

Economic Impacts of Extending Federal Solar Tax Credits

Final Report

Prepared for the

Solar Energy Research and Education
Foundation (SEREF)

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Content of Report

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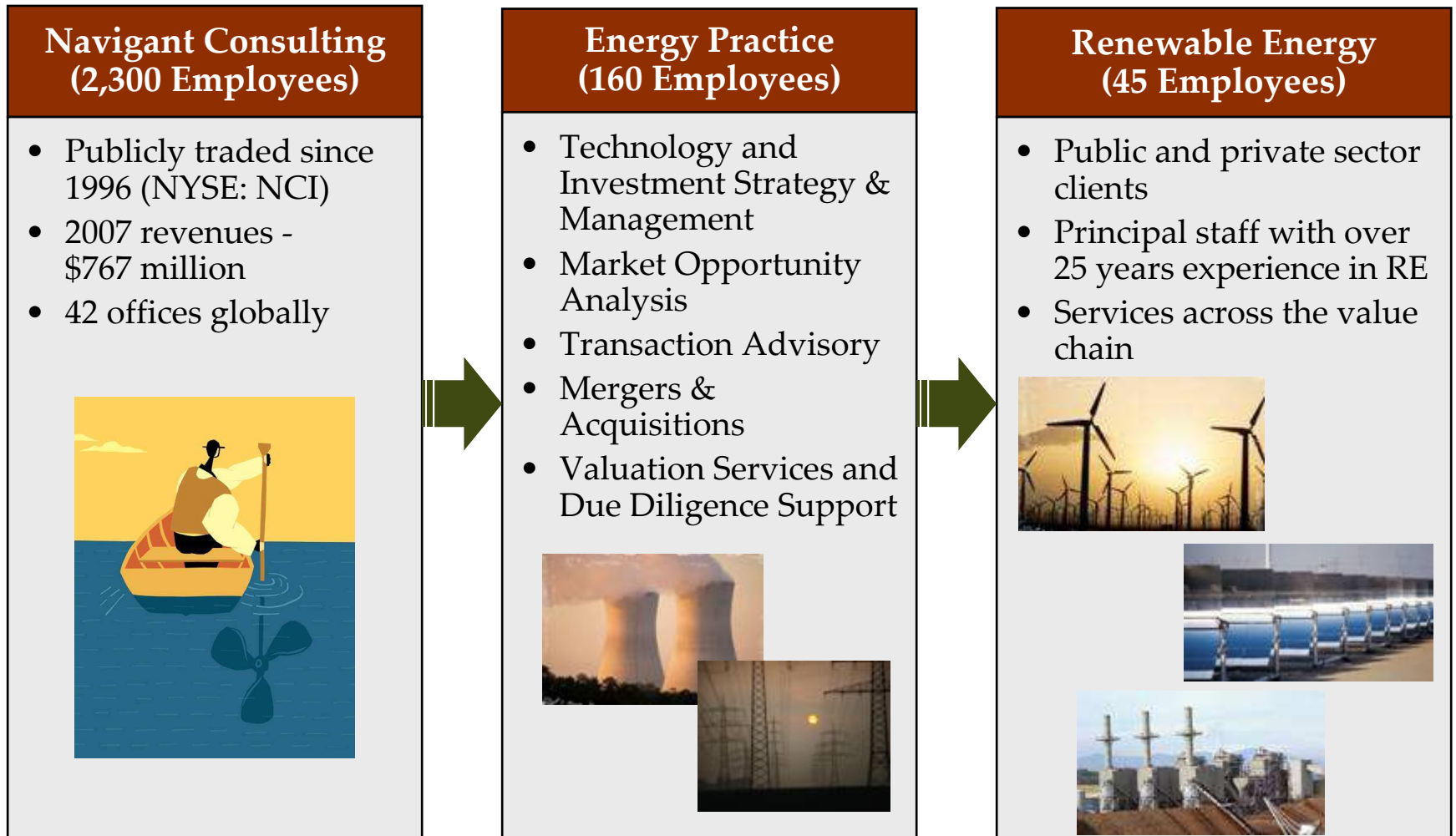
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About NCI

Navigant Consulting, Inc. (NCI) is a specialized consulting firm known globally for its renewable energy technology and strategy expertise.



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Purpose and Methodology

The purpose of this study was to analyze the gross economic impact on the U.S. economy of extending federal tax credits for solar technologies - photovoltaics (PV), solar water heating, and concentrating solar power (CSP). This study analyzed an 8-year extension of the current federal Investment Tax Credit (ITC) for solar technologies. Navigant Consulting analyzed the impact of a full 8-year extension, as opposed to several 1-year or 2-year extensions. Short term extensions do not provide stable support for long term capital investments to increase manufacturing or complete utility-scale solar power plants, and typically lead to “boom-bust” cycles of annual installations, as seen in the U.S. wind industry.

First, Navigant Consulting projected market size with current and reduced federal tax credits. Next, Navigant Consulting estimated direct employment and investment impacts using internal databases, industry interviews and publicly available models. Finally, Navigant Consulting projected indirect and induced¹ impacts using publicly available studies and models.

Definitions²

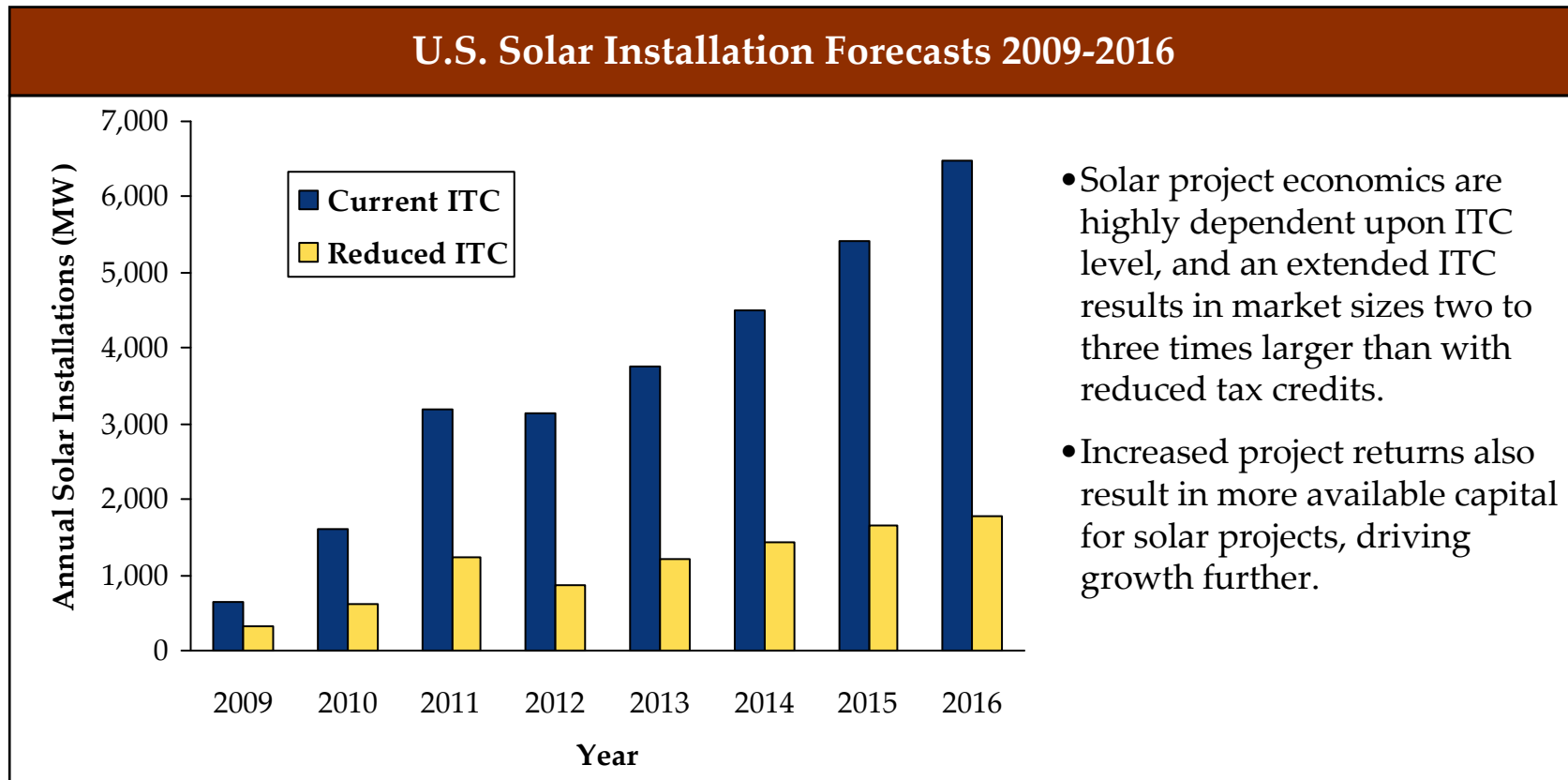
Current ITC - Provides a 30% tax credit for residential systems (capped at \$2,000 for qualified solar properties) and a 30% tax credit for commercial properties. (Throughout this report, the term "Current ITC" refers to an 8-year extension of the current ITC.)

Reduced ITC - Assumes that the current ITC will expire at the end of 2008, eliminating the residential credit and decreasing the commercial credit to 10%.

Notes:

1. Refer to the appendix for a description of direct, indirect, and induced
2. Refer to the appendix for a history of the ITC

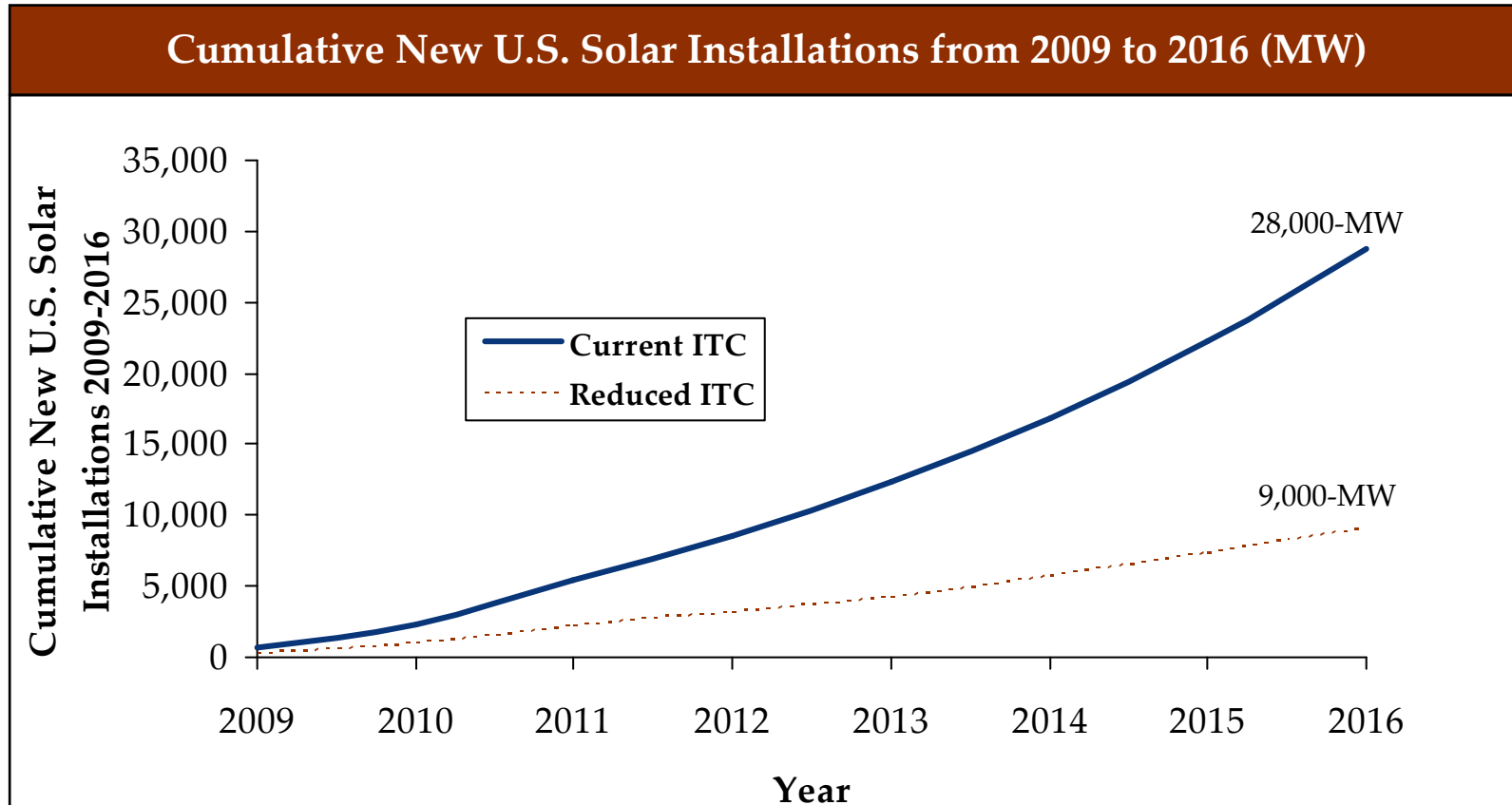
Navigant Consulting projected PV, Solar Water Heating, and CSP markets with the current ITC extended eight years and a reduced ITC.



Notes:

1. PV market converted from megawatts direct current (MW_{DC}) to megawatts alternating current (MW_{AC}) using an 84% de-rate.
2. Solar Water Heating market data converted from area to energy using a conversion factor of $0.7 \text{ m}^2/\text{kW}_{th}$.
3. CSP is represented in MW_{AC} .
4. In the current ITC case, Navigant Consulting projects a large number of CSP projects being installed in 2011, thus giving the appearance of flat growth from 2011 to 2012. Refer to the main body of the report for more detail.

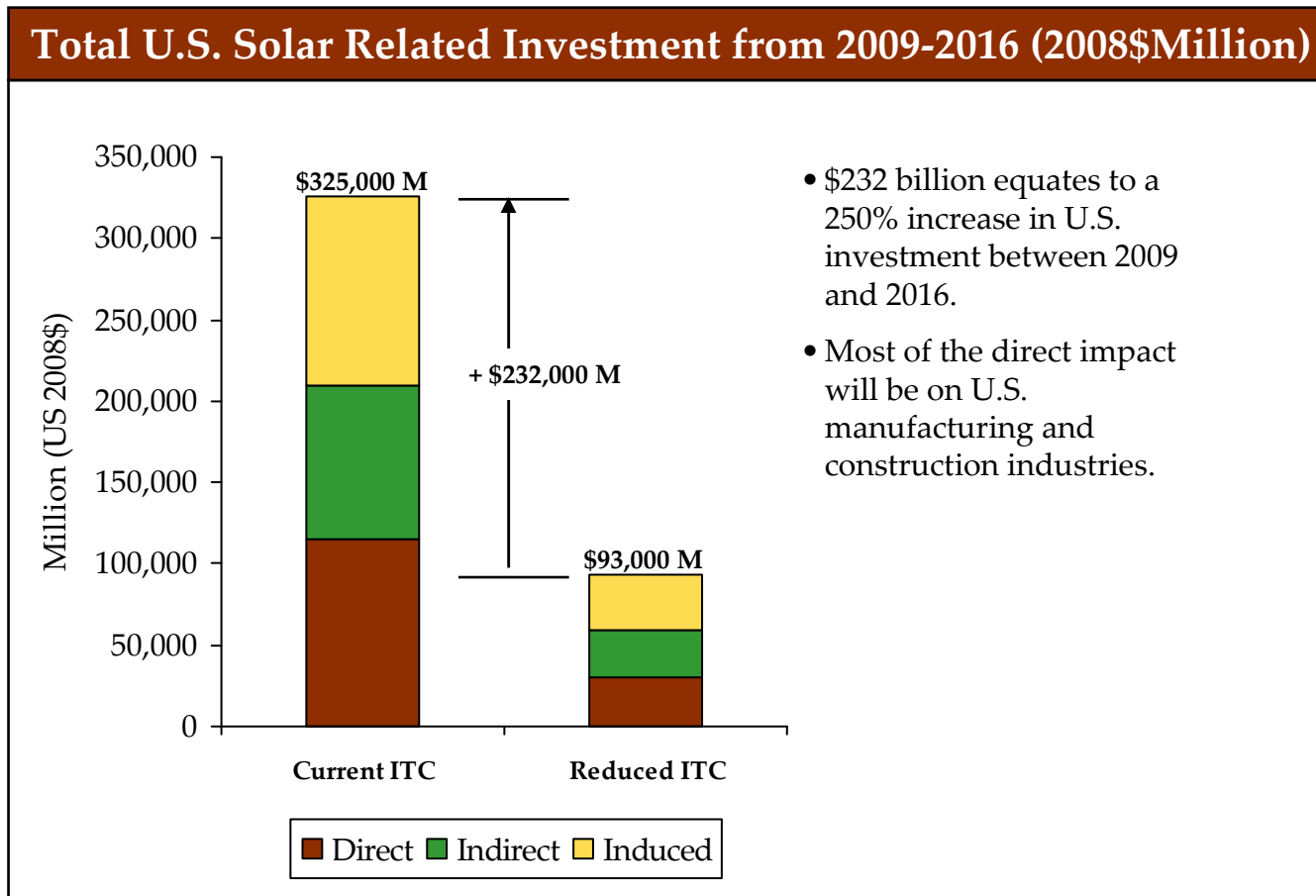
Extension of the current ITC could drive 19,000 MW additional solar energy installations.



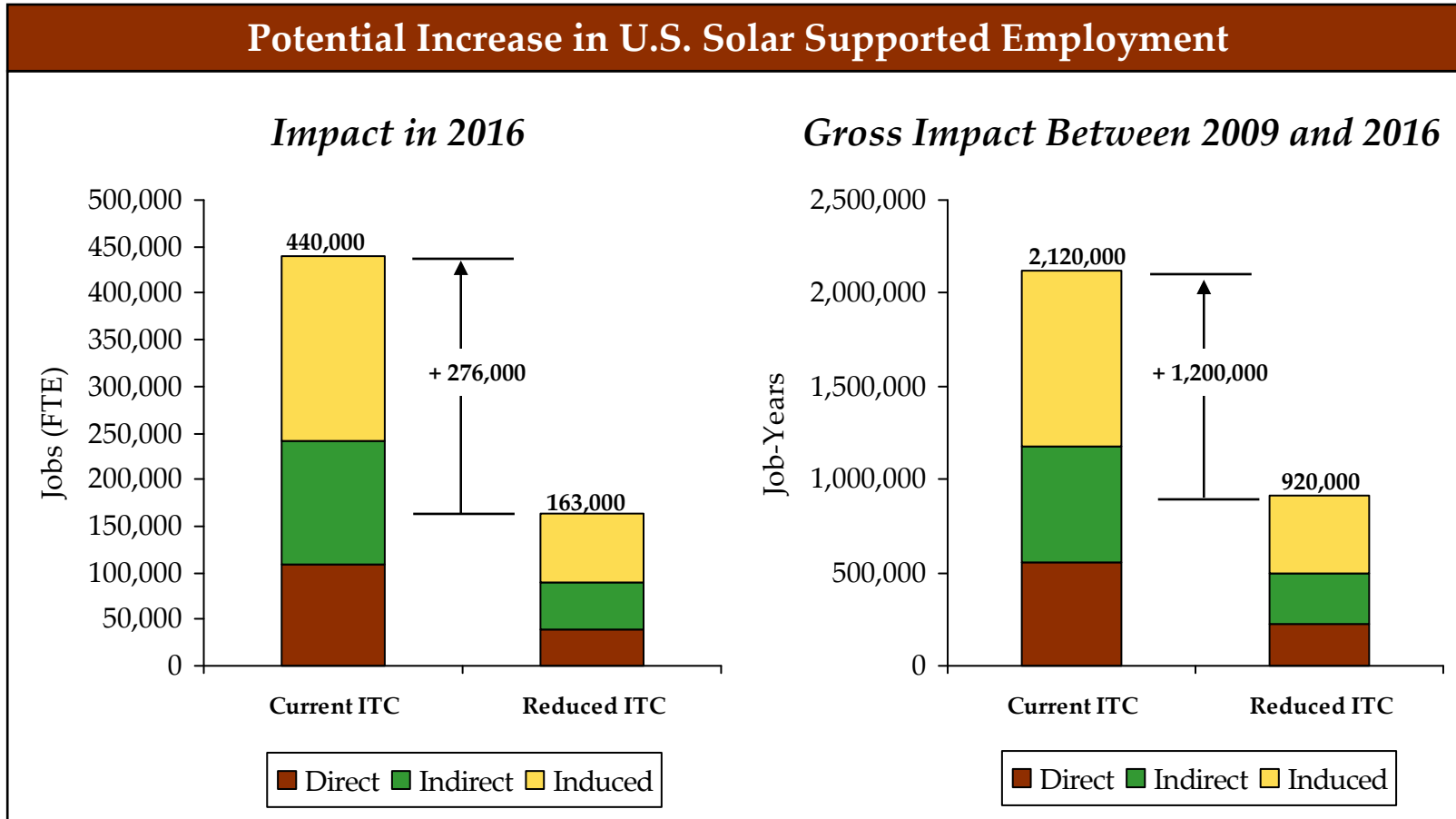
Notes:

1. PV market converted from MW_{DC} to MW_{AC} using an 84% de-rate.
2. Solar Water Heating market data converted from area to energy using a conversion factor of $0.7 \text{ m}^2/\text{kW}_{th}$.
3. CSP is represented in MW_{AC} .
4. Data does not include solar installations prior to 2009.

Extending the ITC could result in increased investment of \$232 billion between 2009 and 2016.



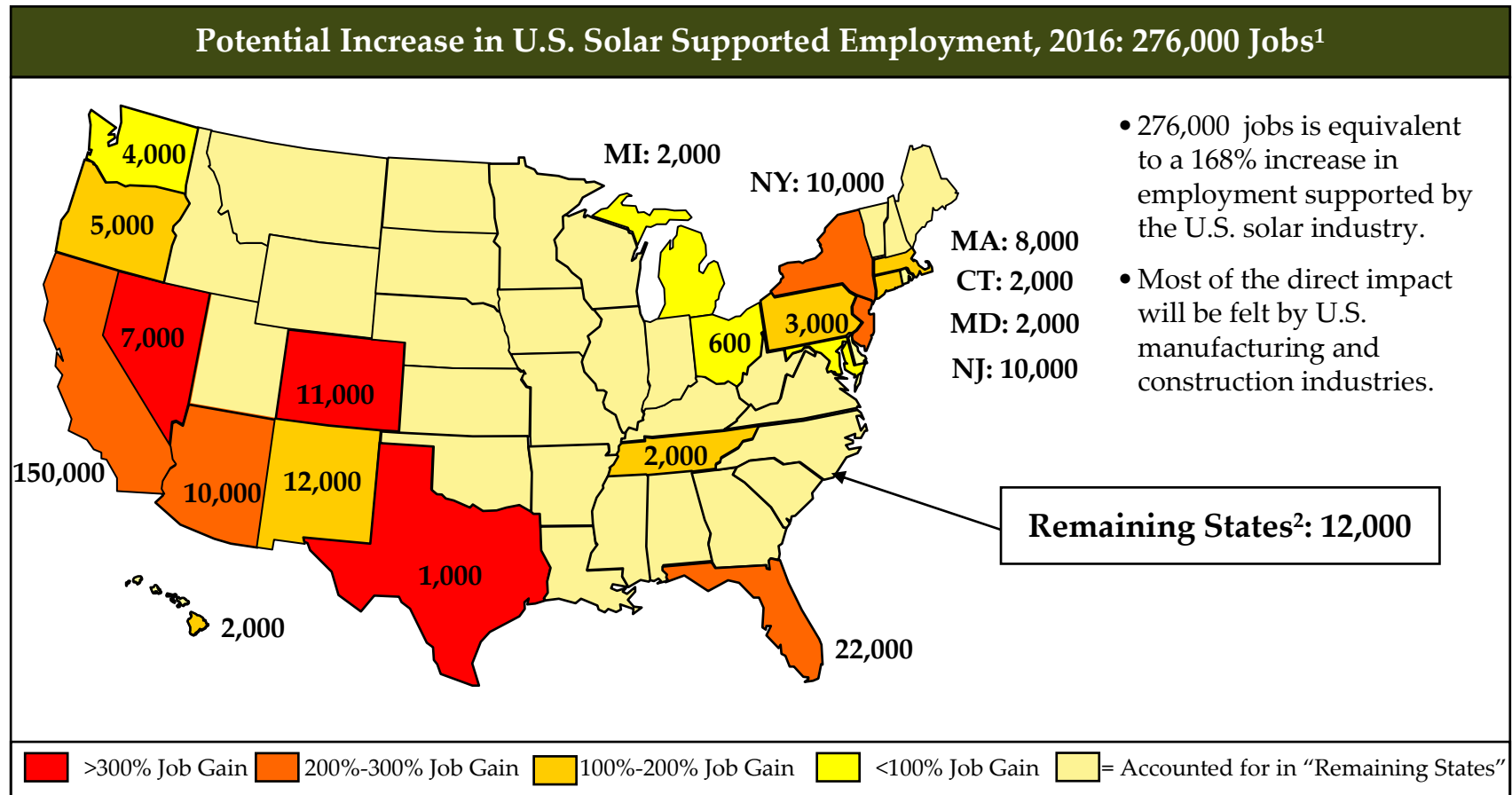
Extending the current ITC could spur an additional 276,000 jobs and 1,200,000 job-years¹ of employment between 2009 and 2016.



Notes:

1. Refer to the appendix for a definition of job-years.

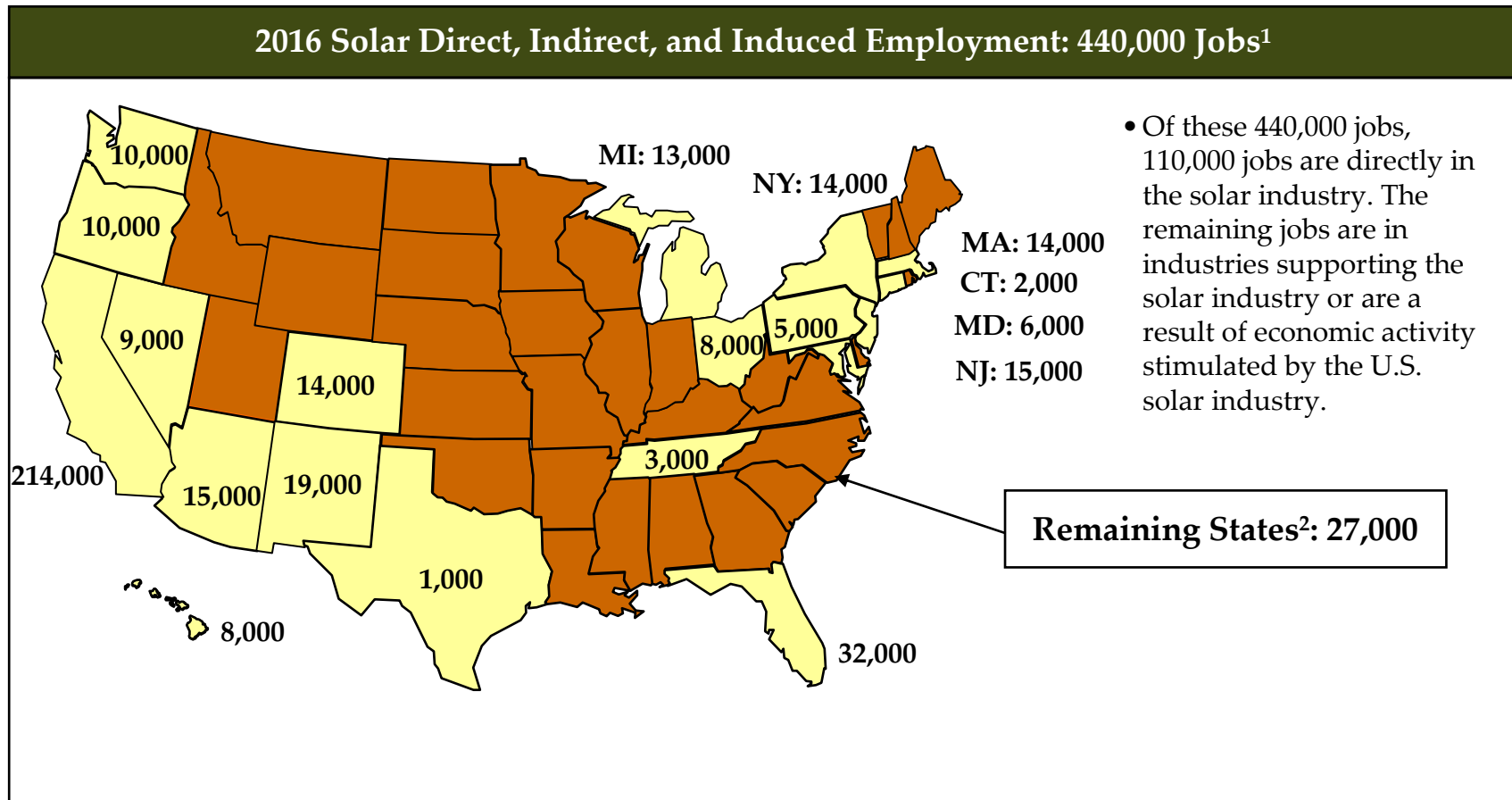
Extending the ITC could result in increased employment opportunity of over 276,000 jobs in 2016.



Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.
2. Remaining states defined as those with less than 600 jobs gained.
3. Refer to the appendix for a definition of direct, indirect, and induced.

By extending the ITC, the U.S. solar industry could drive 440,000 jobs in 2016.



Notes:

1. Refer to the appendix for definitions of direct, indirect, and induced . Figures might not add correctly due to rounding.
2. Remaining states defined as those with less than 1,000 people employed.

Below are key assumptions relevant to the Navigant Consulting analysis.

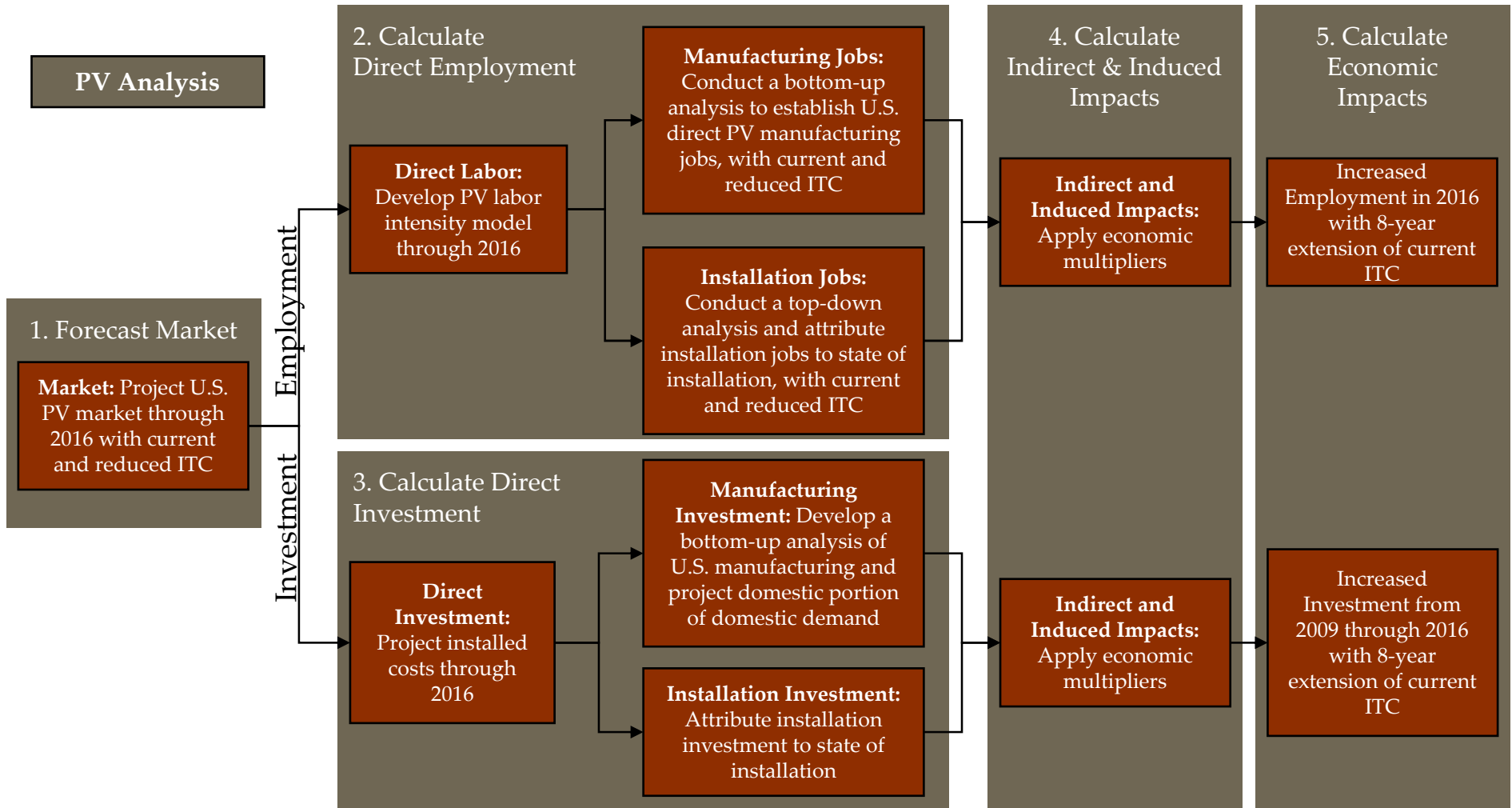
Key Assumptions

- This analysis assumes a full 8-year extension of the current ITC, not several 1-year or 2-year extensions.
- This analysis only looks at the gross impacts of extending federal solar tax credits, meaning the impacts to other industries (i.e. coal, natural gas, etc.) are not accounted for.
- For state level results, Navigant Consulting made the simplifying assumption that indirect and induced impacts occur in the state of direct impact.
- All analysis is done in year 2008 dollars.

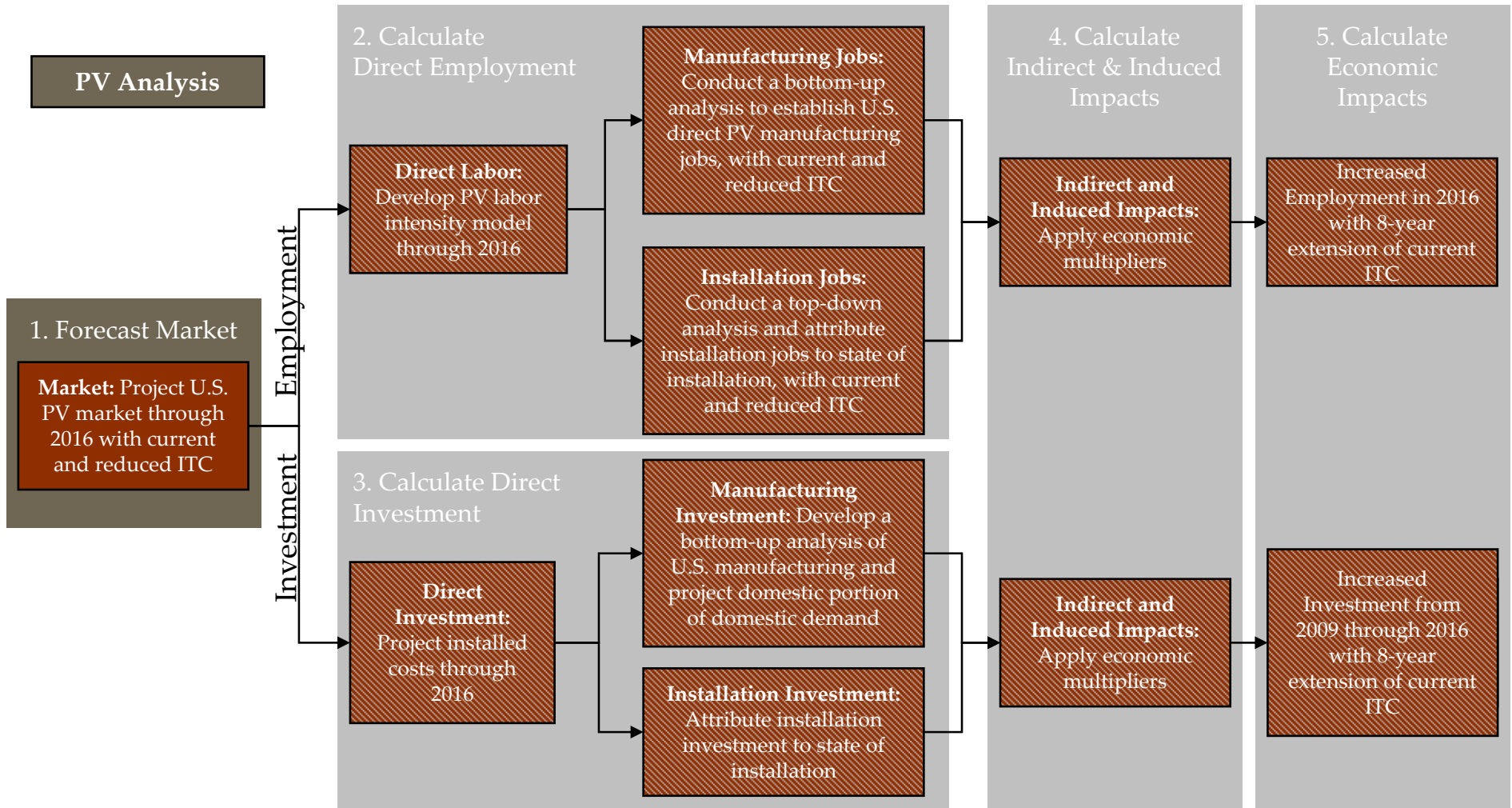
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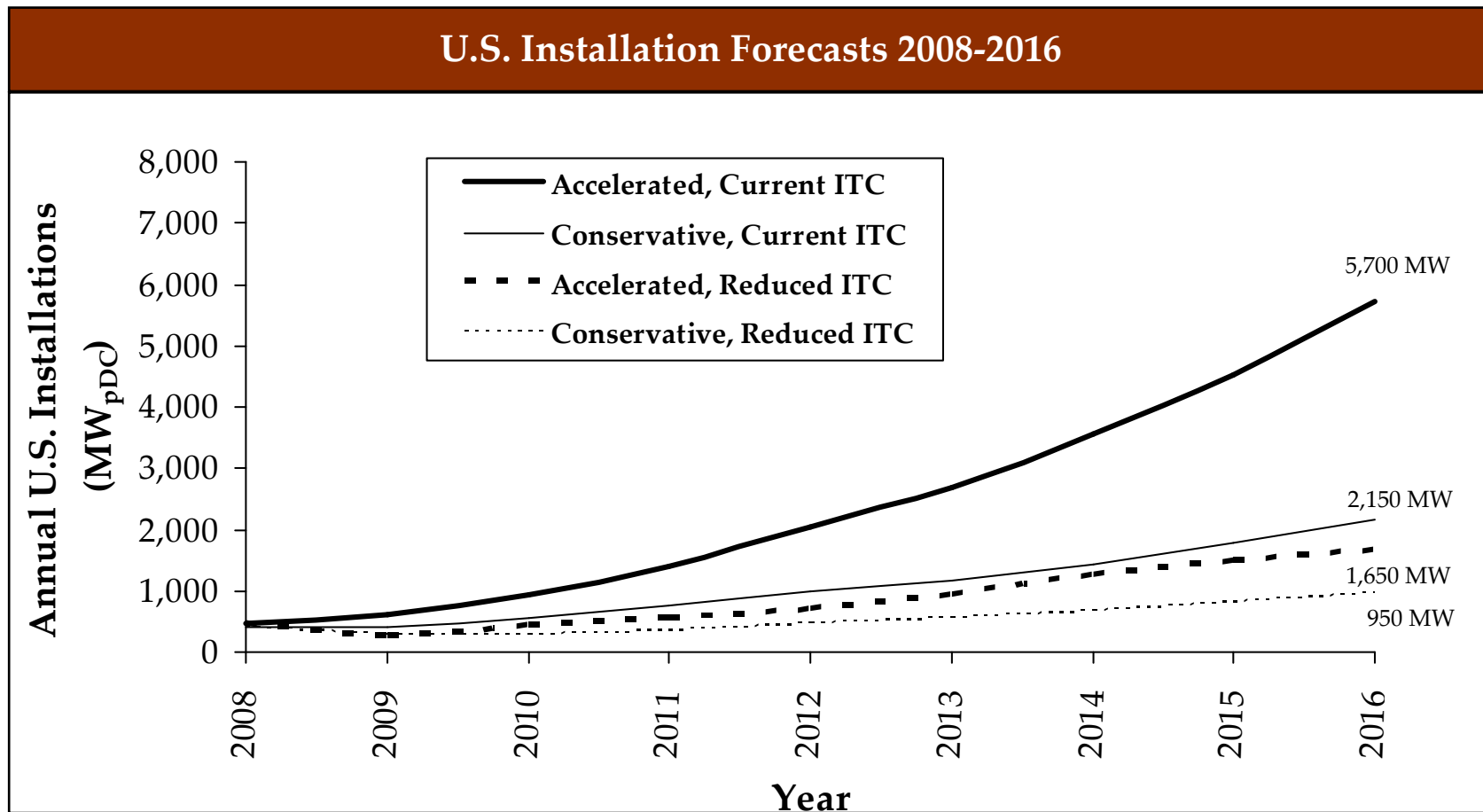
Navigant Consulting analyzed photovoltaic (PV) investment and employment impacts separately.



Navigant Consulting started with U.S. market projections.



Navigant Consulting used two PV installation forecasts.



Notes:

1. Navigant Consulting projects breakouts of 14% remote, 18% utility, 21% residential, and 47% commercial.
2. Given the number of other variables influencing the U.S. PV market, Navigant Consulting provided two market projections, but only one projection for the other technologies in this report.
3. Refer to the appendix for definition of MW_{pDC}.

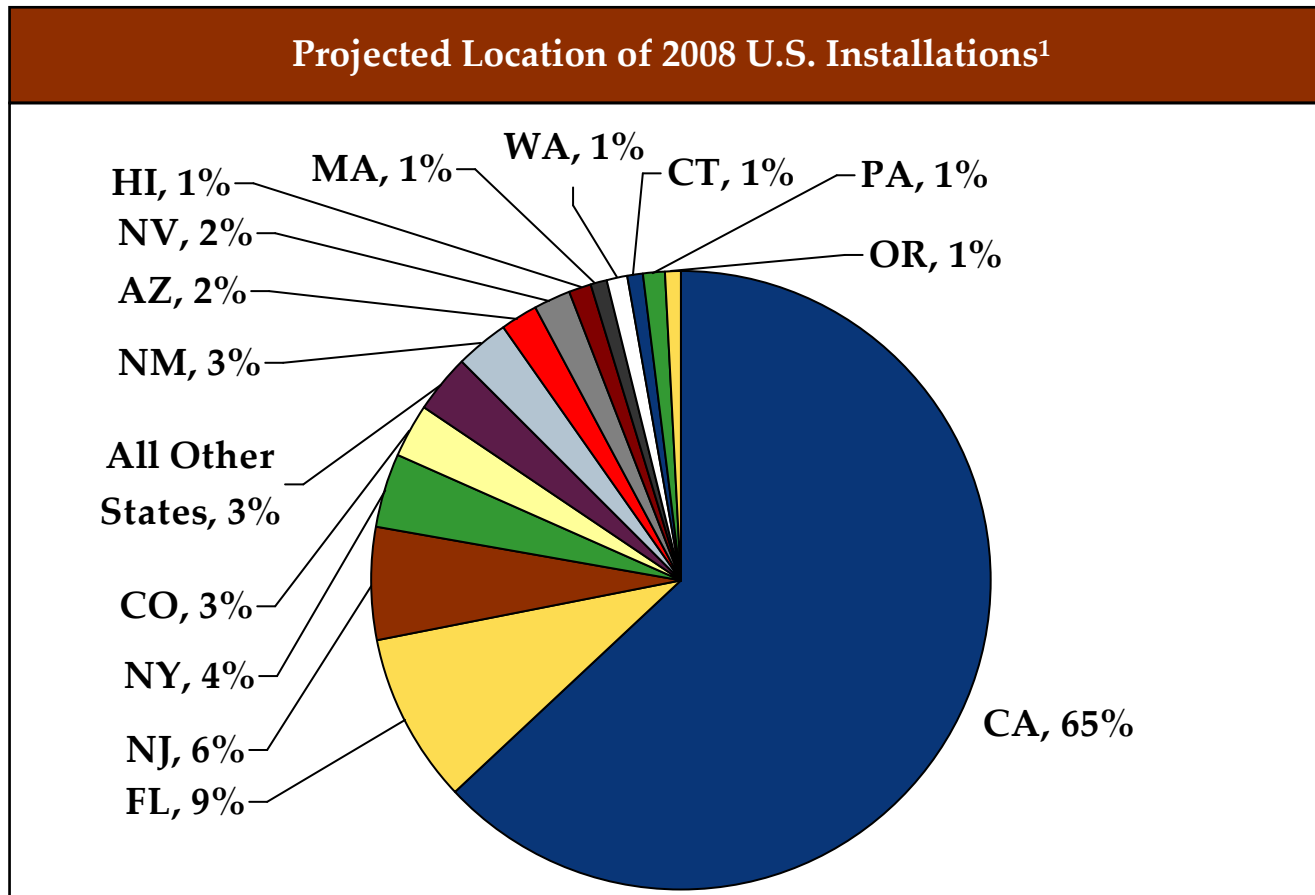
Below are definitions relevant to Navigant Consulting's market projections.

Market Projection Definitions

Accelerated Scenario - Assumes faster passage of ITC, faster ramp up of investment models for residential and utility models, and continued strong growth of large commercial, faster worldwide economic recovery (perhaps Q3) and easier money availability. This scenario also assumes: lower module prices and more availability with changing EU market; less expensive modules and Balance of System (BOS) may allow, over time, growth without incentives; entry of larger vertical companies (i.e., SunPower, First Solar, SolarWorld) that can deliver the module to the project at cost and take advantage of economies of scale; and higher energy prices and less use of substitutes.

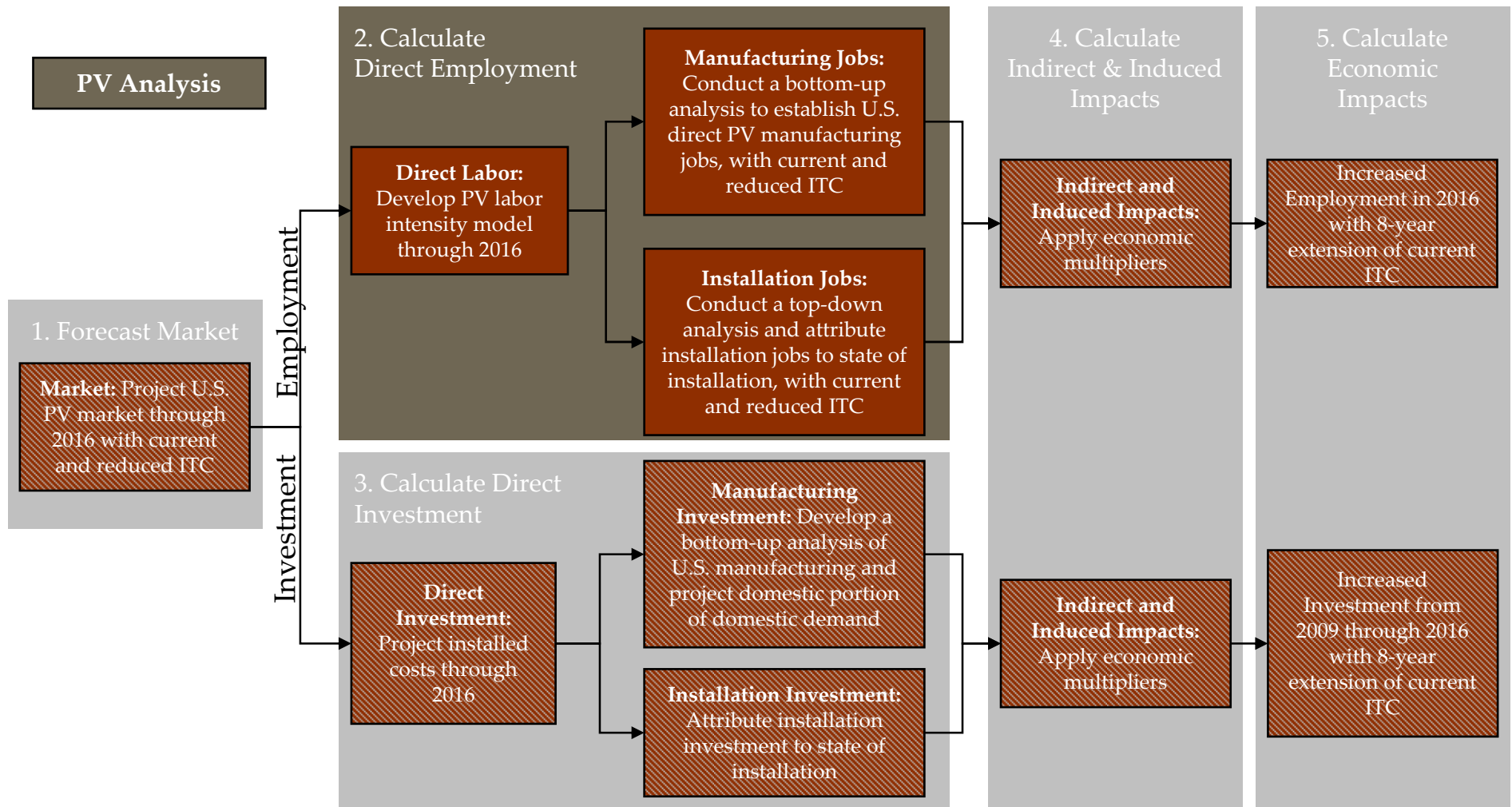
Conservative Scenario - Assumes longer time to pass ITC, longer time for economy to recover, tighter money, less desire to assume risk, higher module prices, continued strong demand in Europe making modules scarce, more robust substitutes. Also, slower maturing and acceptance of business models for residential and utility customers could slow growth.

Navigant Consulting assumed future installations will be distributed the same as 2008's projected installations.



Source: Navigant Consulting PV Services Program, July, 2008

Navigant Consulting analyzed direct impacts, starting with employment.

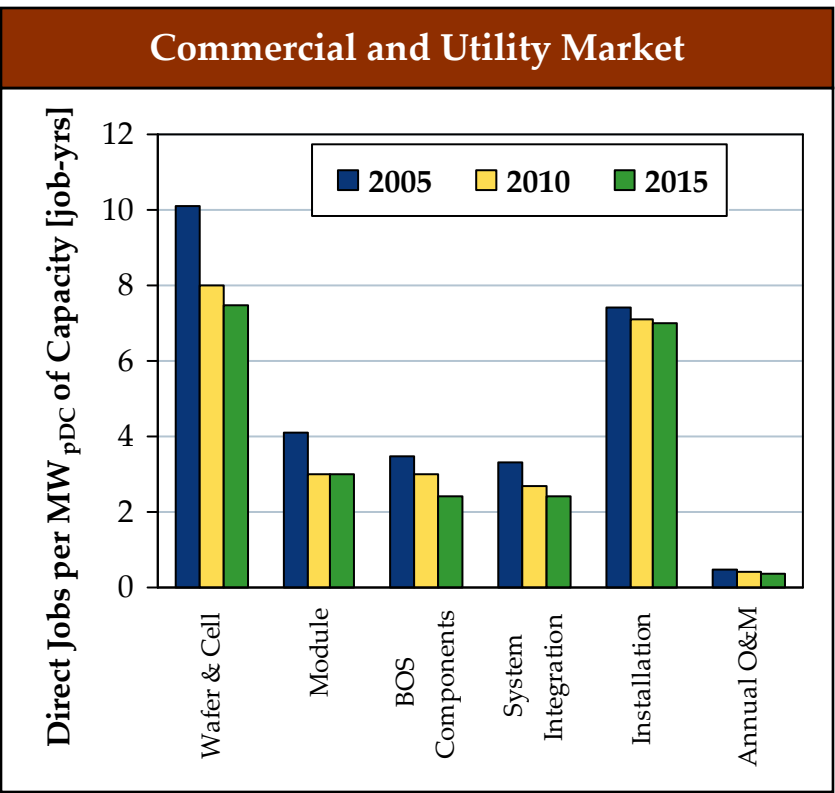
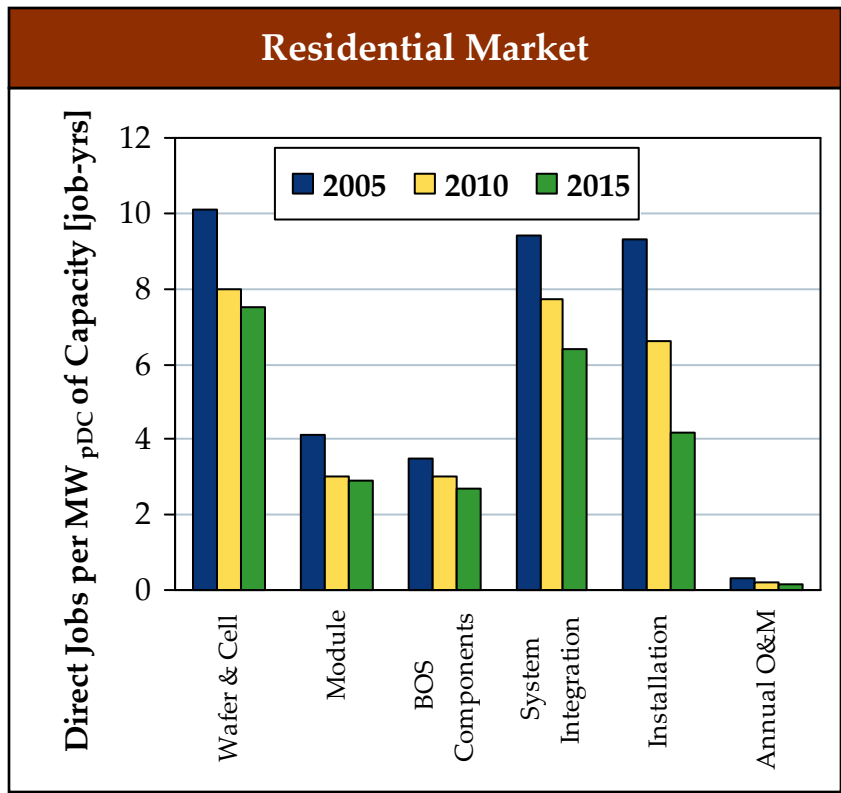


Potential PV-related employment rates were calculated as a function of time.

