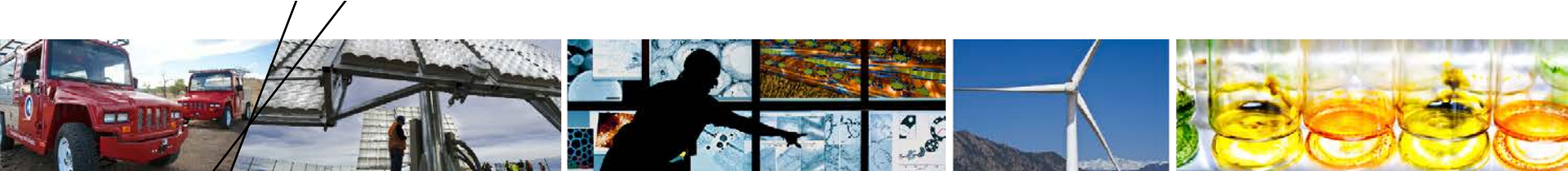


Clean Energy Manufacturing: U.S. Competitiveness and State Policy Strategies



**NGA Policy Academy: Economic Development
in the Clean Energy Sector**

Eric Lantz (NREL)

**National Governors Association
December 9, 2013**

NREL/PR-6A20-61265

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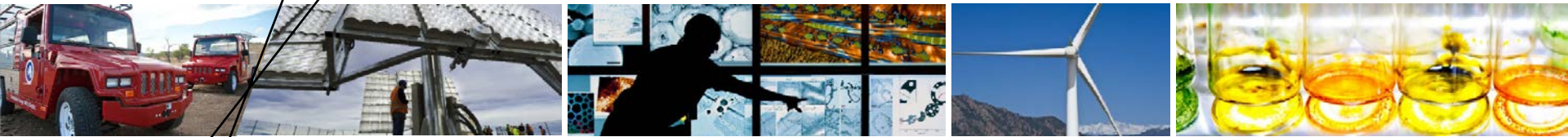
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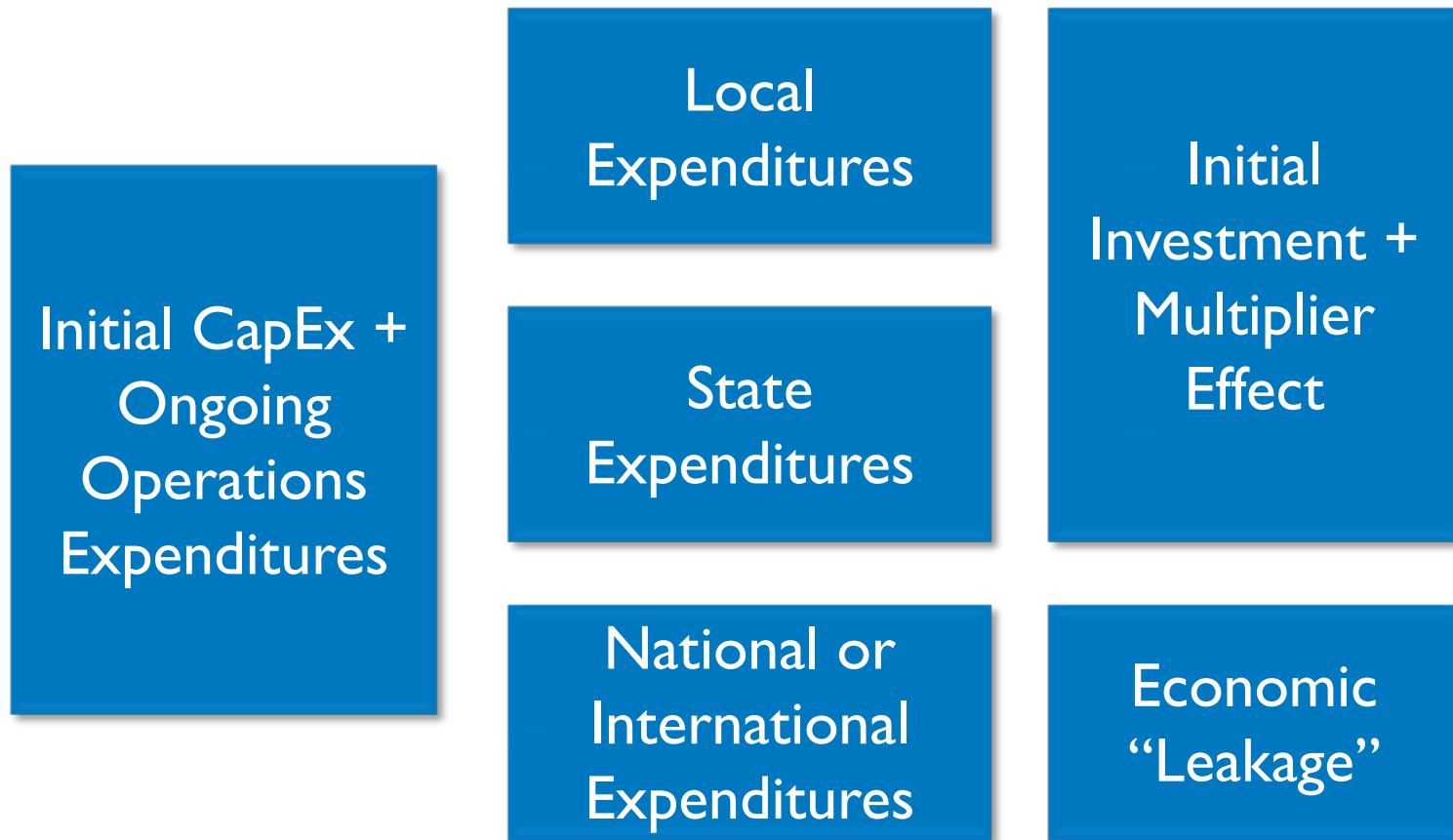
Presentation Overview

- **Background: Clean Energy Economic Development Drivers**
- **Case study: U.S. Competitiveness in Wind Turbine Blade Manufacturing**
- **Snapshot: U.S. Competitiveness in Solar PV Manufacturing**
- **Other Considerations and Observations**



