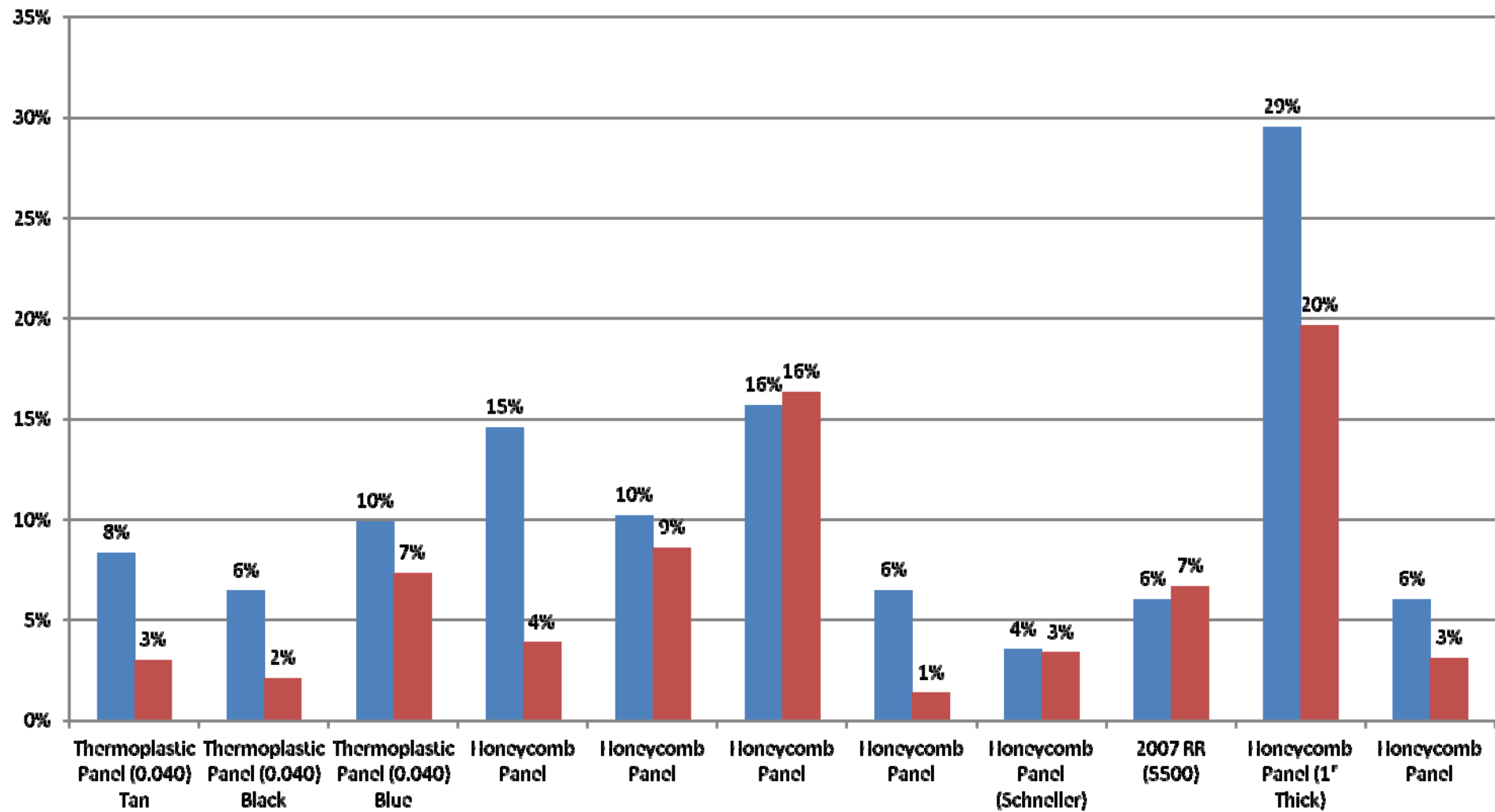
OSU HR2



OSU / HR2 Comparison Data

Total HRR Repeatability (% STDEV)

OSU HR2



2012 International Round Robin Participants

Aeroworks Composites (Netherlands)	Heath Tecna (Bellingham, WA)
AIM Composites (England)	Herb Curry (Mt. Vernon, IN)
Airbus (Germany)	Isavolta (Harrisburg, OR)
Avio Interiors (Italy)	Isavolta AG (Austria)
Boeing (Everett, WA)	JAMCO (Japan)
Boeing (Seattle, WA)	JAMCO (Singapore)
CD Zodiac (La Palma, CA)	JAMCO (Seattle, WA)
CD Zodiac (Marysville, WA)	Krueger Consulting LLC (Stanwood, WA)
CD Zodiac (Huntington Beach, CA)	L3 Communications (Greenville, TX)
CD Zodiac (Santa Maria, CA)	Lufthansa Technik AG (Germany)
CTA (Spain)	Schneller #1 (Kent, OH)
Custom Scientific Instruments, INC. (Easton, PA)	Schneller #2 (Kent, OH)
Delsen (Glendale, CA)	SELL (Germany)
DLR (Germany)	Showa (Japan)
FAA [HR2] (FAATC, NJ)	Test Center of CAAC (China)
FAA [OSU] (FAATC, NJ)	TestCorp (Mission Viejo, CA)
FAA [Chem Lab] (FAATC, NJ)	TestCorp (Mission Viejo, CA)
GovMark (Farmingdale, NY)	TTF (Auburn, WA)



2012 Heat Release Round Robin

- 36 Participating OSU's
- 3 specimens each : 2 Honeycomb Panels (Dark & Light) / 3 Thermoplastic Panels (Black, Tan, Blue)
- Red / Yellow columns indicate a deviation greater than 10% from average
- Each lab repeatability (% STDEV) for testing that particular material is included on the secondary axis.
- Lab code "B" denotes International testing facilities
- FAA Tech Center Lab Codes: HR2 Prototype = A03, OSU = A20

Round Robin Materials

Dark Brown Honeycomb Panel

- Two from the same lot (48% Resin) / 1 from a different lot (49% Resin)
- Single Peak Material
- This material is probably best indicator of time to peak data for this RR (The only Chart color coded with 10% Range)



2012 Heat Release Round Robin

Light Brown Honeycomb Panel

- Double peak material
- Each peak approximately the same height occurring approximately 25 seconds and 100 seconds
- Many factors can effect time to peak, some include:
 - Air flow / Air flow split
 - Heat Flux / Uniformity
 - Thermocouple Bead Size / Cleanliness / Uniformity of hot zone measurement (Alignment of Upper Pyramid Section & Baffle Plate)

Thermoplastic Panels (Black, Tan & Blue)

- Each 0.040” Thickness
- Material occasionally pulled from sides or top and shrunk which reduced the heat release numbers (Peak and Total) for that test
- This may be a contributing factor in poor repeatability in time to peak data
- Labs who had very sharp drops in data due to upper pilot extinguishing may have the burner out of position (too far forward)



