

# **RENEWABLE ENERGY AND ENERGY EFFICIENCY: ECONOMIC DRIVERS FOR THE 21<sup>ST</sup> CENTURY**

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# WHAT IS CURRENT STATUS OF THE INDUSTRY?

*“Prior to determining where we are going, we must determine from whence we came.” – A. Lincoln*

- **Current size of RE&EE Industries is unknown**
- **Any forecasts are meaningless unless we know what the size of the industry is – or was in 2006**
- **First, must estimate current size of EE&RE industries – this has not been done before**
  - U.S.
  - Ohio
- **Then, forecast industries growth to 2030**
  - 3 scenarios
  - U.S.
  - Ohio

## U.S. RE & EE INDUSTRIES IN 2006

Industry	Revenues (billions)	Direct Jobs (thousands)	Total (direct plus indirect) Jobs Created (thousands)
<b>Renewable Energy</b>	\$39.2	194	446
<b>Energy Efficiency</b>	932.6	3,498	8,046
<b>TOTAL</b>	\$971.8	3,692	8,492

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# U.S. RE INDUSTRY IN 2006

Industry Segment	Revenues/ Budgets (billions)	Direct Jobs	Total (direct plus indirect) Jobs Created
Wind	\$3.0	16,000	36,800
Photovoltaics	1.0	6,800	15,700
Solar Thermal	0.1	800	1,900
Hydroelectric Power	4.0	8,000	19,000
Geothermal	2.0	9,000	21,000
Biomass			
Ethanol	6.3	67,000	154,000
Biodiesel	0.3	2,750	6,300
Biomass Power	17.0	66,000	152,000
Fuel Cells	0.9	4,800	11,100
Hydrogen	0.8	4,000	9,200
<b>Total, Private Industry</b>	<b>35.4</b>	<b>185,150</b>	<b>427,000</b>
Federal Government	0.5	800*	1,850
DOE Laboratories	1.8	3,600**	8,300
State and Local Government	0.9	2,500	5,750
<b>Total Government</b>	<b>3.2</b>	<b>6,900</b>	<b>15,870</b>
Trade and Professional Associations and NGOs	0.6	1,500	3,450
<b>TOTAL, ALL SECTORS</b>	<b>\$39.2</b>	<b>193,550</b>	<b>446,320</b>

\*Includes Federal employees and direct support contractors.

\*\*Includes Federal employees, laboratory employees, and direct support contractors.

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# U.S. EE INDUSTRY IN 2006

Industry Segment	Revenues/ Budgets (billions)	Direct Jobs (thousands)	Total (direct plus indirect) Jobs Created (thousands)
Insulation	\$5	26	60
ESCO	3	19	44
Recycling	275	1,310	3,013
Vehicle manufacturing	73	165	380
Household appliances and lighting	22	86	198
Windows and doors	12	51	117
Computers, copies, and FAX machines	90	312	718
TV, Video, and Audio equipment	45	183	421
HVAC systems	12	45	104
Industrial and related machinery	19	76	175
Miscellaneous durable manufacturing	105	389	894
Nondurable manufacturing	220	528	1,214
Utilities	2	14	32
Construction	36	227	522
<b>Total, Private Industry</b>	<b>919</b>	<b>3,431</b>	<b>7,892</b>
Federal government EE spending	3.3	15	35
State government EE spending	3	28	64
Local government EE spending	2.3	21	48
<b>Total Government</b>	<b>8.6</b>	<b>64</b>	<b>147</b>
EE Trade and Professional Associations and NGOs	0.5	3	7
<b>TOTAL, ALL SECTORS</b>	<b>\$932.6</b>	<b>3,498</b>	<b>8,046</b>

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# ECONOMIC IMPACT OF RE&EE IS ENORMOUS

- **2006 RE&EE sales represent substantially more than the combined 2006 sales of the 3 largest U.S. corporations (Wal-Mart, ExxonMobil, & GM)**
- RE&EE are growing more rapidly than U.S. average
- Contain some of the most rapidly growing industries in the world, such as wind, fuel cells, and biofuels

## **In 2006 they generated annually:**

- Nearly a trillion dollars in industry sales
- **8.5 million new jobs**
- More than \$100 billion in industry profits
- **More than \$150 billion in increased federal, state, and local government tax revenues**
- Stimulus to the U.S. manufacturing industry
- Significant displacement of imported oil
- Reduction in the U.S. trade deficit