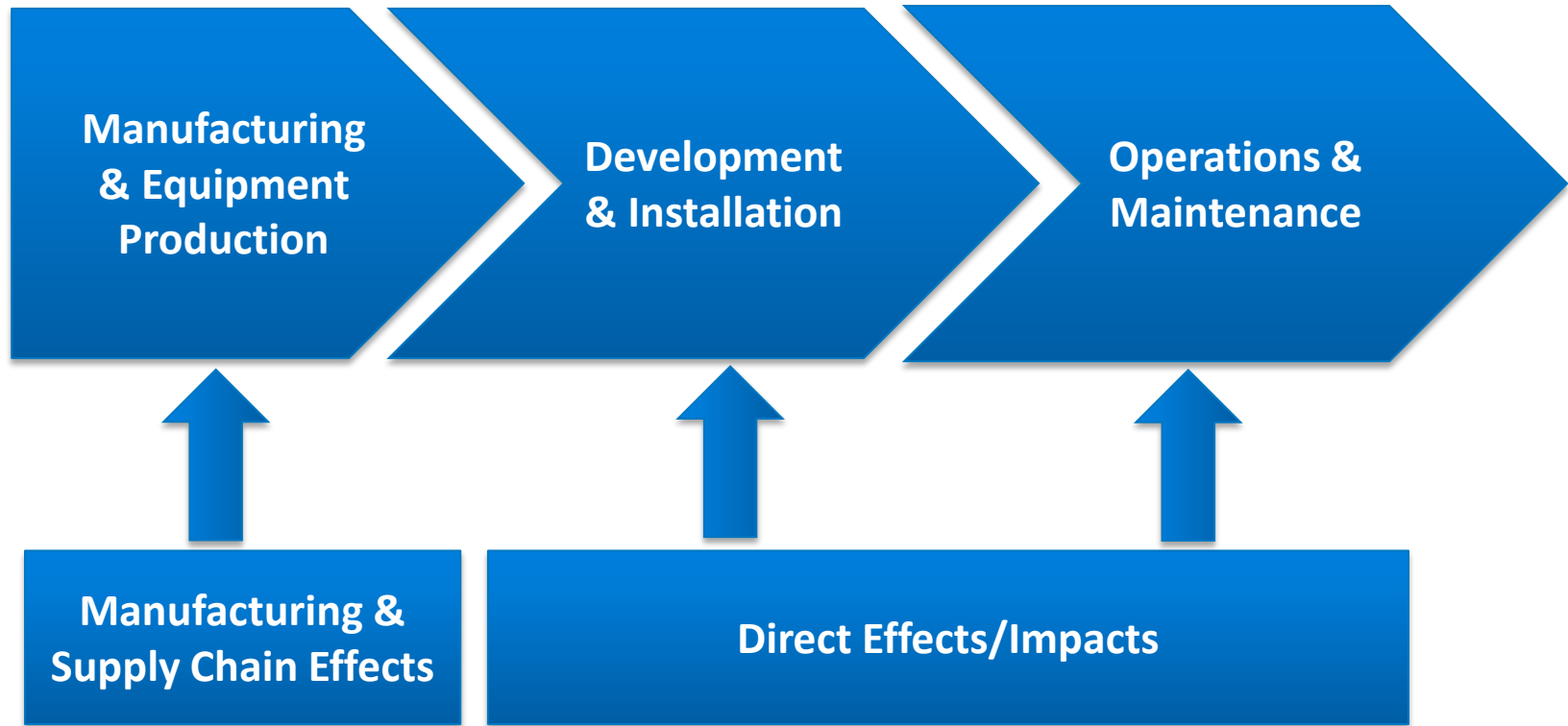
Background

Economic Development is Driven by the Capture of New Investment



Increasing economic development begins with simply pulling a greater share of industry expenditures into a given region or locality

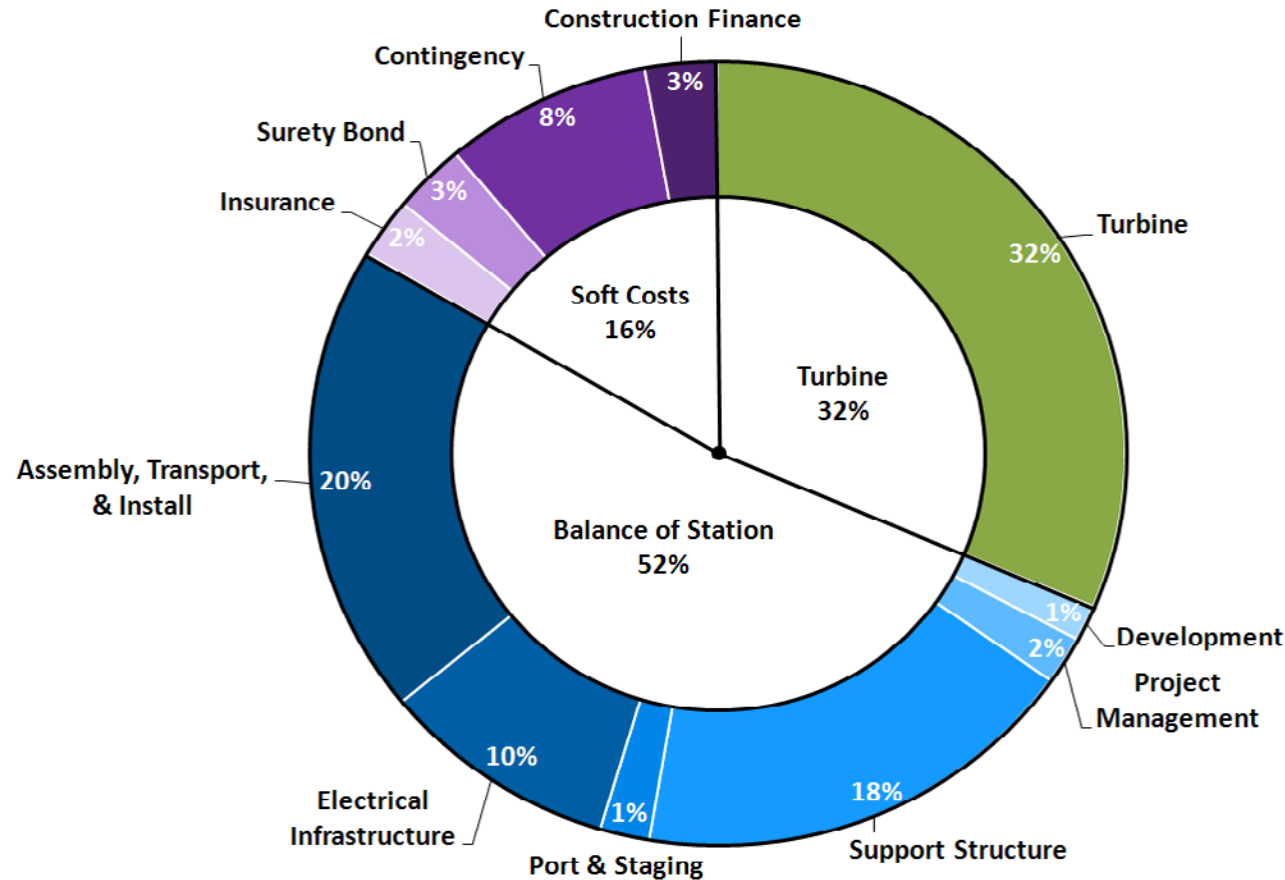
Economic Development Can Accrue from Various Activities



