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Ending Poverty in California with Solar (EPICS)

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Summary: *Ending Poverty in California with Solar*, or "EPICS," is a program designed to provide, by 2060, every individual in California with 10 kilowatts of installed solar photovoltaic panels and a monthly basic income, from birth to death and regardless of wealth and income, through the sale of the generated electricity. This is to be achieved by, first, giving every Californian with a share in the California Solar Energy Commons, linked to the total solar energy falling on the state; second, by assigning a 10kW solar photovoltaic array to every individual resident, from which sale of electricity will provide a basic income of $1,000 per month. This document describes the elements of EPICS and how it can be implemented.

I. The problem of poverty, in California and around the world

An enduring problem across the United States and the world is endemic poverty. Notwithstanding rising incomes in China and India over the past two decades, 46% of the world's population lives on less than $5.50 per day (or about $2,000 per year). In the United States, almost 12% of the population (close to 40 million people) were living in poverty in 2018, on about $17 per day ($6,500 per year). In California, the poverty rate is between 12.8 and 17% (roughly 5-7 million people) depending on how the number is calculated. Note that official poverty rates are set fairly low in order to keep the picture from looking much worse, with those above the poverty thresholds hardly being that much better off.[1]

Poverty is not something that people choose; it arises from a combination of factors that are extremely difficult to escape, especially for larger families. And poverty has proven to be surprisingly stubborn, notwithstanding many, many efforts to address it. One approach to ending poverty, proposed by both conservatives and liberals alike, is the "basic income," which provides a fixed monthly payment to individuals and

[1] World Bank. "Poverty and Shared Prosperity 2018: Piecing Together the Poverty Puzzle," Washington, DC: World Bank, 2018, P. 7, at: https://openknowledge.worldbank.org/bitstream/handle/10986/30418/9781464813306.pdf (accessed December 23, 2019); Jessica Semega, Melissa Kollar, John Creamer, and Abinash Mohanty, " Income and Poverty in the United States: 2018," Washington, DC: U.S. Bureau of the Census, September 2019, at: https://www.census.gov/content/dam/Census/library/publications/2019/demo/p60-268.pdf (accessed December 23, 2019); Sarah Bohn, Caroline Danielson, and Tess Thorman, "Poverty in California," San Francisco, CA: Public Policy Institute of California, July 2019, at: https://www.ppic.org/wp-content/uploads/JTF_PovertyJTF.pdf (accessed December 23, 2019).

families who meet stipulated requirements and, unlike welfare or unemployment insurance, comes with no strings or requirements attached. A few experiments with basic incomes have been tried, but the high cost of a comprehensive program, which would have to come from the taxes of nonbeneficiaries, have prevented any more comprehensive testing.

Ending Poverty in California with Solar, or "EPICS," is a program designed to provide every individual in California with a basic monthly income from the sale of the electricity generated by 10 kilowatts of solar photovoltaic panels, from birth to death and regardless of wealth and income. This program is based on Robert Stayton's proposal in *Solar Dividends—How Solar Energy can Generate a Basic Income for Everyone on Earth* (Santa Cruz, Calif.: Sandstone, 2019) and the name has been inspired by Upton Sinclair's 1934 California gubernatorial campaign and his plan to "End Poverty in California," which would have created millions of jobs to employ those thrown out of work by the Great Depression.[2] But, whereas Sinclair saw state taxes as the funding source for EPIC, EPICS will be financed by the sale of a commodity: electricity.

II. Who owns the Sun? We all do, in common.

Until now, solar electricity has been available only to individuals who can afford to purchase solar photovoltaic panels and own space on which to install them (for example, on the roofs of their homes). Along with the owners of the large, privately-owned solar farms that sell electricity distributed by utilities over the state's grid, individual homeowners have been able to take advantage of the open access nature of solar insolation, which is available to whomever can capture it and privatize that energy for individual and corporate use. This is in the nature of such resources: whomever owns the technology that can mine or extract or transform a resource can capture privately the benefits and deny them to society as a whole.