# EE&RE OCCUPATIONS: WAGES, EDUCATIONAL REQUIREMENTS, AND GROWTH FORECASTS (Selected Occupations)

<b>Occupation</b>	<b>10 year % Growth Forecast</b>	<b>Median Salary</b>	<b>% With Bachelor's Degree</b>	<b>Education</b>
Materials Scientists	8	\$74,400	94	Bachelor's
Physicists	7	91,500	92	Doctoral
Microbiologists	17	63,400	96	Doctoral
Biological Technicians	17	36,500	60	Associate
Conservation Scientists	6	53,800	88	Bachelor's
Chemists	7	63,500	94	Bachelor's
Chemical Technicians	4	40,100	27	Associate
Geoscientists	6	73,200	94	Doctoral
Natural Science Managers	14	99,100	90	Bachelor's
Environmental Eng. Technicians	24	42,000	18	Associate
Soil and Plant Scientists	20	58,000	64	Bachelor's
Mechanical Eng. Technicians	12	46,500	18	Associate
Environmental Sci. Technicians	16	38,500	47	Associate
Biomedical Engineers	31	75,400	60	Bachelor's
Chemical Engineers	11	79,200	92	Bachelor's
Mechanical Engineers	10	77,000	88	Bachelor's
Electrical Engineers	12	76,000	83	Bachelor's
Environmental Engineers	14	74,500	82	Bachelor's
Computer Scientists	26	94,000	67	Doctoral
Life & Physical Sci. Technicians	20	45,200	50	Associate
Utility Plant Operatives	4	53,000	10	OJT
HVAC Technicians	12	37,600	14	OJT
Energy Audit Specialists	18	39,500	18	OJT
Forest & Conservation Workers	6	27,000	8	OJT
Refuse & Recycling Workers	5	26,000	2	OJT
Insulation Workers	6	\$30,200	2	OJT

Source: Management Information Services, Inc. and U.S. Bureau of Labor Statistics, 2007.

# TYPICAL EMPLOYEE PROFILE OF A 250-PERSON WIND TURBINE MFG COMPANY, 2006 (Selected Occupations)

Occupation	Employees	Earnings
Engine and Other Machine Assemblers	31	\$36,300
Machinists	27	40,500
Team Assemblers	16	30,100
Computer-Controlled Machine Tool Operators	12	40,600
Mechanical Engineers	10	71,600
First-Line Supervisors/Managers of Production	10	59,600
Inspectors, Testers, Sorters, and Samplers	8	40,400
Lathe and Turning Machine Tool Operators	6	40,000
Drilling and Boring Machine Tool Operators	4	39,800
Welders, Cutters, Solderers, and Brazers	4	39,900
Laborers and Freight, Stock, and Material Movers	4	29,800
Maintenance and Repair Workers	4	44,100
Tool and Die Makers	4	43,600
Grinding/Polishing/Buffing Machine Tool Operators	4	34,800
Multiple Machine Tool Operators	4	40,800
Industrial Engineers	3	70,400
Industrial Machinery Mechanics	3	46,000
Purchasing Agents	3	56,200
Engineering Managers	3	108,300
Shipping, Receiving, and Traffic Clerks	3	32,100
Accountants and Auditors	2	59,800
Executive Secretaries and Administrative Assistants	2	43,200
Electricians	2	49,600
Mechanical Engineering Technicians	2	50,900
Janitors and Cleaners	2	29,800

Source: Management Information Services, Inc., 2007.

# THREE FORECAST SCENARIOS FOR 2030

## THE BASE CASE:

- Is essentially a “**business as usual**” case scenario that assumes no change in policy
- **We use the base case as a comparison against the two alternative scenarios**

## THE ADVANCED SCENARIO:

- “**pushes the envelope**” on RE&EE industry possible from current or impending technologies
- Represents a **dramatic indication of what would be possible under an aggressive renewable energy scenario**

