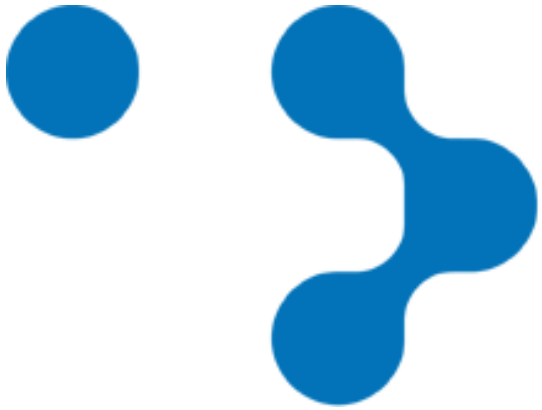

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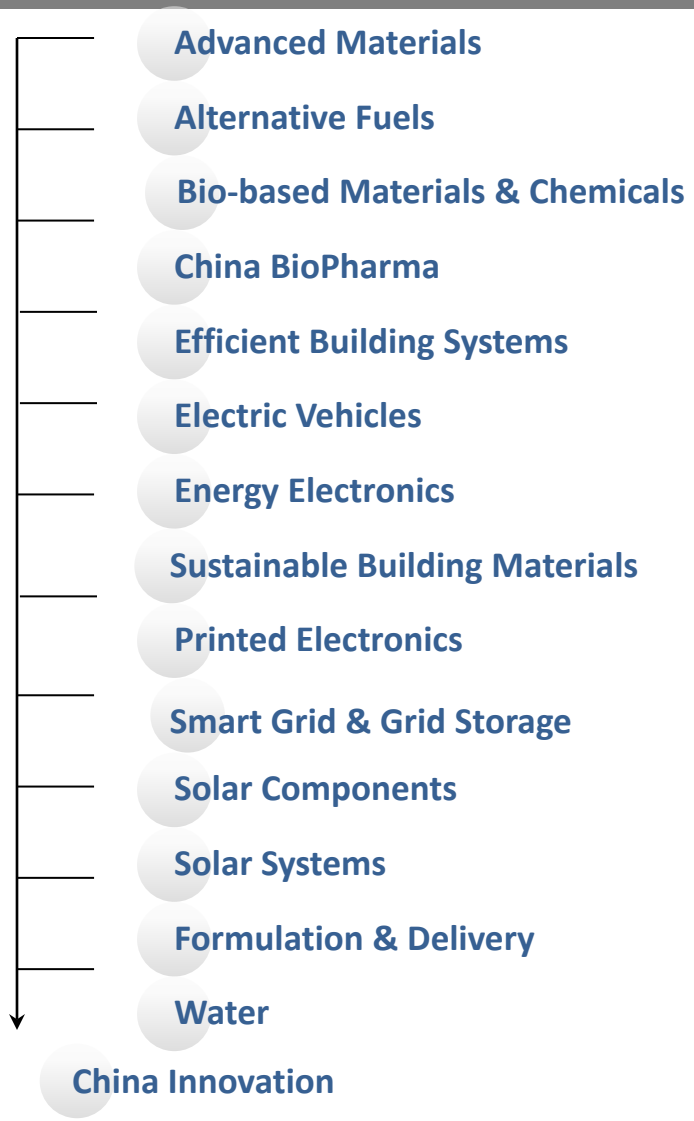
Ongoing **Intelligence** helps clients make sense of the business and technology landscape in targeted sectors. Each service:

- **Delivers a Clear Process to Capitalize** on science-driven innovation, identifying new business opportunities from **emerging technologies in the physical sciences**
- **Activates New Business Growth Drivers** for clients with emerging technology evaluation-monitoring and market intelligence
- **Leads 200 Clients on Six Continents into New Emerging Technology Opportunities**, supporting Fortune 100 and 500 multinationals, financial institutions, national governments, universities, and small-medium businesses
- **Collects and Analyzes for Clients Primary Intelligence** through onsite technology firm visits and networking with CEOs and senior executives
- **Possesses a Global Business-Actionable Network** with offices in Boston, New York, Amsterdam, Singapore, Shanghai, Tokyo, and Seoul
- **Combines Solid Competence** in **technology** with business analysis; 60% of research team possesses advanced degrees in science or engineering



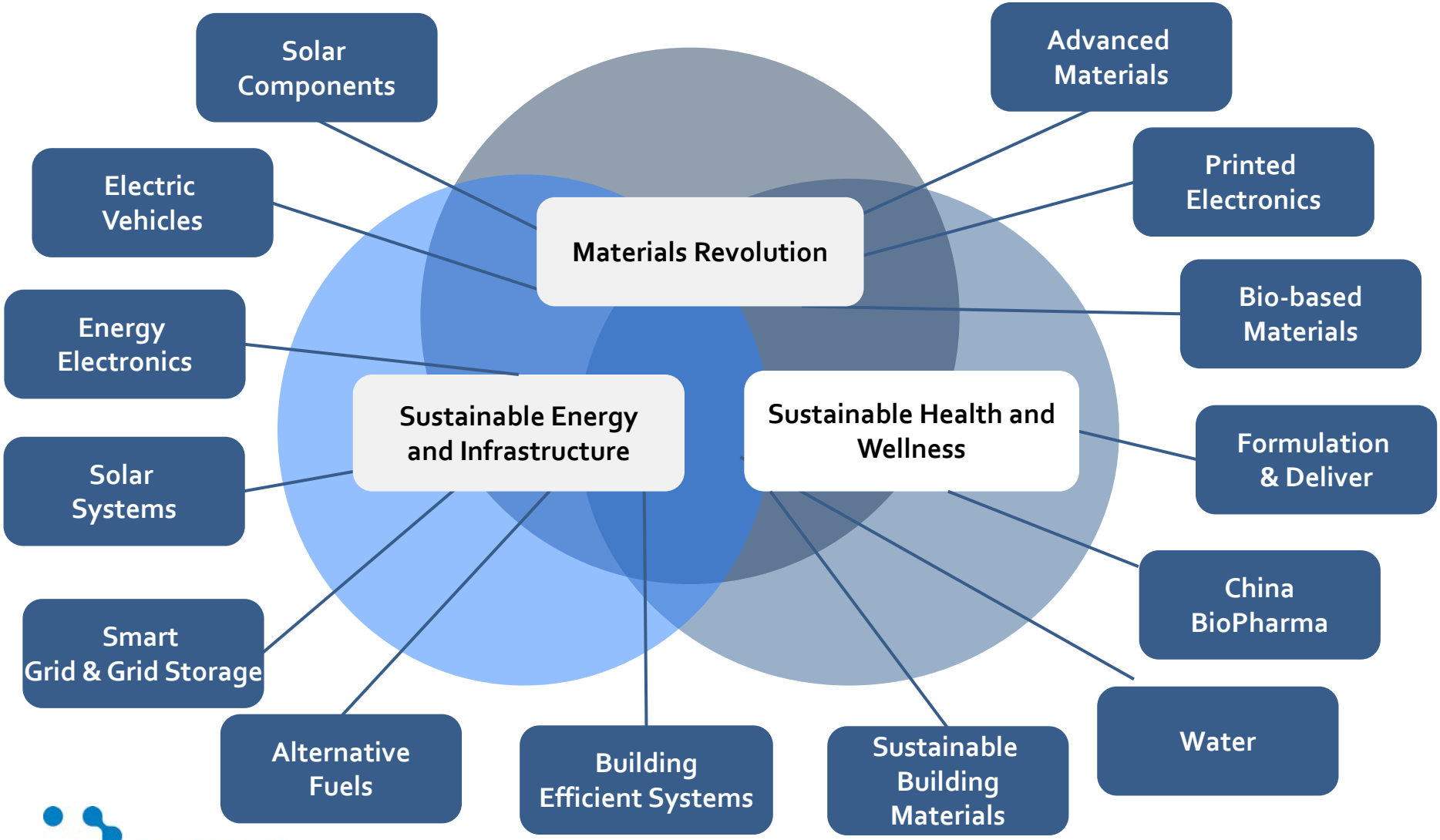
Nanotechnology in the Energy Sector

Hilary Flynn
Lux Research, Inc.