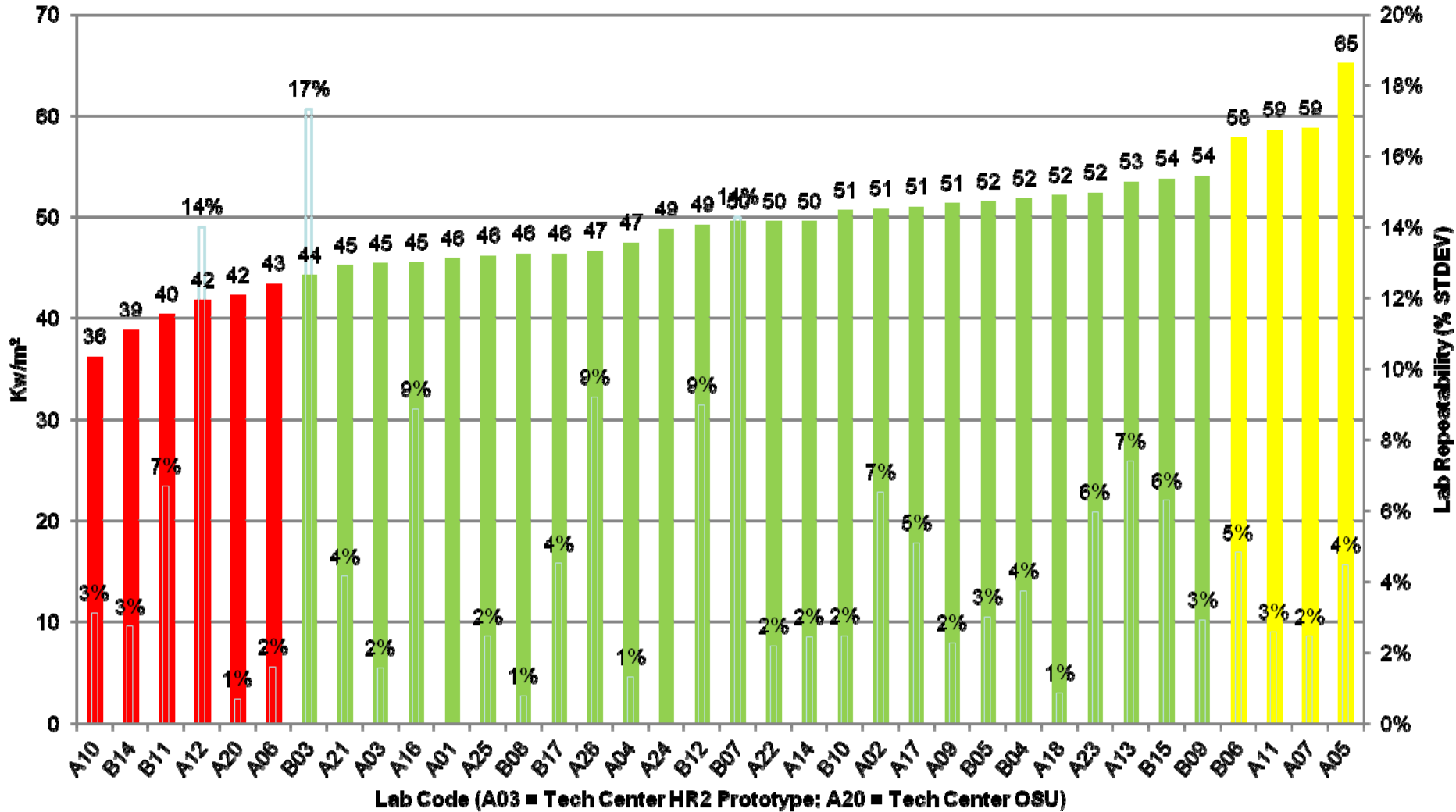
2012 Heat Release Round Robin

Peak Heat Release Rate Data



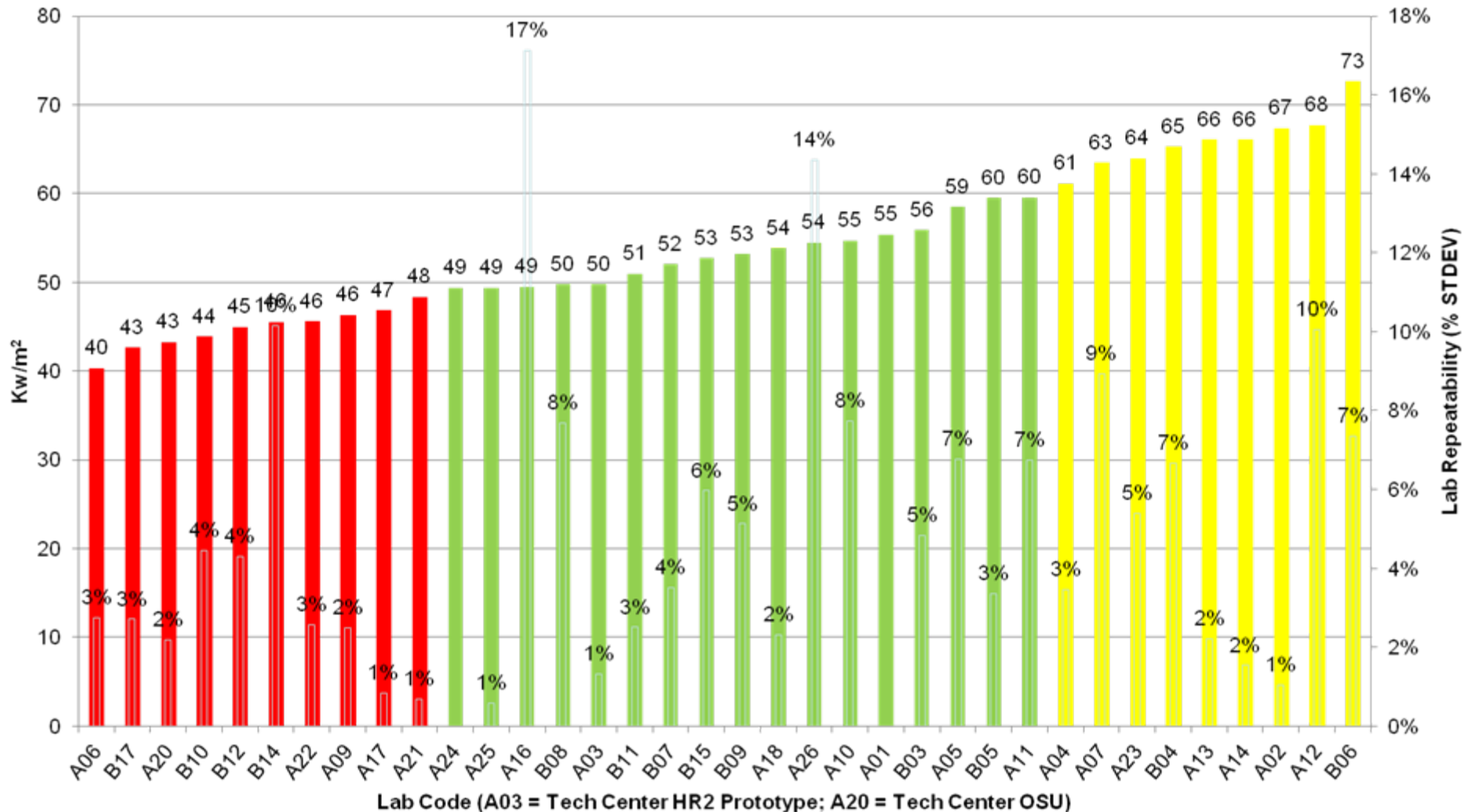
Dark Brown Honeycomb Panel Peak HRR vs. % STDEV

Avg = 49 kW/m²; 12% STDEV



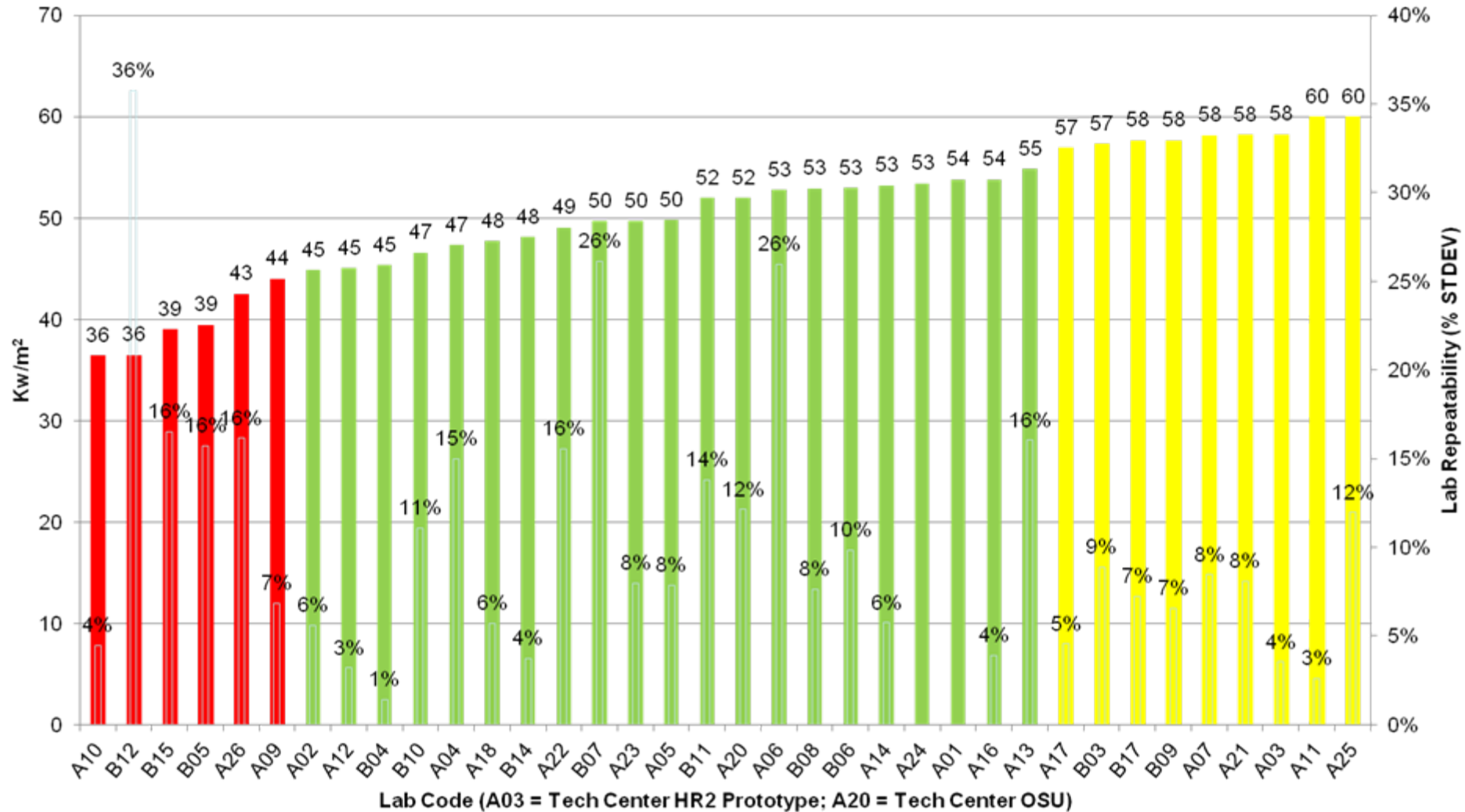
Light Brown Honeycomb Panel Peak HRR vs. % STDEV

Avg = 54 kW/m²; 16% STDEV



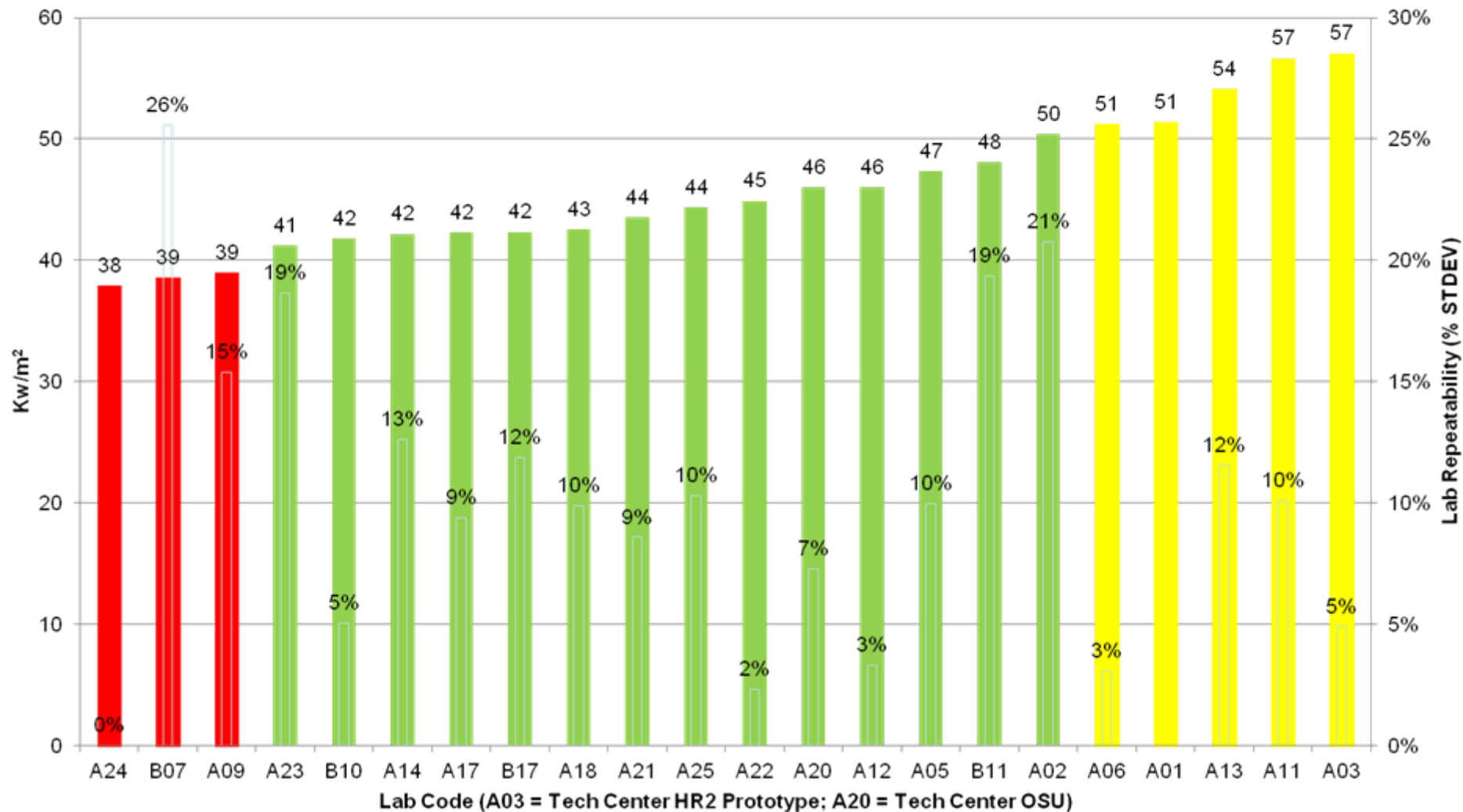
Black Thermoplastic Panel Peak HRR vs. % STDEV