Navigant Consulting PV Labor Intensity Model	
Primary Data Sources and Data Elements¹	<ul style="list-style-type: none"> • Navigant Consulting’s PV module manufacturing cost model and Levelized Cost of Energy (LCOE) model. <ul style="list-style-type: none"> – These models provide detailed labor and non-labor cost estimates for all aspects of PV system manufacturing and installation. • Interviews with PV industry sources – manufacturers, equipment suppliers, and installers. • <i>The Work That Goes Into Renewable Energy</i>, Renewable Energy Policy Project (REPP), November 2001, Research Report No. 13.
Method	<ul style="list-style-type: none"> • Use Navigant Consulting models and interview results to confirm and update REPP labor estimates. <ul style="list-style-type: none"> – Navigant Consulting accounted for changes in technology, automation and material prices, and applied the updates to the range of available PV technologies. • Weight the hour estimates by technology market shares to derive a weighted average hour for each labor task category. • Convert weighted estimates to job-years (1 job-year = 1,960 hours). • Using labor-hours and material estimates per installation task from Navigant Consulting’s LCOE model, and labor rate data from interviews with industry professionals and R. S. Means, calculate labor costs for residential: 3.5-kW, commercial: 1,500-kW and utility central station: 2-MW system installations. • Convert all results to per-MW costs.

1. In the manufacturing model, a process flow details each step and its costs, with technology improvements tracked as they occur. For each step, a detailed activity-based accounting is made of material, labor, capital and overhead costs, based on material quotes, machine capability spec sheets, machine cost quotations, U.S. labor rates, and industry financial parameters. The LCOE model accounts for module prices, inverter costs, installation labor, system integration, installer margins, etc. to build total system price, based on interviews with a wide array of industry sources.

While total employment will increase, Navigant Consulting projects decreasing labor intensity from learning curve effects.



Source: Navigant Consulting, Inc. estimates, June 2006.

Notes:

1. One job-year is equal to 1,960 hours of labor (40 hours per week, 49 weeks per year).
2. System Integration includes system integration, design and distribution. Residential installation practices are expected to streamline significantly, leading to lower labor intensity.
3. For this analysis, Navigant Consulting assumed similar labor intensity between the commercial and utility markets and between the residential and remote markets.

Navigant Consulting conducted a bottom-up analysis to catalog U.S. direct PV manufacturing jobs by state.

Creation of Direct PV Manufacturing Projections	
Primary Data Sources and Data Elements	<ul style="list-style-type: none"> • Interviews with current U.S. cell to wafer, module, and balance of system (BOS) manufacturers. <ul style="list-style-type: none"> – Established a baseline for current manufacturing capacity, employment levels, shipments, revenues, and product allocations for the domestic market. – Discussed specific manufacturer expansion plans; detailing scope, location and likelihood of implementation under the various market scenarios. – Detailed the impact of U.S. market demand on manufacturer business models under the various market scenarios. • Review of other information sources including financial statements for public companies and other announced capacity additions or business expansions.
Projection Methodology	<ul style="list-style-type: none"> • Profiled 16 of the largest U.S. manufacturers and forecast job growth for each under the various market scenarios. <ul style="list-style-type: none"> – Allocated jobs to state markets based on current manufacturing locations and announced or expected citing of future facilities. – Assumed these companies represented 75% of domestic cell to wafer and module production, and 40% of domestic BOS production. This was based on percent of total U.S. market that had been identified in gathering primary data. <ul style="list-style-type: none"> ▪ Balance was allocated by location of other companies not profiled, or distributed evenly across regions where future facilities are likely to be cited. • Forecast aggregate job growth from manufacturers not currently in production including companies currently in pre-commercial technology development.

Notes:

1. For installation jobs (including system integration) and O&M jobs, Navigant Consulting attributed the labor to the state of installation.

PV manufacturing and installation requires a wide variety of skill sets and educational backgrounds.

Manufacturing Jobs

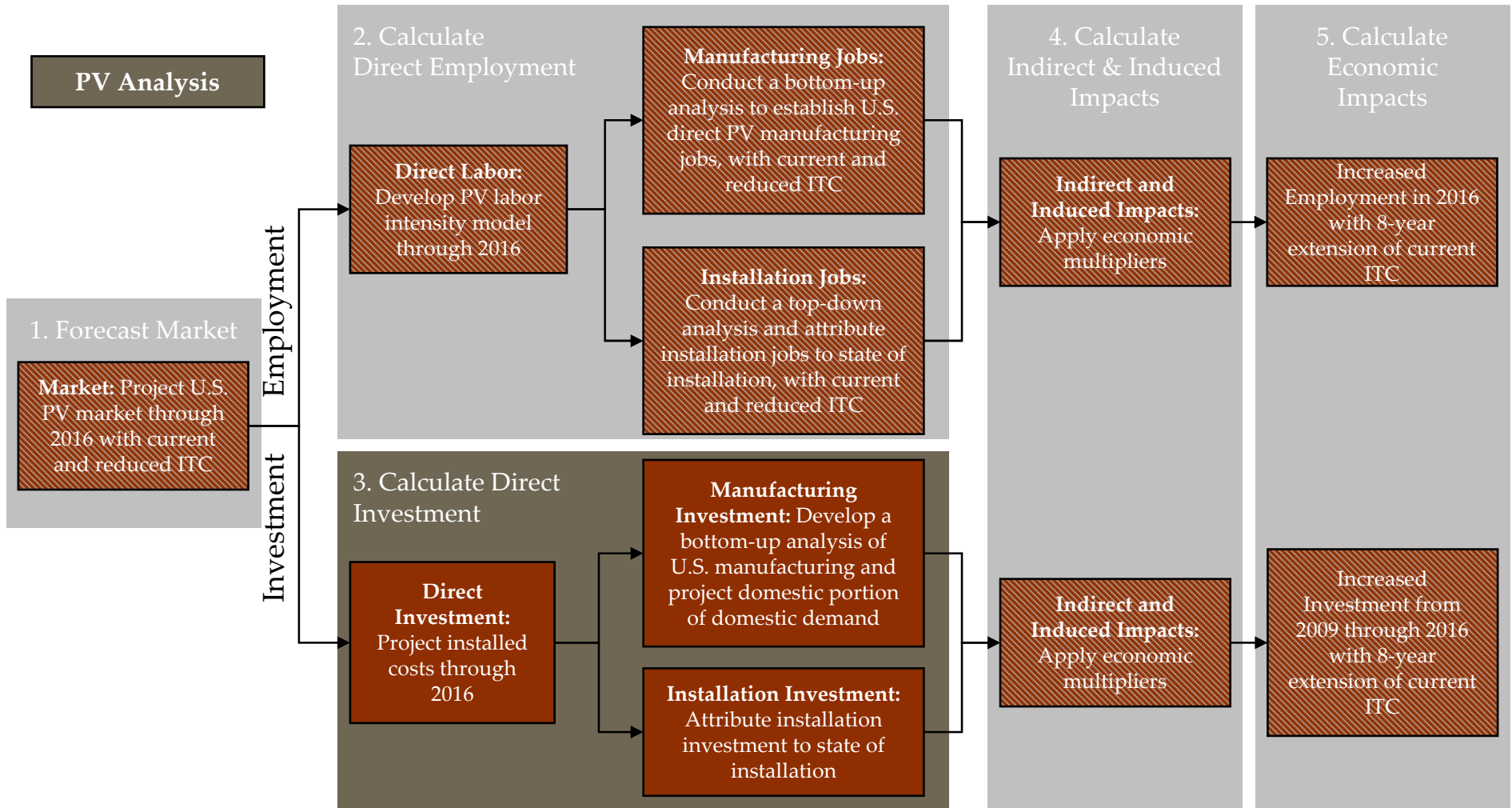
- Manufacturing
 - Factory worker
 - Technician (including semiconductor technician)
 - Material handler
 - Factory supervisor
 - Manufacturing engineer
 - Manufacturing manager
 - Quality assurance engineer/technician
 - Chemical/Process engineer
- Design
 - Material scientist
 - Electrical engineer
- Administrative and support
 - Purchasing agent
 - Director
 - Health and safety officer
 - Accountant
 - Administrative assistant
 - Information technology professional

Installation Jobs

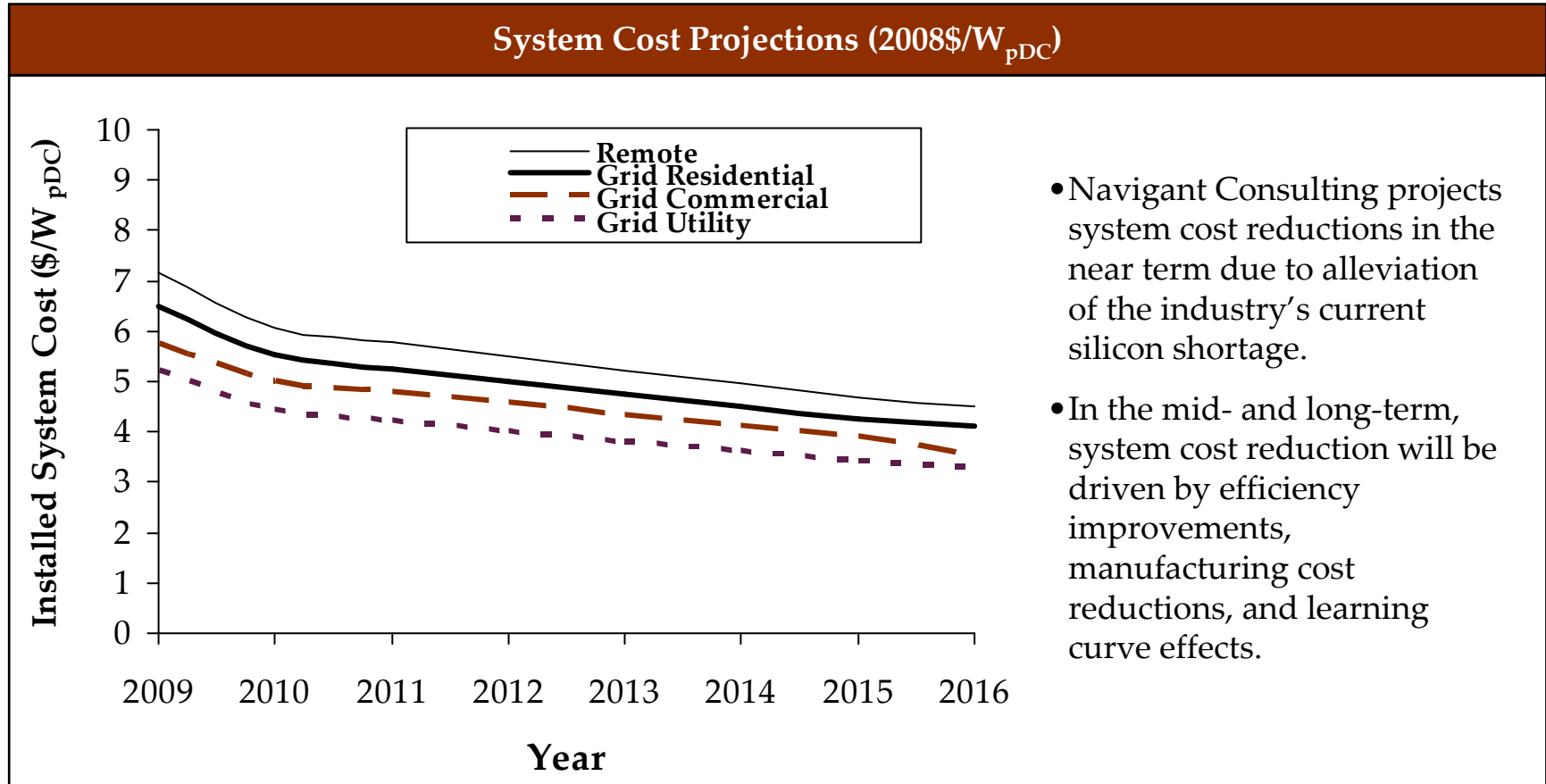
- Installation
 - Electrician
 - Roofing contractor
 - General contractor
 - Shift supervisor
 - Foreman
 - Heavy construction (for utility scale projects)
- Design
 - Mechanical engineer
 - Electrical engineer
 - Civil engineer
- Administrative and support
 - Health and safety officer
 - Accountant
 - Administrative assistant
 - Information technology professional

Source: Navigant Consulting, July 2008 and Navigant Consulting's Module Manufacturing Cost Model, June, 2008

Navigant Consulting started with installed cost projections to analyze PV investment.



To understand how much direct investment will occur, Navigant Consulting first projected system installed costs over time.



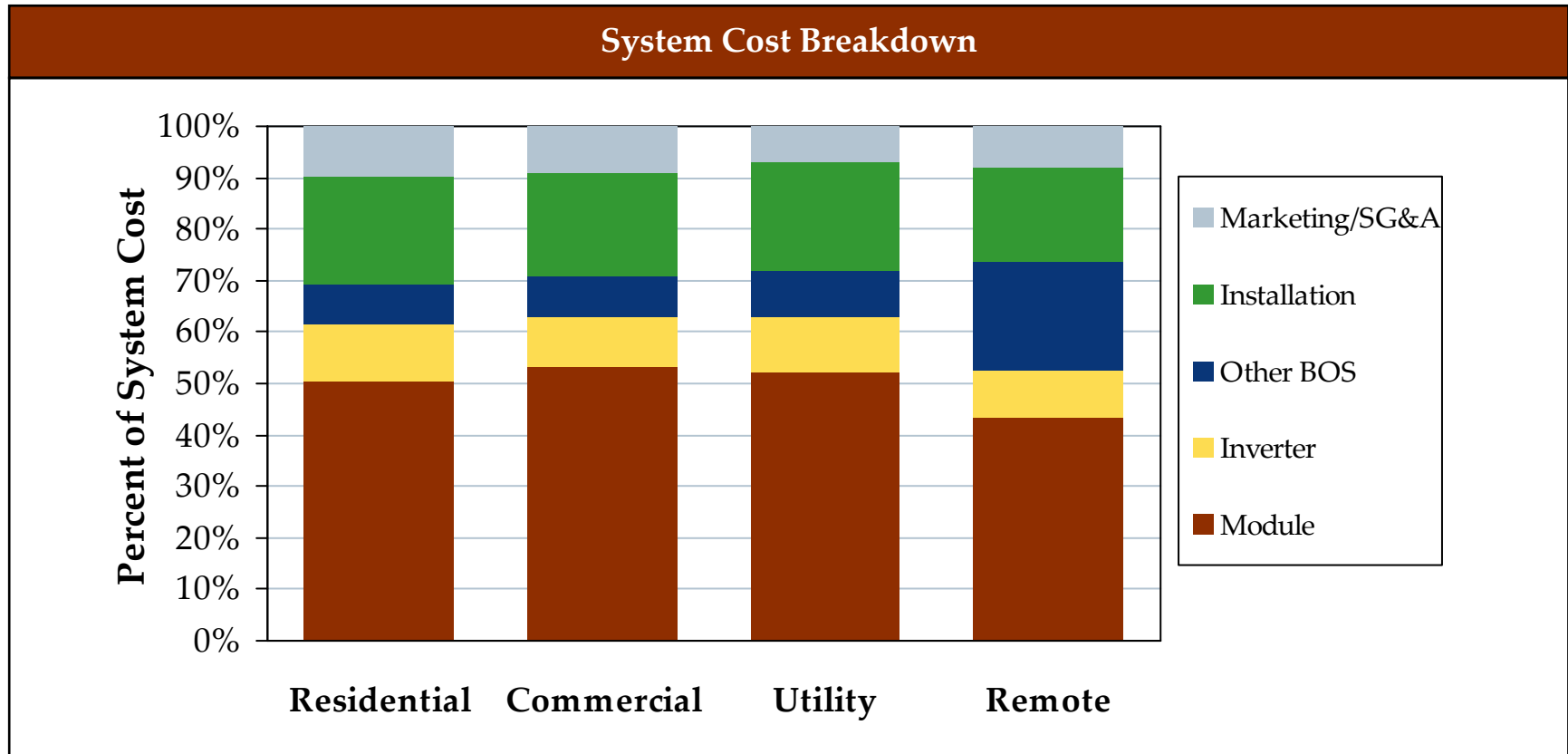
- Navigant Consulting projects system cost reductions in the near term due to alleviation of the industry’s current silicon shortage.
- In the mid- and long-term, system cost reduction will be driven by efficiency improvements, manufacturing cost reductions, and learning curve effects.

Source: Navigant Consulting July, 2008.

Notes:

1. O&M costs ranged from 10-12 \$/kW-Yr in 2009, declining to 8-9 \$/kW-Yr.
2. Assuming 10 year inverter life, this study did not consider inverter replacement costs because this study only covers 8 years.

To analyze domestic versus international investment flows, system cost breakdowns were first calculated.

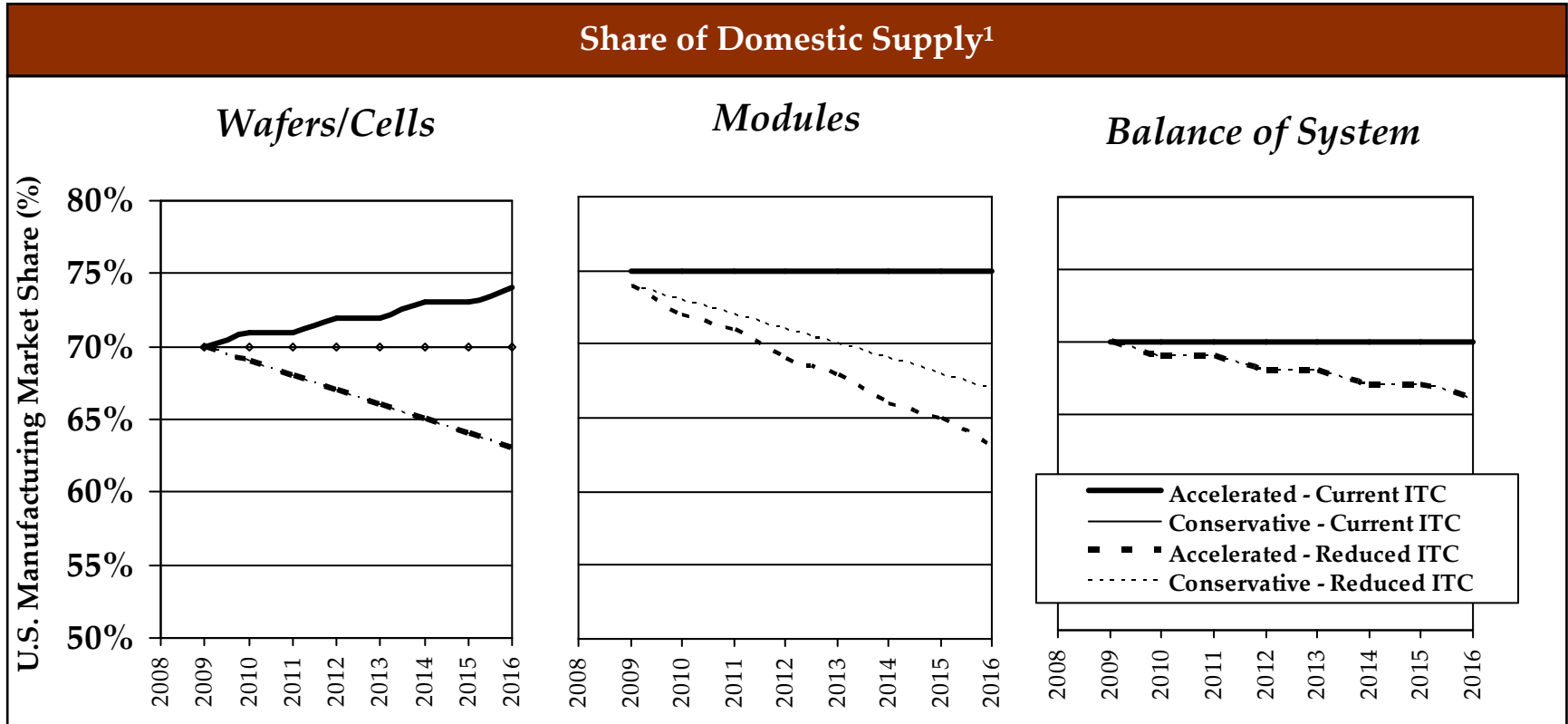


Source: Navigant Consulting July 2008

Notes:

1. Navigant Consulting assumed domestic installation (Installation and system, design and integration) expenditures, but broke down manufacturing expenditures into domestic versus international, per the next slide.
2. SG&A stands for Selling General, and Administrative.
3. BOS stands for Balance of System.

To look at the impact of the ITC on domestic supply, domestic market shares were projected.

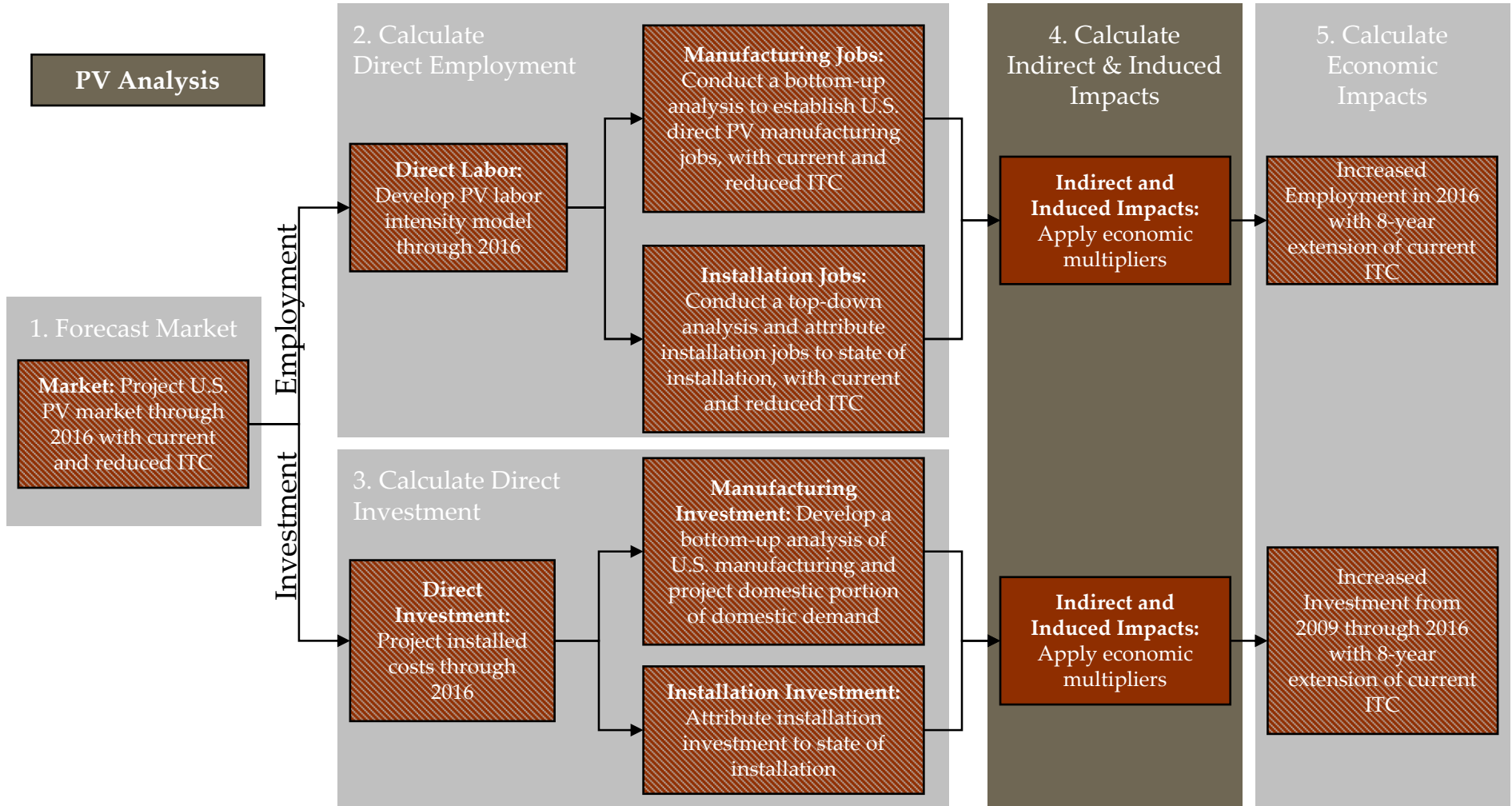


Sources: Navigant Consulting July 2008 based upon Navigant Consulting market knowledge and industry interviews.

Notes:

1. While the domestic share of manufacturing stays constant in some cases, note that the overall size of domestic manufacturing is increasing because the U.S. market is growing in those instances.
2. Navigant Consulting assumed domestic installation expenditures, but broke down manufacturing investments into domestic versus international.
3. Balance of System includes inverters.

Navigant Consulting applied economic multipliers to assess indirect and induced impacts of PV activity.



A recent NREL study looked at the economic impacts of DOE’s Solar America Initiative and reported economic multipliers.

Employment Economic Multipliers			
Construction and Manufacturing		Operation and Maintenance	
Ratio of Indirect to Direct	Ratio of Induced to Direct	Ratio of Indirect to Direct	Ratio of Induced to Direct
1.4	2.1	0.5	0.8

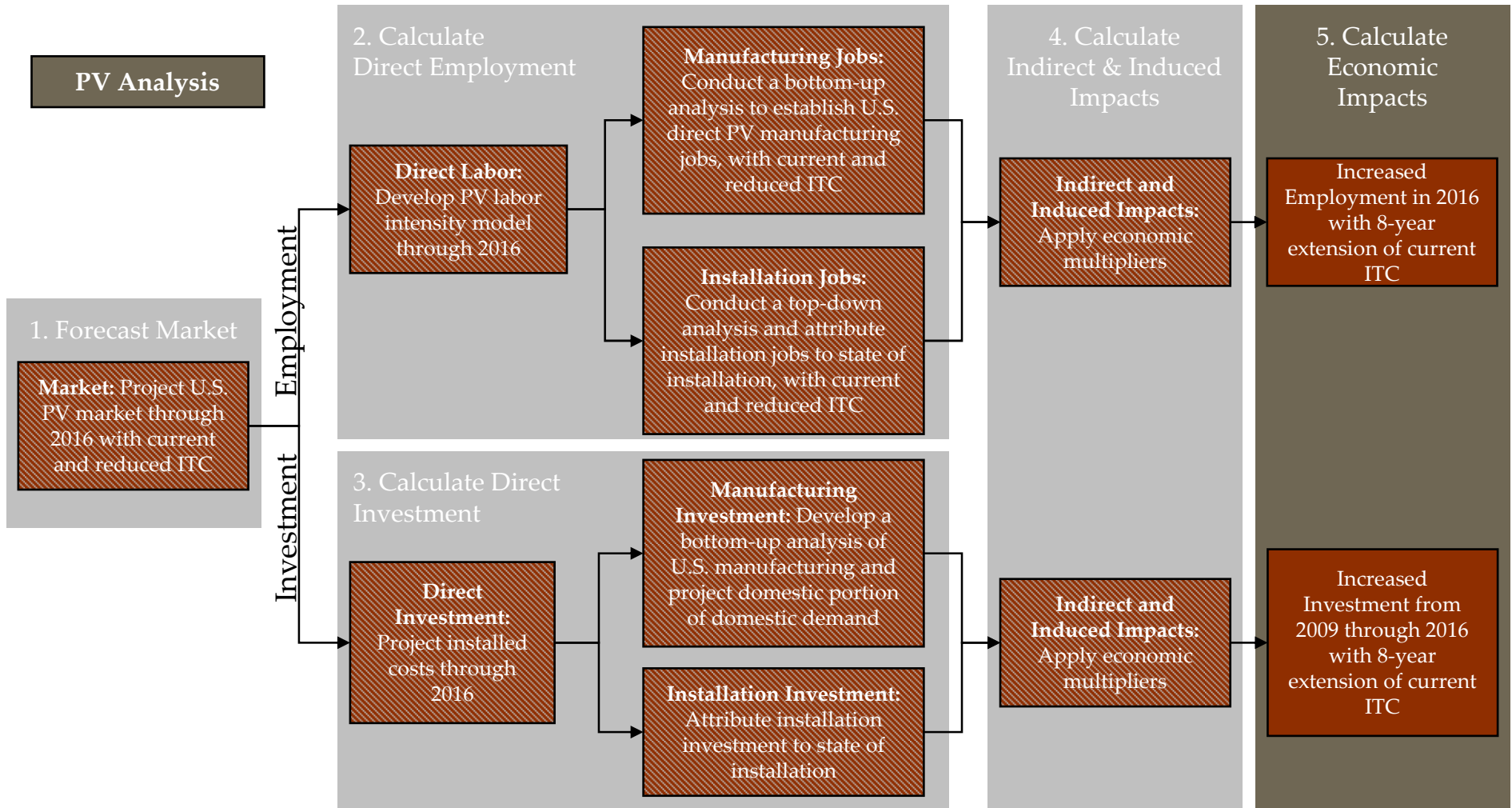
Investment Economic Multipliers			
Construction and Manufacturing		Operation and Maintenance	
Ratio of Indirect to Direct	Ratio of Induced to Direct	Ratio of Indirect to Direct	Ratio of Induced to Direct
1.1	1.3	0.7	0.9

Source: S. Grover, “Energy, Economic, and Environmental Benefits of the Solar America Initiative”, August 2007, NREL/SR-640-41998.
 Economic multipliers calculated using IMPLAN regional economic modeling software.

