Innovation for Cool Earth Forum

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ICEF DISTRIBUTED SOLAR AND STORAGE ROADMAP 1.0

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ICEF INNOVATION ROADMAP PROJECT

GOAL

- *To use the Innovation for Cool Earth Forum (ICEF) to help promote the development and deployment of clean energy technologies*

1st ICEF Annual Meeting: Session Summary & Webcast

ICEF DISTRIBUTED SOLAR AND STORAGE ROADMAP 1.0 (2015)

PROJECT GOALS

- To assess possible scenarios for deployment of solar and storage technologies
- To identify strategies for overcoming barriers to deployment
- To evaluate potential methodologies for future ICEF Innovation Roadmaps

PROJECT SCOPE

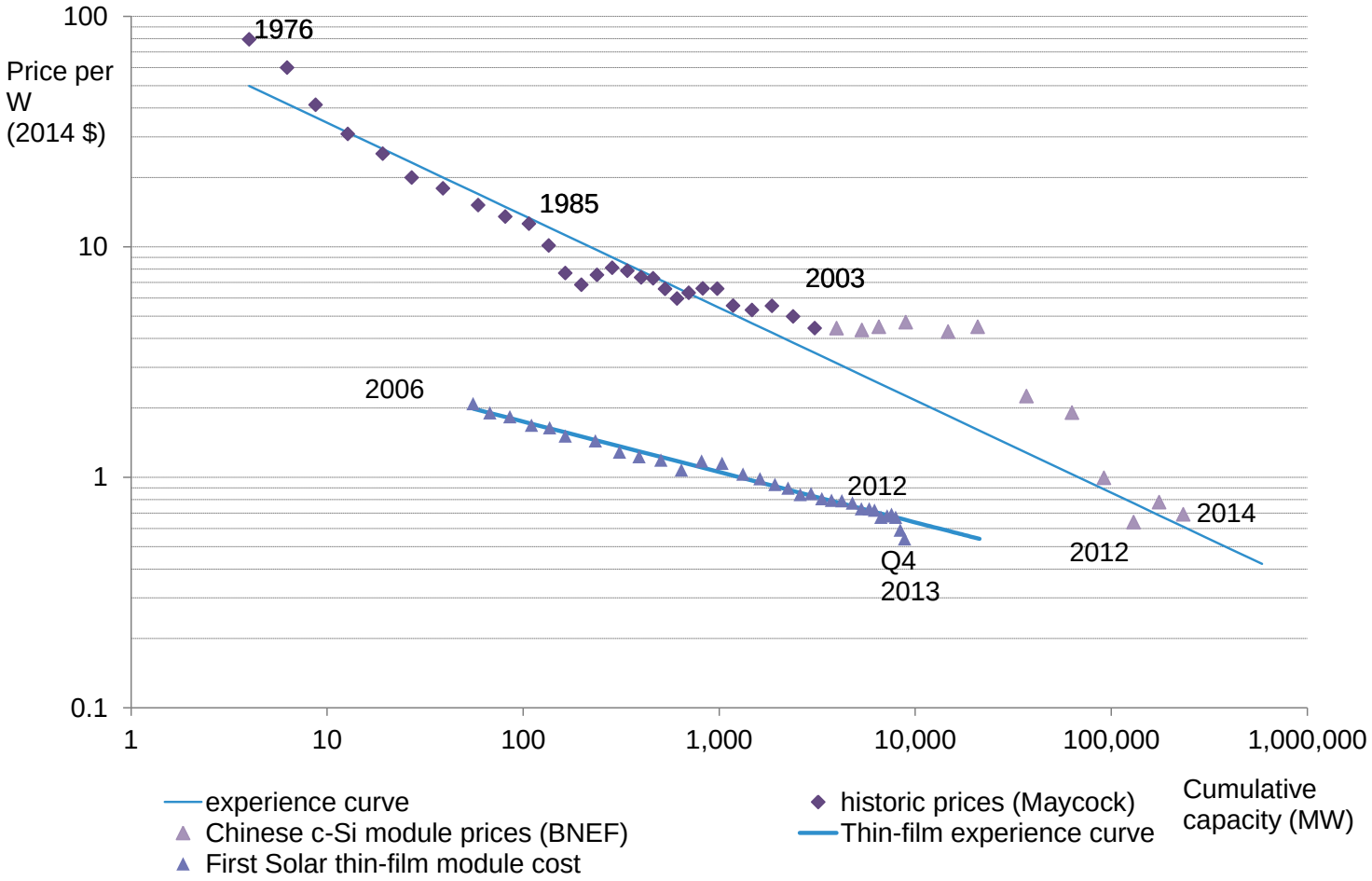
- Solar and storage in combination
- Rooftop and community-scale