OECD
Washington, DC
March 27, 2012

Global Nanotechnology Funding and Impacts

Lux Research Addresses Key Global Megatrends – why no nano?



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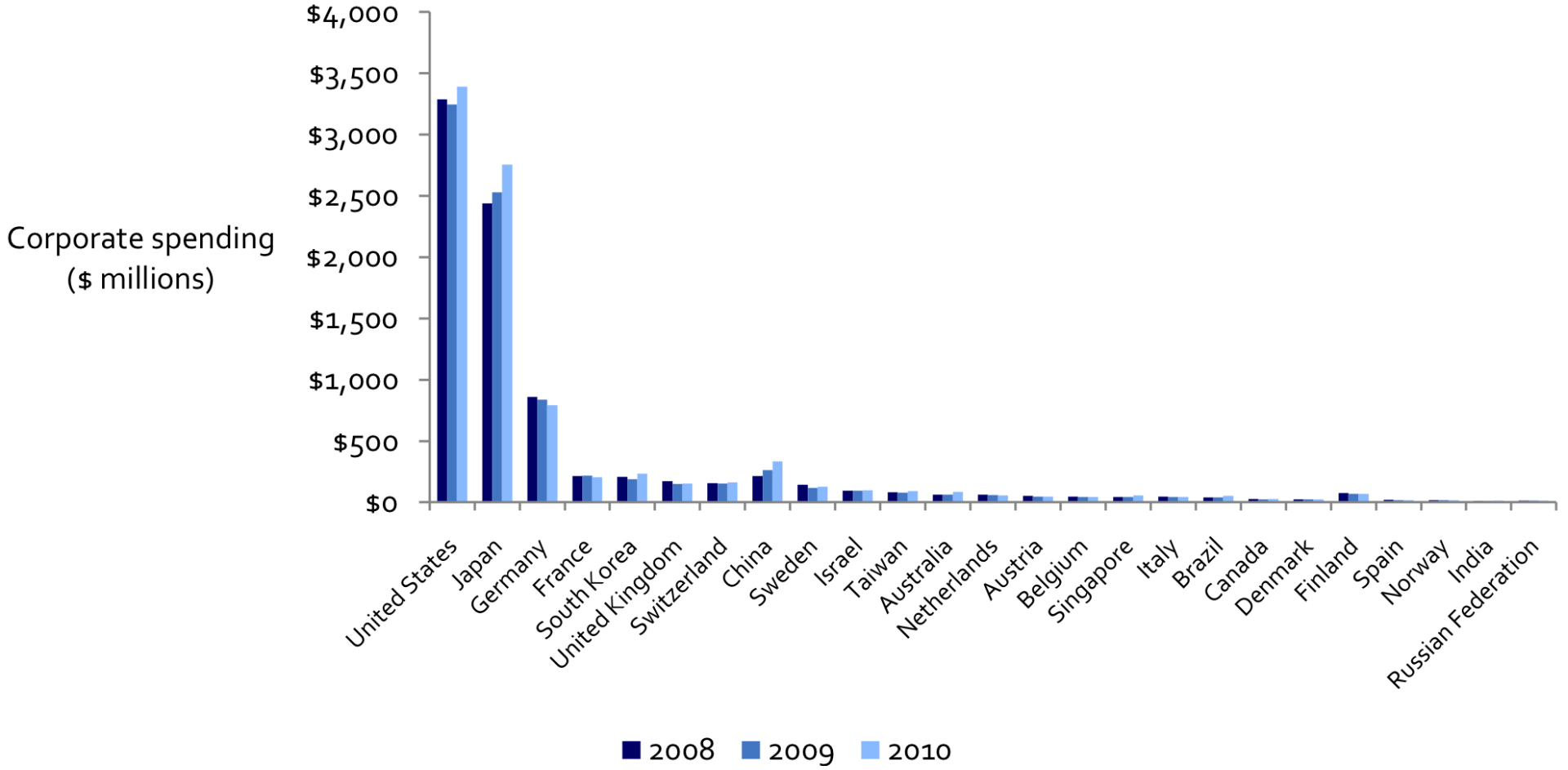
U.S. and Japan Still Reign Supreme in Corporate Spending on Nano Compared to Rest of the World



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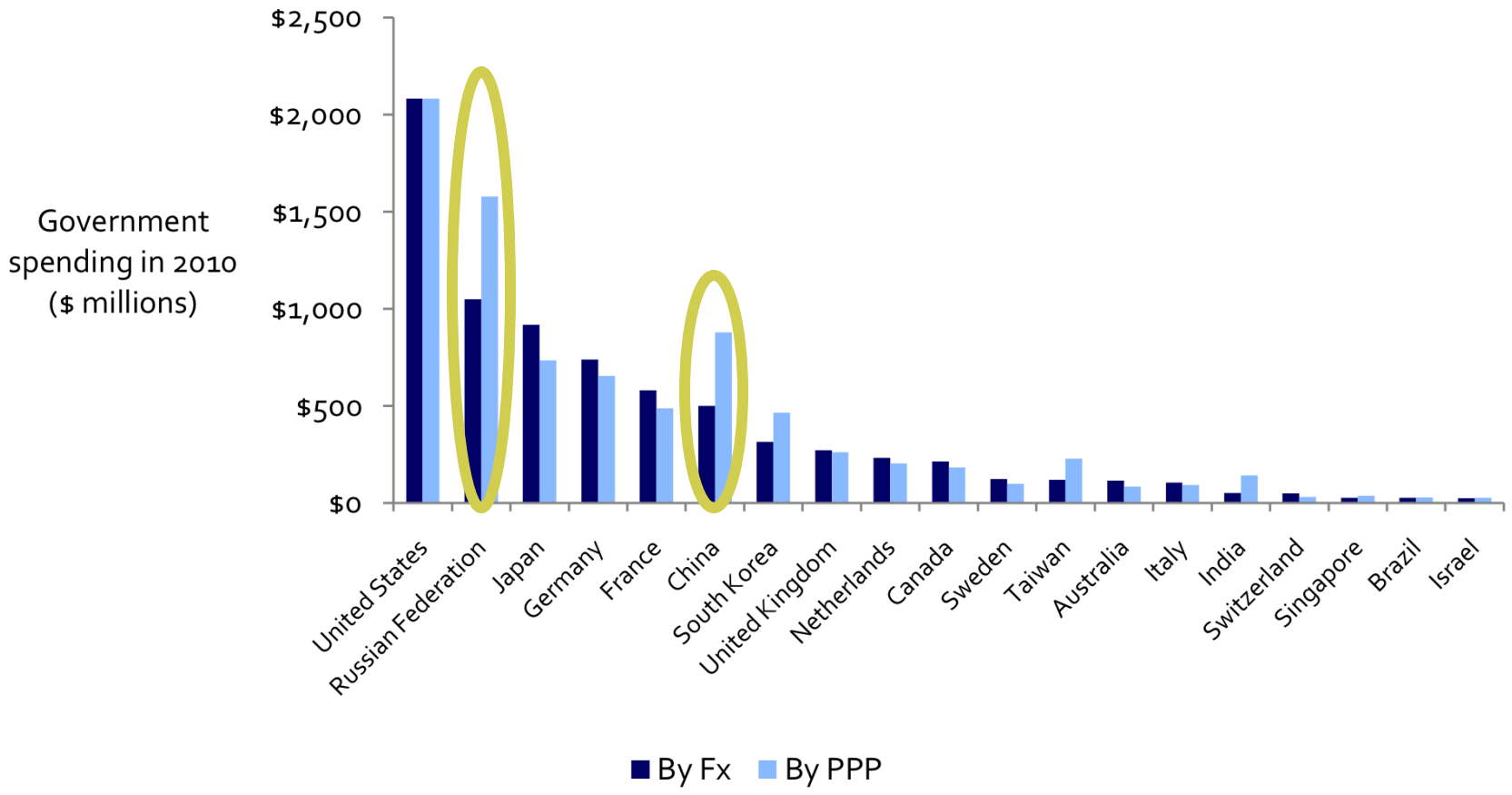
U.S. Still Dominates Government Spending, but notable spending by Russia and China on PPP basis