Some countries—but not the United States—have declared subsurface mineral resources to be the property of the state (and its citizens), with returns from mineral sales to be directed to national treasuries to finance operations and social expenditures. In many instances, however, these revenues are diverted into the pockets and bank accounts of ruling elites and never trickle down to those most in need of assistance. In the United States, resources on or under public lands are leased to private entities, who pay royalties on the land or extracted minerals, but these revenues tend to be quite small and make little difference to the public.

Solar energy, however, falls on everyone and everything. It drives photosynthesis, weather cycles, hydrology and, indeed, life itself. The quantity of solar energy that hits the Earth *every hour* is greater than humans generate and consume in one year. *And no one privately owns any of that solar energy!* We are proposing a law that will

[2] James N. Gregory, et al., "Upton Sinclair's End Poverty in California campaign," Seattle, Wash.: Civil Rights & Labor History Consortium, University of Washington, 2015-2019, at: https://depts.washington.edu/epic34/campaign.shtml (accessed December 23, 2019).

give every resident of the state one lifetime share in the California Solar Energy Commons (CalSEC), which cannot be sold but which will have a face value of $13,000. This share will entitle the shareholder to the energy falling on an area equivalent to that covered by a 10 kW solar PV array. The face value of the share is the size of the basic income generated by the sale of electricity from a 10 kW array to the state's electrical utilities, power coops and community choice aggregators.[3]

III. How will EPICS be accomplished?

A 10 kW solar array covers an area of approximately 50 to 65 square meters (or about 600 square feet, depending on the power rating of the PV panels). Forty million arrays will cover less than 900 square miles (by contrast, metropolitan Los Angeles covers 4,850 square miles, and California, a little less than 164,000 square miles; Santa Cruz County, 604 square miles). While this is not an inconsiderable area to be covered, it does not seem insurmountable. New solar technologies will make it possible to mount panels over agricultural fields, generating power from light frequencies other than those required for photosynthesis while paying ground rents to farmers and landowners.

EPICS is a 40 year project and will require construction of one million solar arrays every year beginning with the state's poorest residents (by the time the final tranche is installed, the first one will need to be replaced). A 10 kW solar PV array generates about 36 kWh per day, or roughly 13,000 kWh per year. Sale of this electricity at $1/kWh will thus generate $13,000 per year of which $1,000 ($83/month) will go to operation and maintenance of the arrays, leaving $12,000 per year (or $1,000/month). If the program begins in 2025, by 2065, every resident of California will be receiving a basic annual income of $12,000 from the sale of electricity into the state's grid at a tariff of $1 per kWh. While this might seem like a very high price for one kilowatt hour, it is not the average price, which will be determined by the generation mix at any one time. By 2065, moreover (and as discussed below), the retail price of one kWh is likely to be considerably higher than 50¢/kWh.

Finally, what will all of this cost and who will pay for it? The cost of arrays will be repaid from the basic income. At the present time, a 10 kW array costs about $20,000 to install, with a simple payback time of less than two years. At the end of the payment period, the basic income will rise to $1,000 per month.

Lest all of this appear too blue sky for words, it is worth putting EPICS in the context of California's renewable portfolio standard, which mandates that 50% of the state's electricity generation come from renewable sources by 2030. California's current generating capacity is 80 GW, producing roughly 285.5 terrawatt-hours per year.[4] Current state energy consumption is roughly 2,340 TWh(e)/year (primary energy in terms of kWh). Assuming 35% efficiency, non-electrical delivered energy is

[3] While a CalSEC share cannot be sold, it can be borrowed against in order to finance individual projects. The income from the share will then be directed toward repayment of the loan.

[4] One terawatt hour equals one billion kilowatt hours.

approximately 720 TWh(e)/year.

Each tranche of one million arrays will generate roughly 13 billion kilowatt hours per year; by 2035, 10 million will be generating 130 TWh or 46% of current state consumption. At full buildout in 2065, EPICS will produce 520 TWh per year, more than enough to supply all of the state's future electricity requirements.

Generally speaking, we assume that the cost of electricity and energy to the consumer will rise over the coming 40 years. The average cost of energy has been extraordinarily low over most of the century between 1920 and 2020, and much of the growth in consumption is predicted to be in the form of electricity as the world weans itself from greenhouse gas-intensive fossil fuels.

