Thursday, August 24, 2017

How would we build Berkeley if we started today?

Use Drawdown Solutions [http://www.drawdown.org/solutions] ranking of technologies by carbon impact.

Specific data and technology initiatives for Berkeley 2050 ranked by Drawdown Gigaton removal estimates.

Followed by a listing of people from UC Berkeley, City of Berkeley, and major Berkeley institutions with relevant infrastructure responsibilities and capabilities.

Here is the Drawdown appendix, with the Berkeley Measure columns listing city data to be gathered, technology inventories, and near-term and long-term actions. I'm using Life Cycle costing analysis developed by UCB Arpad Horvath and the Berkeley Water Center.

Drawdown Solutions

	Solution Name	Sector	Tons of Carbon	Cost	Savings	Berkeley Measure	Sunk Cost	New Cost	Action	Actor
1	Refrigerant Management	Materials	89.74	N/A	-$902.77	# refrigerators;#heat exchangers;#AC;Total Volume of Refrigerant: Residence, Commercial;, Industry;Campus, ; age;			replace refrig, AC; refuel;	City
2	Wind Turbines (Onshore)	Energy	84.60	$1,225.37	$7,425.00	Count;wind patterns; sky vanes;				
3	Reduced Food Waste	Food	70.53	N/A	N/A	Total mass entering B; home-grown; #restaurants, food prep; disposal volume; green pickup mass; dump and recycle centers; biomass generated daily;				
4	Plant-Rich Diet	Food	66.11	N/A	N/A	Current meat volumes: home, restaurant, dorm; distance to source; butcher shops;				
5	Tropical Forests	Land Use	61.23	N/A	N/A	Number of trees; species; Botanical Garden; Campus; Eucalyptus				
6	Educating Girls	Women and Girls	59.60	N/A	N/A	School Stats; weekly progress; Girls Garage; Maker Faire;				
7	Family Planning	Women and Girls	59.60	N/A	N/A	Fertile; births; deaths;				
8	Solar Farms	Energy	36.90	-$80.60	$5,023.84	Available PV area; angle; efficiency; inventory; roof area; installed base; inverter inventory; solar thermal; thermoelectric potential; artificial leaf				

9	Silvopasture	Food	31.19	$41.59	$699.37	Tree inventory; available area; construction volume annually; distance of transport				
10	Rooftop Solar	Energy	24.60	$453.14	$3,457.63	Available PV area; angle; efficiency; inventory; roof area; installed base; inverter inventory; solar thermal; thermoelectric potential; artificial leaf; bond-financed finance; PACE				
11	Regenerative Agriculture	Food	23.15	$57.22	$1,928.10	Food production in Berkeley; marshland				
12	Temperate Forests	Land Use	22.61	N/A	N/A	Tree inventory; available area; construction volume annually; distance of transport				
13	Peatlands	Land Use	21.57	N/A	N/A	Inventory				
14	Tropical Staple Trees	Food	20.19	$120.07	$626.97	Inventory				
15	Afforestation	Land Use	18.06	$29.44	$392.33	Inventory				
16	Conservation Agriculture	Food	17.35	$37.53	$2,119.07	Inventory				
17	Tree Intercropping	Food	17.20	$146.99	$22.10	Inventory				
18	Geothermal	Energy	16.60	-$155.48	$1,024.34	Geology; inventory; heat exchanger inventory;				
19	Managed Grazing	Food	16.34	$50.48	$735.27	Livestock inventory; species inventory				
20	Nuclear	Energy	16.09	$0.88	$1,713.40	Reopen nuclear reactor				
21	Clean Cookstoves	Food	15.81	$72.16	$166.28	Stove inventory; vent sensors; temp sensors; electric signature; disaster stockpile; REI				
22	Wind Turbines (Offshore)	Energy	14.10	$572.40	$274.57	PG&E tariff; COB credits;				
23	Farmland Restoration	Food	14.08	$72.24	$1,342.47	Inventory				
24	Improved Rice Cultivation	Food	11.34	N/A	$519.06	Volume of rice eaten in Berkeley; source; whole rice; rice substitutes				
25	Concentrated Solar	Energy	10.90	$1,319.70	$413.85	Inventory				

