

# Renewable Energy and National Economic Wealth Program: California Version

RENEW: A program that will stimulate the economy, lower energy costs, and improve national security by encouraging the production and use of clean and sustainable energy sources.

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## Jared Fox

- B.S. Computer Science from Arizona State Univ.
- B.S. Mathematics from Arizona State Univ.
- PhD student at UCLA in Computer Science.
- President of the UCLA Graduate Student Assn.
- Worked at Brookhaven National Lab and Pacific Northwest National Lab with atmospheric data for simulations of future climatology.
- RENEW designed with ZERO funding or incentives other than to improve my country and the world.

## The Problems:

1. The State Economy is Struggling
2. Traffic Congestion Wastes Billions of Dollars and Man Hours Annually.
3. High Pollution Levels Threaten Federal Funding and Public Health
4. National Dependence on Foreign Oil is a Huge Threat to the Economy and National Security
5. Global Warming Could Raise the Level of the Oceans, Flooding Millions of Acres of Beautiful Beaches and Homes.

## Pieces of the Problems

- 60% of US oil consumption is imported, removing \$200 billion from the US economy each year. (EIA)
- US dependence on historically unstable regions and OPEC price-fixing can cause tremendous instability for the entire US economy.
- Foreign oil dependence can lead to wars and other military conflicts.
- Traffic congestion costs \$16 Billion annually for Los Angeles drivers *alone*. (US DOT)

## Pieces of the Problem

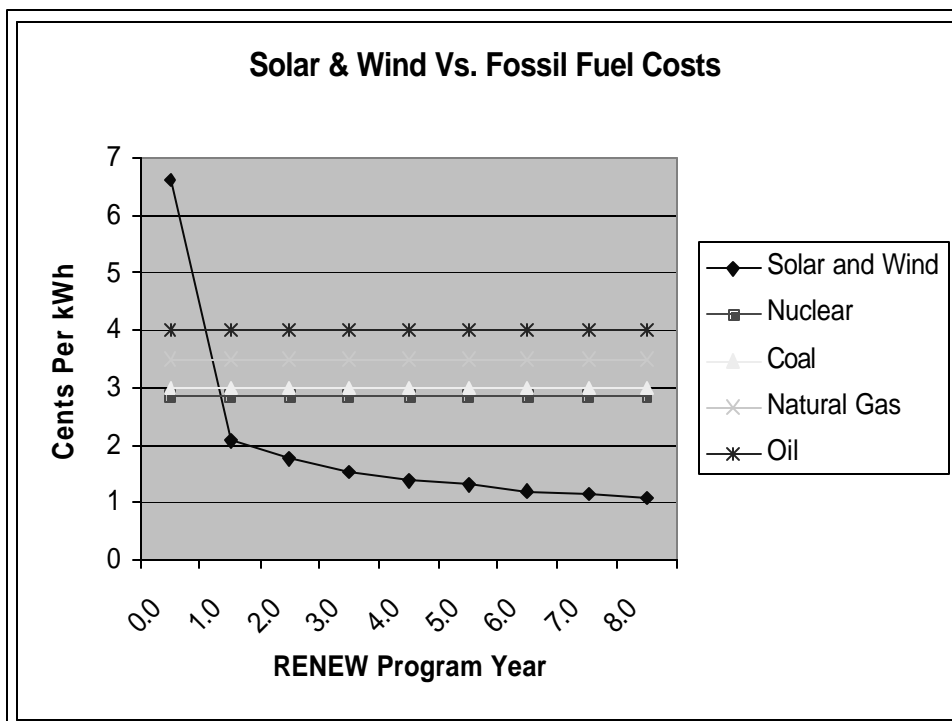
- California energy prices are the highest in the nation.
- The US emits 25% of the entire world's greenhouse gas emissions, but has only 4.6% of the world's population.
- 99% of these emissions come from burning and processing coal, oil, and natural gas.
- Man has increased atmospheric concentrations of carbon dioxide by 30% since the dawn of the Industrial Age.

