The Emerging Chinese Market for Energy Efficient Data Centers

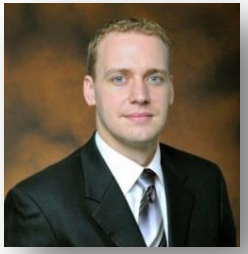
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Government and industry insights based on years of U.S. – China collaboration

Webinar

May 19, 2015

Speakers



Moderator
Brian Holuj
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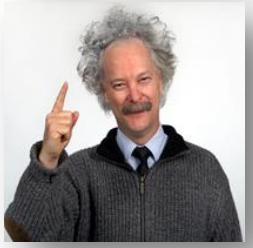

Context on China's Data Center Market
Dale Sartor, PE
Staff Scientist/Engineer, Lawrence Berkeley National Laboratory
DASartor@LBL.gov

Perspectives from an SME
Alex McEachern
President, Power Standards Lab
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Perspectives from a Multinational
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World Wide Director for Data Center Design & Implementation, Hewlett-Packard
MLepore@hp.com

DOE Data Center Initiatives and Resources

Better Buildings® CHALLENGE
U.S. DEPARTMENT OF ENERGY

Data Center Partners commit to:

- 20% portfolio energy savings over 10 years, *or*
- 25% energy savings in one showcase data center over 5 years (100kW facility or larger)

Visit the Challenge website, for more info: datacenterpartners@ee.doe.gov

CENTER OF EXPERTISE FOR ENERGY EFFICIENCY IN DATA CENTERS

SEARCH

U.S. DEPARTMENT OF ENERGY | FEMP Federal Energy Management Program | BERKELEY LAB

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Apply Reset

Title	Files and Links
Direct Liquid Cooling For Electronic Equipment Report on the demonstration of direct liquid cooling for electronic equipment. Cisco C200 M3 servers were retrofitted with the Asetek direct cooling technology.	Direct Liquid Cooling
Sybase Case Study: Database Technology Company Saves $262,000 Annually In 2005, Sybase conducted an energy audit that revealed that their data center N+1 cooling capacity was at risk due to the center's rapid growth.	Sybase_Case_Study.pdf
Best Practices for Data Center Energy Efficiency: Labs21 Workshop - San Jose, CA 2012	Sartor - 10-1-2012
Recommendation to ASHRAE TC 9.9 - Liquid Cooling GuidelinesHPC Compressorless Liquid Cooling Building Supplied Cooling Water Guideline	Recommendations to ASHRAE TC 9.9

U.S. – China Collaboration Relevant for ITC

Commercial Building Energy Code (2015)

- Applies to buildings, including those with data centers

Standards: BEST-DATA Project

- Partners: MIIT, CIE, Open Compute Project, others
- Promote efficiency using open standards and specs

Training and Tools

- Partners: CIE, CESI, Energy Cooperation Program, Data Center Dynamics
- Assessments with DC Profiling tool – infrastructure & IT efficiency

Demonstration Project

- USTDA-funded demo of U.S. technology and training in Chinese data centers

Initiatives and Events

- Renewable Energy and Energy Efficiency Export Initiative (RE4I)
- International Partnership for Energy Efficiency Cooperation (IPEEC)
- U.S. – Energy Efficiency Forum (EEF)

U.S. Trade Promotion Agencies: Supporting U.S. Businesses in China

- Foreign industry insights and matchmaking
- Market access
- Trade promotion
- Anti-dumping and countervailing duties
- *Tom Dycus thomas.dycus@trade.gov 202-482-2295*

- Reverse trade missions
- Feasibility studies
- Conferences and workshops
- Pilot projects
- Technical assistance
- *Verinda Fike vfike@ustda.gov 703-875-4278*

- Commercial and political risk insurance
- Loan guarantees
- Working capital loans for U.S. companies to fulfill export orders
- Term financing for foreign buyers of U.S. goods
- *Rich Pearson richard.pearson@exim.gov 202-565-3709*

Context on China's Data Center Market

Dale Sartor, PE

Applications Team, Building Technologies
Lawrence Berkeley National Laboratory (LBNL)
http://Ateam.LBL.gov

China Market Size

- China has 5% of world's data center space, $24B value (2013)
- Making 6-8% of the global investment, growing 20% annually (2X the average of the Asia-Pacific region)
- Total space expanding 15% annually, on average
- China has many small and midsized data centers; with rapid growth in large data centers.

Parameter	2012	2013	2014	2015(e)
White space (m2)	1,210,000	1,500,000	1,790,000	2,080,000
Investment (US $Million)	6,540	7,650	9,810	11,080
Power (GW)	1.56	1.79	2.12	2.65

