GARTEN ROTHKOPF

Anatomy of a Partnership

Benefits of US-China Private Sector Cooperation in the Power Sector

Introduction

The US and China will lead the world in addressing energy and climate change, and there is tremendous unrealized potential in this economic relationship that will sustain and create growth and jobs for both countries

US, China In Need of Continued Clean Technology Collaboration

Both countries share common characteristics and challenges

CO2 Leaders *(MM tonnes carbon, 2006)*

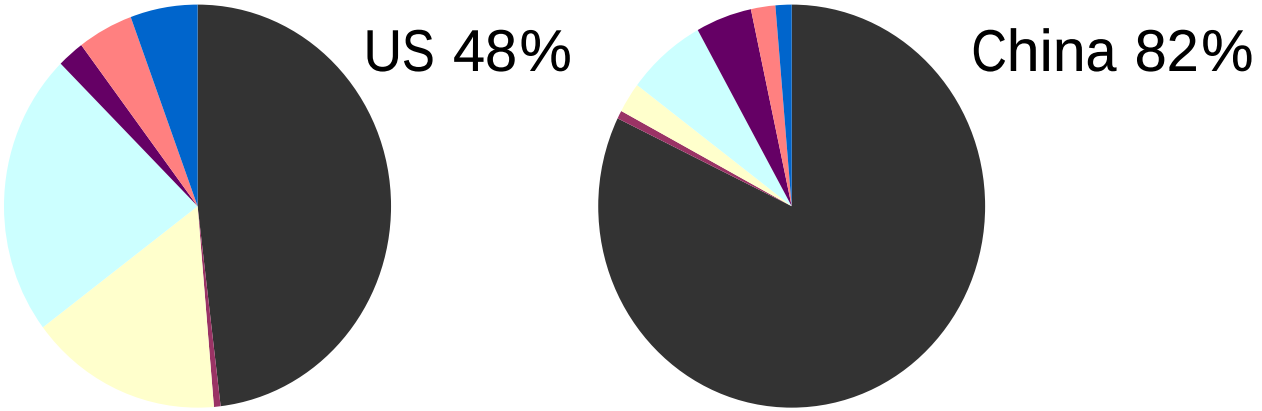
China	**6,103**	*~42% of total*
US	**5,975**	
Russia	1,557	
India	1,510	
Japan	1,273	

Source: UN Statistics Division

US, China In Need of Continued Clean Technology Collaboration

Both countries share common characteristics and challenges

Coal Dependent *(% of power gen, projected 2030)*



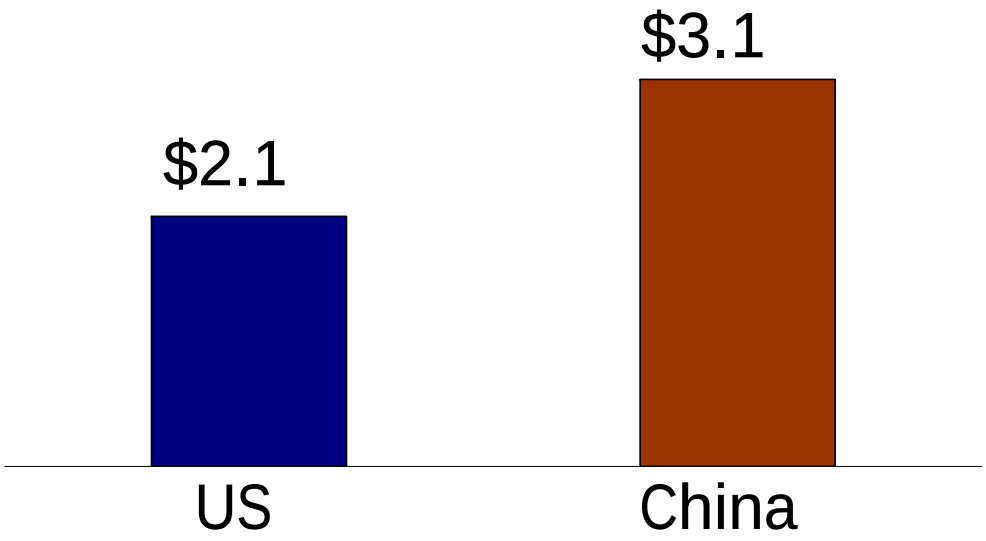
Source: IEA

US, China In Need of Continued Clean Technology Collaboration

Both countries share common characteristics and challenges

Need Huge Investments in Power, Electricity

Projected investment needed in power infrastructure by 2030, Trillions



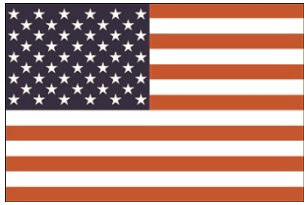
Source: IEA

US, China In Need of Continued Clean Technology Collaboration

Both countries share common characteristics and challenges

Need to Reduce Dependency on Oil Imports

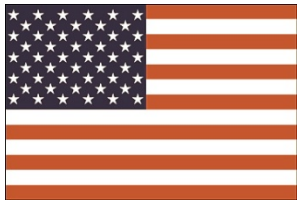
Oil Imports in 2030



11.9 mbpd
63% of total
Rank #2

12.5 mbpd
75% of total
Rank #1

Government Commitments Illustrate Recognition of Need for Action



Proposed legislation:

- 17-20% emissions reductions by 2020, more than 80% by 2050 (from 2005 levels)
- Federal renewable portfolio standard of 15-20% by 2020/1
- More stringent efficiency requirements for industry, appliances, and buildings

Climate Change Program:

- Reduce energy intensity per unit GDP by 20% from 2006-2010
- Increase renewable energy to 15% by 2020
- Increase total forest cover to 20% by 2020