## The 4 Actions RENEW CA Will:

1. Provide rebates for California businesses to install hydrogen generation systems that are powered with renewable energy at locations close to point of sale.
2. Purchase and install hydrogen pumping facilities at 1800 strategically located gas stations across the state.
3. Provide funds to convert cars and trucks to additionally run on hydrogen.
4. Provide rebates for utilities to install renewable energy devices at sunny and windy areas and power lines to carry the energy into the cities.

## WHY?

- The large purchases of renewable energy generation devices (like solar panels and wind turbines) will induce mass production of these devices and greatly lower their cost. Wind energy will drop to 1cent/kWh (1/3 the cost of coal). Hydrogen generated from this energy will cost \$0.60/gallon of gasoline equivalent (plus taxes).
- The massive revenue will generate large amounts of research and encourage consumers and utilities to integrate these devices into their energy supplies and lead to increased innovation for clean and sustainable products.
- The hydrogen infrastructure will allow consumers to purchase cars that run on this clean and domestically sustainable fuel.



## WHY?

- Producing the hydrogen (and the renewable energy that powers hydrogen production) close to the gas station will make it essentially impossible to disrupt local fuel supplies (through terrorism or other means), and also eliminates transportation expenses.
- Utilities can setup wind farms in high wind areas (where people generally choose not to live) and send this VERY inexpensive power to big cities. EVERY part of the state is within transmission distance of excellent wind and solar resources.
- Since the hydrogen and electricity will be generated from renewable energy, emissions of greenhouse gases and other pollutants will decrease, and the fuel is domestically sustainable.

## Why Not Ethanol or Biodiesel?

- Creating 10 gallons of ethanol requires 5-15 gallons of gasoline (or other equivalent fossil fuel).
- Replacing US oil imports with either ethanol or biodiesel would require at minimum an area equal to the entire US dedicated to growing crops for fuel. Using solar and wind power to generate hydrogen requires much less than 1% of the US land area.
- Not only would this be impractical and environmentally destructive, it would be impossible to provide enough irrigation to support this much growth. The petroleum derived fertilizer use would also be immense.

## The 4 Main Results RENEW Will:

1. Lower energy costs
2. Revitalize the economy
3. Increase national security
4. Decrease pollution

### Result 1: Lower Energy Costs

Decreased demand for fossil fuels and electricity generated from renewable sources will result in lower costs for these items.

- 50% drop in electricity prices will save **\$15 Billion** annually.
- Natural gas price reduction of \$2/thousand cubic feet saves **\$5 Billion** annually.
- Using \$1/gallon equivalent hydrogen instead of \$2.20/gallon gas saves **\$20 Billion** annually.
- Total: **\$35 Billion** permanent after-tax savings per year (since the program cost averages \$5 Billion per year).

## Result 2: Revitalize the Economy

- Create thousands of jobs for people making, installing, selling, distributing, and developing renewable energy devices.
- Energy costs will be reduced by \$1000 per person per year.
- Massive production and innovation in the globally valuable renewable energy market will create an industrial revolution similar to the multi-decade semiconductor and computing economic boom.
- California will be able to export energy and energy creation devices to other countries and other states.

## Result 3: Increase National Security

- Reducing oil imports greatly reduces US vulnerability to terrorist attacks and political instability abroad.
- Transportation accounts for approximately 100% of US oil imports. We can eliminate foreign oil dependence without hurting domestic industries by simply switching transportation to domestic fuels.
- California can show the rest of the nation that domestically sustainable energy is possible.

## Result 4: Decrease Pollution

- Reduces California greenhouse gas emissions 72% in 7 years.
- Reduces particulates and volatile organic compound emissions by 70% each, both are major components of smog.
- Improves air quality for the millions of Californians that live in areas with dangerously high pollution levels.
- California products will allow the rest of the nation to decrease their emissions substantially.

## How Does RENEW Pay For These Improvements?

- RENEW will collect taxes from polluting items.
- 10 cents/gallon of oil.
- \$1000 minus ten times the vehicle's MPG rating will be charged for new vehicle purchases (\$700 for a 30MPG vehicle).
- \$100 minus the vehicle's MPG rating added to annual registration. (\$70 for a 30MPG vehicle).
- 5 cents/hundred cubic feet of natural gas.
- Taxes are NOT permanent: if consumers switch to renewable energy sources, they will pay none of these taxes.
- Again, the taxes are \$35 Billion per year less than the savings that RENEW provides.