Functionally the activities that drive economic development from Clean Energy investment are not unique to Clean Energy

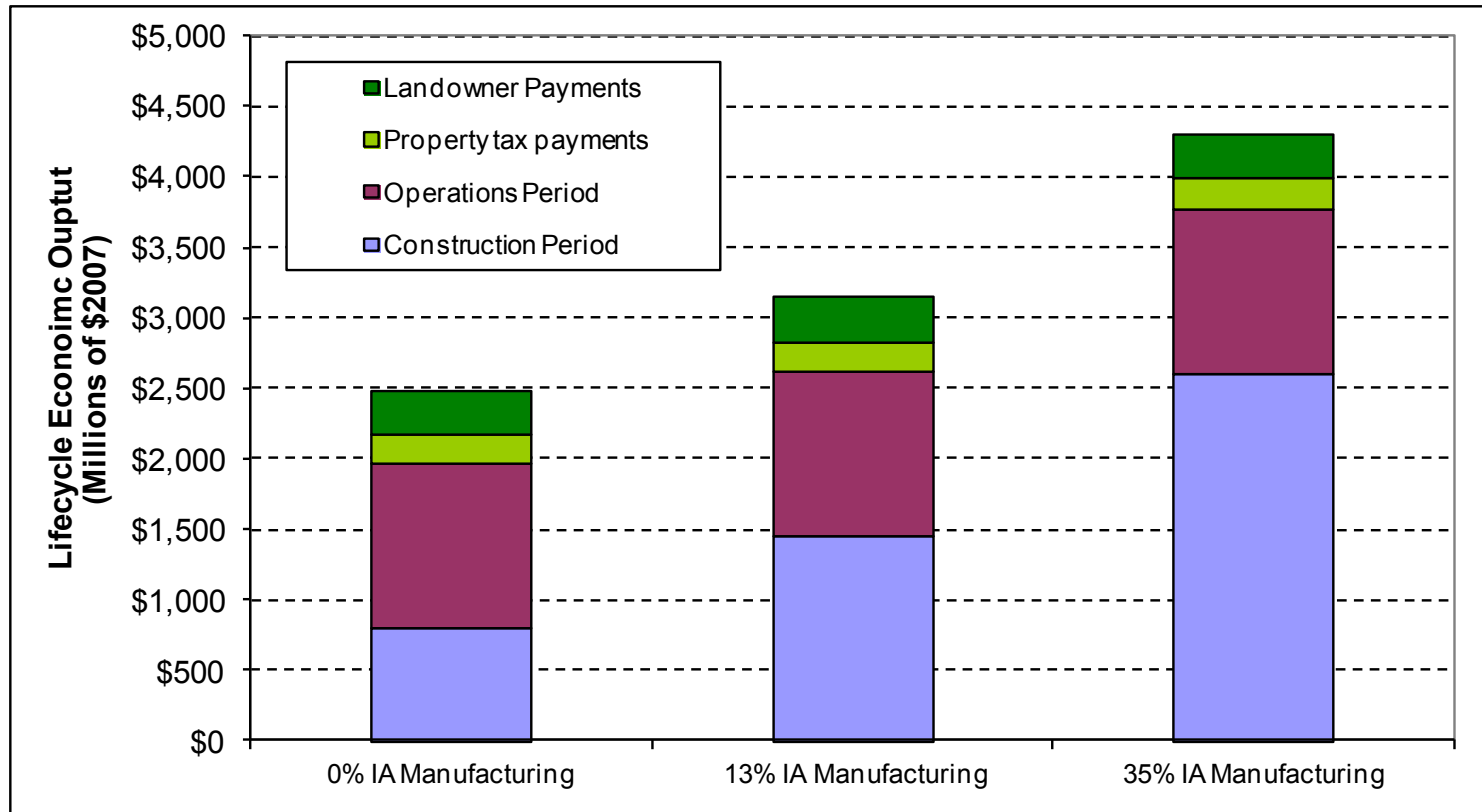
Attention is Often Focused on Manufacturing for Clean Energy Due to the Capital Intensive Nature of the Technologies