IV. EPICS Program elements

Of course, EPICS cannot be built in a day or even a decade, but design and planning are required now if the first tranche of solar arrays is to be built in 2025. The elements below comprise just a portion of the design and planning phase, which must be started immediately in order to meet the launch date.

1. **Technical policy report** (2020)**:** Drawing on a range of experts in relevant technological, regulatory and economic fields, preparation of a study that analyzes and vets the basic propositions, requirements and benefits of EPICS, creates a viable schedule, and develops a viable framework for financing and deployment;

2. **EPICS network** (2020-21): Creation of a partnership with committed private foundations, community choice aggregators and municipalities and agencies committed to provision of a non-tax based basic income, meeting the targets of California's Renewable Portfolio Standards, solar PV distributors and installers and other public, private and non-profit entities;

3. **Pilot project** (2021-23): Acquiring funding to construct an array of 1,000 10-kW PV installations at a single site, with support of foundations, corporations and other sources, identification and enrollment of selected, qualified households in the pilot, and sale of electricity to a selected community choice aggregator;

4. **Outreach & publicity campaign** (2020-24): Creation of communication and publicity campaign to disseminate EPICS over a wide range of channels, including brochures, talks, contest entries, internet and social media, education, conferences, workshops and other public events.

5. **Creation and implementation of CalSEC, the California Solar Energy Commons** (2022-24): Writing of legislation to create CalSEC, which awards every resident of California a 10 kilowatt equivalent share in the solar energy commons, along with public education, lobbying campaign and, possibly, a state referendum.

Preliminary project budget

EPICS Program element	2020	2021	2022	2023	2024	2025	
Policy paper							
Project manager/Analyst	$25,000	$40,000	$75,000	$75,000	$90,000	$90,000	
Intern	$5,000	$5,000	$6,000	$6,000	$7,500	$7,500	
Research & travel costs	$2,500	$2,500	$3,000	$3,500	$4,000	$5,000	
Network building							
Communications/fundraising	$10,000	$25,000	$40,000	$60,000	$75,000	$90,000	
Intern	$5,000	$5,000	$6,000	$6,000	$7,500	$7,500	
Research & travel costs	$2,500	$2,500	$3,000	$3,500	$4,000	$5,000	
Pilot project						PILOT PROJECT LAUNCH	
Planner/designer		$25,000	$40,000	$30,000	$30,000	$60,000	
Financial analyst/manager		$15,000	$30,000	$45,000	$60,000	$60,000	
Intern		$5,000	$6,000	$6,000	$7,500	$7,500	
Design/construction		$25,000	$40,000	$60,000	$60,000	$25,000	
Real Estate Developer		$10,000	$15,000	$20,000	$25,000		
Outreach & PR							
Communications specialist	$10,000	$25,000	$40,000	$50,000	$50,000	$50,000	
Intern	$5,000	$5,000	$6,000	$6,000	$7,500	$7,500	
CalSEC prep & lobbying							
Analyst	$15,000	$30,000	$45,000	$45,000	$25,000	$15,000	
Intern	$5,000	$5,000	$6,000	$6,000	$7,500	$7,500	
Travel	$2,500	$2,500	$5,000	$5,000			
Equipment	$2,500	$3,000	$3,000	$3,000	$3,000	$3,000	
Office supplies	$1,000	$2,000	$2,500	$2,500	$2,500	$2,500	
Misc. costs (inc. rent)	$5,000	$10,000	$10,000	$10,000	$10,000	$10,000	
	$96,000	$242,500	$381,500	$442,500	$476,000	$453,000	$2,091,500

These are provisional estimates of project costs, exclusive of the cost of installing arrays and providing the basic income. It includes our judgement of the various staff and estimated salaries (some of these individuals will be hired on a consulting basis) and project material costs.

Appendix: The details are in the math

Goal: To provide every resident of California with $1,000/month ($12,000/year) in basic income from sale of solar PV electricity, with full program rollout over 40 years.