## Examples of Other RENEW Benefits

- Hydrogen fuel cells produce power with absolutely no emissions except 100% pure water.
- We will be able to conserve our petroleum to make products like fertilizer, plastics, textiles, insulation, lubricants, asphalt, etc.
- Purchasing fuel from local businesses keeps your money in your local community, instead of sending it to a foreign country.
- Solar energy production peaks during peak demand hours, especially during the summer.

## Examples of Other RENEW Benefits

- Using hydrogen fuel cells in automobiles is more efficient than gasoline. 40-60% efficiency for hydrogen, 15-30% for gasoline.
- Hydrogen can be generated in your own home using only electricity and water.
- The water used to generate hydrogen can be filtered wastewater or inexpensively processed seawater.
- Large wind farms can be placed at sea to generate hydrogen which can be safely shipped to shore.

## Examples of Other RENEW Benefits

- Southern California has one of the highest solar radiation indexes in the nation.
- California could generate enough electricity and hydrogen to supply 100% of the nation's energy needs with solar panels covering an area of 120 miles x 120 miles (Although this would be unwise since the entire nation would be dependent on one small area) .
- California could generate 100% of its electricity needs with solar panels covering an area of 1/5 of one percent of the state. These could easily be placed on roofs or in some of the state's vast desert regions.

## Examples of Other RENEW Benefits

- California is home to many solar panel and wind turbine manufacturers.
- RENEW will turn renewable energy into a multi-billion dollar industry.
- The benefits of a completely sustainable energy economy are too numerous to mention. The solution is here. There is simply no reason to delay.

## Summary of The 4 Actions RENEW Will:

1. Provide rebates for California businesses to purchase (or manufacture) and install hydrogen generation systems that are powered with renewable energy at locations close to point of sale.
2. Purchase and install hydrogen pumping facilities at 1800 strategically located gas stations across the state.
3. Provide funds for clean public transportation and car and truck conversion to hydrogen.
4. Provide rebates for utilities to install renewable energy devices at sunny and windy areas and power lines to carry the energy into the cities.

## Result Summary

- Reduces energy costs by \$35 Billion per year after taxes (\$1000 per person).
- Reduces dependence on foreign oil.
- Creates millions of jobs.
- Reduces greenhouse gases and other pollutants.

## For Questions or Comments Please Contact

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Results of RENEW California Program

Year	1	2	3	4	5	6
Thousand Trucks Converted	0	10	35	60	85	110
Million Barrels oil saved	11	35	86	179	316	452
Million kg Hydrogen Produced	500	1500	3500	7500	13500	19500
Million kg Hydrogen Consumed	450	1480	3605	7530	13255	18980
Million Tons Carbon Dioxide Emissions Avoided	7	22	55	116	206	296
Percent Reduction from 2002 Carbon Dioxide Emissions	2	5	13	28	50	72
Million Cars Converted	0.75	2.25	5.25	11.25	20.25	29.25
Billion kWh Generated By Renewable Energy	4	14	34	74	134	194
Billion Cubic Feet of Natural Gas Saved	35	122	295	643	1164	1686

# RENEW California Program Expenditures

All monetary figures are in millions of dollars

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	Item Expense	Total Expense	
<b>First Year:</b>			
<b>Renewable, Hydrogen, and Vehicle Research</b>		\$320	
+ Lightweight, Efficient, Hydrogen Fuel Cell Vehicle Research/Prototyping	\$10		
+ Low Cost, Strong, Lightweight, Advanced Materials Research	\$10		
+ Efficient and Low Cost Hydrogen Fuel Cell Research	\$100		
+ Photovoltaic and Wind Turbine Research	\$200		
<b>Rebates</b>		\$7,475	
+ Hydrogen Pumping & Storage Installation at Gas Station Rebates (\$500k)	\$200		400 Gas Stations
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$20k)	\$0		0 Thousand Trucks
+ Renewably Powered H2 Generation Systems 500M kg @ \$8/kg of Annual Output (>20y)	\$4,000		500 M kg H2/yr
+ 500kV Power Lines from Large Renewable Energy Farms to Cities (100 miles @ \$1M/mile)	\$100		
+ Renewable Energy Generation Devices 2GW @ \$1/W	\$2,000		4 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$800		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$500)	\$375		0.75 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$7,825	
<b>Previous Balance</b>		\$0	
<b>Tax Revenue</b>		\$8,834	
<b>Total Funds Available</b>		<b>\$8,834</b>	
<b>Ending Balance</b>		\$1,009	