26	Electric Vehicles	Transport	10.80	$14,148.00	$9,726.40	Inventory; grid control; storage at house; fleet conversion, UC and city; power distribution by PG&E; energy storage capacity; charging spaces; pooling; Phasor Sensing Units				
27	District Heating	Buildings and Cities	9.38	$457.10	$3,543.50	Survey; Inventory of HVAC;				
28	Multistrata Agroforestry	Food	9.28	$26.76	$709.75	Inventory				
29	Wave and Tidal	Energy	9.20	$411.84	-$1,004.70					
30	Methane Digesters (Large)	Energy	8.40	$201.41	$148.83	Total mass cycle; EBMUD capture; biomass capture; dump; anaerobic population; marsh and wetland analyze composting losses				
31	Insulation	Buildings and Cities	8.27	$3,655.92	$2,513.33	HH inventory; commercial; campus; structural inventory; temperature sensors; IR inventories; incentive plans;				
32	Ships	Transport	7.87	$915.93	$424.38	Berkeley dock; ferry stop costs;				
33	LED Lighting (Household)	Buildings and Cities	7.81	$323.52	$1,729.54	Inventory; retrofit programs; HH rewiring; comms applications?; indoor/outdoor retrofit; street retrofit				
34	Biomass	Energy	7.50	$402.31	$519.35	mass created daily; mass removed;				
35	Bamboo	Land Use	7.22	$23.79	$264.80	Inventory; neighborhood gardens; furniture replacement; construction materials				
36	Alternative Cement	Materials	6.69	-$273.90	N/A	Inventory all existing asphalt, concrete; building mass; demolition mass; recycle to porous pavement; CO2 capture; Introduction of FOSS strain sensors				
37	Mass Transit	Transport	6.57	N/A	$2,379.73	Increase diversity of terminal feeders; Calthorpe measures of multi-modal				
38	Forest Protection	Land Use	6.20	N/A	N/A	Tree canopy inventory; shade impact;				

39	Indigenous Peoples' Land Management	Land Use	6.19	N/A	N/A	Ohlone tribe?				
40	Trucks	Transport	6.18	$543.54	$2,781.63	Last mile diversification; alley, street parking impact; volume of daily load; weight impact on streets;real-time FOSS				
41	Solar Water	Energy	6.08	$2.99	$773.65	Inventory				
42	Heat Pumps	Buildings and Cities	5.20	$118.71	$1,546.66	Inventory; add thermoelectric capture;				
43	Airplanes	Transport	5.05	$662.42	$3,187.80					
44	LED Lighting (Commercial)	Buildings and Cities	5.04	-$205.05	$1,089.63	Inventory; retrofit programs; HH rewiring; comms applications?; indoor/outdoor retrofit; retrofit campus, hospitals; free space optical transmission				
45	Building Automation	Buildings and Cities	4.62	$68.12	$880.55	sensors, eliminate SCADA; BIM requirements				
46	Water Saving - Home	Materials	4.61	$72.44	$1,800.12	leak detection; signal processing in water column; toilet and faucet monitoring; drip irrigation; total potable reuse; grey for gardens;				
47	Bioplastic	Materials	4.30	$19.15	N/A	mass used inventory; container trash mass; change in thermal values;				
48	In-Stream Hydro	Energy	4.00	$202.53	$568.36	add in-sewer generation; underground flows; storm water				
49	Cars	Transport	4.00	-$598.69	$1,761.72	Car free areas; alternate parking; alternate final mile; inventory; daily street pattern; change parking patterns; space real-time control; exhaust monitoring				
50	Cogeneration	Energy	3.97	$279.25	$566.93	inventory all existing thermal capture; residential; campus; incentivize;				
51	Perennial Biomass	Land Use	3.33	$77.94	$541.89	Wood inventory in existing structures; reuse of all material in new building; wood houses				
52	Coastal Wetland	Land Use	3.19	N/A	N/A	rebuild; regrow species;				