Joint US-China Energy Partnerships: Tremendous Untapped Potential and Win-Win for US and China

- Generates mutual economic and employment benefits
- Drives two-way investment
- Accelerates development of climate-saving energy technologies needed by both the US and China
  - CCS, IGCC, Solar, and Smart Grid

- Access to China's rapidly growing power generation sector
- Access to economically produced component parts for smart grid technologies and solar PV cells
- Opportunity to up learning curve for deployment of clean coal technologies

- Access to new technologies to drive plans for coal-generation expansion and smart grid deployment
- Access to another burgeoning solar market, in the US
- Manufacturing jobs for component parts and increased export market

Public Sector is Forging a Bilateral Commitment

A series of existing partnerships has already laid a foundation upon which to build further collaboration

US-China Clean Energy Research Center (Est. 2009)	• *Joint R&D in Cleantech* • *Focus on building energy efficiency, clean coal including CCS, and clean vehicles*
Eco-Partnerships (Est. 2007)	• *Government-to-government partnerships at the local, state or provincial level, as well as partnerships among businesses, universities, and non-profit organizations*
U.S.-China Protocol for EE/RE Technology Development (Est. 2007)	• *DOE and China's Ministry of Science and Technology cooperate areas of energy efficiency and renewable energy*
U.S.-China Energy Policy Dialogue (Est. 2004)	• *Facilitates policy-level exchanges of views on energy security, mutual economic issues, and energy technology options*

Private Sector is Beginning to Act on the Opportunity

First Solar

Signed MOU with China to partner on a 2GW solar power plant

Duke Energy

Joint development agreement with ENN to build large scale solar power plants in US

Plans to collaborate with State Grid on smart grid initiatives

Duke Energy

Signed MOU with Huaneng Group to pursue clean coal technology

US-China Partnerships: Collaboration in the Power Sector Creates a Unique Opportunity

The power sector is a boon for the local economy in each country

Opportunities to generate jobs in both US and China, regardless of project location

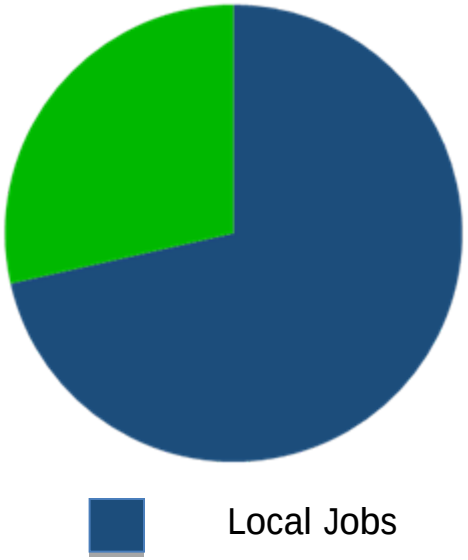
Certain steps in the supply chain can be outsourced to international partners...

Power Sector Supply Chain

R&D	Manufac-turing	Construction & Installation	Operations & Maintenance

...while others require local labor support

For the illustrative power sector projects that follow, 73% of direct jobs created are in the country of power generation.



Average of jobs created over three projects: 67% for Solar PV, 66% for IGCC, 79% for Supercritical Coal, 95% for Smart Grid deployment

Illustrative Partnerships

To illustrate the dual employment benefits for both China and the US, four hypothetical partnerships have been constructed in areas of current partnership activity and enormous potential.

IGCC w/ CO2 Capture

- $5 billion investment
- 5 - 650MW plants constructed in China

Solar PV

- $1 billion investment
- 400 MW installation in the US

Supercritical

- $5 billion investment
- 6 -1GW plants constructed in China

Smart Grid

- $1.4 billion dollar investment
- 2 million smart meters deployed in the US

Methodology

Selection of Technologies

- **IGCC and Supercritical Coal**
  - Greening of coal powered fired essential to both countries
  - China's policy mandates IGCC or Supercritical plants for all new construction
  - US-China partnerships begin to take shape in the area
- **Solar PV Manufacturing and Installation**
  - Technology with considerable growth potential
  - China emerging as a lost cost manufacture.
- **Smart Grid**
  - Huge scope for efficiency improvements in both countries
  - Allows for greater use of intermittent renewables such as solar

Job Creation Estimation

- **Over 30 interviews with power project and technology company executives and academics, acquiring:**
  - Employment projections based on actual budgeted estimates
  - Understanding of supply chain from current perspectives and purchasing decisions

IGCC with Carbon Capture

Partnership Structure

Overview

•JV among leading Chinese and US companies in the power sector
•3.25 GW Capacity through agreement to construct five 650 MW IGCC plants with carbon capture in China
•$5 billion total investment between participants and government incentives