	Item Expense	Total Expense	
<b>Second Year:</b>			
<b>Renewable, Hydrogen, and Vehicle Research</b>		\$320	
+ Low Cost, Strong, Lightweight, Advanced Materials Research	\$10		
+ Lightweight, Efficient, Hydrogen Fuel Cell Vehicle Research/Prototyping	\$10		
+ Efficient and Low Cost Hydrogen Fuel Cell Research	\$100		
+ Photovoltaic/Wind Turbine Research	\$200		
<b>Rebates</b>		\$9,330	
+ Hydrogen Pumping & Storage Installation At Gas Station Rebates (\$450k)	\$180		400 Gas Stations
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$15k)	\$150		10 Thousand Trucks
+ Renewably Powered H2 Generation Systems 1B kg @ \$5/kg of Annual Output (>20y)	\$5,000		1000 M kg H2/yr
+ 500kV Power Lines from Large Renewable Energy Farms to Cities (200 miles @ \$1M/mile)	\$200		
+ Renewable Energy Generation Devices 5GW @ \$0.50/W	\$2,500		10 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$700		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$400)	\$600		1.5 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$9,680	
<b>Previous Balance</b>		\$1,009	
<b>Tax Revenue</b>		\$8,891	
<b>Total Funds Available</b>		<b>\$9,900</b>	
<b>Ending Balance</b>		\$220	

	Item Expense	Total Expense	
<b>Third Year:</b>			
<b>Renewable, Hydrogen, and Vehicle Research</b>		\$230	
+ Lightweight, Efficient, Hydrogen Fuel Cell Vehicle Research/Prototyping	\$10		
+ Hydrogen Powered Airplanes Research/Prototyping	\$100		
+ Efficient and Low Cost Hydrogen Fuel Cell Research	\$10		
+ Photovoltaic/Wind Turbine Research	\$100		
+ Carbon Dioxide into Carbon and Oxygen Research	\$10		
<b>Rebates</b>		\$7,840	
+ Hydrogen Pumping & Storage Installation At Gas Station Rebates (\$400k)	\$180		
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$10k)	\$250		
+ Renewably Powered H2 Generation Systems 2B kg @ \$2/kg of Annual Output (>20y)	\$4,000		25 Thousand Trucks 2000 M kg H2/yr
+ 500kV Power Lines from Large Renewable Energy Farms to Cities (200 miles @ \$800k/mile)	\$160		
+ Renewable Energy Generation Devices 10GW@ \$0.2/W	\$2,000		20 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$500		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$250)	\$750		3 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$8,100	
<b>Previous Balance</b>		\$220	
<b>Tax Revenue</b>		\$8,689	
<b>Total Funds Available</b>		<b>\$8,909</b>	
<b>Ending Balance</b>		\$809	

	Item Expense	Total Expense	
<b>Fourth Year:</b>			
<b>Renewable, Hydrogen, and Vehicle Research</b>		\$50	
+ Hydrogen Powered Airplanes Research/Prototyping	\$20		
+ Efficient and Low Cost Hydrogen Fuel Cell Research	\$10		
+ Photovoltaic/Wind Turbine Research	\$20		
<b>Rebates</b>		\$7,140	
+ Hydrogen Pumping & Storage Installation At Gas Station Rebates (\$350k)	\$175		
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$5k)	\$125		
+ Renewably Powered H2 Generation Systems 4B kg @ \$1/kg of Annual Output (>20y)	\$4,000		500 Gas Stations 25 Thousand Trucks 4000 M kg H2/yr
+ 500kV Power Lines from Large Renewable Energy Farms to Cities (400 miles @ \$600k/mile)	\$240		
+ Renewable Energy Generation Devices 20GW@ \$0.05/W	\$1,000		40 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$400		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$200)	\$1,200		6 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$7,220	
<b>Previous Balance</b>		\$809	
<b>Tax Revenue</b>		\$8,047	
<b>Total Funds Available</b>		<b>\$8,857</b>	
<b>Ending Balance</b>		\$1,637	