Avg = 50 kW/m²; 13% STDEV



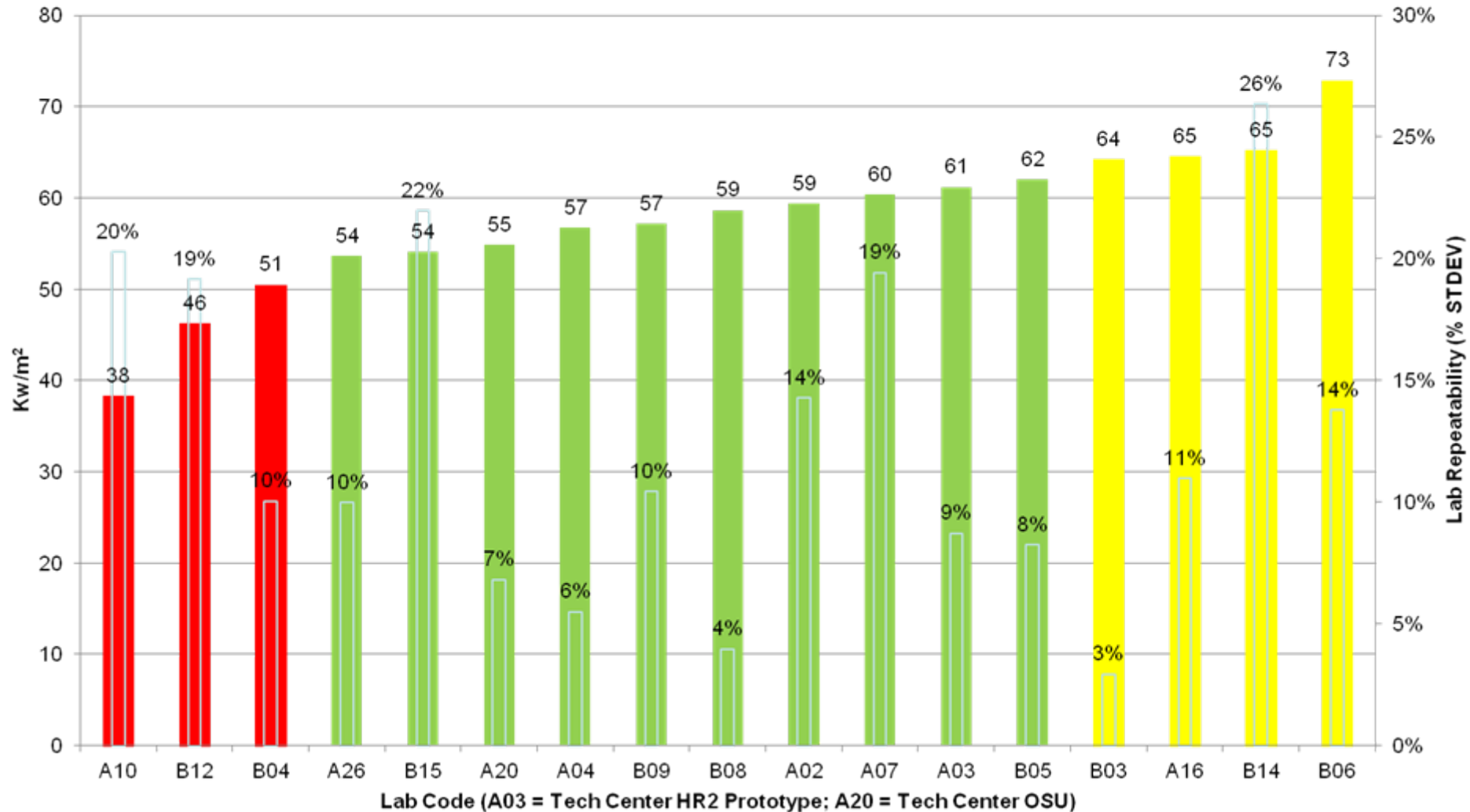
Light Thermoplastic Panel Peak HRR vs. % STDEV

Avg = 46 kW/m²; 12% STDEV



Blue Thermoplastic Panel Peak HRR vs. % STDEV

Avg = 58 kW/m²; 14% STDEV



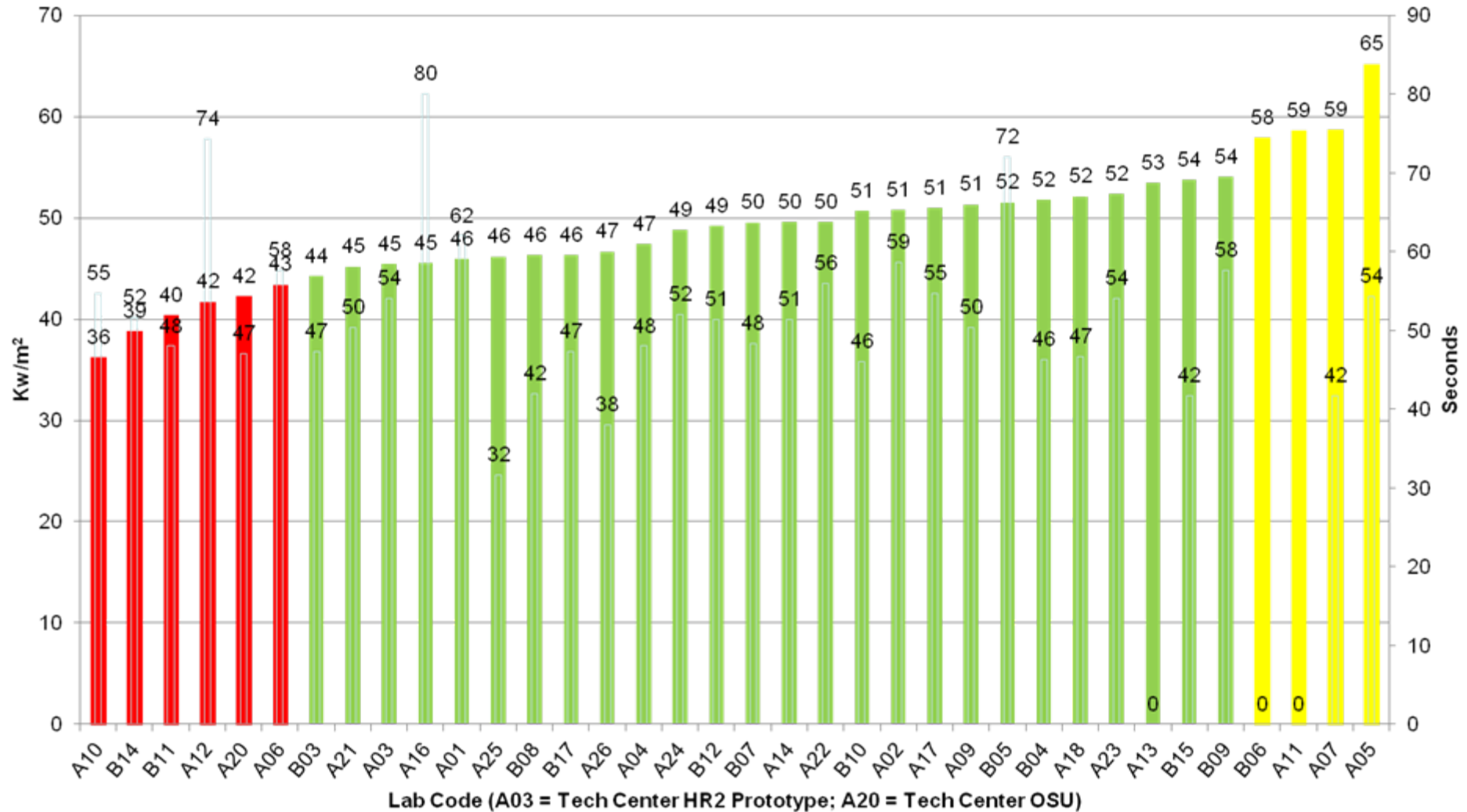
2012 Heat Release Round Robin

Peak Heat Release Rate vs. Time to Peak (Seconds)



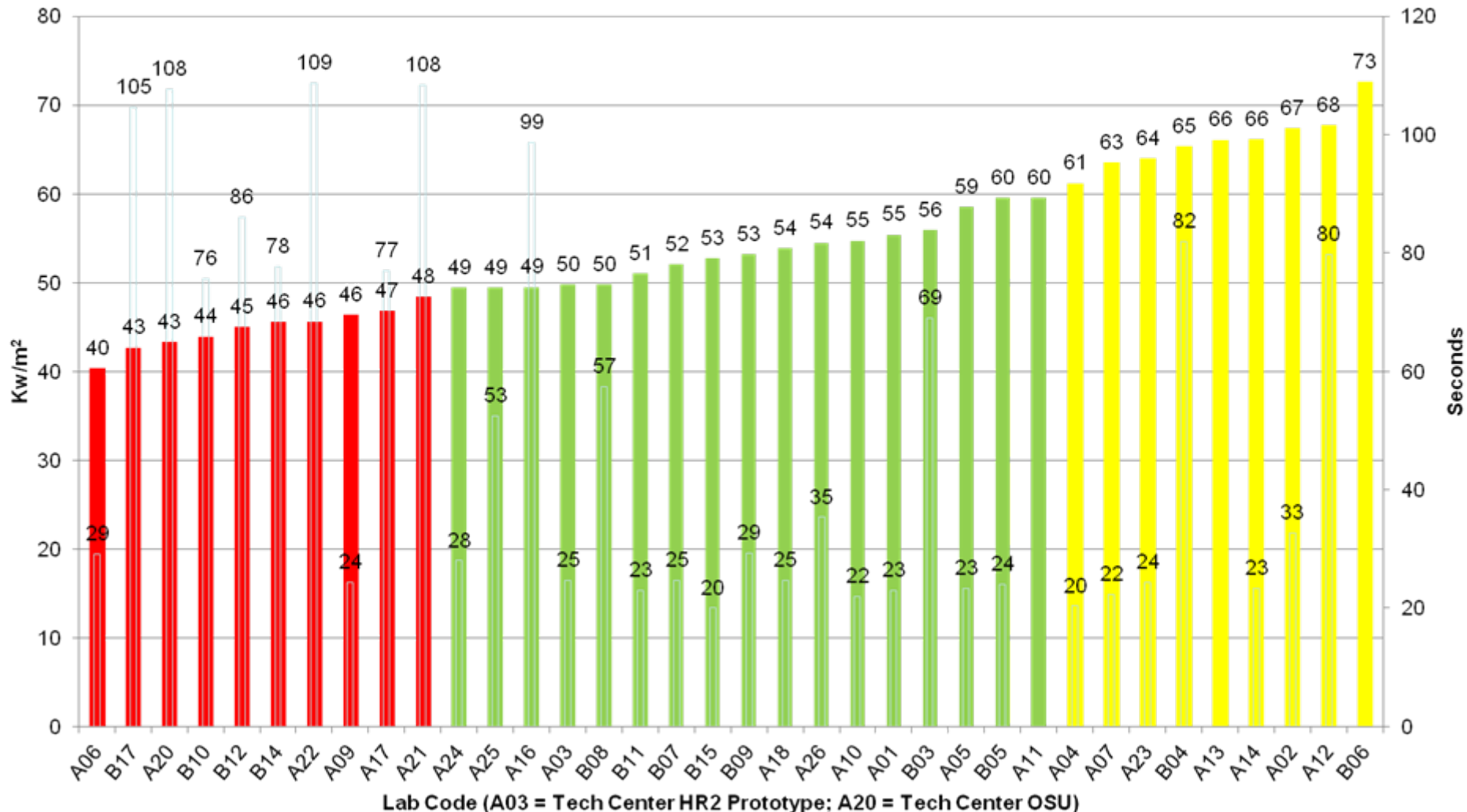
Dark Brown Honeycomb Panel Peak HRR vs. TTP