ICEF DISTRIBUTED SOLAR AND STORAGE ROADMAP 1.0

Outline

1. Technology Background
2. Survey R&D programs
3. Country Background
4. Sources of Uncertainty
5. Scenario Analysis
6. Barriers
7. Recommendations

PV EXPERIENCE CURVE, 1976-2014 (2014 $/W)

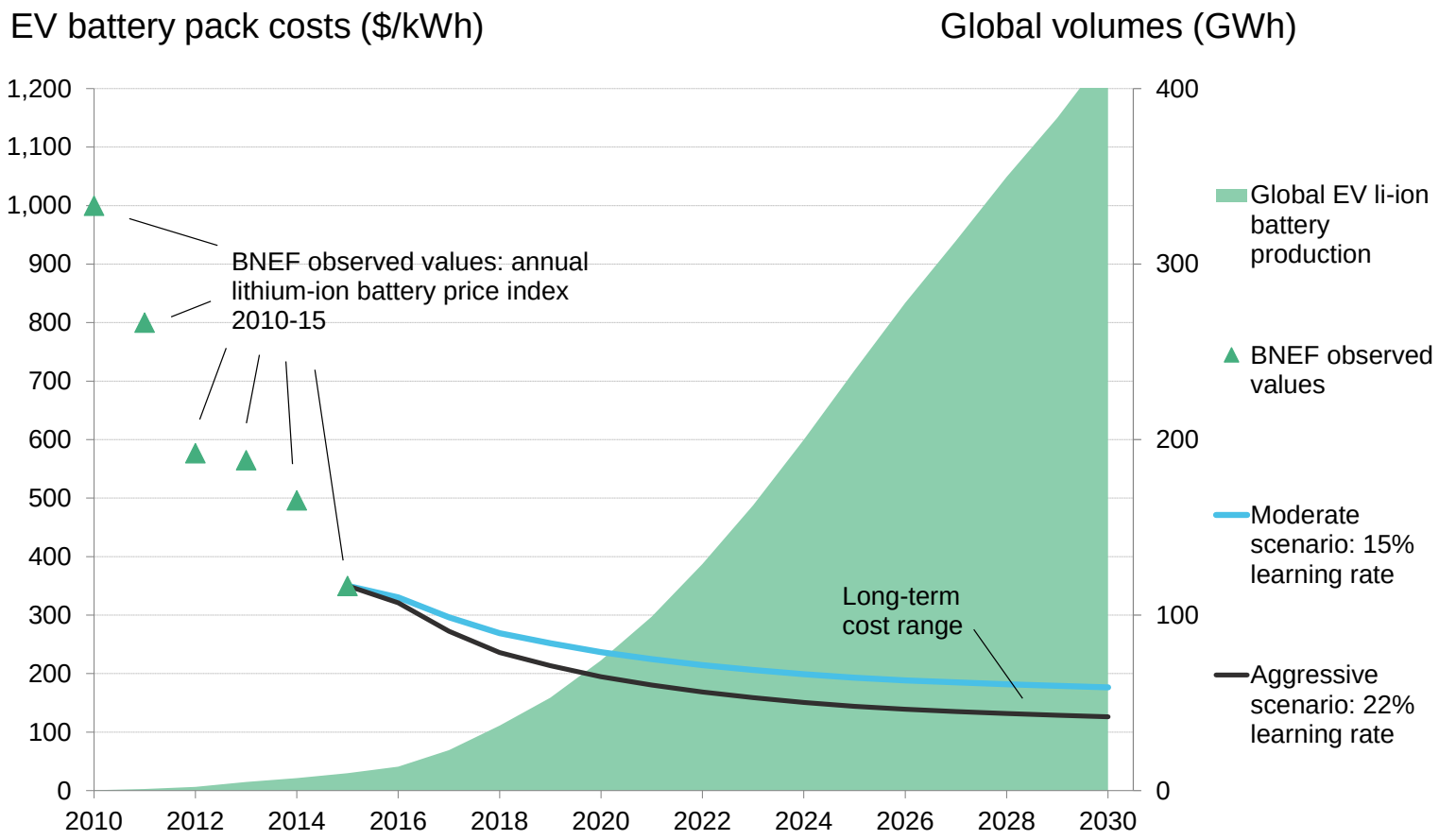


- Historical 26% drop in PV prices for every doubling in volume.
- 50% drop in PV system costs likely during next 25 years, even if no breakthrough technology replaces crystalline silicon.

Note: Prices inflation indexed to US PPI.

Source: Paul Maycock, First Solar, Bloomberg New Energy Finance

EV LITHIUM-ION BATTERY COST OUTLOOK, 2011-2030 ($/KWH, GWH)



- In past several decades, lithium-ion battery costs declined 22% for each doubling in volume.
- However BNEF's cost surveys suggest that over the past five years there has been a slower 15% learning rate.
- Between now and 2030 electric vehicles will become the primary driver of lithium-ion battery volumes.

Note: Values from 2010-2015 are based on BNEF's annual battery price index. For more see here: https://www.bnef.com/Insight/13363. Cumulative production is based on total EVs sold and their respective battery pack size.

Bloomberg New Energy Finance

SOURCES OF UNCERTAINTY REGARDING THE FUTURE OF NON-UTILITY SOLAR AND STORAGE IN MATURE MARKETS

	Low impact	Medium impact	High impact
High uncertainty			
Medium uncertainty			
Low uncertainty			

- In order to understand the future of solar and storage, we first need to determine which future variables are both uncertain and will have a high impact
- We convened a workshop to:
  - Brainstorm a number of relevant factors
  - Compare their uncertainty and impact