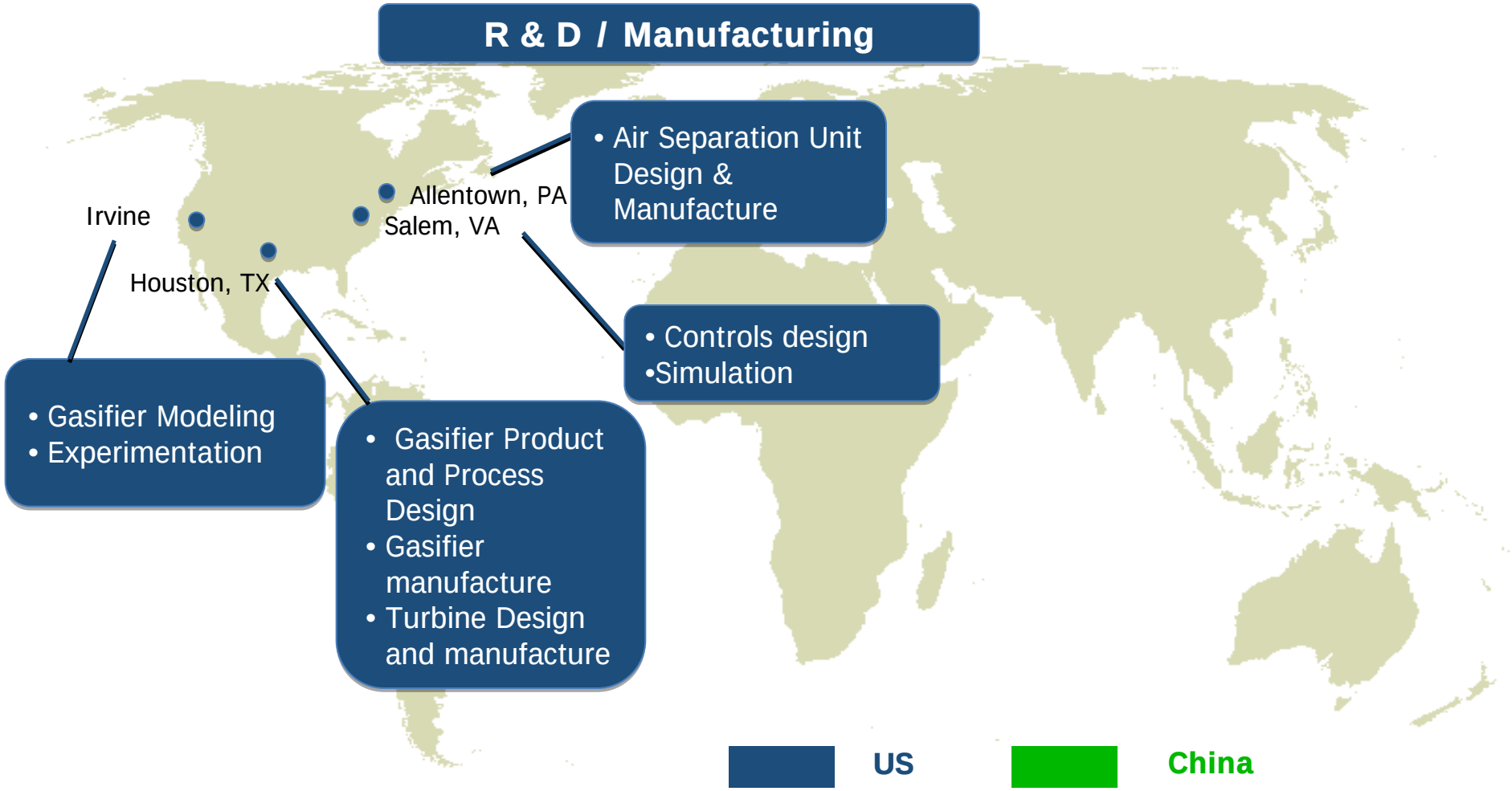
Key Partners and Expertise

•US Based Power Co
  • Operational and grid connection and management experience
•US based component manufacturers
  • Supply of central elements - Gasifier, Turbine, Air Separation Unit
•Chinese Power Co
  • On the ground local knowledge and operating experience