Avg = 49 kW/m²; 12% STDEV



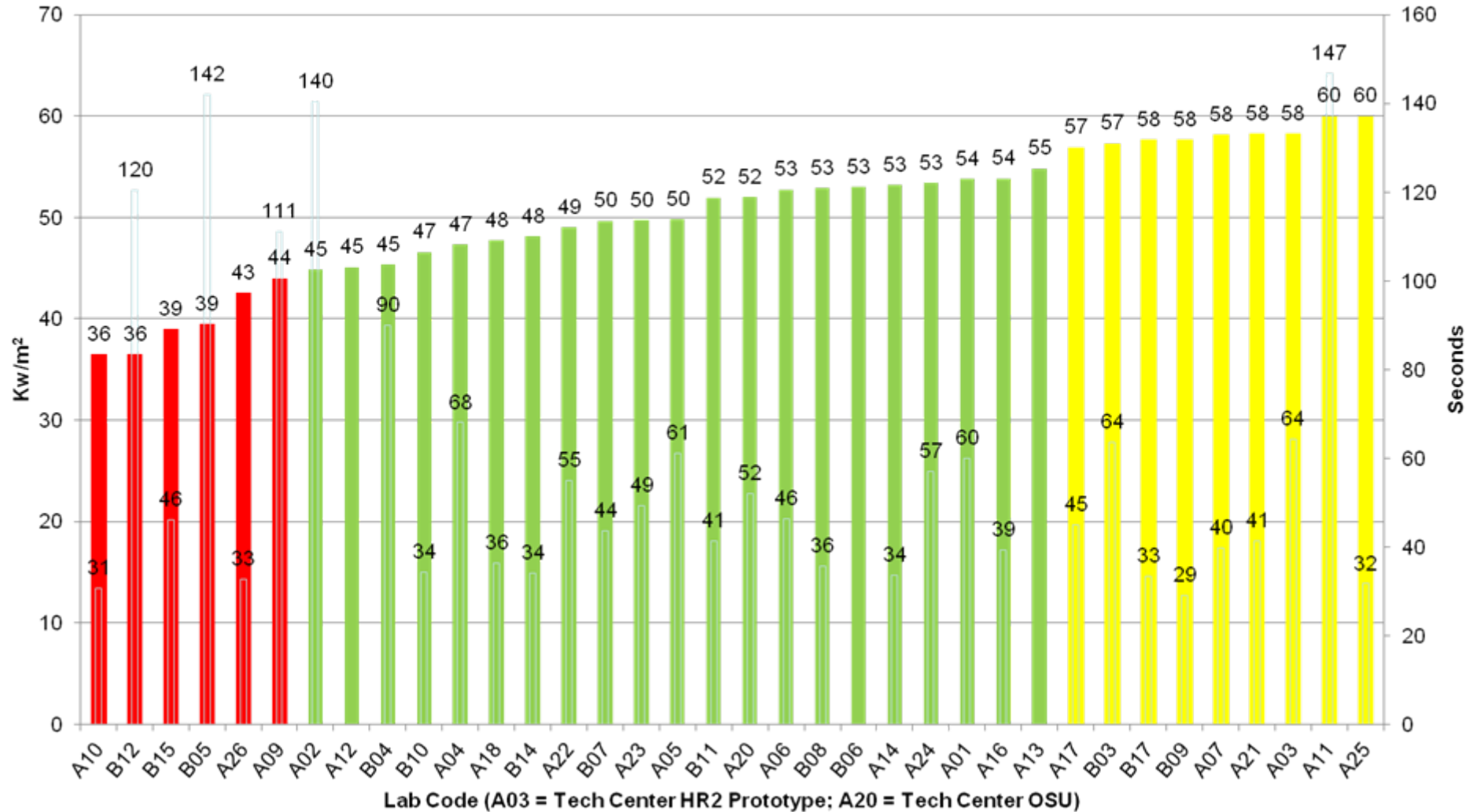
Light Brown Honeycomb Panel Peak HRR vs. TTP

Avg = 54 kW/m²; 15% STDEV



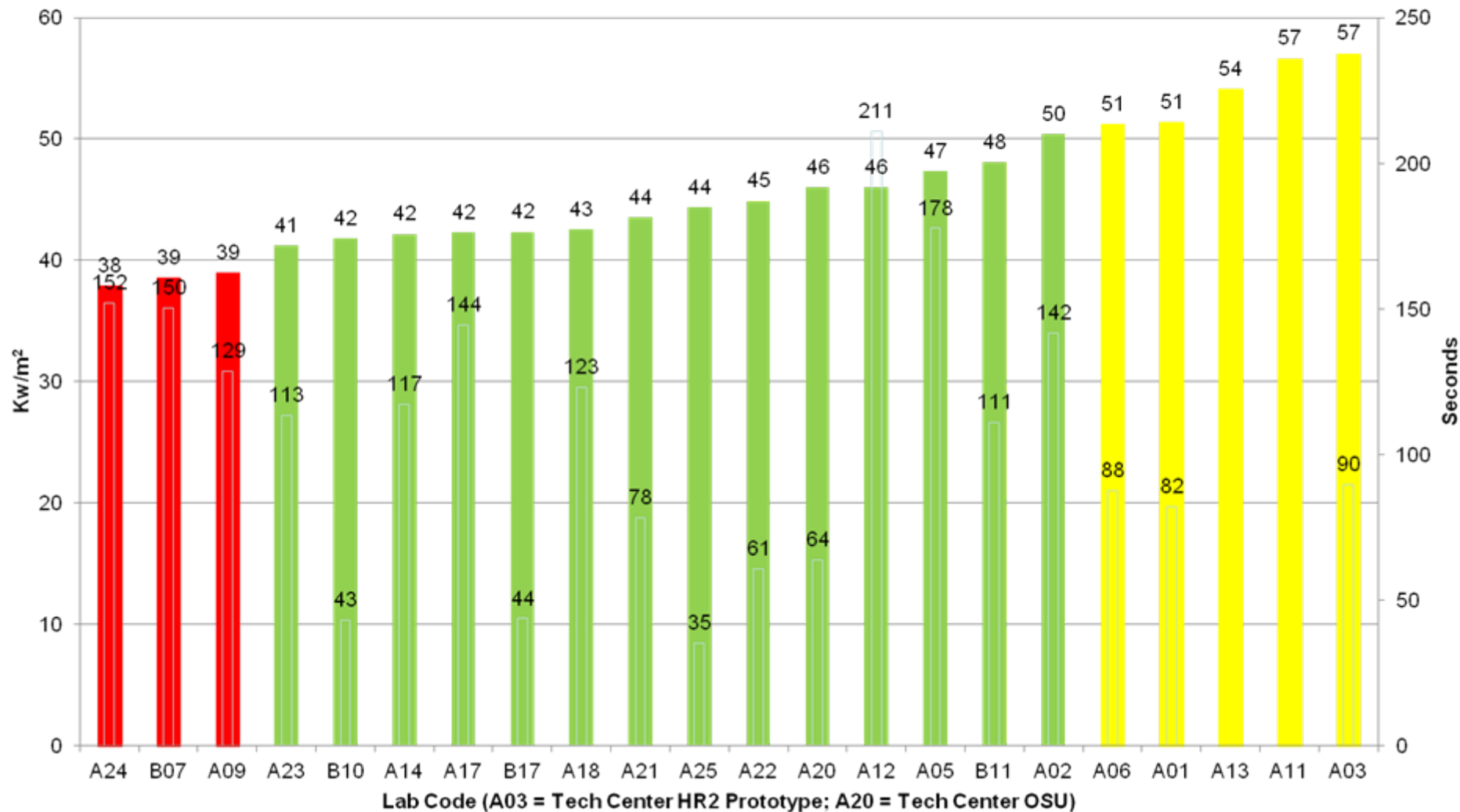
Black Thermoplastic Panel Peak HRR vs. TTP

Avg = 50 kW/m²; 13% STDEV



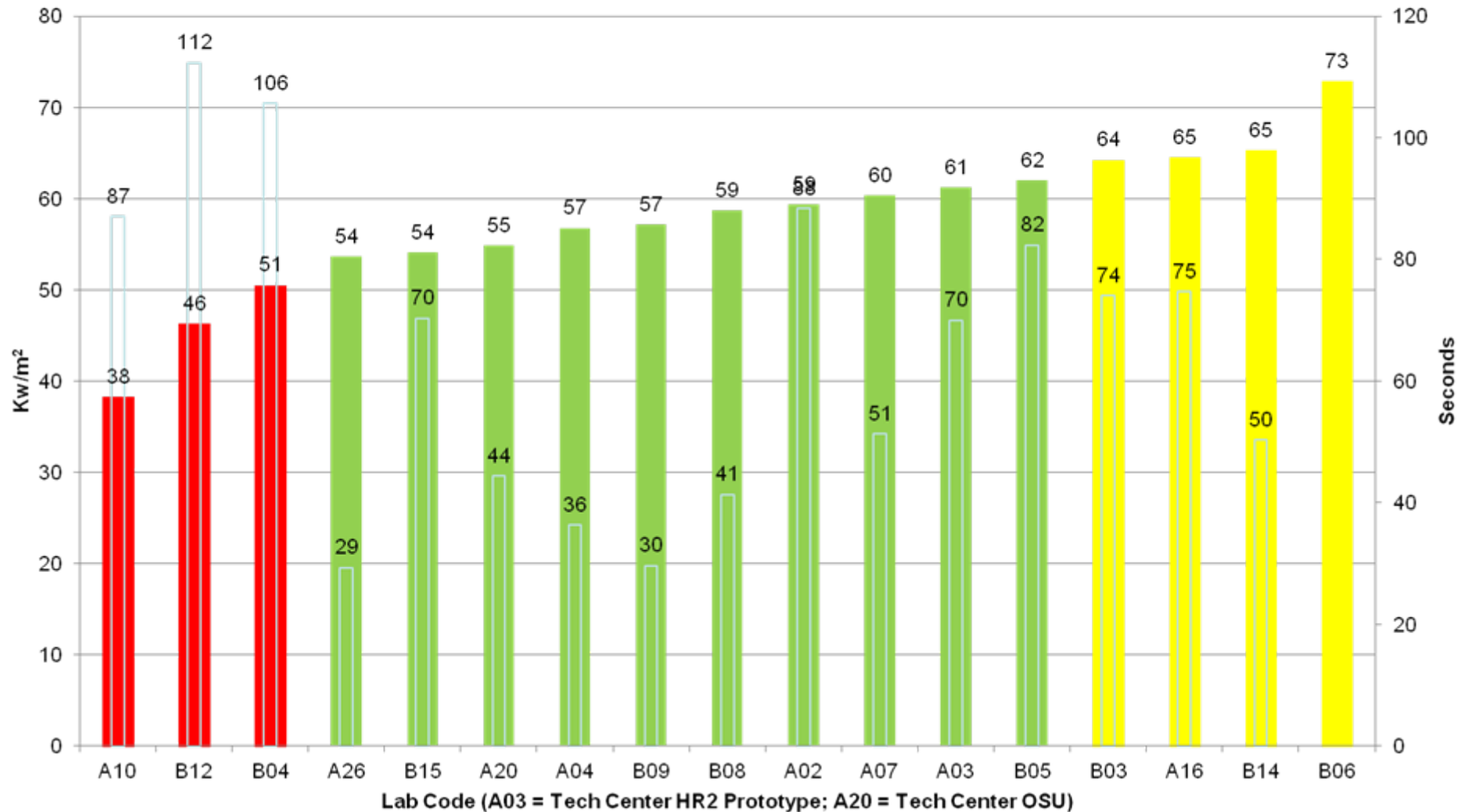
Light Thermoplastic Panel Peak HRR vs. TTP