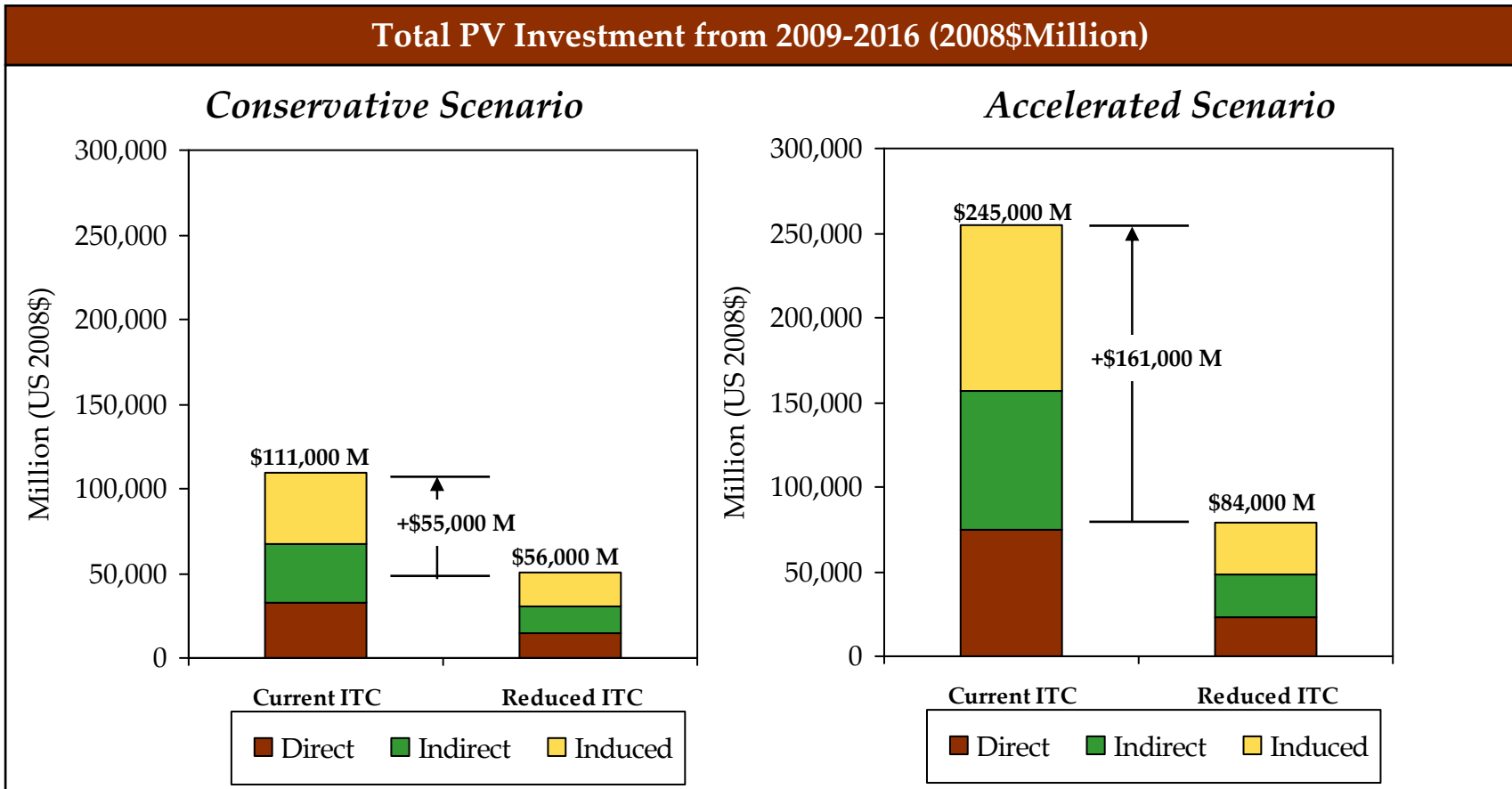
Notes:

1. Refer to the appendix for definition of direct, indirect, and induced impacts.

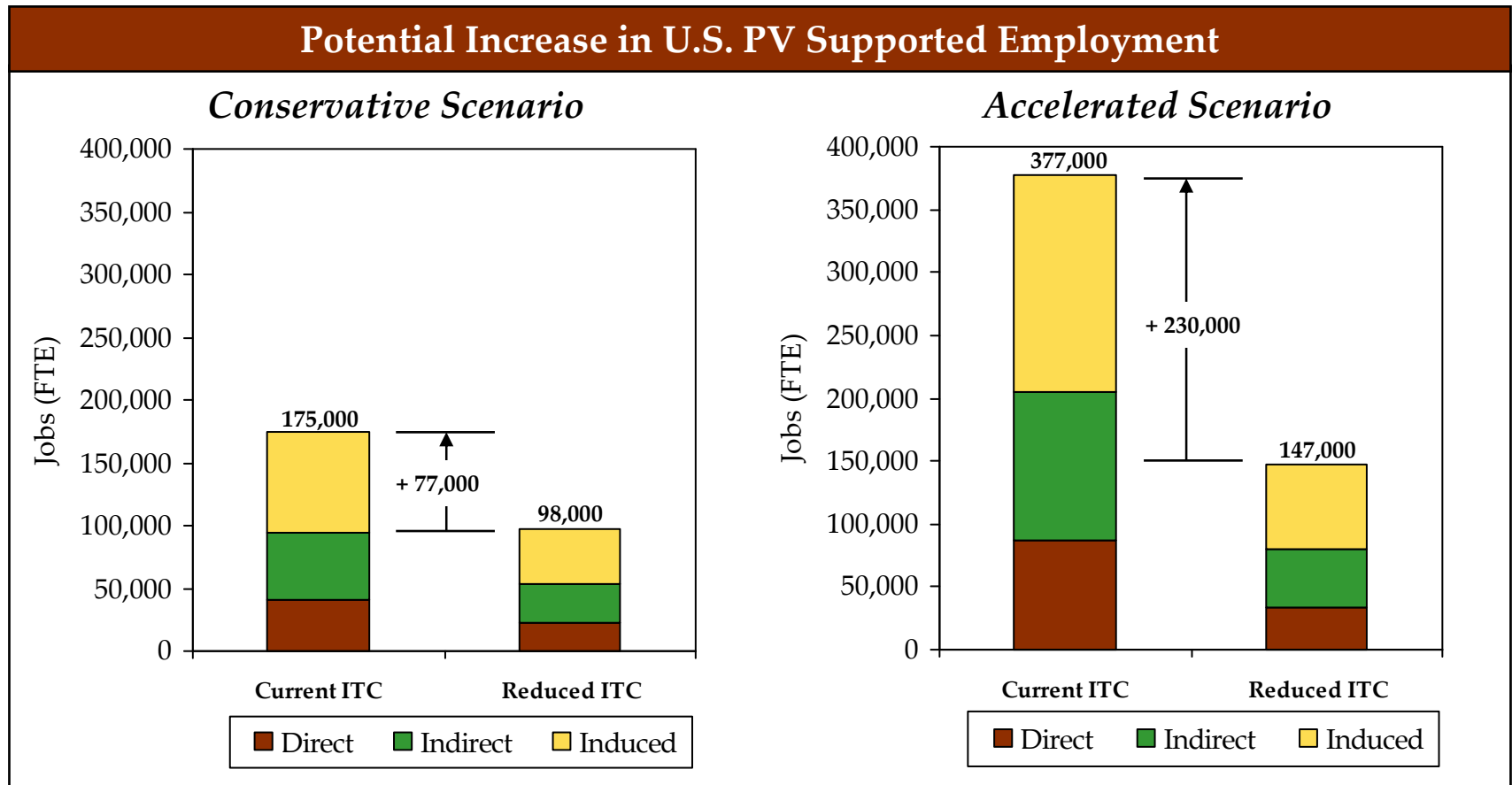
Finally, Navigant Consulting calculated the total economic impacts.



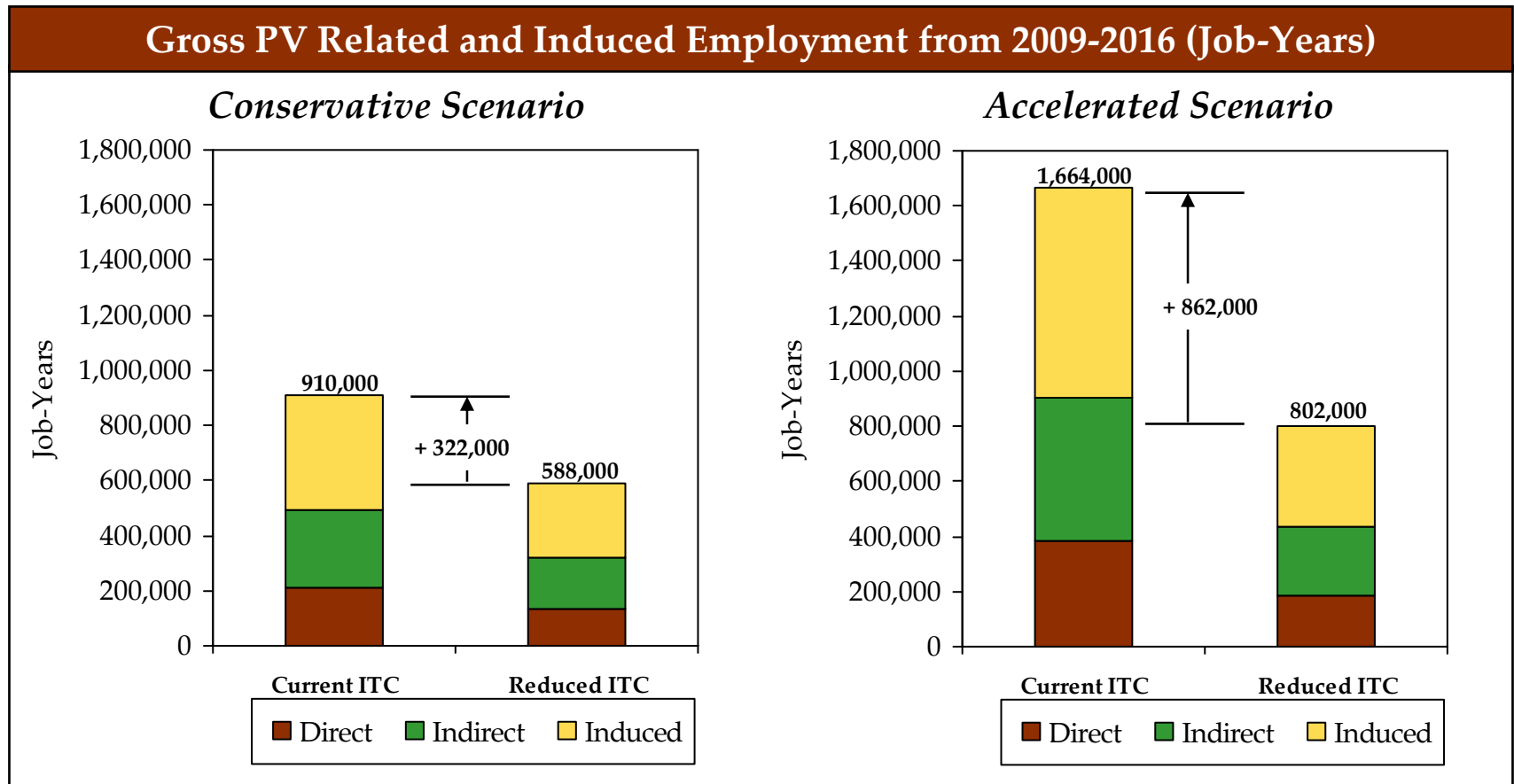
Extension of the current ITC could result in an investment gain of \$55 to \$161 billion between 2009 and 2016.



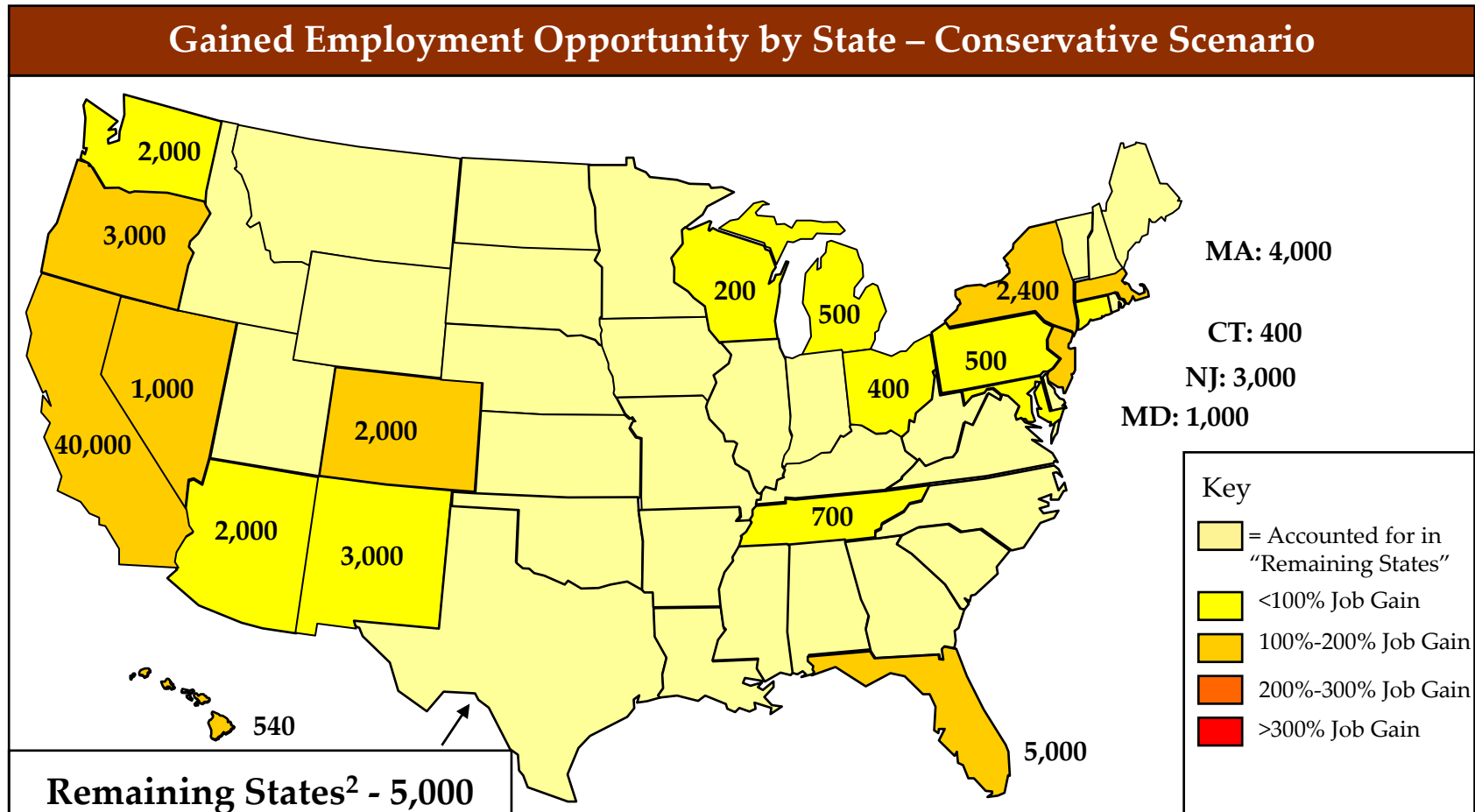
Extension of the current ITC could result in increased employment opportunity of between 77,000 and 230,000 in 2016.



Extension of the current ITC could result in employment gains of between 322,000 and 862,000 job-years from 2009 to 2016.



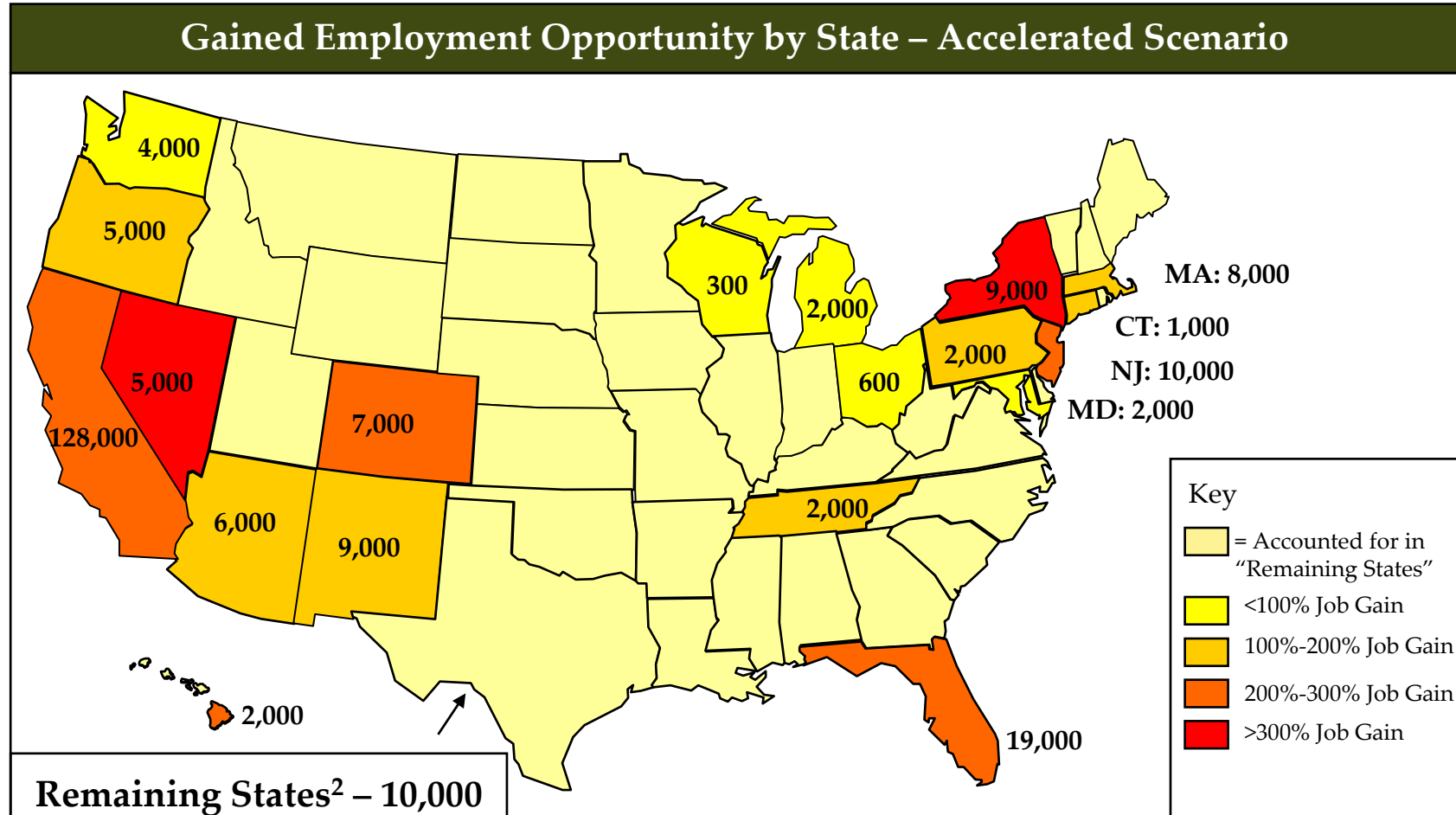
Extension of the current ITC could lead to increased employment opportunity of ~77,000 jobs by 2016 in the conservative scenario.



Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.
2. Remaining states defined as those with less than 200 jobs gained.

Extension of the current ITC could lead to increased employment opportunity of ~230,000 jobs by 2016 in the accelerated scenario.



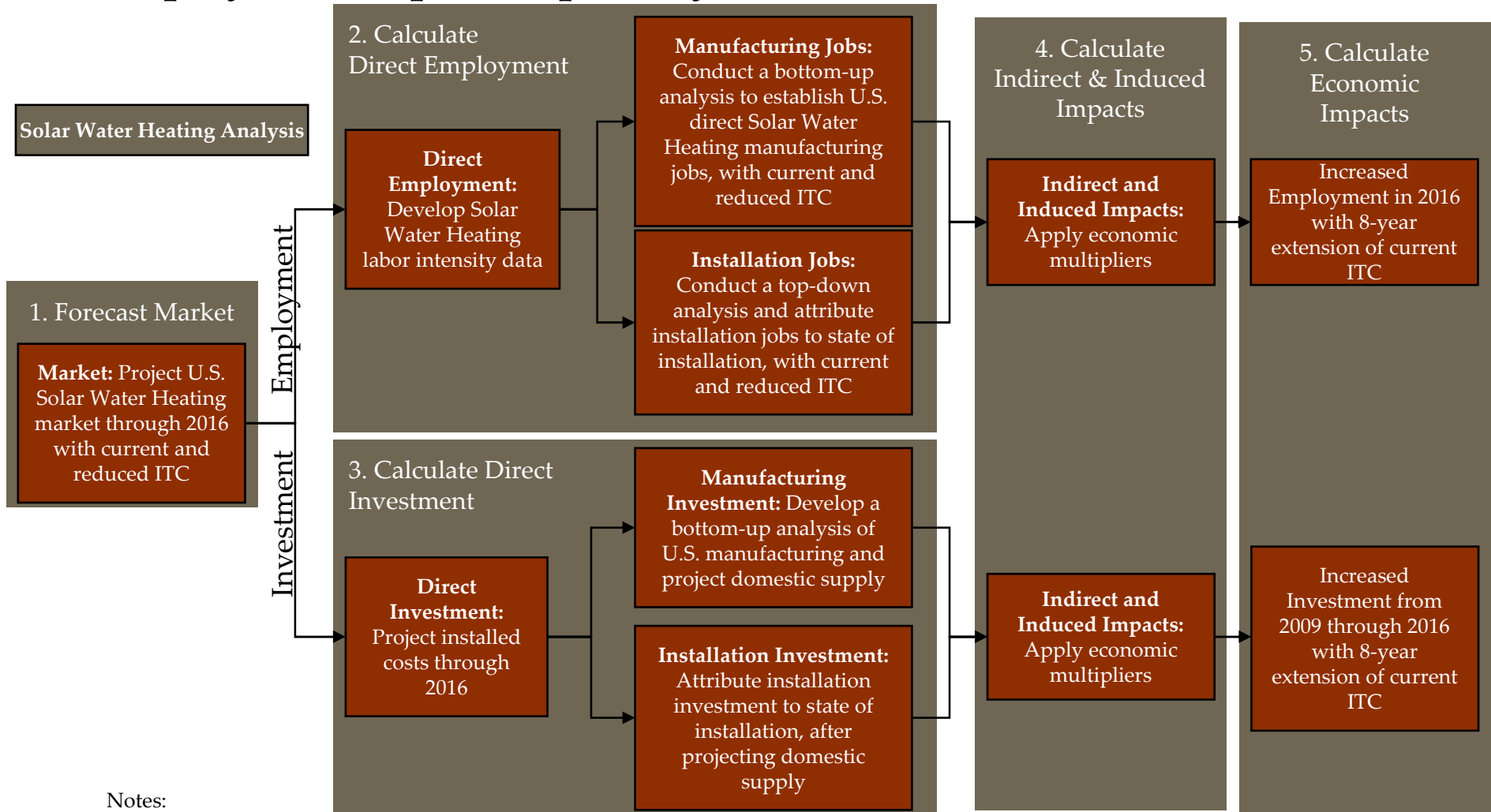
Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.
2. Remaining states defined as those with less than 300 jobs gained.

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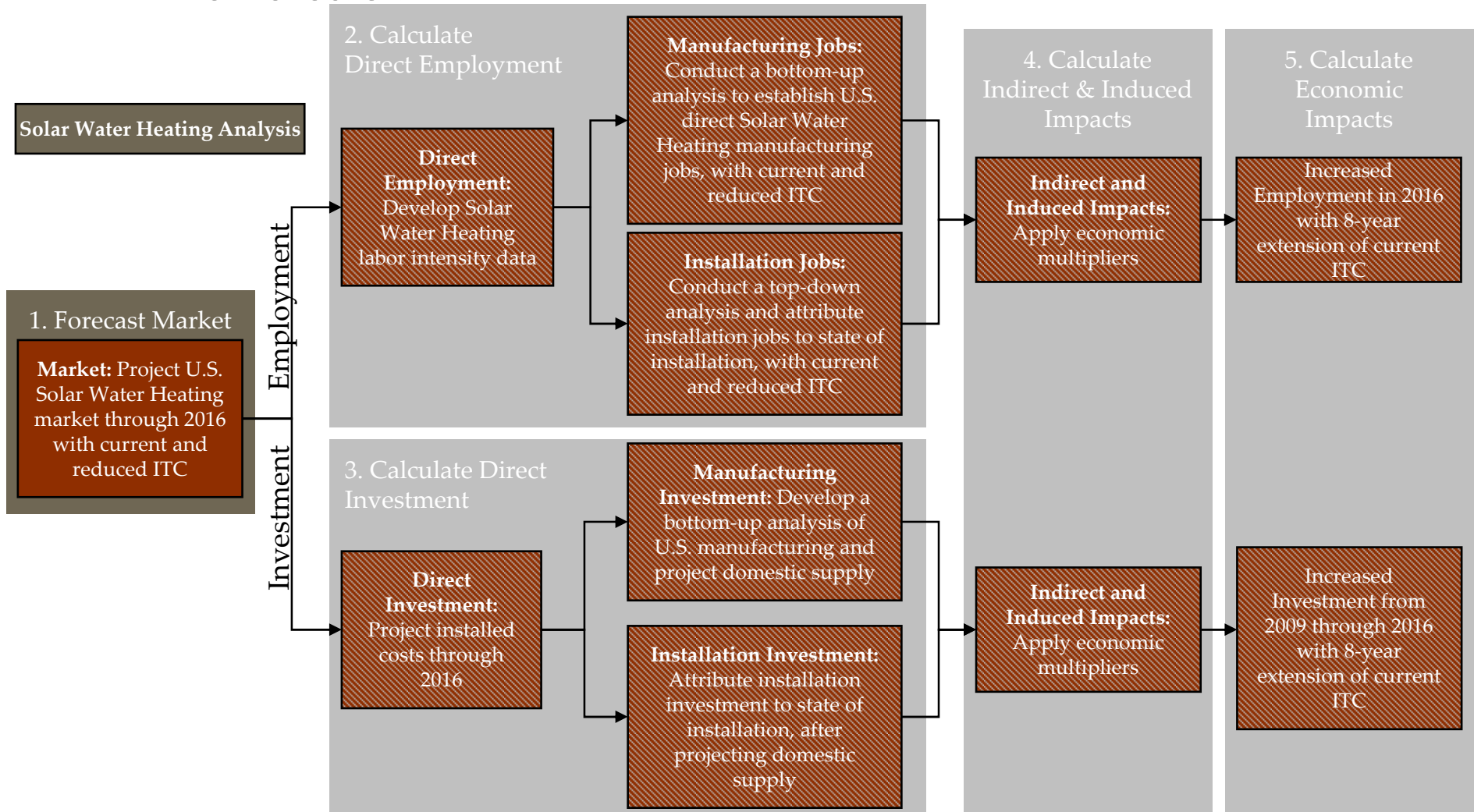
Navigant Consulting analyzed Solar Water Heating investment and employment impacts separately.