1. ***Distribution of arrays***:
   i. Each of the 40 million California residents will receive the return from a 10 kilowatt PV array installed at a solar farm.
   ii. At full buildout, this will add 10 kW x 40,000,000 = 400 GW (gigawatts) of peak capacity, which will generate about 520 terrawatt-hours/year (13,000 kWh/year from each array).
   iii. By comparison, California's current generating capacity is 80 GW, generating roughly 285.5 terrawatt-hours per year.
   iv. Current state energy consumption is roughly 2,340 TWh(e)/year (primary energy in terms of kWh) and assuming 35% efficiency, non-electrical delivered energy is approximately 720 TWh(e)/year.
   v. As the system is rolled out, California will be shifting its energy mix away from fossil fuels (especially liquids) to electricity.

2. ***Cost of* arrays**:
   i. The cost of a 10kW PV array installed at a solar energy farm is currently about $2,000 per kilowatt, or $20,000.
   ii. The cost of installing 1,000,000 arrays will be $20 billion; the total cost over 40 years will be $800 billion.
   iii. Each array will return $12,000 per year, with a simple payback period of less than two years
   iv. The cost per solar kilowatt is projected to drop in the future to $1,000-$1,500 (in real dollars).
   v. These sums should be compared to the size of the state's economy. California's 2019 GDP was $3 trillion/yr., so the annual cost of arrays is less than 1% of GDP.
   vi. In 2017, annual per person expenditure on energy was about $3,200 or roughly $128 billion for all of the state's residents.
   vii. We assume that per capita energy consumption (from all sources) will remain the same while real energy prices will double or triple if the costs of climate and other externalities are included, total energy costs will rise to $256 to $384 billion per year, still less than one percent of GDP.

3. ***Cost of generated electricity***:
   i. If we assume a simple payback of two years, and an array lifetime of 40 years, the cost of electricity will be $20,000 divided by (13,000 kWh/yr. x 40 yrs.) = 3.85¢/kWh.
   ii. By comparison, if the array were paid for by a 20 year loan at 4% interest, the cost per kWh would be (2.19 x $20,000) divided by (13,000 kWh/yr. x 40 yrs. = 8.4¢/kWh.
   iii. Including distribution and externalities would raise the cost to about 10¢/kWh.

4. ***Retail price of* electricity**:

i. EPICS envisions the retail price of electricity produced by its arrays to be $1/kWh. This will generate revenues of $13,000/year, from which $1,000 will be deducted for operation and maintenance costs, leading to a basic income of $1,000 per month.

ii. California's average retail price for electricity is about 20¢/kWh.[5] Hawai'ians currently pay about 33¢/kWh, due to the high cost of importing fuels, while PG&E has submitted a time-of-use rate of almost close to 50¢/kWh for customers whose peak consumption is more than 100% of the baseline allowance.

iii. Only electricity from EPICS arrays will be sold for $1/kWh. The table below illustrates the rise in average electricity prices as EPICS is phased in over 40 years. For the purposes of this calculation, we assume that, by 2065, all electricity is provided through EPICS.

Year	# of installed arrays	EPICS generation (billion kWh)	Cost of EPICS electricity	Total assumed generation (kWh)	Non-EPICS generation (kWh)	Non-EPICS Cost @ 20¢/kWh	Total cost	Average cost of electricity
2025	1,000,000	13	$13 billion	285	272	$54.4 billion	$67.4 billion	23.6¢
2030	6,000,000	78	$78 billion	314.4	236.4	$47.3 billion	$125.3 billion	39.8¢
2035	11,000,000	143	$143 billion	344	201	$40.2 billion	$183.2 billion	53.3¢
2040	16,000,000	208	$208 billion	373.1	165.1	$33 billion	$241 billion	64.6¢
2045	21,000,000	273	$273 billion	402.5	129.5	$25.9 billion	$298.9 billion	72¢
2050	26,000,000	338	$338 billion	431.9	93.9	$18.8 billion	$365.8 billion	84.7¢
2055	31,000,000	403	$403 billion	461.3	58.3	$11.7 billion	$414.7 billion	89.9¢
2060	36,000,000	468	$468 billion	490.7	22.7	$4.5 billion	$472.5 billion	96.3¢
2065	40,000,000	520	$520 billion	520	0	0	$520 billion	$1/kWh

5.*What will be the cost to California households?*

i. California's per capita electricity consumption is the lowest in the United States, at 6,500 kWh/year (542 kWh/mo.), while average household consumption ranges from 667 kWh/month in the very hot Central Valley to 317 kWh/month in very cool San Francisco.