	Item Expense	Total Expense	
<b>Fifth Year:</b>			
<b>Rebates</b>		\$10,025	
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$5k)	\$125		25 Thousand Trucks
+ Renewably Powered H2 Generation Systems 6B kg @ \$1/kg of Annual Output (>20y)	\$6,000		6000 M kg H2/yr
+ 500kV Power Lines from Large Renewable Energy Farms to Cities (500 miles @ \$400k/mile)	\$200		
+ Renewable Energy Generation Devices 30GW@ \$0.05/W	\$1,500		60 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$400		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$200)	\$1,800		9 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$10,055	
<b>Previous Balance</b>		\$1,637	
<b>Tax Revenue</b>		\$6,940	
<b>Total Funds Available</b>		<b>\$8,577</b>	
<b>Ending Balance</b>		<b>(\$1,478)</b>	

	Item Expense	Total Expense	
<b>Sixth Year:</b>			
<b>Rebates</b>		\$5,325	
+ Truck Conversion to Hydrogen or new Hydrogen Purchase (\$5k)	\$125		25 Thousand Trucks
+ Renewably Powered H2 Generation Systems 6B kg @ \$0.50/kg of Annual Output (>20y)	\$3,000		6000 M kg H2/yr
+ Renewable Energy Generation Devices 30GW@ \$0.03/W	\$900		60 B kWh/yr estmt
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$400		
+ Car Conversion to Hydrogen or new Hydrogen Purchase (\$100)	\$900		9 M Cars
<b>Program Administration, Marketing, Education, Publicity</b>		\$30	
<b>Total Planned Expenditures</b>		\$5,355	
<b>Previous Balance</b>		<b>(\$1,478)</b>	
<b>Tax Revenue</b>		\$5,107	
<b>Total Funds Available</b>		<b>\$3,630</b>	
<b>Ending Balance</b>		<b>(\$1,725)</b>	

	Item Expense	Total Expense	
<b>Seventh Year:</b>			
<b>Rebates</b>		\$1,200	
+ Grant to UC, CSU, and K-12	\$800		
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$400		
<b>Total Planned Expenditures</b>		\$1,200	
<b>Previous Balance</b>		<b>(\$1,725)</b>	
<b>Tax Revenue</b>		\$3,046	
<b>Total Funds Available</b>		<b>\$1,320</b>	
<b>Ending Balance</b>		\$120	

	Item Expense	Total Expense
<b>Eighth Year:</b>		
<b>Rebates</b>		\$1,700
+ Grant to UC, CSU, and K-12	\$1,300	
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$400	
<b>Total Planned Expenditures</b>		\$1,700
<b>Previous Balance</b>		\$120
<b>Tax Revenue</b>		\$1,643
<b>Total Funds Available</b>		<b>\$1,763</b>
<b>Ending Balance</b>		\$63

	Item Expense	Total Expense
<b>Ninth Year:</b>		
<b>Rebates</b>		\$900
+ Grant to UC, CSU, and K-12	\$700	
+ Public Transportation Running on Renewable Energy (Local and Statewide)	\$200	
<b>Total Planned Expenditures</b>		\$900
<b>Previous Balance</b>		\$63
<b>Tax Revenue</b>		\$838
<b>Total Funds Available</b>		<b>\$901</b>
<b>Ending Balance</b>		\$1