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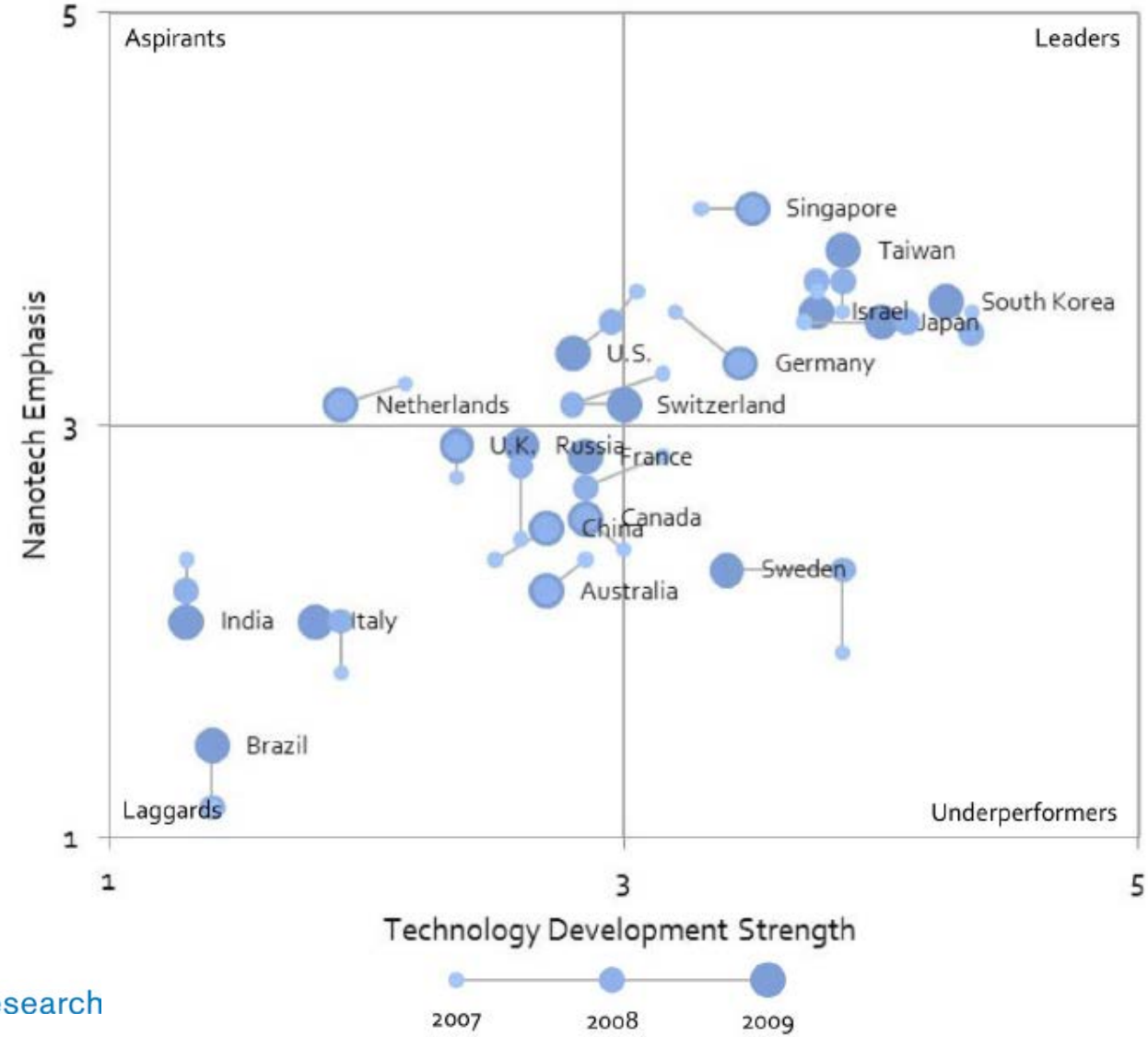
Nanotech emphasis vs development strength indicates which countries are most nanotech-focused