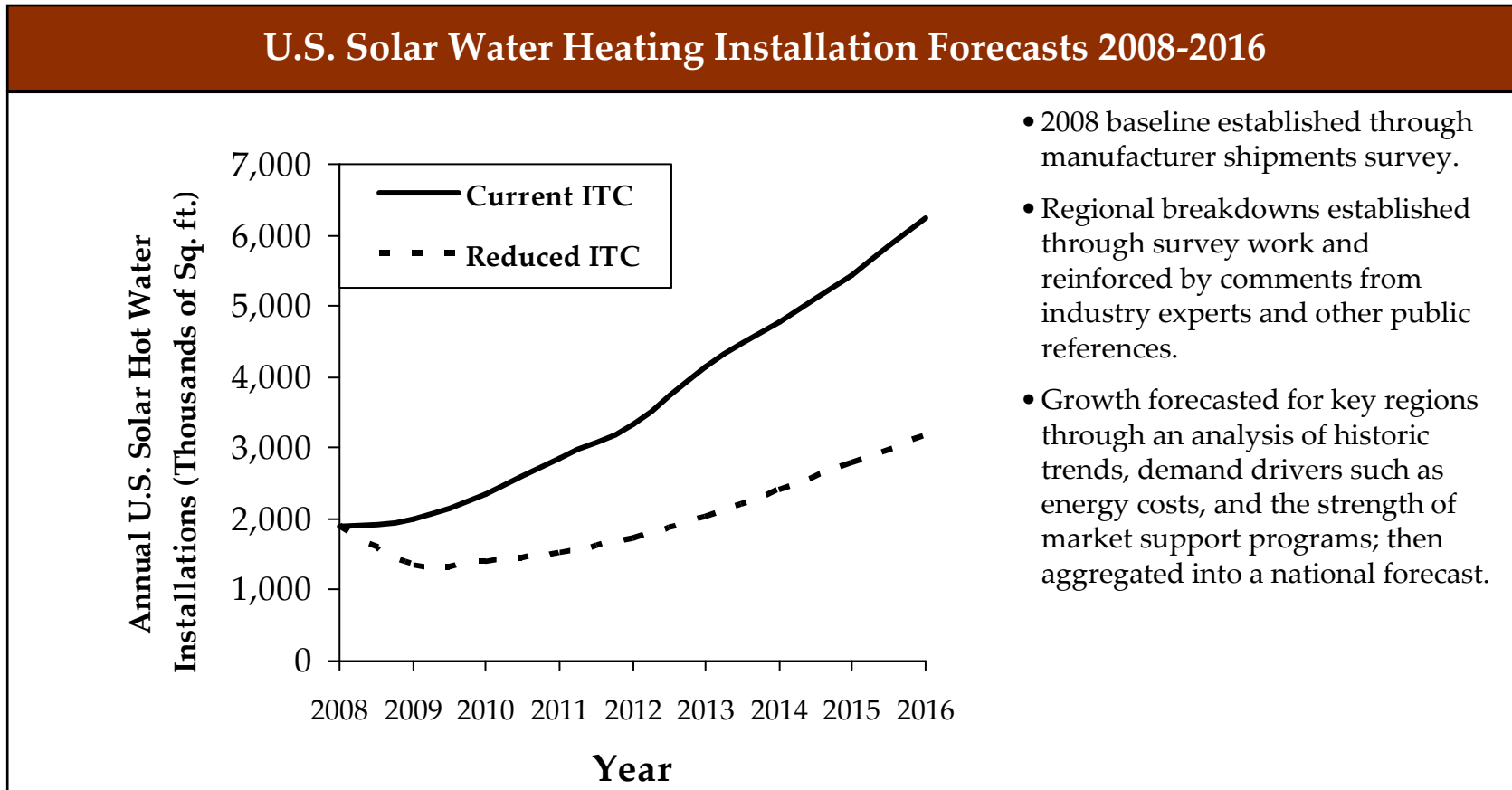
Notes:

- This study did not analyze pool heating systems, as pool heating systems are not eligible for federal tax credits.

Navigant Consulting started by creating a U.S. Solar Water Heating market forecast.



Navigant Consulting used a survey based methodology to create a Solar Water Heating market projection.



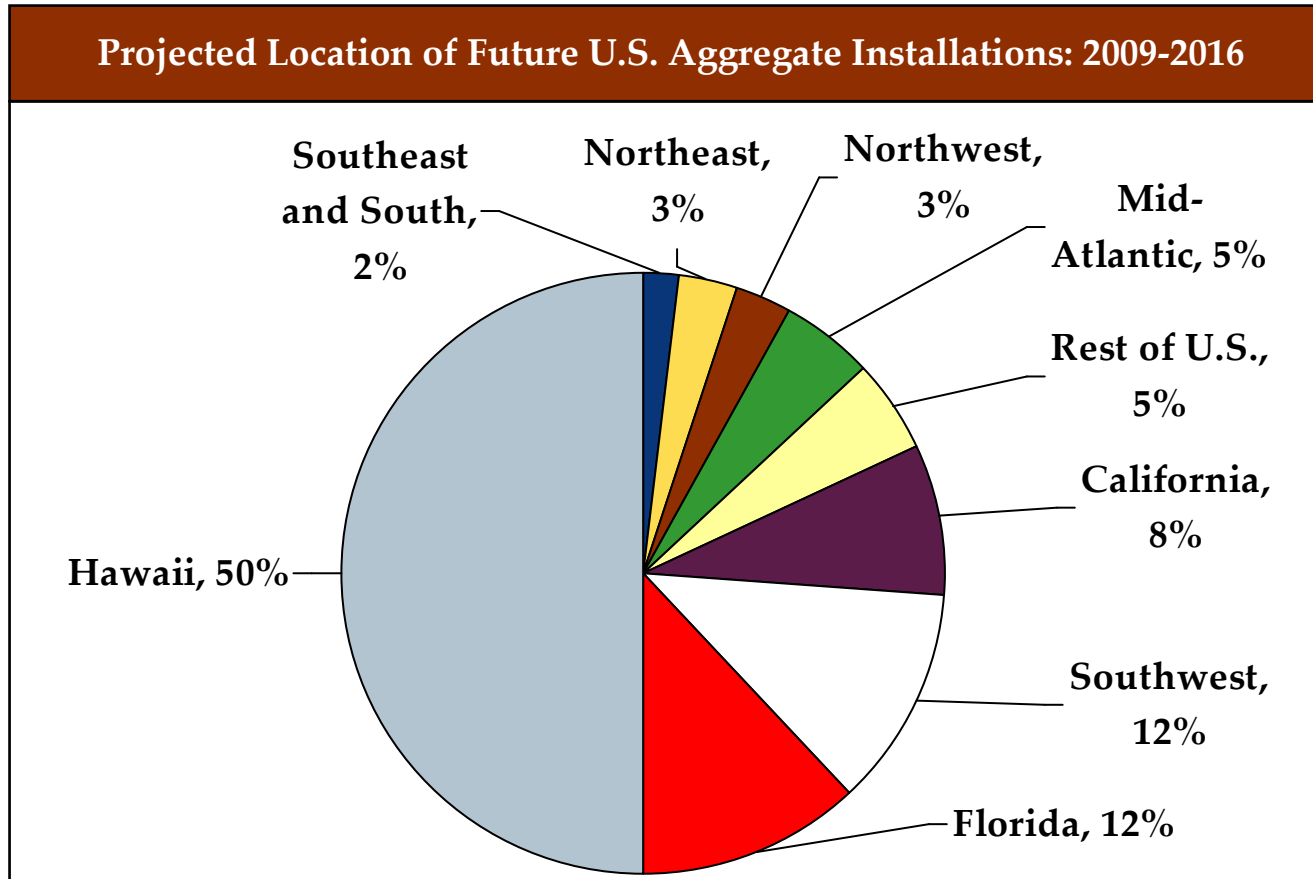
- 2008 baseline established through manufacturer shipments survey.
- Regional breakdowns established through survey work and reinforced by comments from industry experts and other public references.
- Growth forecasted for key regions through an analysis of historic trends, demand drivers such as energy costs, and the strength of market support programs; then aggregated into a national forecast.

Source: Navigant Consulting, August 2008

Notes:

1. Residential system size is typically 40 Sq. Ft. and a commercial system varies from 500 Sq. Ft. to 50,000 Sq. Ft.

Navigant Consulting projected future Solar Water Heating installations.

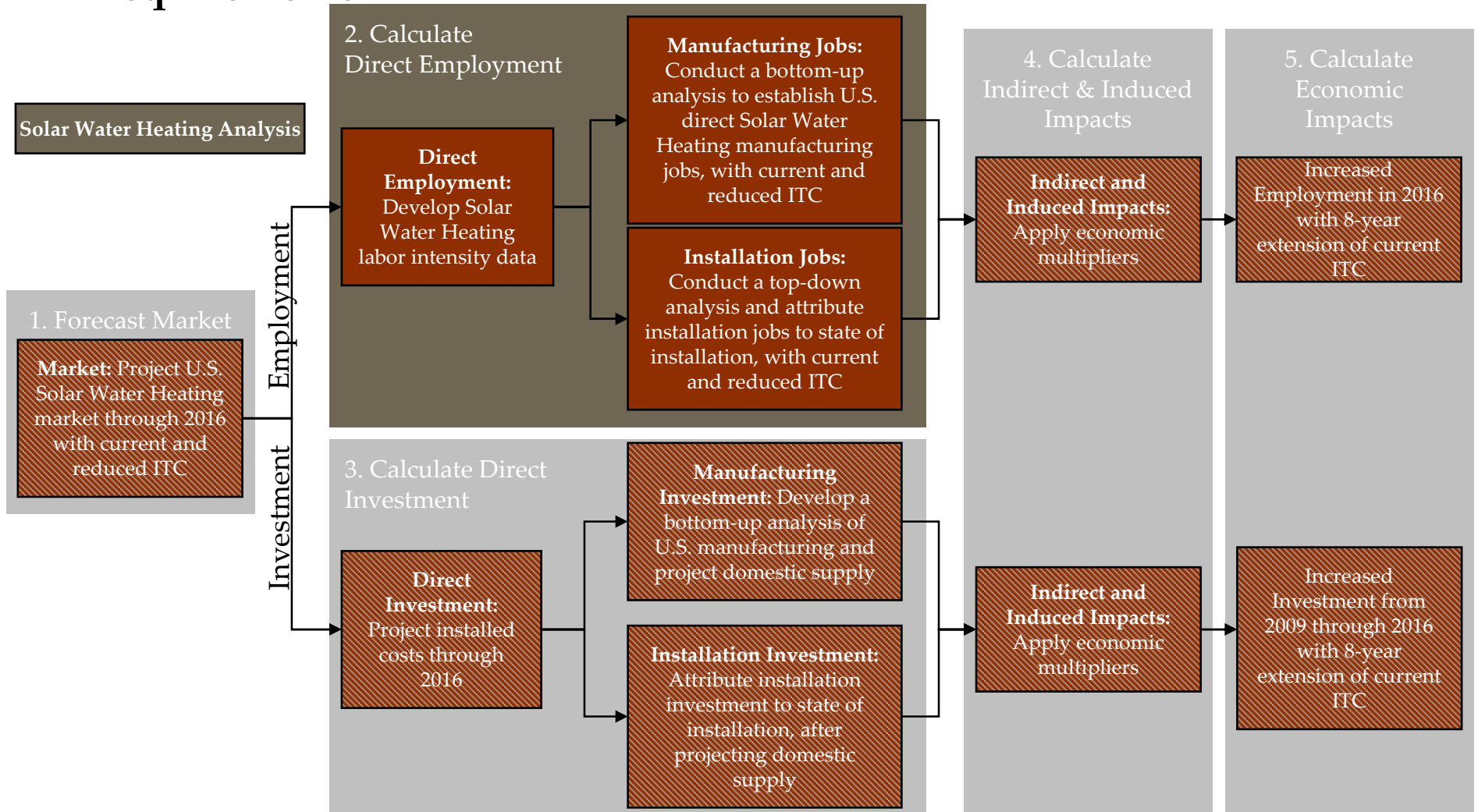


Source: NCI, August 2008

Notes:

1. Methodology - Regional breakdowns established through survey work and reinforced by comments from industry experts and other public market references.
2. Regional definitions: Northeast-MA, CT, ME, NH, VT, NY; Northwest-OR, WA; Mid-Atlantic-VA, MD, DC, NJ, PA; Southwest-AZ, NM, CO, TX; and South/Southeast-AL, SC, NC, TN, MS, GA.

Next, Navigant Consulting calculated Solar Water Heating employment requirements.



Navigant Consulting calculated labor requirements using interviews and publicly available sources.

Solar Water Heating Labor Intensity Data	
Primary Data Sources and Data Elements	<ul style="list-style-type: none"> • Interviews with manufacturers supplying the U.S. Solar Water Heating market. • <i>R.S. Means Mechanical Cost Data 2008</i> was used for installation labor requirements. R.S. Means is a key cost and labor estimating tool used in the building and construction industries.
Method	<ul style="list-style-type: none"> • Interviews with current U.S. collector and balance of system (BOS) manufacturers. <ul style="list-style-type: none"> – Established a baseline for current manufacturing capacity and employment levels. – Discussed specific manufacturer expansion plans and the likelihood of growth under both current and reduced ITC cases. – Profiled 19 solar water heating collector and component suppliers to the U.S. market, forecasting job growth for each individual company. – Allocated manufacturing jobs to state markets based on current manufacturing locations and announced or expected citing of future facilities. – Assumed these companies represented 80% SWH manufacturing, based on percent of total U.S. market identified in gathering primary data. <ul style="list-style-type: none"> ▪ Balance allocated by location of other companies not profiled. • To estimate installation labor, a system with 3 collectors and varied system configuration (e.g. indirect vs. direct, drainback, etc.) was used to look at the variation in labor requirements by configuration type. Then average required labor hours were calculated as projected by R.S. Means which was 70 labor hours per installation.

Solar Water Heating manufacturing and installation requires a wide variety of skill sets and educational backgrounds.

Manufacturing Jobs

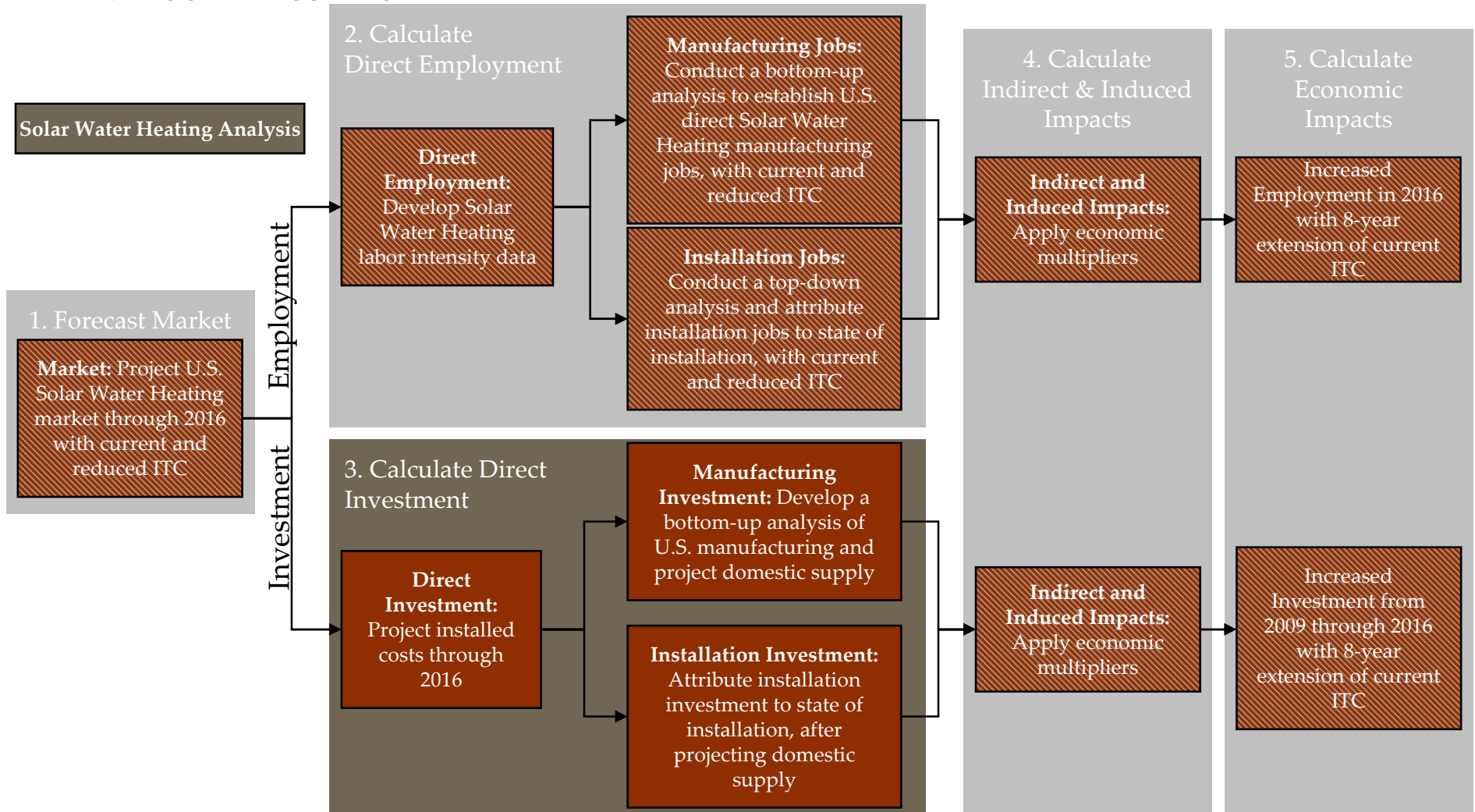
- Manufacturing
 - Sheet metal worker
 - Technician
 - Material handler
 - Factory supervisor
 - Manufacturing engineer
 - Manufacturing manager
- Design
 - Mechanical engineer
 - Materials scientist
- Administrative and support
 - Directors
 - Purchasing agent
 - Quality assurance
 - Health and safety officer
 - Accountant
 - Administrative assistant
 - Information technology professional

Installation Jobs

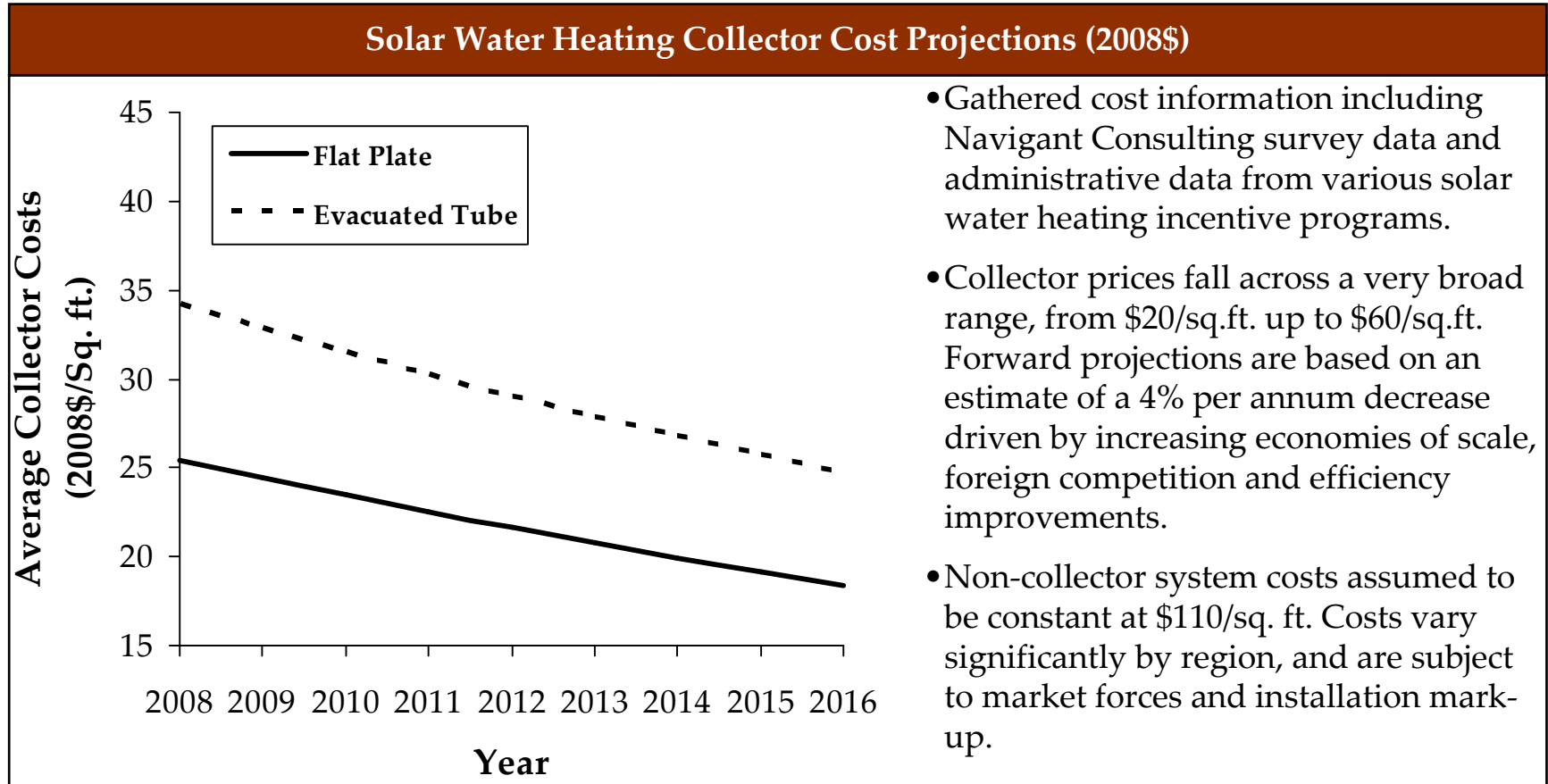
- Installation
 - Plumbing
 - General contractor
 - Shift supervisor (for large commercial projects)
 - Foreman (for large commercial projects)
- Design
 - Mechanical engineer
- Administrative and support
 - Accountant
 - Administrative assistant
 - Information technology professional

Source: Navigant Consulting, July 2008

Next, Navigant Consulting projected installed system costs to analyze direct investment.

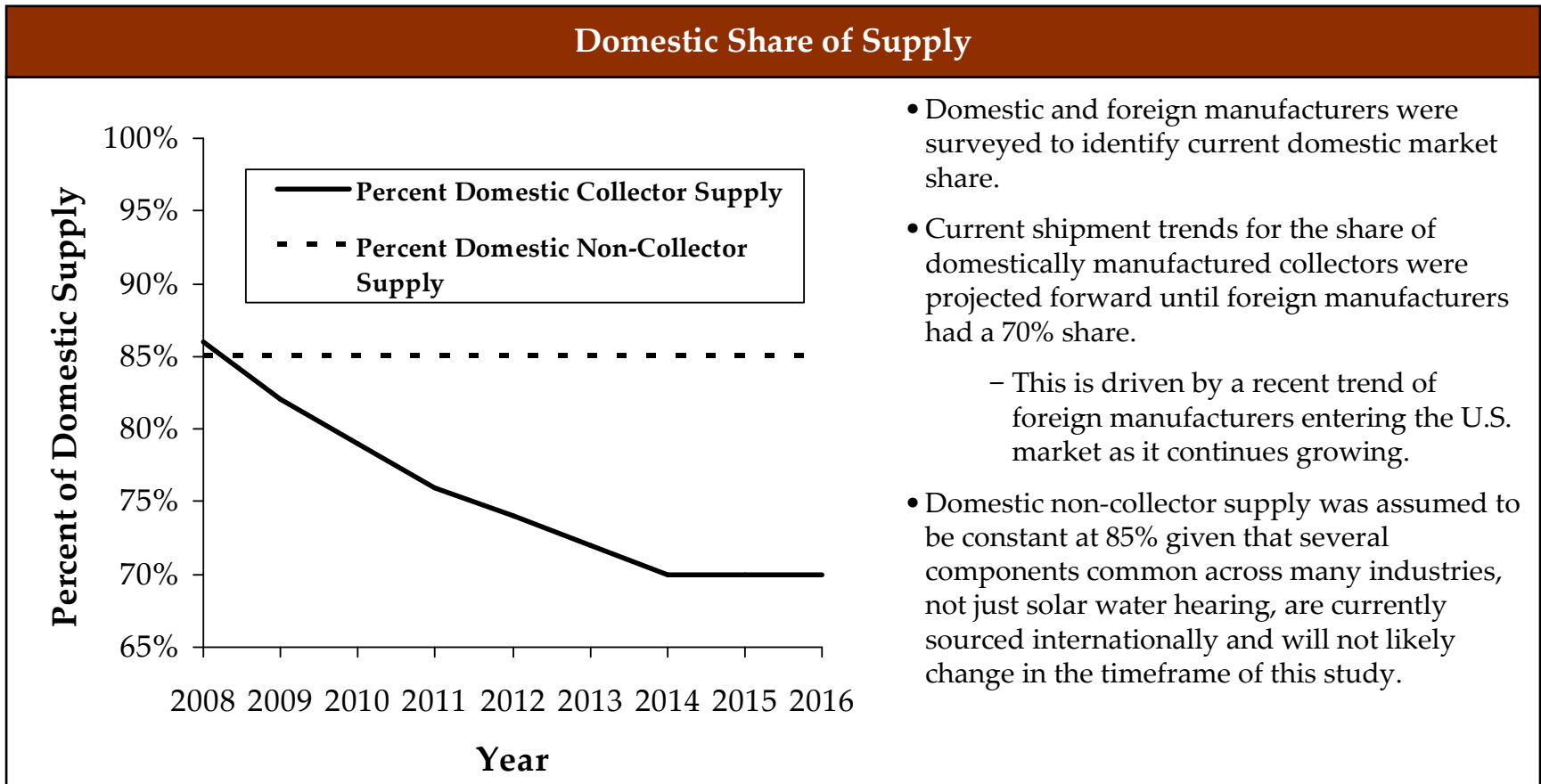


To understand how much direct investment will occur, Navigant Consulting first projected installed costs over time.



Sources: Navigant Consulting, August 2008.

To look at the impact of the ITC on the proportion of materials coming from domestic supply, domestic market shares were projected.