Source: Data Center Dynamics Intelligence, 2013-2015

China DC Market Distribution

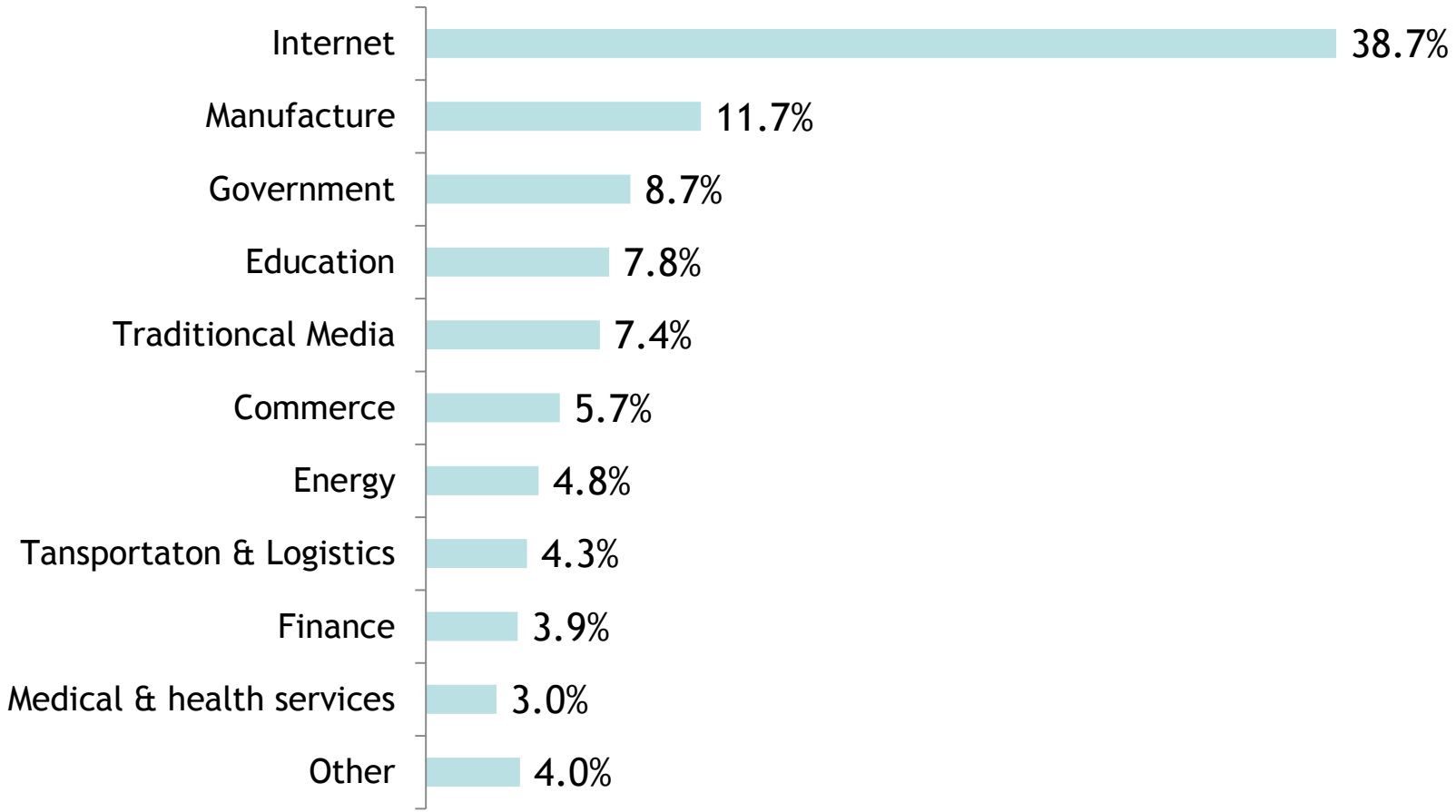


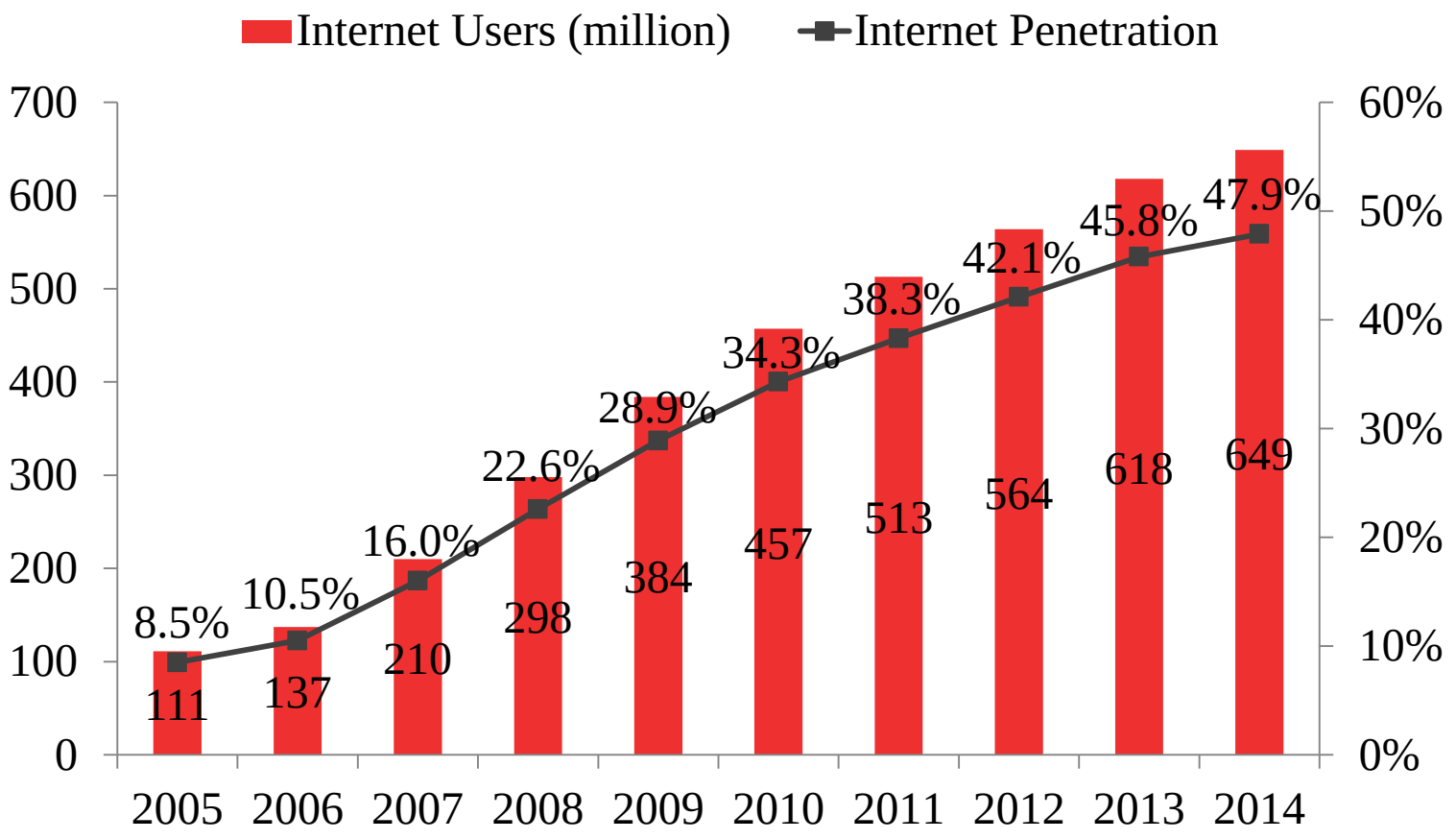
Fig. User Distribution of Data Centers in China, 2012