SOURCES OF UNCERTAINTY:
COST OF STORAGE

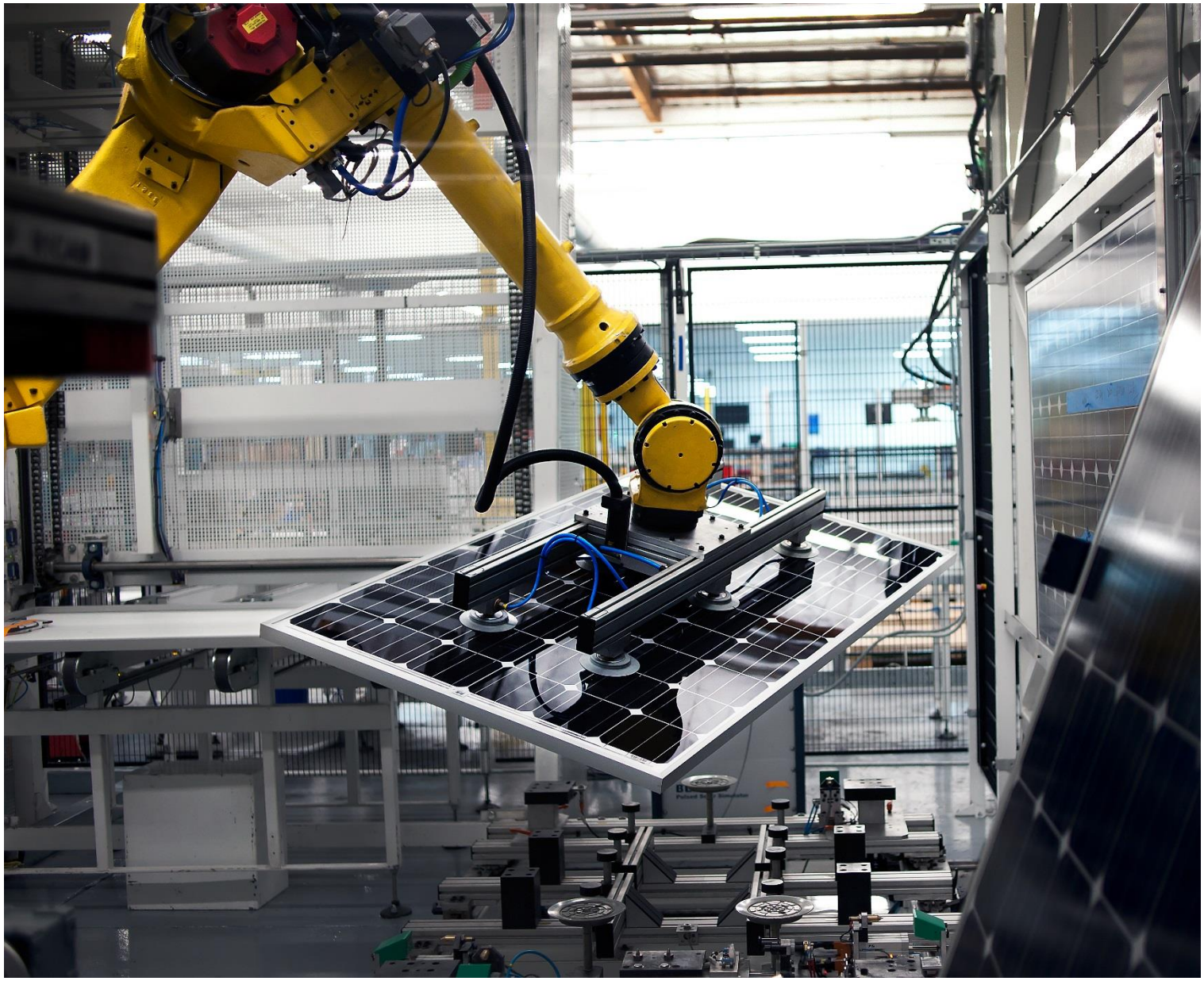
VERDICT

High impact

High uncertainty

- High costs are currently a bottleneck to the deployment of storage
- Factors affecting future costs include:
  - Ability of manufacturing to scale with global markets
  - Breakthroughs in non lithium-ion alternatives

SOURCES OF UNCERTAINTY:
COST OF PV TECHNOLOGY



VERDICT

Medium impact

Medium uncertainty

- Cost of PVs is a small component of overall cost of solar (let alone solar with storage)
- Continued costs decline probable

SOURCES OF UNCERTAINTY:
REGULATION

VERDICT

High impact

High uncertainty

- Regulation can strongly influence the opportunity for distributed solar and storage through
  - Pricing regimes (e.g. time of use, net metering, connection charges)
  - Tax on self-consumption
  - Subsidies
- Current electricity market regulation is highly varied and uncertain.

BARRIERS

- Storage costs decline slowly
- Cheap alternatives (including subsidized electricity and cheap natural gas)
- Regulation protects incumbents
- Trade barriers
- Quality and safety issues
- Cyber threats

RECOMMENDATIONS

Industrial strategies

- Create manufacturing scale
- Pursue synergies with the EV industry
- Encourage start-ups with different business models

Policy and regulatory strategies

- Reform electricity markets for DG
- Reform electricity markets for storage
- Invest in R&D
- Establish quality & safety standards
- Reduce diesel subsidies
- Cut trade barriers