Avg = 46 kW/m²; 12% STDEV



Blue Thermoplastic Panel Peak HRR vs. TTP

Avg = 58 kW/m²; 14% STDEV



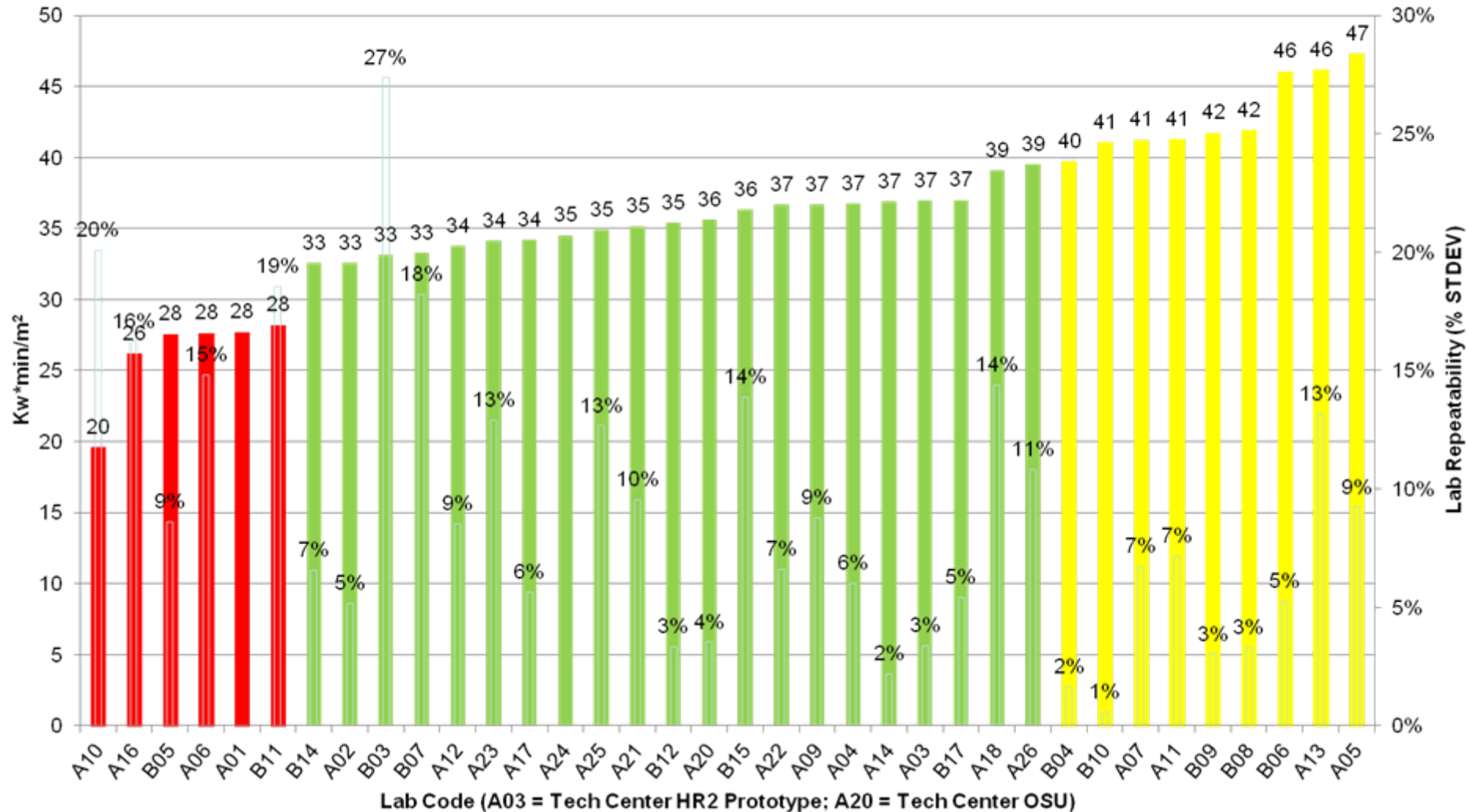
2012 Heat Release Round Robin

Total Heat Release Rate Data



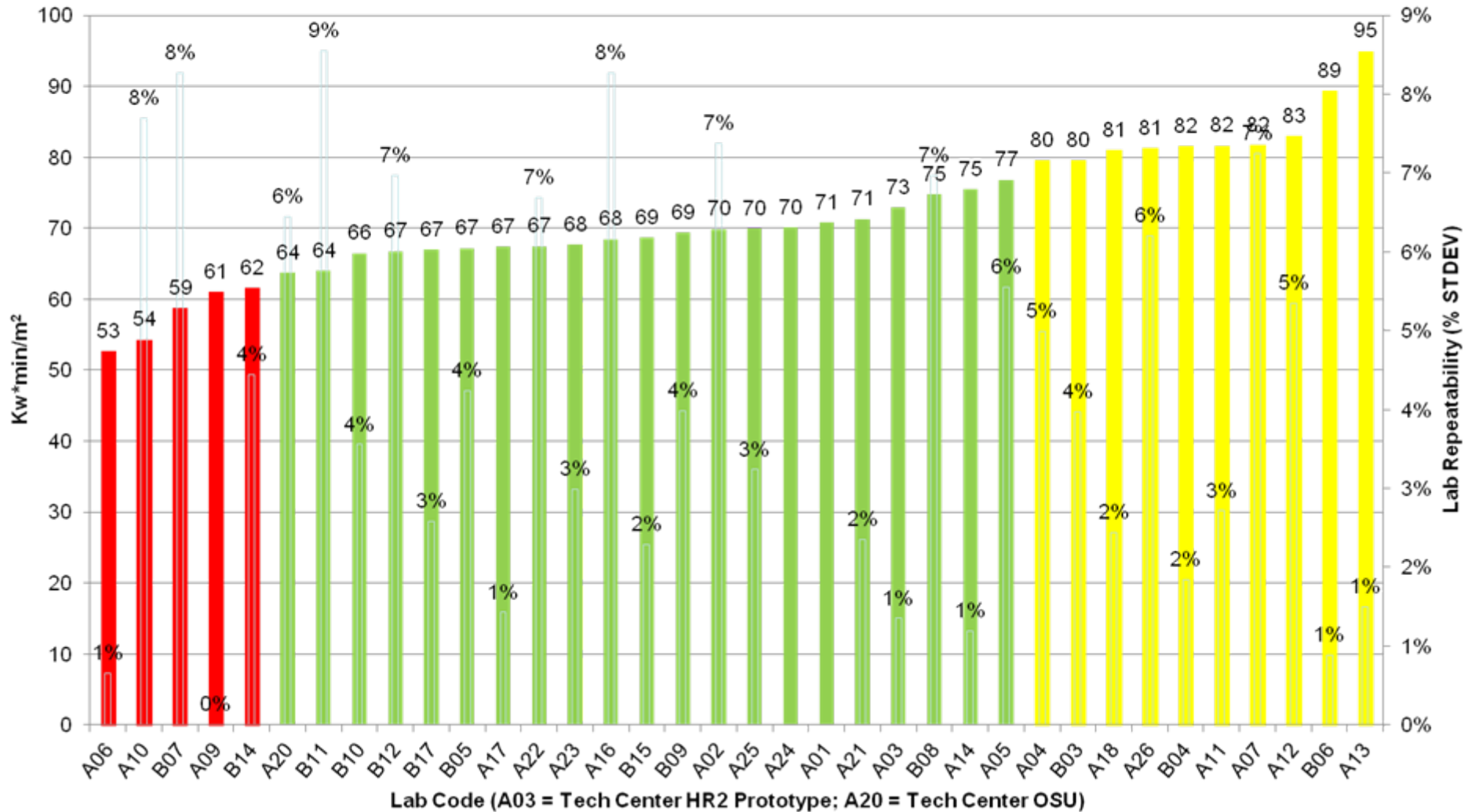
Dark Brown Honeycomb Panel Total HR vs. % STDEV

Avg = 36 kW*min/m²; 16% STDEV



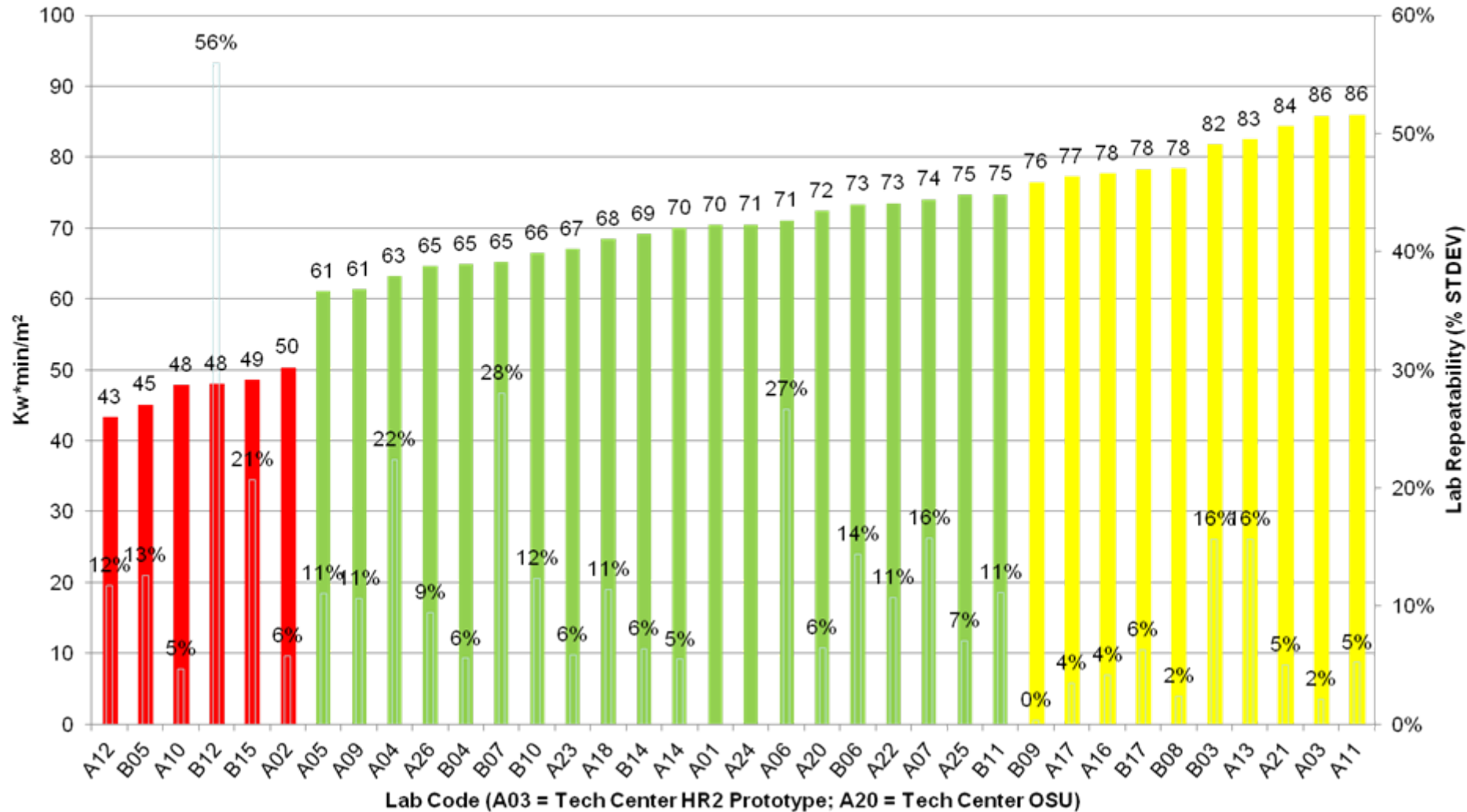
Light Brown Honeycomb Panel Total HR vs. % STDEV

