



# Cooling Trends Data Center Storage



# SNIA Forward Looking Information Disclosure Statement



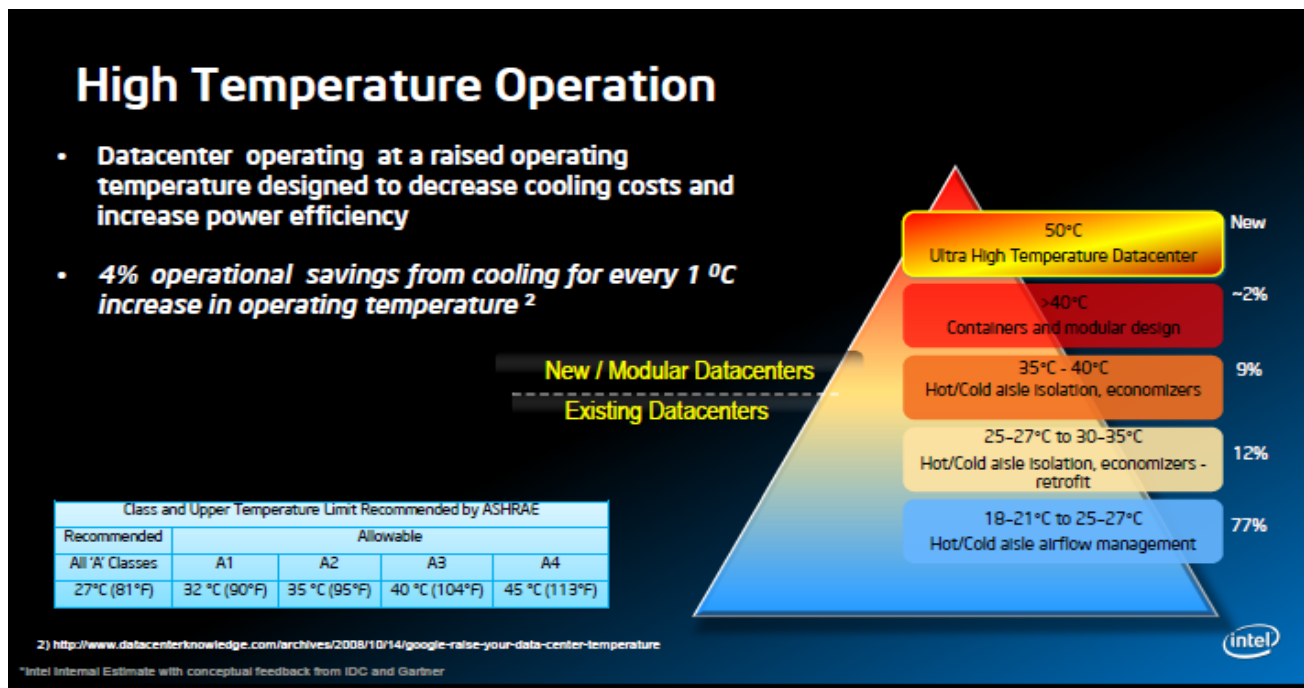
This SNIA presentation as part of the industry EPA ENERGYSTAR Data Center Storage Stakeholders Meeting November 18 2015 may include timetables, roadmaps, new technologies entering the mainstream, predictions, estimates or other information that might be considered forward-looking. While these forward-looking statements represent our current judgment on what the future holds, they are subject to risks and uncertainties that could cause actual timeframes and results to differ materially. Readers are cautioned not to place undue reliance on these forward-looking statements, which reflect our opinions and best effort planning only as of the date of this presentation. Please keep in mind that we are not obligating ourselves to revise or publicly release the results of any revision to these forward-looking statements in light of new information or future events. Throughout the discussion in the delivery of this presentation, we will attempt to present some important factors relating to the topic that may affect our estimates and predictions.