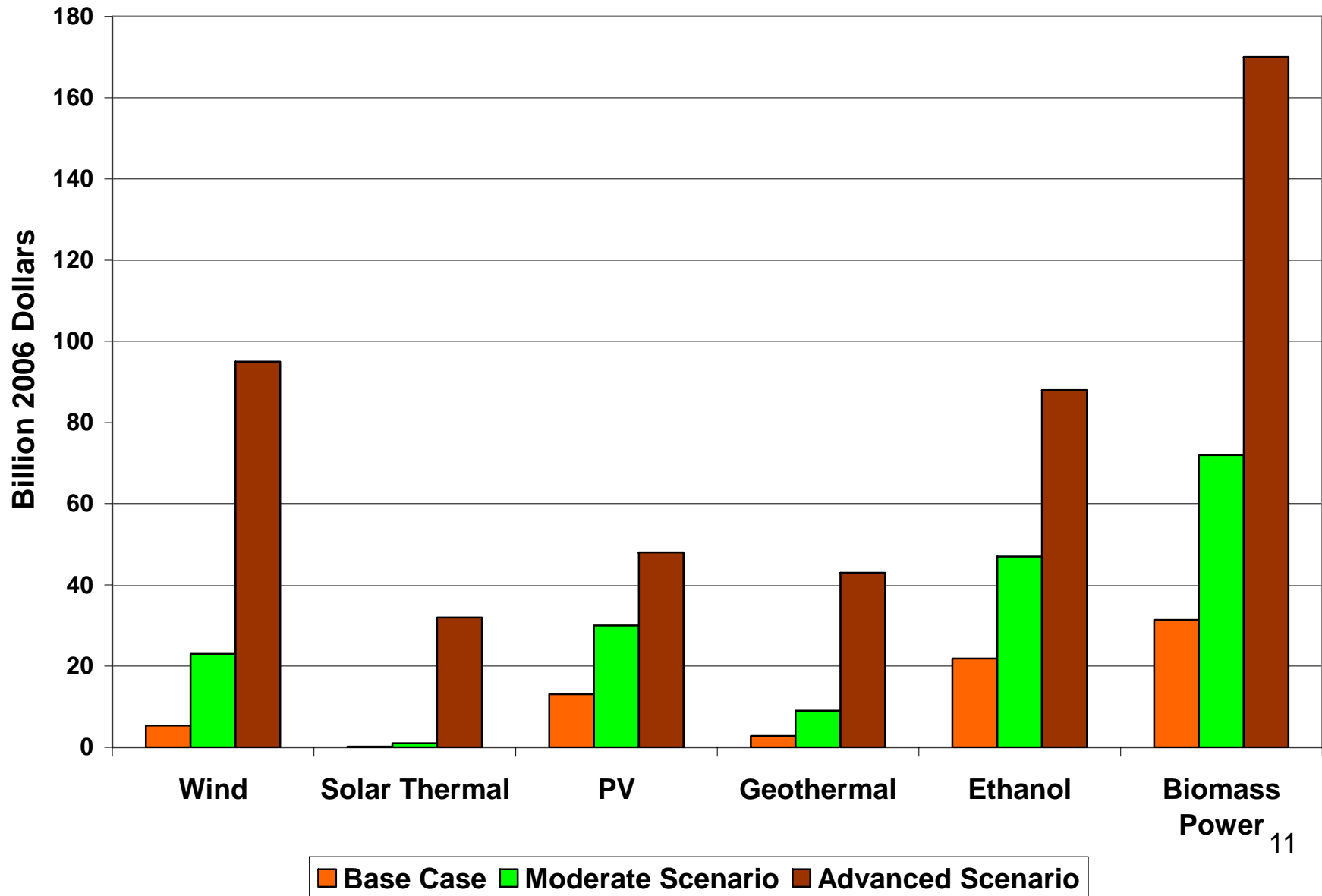
## THE MODERATE SCENARIO:

- Assumes that various moderate, incremental (above the base case) Federal and state RE&EE initiatives are put in place over next two decades
- **Based on various “mid-range” estimates, incorporating modest initiatives**

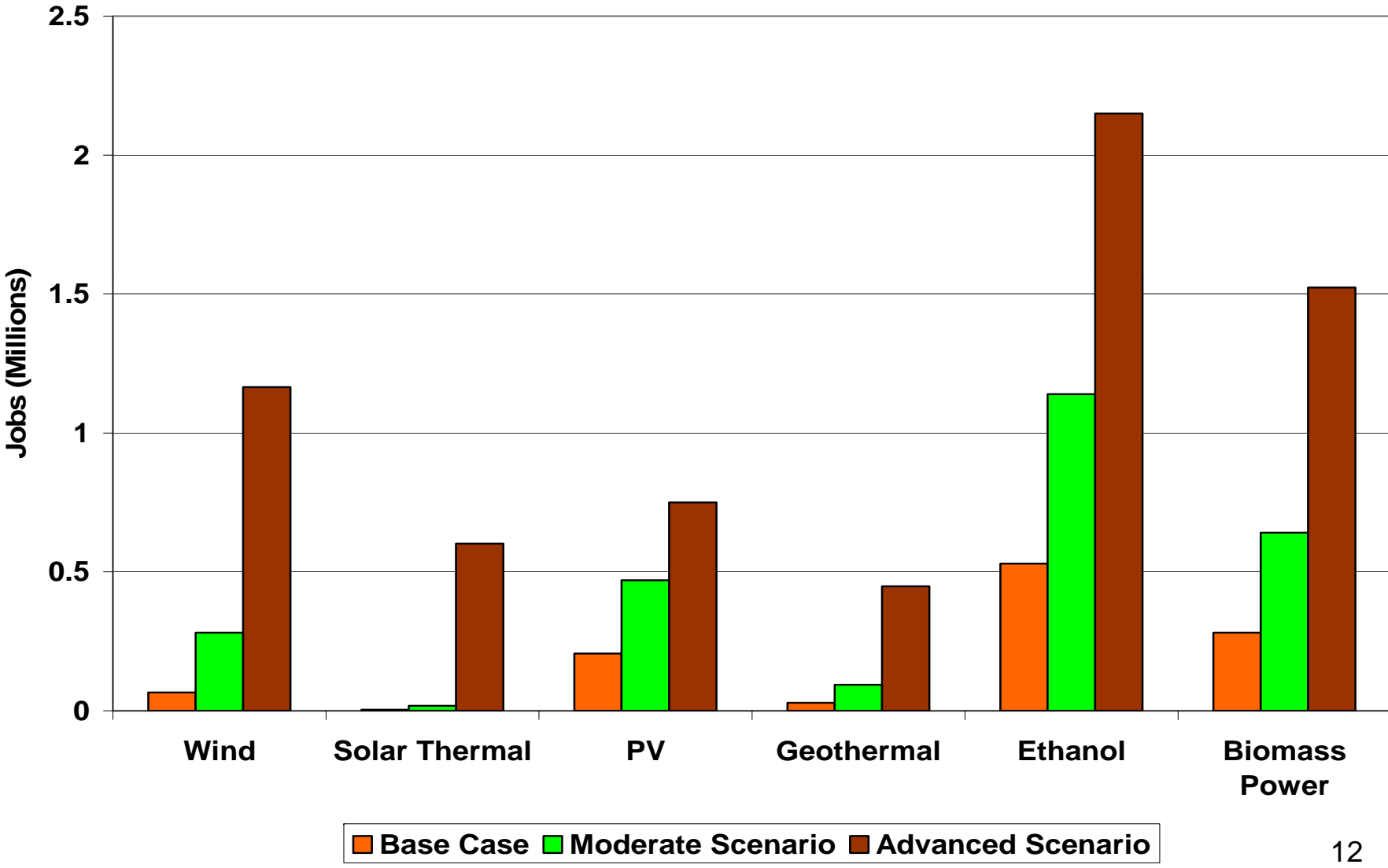
## **THE U.S. RE & EE INDUSTRIES IN 2030**