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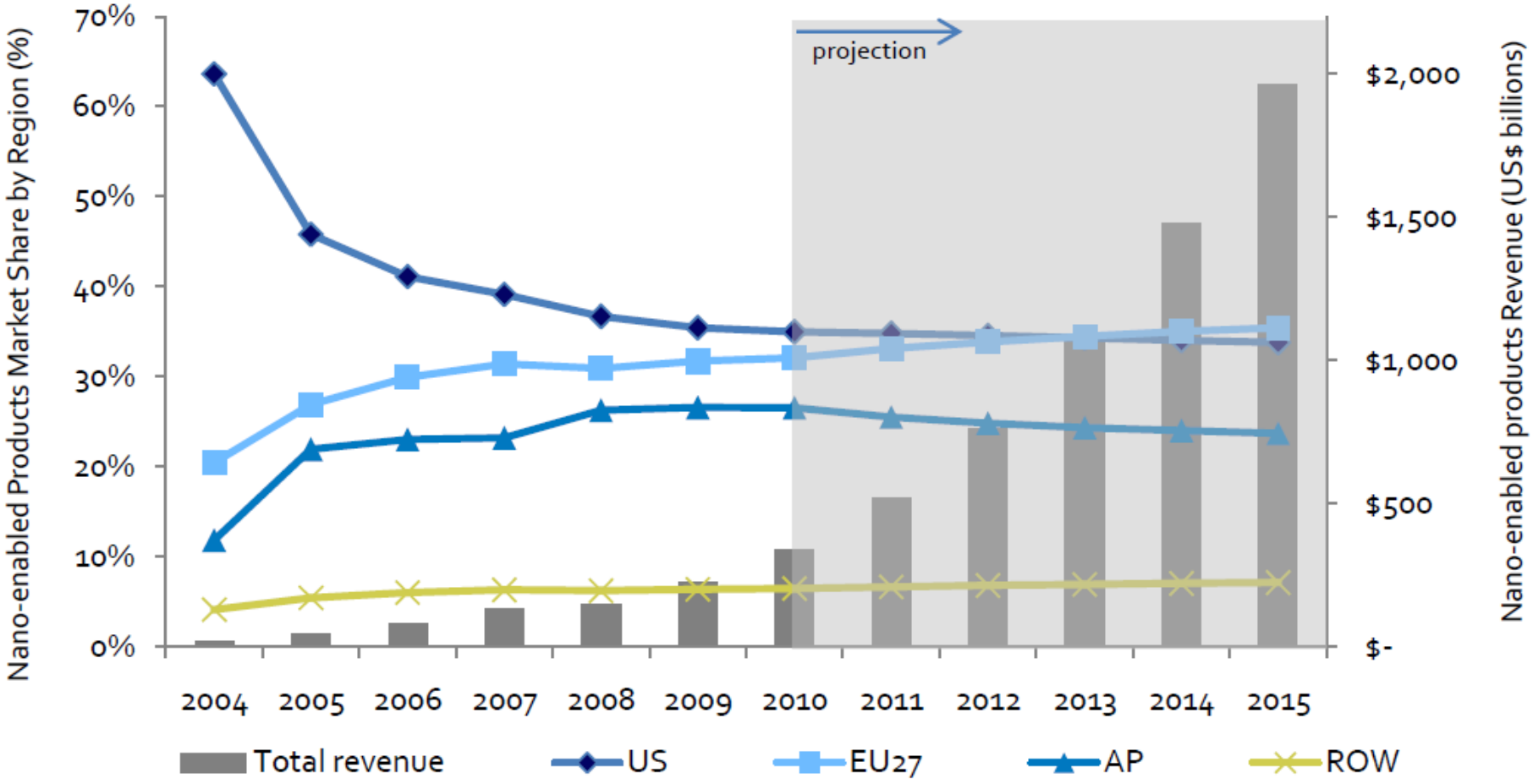
Value of Moving Down the Nanotech Value Chain

TOTAL GLOBAL REVENUE	2004	2009	*2015*
Nanomaterials	$0.29 b	$1 b	*$2.9 b*
Nanointermediates	$2.5 b	$27 b	*$474 b*
Nano-enabled products	$16 b	$223 b	*$1960 b*

Italics indicate projected

- Nanomaterials contribute the smallest portion of revenue
- Due to naturally hefty price tags and large volumes, nano-enabled products garner the biggest share of revenue in the nanotech value chain
- A keen focus on end applications is required to convert nanotechnology from a materials play into a solid investment.

Emerging Nano-enabled Products Revenue: Europe Will Pass the U.S. by 2015



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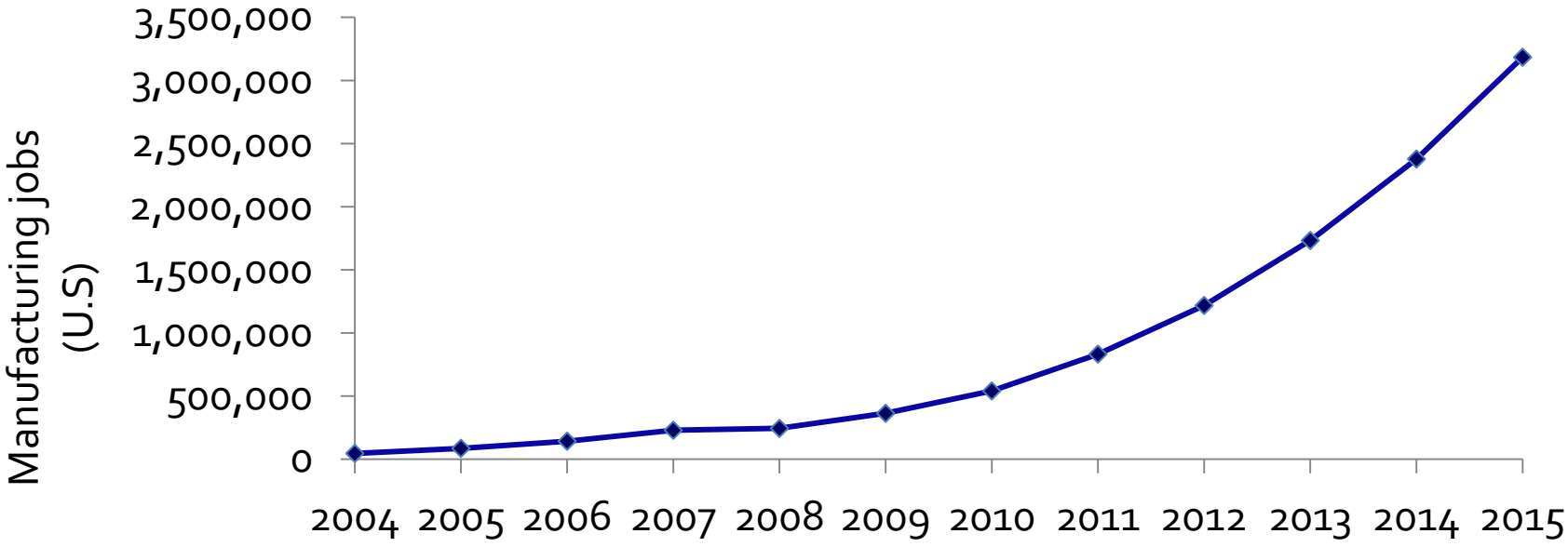
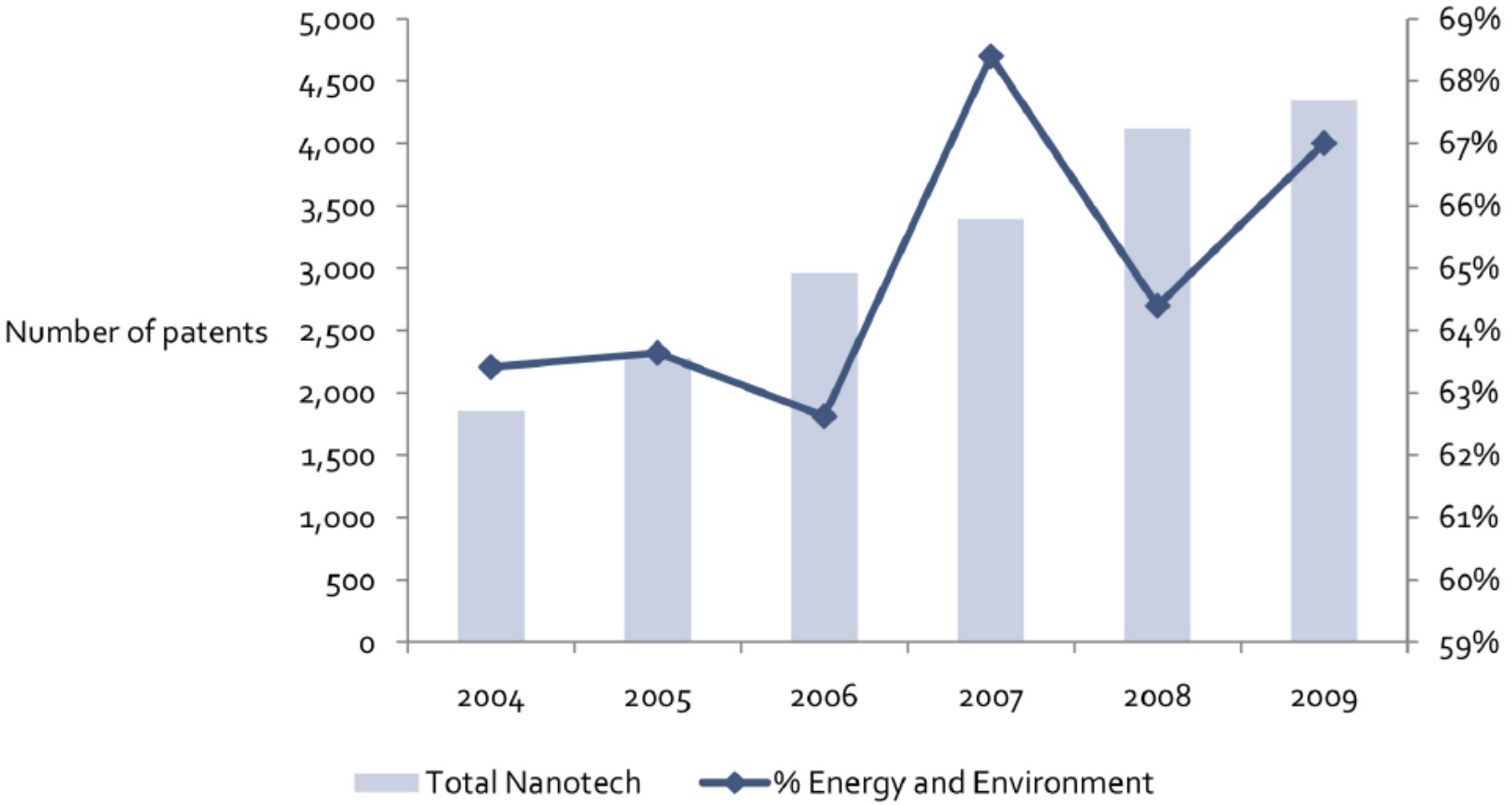
Nanotech's impact on jobs