53	System of Rice Intensification	Food	3.13	N/A	$677.83	Any grown in Berkeley?				
54	Walkable Cities	Buildings and Cities	2.92	N/A	$3,278.24	Match to Rockefeller incentives				
55	Household Recycling	Materials	2.77	$366.92	$71.13	Decentralize; public inventory, public exchange: Elmwood; new composting tech; sewage composting; urine separation for fertilizer				
56	Industrial Recycling	Materials	2.77	$366.92	$71.13	Inventory mass moving today; re-chain production; waste capture, reuse;				
57	Smart Thermostats	Buildings and Cities	2.62	$74.16	$640.10	Deploy in all structures; residential, commercial; industrial; process industry model				
58	Landfill Methane	Buildings and Cities	2.50	-$1.82	$67.57	Real-time measurement; label all methane processes: septic, biomass, EBMUD. Total methane cycle; reengineer anaerobic species;				
59	Bike Infrastructure	Buildings and Cities	2.31	-$2,026.97	$400.47	Fleet of white bikes; electric recharging; maintenance centers; parking centers; use for cm accurate street quality sensors				
60	Composting	Food	2.28	-$63.72	-$60.82	HH composting bins for all HH; instruction; compost exchange for gardens;				
61	Smart Glass	Buildings and Cities	2.19	$932.30	$325.10	Inventory; Replacement schedule;				
62	Women Smallholders	Women and Girls	2.06	N/A	$87.60	Property title inventory;				
63	Telepresence	Transport	1.99	$127.72	$1,310.59	Jobs for HH; decrease transport and parking load				
64	Methane Digesters (Small)	Energy	1.90	$15.50	$13.90	Inventory; link to composting anaerobic				
65	Nutrient Management	Food	1.81	N/A	$102.32	analyze all flows; follow protein streams;				
66	High-speed Rail	Transport	1.52	$1,040.98	$368.10	CalTrans plans;				
67	Farmland Irrigation	Food	1.33	$216.16	$429.67					

68	Waste-to-Energy	Energy	1.10	$36.00	$19.82	Links to Total Potable reuse composting, urine separation;Solid trash treatment with Janicki (Gates Foundation) pyrolysis machine; redo all trash collection; HH disposal re plumbing				
69	Electric Bikes	Transport	0.96	$106.75	$226.07	SF Program; Amsterdam				
70	Recycled Paper	Materials	0.90	$573.48	N/A	Tonnage; local reuse				
71	Water Distribution	Buildings and Cities	0.87	$137.37	$903.11	EBMUD redesign for distributed treatment; water main, fire pressure system monitoring ;reservoir rebuilding; new pump systems;TPR				
72	Biochar	Food	0.81	N/A	N/A					
73	Green Roofs	Buildings and Cities	0.77	$1,393.29	$988.46	LBL criteria for white roofs; water estimates, cooling; PV vs green				
74	Trains	Transport	0.52	$808.64	$313.86	Bus use of roadbed;				
75	Ridesharing	Transport	0.32	N/A	$185.56	impact of autonomous; freight-sharing;;				
76	Micro Wind	Energy	0.20	$36.12	$19.90	evaluate; aerial tether;				
77	Energy Storage (Distributed)	Energy	N/A	N/A	N/A	35,000 residential retrofits				
77	Energy Storage (Utilities)	Energy	N/A	N/A	N/A	design capital reward for utilities to shift to distributed storage				
77	Grid Flexibility	Energy	N/A	N/A	N/A	Couple local storage with grid reliability; harmonic distortion, phase imbalance,;power factor correction				
78	Microgrids	Energy	N/A	N/A	N/A	Couple local storage with grid reliability; harmonic distortion, phase imbalance,;power factor correction				
79	Net Zero Buildings	Buildings and Cities	N/A	N/A	N/A	NetZero Water				
80	Retrofitting	Buildings and Cities	N/A	N/A	N/A	tax structure for 2% annual turnover; lead pipe analysis; legal structure for new tax, test, monitor standards; NetZero requirement for all sales				

Sum by column			1050.99	$29,638.96	$73,874.44	0	0	0	0	0
Totals from website			1050.99	$29,638.96	$73,874.44					

This is an outline of data we need to understand our community, some suggestions about how to acquire it, some references to existing projects, and preliminary figures of merit we might use to assess our progress. As a starting point, we use the "Drawdown" metrics of global
carbon reduction potential

