



University of
California,
Berkeley

Building a Strong, Inclusive Green Economy in California

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Sacramento, CA, March 26, 2009

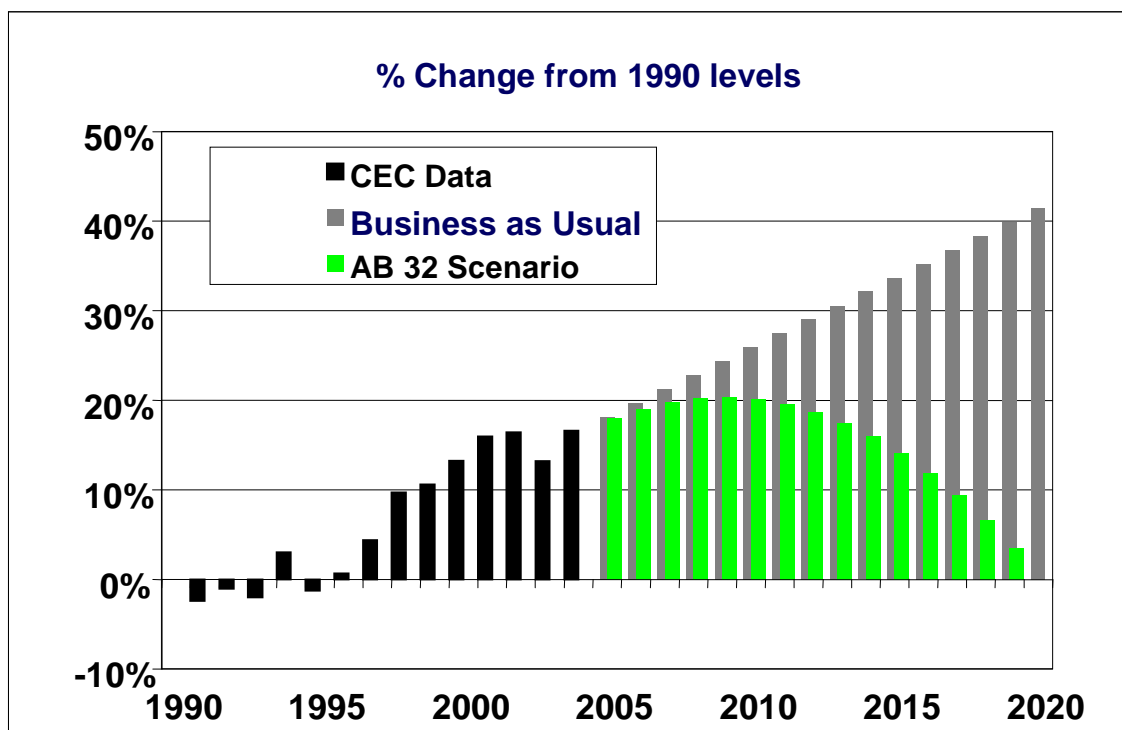
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Green Jobs