Avg = 72 kW*min/m²; 13% STDEV



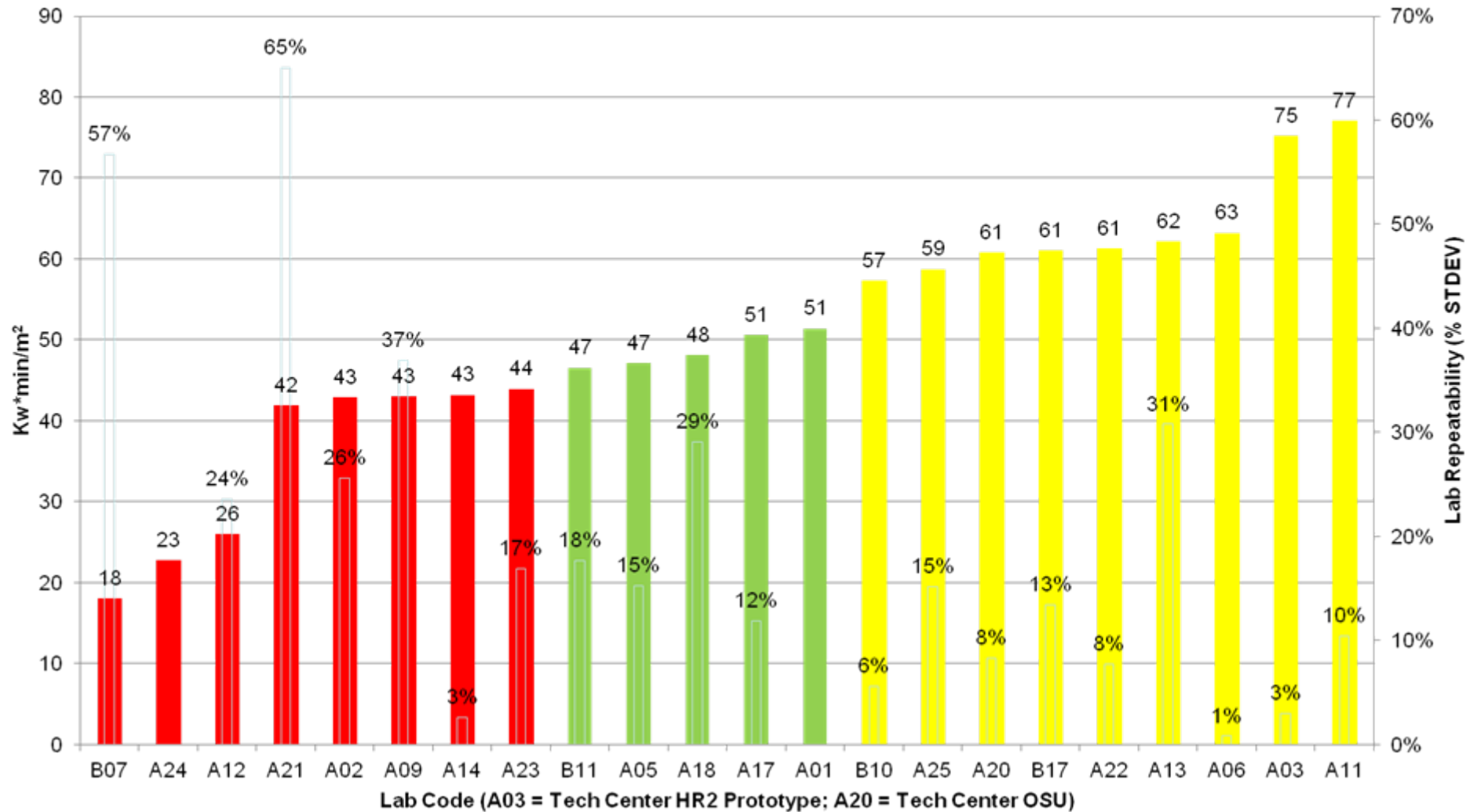
Black Thermoplastic Panel Total HR vs. % STDEV

Avg = 68 kW*min/m²; 17% STDEV



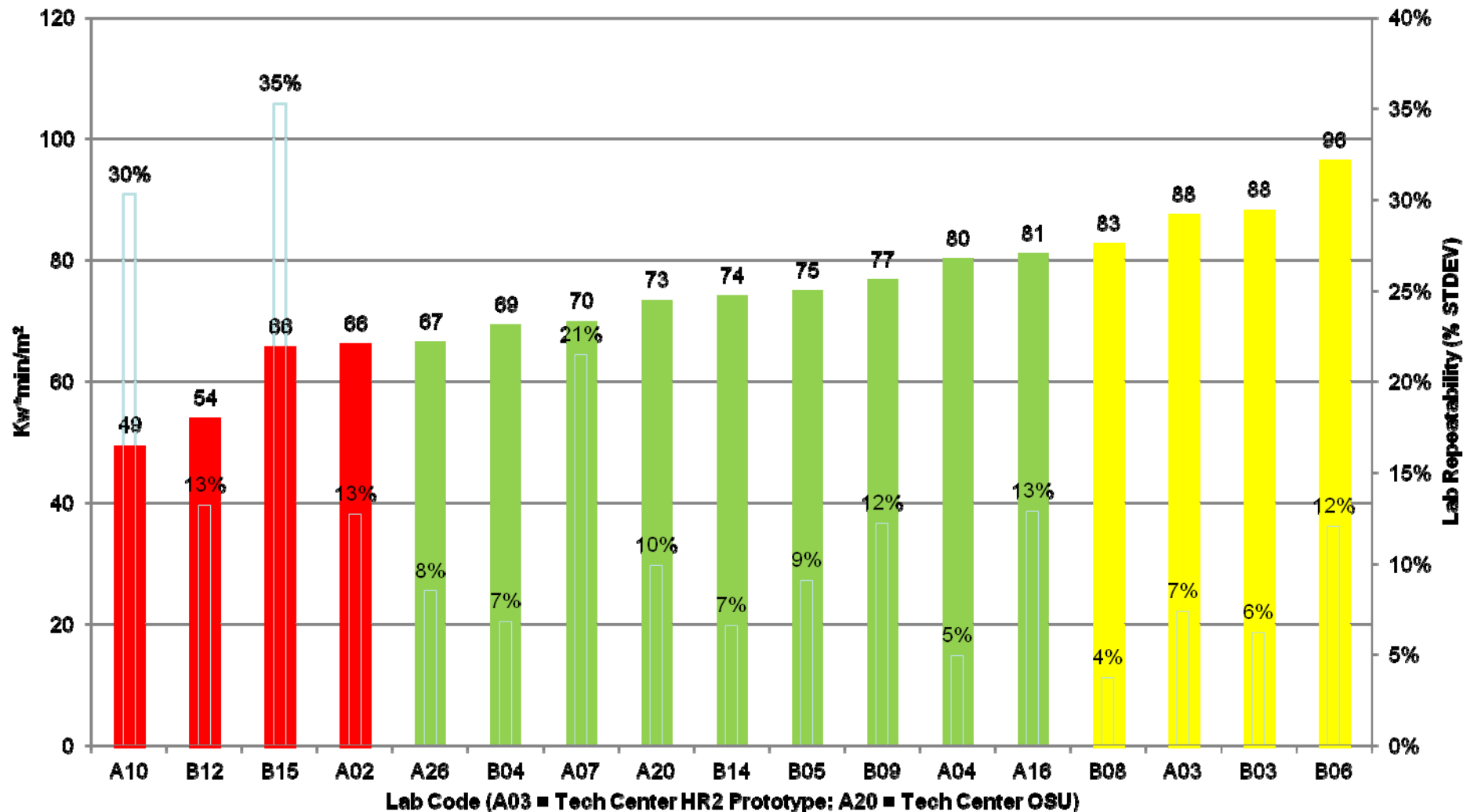
Light Thermoplastic Panel Total HR vs. % STDEV

Avg = 50 kW*min/m²; 30% STDEV



Blue Thermoplastic Panel Total HR vs. % STDEV

Avg = 74 kW*min/m²; 16% STDEV



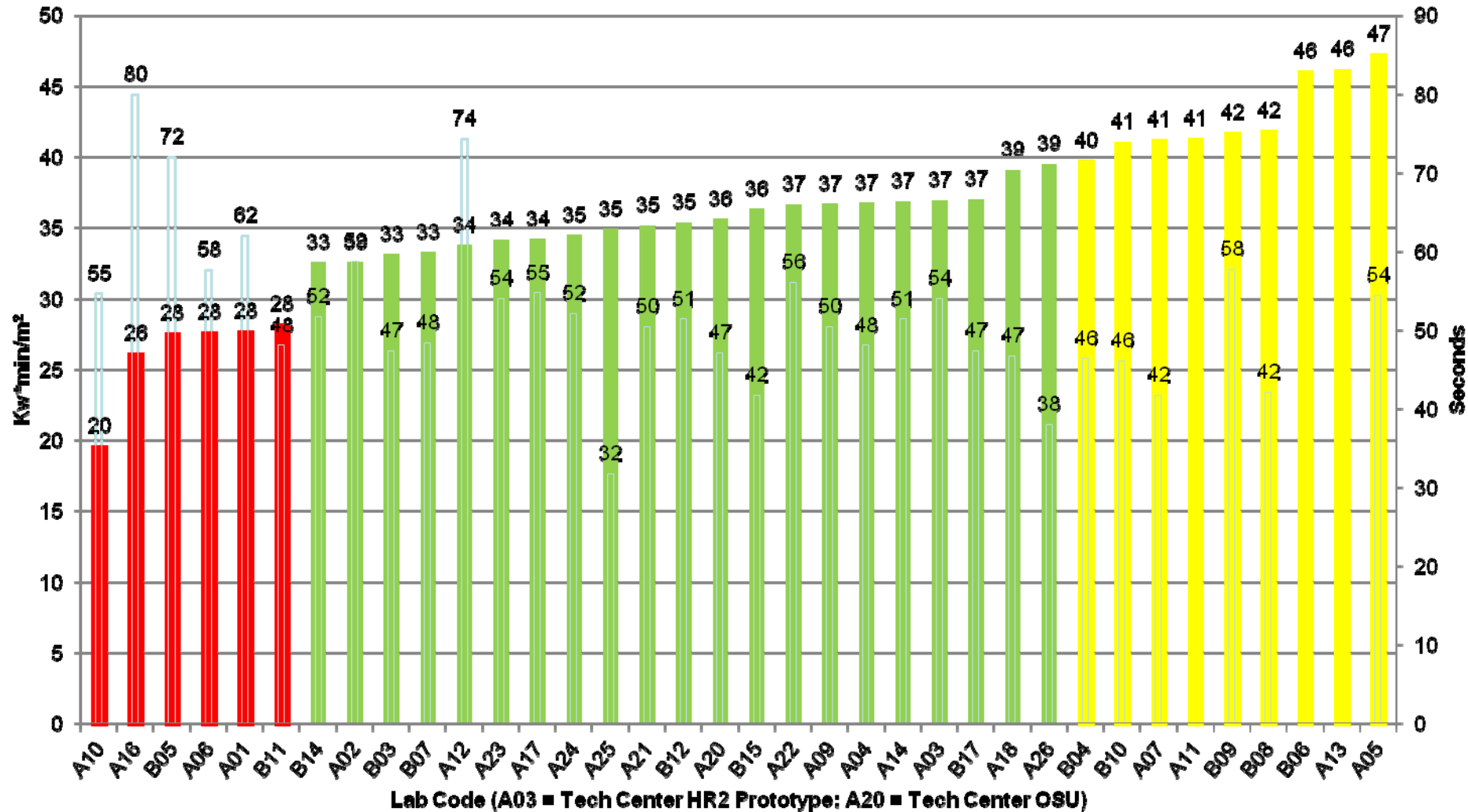
2012 Heat Release Round Robin

Total Heat Release vs. Time to Peak (Seconds)