	Revenues (Billions of 2006 Dollars)			Total Jobs Created (Direct Plus Indirect – Thousands)		
	Base Case	Moderate Scenario	Aggressive Scenario	Base Case	Moderate Scenario	Aggressive Scenario
<b>RE</b>	\$95	\$227	\$597	1,305	3,138	7,935
<b>EE</b>	1,818	2,152	3,933	14,953	17,825	32,185
<b>Total</b>	\$1,913	\$2,379	\$4,530	16,258	20,963	40,120

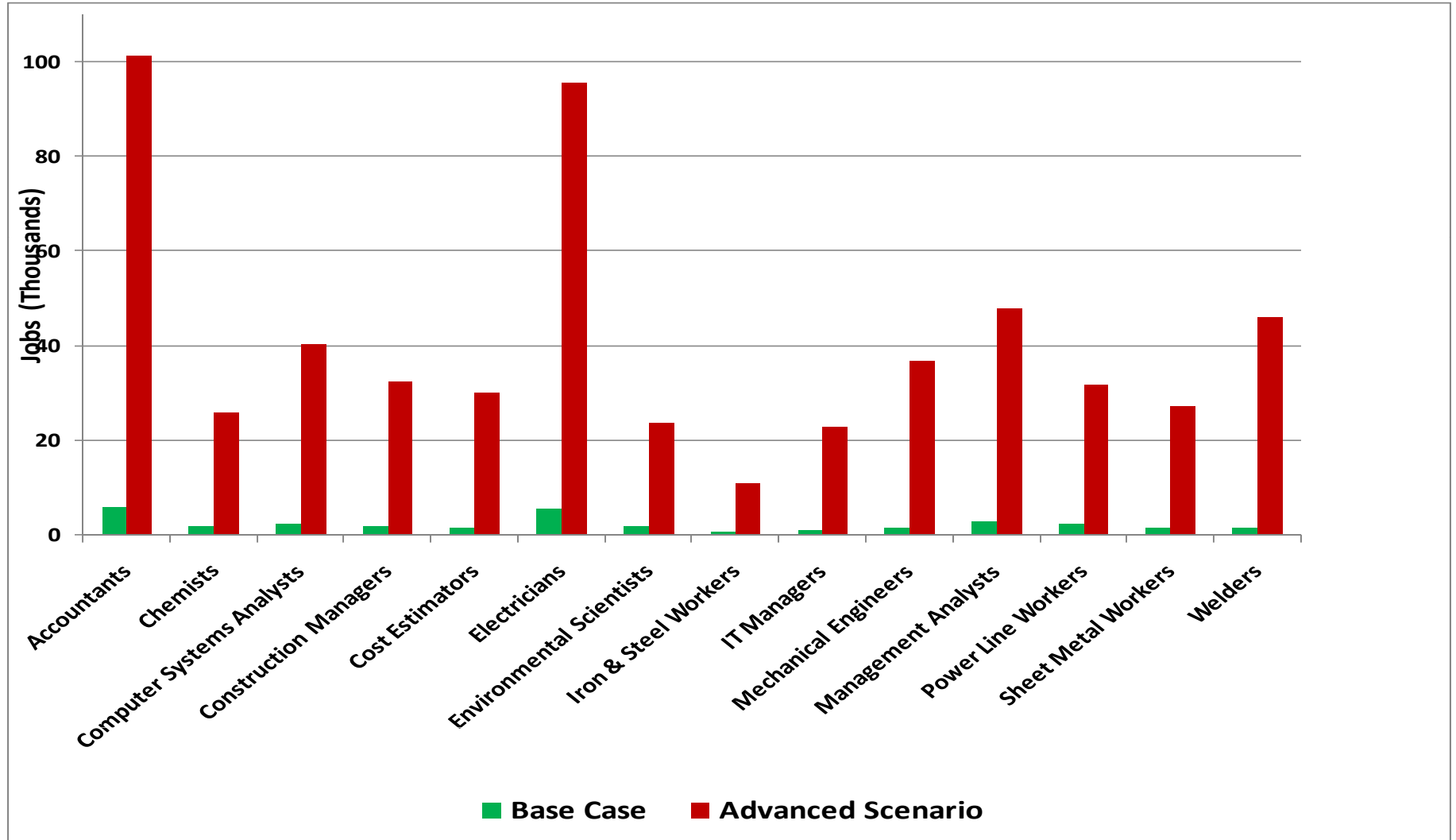
# The U.S RE INDUSTRY IN 2030 (SELECTED TECHNOLOGIES)