Source: Jingyi Hu, MIIT/CESI 2013

China Users and Devices

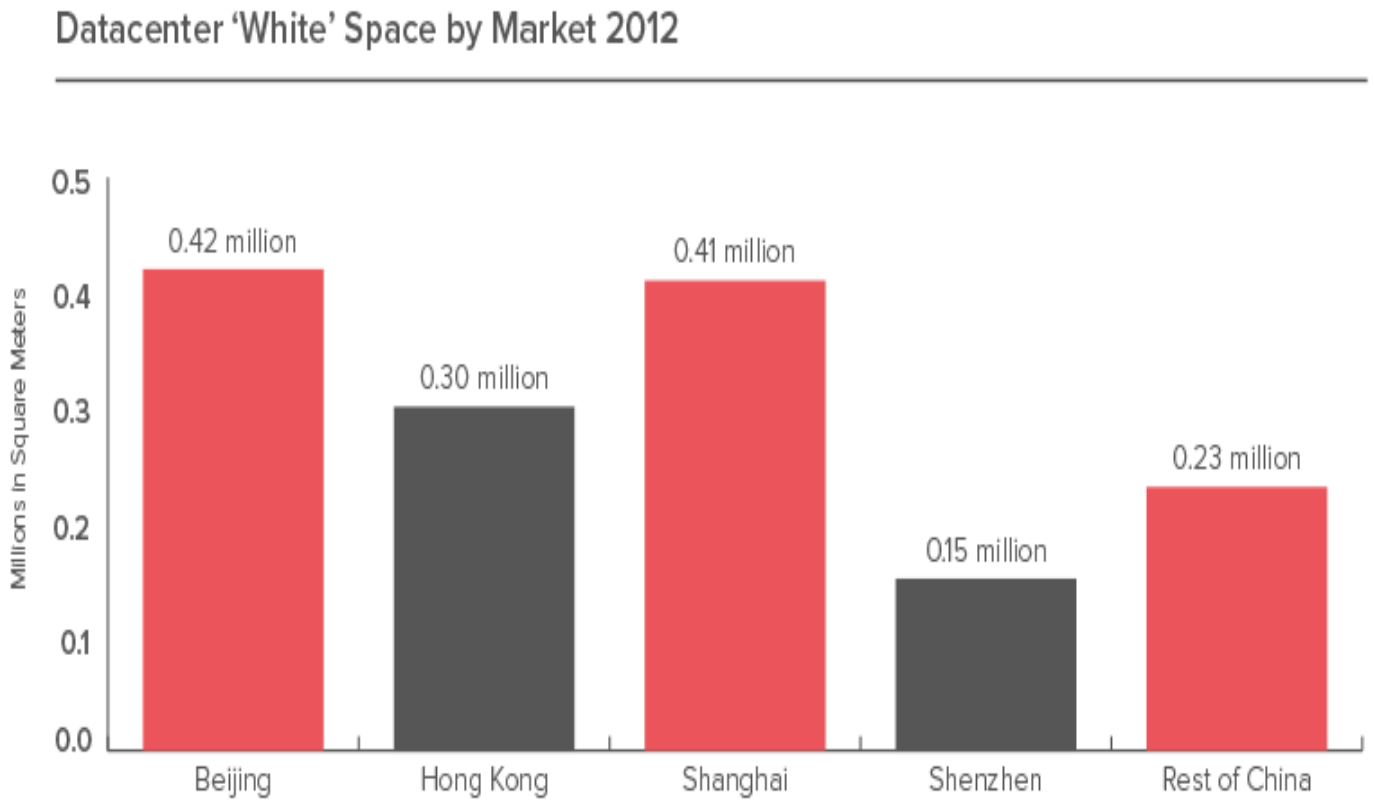
- **649M** 'netizens' accessing webpages via **557M** mobile phones (PCs and tablets less, but coming on strong)