Offshore Wind Project Costs as a Share of Total Capital Expenditures



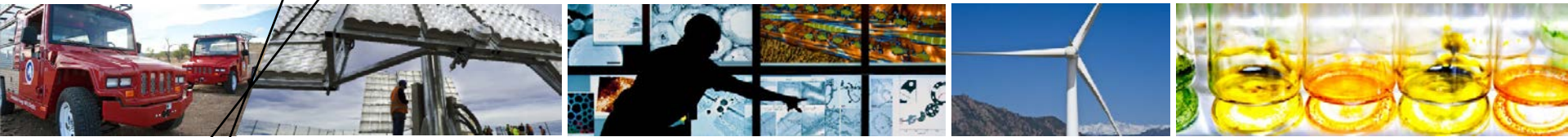
Source: NREL 2012

Coupling a Robust Supply Chain with Local Demand Can Fundamentally Alter the Economic Development Outlook



Source: Lantz and Tegen 2008

- **Scenarios consider 2,400 MW of new wind in Iowa**
- **Manufacturing levels were based on historical trends, OEMs selected for proposed projects, and Iowa's total manufacturing capacity at the time**
- **In-state manufacturing boosts Iowa's economic development potential by as much as 24% to 70%**



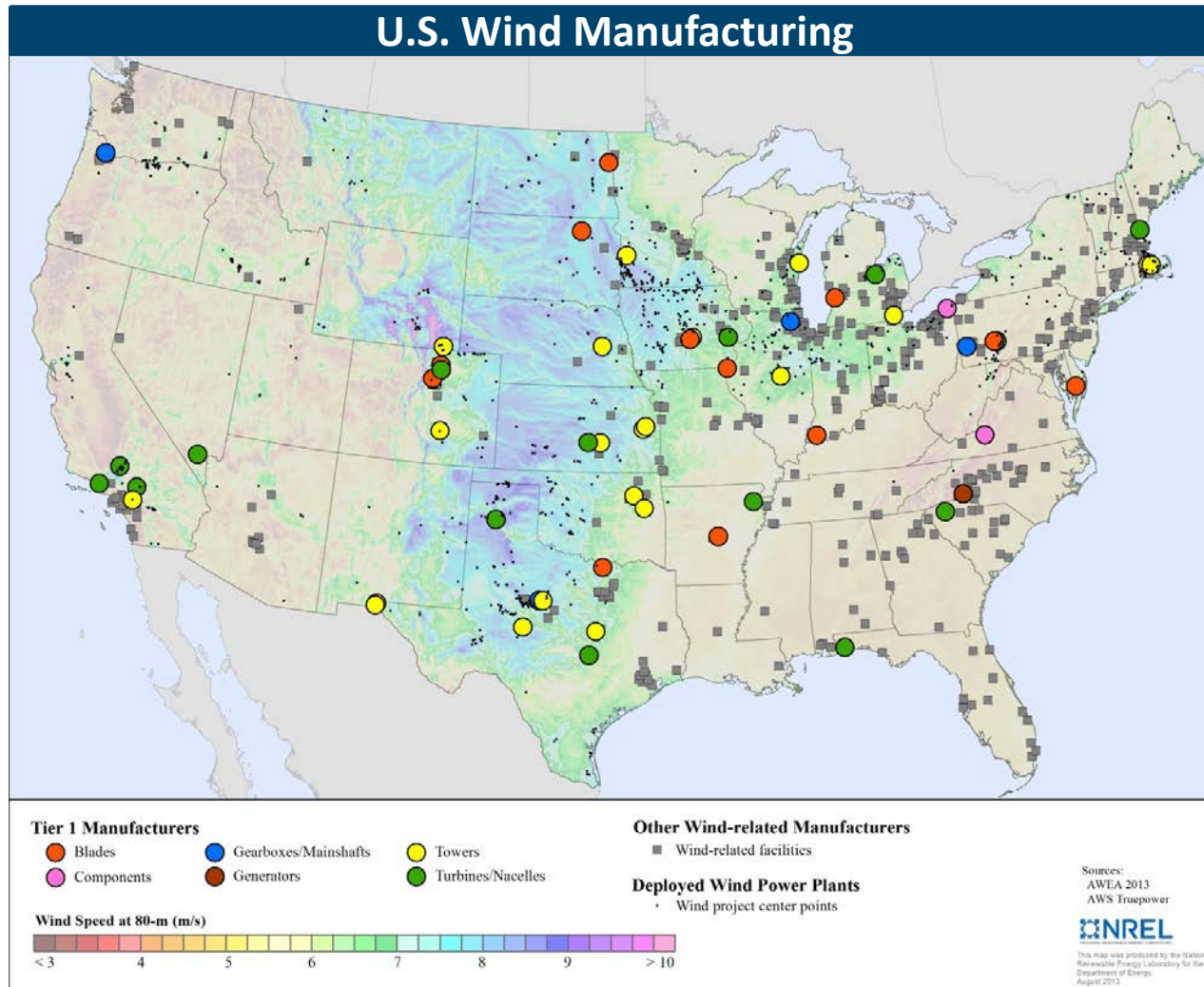
Case Study:

U.S. Wind Turbine Blade Manufacturing

The following slides have been selected from the NREL report, “Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry,” for access to the full report please see:

<http://www.nrel.gov/docs/fy14osti/60063.pdf>

Domestic Manufacturing Growth has been Stimulated by Demand Over the Past 5-7 years