- The market progress of nanotechnology means that over 540,000 U.S. manufacturing jobs were impacted by nanotech in 2010 – and over 3.1 million in 2015
- These jobs aren't necessarily "created" by nanotechnology, but they may be at risk if U.S. loses its technological advantage in this area

Nanotech in the Energy Sector

Energy/environmental apps are leveraging nanotech more than any other sector (based on patents)



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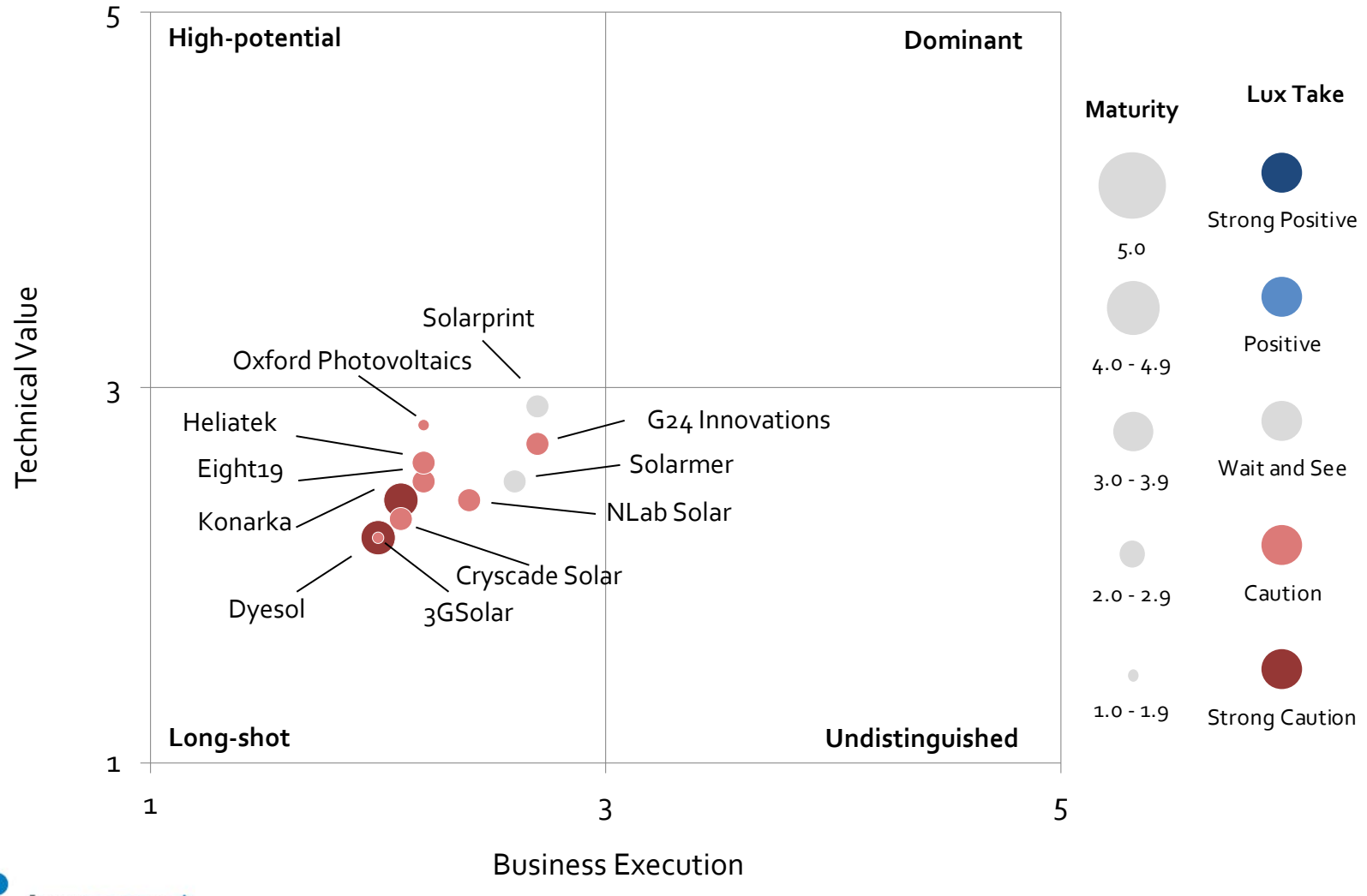
Few promising OPV companies, cannot compete with other solar technologies