Source: Data Center Dynamics Intelligence and CNNIC, 2015



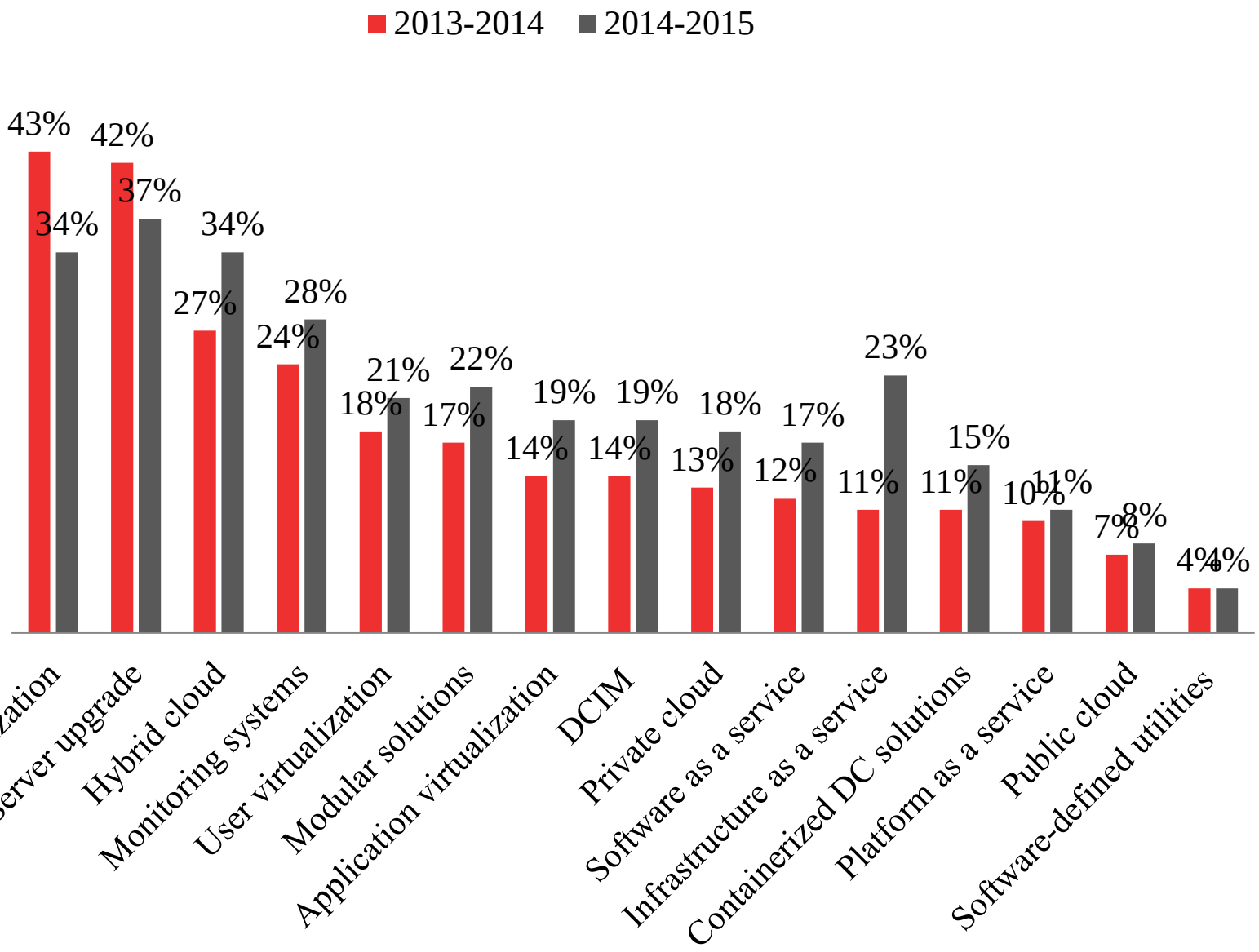
Beijing's DC Footprint

- Most amount of "white space" in China, with double the growth of the rest of the country
- 32% of all China DC investment from 2011-2012
- High energy and real estate prices driving facilities into new locations



Source: Data Center Dynamics Intelligence, 2013

Technology Adoption



Source: Data Center Dynamics Intelligence, 2015

Data Center Power Density

Proportion of Racks with Densities over 10 kW

Source: Data Center Dynamics Intelligence, 2015

Programs and Policies

- 12th Five-Year Plan
  - Cloud computing is one of the key areas of new strategic industries.
  - The proportion of the added value of new strategic industries to GDP should attain about 8%.
- MIIT Guiding Opinion on Construction and Distribution of Data Centers
  - Site selection of new data centers: Cold zones are preferred.
  - Encourages new data centers with PUE of ≤ 1.5 and existing data centers with PUE≤ 2.0, and encourages local incentives such as land, increased power supply, direct access, and network infrastructure
- China National Institute of Standardization (CNIS)
  - Standards: Server energy efficiency; data center M&V; Energy Management System for data centers

Programs and Policies (cont.)

- ISO/IEC JTC 1/SC 39: Working in Resource Efficient Data Centers
  - Resource efficiency taxonomy, vocabulary, and maturity model
  - Key Performance Indicators
  - Energy management system standard

- Beijing: Energy Efficiency Grades for internet Data Center

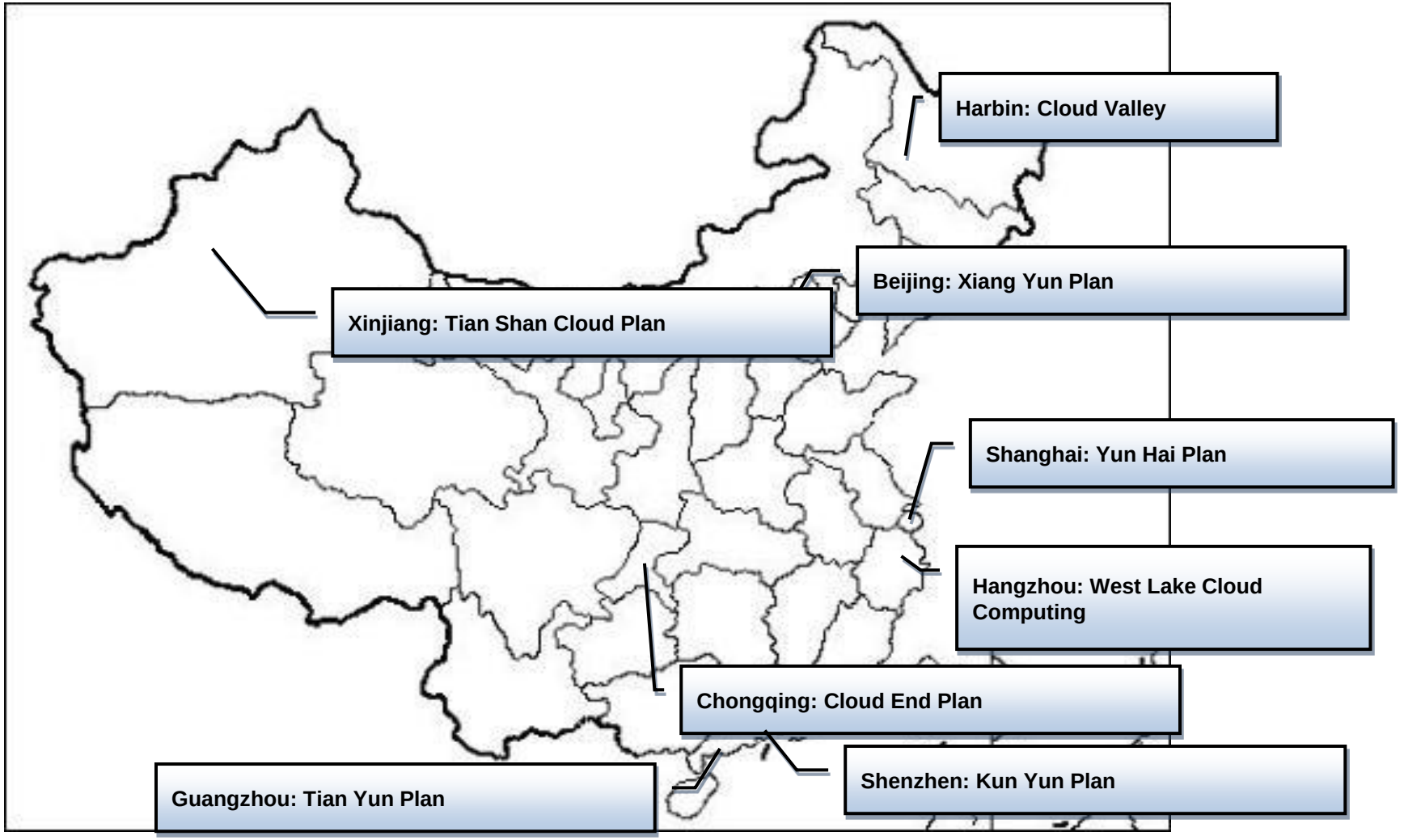
- GB 50174-2008 Code for Design of Electronic Information System Room