Triple benefit

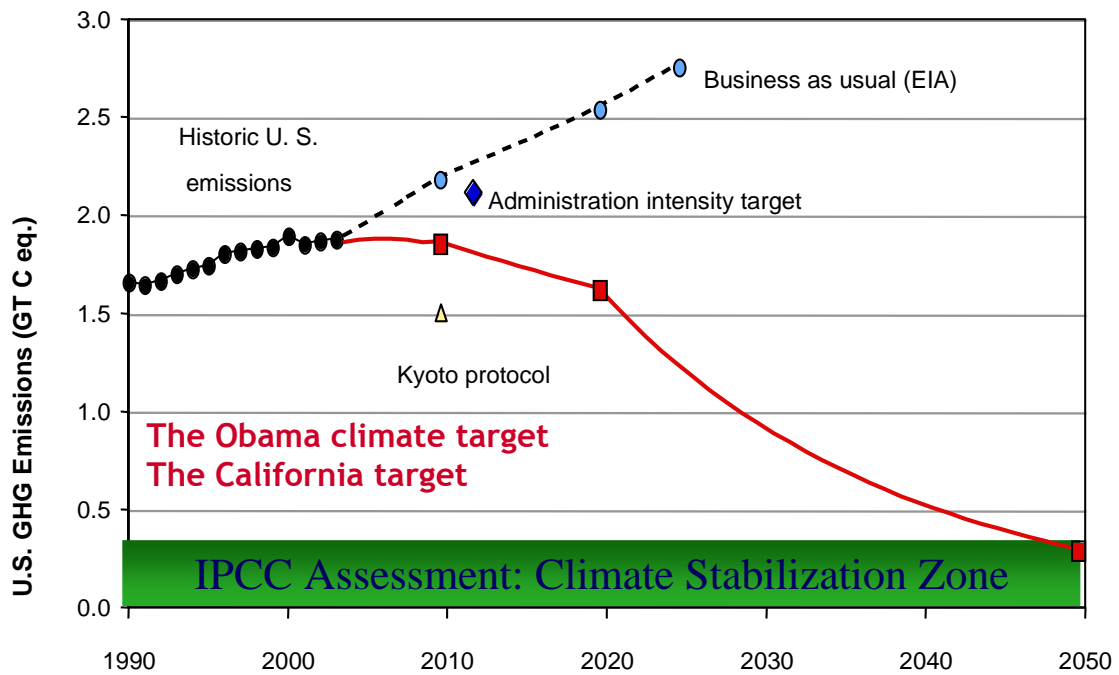
- Better environment
- Domestic security from domestic energy supply
- Economic benefits - Jobs, reduced capital outflow

California Global Warming Solutions Act: 25% cut in emissions by 2020



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The Cascade of Commitment: From the IPCC to California to the USA



Kammen, "September 27, 2006 – A day to remember", *San Francisco Chronicle*, September 27,

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REPORT OF THE
RENEWABLE AND APPROPRIATE ENERGY
LABORATORY

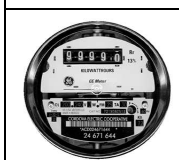
**Putting Renewables to Work:
How Many Jobs Can the
Clean Energy Industry
Generate?**

by

**Daniel M. Kammen
Kamal Kapadia
Matthias Fripp**

of the
Energy and Resources Group &
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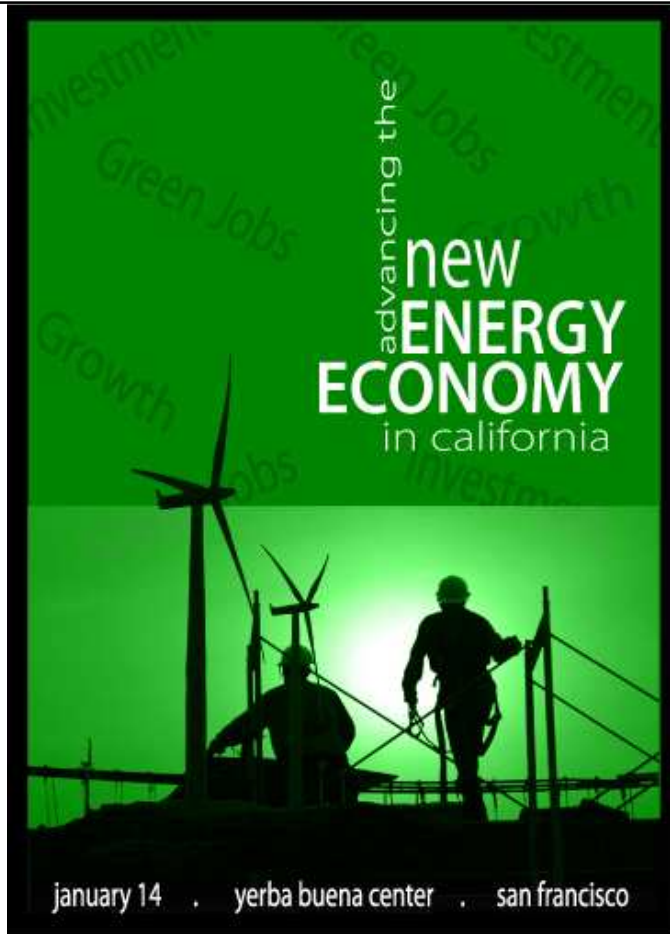
APRIL 13, 2004