# High Temperature Ambient (HTA) Data Centers

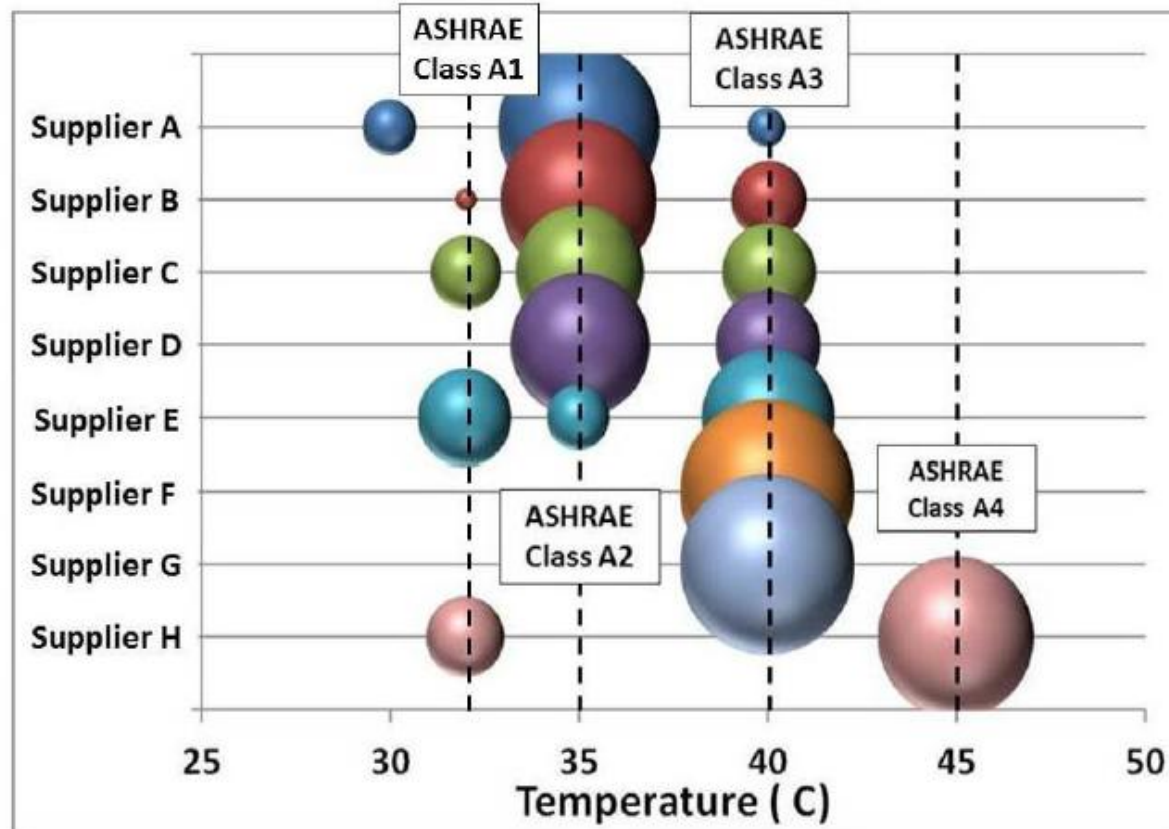
EU Lot9 Task 7 Recommendations: Consider a higher inlet temperature such as ASHRAE Class A1 allowable temperature & humidity range. Implement A1 by 2018 and target A2 for 2022

Acknowledge potential issues with electronics reliability, higher acoustical noise from higher fan speeds, corrosion from higher temperature and humidity changes, and possible performance loss due to inappropriate thermal management



Sources: 2011 ASHRAE data center guidelines, and <http://www.intel.com/content/dam/doc/technology-brief/efficient-datacenter-high-ambient-temperature-operation-brief.pdf>

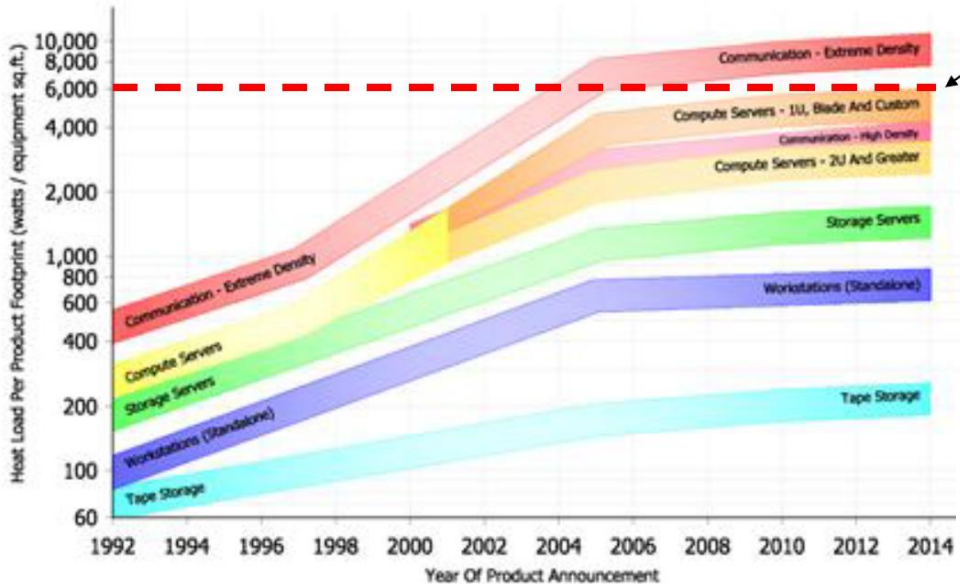
# Storage OEM Benchmarking Survey



Source: ASHRAE TC9.9 Storage White Paper 2015

Maximum operational rated air inlet temperatures; 8 of the major storage array suppliers and more than 200 model offerings