Projects with relevant data	UC Berkeley Principal Investigators: Carol Christ; Paul Alivisatos;Steff Bertozzi; Henry Brady; Keith Gilless; Shankar Sastry;Sally McGarrahan, Assets;;	City of Berkeley	EBMUD, PG&E, ATT, Comcast, AMTRAK, CalTrans;	EPA, DoEnergy, DofAgriculture,	Tarana;Sherwood;McCutcheon Construction; Tulloch; John Gordon; Patrick Kennedy;	Pacific Institute; Earth Genome; Nature Conservancy; Sierra Club; WWF; NRDC;	Stanford; MIT; Johns Hopkins; INRIA; IIT: Mumbai,Kanpur, Delhi; Tsinghua;	Center for Investigative Reporting; Daily Cal; Oakland Tribune;KPFA; SF Chronicle; Maven;PBS; NYT;WSJ;
Ecoblock: Oakland	ERG:Dan Kammen, Harrison Fraker;	Urban Planning, Chief Resilience Officer: Tim Buirroughs	Alex Coate; Eileen White; Sophia Skoda; Michael Hazinski;					Phil Bronstein; Rosey Rosenfeld;
Rivendell:	Irene Fung	City Manager:Dee Williams-Ridley						
Sensor networks	CS:Dave Culler, Eric Brewer, Ken Goldberg;	Resilience Strategy: Tim Burroughs,						
Sensor design	Civil EnvironEng: Steven Glaser							
Transportation	Institute of Transportation Studies: Alexandre Bayen;	Katie Van Dyke; Phil Harrington;						
Broadband	Berkeley Wireless Research Center; CITRIS: Costas Spanos, CS;	Carol Johnson						
Food; Biology	Berkeley Food Institute; David Ackerman, Integrative Biology; Tim Pine,	Caytie Campbell-Orrock						
Data	Berkeley Institute for Data Science: Kevin Koy, Saul Perlmutter; Josh Bloom, Center for Time Domain Informatics;	Cheryl Johnson						
Water	Berkeley Water Center: David Sedlak, Kara Nelson,	Christina Erickson				Peter Gleick; Heather Cooley;		
Civil Engineering:	Lisa Alvarez-Cohen; Kara Nelson; Steven Glaser; Slav Hermanowicz;	Daniel Akagi						

Berkeley 101	Ed Miguel, Center for Effective Global Action; Henry Brady, Public Policy; Sol Hsiang;	David Brannigan						
Resilience	Berkeley Seismological Lab;	Chief Resilience Officer;						

Figures of Merit for assessment and modeling

Who are we, where are we, how do we get the resources we need to live, and what continuous flows of energy, water, air, food, heat, money, and materials sustain us and our environment?
Stocks: lands, buildings, trees, physical inventory ; flows: water, energy, information, people, food, wastes, heat, power

Who are we? How many of us are there ?

Where we live: number of residences, apartments, hotels, dorms, homeless: from City; # sleeping in Berkeley ;transient sleepers;

Where we work: cars, BART in; parking; structures; campus; biggest employers; on-line employees; payroll, by amount, by job category ; income distribution;

How we travel: routes in, routes out; times of maximum use; measures of capacity; emergency vehicles response times; fire vehicle dispatch; flows on all streets; length of streets; AC Transit; BART; airport distances; distance each food travels; distance each water molecule travels.

Where water comes from: EBMUD maps; flow to Orinda treatment; flow from Orinda treatment;

Where wastes and trash go: 400 miles of sewer; sewer laterals; daily flow into sewer;

How do we drink?

Every day, a million liters of water passes in to Berkeley.

Map: showing main entry pipes, their volumes, main trunk lines

Show difference between water entering and water leaving

Renew EBMUD data systems; add signal processing capability to water meters for valve and leak monitoring;

Open Data

Ten thousand gallons of milk, twenty thousand gallons of soft drinks, a thousand gallons of wine, five thousand gallons of beer, ? of orange juice,

Andronico’s, Whole Foods, Berkeley …..,

two hundred cafes, two hundred bars, four hundred restaurants

(Right-hand column with per-capita visualization….as a flip page animation.)

Flows: show relative flows….

Daily people

Daily cars

Daily water in, sewage out

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Daily transpiration

How do we eat?

How do we eliminate?

How do we die?

How many bodies come in and go out of Berkeley each day?

Who are they?

What is age distribution at discrete locations, by time of day? At gym, at restaurants, at book fair, at demonstrations, in parks, in shopping districts

Show use photos at each location

How do we wash?

How do we travel?

What do we own?: wealth in Berkeley: values of land, of structures, of businesses; stock holdings; personal wealth of residents;

- Sensor sites in Berkeley
- Ratios that matter
-

How do we communicate?

gigabit broadband; NLOS microwave from distributed back-haul locations;

in-pipe leak detection; water-column signal transmission; FOSS for strain sensing;

mycelium transport; root network transport;

fabric of communication for all control devices

fabric of sensor and data acquisition

Multiple transport: aerial transport, suspended reflector; use of NLOS algorithms for moving vehicle station retransmissions

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