Study reviews:

- 20+ studies of job creation
- 3 - 5 *times* More jobs per dollar invested in the renewables and energy efficiency sector than in fossil fuels

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Recent clean energy/green jobs summits:

- Research to implementation
- Economic revitalization
- Equity
- Global growth

GOODJOBS
GREENJOBS
A National Green Jobs Conference



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Updated Study on Renewable Energy Job Creation

(Max Wei, Shana Patadia, Dan Kammen April 2009)

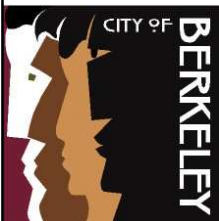
- Summarizes findings of a 20+ studies on renewable energy job creation
 - Solar, Wind, Geothermal, Biomass and Energy Efficiency
 - Also includes “Low Carbon” technologies : Carbon Capture and Storage, Nuclear, Conventional Hydro
 - Models *Net* job creation by considering losses to coal and natural gas industry and referencing BAU cases for energy generation and RPS percentages.
 - Simple spreadsheet model allow for scenario modeling through 2030.
 - Note: Not an input-output model

Jobs per MW: Empirical Estimates

Energy Technology	Source	Total #jobs/MW a	Capacity Factor	Eqpt lifetime (years)
Biomass	REPP 2006	1.95	85%	25.00
Geothermal	CDEAC 2006	1.04	90%	35.00
Energy Efficiency	ACEEE/Roland-Holst/Goldemberg	~2-4	100%	20.00
REPP components:	REPP 2006	6.18	25%	25.00
Solar PV 1	REPP 2006	4.50	20%	25.00
Solar PV 2	IDEA 2005	7.37	20%	25.00
Solar PV 3	CALPIRG 2002	2.53	20%	25.00
Solar PV 4	EPIA/Greenpeace 2001	12.20	20%	25.00
Solar Thermal 1	NREL 2008	1.85	40%	25.00
Solar Thermal 2	NREL 2006	1.40	40%	25.00
Solar Thermal 3	CALPIRG 2002	2.29	30%	25.00
Wind1	EWEA 2008	2.10	35%	25.00
Wind 2	REPP 2006	0.57	35%	25.00
Wind 3	VESTAS 2006	1.75	35%	25.00
Carbon Capture & Storage	J. Friedmann, 2009	1.2+	80%	40.00
Nuclear	INEEL 2004	1.29	90%	40.00
Coal	REPP, 2001	1.00	80%	40.00
Natural Gas	CALPIRG 2002	0.99	85%	40

Municipal Clean Energy Financing

- 2006 Popular Vote: City of Berkeley, California Climate Target established of 80% emissions cuts by 2050
- City funds made available for energy efficiency and solar power
- Property owners fully repay loan over 20 years
- Loan attached to the property - builds clean energy equity
- What about low income / renters / r



SOLAR AMERICA CITY
2007





Vestas is the largest Wind Turbine
manufacturer in the world

Employing approx. 20,500 people

24 countries worldwide

Just opened the
world's biggest R&D center

Install a new wind turbine every 5 hours

80 x V80-2.0 MW, HornReef, Denmark

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Vestas Product family

Our fleet:
35,000 Turbines
delivered

= Total required power in
 Spain

63 countries
55kW ... 3.0 MW



Future:
 Cost of energy
 Reliability
 Technology

Product/ Rotor diameter (m)	V15	V17	V19	V20	V25	V27	V39	V44	V47	V52	V66	V80	V82	V90	V90
Year of installation	1981	1984	1986	1987	1988	1989	1991	1995	1997	2000	1999	2001	2003	2004	2002
Capacity (kW)	55	75	90	100	200	225	500	600	660	850	1,750	1,800	1,650	1,800	3,000
MWh/year	217	265	301	346	481	647	1,304	1,581	1,947	2,530	4,705	6,320	6,414	7,498	9,154
												6,668		7,295	