# U.S. JOBS CREATED BY RE IN 2030 (TOTAL JOBS CREATED -- SELECTED TECHNOLOGIES)



# U.S. JOBS CREATED BY RE IN 2030 (TOTAL JOBS CREATED -- SELECTED OCCUPATIONS)



# EE&RE IMPACT IN OHIO

## EE&RE INDUSTRIES IN OHIO, 2006

<b>Industry</b>	<b>Revenues (millions)</b>	<b>Direct Jobs</b>	<b>Total (direct plus indirect) Jobs Created</b>
<b>Renewable Energy</b>	\$785	2,880	6,615
<b>Energy Efficiency</b>	50,120	205,780	496,535
<b>TOTAL</b>	<b>\$50,905</b>	<b>208,660</b>	<b>503,150</b>

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# RE INDUSTRY IN OHIO, 2006

Industry Segment	Revenues/ Budgets (millions)	Direct Jobs	Total (direct plus indirect) Jobs Created
Wind	\$250	740	1,700
Photovoltaics	25	200	460
Solar Thermal	1	10	20
Hydroelectric Power	120	200	460
Geothermal	112	550	1,270
Biomass			
Ethanol	30	200	460
Biodiesel	12	80	180
Biomass Power	125	370	850
Fuel Cells and Hydrogen	80	450	1,030
<b>Total, Private Industry</b>	<b>755</b>	<b>2,800</b>	<b>6,430</b>
Federal Government	6	20	45
State and Local Government	4	10	25
<b>Total Government</b>	<b>10</b>	<b>30</b>	<b>70</b>
Trade/Professional Associations & NGOs	20	50	115
<b>TOTAL, ALL SECTORS</b>	<b>\$785</b>	<b>2,880</b>	<b>6,615</b>

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# EE INDUSTRY IN OHIO, 2006

Industry Segment	Revenues/ Budgets (millions)	Direct Jobs	Total (direct plus indirect) Jobs Created
Insulation	\$220	1,100	2,500
ESCO	130	630	1,450
Recycling	18,500	97,300	224,000
Vehicle manufacturing	2,870	24,800	57,100
Household appliances and lighting	1,830	8,650	19,900
Windows and doors	550	3,020	6,900
Computers, copies, and FAX machines	1,100	5,650	13,000
TV, Video, and Audio equipment	4,360	14,820	34,100
HVAC systems	510	2,650	6,100
Industrial and related machinery	1,150	5,060	11,640
Miscellaneous durable manufacturing	7,240	25,300	58,200
Nondurable manufacturing	10,120	18,300	42,100
Utilities	18	220	500
Construction	1,110	7,720	17,750
<b>Total, Private Industry</b>	<b>49,700</b>	<b>205,220</b>	<b>495,240</b>
Federal government EE spending	5	20	45
State and local government EE spending	15	40	100
<b>Total Government</b>	<b>20</b>	<b>60</b>	<b>145</b>
Trade/Professional Associations & NGOs	\$400	500	1,150
<b>TOTAL, ALL SECTORS</b>	<b>\$50,120</b>	<b>205,780</b>	<b>496,535</b>

Source : Management Information Services, Inc. and American Solar Energy Society, 2007.