RENEW California Program Tax Revenue

Year	1	2	3	4	5	6	7	8	9
<b>Tax on Oil</b>									
\$Tax/Barrel Oil	\$4.20	\$4.62	\$5.08	\$5.59	\$6.15	\$6.76	\$7.44	\$8.18	\$9.00
Millions of Barrels/Year	650.00	639.29	614.76	564.17	470.71	334.40	198.10	100.00	50.00
Revenue From Oil Tax (\$M)	<b>\$2,730</b>	<b>\$2,954</b>	<b>\$3,124</b>	<b>\$3,154</b>	<b>\$2,895</b>	<b>\$2,262</b>	<b>\$1,474</b>	<b>\$818</b>	<b>\$450</b>
<b>Tax on Coal</b>									
\$Tax/Ton Coal	\$4.00	\$4.40	\$4.84	\$5.32	\$5.86	\$6.44	\$7.09	\$7.79	\$8.57
Thousands of Tons of Coal/Year	1000.00	900.00	800.00	700.00	600.00	500.00	400.00	300.00	200.00
Revenue From Coal Tax (\$M)	<b>\$4</b>	<b>\$4</b>	<b>\$4</b>	<b>\$4</b>	<b>\$4</b>	<b>\$3</b>	<b>\$3</b>	<b>\$2</b>	<b>\$2</b>
<b>Tax on Natural Gas</b>									
\$Tax/Thousand ft <sup>3</sup> natural gas	0.50	0.55	0.61	0.67	0.73	0.81	0.89	0.97	1.07
Millions of TCF/year	2600.00	2565.24	2478.34	2304.54	1956.94	1435.54	914.14	500.00	300.00
Revenue From Natural Gas Tax (\$M)	<b>\$1,300</b>	<b>\$1,411</b>	<b>\$1,499</b>	<b>\$1,534</b>	<b>\$1,433</b>	<b>\$1,156</b>	<b>\$810</b>	<b>\$487</b>	<b>\$322</b>
<b>Vehicle Registration Fee</b>									
Average MPG of Gas Vehicles	20.00	21.00	23.00	25.00	27.00	29.00	31.00	33.00	35.00
Millions of Gas Vehicles	30.00	29.25	27.75	24.75	18.75	9.75	1.00	0.00	0.00
Registration Tax Revenue (\$M)	<b>\$2,400</b>	<b>\$2,311</b>	<b>\$2,137</b>	<b>\$1,856</b>	<b>\$1,369</b>	<b>\$692</b>	<b>\$69</b>	<b>\$0</b>	<b>\$0</b>
<b>New Vehicle Purchase Tax</b>									
Average MPG of New Gas Vehicles	20.00	21.00	23.00	25.00	27.00	29.00	31.00	33.00	35.00
Thousand New Gas Vehicles Purchased	3000.00	2800.00	2500.00	2000.00	1700.00	1400.00	1000.00	500.00	100.00
New Vehicle Purchase Tax Revenue (\$M)	<b>\$2,400</b>	<b>\$2,212</b>	<b>\$1,925</b>	<b>\$1,500</b>	<b>\$1,241</b>	<b>\$994</b>	<b>\$690</b>	<b>\$335</b>	<b>\$65</b>
<b>Total Revenue (\$M)</b>	<b>\$8,834</b>	<b>\$8,891</b>	<b>\$8,689</b>	<b>\$8,047</b>	<b>\$6,940</b>	<b>\$5,107</b>	<b>\$3,046</b>	<b>\$1,643</b>	<b>\$838</b>

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RENEW Program Estimated Solar Energy Cost Sheet

This Purchase (GW)	Total Purchased (GW)	\$/Watt	Percent Reduction in Price Due to Doubling Capacity	This Purchase Cost (\$Billions)	Total Cost (\$Billions)	Cents/kWh Given 25 year Panel Life	Cents/kWh Given 40 year Panel Life	Billions of kWh Generated
0.55	0.55	3.000		1.65	1.65	6.575	4.110	1.0
0.55	1.10	2.400	20	1.32	2.97	5.260	3.288	2.1
1.10	2.20	1.944	19	2.14	5.11	4.261	2.663	4.1
2.20	4.40	1.594	18	3.51	8.62	3.494	2.184	8.3
4.40	8.80	1.323	17	5.82	14.44	2.900	1.812	16.5
8.80	17.60	1.111	16	9.78	24.22	2.436	1.522	33.0
17.60	35.20	0.945	15	16.63	40.84	2.071	1.294	66.0
35.20	70.40	0.812	14	28.60	69.44	1.781	1.113	132.0
70.40	140.80	0.707	13	49.76	119.20	1.549	0.968	264.0

The data contained in this worksheet is based upon historical photovoltaic industry data where the price per Watt has decreased by 20% for every doubling of output capacity. 2003 global photovoltaic production was approximately 550MW.

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