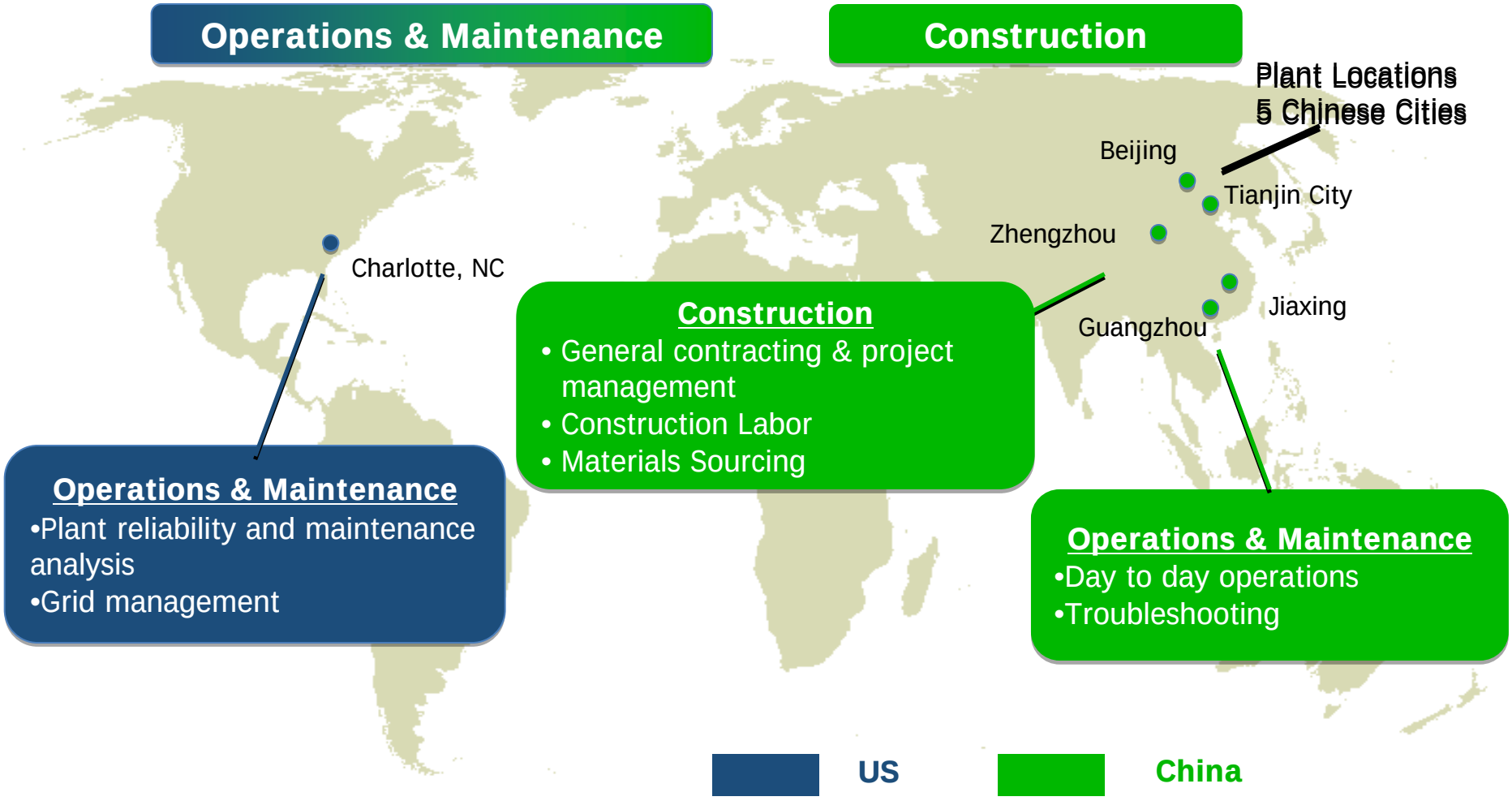
Knock-on Effects

•China acquires critical technology transfer and know how, while the US gains the opportunity to scale the learning curve, applying knowledge to a large US market
•Potential for as many 56 new IGCC plants in the US to 2030, driven by large increase in power generation capacity and a need for cleaner and more efficient generation

IGCC with Carbon Capture Supply Chain



IGCC with Carbon Capture Supply Chain



IGCC with Carbon Capture

Supply Chain and Job Creation Potential

	R&D	Manufacturing	Construction & Installation	Operations & Maintenance
Additional Info	• Design and testing of gasifier, generating turbines, air separation unit. • Plant design and layout	• Manufacturing of central components (gasifier, turbine, air separation unit)	• Construction and installation of components • Some professional services related to plant design and layout	• Routine operations and maintenance – Primarily Chinese Labor • Services from US partners to enhance plant reliability
Jobs Created	• **3,000 direct** • **5,750 total**	• **15,000 direct** • **29,500 total**	• **33,750 direct** • **131,625 total**	• **1,285 direct** • **5,010 total** • **1,715 direct** • **3,258 total**

US

- **19,715 direct jobs at $23 – $40 / hour**
- **40,950 total direct and indirect jobs**

China

- **35,035 direct jobs at $2.70 to $3.05/ hour**
- **136,636 total direct and indirect jobs**

Utility-Scale Solar PV

Partnership Structure

Overview

•JV among leading Chinese and US companies in the solar and utility sectors
•400 MW capacity through agreement to construct utility-scale solar power plants in the US
•$1 billion total investment between participants and government incentives