Dark Brown Honeycomb Panel Total HR vs. TTP

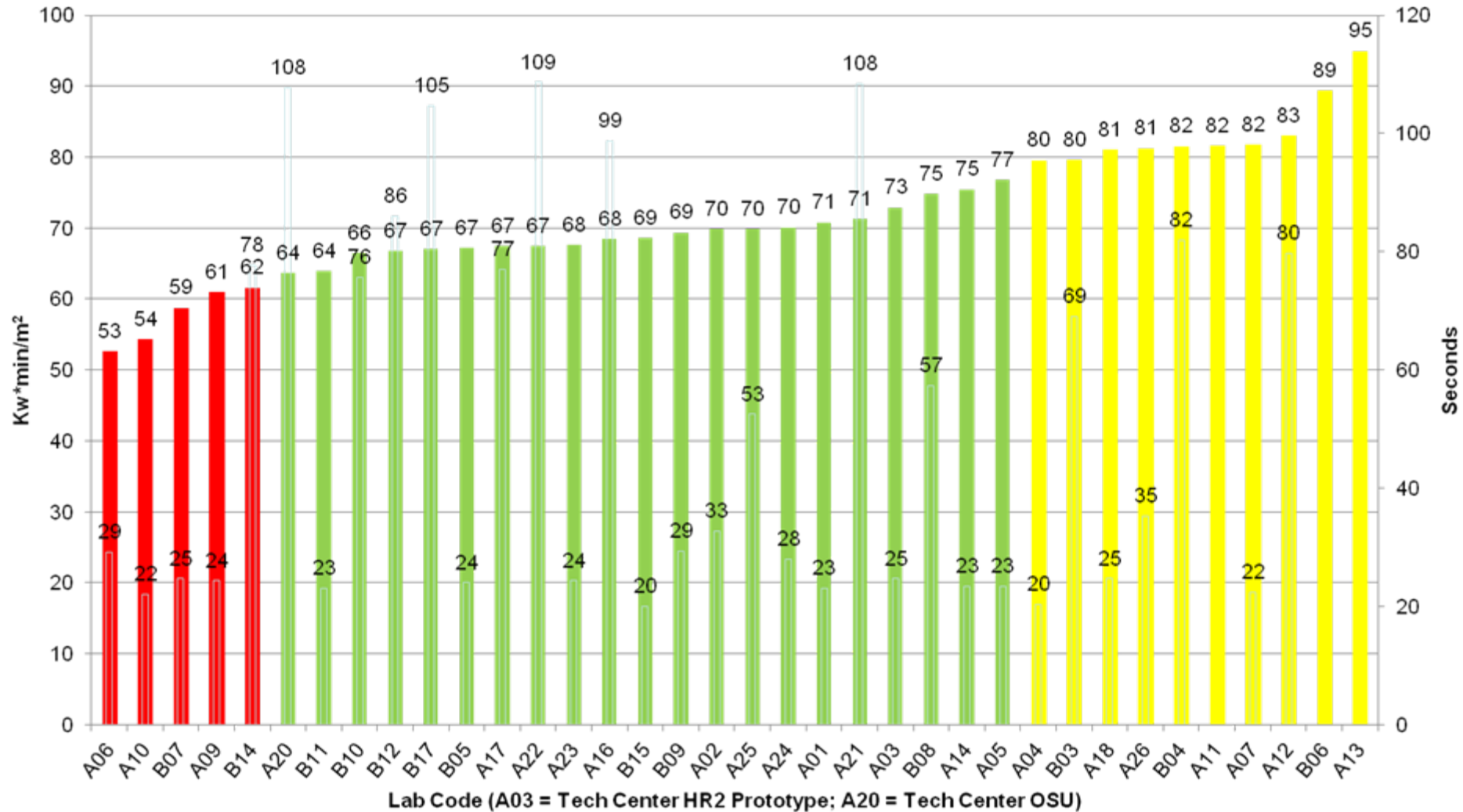
Avg = 36 kW*min/m²; 16% STDEV



Light Brown Honeycomb Panel

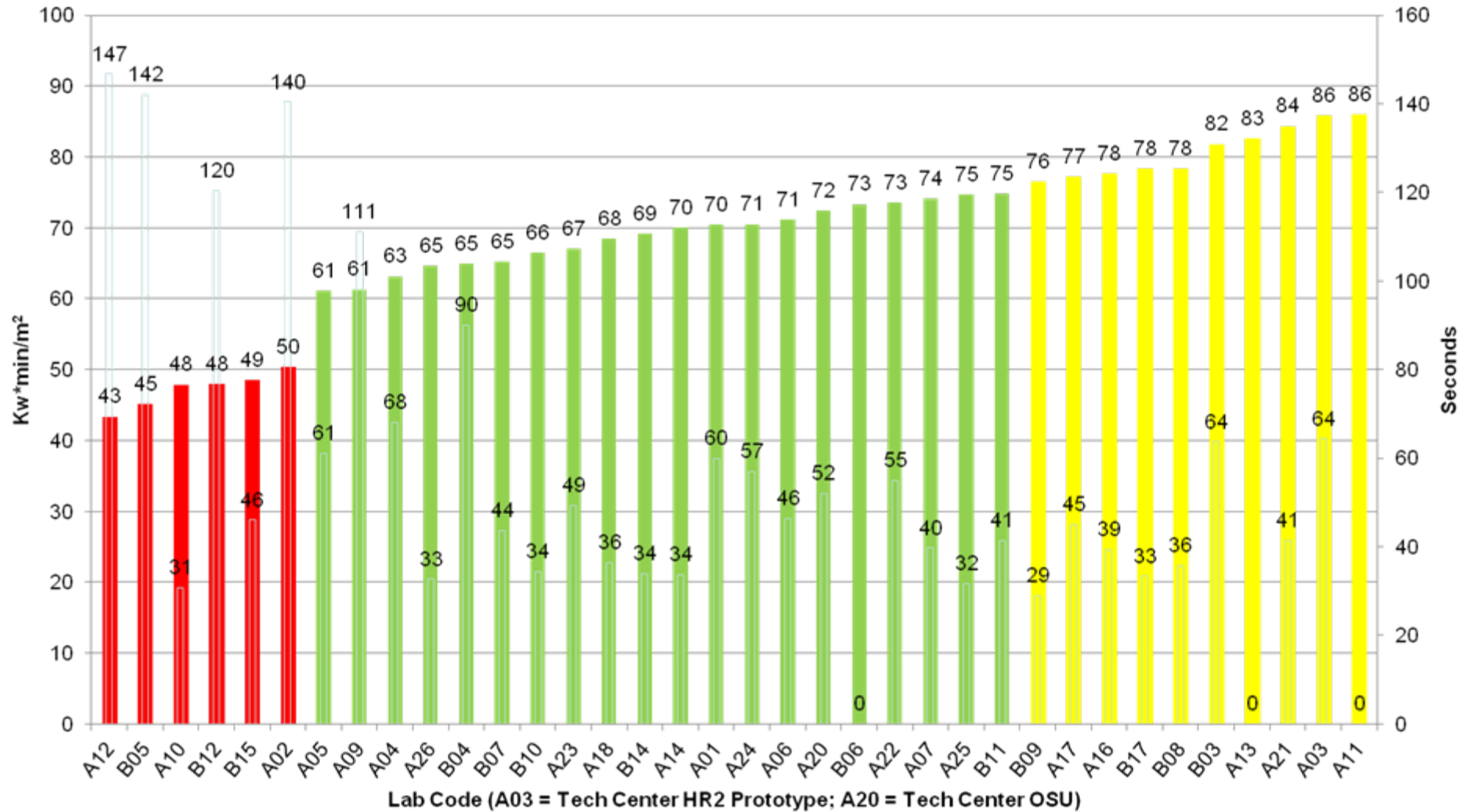
Total HR vs. TTP

Avg = 72 kW*min/m²; 13% STDEV



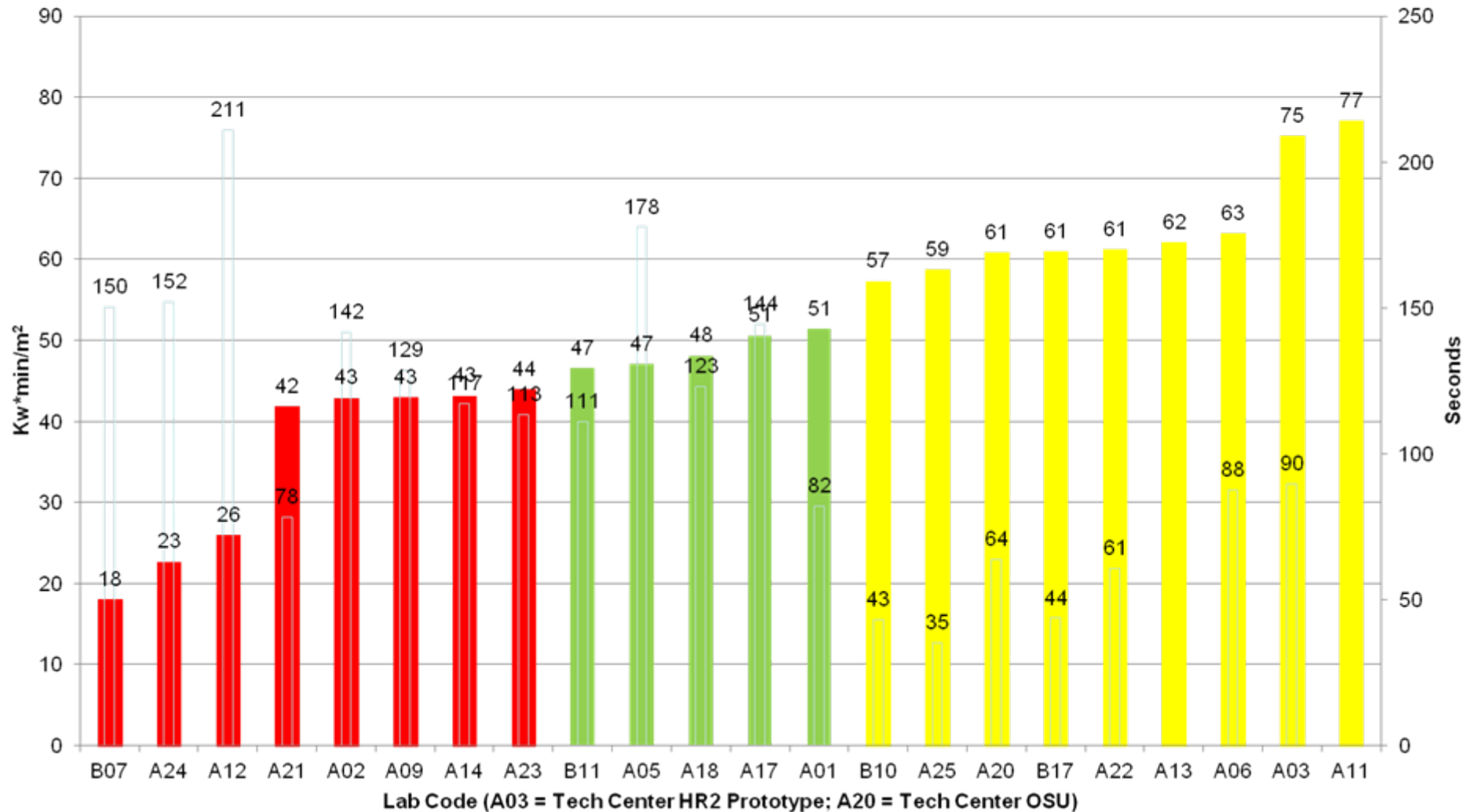
Black Thermoplastic Panel Total HR vs. TTP