# Heat Load Footprints



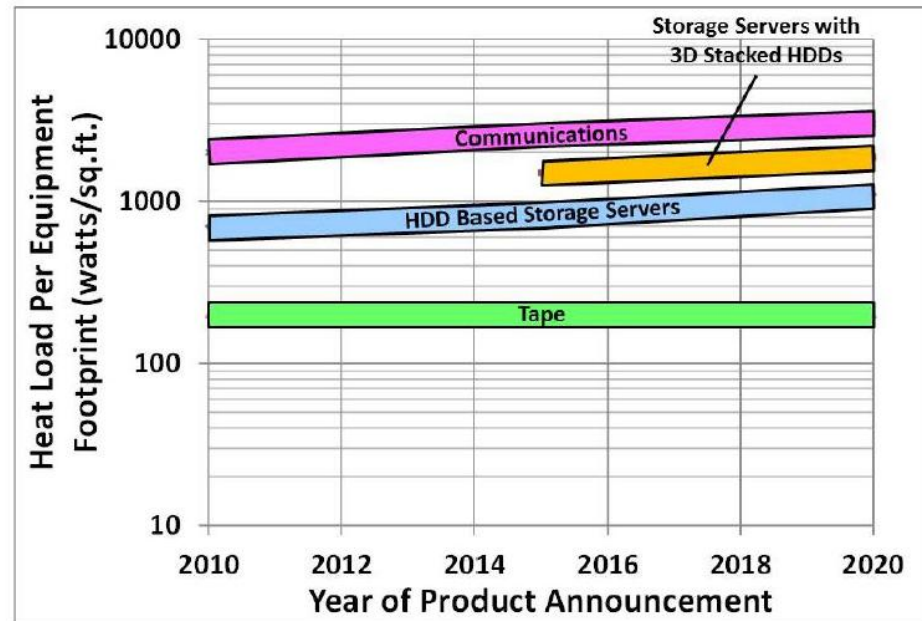
C-Class Server rack up to 36 KW in some cases

Rack footprints are commonly 6-8 sq.ft.

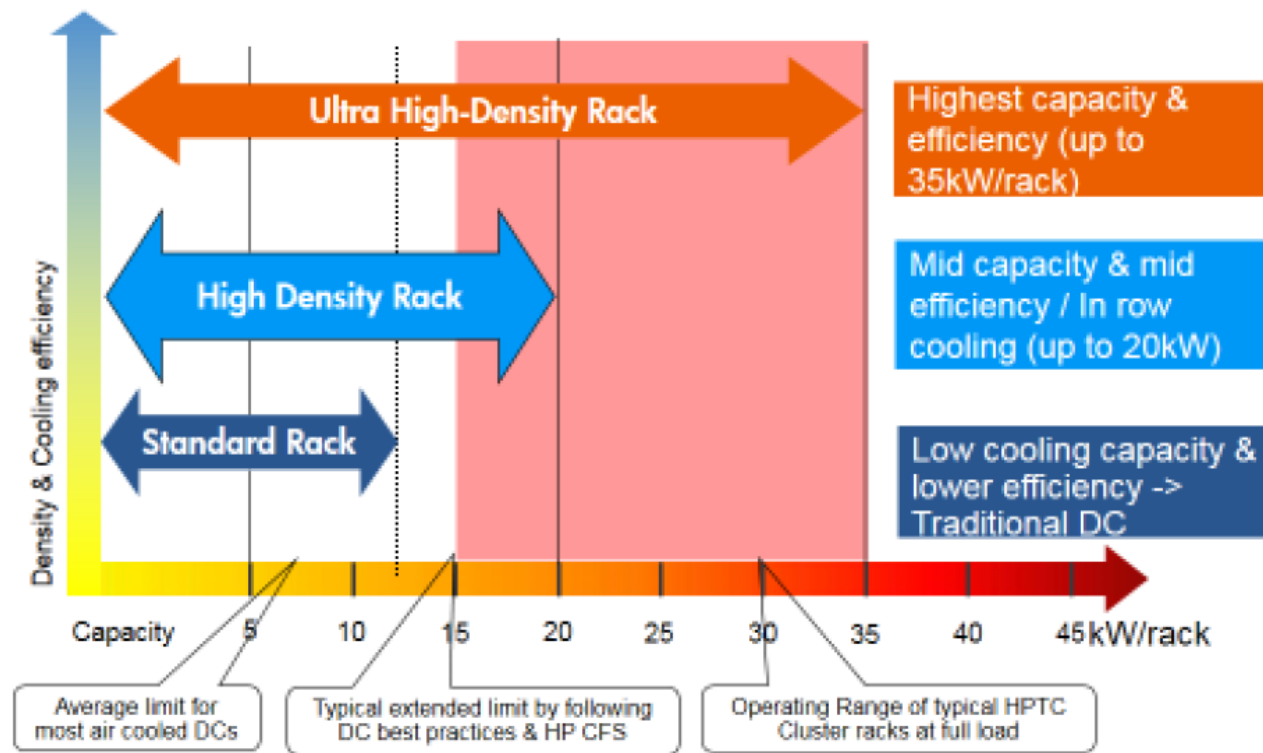
Sources:

