What makes a good metric?

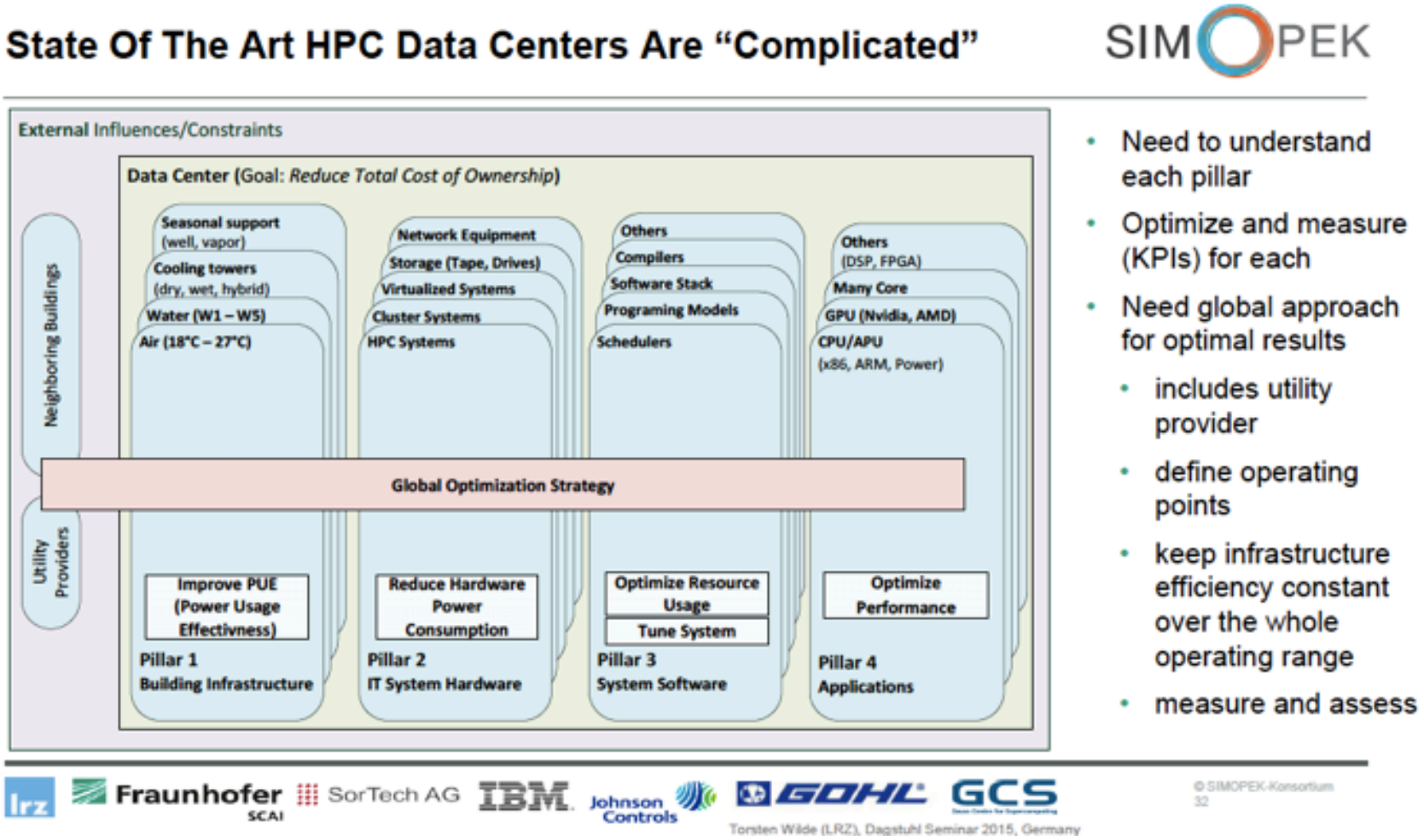
- Simple, measurable, actionable.
- Tied to an objective and links with a clear goal.
- It matters.

- Metrics are indicators to be used as part of a continual improvement process.

Energy efficiency improvements. No silver bullet…

… lots of silver BBs.

Four pillar framework



- Need to understand each pillar
- Optimize and measure (KPIs) for each
- Need global approach for optimal results
  - includes utility provider
  - define operating points
  - keep infrastructure efficiency constant over the whole operating range
  - measure and assess

Slide curtesy of Torsten Wilde (LRZ) [www.simopek.de]; HPC Data Center Infrastructure Challenges Under A Power Bound, Dagstuhl Seminar 2015, Germany
Open Access 4 Pillar Framework Paper: http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s00450-013-0244-6

No single metric,

- Identify and prioritize HPC center energy parameters for dashboards
- Identify potential stakeholder(s) for each of the energy parameters
- Document recommendations to assist the HPC community to choose the parameters they want to monitor and manage

… but a list to choose from.

The list is stakeholder dependent

- Director – Responsible for the overall center's activity
- Facility Manager – Primarily responsible for the physical infrastructure
- Information Technology Manager – Primarily responsible for the information technologies (hardware & software) in the data center

General Recommendations for High Performance Computing Data Center Energy Management Dashboard Display, Sartor, D. et al. http://doi.ieeecomputersociety.org/10.1109/IPDPSW.2013.272

Facility manager's items

Item	Primary Information	Unit
1	Total power/energy	kW & kWh
2	IT Power /energy	kW & kWh
3	Power Usage Effectiveness -Power	Index
4	Power Usage Effectiveness- Energy	Index
5	Cooling Efficiency	kW/ton
6	Cooling Energy Use	kWh
7	Data center IT equipment cooling diagram	degF/C
8	Temperature (map)	degF/C
9	UPS input / output power /Energy	kW & kWh
10	Data center electrical distribution diagram	
11	CRAC/CRAH/AHU RAT (avg, min, max)	degF/C
12	CRAC/CRAH/AHU SAT (avg, min, max)	degF/C

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Systems manager's items

Item	Primary Information	Unit
1	Energy Cost per data processing unit	$/unit
2	Total power/energy	kW & kWh
3	IT Power /energy	kW & kWh
4	Average IT utilization-Compute System	Percent
5	Power Usage Effectiveness – Power	Index
6	Power Usage Effectiveness-Energy	Index
7	IT efficiency[a]	Work output/W*
8	Data center IT equipment cooling diagram	degF/C

[a] Depends on how each HPC center defines its work output

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Director's items

Item	Primary Information	Unit
1	Total power & energy	kW & kWh
2	Energy cost	$
3	Average IT utilization-Compute System	Percent
4	Power Usage Effectiveness –Power	Index
5	Power Usage Effectiveness- Energy	Index
6	IT efficiency [a]	Work output/Watt

[a] Depends on how each HPC center defines its work output

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It is time to update these lists

- Please complete the survey and give us your input

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- Thank you!
- Questions?

http://eehpcwg.llnl.gov

natalie.jean.bates@gmail.com