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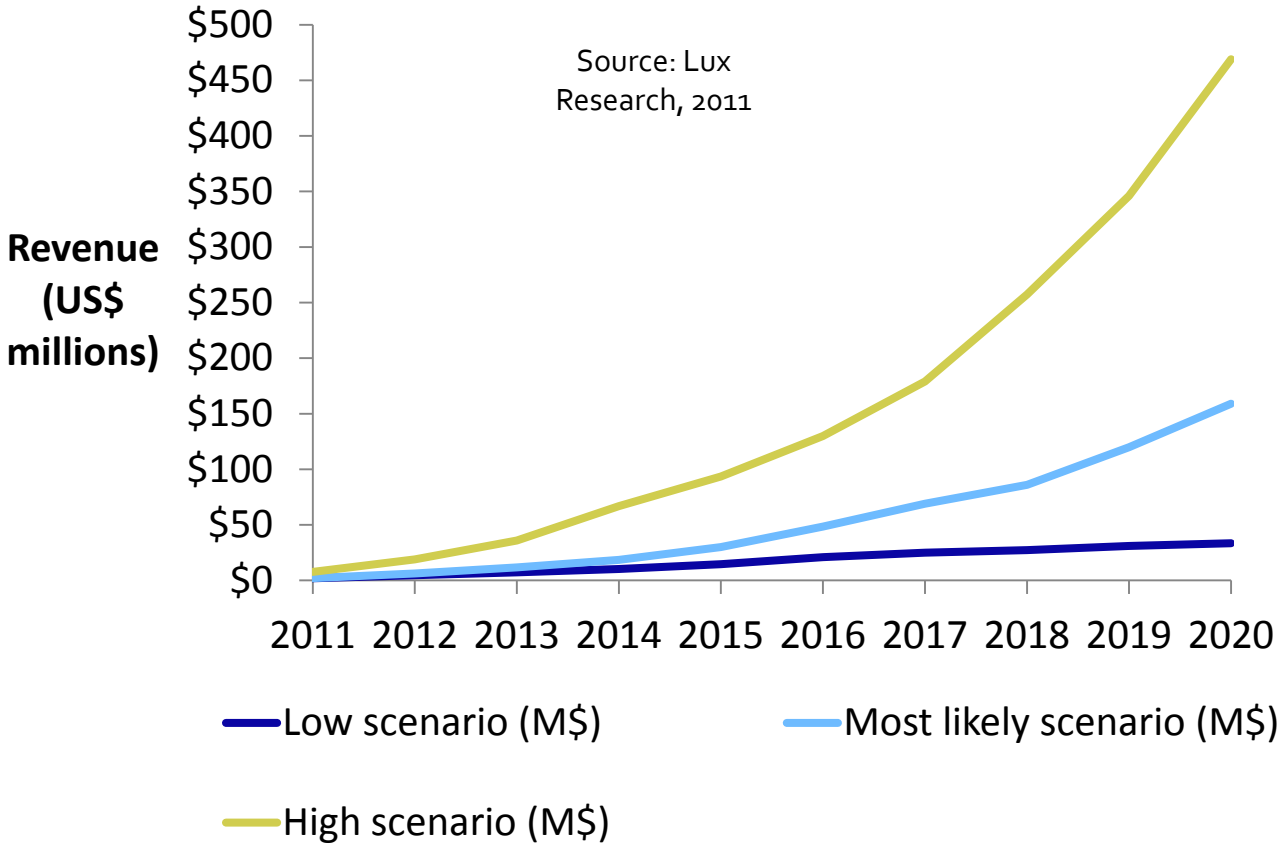
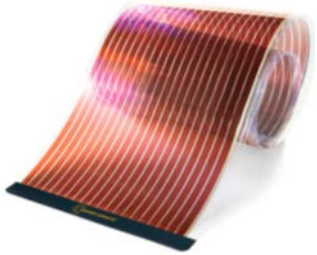
Performance and cost of OPV still lag other solar technologies, expect market ~$160mn by 2020

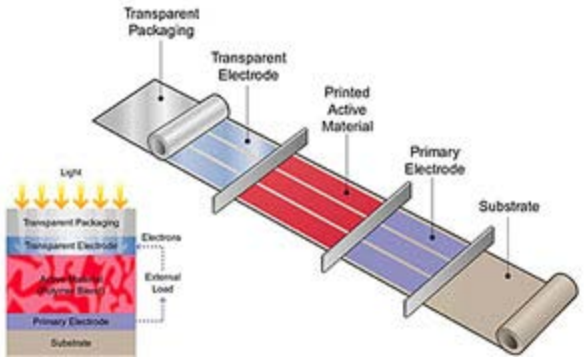


The OPV market in the most likely scenario will be $159mn in 2020, but great uncertainty means that in other scenarios it could reach as high as $470mn or as little as $33mn.

OPV company profile: Konarka

- **What you need to know:**
  - OPV developer
  - Champion cell almost 6%, current likely ca. 3%; cost estimated at $10-12/W
  - Claims 1GW of production capacity
  - Applications include BIPV and consumer electronics charge
  - Investments from Total, Konica Minolta
  - Costs high with no clear path to viability for BIPV applications; excess cash burn likely to catch up with it soon





- **Lux Take: Strong Caution**

Why nano is not enough?

- Lab to production transition non-trivial, expensive, and time consuming
- First Solar and low cost c-Si manufacturers are not waiting for others to catch up
  - First Solar funded by Walton family in 1999- had the luxuries of time and money to develop their technology, unlike contemporary PV startups funded by VCs
  - China heavily subsidizes land and loans, has low labor costs, inexpensive construction, and expedited permit approval
- Any PV startup with a new technology trying to become a vertically integrated module maker is going to face a significant uphill challenge

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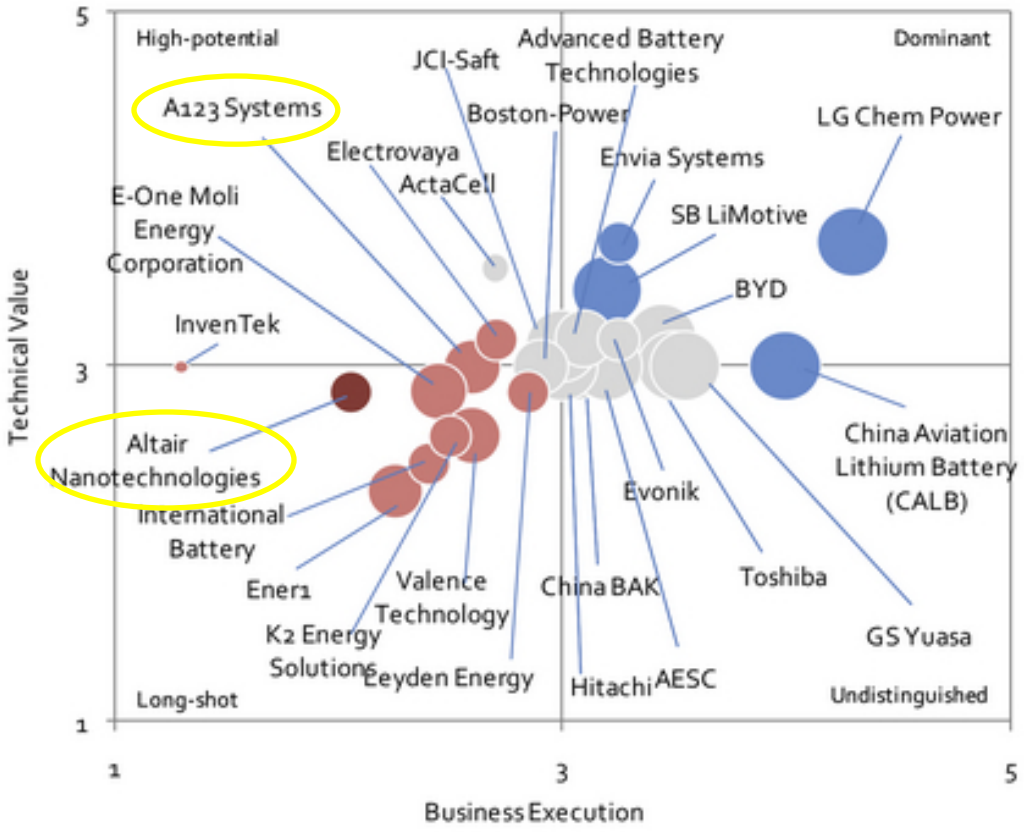
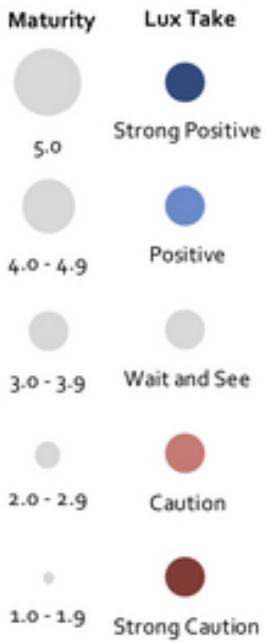
Lux Innovation Grid for Li-ion Batteries in Transportation: Nano companies not "Dominant"