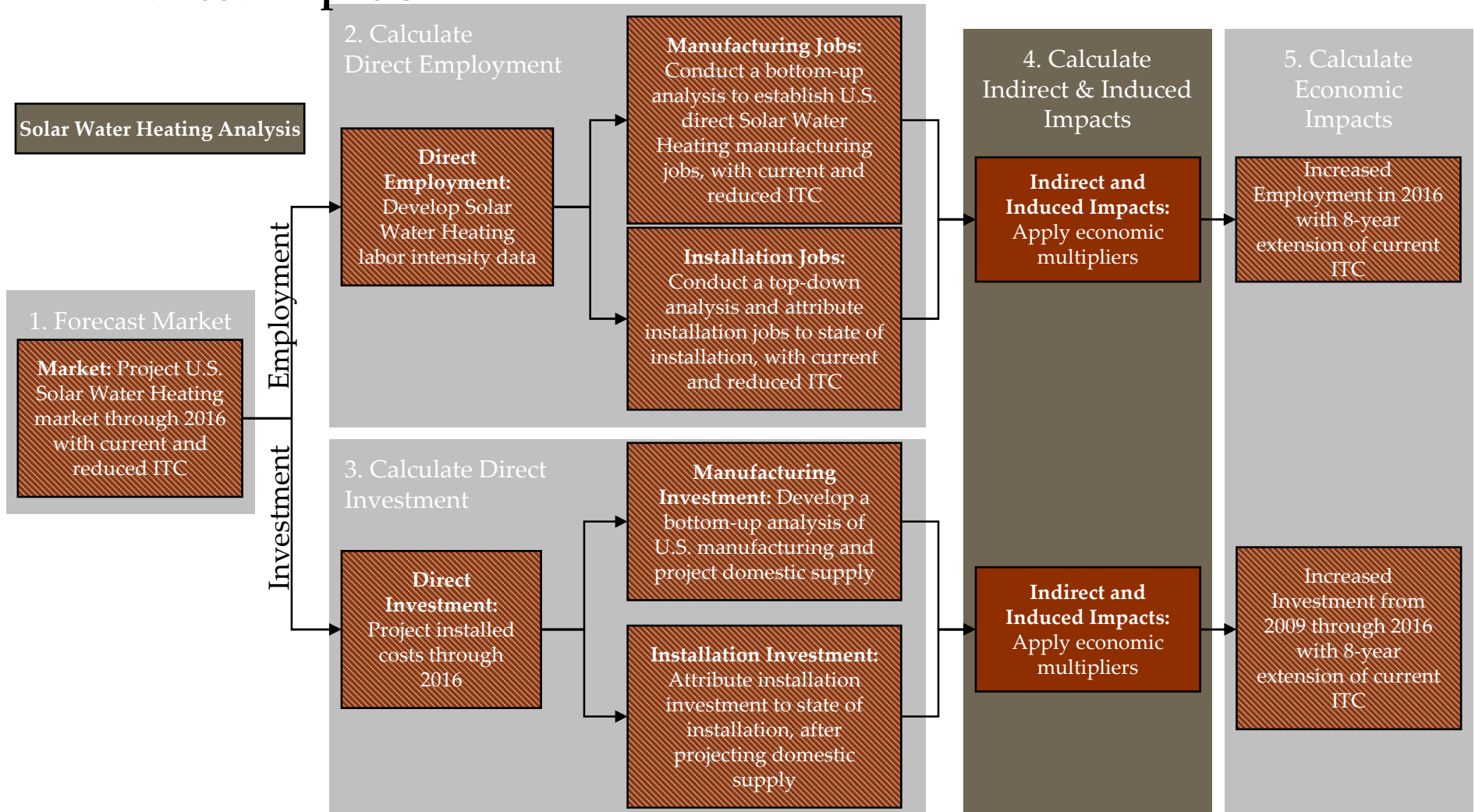


Sources: Navigant Consulting, August 2008

Notes:

1. Even with domestic market share decreasing, overall U.S. manufacturing will be increasing because of the industry's growth rate.

Navigant Consulting used an existing study to project indirect and induced impacts.



Navigant Consulting used PV indirect and induced impacts as a proxy for solar water heating impacts.

Employment Economic Multipliers			
Construction and Manufacturing		Operation and Maintenance	
Ratio of Indirect to Direct	Ratio of Induced to Direct	Ratio of Indirect to Direct	Ratio of Induced to Direct
1.4	2.1	0.5	0.8

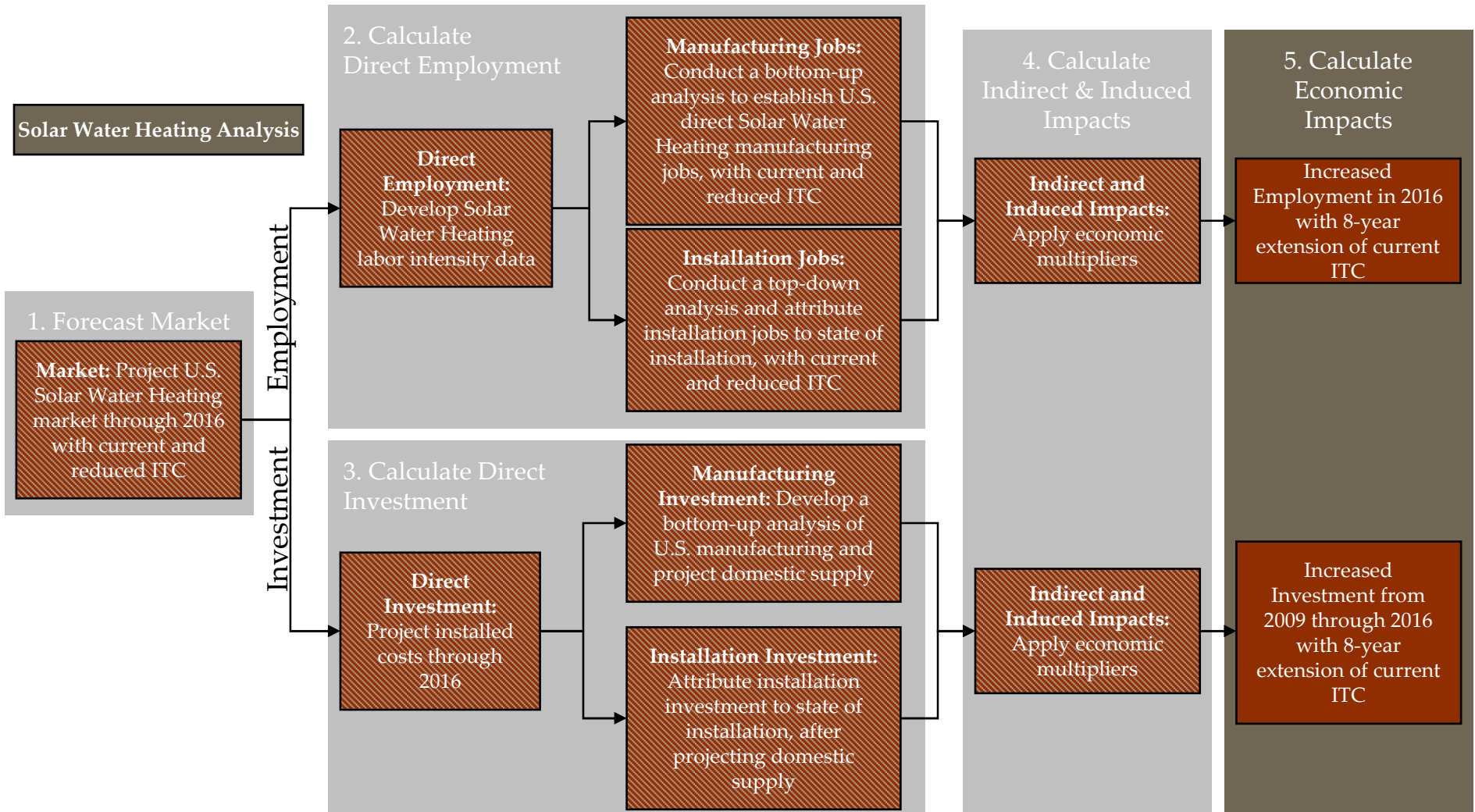
Investment Economic Multipliers			
Construction and Manufacturing		Operation and Maintenance	
Ratio of Indirect to Direct	Ratio of Induced to Direct	Ratio of Indirect to Direct	Ratio of Induced to Direct
1.1	1.3	0.7	0.9

Source: S. Grover, “Energy, Economic, and Environmental Benefits of the Solar America Initiative”, August 2007, NREL/SR-640-41998.
 Economic multipliers calculated using IMPLAN regional economic modeling software.

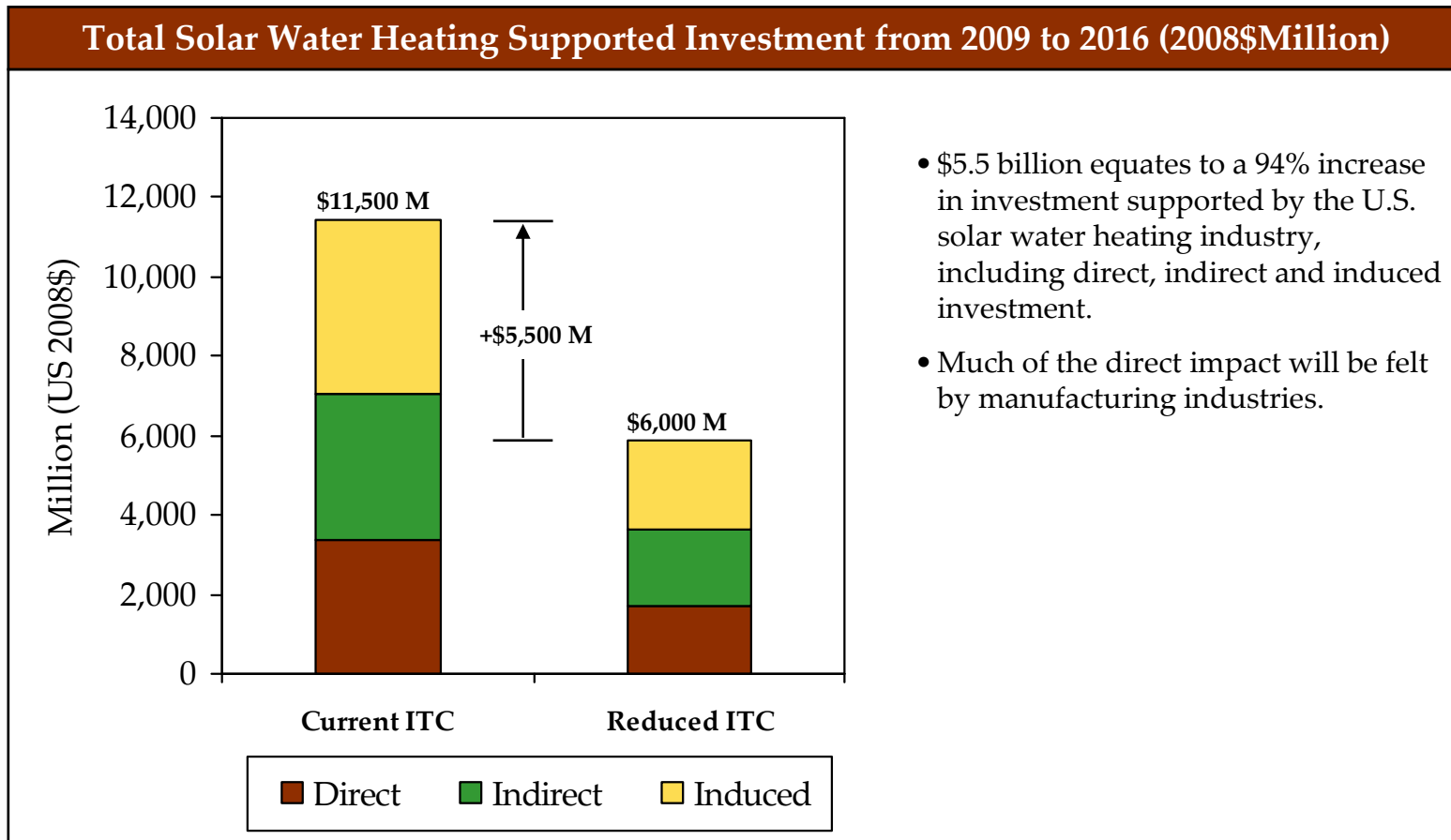
Notes:

1. Refer to the appendix for definitions of direct, indirect, and induced.
2. No studies exist on solar water heating impacts, but given similarities between PV and solar water heating; in terms of value chain, end use, and market segments; Navigant Consulting assumed the study’s results were appropriate.

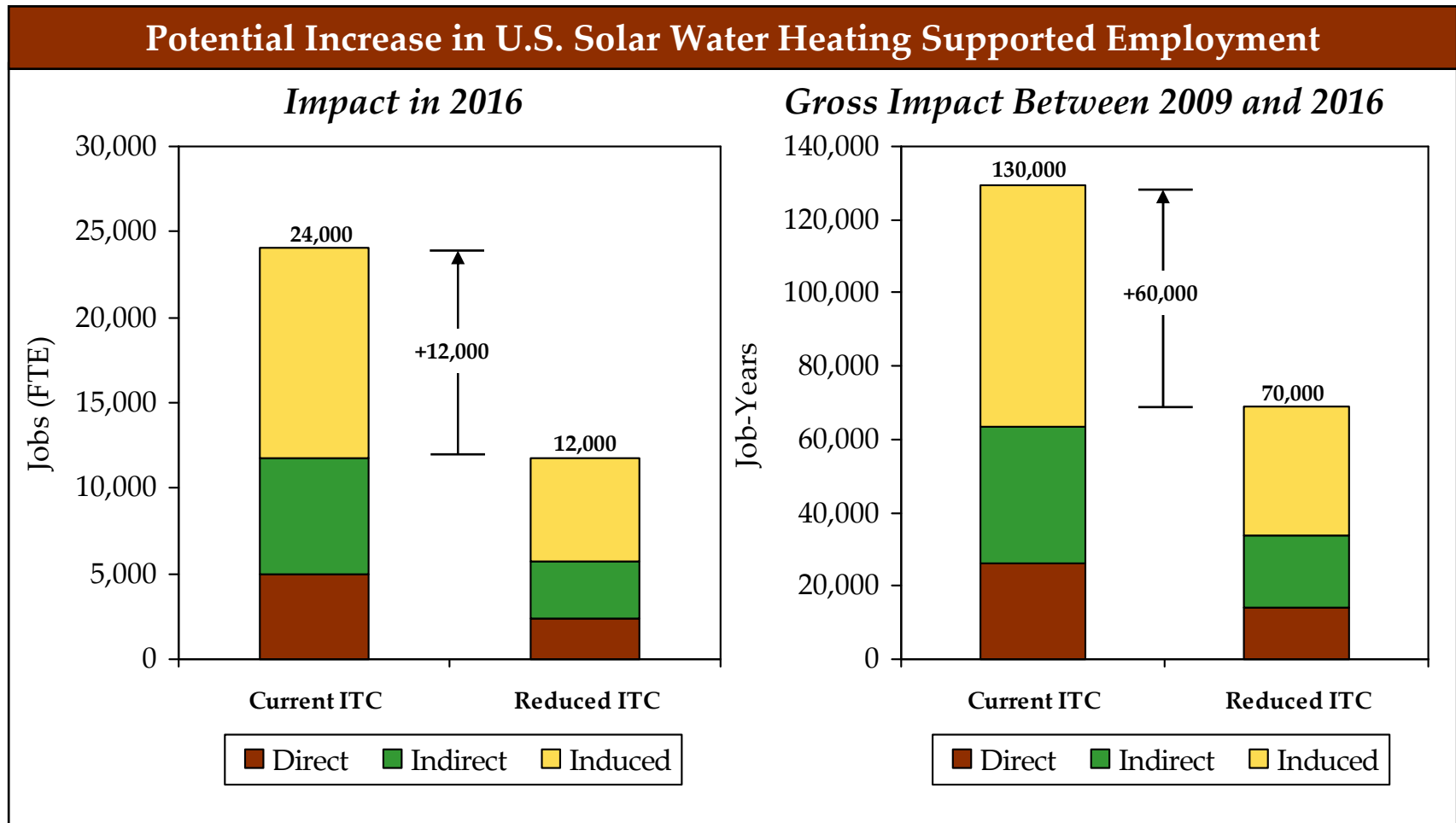
Finally, Navigant Consulting calculated the gross impacts.



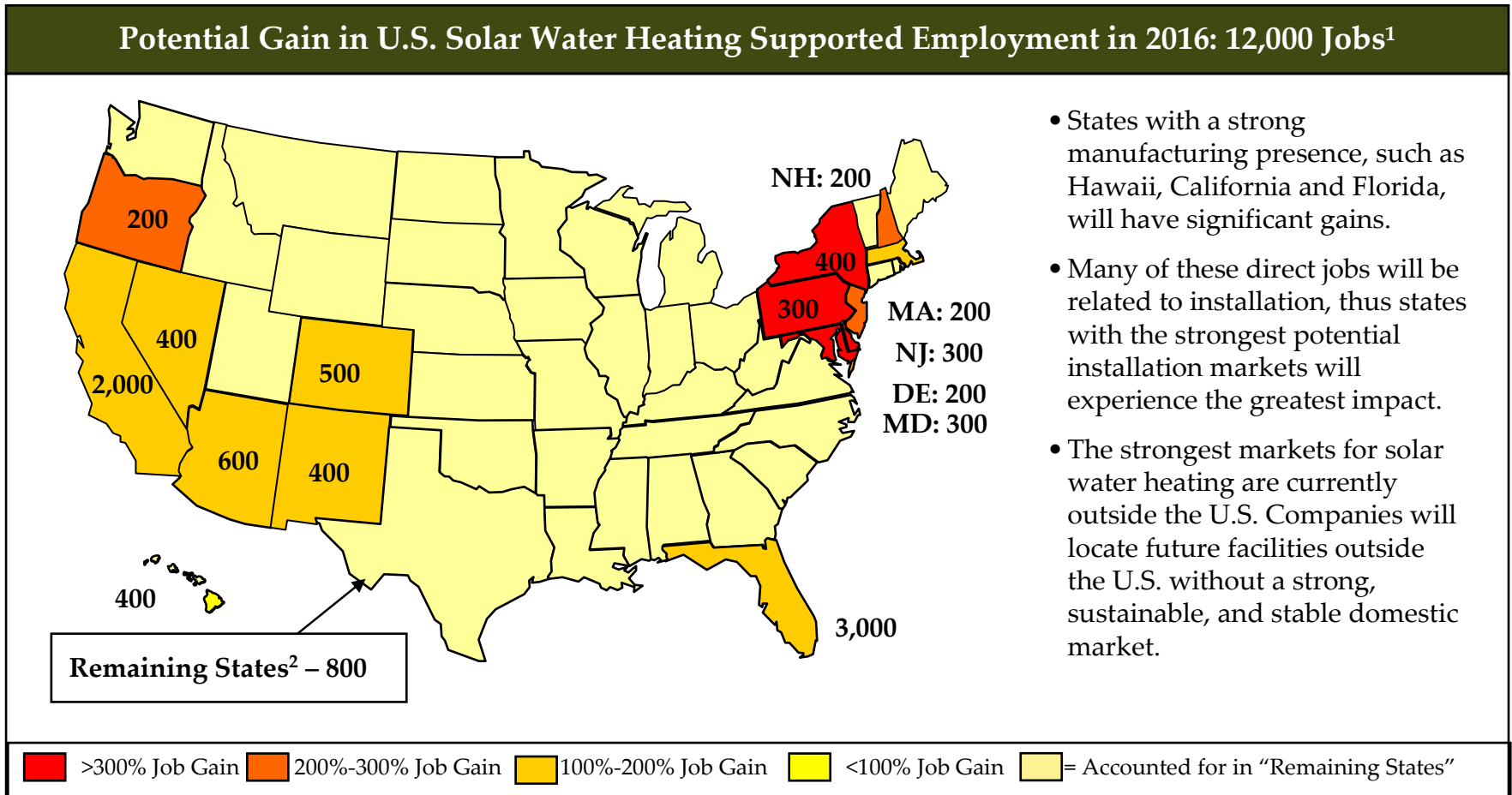
Extension of the current ITC could result in gained investment of \$5.5 billion between 2009 and 2016.



Extending the current ITC could spur an additional 12,000 jobs and 60,000 job-years of employment between 2009 and 2016.



Gained employment would occur primarily in a couple of state clusters.



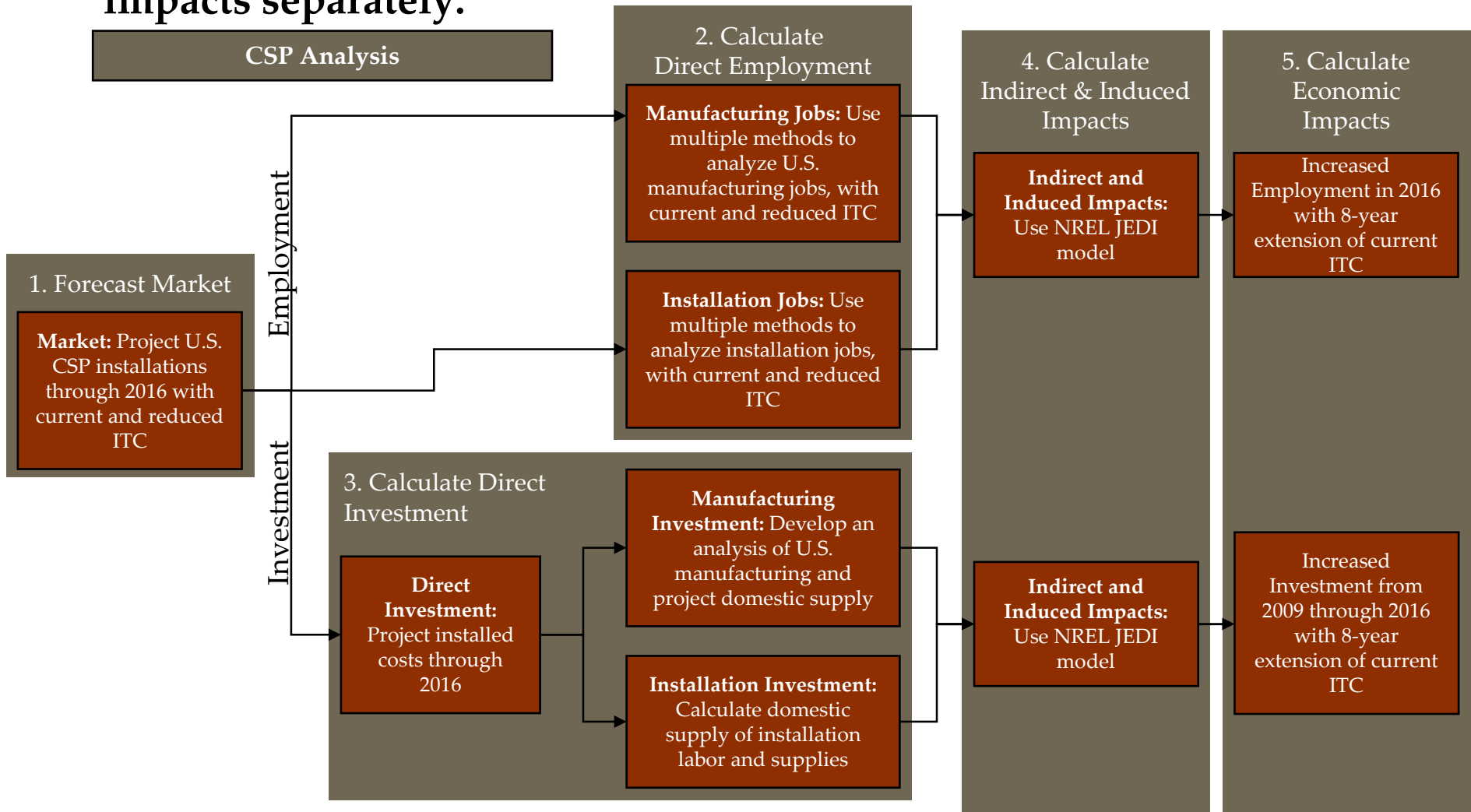
Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.
2. Remaining states are those with less than 800 jobs gained.

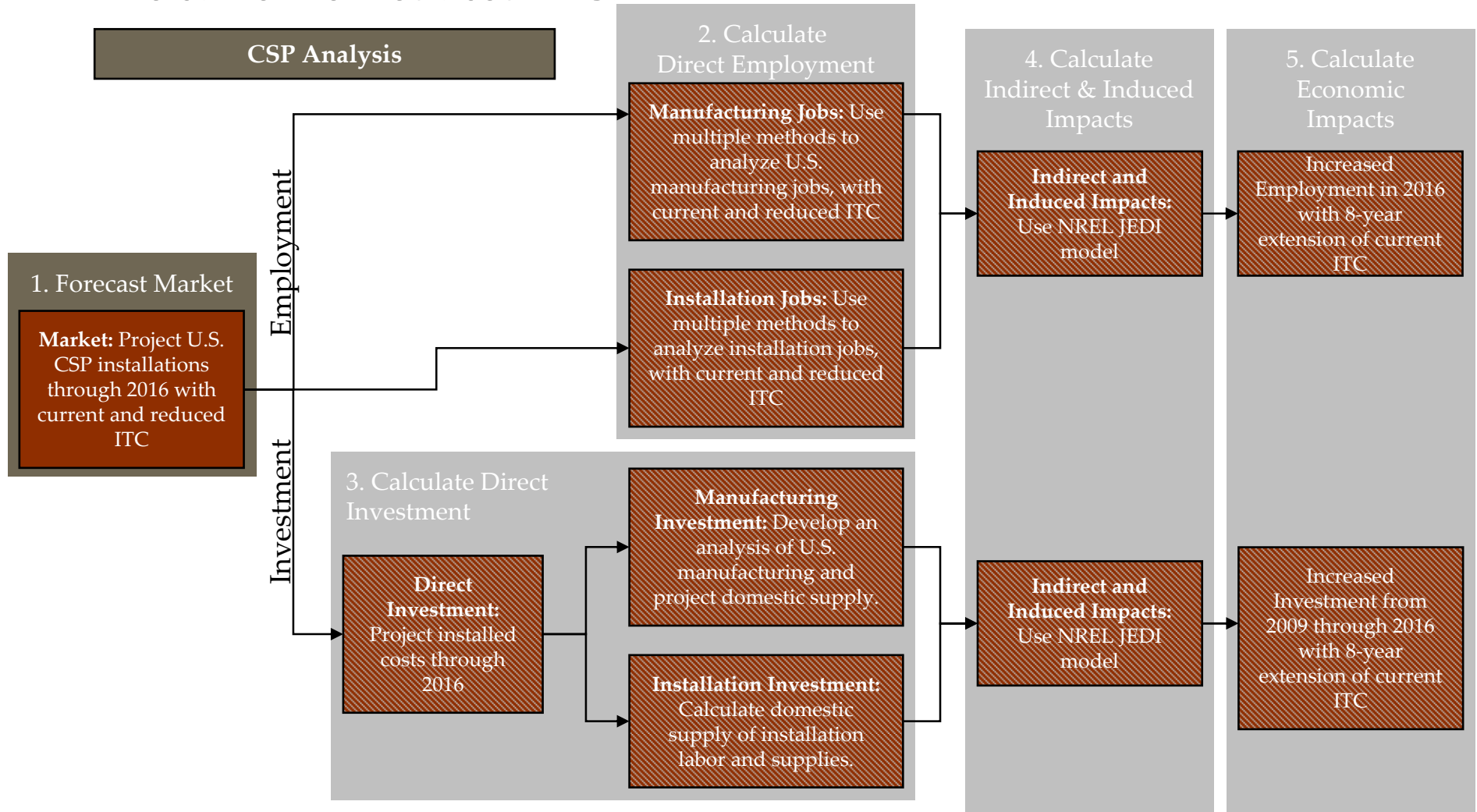
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Navigant Consulting analyzed CSP investment and employment impacts separately.