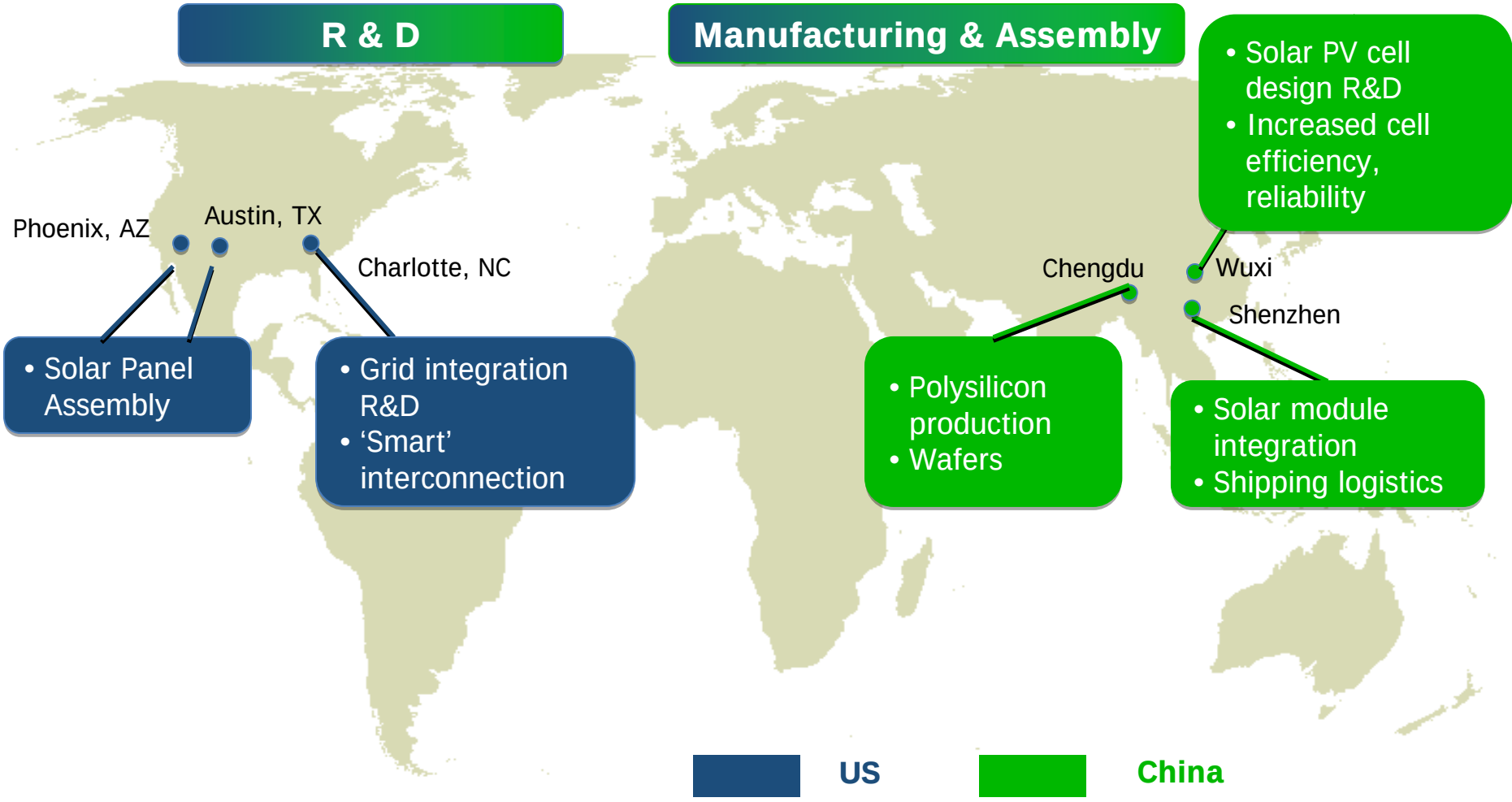
Key Partners and Expertise

•US Based Power Co
  • Local knowledge, operational and grid connection and management experience
•Chinese PV manufacturer
  • Supply of lower-cost solar panels

Knock-on Effects

•China solidifies opportunity to move into US market , while US acquires economic PV cells
•Annual US solar PV installations are to increase to 1515MW by 2013, creating a large market for Chinese manufactured solar PV cells and installation and maintenance services in the US

Solar PV Supply Chain



Solar PV Supply Chain

Operations & Maintenance

Construction

3 US Plant Locations

San Diego, CA

Austin, TX

Charlotte, NC

Construction
- General contracting & project management
- Construction Labor
- Materials Sourcing

Operations & Maintenance
- Day to day operations
- Analysis of performance, impacts on grid reliability

US

China

Utility-Scale Solar PV

Supply Chain and Job Creation Potential

	R&D	Manufacturing & Assembly	Installation	Operations & Maintenance
Additional Info	• Design and testing of PV cells, solar module designs • Large-scale plant design and layout • Grid integration obstacles	• Manufacturing of components (silicon, wafers, PV cells) • Solar panel assembly (US) • Shipping services	• Installation of components • Professional services related to design, layout, grid interoperability	• Routine maintenance of panels, grid connections • Panel cleaning, troubleshooting • Panel efficiency analysis
Jobs Created	• **500 direct** • **1,950 total** • **1,000 direct** • **1900 total**	• **4,320 direct** • **16,848 total** • **3,680 direct** • **6,992 total**	• **4,160 direct** • **12,060 total**	• **1,040 direct** • **3,016 total**

US

- **9,880 direct jobs at $15– $41 / hour**
- **18,772 total direct and indirect jobs**

China

- **4,820 direct jobs at $1.50 to $3.00/ hour**
- **18,798 total direct and indirect jobs**

Supercritical Coal

Partnership Structure

Overview

•JV among leading Chinese and US companies in the power sector

• Six 1,000 MW USC plants

• $5 billion total investment between participants and government incentives

Key Partners and Expertise

•US Based Power Co

- Operational and grid connection and management experience

•US based component manufacturers

- Supply of central elements – Advanced boiler materials, Turbines

•Chinese Power Co

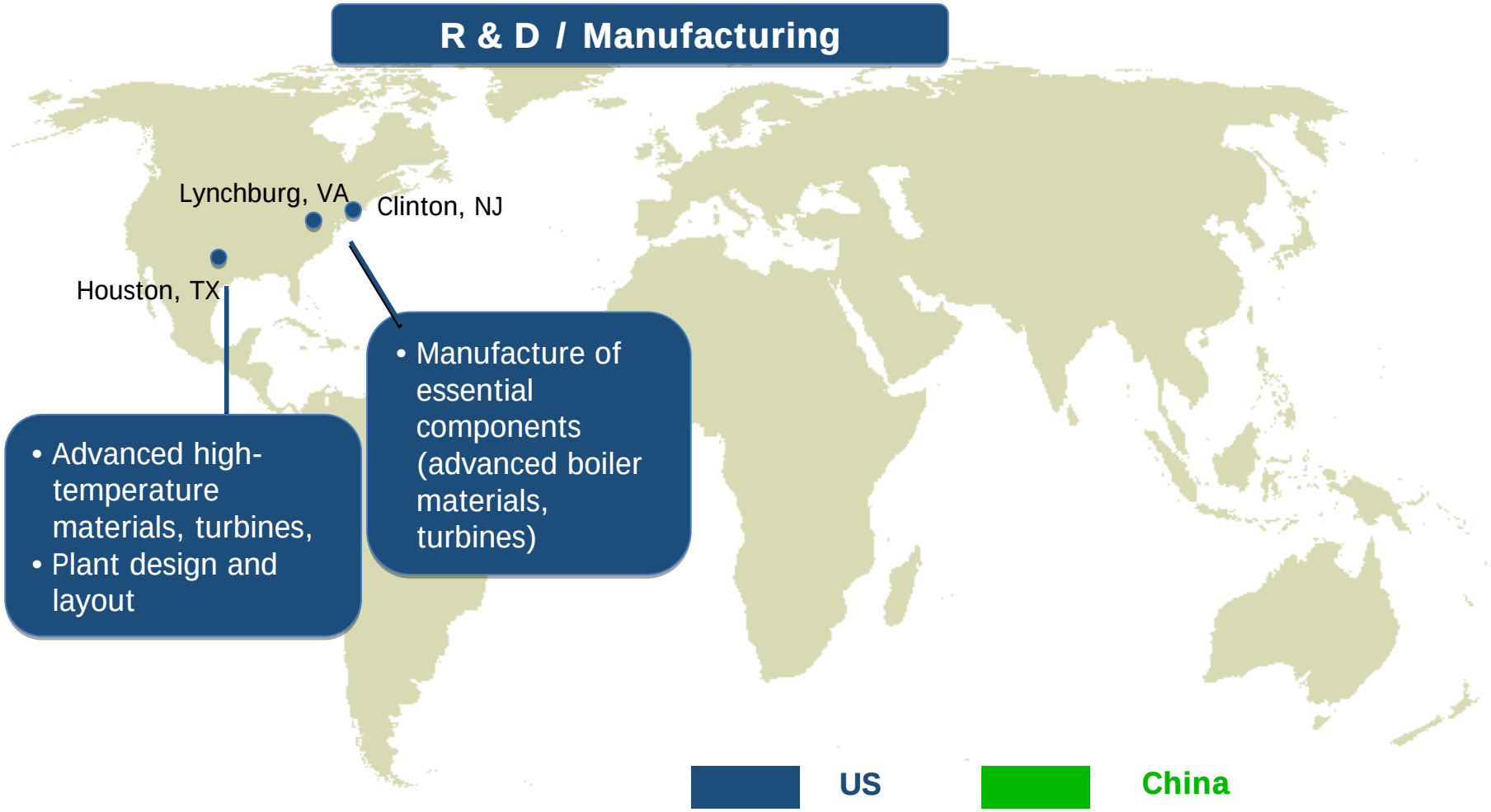
- On the ground local knowledge and operating experience