Main stream product

Sensitivity of Various Options

Approach	Net Jobs-Yrs in 2020
Energy Efficiency (BAU 24% growth)	
12% growth	481,403
0% growth	1,092,427
RPS Percentage	
BAU 7.4% of overall generation	-
20% of overall generation [U.S. target]	399,562
30% of overall generation	707,094
0% of overall generation	(657,300)
Distribution Of RPS Technologies	
20% of overall generation with BAU distribution	399,562
20% of overall generation with 10% solar PV	732,308
20% of overall generation with 50% wind	322,068
Carbon Capture and Storage	
25% of coal generation	-
50% of coal generation	-
Nuclear Power Options (BAU 18.7%)	
25% of overall generation	332,358
30% of overall generation	595,378
35% of overall generation	858,398

- Many drivers for job creation: all may be needed.
- Renewable Energy creates far more jobs than Coal/NG

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Paths to Cleaner Energy and More Jobs

Scenario	%Renewable Energy	% Low Carbon	%Renewable + Low Carbon	Net Total Job-Years
RPS 20% 2020	20%	24.6%	44.6%	399,562
RPS 25% 2025	25%	24.6%	49.6%	1,162,127
RPS 33% 2020	33%	24.6%	57.6%	794,912
Add 0.5X BAU growth	20%	25.7%	45.7%	849,688
Add 0.5X BAU growth	25%	25.7%	50.7%	2,095,403
Add 0.5X BAU growth	33%	25.7%	58.7%	1,230,323
Increase to 30% nuclear	20%	36.2%	56.2%	1,383,310
Increase to 30% nuclear	25%	36.2%	61.2%	3,096,949
Increase to 30% nuclear	33%	36.2%	69.2%	1,763,944
Add 25% Carbon Capture & Storage	20%	61.2%	81.2%	1,383,310
Add 25% Carbon Capture & Storage	25%	61.2%	86.2%	3,096,949
Add 25% Carbon Capture & Storage	33%	61.2%	94.2%	1,763,944
Increase to 30% nuclear	20%	65.0%	85.0%	1,458,458
Increase to 30% nuclear	25%	65.0%	90.0%	3,236,893
Increase to 30% nuclear	33%	65.0%	98.0%	1,839,093

- Scenario for over 80% of energy supply renewable or low carbon sources and 2-3M jobs by 2020.

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California Job Gains from EE and RPS

Key	Scenario	Net Direct Jobs-Yrs	Net Indirect Job-Yrs	Total Net Job-Yrs
1	RPS 10% in 2020	27,155	66,566	93,722
2	RPS 33% in 2020	152,594	173,781	326,375
3	RPS 40% in 2020	202,078	216,801	418,879
4	RPS 33% + 0.5X BAU growth	191,531	625,278	816,809
5	RPS 33% + Zero Growth	232,872	1,095,928	1,328,800
2-1	Increase RPS to 33%	125,439	107,215	232,653
3-1	Increase RPS to 40%	174,923	150,235	325,157
4-1	Reduce growth to 0.5X	164,376	558,712	723,087
5-1	Achieve Zero Growth	205,717	1,029,362	1,235,078

Conclusions

- Consistent policies a key driver for “green economy” growth and provide long term economic dividends
- 40% of energy package in the 2009 U.S. Stimulus is for energy efficiency
- Energy efficiency offers high payoff in induced jobs and is often the most “wrench-ready”
- New RAEL study examines job growth in renewable energy, energy efficiency, CCS, and nuclear technologies. All of these technologies generate more jobs than BAU fossil fuels.

Securing a Clean Energy Future

Opportunities for States in Clean Energy Research, Development, & Demonstration

*A Report for the National Governors Association as part of the
Securing a Clean Energy Future Initiative*



Drivers for Vestas Global Research

How to break the CoE curve?