Datacom Equipment Power Trends and Cooling Applications, ASHRAE 2012

Updated Storage and Networking Trends, ASHRAE TC9.9 Storage White Paper 2015



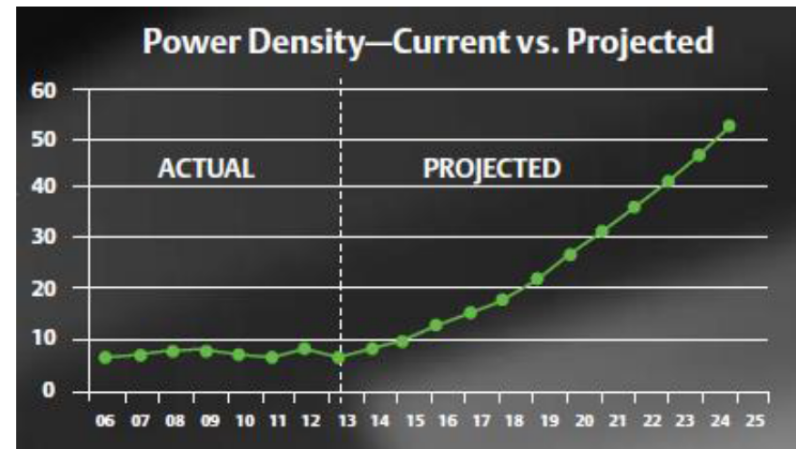
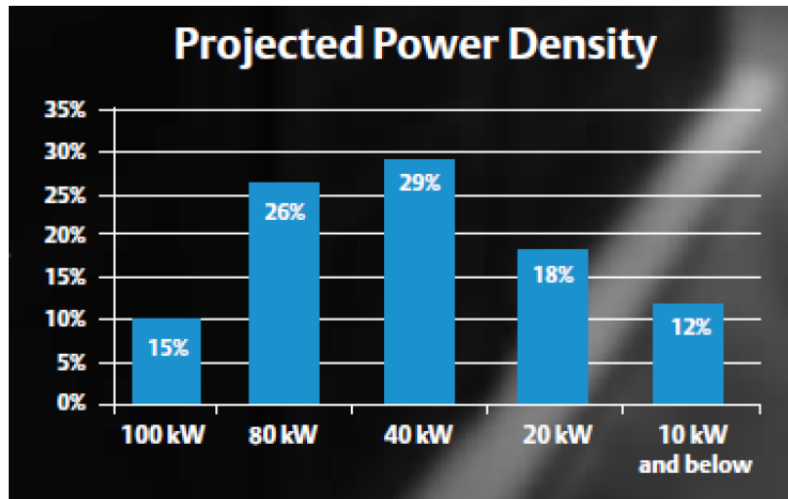
# Limits of Data Center Infrastructure



Source: T. Cader, "The Evolving Data Center; How Power, Cooling, and Standards are Driving Change" IMAP Sept 2015