Navigant Consulting started by creating a CSP market projection with the current or reduced ITC.

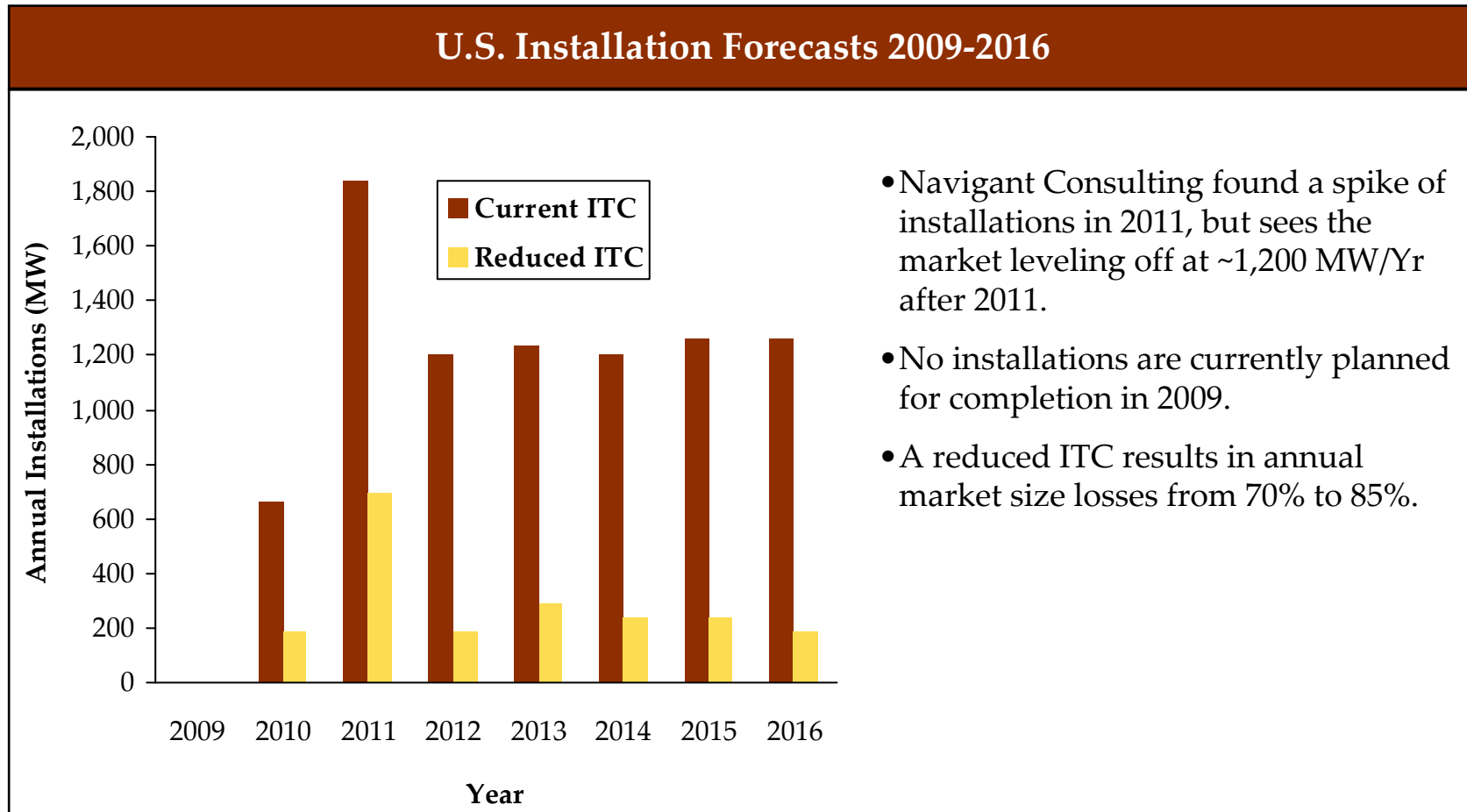


Navigant Consulting projected U.S. CSP installations with the current and reduced ITC.

Projection Methodology

- **Current ITC** – Navigant Consulting maintains a market projection of U.S. installations based upon press releases and research. Navigant Consulting conducted industry interviews with 11 key CSP manufacturers and developers to review this database and obtain additional pipeline data between 2009 and 2016. Navigant Consulting then updated its market projections based upon this feedback.
- **Reduced ITC** – Navigant Consulting developed projections of U.S. installations based on information gathered in the interviews with key CSP manufacturers and developers. In general, on-going and potential CSP projects depend on the current ITC for near term planning, so a large portion of the planned annual installations (70 - 80% over the years considered) will be canceled if the current ITC is allowed to expire. The installations that will still occur fall into a few categories:
 - Projects that are less susceptible to the loss of the ITC due to sufficient financial backing,
 - Projects that are being undertaken by utilities, and
 - Projects that are essentially demonstrations of commercial viability for companies. Although these projects will be installed, some completion dates will be delayed.

An extended ITC will significantly impact the U.S. CSP market.

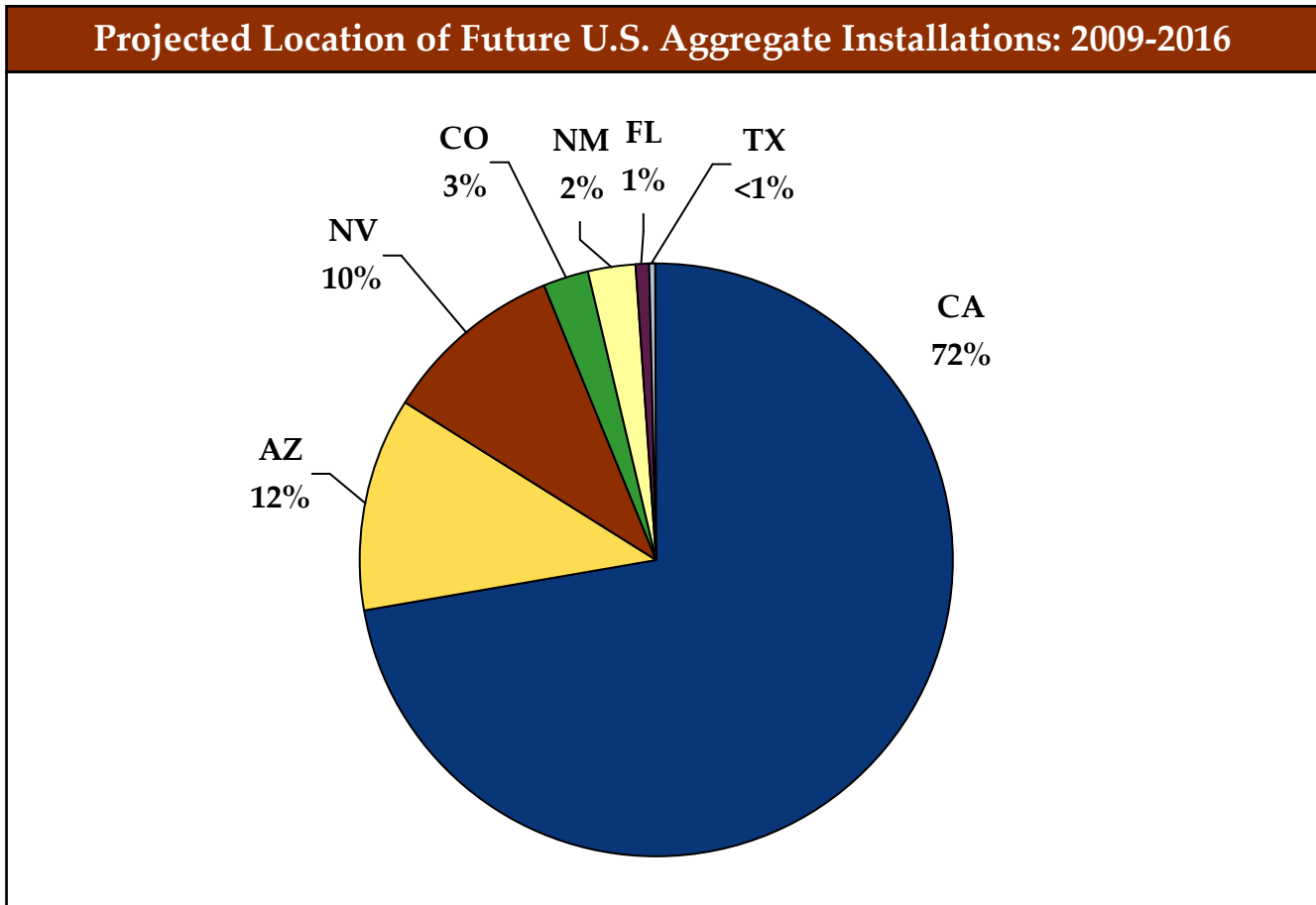


Source: Navigant Consulting, August 2008

Notes:

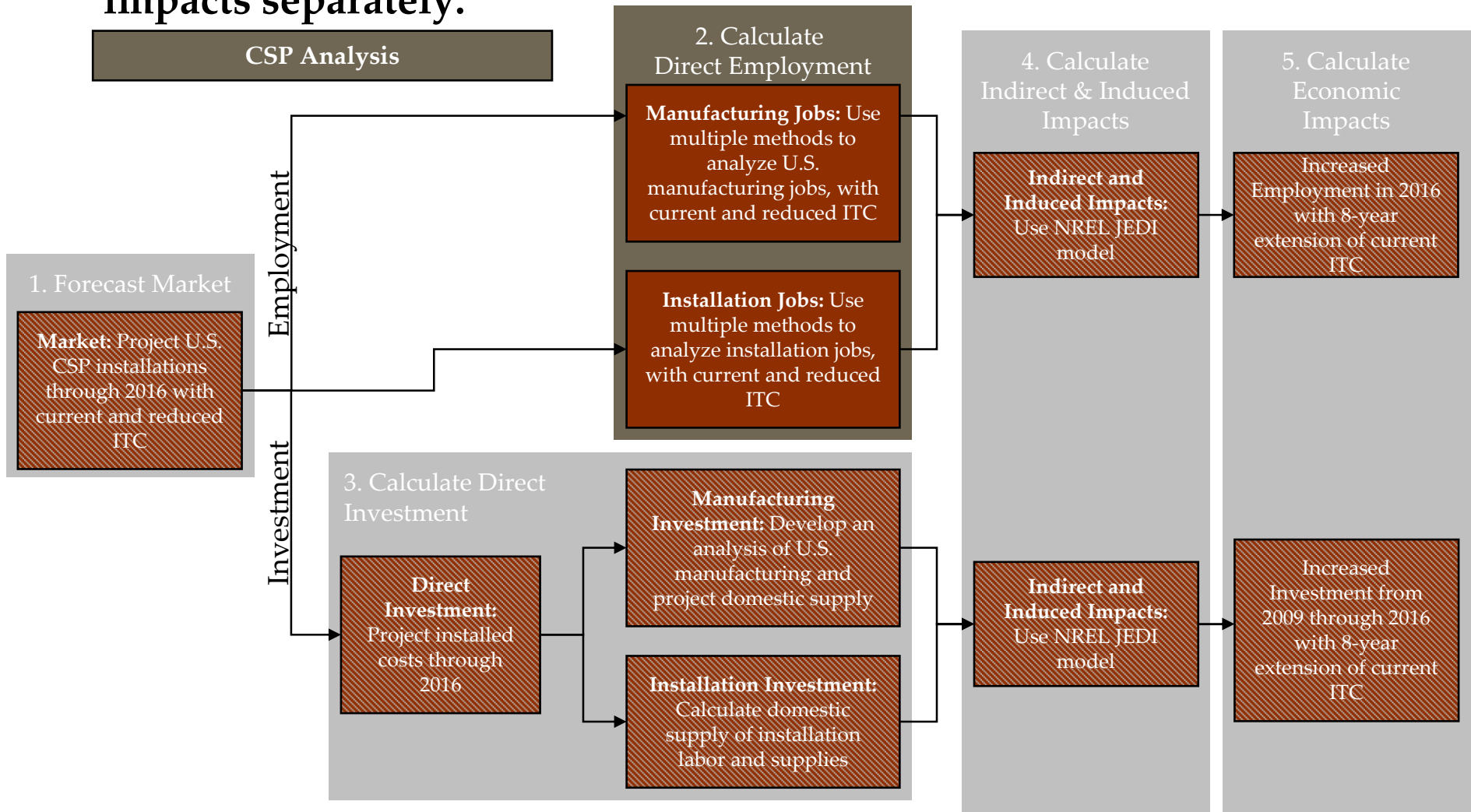
1. This forecast assumes adequate transmission is available to support all projects built.

CSP projects will primarily be installed in the Southwestern United States, given the region's strong solar resources.



Source: Navigant Consulting, August 2008

Navigant Consulting analyzed CSP investment and employment impacts separately.



Navigant Consulting calculated CSP direct employment using several data sources.

Calculation of CSP Direct Manufacturing, Installation, and Operation & Maintenance Jobs	
Primary Data Sources and Data Elements	<ul style="list-style-type: none"> Publicly announced CSP manufacturing facilities under construction or scheduled to be built. Industry interviews with technology developers, manufacturers, and project developers. <i>Application for Certification</i> forms submitted to the state of California by project developers¹. Results from the National Renewable Energy Laboratory's <i>CSP Jobs and Economic Development Impact (JEDI) Model</i>².
Method	<ul style="list-style-type: none"> Navigant Consulting performed a bottom-up assessment of direct manufacturing jobs for the primary components of CSP installations, including the mirrors and heat collection elements, and estimated current and future jobs for these manufacturers based on interviews and public announcements. Direct installation and O&M jobs were developed based on projected installations and estimated construction and operation and maintenance labor requirements, which were developed through interviews and Applications for Certification forms. The remaining direct jobs were calculated per the JEDI model. This method was used for each project in Navigant Consulting's database.

Notes:

- Application for Certification forms are filed by project developers for projects built in CA and are available from the California Energy Commission at www.energy.ca.gov.
- Model available at <http://www.nrel.gov/analysis/jedi/>. NREL's model is discussed fully in the next section.

CSP manufacturing and installation requires a wide variety of skill sets and educational backgrounds.

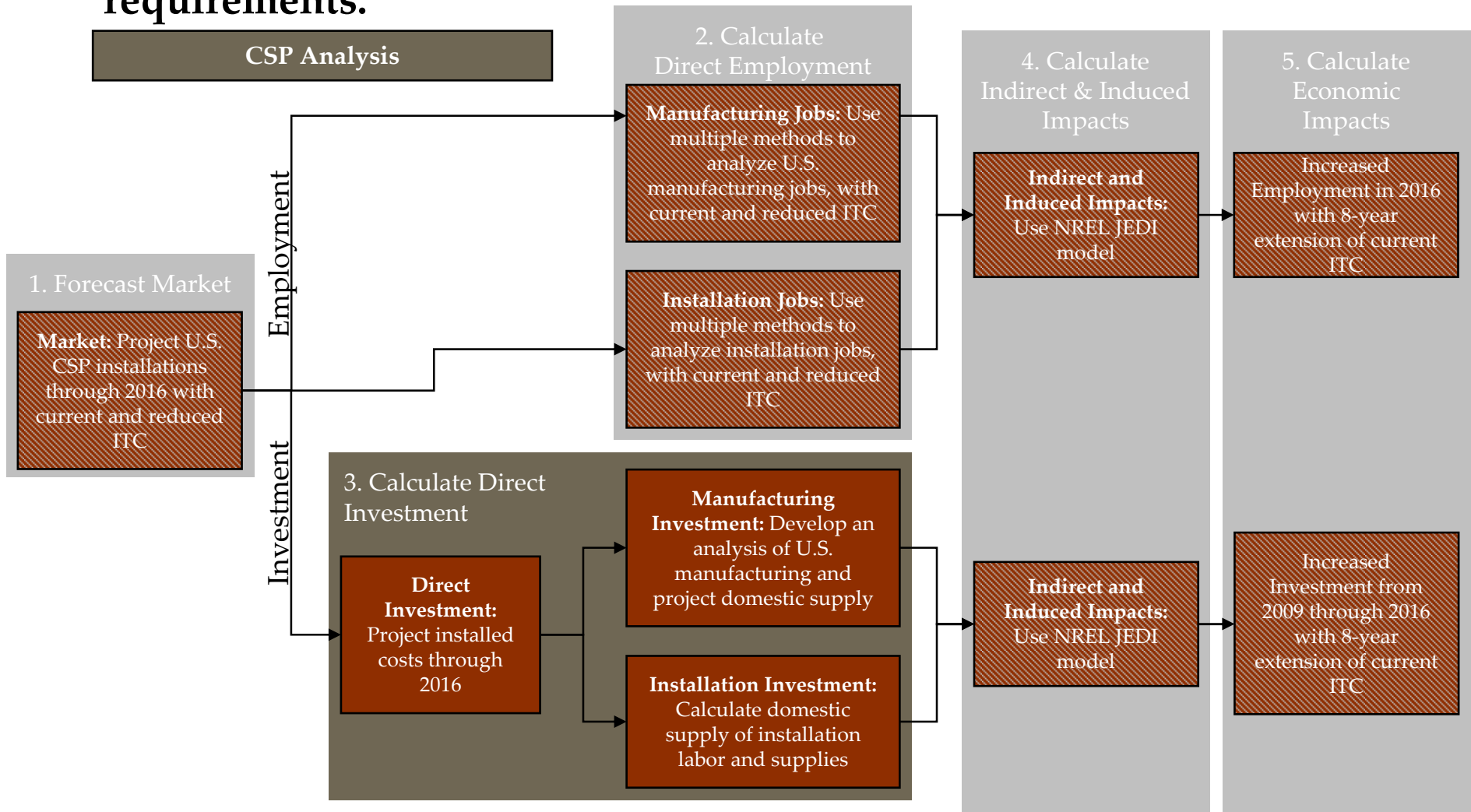
Manufacturing Jobs

- Manufacturing
 - Technician
 - Sheet metal worker
 - Glass worker
 - Material handler
 - Factory supervisor
 - Manufacturing engineer
 - Manufacturing manager
- Design
 - Mechanical engineer
 - Electrical engineer
 - Optical engineer
 - Materials scientist
- Administrative and support
 - Director
 - Purchasing agent
 - Quality assurance
 - Health and safety officer
 - Accountant
 - Administrative assistant
 - Information technology professional

Installation Jobs

- Installation
 - General contractor
 - Electrician
 - Shift supervisor
 - Foreman
 - Heavy construction
 - Welder
 - Pipefitter
- Design
 - Mechanical engineer
 - Civil engineer
 - Electrical engineers
- Administrative and support
 - Health and safety officer
 - Accountant
 - Administrative assistant
 - Information technology professional

Navigant Consulting then collected data on direct investment requirements.



To understand how much direct investment will occur, Navigant Consulting first projected system installed costs over time.

CSP Installed System Costs

• Installed Costs

- Current projects in development use the following technologies: parabolic trough, power tower, compact linear Fresnel, and dish Stirling.
- Through publicly available reports and industry interviews, Navigant Consulting collected installed costs for each technology and project, ranging from \$2,000/kW to \$6,000/kW.
- Of the technologies considered in this study, only parabolic trough costs have been publicly reported. To protect confidential information, Navigant Consulting will not report project or technology specific costs different than those reported in public literature.
- For system cost breakdowns, Navigant Consulting started with default assumptions in NREL's JEDI¹ model and altered the assumptions where applicable (i.e., removing storage costs for a project without storage or removing turbine costs for a project without a central power block).

• Operation and Maintenance (O&M) Costs

- Through publicly available reports and industry interviews, Navigant Consulting found a wide variation in project O&M costs. Navigant Consulting used an average value of \$60/kW-Yr.

Source: Navigant Consulting August, 2008

Notes:

1. Refer to NREL's JEDI model for a breakdown of installed costs, at <http://www.nrel.gov/analysis/jedi/>.

To look at the impact of the ITC on domestic supply, domestic market shares were projected.

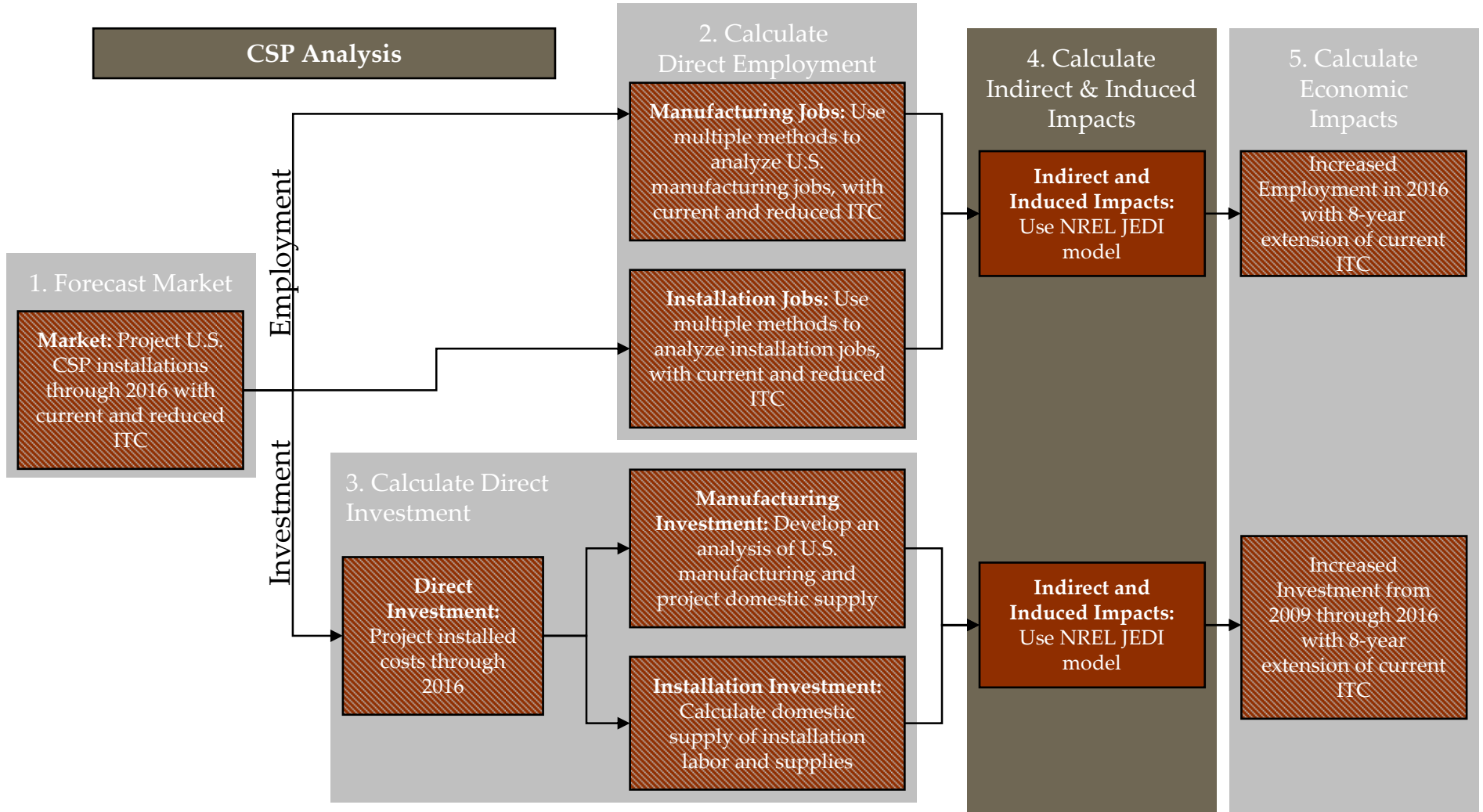
Domestic Supply

- Navigant Consulting started with the default domestic supply assumptions in NREL's JEDI model¹.
 - These defaults are based on a 2006 Black and Veatch study of the economic impacts of concentrating solar power². Navigant Consulting reviewed this report and believes it is a good proxy for the U.S. CSP industry.
- Navigant Consulting then tailored the share of domestic supply for each project based upon industry interviews and publicly announced projects.
 - Navigant Consulting focused on direct investment in items such as receivers, mirrors/heliostats, support structures, turbines, etc.
- Navigant Consulting used the JEDI defaults for projects which Navigant Consulting did not obtain any data.

Notes:

1. Refer to NREL's JEDI model for default assumptions, at <http://www.nrel.gov/analysis/jedi/>.
2. The Black and Veatch study is entitled *Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California*.

Navigant Consulting used a publicly available model to calculate indirect and induced impacts.



Navigant Consulting used NREL’s Parabolic Trough Jobs and Economic Development Impact (JEDI) model to assess CSP’s indirect and induced impacts.

Example of JEDI Outputs for a 2010 100 MW Parabolic Trough Plant in CA ¹		
Output	Jobs [FTE]	Investment [\$M]
During Construction		
Direct	1,031	215.81
Indirect	424	58.88
Induced	745	92.04
During Operation		
Direct	50	6.33
Indirect	16	2.31
Induced	47	5.77

Source: NREL’s JEDI model can be found at <http://www.nrel.gov/analysis/jedi/>

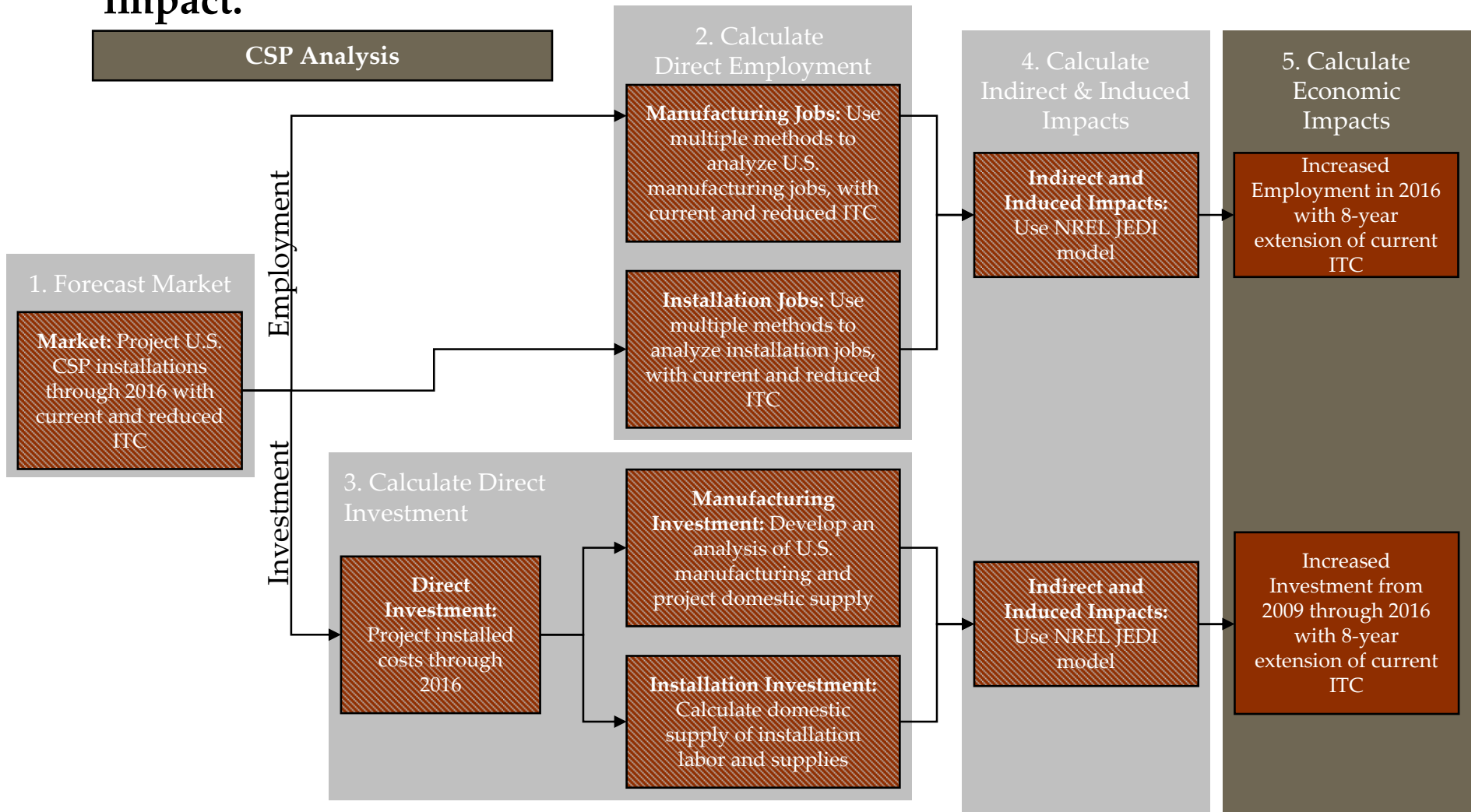
Notes:

1. Assuming 4,862 \$/kW installed costs, 72.68 \$/kW-Yr O&M Costs.
2. More information on IMPLAN modeling software can be found at <http://www.implan.com/>
3. Refer to appendix for definition of FTE.