Knock-on Effects

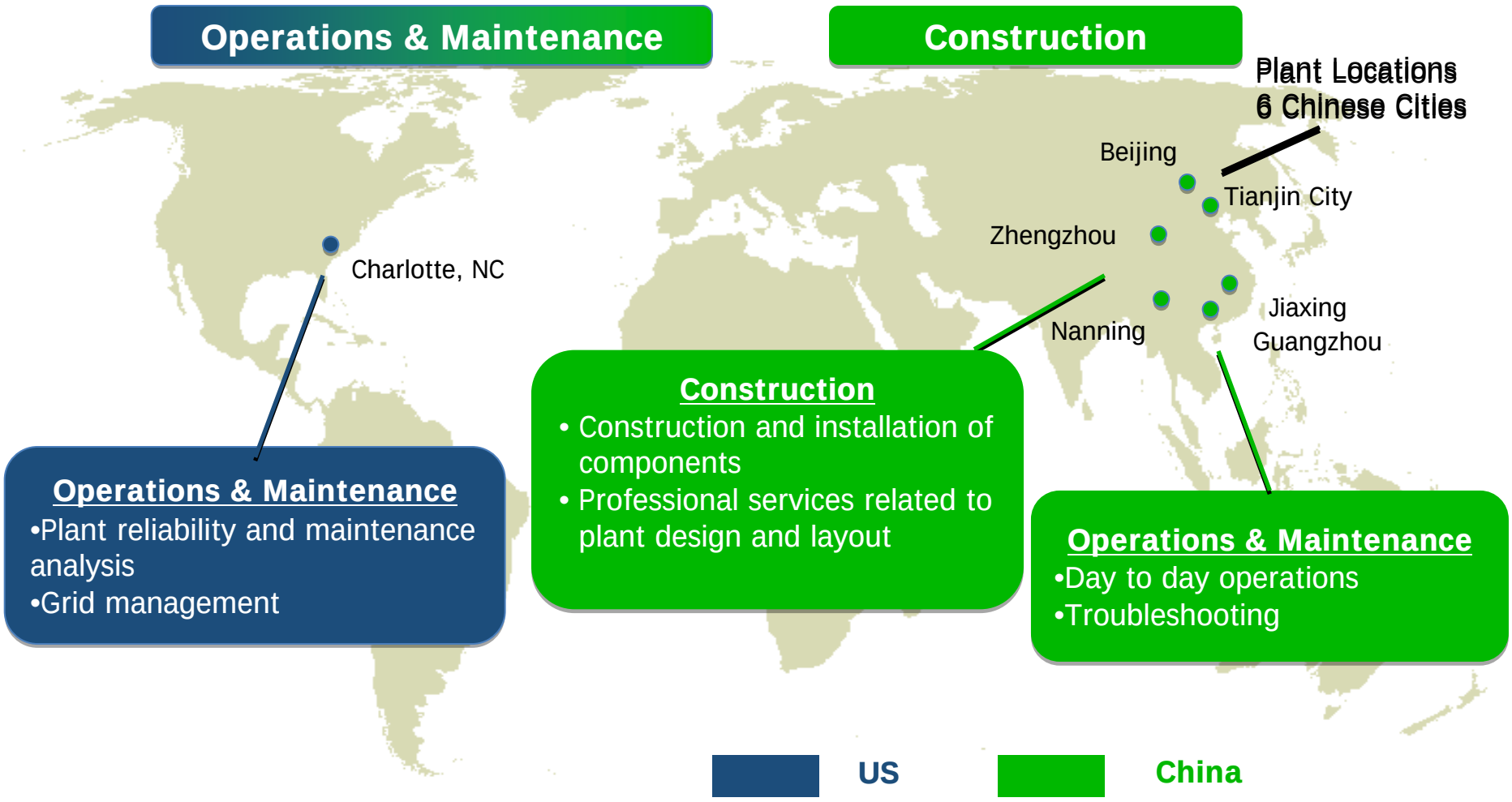
•China benefits by gaining heat resistant materials technology, while US based firms expand exports while scaling learning curve, reducing costs of constructing new plants

•Additional electricity capacity needed creates huge market potential Supercritical technology, for as many as 377 supercritical coal plants in China and 36 in the US to 2030