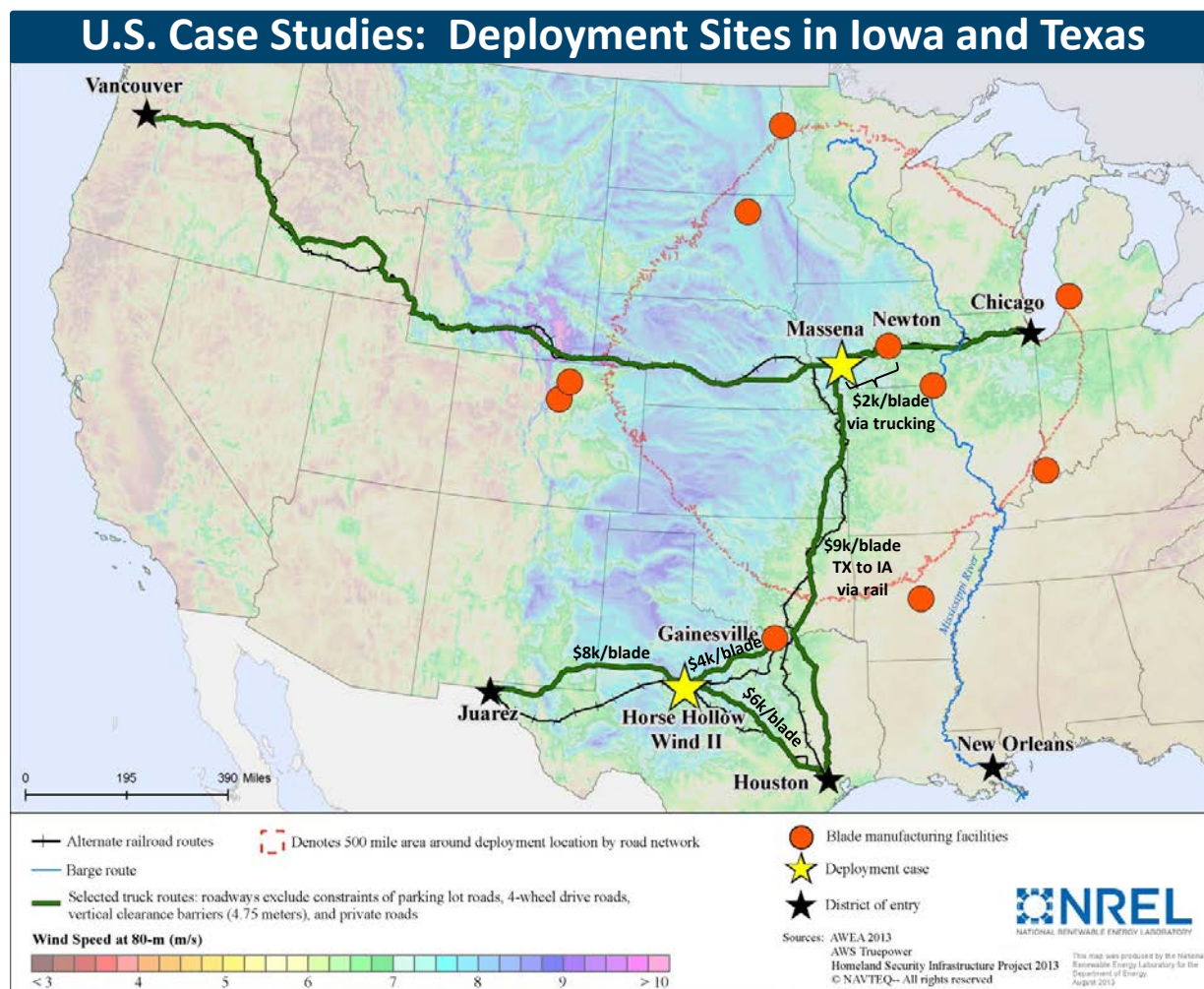


Status of the U.S. Market:

- **Production:** About 550 U.S.-based manufacturers sold into the wind industry in 2012; more than 60 of these are Tier 1 facilities.
- **Demand:** Annual average installed capacity was 8.7 GW from 2007-2012.
- **Location:** Wind power deployment areas may influence some factory location decisions.

Source: James, T. and Goodrich, A. (2013). "Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry." NREL Technical Report. PR-6A20-60063.

Potential Supply Routes to Project Sites in Iowa and Texas



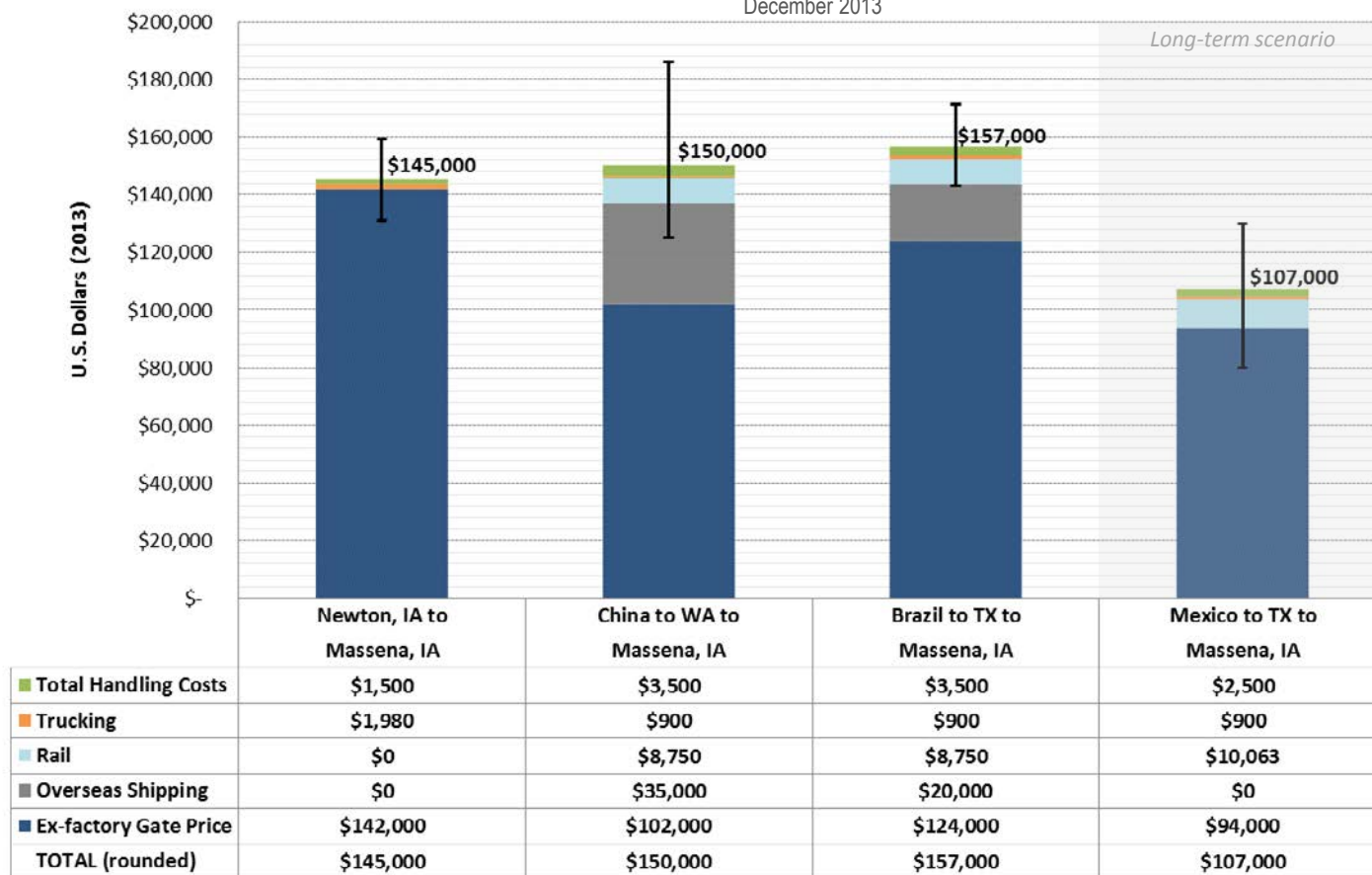
Project sites in the Central Plains tend to disadvantage some imports

