RENEWABLE ENERGY AND ENERGY EFFICIENCY: ECONOMIC & JOB DRIVERS FOR THE 21ST CENTURY

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Robert M. Wendling
Management Information Services, Inc.
Washington, D.C.
bwendling@misi-net.com

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 last year**
- **First**, must **estimate current size of EE&RE industries** – ***this had 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)
Renewable Energy	$39.2	194	446
Energy Efficiency	932.6	3,498	8,046
TOTAL	$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
Total, Private Industry	35.4	185,150	427,000
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
Total Government	3.2	6,900	15,870
Trade and Professional Associations and NGOs	0.6	1,500	3,450
TOTAL, ALL SECTORS	$39.2	193,550	446,320

*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.

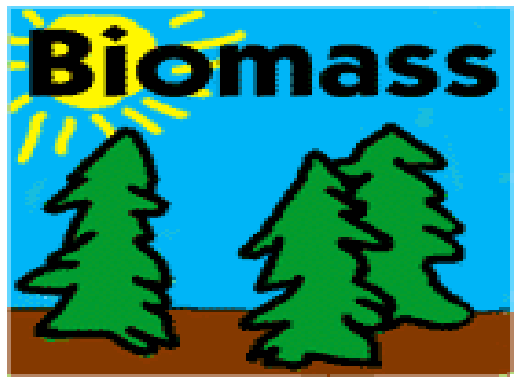
U.S. EE INDUSTRY IN 2006

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
Total, Private Industry	919	3,431	7,892
Federal government EE spending	3.3	15	35
State government EE spending	3	28	64
Local government EE spending	2.3	21	48
Total Government	8.6	64	147
EE Trade and Professional Associations and NGOs	0.5	3	7
TOTAL, ALL SECTORS	$932.6	3,498	8,046

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)

Occupation	10 year % Growth Forecast	Median Salary	% With Bachelor's Degree	Education
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.

WORKFORCE FOR THE NEW ENERGY ECONOMY: WIND ENERGY

Resource Extraction
Transportation
Manufacturing
Integration/Assembly
Transportation/Shipping
Wholesales Sales
Shipping/Transportation
Retail Sales
Shipping
Installation
Certification/Activation
Maintenance/Operation

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
RE	$95	$227	$597	1,305	3,138	7,935
EE	1,818	2,152	3,933	14,953	17,825	32,185
Total	$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)

Jobs (Millions)

2.5
2
1.5
1
0.5
0

Wind | Solar Thermal | PV | Geothermal | Ethanol | Biomass Power

Base Case | Moderate Scenario | Advanced Scenario

U.S. JOBS CREATED BY RE IN 2030
(Total Jobs Created -- Selected Occupations)

HIGHLIGHTS OF THE NATIONAL SCENARIOS: 2006 - 2030

- **In base case: RE revenues increase 145%, from $39B to $95B**; EE revenues increase 95%, from $933B to $1,818B
- **In base case: Jobs created by RE increase 190%, from 446,000 to 1.3 million**; jobs created by EE increase 85%, from 8 million to 15 million
- **In aggressive scenario, RE revenues increase 1,400%, from $39B to $597B**; EE revenues increase 320%, from $933B to $3,933B
- **In aggressive scenario: Jobs created by RE increase 1,700%, from 446,000 to 7.9 million**; jobs created by EE increase 300%, from 8 million to 32 million
- Thus, **under all scenarios RE growth is much larger than EE growth**
- Nevertheless, the economic and job impact of EE remains orders of magnitude larger than RE

EE&RE STATE BENEFITS

- New investments
- Total industry sales
- Industry profits
- Total (direct and indirect) employment created
- Specific jobs created by occupation and skill
- Stimulation of the manufacturing sector
- Tax revenues for the state and local governments
- Technology development and spin-offs
- Revitalization of depressed regions
- Volumes and timeframes of conventional energy displacement

EE&RE OFFER DEVELOPMENT OPPORTUNITIES FOR STATES

- **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 pre-existing manufacturing skills**
- **Traditional manufacturing economies, 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**: State & local communities can build clusters around industry sectors
- **Many entrance points makes EE&RE market easier to penetrate if the state 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 states are eager to attract and retain:
  - -- **College-educated professional workers**, many with advanced degrees
  - -- **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 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**
- ***However: All states are in competition with other states for these new energy economy jobs***

CONTRAST WITH GERMANY

(Note that Ohio has much better RE resources than Germany)

- Germany has about ¼ GDP and population of U.S.
- Nevertheless:
  - -- RE jobs in Germany: 214,000
  - -- RE jobs in U.S.: 194,000 (20,000 less than in Germany)
  - -- Germany RE employment has increased 36% in 2 years
  - -- U.S. RE employment has increased ??% – **we don't know!**
- Germany produces 1/2 of the wind rotors in the world
- Germany produces 1/3 of the solar panels in the world
- Germany leads in biodiesel; is 2nd to Japan in fuel cells and hybrids
- **By 2020, German RE jobs will exceed those in machinery or in vehicle mfg.**
- **Implications for U.S. – are obvious**

STATE AND CITY PLANNING STRATEGY

- Rigorously define and agree on the definition of “Green Collar Jobs”
- Identify companies and estimate current Green Collar employment by industry and occupation
- Estimate current RE and EE industry impact on State/City economy
- Forecast BAU and enhanced scenarios for RE and EE
- Identify deficits in required employment demand by industry and occupation
- Identify and examine current Model/Best-Case workforce development programs in other states
- Design educational and training programs to help meet those forecasted needs in your state/city.

-Thanks-