- Nano will have an impact, but introducing it has cost challenges.
- Generally, technology among nano-enabled LiB companies is not differentiated

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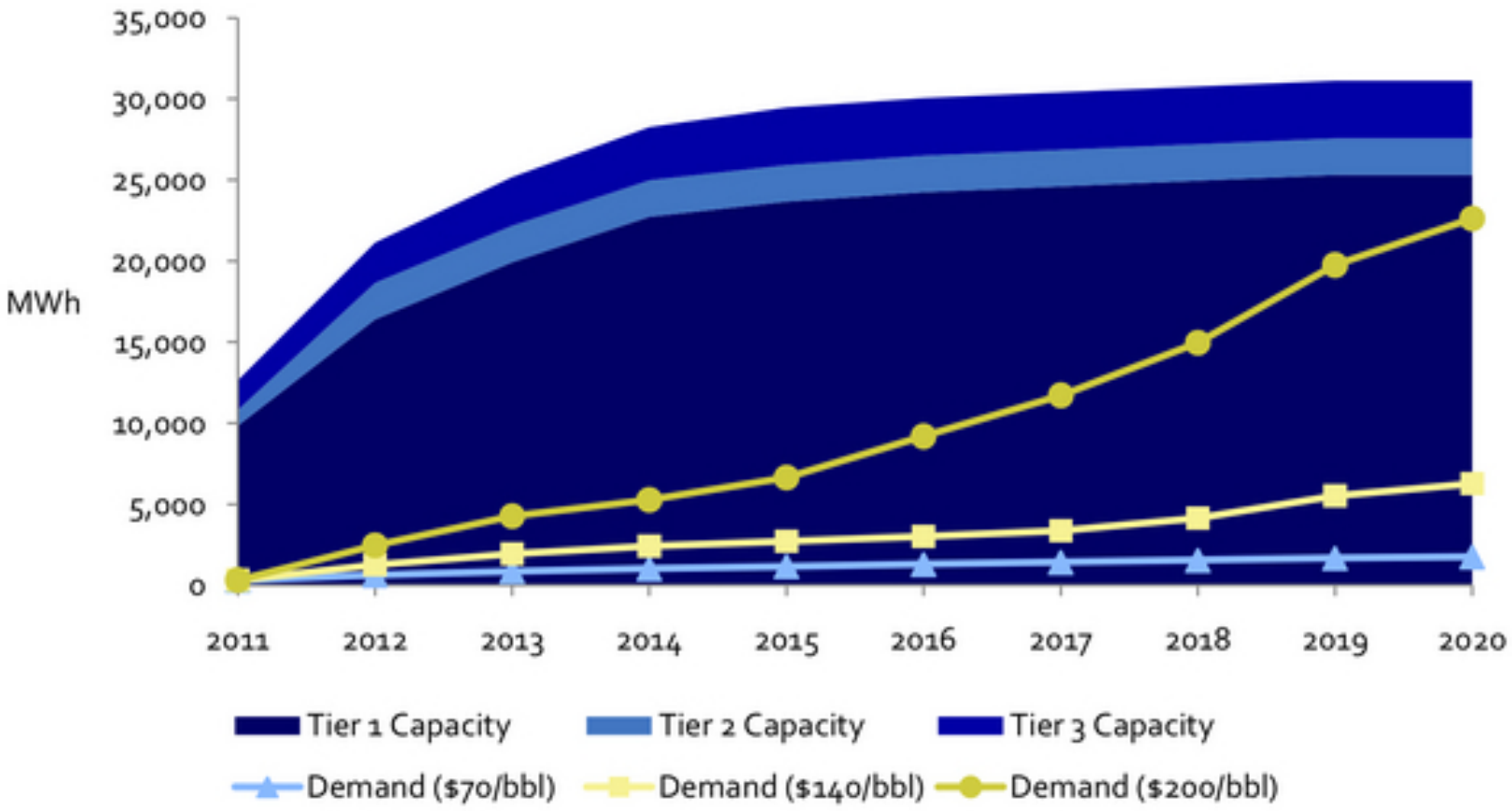
Slow Demand for Li-ion-Powered HEVs, PHEVs, and EVs Will Lead to a Li-ion Glut



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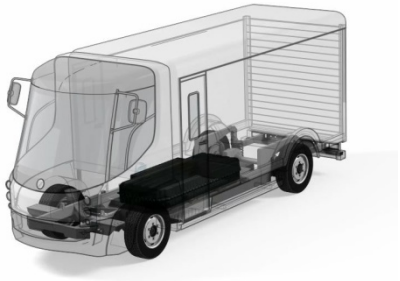
LIB company profile: A123