Programs and Policies (cont.)

- National Green Data Center Pilot Program:
  - Announced March 2015 by Ministry of Industry and Information Technology (MIIT), State Council Government Offices Administration (GOA), and National Energy Administration (NEA)
- Goals
  - Establish 100 Green data center pilots to promote EE and low carbon
  - Implement by sector, by region and by scale; focus on both new design and retrofit of legacy facilities
  - Develop national standards on green data centers
  - Promote best practices
  - Establish monitoring system for energy and environmental performance
  - Draw on international experience and promote cooperation
  - Explore energy performance contracting and new finance models

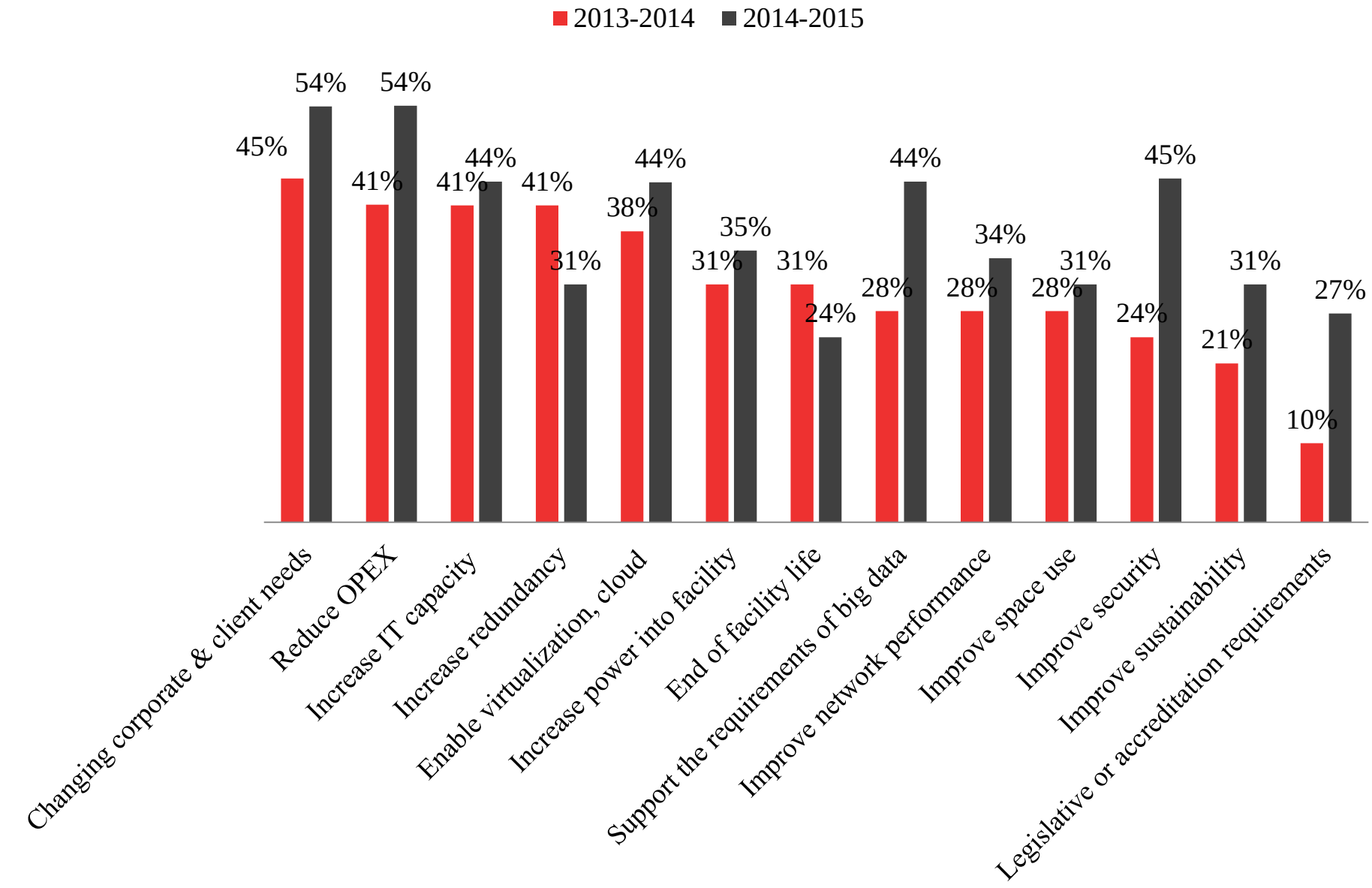
Cloud Computing Construction Plans

Est. 5M servers to be installed over 5 years to meet demand



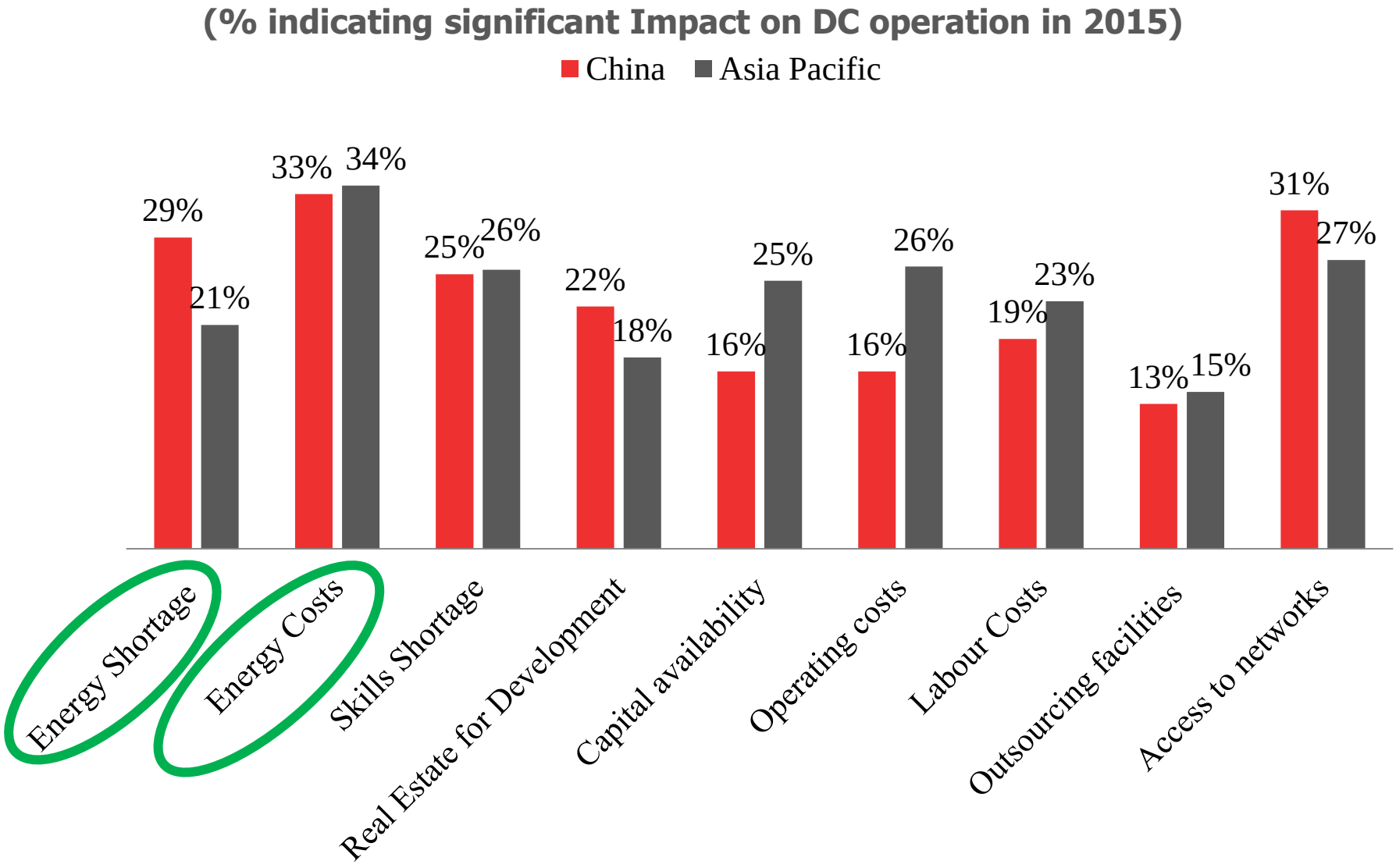
Source: Jingyi Hu, 2013

Investment Drivers



Source: Data Center Dynamics Intelligence, 2015

Barriers to Growth



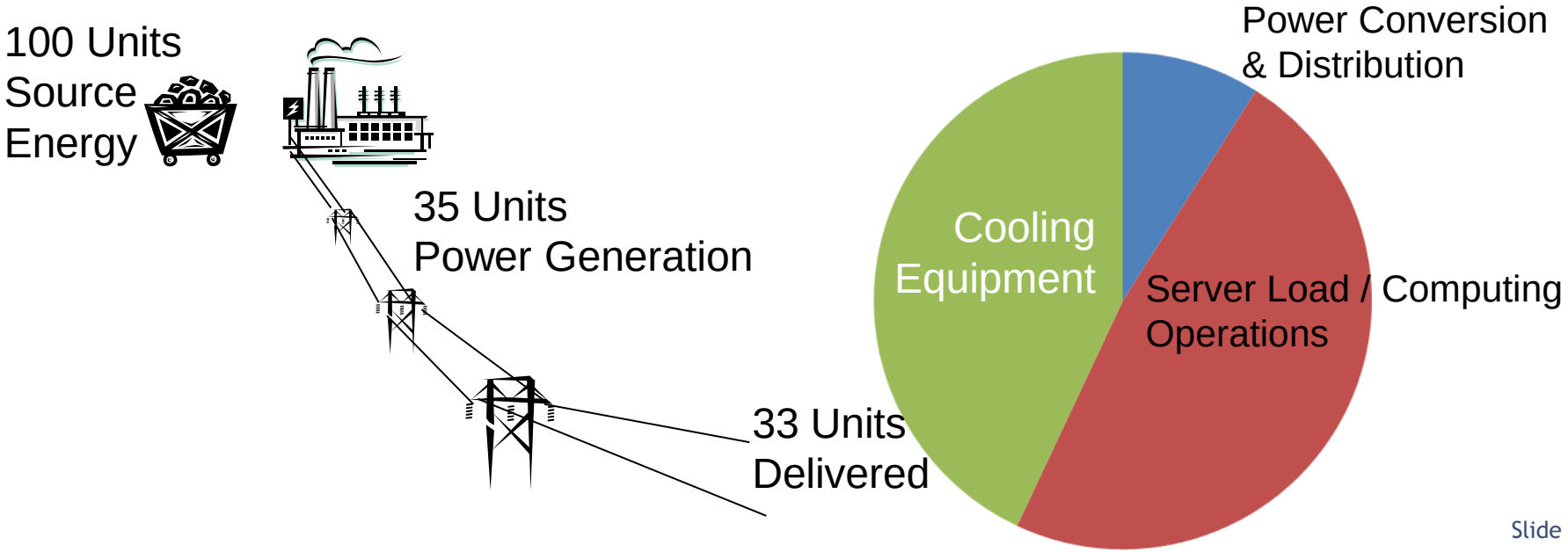
Source: Data Center Dynamics Intelligence, 2015