# EE&RE FIRMS IN OHIO

We conducted a **survey of existing EE&RE companies in Ohio**, examining a functional, technological, and geographic mix of companies. Our research revealed a **wide range of firms**, and they:

- Are located throughout the state, in major urban centers, suburbs, small towns, and rural areas.
- Range in size from small firms of several employees to large firms employing hundreds
- Are engaged a wide variety of activities, including manufacturing, engineering, R&D, installation, monitoring, analysis, etc.
- Include some of the most sophisticated, innovative, high-tech firms in the state

# EE&RE FIRMS IN OHIO

## (Examples of Selected Firms)

Company	Sector	Location	Company	Sector	Location
Advanced Hydro Solutions	RE	Fairlawn	North Coast Wind & Power	RE	Port Clinton
American Ag Fuels	RE	Defiance	Novar Controls Corp.	EE	Cleveland
AMTEK Solid State Controls	EE	Columbus	O'Brock Windmill Distributors	RE	North Benton
CybetUtility	RE	Cleveland	Ohio Windmill Mfg. Co.	RE	Berlin Center
Dovetail Solar & Wind	RE	Glouster	Owens Corning	EE	Toledo
Energy Technologies, Inc.	EE	Mansfield	Renewable Lubricants, Inc.	RE	Hartville
EXTOL of Ohio	EE	Norwalk	Repower Solutions	EE	Cleveland
Eye Lighting International	EE	Mentor	Schward Electrical	RE	Dayton
Energy Technologies, Inc.	EE	Mansfield	SCI Engineered Materials	RE	Columbus
Essential Research, Inc.	EE&RE	Cleveland	Solar Creations	RE	Perrysville
First Solar	RE	Perrysburg	Special Materials Research	EE	Strongsville
Forry, Inc.	EE	Chagrin Falls	SSOE Systems, Inc.	EE	Toledo
Gardiner Trane	EE	Solon	Staco Energy Products	EE	Dayton
James Leffel & Company	RE	Springfield	SunLight Energy Systems	RE	North Lawrence
Jatro Diesel	RE	Mason	Sunpower, Inc.	RE&EE	Athens
Joe Mescan Windmill	RE	Columbia Station	Technology Bus. Development	RE	North Ridgeville
Liquid Resources of Ohio	RE	Medina	Teron Lighting, Inc.	EE	Fairfield
M&B's Battery Company	RE&EE	Harrison	The Enterprise Corp.	EE	Twinsburg
Malcolm Pirnie	EE	Akron	Third Sun Solar & Wind Power	RE	Athens
Michael Byrne Mfg. Co.	EE	Mansfield	Universal Electric Power	RE	Akron
Mariner Energy Systems	EE	Brunswick	Vanner, Inc.	EE	Hilliard
Midwest Mechanical Power	RE&EE	Plain City	Venture Lighting	EE	Solon
National Electric Coil	EE	Columbus			

Source: Management Information Services, Inc. and Green Energy Ohio, 2007.