Source: James, T. and Goodrich, A. (2013). "Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry." NREL Technical Report. PR-6A20-60063.

For Most Midwest Deployment Locations and Today's Blades, Shipping Costs Exceed the Benefits of Manufacturing in Lower Cost Labor Regions

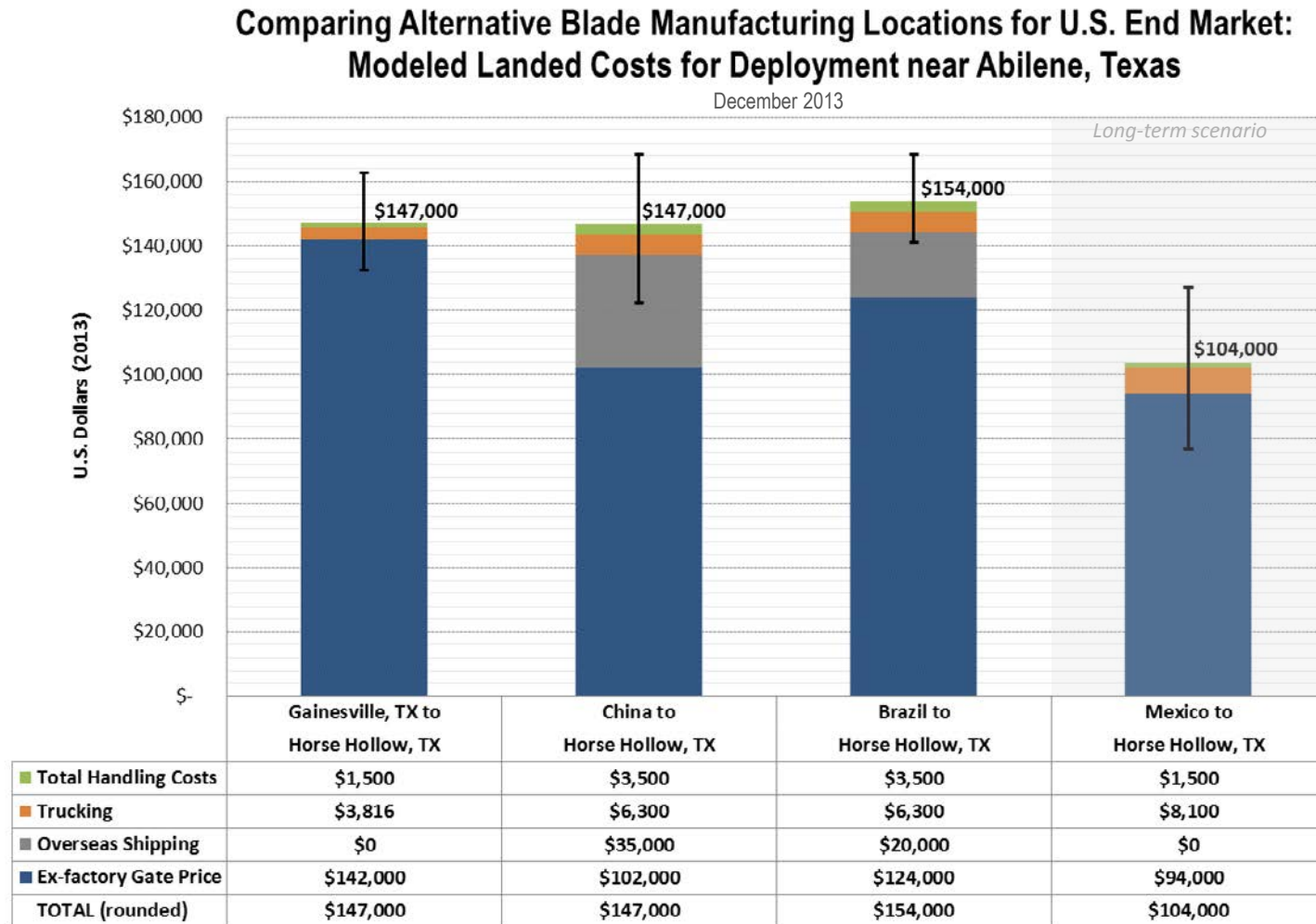
Comparing Alternative Blade Manufacturing Locations for U.S. End Market:
Modeled Landed Costs for Deployment in Massena, Iowa

December 2013



Source: James, T. and Goodrich, A. (2013). "Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry." NREL Technical Report. PR-6A20-60063.