Supercritical Coal Supply Chain



Supercritical Coal Supply Chain



Supercritical Coal

Supply Chain and Job Creation Potential

	R&D	Manufacturing	Construction & Installation	Operations & Maintenance
Additional Info	• Advanced high-temperature materials, turbines, heat-resistant materials • Plant design and layout	• Manufacture of essential components (advanced boiler materials, turbines)	• Construction and installation of components • Professional services related to plant design and layout	• Services from US partners to enhance plant reliability – plant design optimization • Routine utility maintenance and plant operations • Grid connection management
Jobs Created	• **6,000 direct** • **11,400 total**	• **15,000 direct** • **28,500 total**	• **78,000 direct** • **304,200 total**	• **810 direct** • **3,159 total** • **1,620 direct** • **3,078 total**

US

- **23,430 direct jobs at $23-51 / hour**
- **44,517 total direct and indirect jobs**

China

- **78,810 direct jobs at $1.5 to $3.05 / hour**
- **307,360 total direct and indirect jobs**

Smart Grid

Partnership Structure

Overview

•JV among leading Chinese and US companies in the power sector

• 2 million meters deployed

• $1.4 billion total investment between participants and government incentives

Key Partners and Expertise

•US Based Power Co

- Operational and grid connection and management experience

•US based component manufacturers

- Supply of central elements – meters, communications equipment

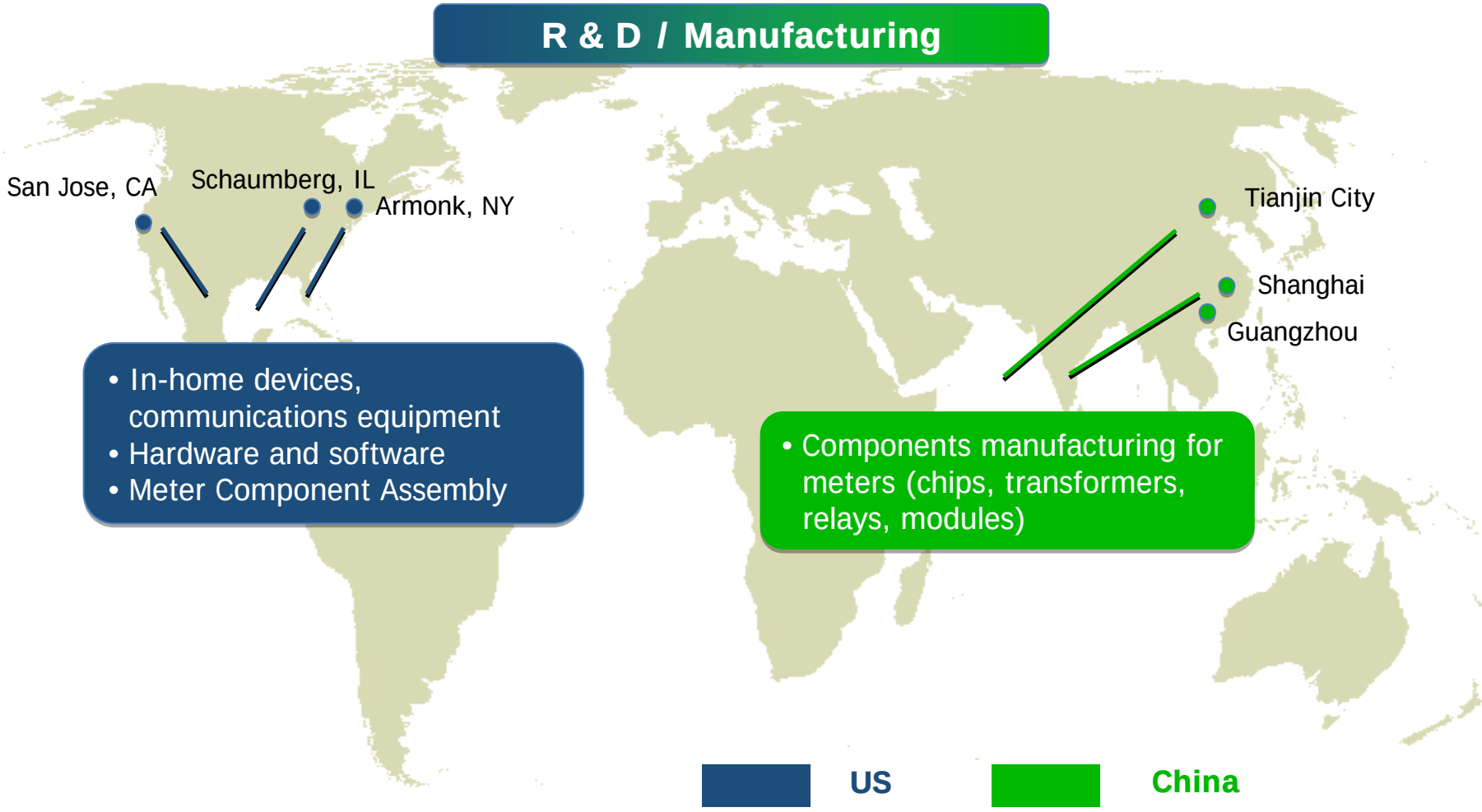
• Chinese based component manufacturers

- Supply of component parts for meters and meters themselves

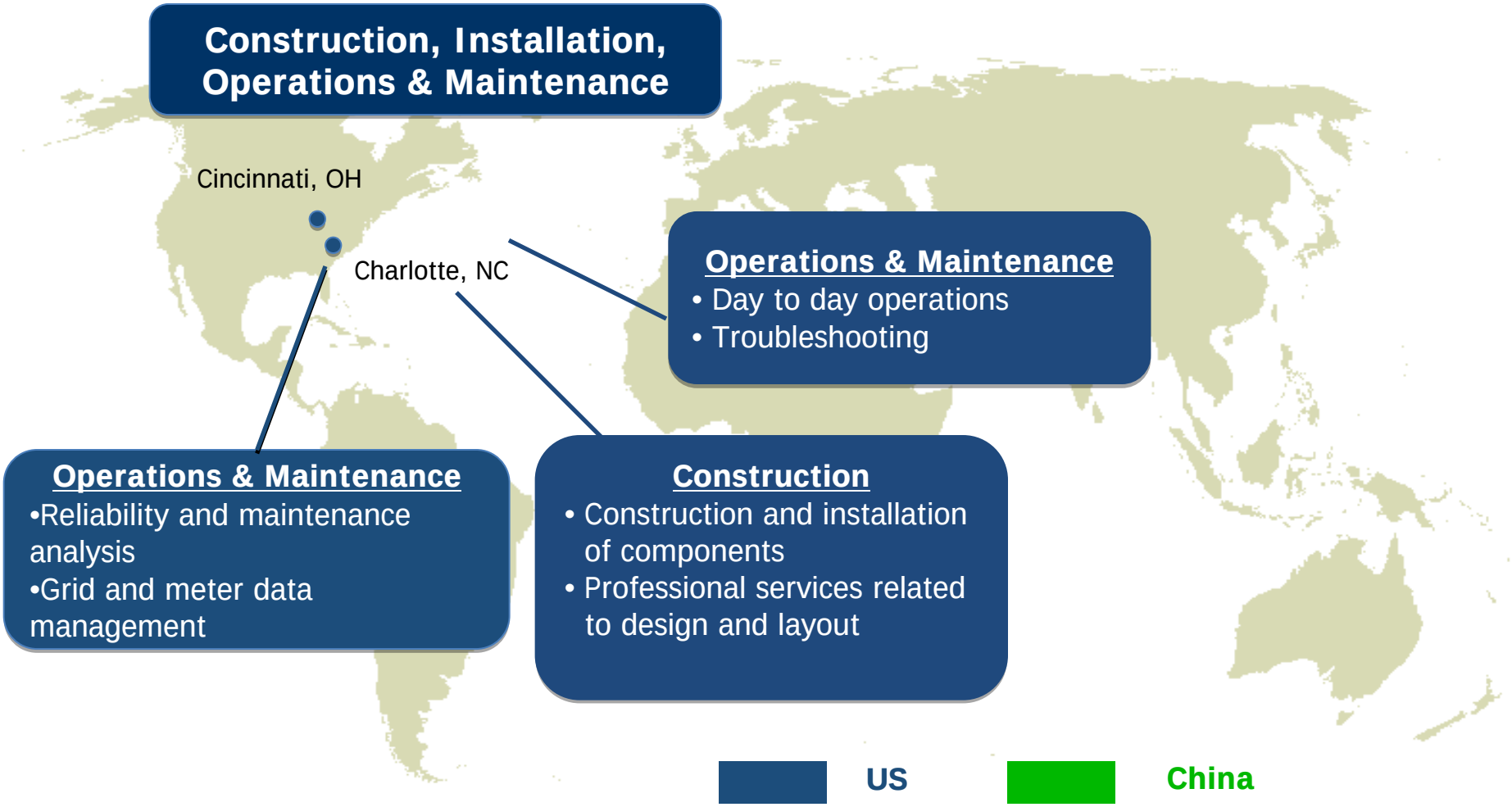
Knock-on Effects

•US provides technology and expertise, while China provides meter manufacturing and access to a burgeoning US market– as much as $63 billion to implement smart meters nationally in the US over the next 15 years

Smart Grid Supply Chain



Smart Grid Supply Chain



Smart Grid

Supply Chain and Job Creation Potential

	Manufacturing	Construction & Installation	Operations & Maintenance