# EXAMPLES OF EE&RE FIRMS IN OHIO

## (Characteristics of Selected Firms)

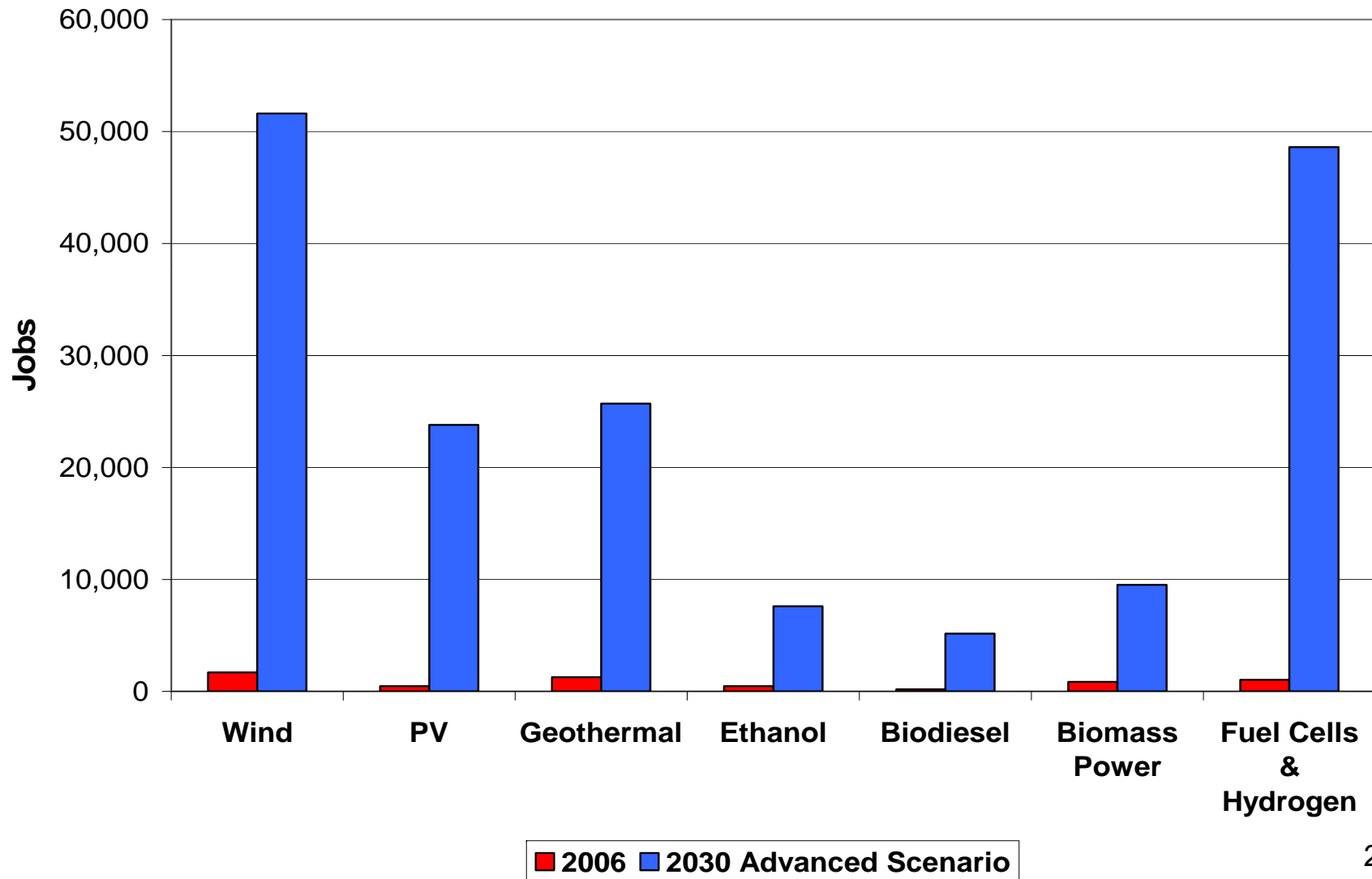
Company	Sector	Products & Services	Location	RE/EE Jobs in Ohio
American Ag Fuels	RE	Biodiesel manufacturing facility	Defiance	11
CybetUtility, LLC	RE	Bio-diesel production	Cleveland	5
Dovetail Solar & Wind	RE	Installer of solar and wind energy products	Glouster	8
Dyson Corporation	RE	Manufacturer of components for wind energy systems	Painesville	12
EXTOL of Ohio, Inc.	EE	Manufacturer and fabricator of thermal insulation systems	Norwalk	45
First Solar, LLC	RE	Manufacturer of solar photovoltaic modules	Perrysburg	150
Forry, Inc.	EE	Manufacturer of microprocessor and electronic EE and environmental controls	Chagrin Falls	120
Malcolm Pirnie	EE	EE and environmental engineering and consulting	Columbus	150
Spero Electric Corporation	EE	Manufacturer of EE lighting systems	Streetsboro	95
Venture Lighting	EE	Manufacturer of metal halide lighting systems	Streetsboro	280
Wastequip	EE	Manufacturer and distributor of waste and recycling equipment	Cleveland	10

Source: Management Information Services, Inc. and Green Energy Ohio, 2007.