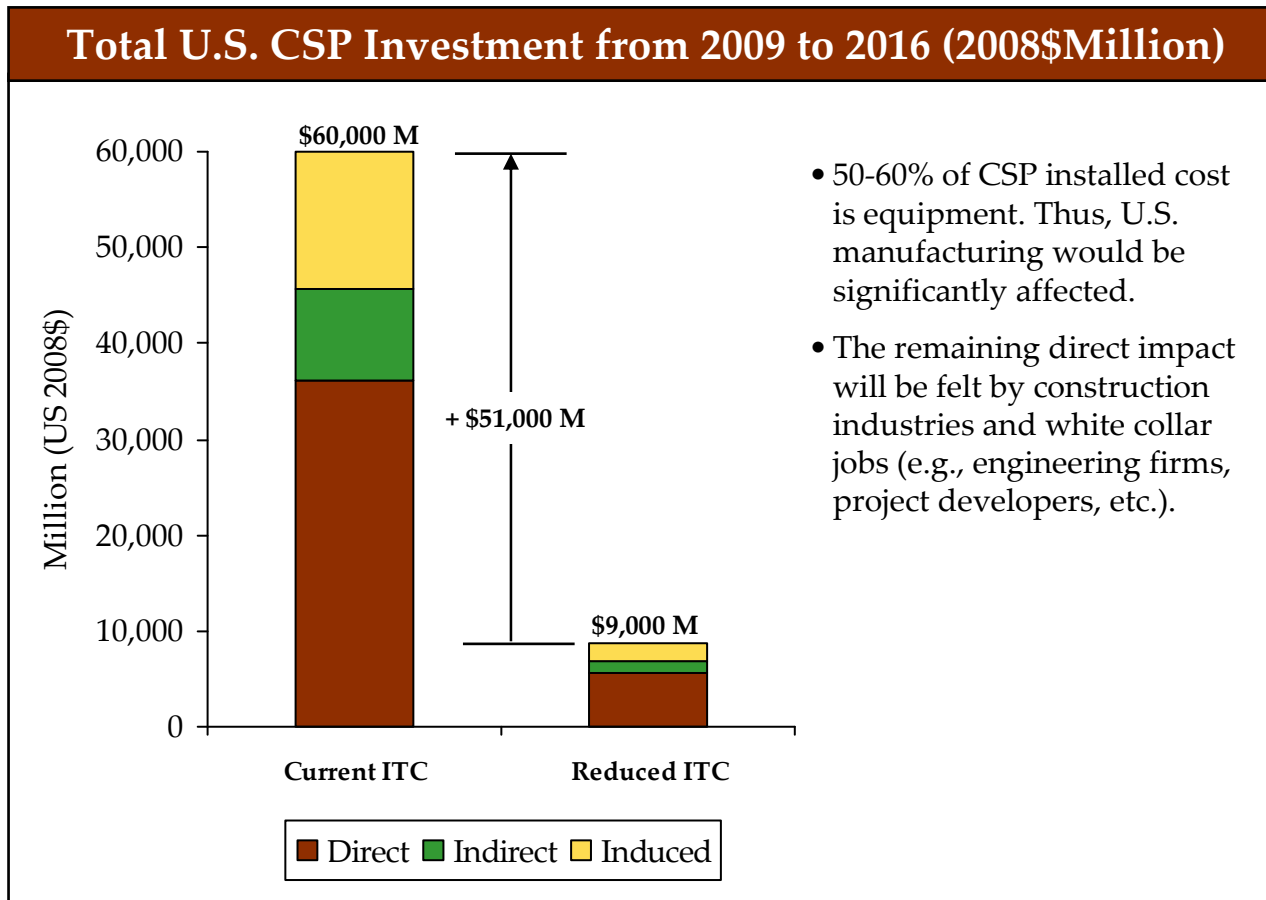
Navigant Consulting Use of JEDI Model

- The JEDI model was developed for the National Renewable Energy Laboratory to analyze the economic benefits of constructing and operating parabolic trough power plants.
- JEDI contains parabolic trough manufacturing and construction labor intensity data and then uses IMPLAN modeling software² to project indirect and induced economic impacts.
- Navigant Consulting conducted a separate JEDI run for each state and year of interest.
 - Indirect and induced impacts vary by state.

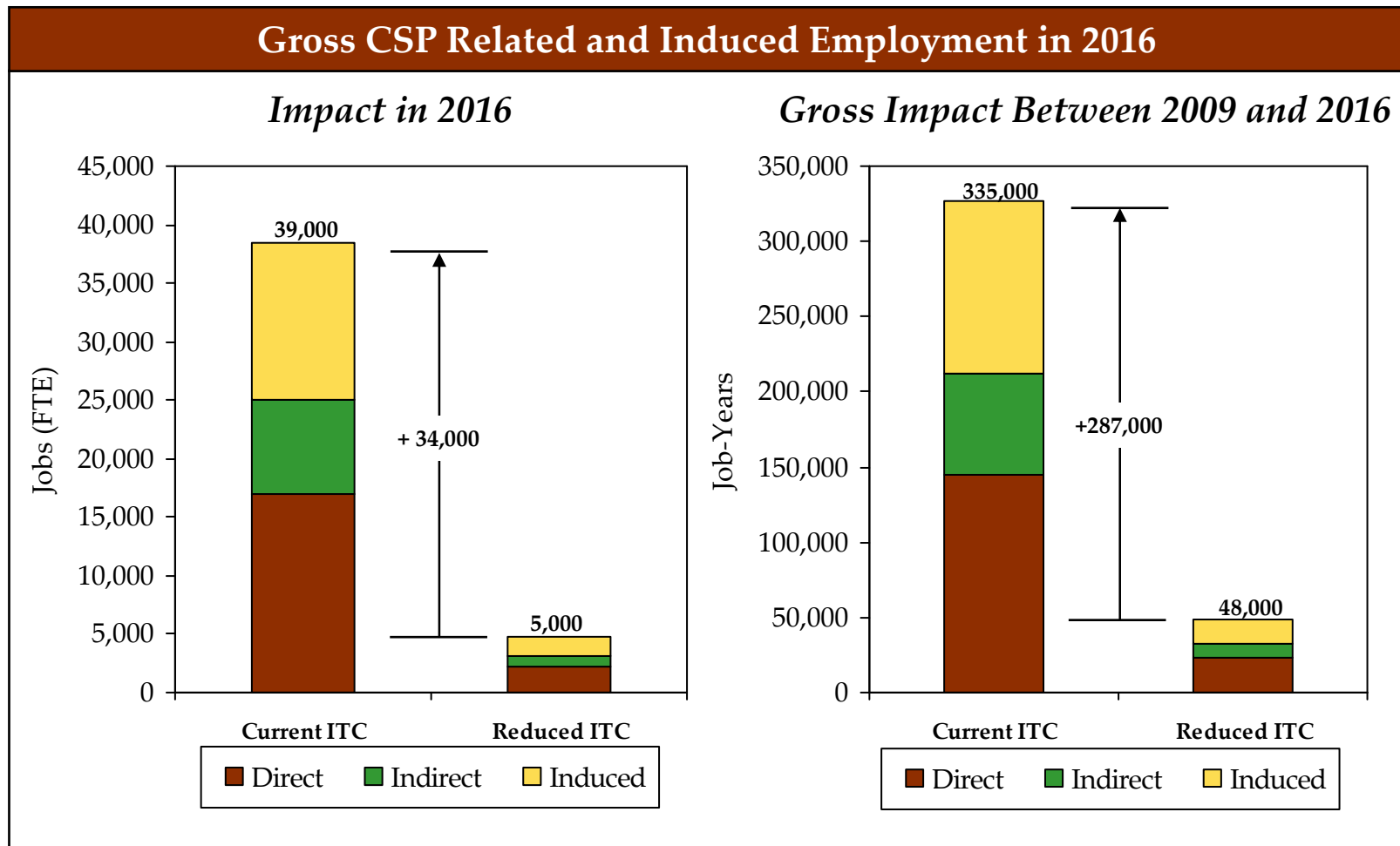
Finally, Navigant Consulting combined the results to get total economic impact.



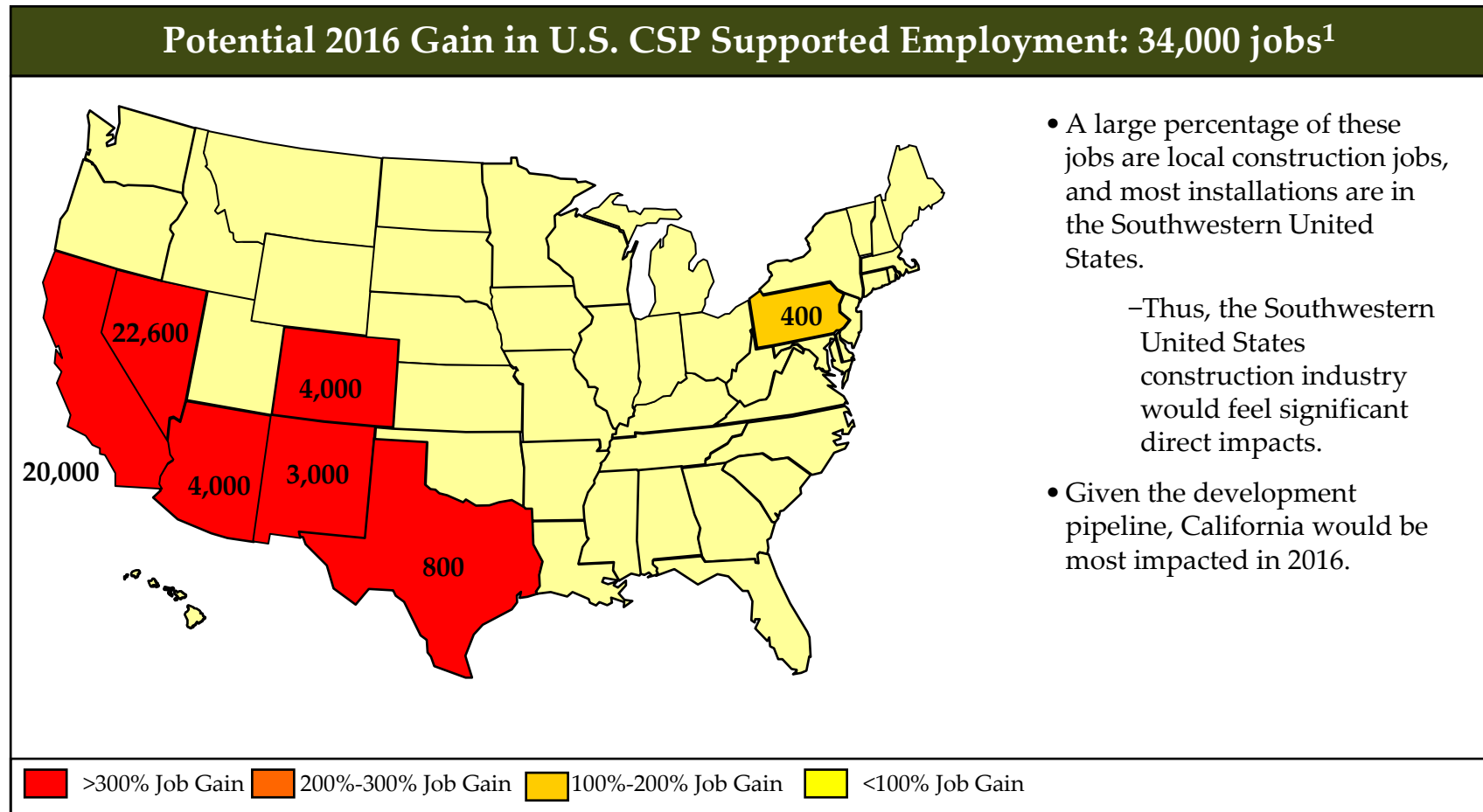
Extension of the current ITC could result in investment gains of \$51 billion between 2009 and 2016.



Extending the current ITC could spur an additional 34,000 jobs and 287,000 job-years of employment between 2009 and 2016.



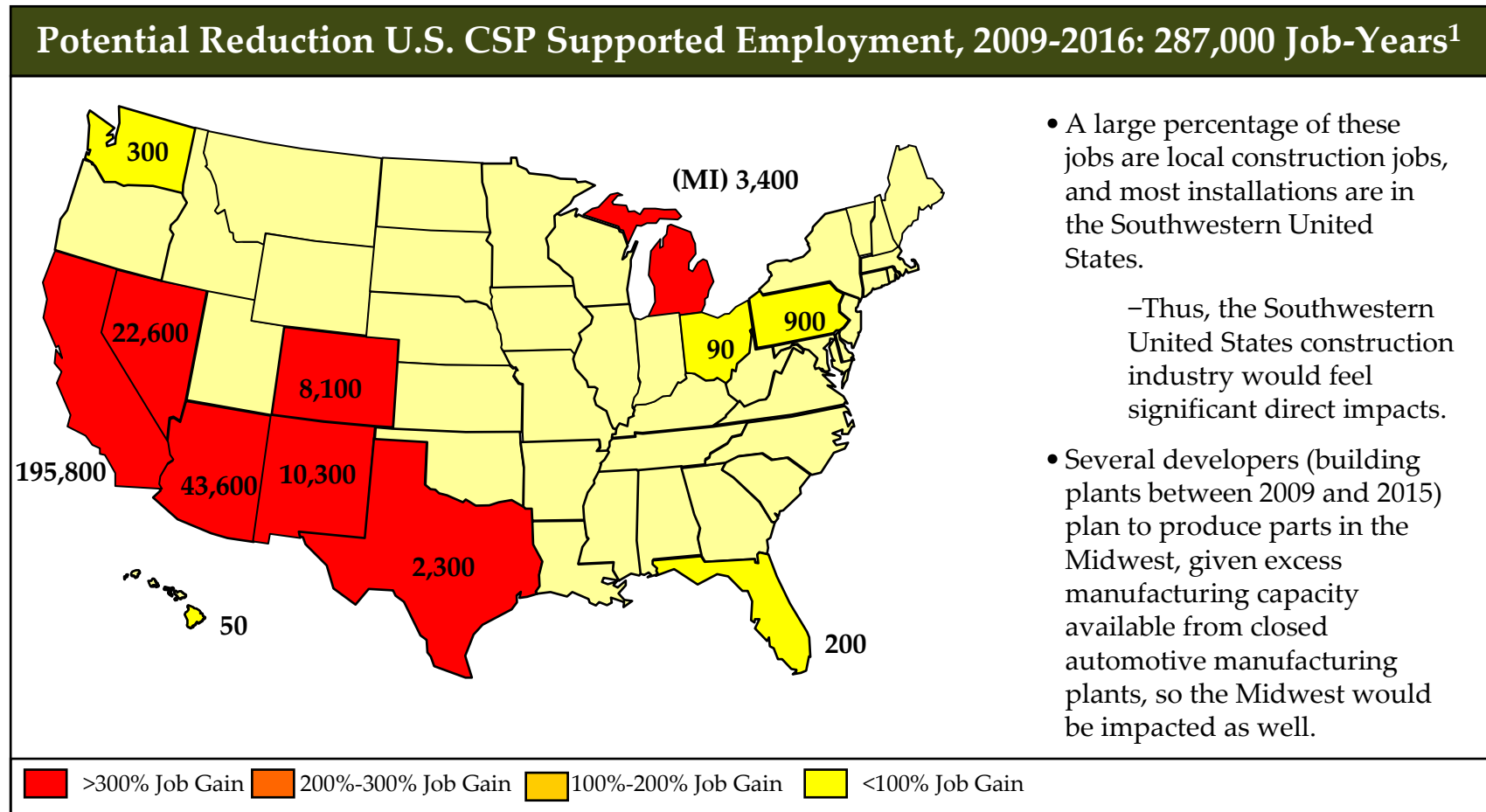
The southwestern U.S. would feel the biggest impact of ITC extension for the CSP segment.



Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.

CSP could support 287,000 more job-years of employment with an extended ITC between 2009 and 2016.



Notes:

1. Employment impacts include direct, indirect, and induced jobs. Figures might not add correctly due to rounding.
2. Refer to the appendix for a definition of job-years.

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Below is background on the federal tax credits in question.

Background

- **ITC** - The Energy Tax Act of 1978 established a 15 percent tax credit for solar energy. This credit continued uninterrupted for 8 years until the Tax Reform Act of 1986 provided for a phased reduction. On January 1, 1987 the credit fell to 12 percent. On January 1, 1988 the credit further reduced to 10 percent. The credit remained at this level until 2005. The Energy Policy Act of 2005 (EPAct 05) created a new commercial and residential ITC for fuel cells and solar energy systems that applied from January 1, 2006 through December 31, 2007. This legislation was the first creation of a residential solar investment tax credit. The credit was extended for one additional year in December 2007 by the Tax Relief and Health Care Act of 2007. The solar ITC will expire on December 31, 2008.

Navigant Consulting used the following definitions of economic impacts.

Definitions

- **Direct Impacts** - represent the initial change in final demand for the industry sector in question. Direct impacts describe the changes in economic activity for sectors that first experience a change in demand because of a project, policy decision, or some other stimuli.
- **Indirect Impacts** - represent the response as supplying industries increase output in order to accommodate the initial change in final demand. These indirect beneficiaries will then spend money for supplies and services, which results in another round of indirect spending.
- **Induced Impacts** - are generated by the spending of households who benefit from the additional wages and business income they earn through all of the direct and indirect activity. The increase in income, in effect, increases the purchasing power of households.

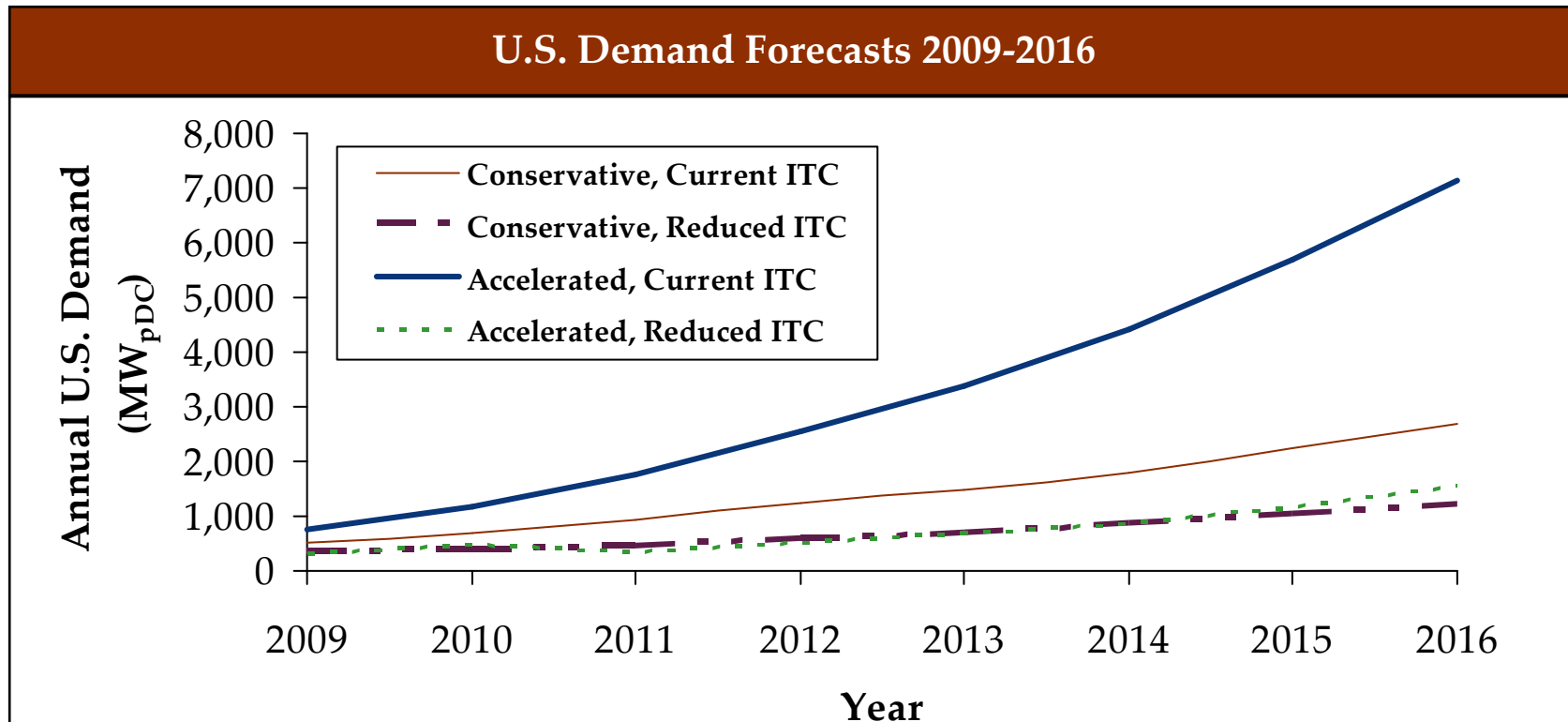
Source: S. Grover, "Energy, Economic, and Environmental Benefits of the Solar America Initiative", August 2007, NREL/SR-640-41998.

Navigant Consulting used the following definitions of throughout the report.

Definitions

- **MW_{pDC}** – The peak electrical capacity of a PV system, in Direct Current.
- **MW_{pAC}** - The peak electrical capacity of a PV system, in Alternating Current, after the Direct Current has passed through an inverter.
- **MW_{th}** – The peak heat capacity of a Solar Water Heating system. This unit is used to compare Solar Water Heating systems to Solar Electric Systems.
- **FTE** – Full time equivalent. Equals employment of one person for a year, or multiple people contributing enough hours to equal one person being employed for a year.
- **Job-Years** - One job-year is equal to 1,960 hours (40 hours per week, 49 weeks per year). This can be one person employed for 1,960 hours, two people for 980 hours each, etc.

Navigant Consulting used two U.S. PV market demand scenarios – conservative and accelerated – with current and reduced ITC

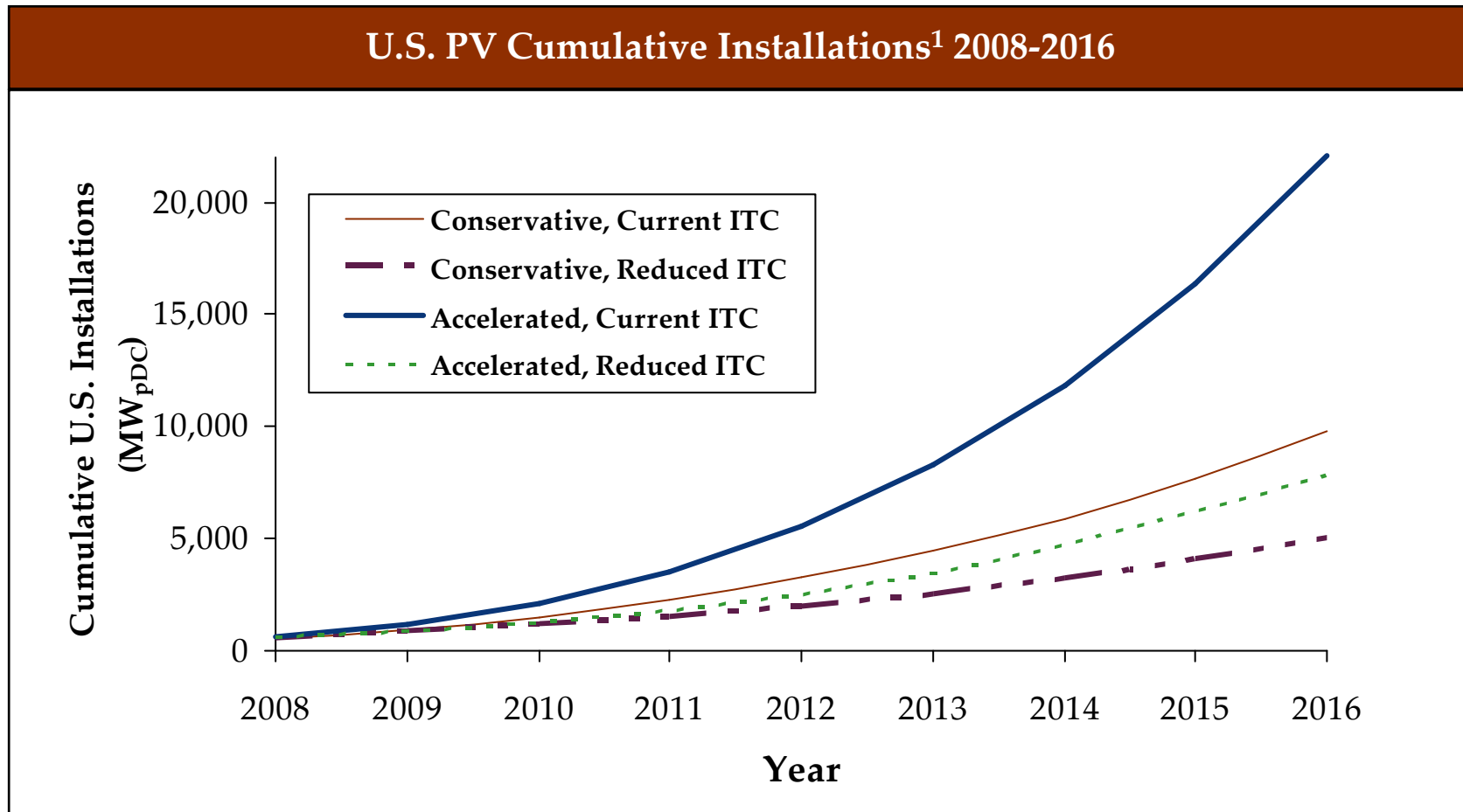


Note: Product that is shipped during a calendar year (i.e. Demand) is not necessarily installed that same year. A number of factors influence this difference among them why the customer (PV selling channel, system integrators, installers, etc) is buying. If there is a supply constraint, the selling channel may buy excess product to have it in inventory to fulfill orders. Or, it may be a requirement for a large installation to have module product on hand well before installation. In some cases, if there is over supply and prices are low, the selling channel buys in bulk at the low price. In some cases, due to other factors such as the ITC extension delay (or, lack of an ITC), projects are cancelled. In a given year, the difference between demand and installation can vary from 85% to 90% of demand installed to 75% or less installed.

Source: Navigant Consulting PV Services Program, July, 2008.

Appendix » Cumulative PV Installations

Below are cumulative PV installations, including 2007 data.



Notes:

1. Does not include installations prior to 2007.