Avg = 68 kW*min/m²; 17% STDEV



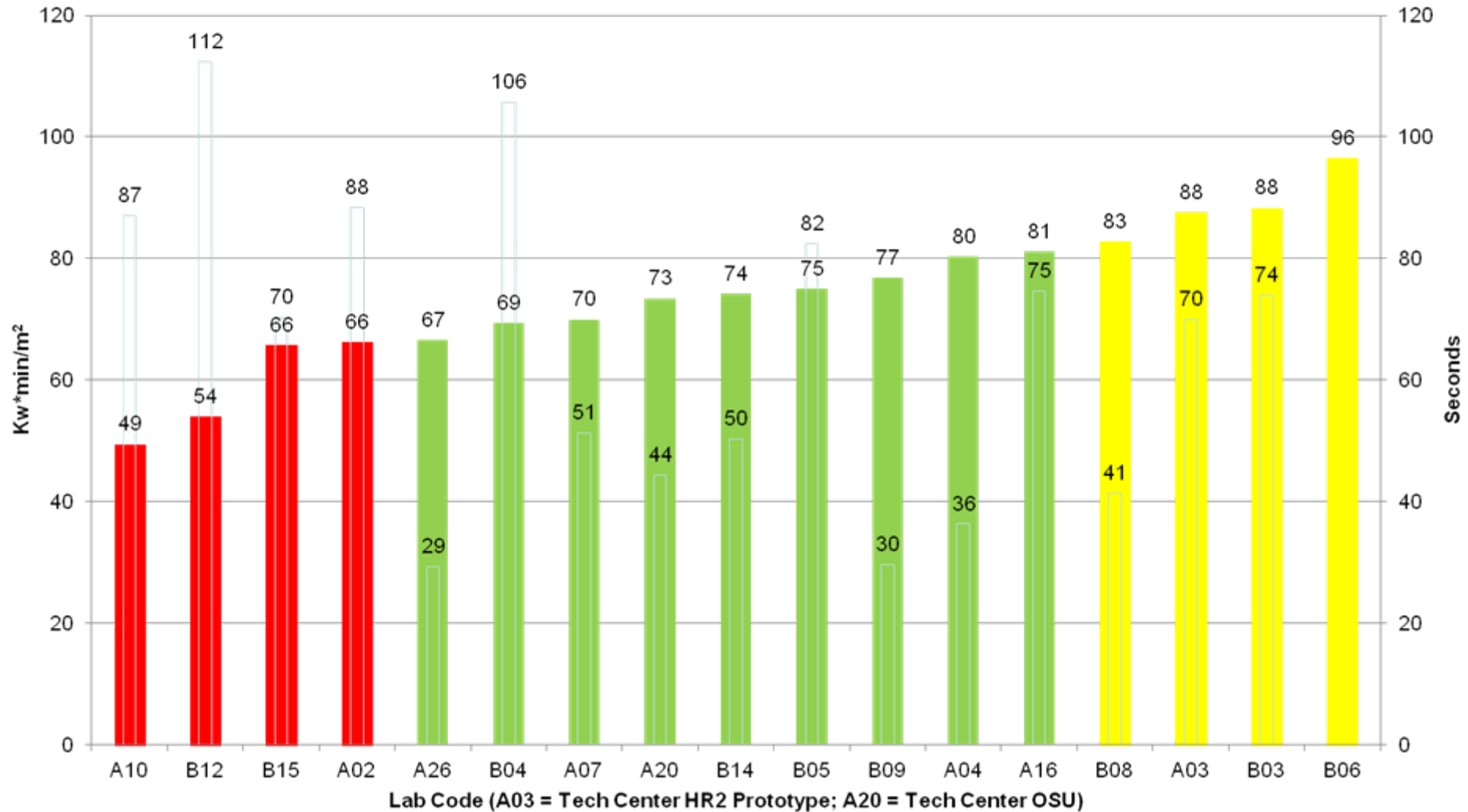
Light Thermoplastic Panel Total HR vs. TTP

Avg = 50 kW*min/m²; 30% STDEV



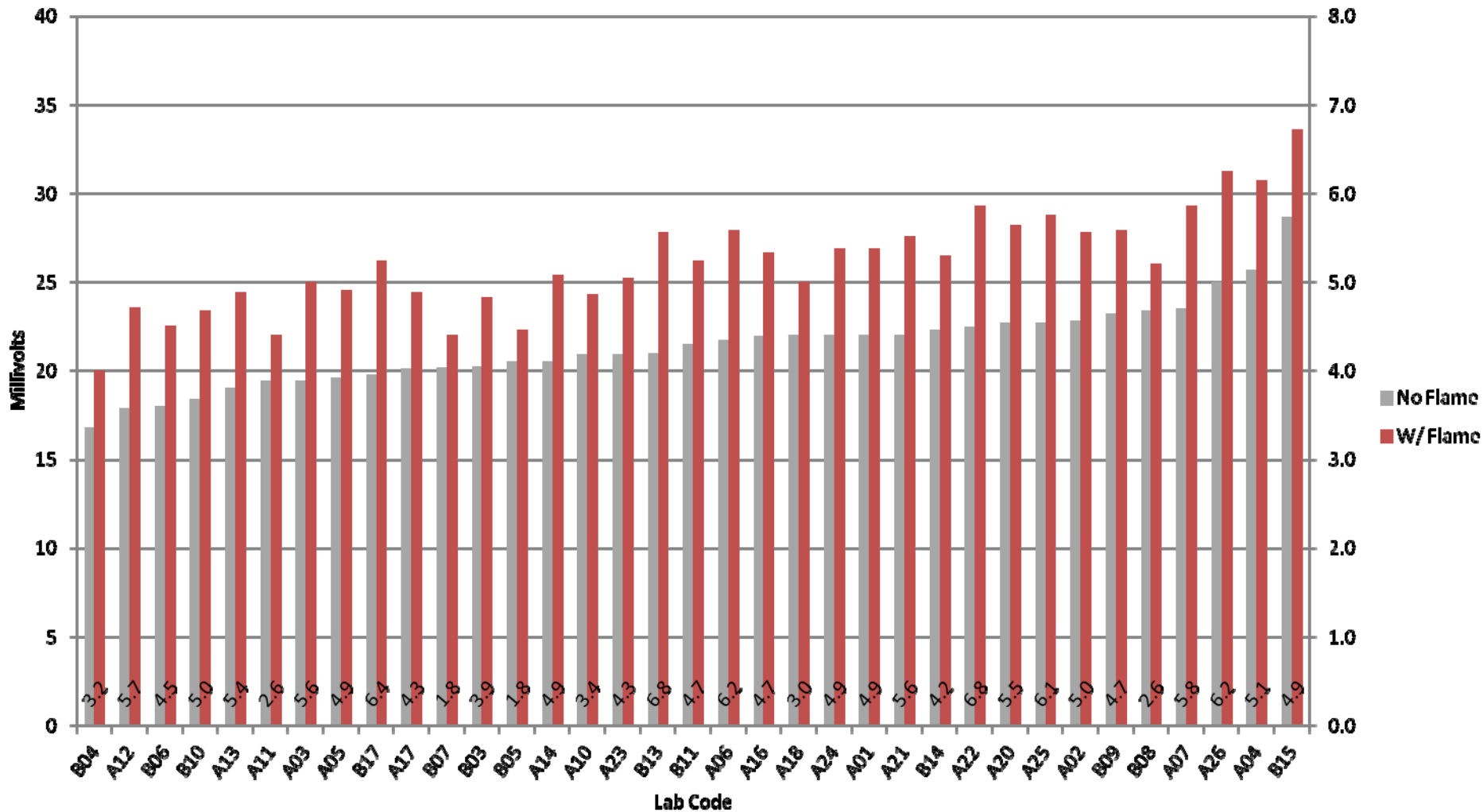
Blue Thermoplastic Panel Total HR vs. TTP

Avg = 74 kW*min/m²; 16% STDEV



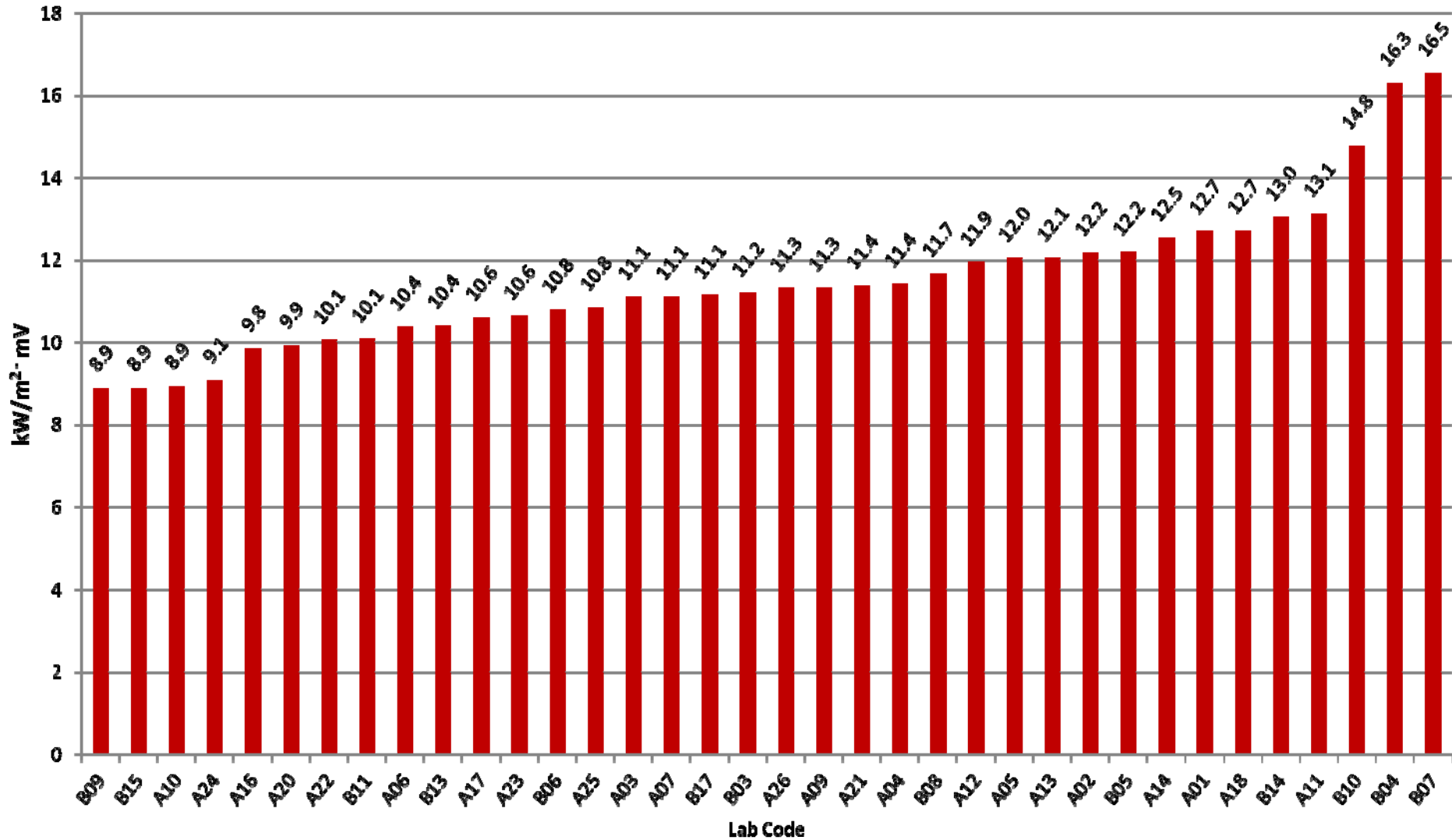
Thermopile Millivolt Data (Sorted by Baseline mV)

Avg (No Flame) 21.4 mV; (W/Flame) 26.1 mV



Calibration Factor Data

Avg 11.48 kW/m²·mV



NEXT

- Continue Development of Chapter HR Supplemental Section
- Began long term repeatability testing program of prototype
- Labs will be contacted for review of Round Robin Data



Brain Teaser

What is the one sport in which neither the spectators nor the participants know the score or the leader until the contest ends?

Answer: Boxing