Additional Info	• Manufacture of essential components (meters components in China, meter assembly, communications equipments in US) • Software Design (US)	• Construction and installation of components • Some professional services related to design and layout, especially MDM	• Services from US partners to enhance reliability • Routine utility maintenance and operations • Meter data management and analysis • Software maintenance
Jobs Created	• **2,878 direct** • **5,296 total** • **172 direct** • **671 total**	• **328 direct** • **624 total**	• **168 direct** • **318 total**

US

- **3,374 direct jobs at $20 to $45/ hour**
- **6,410 direct and indirect jobs**

China

- **172 direct jobs at $1.52 to $2.70 / hour**
- **671 direct and indirect jobs**

Conclusion

US – China partnership in the power sector speeds technology development, creates significant economic benefits , and local job creation

- **Technology learning curve scaled more quickly**
  - Collaboration enables cost reductions and technical improvements, driving greater adoption of cleaner technologies
- **Win-Win economic benefits**
  - For US based firms, participation in China in short term provides local presence in a large, rapidly growing market
  - Chinese firms gain technical expertise, strengthen domestic industry, and gain a presence in US market
- **Large percentage of employment created is in country of power generation, mitigating or eliminating the perception of outsourcing US jobs**
  - Of all direct jobs created
    - IGCC with Carbon Capture – 66%
    - Solar PV Installation – 67%
    - Supercritical Coal – 79%
    - Smart Grid Deployment – 95%

Addendum: US and China Miss Out in Absence of Collaboration

Lack of engagement/cooperation in these areas means both sides lose

- Clean Coal: If China does not acquire heat resistant materials or turbines from US firms, Europe and Japan will likely step in with eyes on the market potential created by an additional 547 GW in power capacity needs to 2030.
- Solar PV: Absent partnership, China may miss out on a growing the US solar PV market that is growing rapidly, with annual installations expected to growth more then six-fold by 2014
- Smart Grid: China's goal to roll out a national smart grid by 2020 relies heavily upon foreign technology and expertise in planning to software and materials; these can be acquired from Europe as easily as from the US