Energy Use

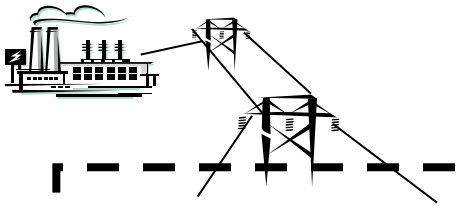
- Data centers consume over 1.5% of China's energy, and energy consumption growing rapidly (raising concern)
- Previously, little attention on facility efficiency → Power Utilization Effectiveness (PUE) of 2.2–3.0 (vs. <2 in U.S.)
- Retrofit savings typically: 20-40%, New: 50%+ is possible

Source: MIIT March 2015

Typical Data Center Efficiency is 15%



Efficiency Opportunities



- Server innovation
- Virtualization
- High efficiency power supplies
- Load management

- Better air management
- Move to liquid cooling
- Optimized chilled-water plants
- Use of free cooling
- Heat recovery

Power Conversion & Distribution

Server Load/ Computing Operations

Cooling Equipment

- High voltage distribution
- High efficiency UPS systems
- Efficient redundancy strategies
- Use of DC power

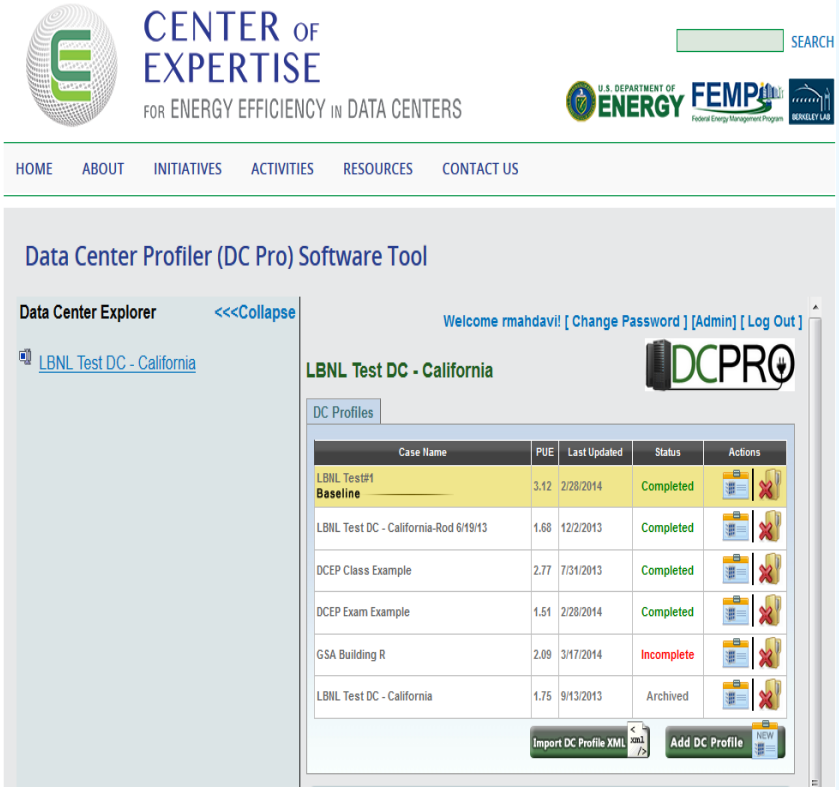
Alternative Power Generation

- On-site generation Including fuel cells and renewable sources
- CHP applications (Waste heat for cooling)

Data Center Profiler tool

INPUTS

- Building
- Utility bill data
- IT
  - Cooling
  - Power/On-site generation



OUTPUTS

- PUE
- End-use breakout
- Areas for efficiency improvement
- Overall energy reduction potential

Data Center Project Execution

- **Independent Design**
  - e.g. Hewlett Packard/EYP, Syska Hennessy, etc.
  - Design Institutes
- **Design by the Book**
  - Many standards, some by Design Institutes
  - Low risk to follow even poor standards
  - CESI and ISO defining best practices
- **Design by vendors, integrators, design/build contractors**
  - e.g. APC, IBM, Dell, etc.

Working in China - Some Potential Issues

- **IP** – Rapid staff turn over; may have to enter into a joint venture and be expected to offer some technology transfer
- **Data Security -** Fears over cyber security are spurring a push for using Chinese "homegrown" products rather than foreign offerings
- **Risk Adverse** – Little reward as early adopter, big potential penalty
- **Cost Perceptions** – U.S. tech expensive; first cost vs. life cycle
- **Awareness and Capacity** – lack information and skills on energy efficiency technology
- **Environment -** Polluted outside air increases reluctance to use outside air cooling
- **Water Pipes Avoided** – CRAHs placed in adjacent room, barrier to liquid cooling solutions (e.g. in-row, rear door, and direct)

Leverage Established Industry Partners

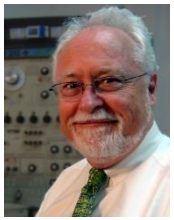
- Multi-Nationals (e.g. IBM's customer center)
- Representatives & Distributors (as used by Power Standards Lab)
- CERC IP protocol and annual IP workshop
- Industry Organizations, such as:
  - U.S. China Energy Cooperation Program (ECP)
  - The Green Grid
  - Information Technology Industry Council (ITI)
  - U.S. China Business Council
  - U.S. China Greentech Initiative
  - CIE/ITI Digital Energy and Sustainability Solutions Campaign (DESSC)
  - China-U.S. Energy Efficiency Alliance