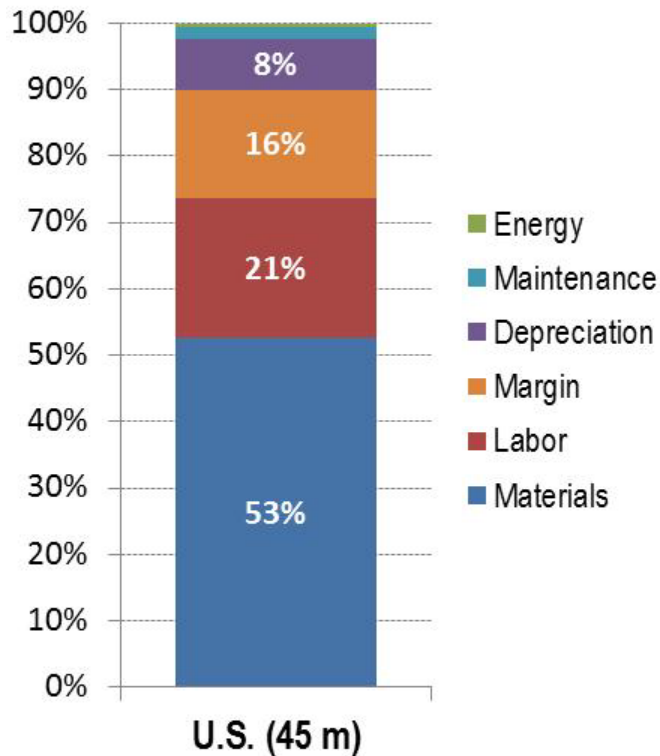
At Sites More Proximate to Ports, Imported Blades May Out Compete Domestic Manufacturers



Source: James, T. and Goodrich, A. (2013). "Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry." NREL Technical Report. PR-6A20-60063.

Larger Blades May Increase U.S. Manufacturing Opportunities; Labor Becomes Less Significant as Blade Sizes Increase

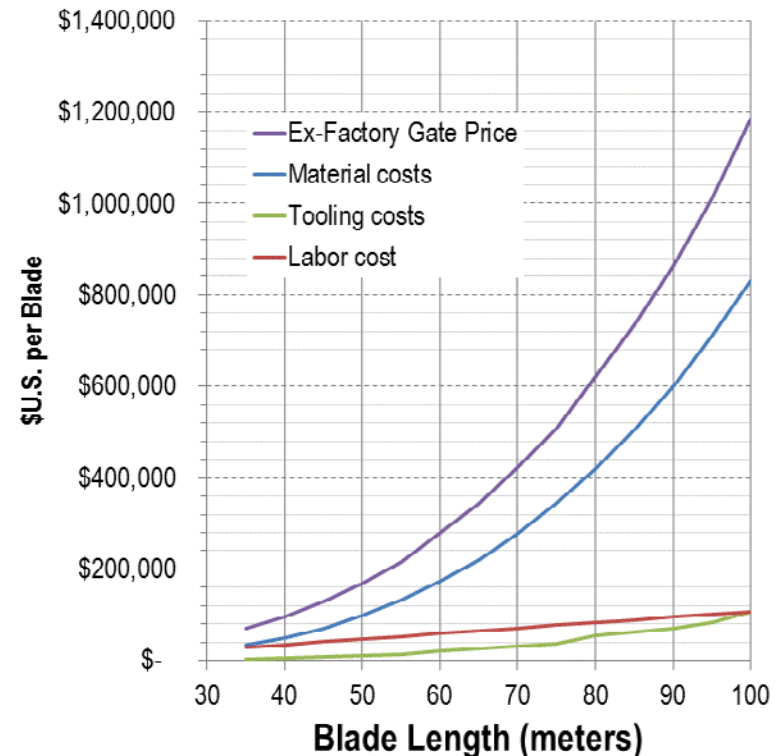
Today's U.S. Factory Gate Prices



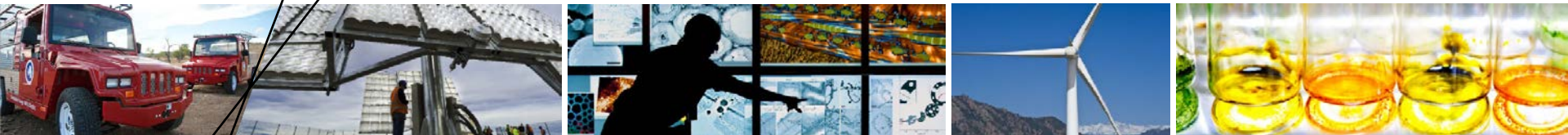
Labor costs account for about 1/5 of factory gate prices, but...