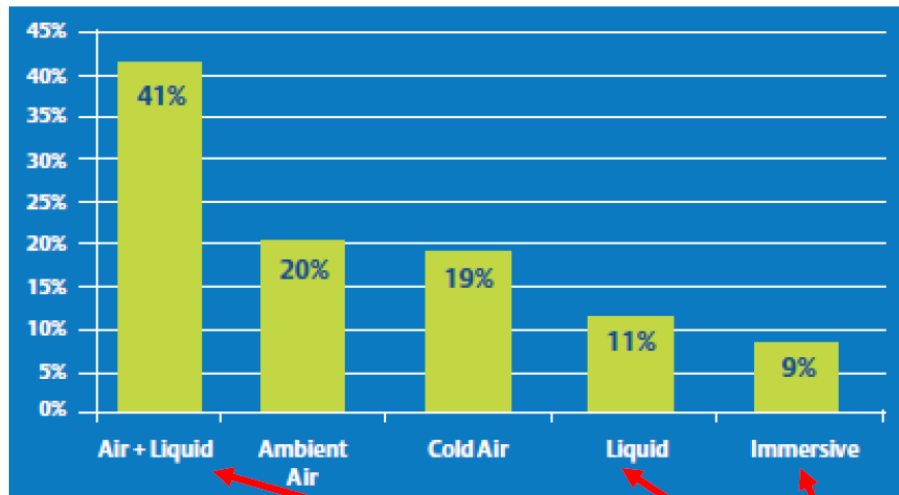


# Projected Rack Power Densities



Source: Emerson Network Power “Data Center 2025” (800 respondents)

# Thermal Management Solutions Evolve



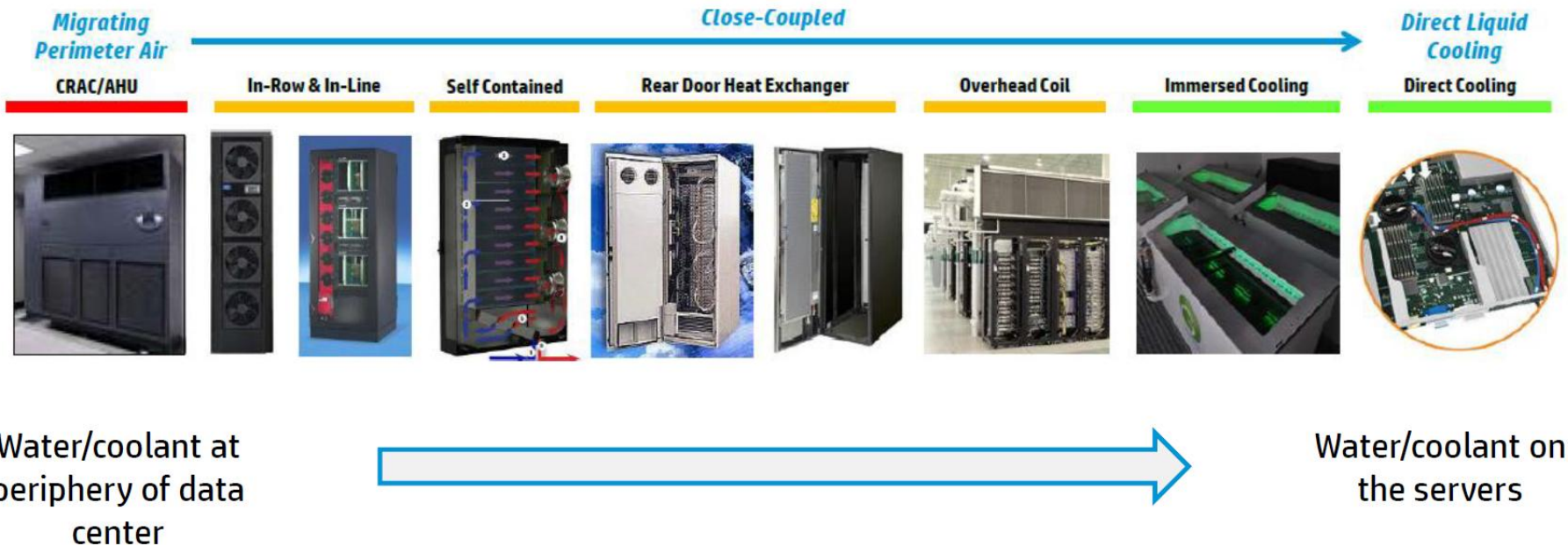
Rapidly rising rack powers are forcing data centers to use/consider more aggressive cooling solutions

61% of the solutions may involve some form of liquid-cooling

Source: Emerson Network Power "Data Center 2025" (800 respondents)



# The Impact of Thermal Solutions on Data Centers is Increasing



Source: T. Cader, "The Evolving Data Center; How Power, Cooling, and Standards are Driving Change" IMAP Sept 2015

## Western Digital

- Hermetically-sealed HDD
- Helium-filled
- Immersed in coolant



# Alternative Energy at Production Data Centers

Fuel cell-powered eBay data center



Solar-powered Apple data center



All images from  
Google.com



Fuel cell-powered  
Microsoft data center