Get Involved w/ Joint Energy Standards

- Major Chinese internet players (e.g. Baidu, Alibaba, Tencent) are developing their own standards, individually and jointly (e.g. Scorpio)
- Some of these conflict with standards outside of China (e.g. DC voltage)
- DOE and MIIT are launching the new **B**ilateral **E**fficiency **St**andards for US and Chinese **Data** Centers Project (BEST-DATA)
  - ✓ China version of Open Compute Project (OCP)
  - ✓ Participate through OCP and other industry organizations
  - ✓ Workshop in China in late summer to identify initial potential open standard(s) and associated work plans for the coming year
  - ✓ Facilitate MOU among stakeholders in both countries
  - ✓ At the U.S. – China Energy Efficiency Forum this fall in Washington DC, MOU signing ceremony and breakout session to advance BEST-DATA
  - ✓ Contact boshen@lbl.gov or DASartor@lbl.gov for more information

Perspectives from PSL

- Power Standards Lab – a 30-person California technology manufacturer
- Alex McEachern (muck-ECK-urn) – President
  - Alex@PowerStandards.com, ++1-510-522-4400
  - Personally doing business in China for 20+ years



- Ultra-high-precision energy and Power Quality meters
- 50% domestic U.S. sales, 50% export
- CHINA is PSL's single largest export market

Marketing Tech in China

- "Best in the world" works.
- Brand recognition is important.
  - Ideally your own brand.
  - If not your own, then your customers' brands…
- Effectiveness of keynote speeches at national conferences
- Acknowledge the regional differences.
- Adapt your products to the local market.
  - Language (written)
  - Standards (GB, in our case)
  - Cultural attitudes (e.g. web sites)

Dealing with IP in China

- Accept that there is a different approach
- In PSL's experience, there are three IP defenses:
  - Agility – rapidly upgrade your product in ways that are important to the users
  - Quality – find a way to make this a strong issue
  - International acceptance – if you can organize your products in a way that requires other countries to accept their results, you get additional protection.

Pricing in China

- Like all countries, culturally based
- Rapid search world-wide for best pricing
- Expected negotiation on price
- Concept of product support, especially if built into product price, is foreign (replacement is more familiar, but does not work for application issues)
- This is a challenge!

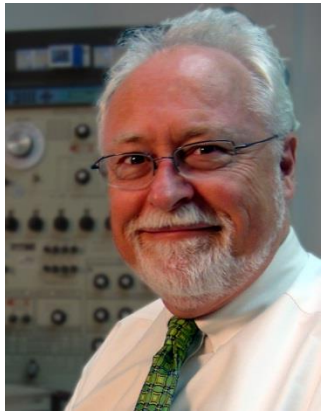
Partners in China

- As a small company, you can't work alone.
- Big, well-connected Chinese partner
  - Great contacts, great relationships
  - You may be so small that you're invisible
- Small Chinese partner
  - You will be important.
  - You may lose opportunities due to lack of contacts, or cultural issues.
- Multiple Chinese partners
  - Can easily turn into a price competition.
- Conclusion: find the right person.

Questions to PSL?

- Does anybody on the call need help with precise electric power instruments for data centers?
- We would love to help!
- http://PQube3.com

- Alex McEachern (muck-ECK-urn) – President
  - Alex@PowerStandards.com, ++1-510-522-4400
  - Personally doing business in China for 20+ years



Data Center Design & Implementation in China

Lessons Learned

How to Succeed in China

1. Understand the Culture, Market and the Competition:
   - Invest the time
   - Bring your management to China
   - Meet with as many people as your can
   - It’s not only about your business, goods, and services
   - learn how to navigate in the culture
2. Boots on the Ground
   - Must have a presence
   - Show a commitment
   - Choose your local staff and partners carefully
   - There is much mistrust
   - “Head of a Lion and Tail of a Snake”

How to Succeed in China

3. Relationships are Key
   - Decisions are top down, all ways work with the decision maker
   - Always respect face -Never push or pressure
   - Again, Invest the time to build trust
   - Never underestimate the power of a relationship
   - Long dinners – you have to learn how to drink and not get drunk
4. Understand the Governments Role
   - All businesses are hierarchical
   - Government is very decentralized, bottom up
   - Meet with the government
   - Understand their role in your market segment
   - Your competition may be subsidized or a SOE

How to Succeed in China

5. Negotiations and Meetings
   - English is not widely understood,
   - Have a good translator and speak slowly and concisely
   - Be prepared, be accurate
   - Document everything in writing
   - Always follow-up with written information
6. Differentiation
   - Clearly articulate what you bring to the table
   - Publish relevant case studies
   - Seeing is believing
   - Provide tours of projects and factories
   - Always be aware of your IP

Thanks

Thank you!

- The webinar recording, slides, and BEST-DATA Project concept paper will be available at: https://datacenters.lbl.gov/china

- **Send your feedback to brian.holuj@ee.doe.gov**
  - **how useful was the webinar?**
  - **how will you apply these insights?**
  - **how might we improve?**

- Q&A Session

Key Ministries and Affiliates

- Ministry of Industry and Information Technology (MIIT) –ICT development
- Ministry of Housing and Urban-Rural Development (MOHURD) - building energy efficiency
- Standardization Administration of China (SAC) - standardization
- National Development and Reform Commission (NDRC) – overall economic planning and energy use efficiency
- Ministry of Science and Technology (MOST) – technology development
- National Energy Administration (NEA) – energy supply and planning
- State-owned Assets Supervision and Administration Commission (SASAC) – oversee state-owned enterprises
- China Institute of Electronics (CIE) – technology application and promotion in electronics and ICT sectors
- China Electronics Standardization Institute (CESI) – Leads for ISO/IEC JTCI SC39 standards for IT sustainability