Cost Proportions Change with Blade Size

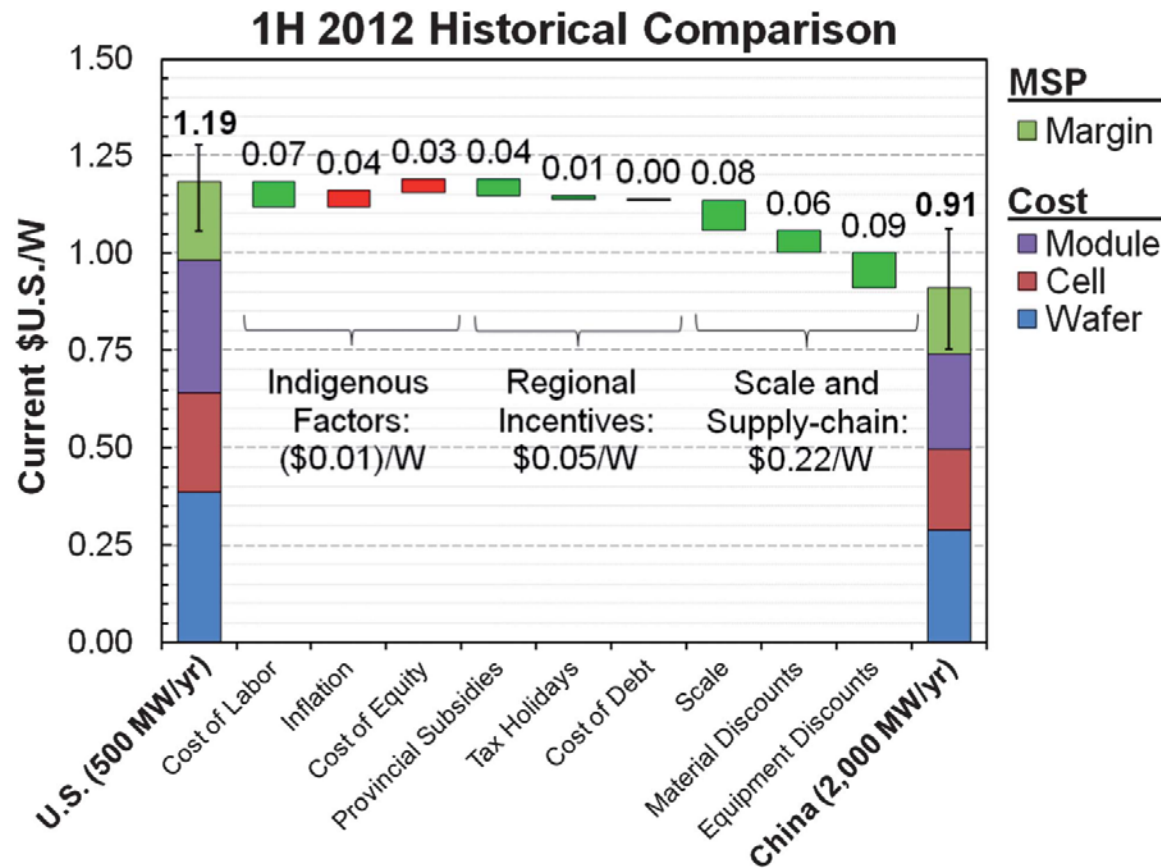


...as blade sizes increase, labor costs become less significant



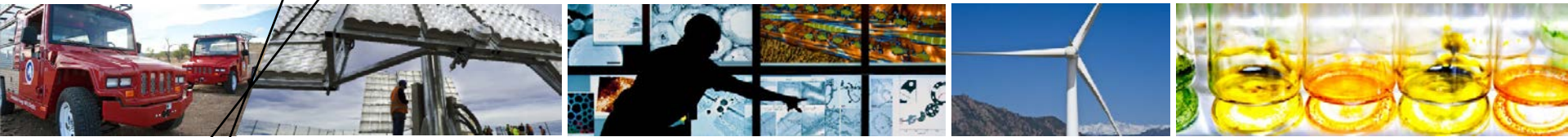
Snapshot: U.S. PV Manufacturing Competitiveness

Cost Drivers in Solar PV Manufacturing



- China's advantage appears not to be derived from indigenous factors (e.g., low cost labor)
- Scale and resulting supply-chain advantages (material & equipment discounts) enabled, in part by enhanced access to capital for domestic firms.

Source: Goodrich, A.; Powell, D.; James, T.; Woodhouse, M.; Buonassisi, T. (2013). "Assessing the Drivers of Regional Trends in Solar Photovoltaic Manufacturing." *Energy and Environmental Science*, Published on September 5, 2013.



Other Considerations and Observations

Factory Location Decisions are Also Influenced by a Range of Less Quantitative Considerations

Top qualitative factors influencing wind blade manufacturing:

Stable market and energy policy outlook is essential to maintaining and growing a U.S. industry.

- *Consensus among industry leaders (NREL's Executive Workshop and industry reports)*

Proximity to suppliers, supply chain maturity, and quality standards sway some decisions.

- *Industry executive interviews (NREL)*

"Ease of doing business" factors, which assess a range of risks, can override cost considerations.

- *Surveys of manufacturing executives (Harvard; The World Bank)*

Other insights from NREL wind industry interviews:

- Proximity to end markets lowers distribution risks (i.e., lowers risks associated with shipping products to assembly facilities and/or wind power project sites).
- Access to quality manufacturing tradesmen is essential.
- Availability of infrastructure is important (particularly large buildings and transportation networks).
- Proximity to R&D facilities and engineering universities can be leveraged in some regions.

Source: James, T. and Goodrich, A. (2013). "Supply Chain and Blade Manufacturing Considerations in the Global Wind Industry." NREL Technical Report. PR-6A20-60063.

Prioritization of Facility Siting Criteria Varies By Position in the Supply Chain

- **OEMs may want to establish assembly facilities proximate to final demand to reduce transport costs**
- **Lower tier suppliers who serve multiple industries may be more interested in minimizing operating costs or leveraging a workforce with existing skills**
- ***Example from Wind:***
 - OEMs have situated their facilities proximate to high quality resource areas while suppliers are distributed in manufacturing hubs around the country

Evidence is Mixed with Respect to the Typical State Policy Strategies

- **Policy tools have historically emphasized financial incentives**
 - Property tax rebates, income tax credits, grants, loans, and sales tax exemptions
 - Local infrastructure improvements are often part of a broader package.
 - States with a robust clean energy manufacturing sector (i.e., Iowa, Colorado, Arkansas, Oregon, Michigan, and New Mexico) have provided individualized incentive packages to firms
- **Empirical evidence on the impact of financial incentives is mixed**
 - Econometric analysis often finds little correlation between explicit financial packages and long-term impacts on economic growth

Research and the experiences of some states (e.g., Colorado, Iowa) suggest that packaging financial incentives with a more broad-based policy strategy can be effective

Observations

- **Regional demand allows the opportunity for economic development from construction, operations, and manufacturing, and may play a role in supporting clean energy clusters**
- **Economic development through export is principally – though not exclusively – in manufacturing of modular or lower tier components that can be easily shipped**
 - Labor intensity and costs as well as scale factor heavily into export viability
- **Clean energy industries are dynamic and require policymakers to stay abreast of industry trends and regularly re-evaluate their economic development strategies**
- **Although characterized by their societal attributes clean energy businesses are in the end still driven by business priorities – they do not necessarily require a uniquely clean energy policy approach**
- **A broad-based policy strategy is often useful and may include:**
 - Leveraging existing strengths
 - Investing in durable assets
 - Minimizing barriers to entry
 - Developing a suite of complementary policies