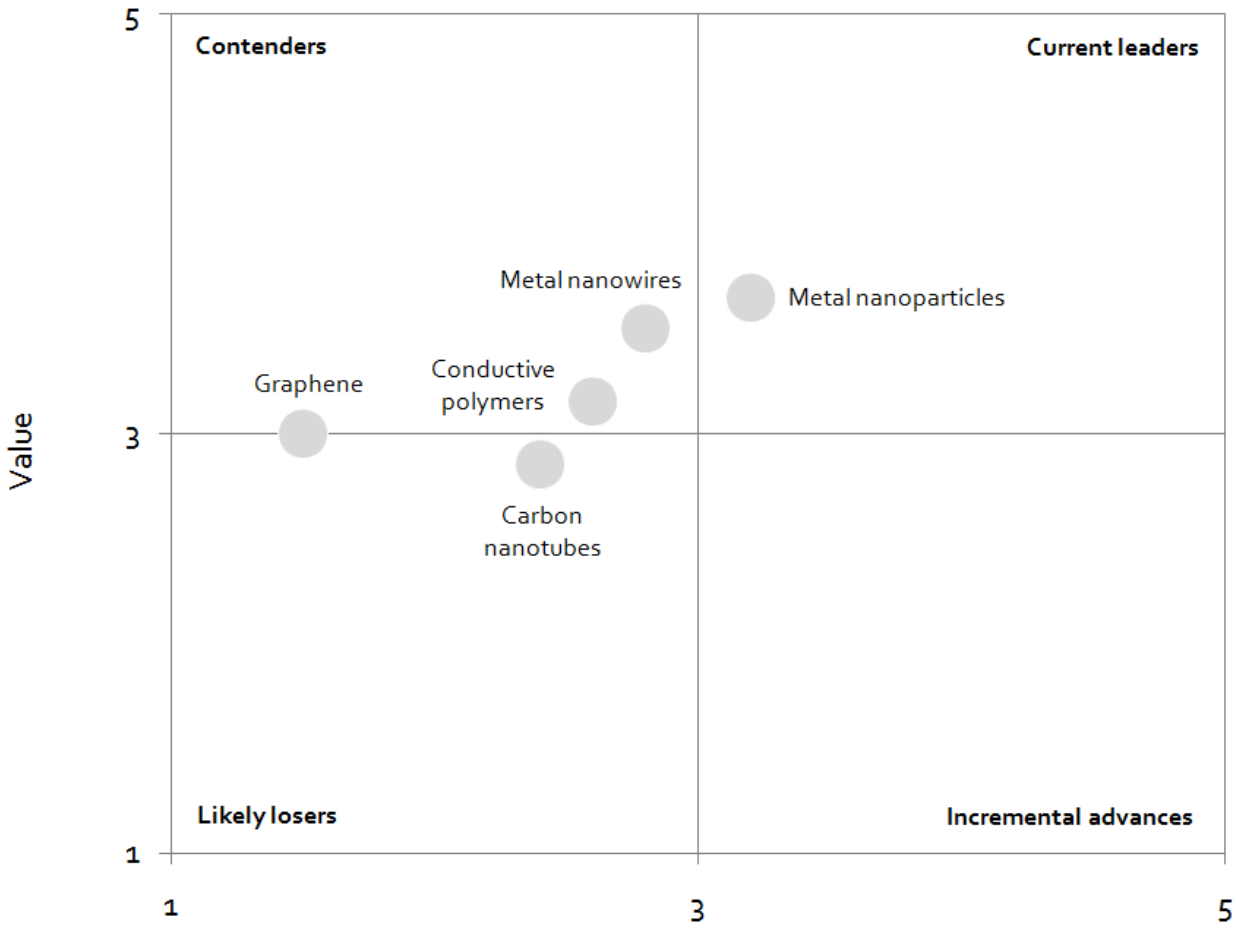
What you need to know

- High-quality lithium-iron phosphate (LFP) cells, modules, and packs
- Growing revenue and strong cash position, but quarterly losses increasing
- Production ramped up significantly in 2011, though at a slower pace than previously expected
- Won a widely publicized contract with GM for electric vehicle (EV) batteries, though details regarding scope, size, and application have yet to be released
- Moving steadily into grid storage market, with containerized installations deployed in North and South America and plans for projects in Europe and Asia
- Recent contract growth is a positive sign, but commercial-scale deployments needed to tip A123 towards profitability



Lux Take: Wait and see

TCFs present several promising opportunities



Currently, indium tin oxide (ITO) is the standard transparent conductive film (TCF), but its high cost, vulnerability to shortage or price fluctuations of indium, and brittleness create opportunity for emerging technologies including metal nanoparticles, metal nanowires, and carbon nanotubes (CNTs).

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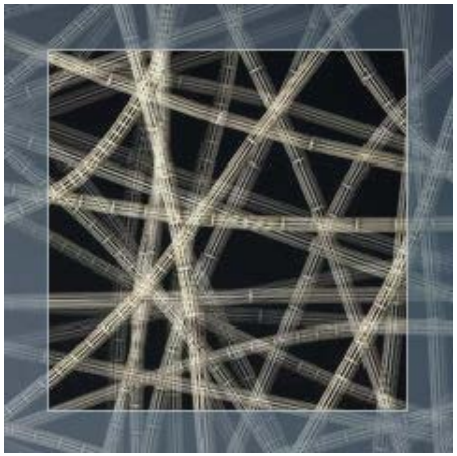
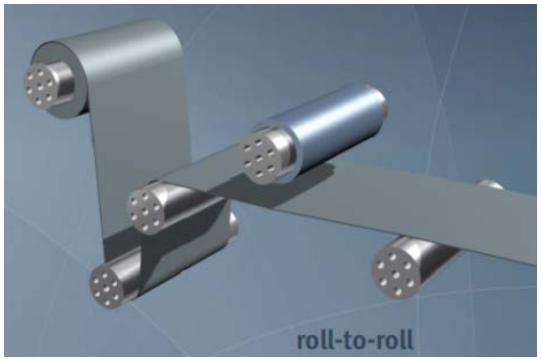
TCF company profile: Cambrios Technologies

What you need to know:

- Selling silver nanowire dispersions as well as coated PET films under the trade name ClearOhm
- Primarily engaged with Asian manufacturers of display and touch-screen components; projects on photovoltaics underway
- ClearOhm slated to appear in a new smart phone model launching towards the end of Q1 2011
- While the electronic quality of Cambrios' transparent conducting film (TCF) is beginning to lag certain competitors, the optical quality remains top-tier
- Cambrios and Cima are pulling ahead of the pack in the TCF startup space, but face threats from corporate contenders such as Fujifilm and Carestream





Lux Take: Positive

Solar company profile: Innovalight

What you need to know

- Developing nanocrystal silicon ink that can boost the efficiency of silicon wafers by 1-2%
- Originally set out to become a panel manufacturer, but in 2008 modified business model to become a materials supplier and technology licenser
- Licensing model insulates it from solar's brutal price competition – turned competitors into customers
- Customers include JA Solar, Motech, Yingli, Jinko Solar, and others.
- Acquired by DuPont in July 2011. Achieving higher cell efficiencies is now much more accessible to new customers.

Lux Take: Wait and see (pre-aquisition)

Nuclear company profile: Kurion

KURION

What you need to know

- Ion specific media and vitrification for radioactive waste cleanup and storage
- Company's expertise, materials on-hand, and exclusive contracts with suppliers gave it a major piece of the $2 billion to $3 billion cleanup project at the Fukushima nuclear powerplant in Japan
- Ongoing nuclear remediation continues with Oak Ridge and Hanford national labs in U.S.
- Unique expertise in a highly sensitive field make Kurion the safe choice for major remediation projects; expertise and networks of key individuals at least as important as corporate IP
- Irreversible vitrification technology remains a small piece of nuclear remediation
- Clients with vested interest in nuclear safety issues should engage

Lux Take: Positive

Nanotech has potential for significant impact on energy sector, but in incremental ways…

- Nanotech companies MUST KNOW THEIR MARKETS – being a good nano or even a good engineering company is not enough
- Leaders in energy sector are not measurably challenged by nano-enabled companies, though some may be testing nanomaterials themselves
- Nanotech companies have cost, efficiency, manufacturability challenges
- There is a huge and profitable opportunity to incorporate proprietary nanotechnologies into existing manufacturing lines. Incremental improvements within existing value chain have much greater chance of success than total overhauls
- Innovations like coatings, additives, encapsulants– which can provide incremental improvements to high-volume products or manufacturing processes – can have a far bigger impact on the bottom line, at least in the near term.
- Focus on economic impact of applications for which there is real demand.

Thank you

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