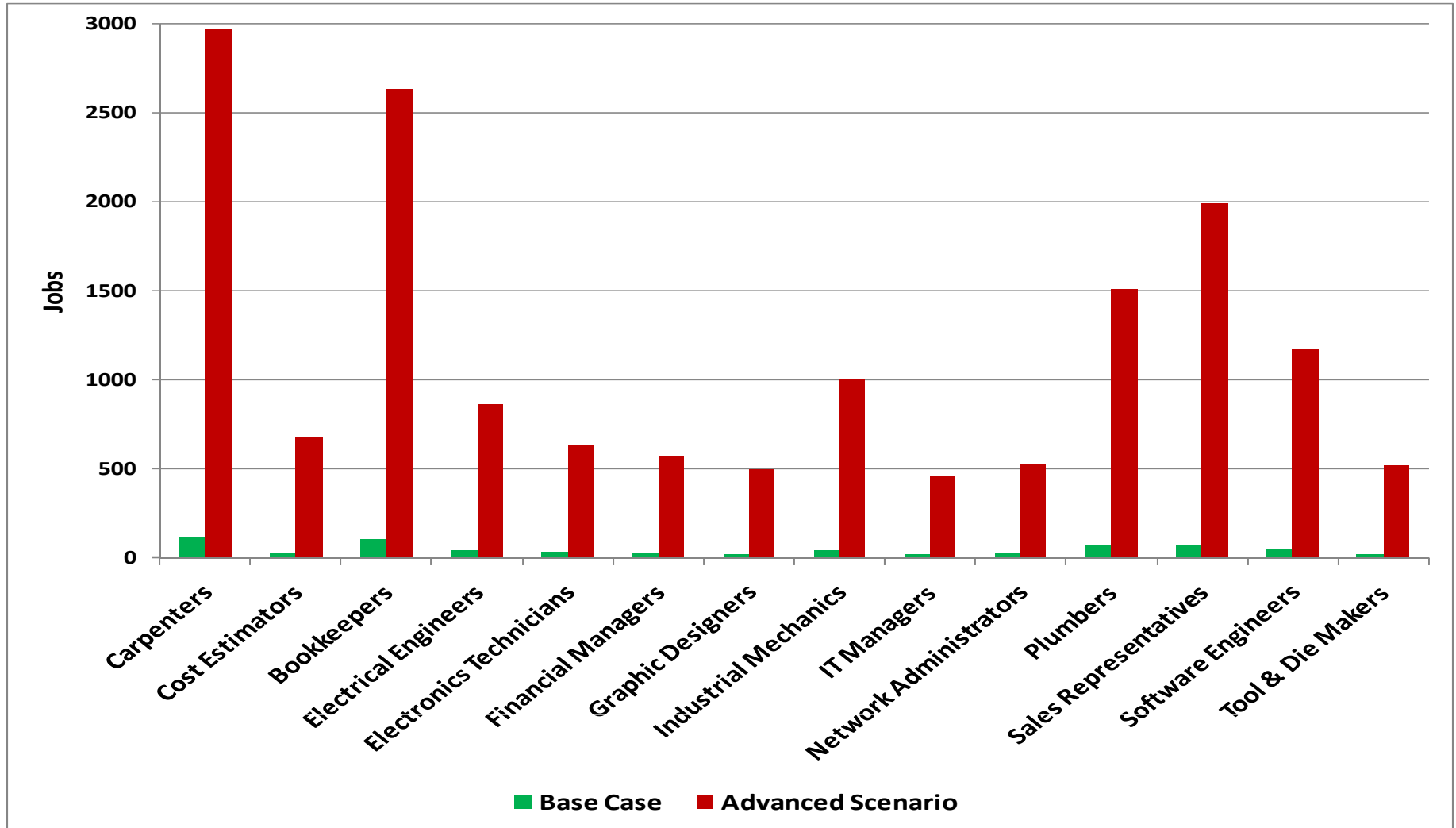
## OHIO EE&RE INDUSTRIES IN 2030

	Revenues (Billions of 2006 Dollars)			Total Jobs Created (Direct Plus Indirect – Thousands)		
	Base Case	Moderate Scenario	Aggressive Scenario	Base Case	Moderate Scenario	Aggressive Scenario
<b>RE</b>	\$2.0	\$5.7	\$17.7	21	56	174
<b>EE</b>	96.7	114.7	202.6	964	1,150	2,096
<b>Total</b>	\$98.7	\$120.4	\$220.3	985	1,206	2,270

# RENEWABLE ENERGY CAN CREATE NEW JOBS IN OHIO



# OHIO JOBS CREATED BY RE IN 2030 (TOTAL JOBS CREATED -- SELECTED OCCUPATIONS)



# EE&RE OFFER DEVELOPMENT OPPORTUNITIES FOR OHIO

- **Employment growth in EE&RE varies among sectors:** Growing sectors include A&E, R&D, ESCO, environmental technologies, bio-fuels, power technologies, industrial processes, distributed generation, computer controls & systems, HVAC systems, and others
- **EE&RE creates a variety of high-paying jobs, many of which take advantage of Ohio manufacturing skills**
- **Ohio, with its traditional manufacturing economy, can recruit EE&RE companies** to take advantage of its skilled workforces for wind turbine manufacturing, biofuels production, etc.
- Wages in many EE&RE sectors are higher than the U.S. average, and EE&RE requires a wide mix of occupations
- EE&RE occupations include many jobs that require associate's degrees, on-the-job training, or trade certifications and which pay high wages
- **Unlike some industries, EE&RE is a realistic target for job creation in Ohio:** State & local communities can build clusters around industry sectors
- **Many entrance points makes EE&RE market easier to penetrate if Ohio can utilize its strengths** in workforce, tech, mfg., R&D, education, etc.

# **RE&EE CREATE SKILLED, WELL-PAYING JOBS NOT SUBJECT TO FOREIGN OUTSOURCING**

- RE&EE can create many **jobs in two categories** that Ohio is eager to attract and retain:
- 1. **College-educated professional workers**, many with advanced degrees
- 2. **Highly skilled, technical workers**, with advanced training and technical expertise, many of them in the manufacturing sector
- RE&EE thus generate jobs that are disproportionately for highly skilled, well-paid, technical and professional workers, who provide the foundation for entrepreneurship and economic growth. **These are the high-skilled, high-wage, technical and professional jobs that all states and regions seek to attract**
- **Ohio is in competition with other states for these new energy economy jobs**