ii. Assuming 12.79 million households in California (with an average of 3.12 persons per household, and an average household electricity consumption of 5,900 kWh/year, total household consumption is 75.5 TWh/year. Total electricity consumption ins California is 285.5 TWh/year, so the difference of 210 TWh/yr. is non-household consumption in 2025 rising to perhaps 370 TWh/yr. in 2065.

iii. What would be the impact of a $1/kWh tariff on the cost of processes, products and services? According to a 2010 engineering study, the materials and manufacturing energy required to produce a washing machine totals about 3,900 megajoules, or 1,080 kWh. Much of this is probably due to materials smelting and fabrication, process heat and assembly line operations. If electricity comprises

[5] Most long-term projections of electricity generating costs show them remaining stable or declining through 2050.

about 25% of the total, that is 270 kWh. The industrial tariff is $0.60-0.80 more than the household price, or an additional $162 to $216 dollars per machine. Washing machines cost between $250 and $2,000, so the higher tariff would increase costs by 100% at the lower end an 10% at the higher end.

6. **What if we link basic income to total household income on a graduated scale?**
   i. The table below illustrates one such scheme. Here, we assume every household includes the statewide average of 3.12 persons, the equivalent of 3.12 arrays per household, generating 40,000 kWh/year. As can be seen from the table, the cost of the basic income at buildout is $265.9 billion per year for 12.8 million households.

Household income	Total # of households	pp EPICS income/mo	est. # persons/HH	Total cost/yr (billions)
>$200,000	1,100,000	0	na	0
$100-200,000	2,890,000	$250	2.5	$21.70
$50-100,000	3,660,000	$500	3	$65.90
$40-50,000	990,000	$600	3	$21.40
$30-40,000	1,080,000	$700	3.5	$31.80
$20-30,000	1,140,000	$800	3.5	$38.30
$10-20,000	1,200,000	$900	4	$51.80
<$10,000	730,000	$1,000	4	$35.00
	TOTAL: 12,790,000			$265.90

   ii. This would bring down the retail price of electricity (to be calculated).

7. **What about a royalty charge on solar energy?**
   i. A royalty is a cost for the right to exploit an energy source charged to the extractor of that energy by the owner of the raw energy. In this instance, the royalty would be charged to the owner/operator of a solar farm composed of the 10 kW arrays.
   ii. A single share in CalSEC gives title to the raw solar energy falling on roughly 660 square feet of land or rooftop, the area covered by a 10kW solar PV installation.
   iii. Tilted at California's average latitude in order to maximize the raw energy source, a 10kW PV installation receives about 360 kWh per day of raw solar energy, which is converted into electricity at an average efficiency of 10%, producing 36 kWh of electricity per day.
   iv. In a typical year, the quantity of *raw* solar energy falling on 40 million arrays will be 5.2 *trillion* kWh.
   v. A royalty rate of 1¢/kWh would raise $52 billion per year; 5¢/kWh, $260 billion

per year.

vi. A combination of royalties, graduated basic incomes and reduced rates to households could hold the retail price of electricity to 50¢/kWh or less.

8. How does EPICS compare to capital investments proposed by the state's monopoly utilities?

i. In a business-as-usual scenario, the state's utilities and power providers will need to invest in new generating capacity and upgrading and maintenance of the various distribution networks comprising the state's power grid over the next 40 years. Current utility rate requests project annual capital investment in the system of $10-15 billion statewide over the next few years, or $400-600 billion by 2060.

ii. If we assume that, by 2060, 50% of the state's present generating capacity (40 GW) will be replaced with an equivalent amount of new capacity, at an average cost of $1,500/kW, or $120 billion, the total capital investment will be $520-720 billion, not that much less than the $800 billion base cost of EPICS.

Note that the numbers and calculations provided here are best-guess estimates. Considerably more input data will be required to make a strong case for EPICS' viability. The point of this exercise is to frame the economics of the proposal in order to assess feasibility. The key point is to demonstrate that a guaranteed income need not be provided through higher taxes but could be implemented through sale of a commodity—in this case, electricity.