

How would we build Kibera if we started today? Use Drawdown Solutions [<http://www.drawdown.org/solutions>] ranking of technologies by global carbon impact as a framework.

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” ordering of technologies by impact on global carbon over the next 40 years. First draft

Projects with relevant data	UC Berkeley Principal Investigators	UC Davis	Stanford	MIT	Johns Hopkins	INRIA	IIT: Mumbai, Kanpur, Delhi
Ecoblock: Oakland	Dan Kammen, Harrison Fraker						
Rivendell:	Irene Fung						
Sensor networks	Dave Culler, Eric Brewer						
Sensor design	Steven Glaser						

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?

Who are we? How many of us are there ?

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

Where we work:walking; boda boda, cars, matatu, bus, rail;parking; structures; downtown Nairobi; biggest employers; on-line employees; payroll, by amount, by job category ; income distribution; by job category: domestic, labor, professional

How we travel: walking times; routes in, routes out; times of maximum use; measures of capacity; emergency vehicles response times; fire vehicle dispatch; flows on all streets, alleys; length of streets; matatu travel times, costs; Bus times; airport distances; food gathering distance, water-gathering distance; firewood-traveling distance; weight carried to and from home; age of traveller, purpose of travel; distance each food travels; distance each water molecule travels.

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Where water comes from: tanks, local distribution; 1,500 Maji Bora members with water points; Bowser volume, selling to tanks, to individuals; Kibera piping maps; flow to Shofco, KTC treatment; flow from treatment; wheelbarrow distribution; jerry-can population, aging, contamination; 2000 water point quality testing program.

Where wastes and trash go: 10 miles of old English sewer on East side; five miles on West side (Makina, Soweto West; sewer laterals; daily flow into sewer; Olympic School sewer connection; Olympic high school distribution;

How do we drink?

Every day, 10 million liters of water passes in to Kibera, or 25 liters for each of 400,000 people.

Map: showing main entry pipes, their volumes, main trunk lines; all boreholes, all tanks, all distribution pipes;

Show difference between water entering and water leaving

Pitch to Nairobi Water and Sewerage Company.

Open Data for Nairobi and Kenya; mandated by World Bank

Ten thousand liters of milk, twenty thousand liters of soft drinks, a thousand liters of wine, five thousand liters of beer, ? of chang'aa, ,

Data from: Nakumatt numbers, 1000 small Kibera shops, Kibera distributors,

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 transport: walk inside Kibera, walk to matatu and bus transport points; transport to greater Nairobi.

Daily water in, sewage out

Daily transpiration of plants

Flows of meat, milk, fish,

Birth and death numbers

How do we eat?

How do we eliminate?

How do we die?

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

Who are they?

What is age distribution in Kibera? At video parlors, at bars, at restaurants, at clinics, at political demonstrations, at Sunday Kamukunji ground meetings, at Olympic School events;

use photos for counts

How do we wash? What do we wash?

How do we travel?

What do we own: wealth in Kibera: values of land, of structures, of businesses; stock holdings; personal wealth of residents; wealth of slum landlords; patterns of ownership: Nubians, Kikuyu, Luo; ownership patterns of Indian families: Chandaria, Merali

- Sensor sites in Kibera

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- Ratios that matter
- Where are they? Kibera artists, musicians, dancers, performers?

How do we think?

What concepts do we use to understand flows and processes?

Intuitive, but incorrect models of biological processes, microbial action

Intuitive, but incorrect models of washing procedures, proper use of soaps

Intuitive, but incorrect models of water efficiency

Intuitive, but incorrect models of disease propagation: e.g., HIV-Aids, ascariasis, cholera

Intuitive, but incorrect models of elements of environment as objects, not processes

Drawdown Solutions, ranked by impact on Global Carbon Levels, 2017

	Solution Name	Sector	Tons of Carbon	Cost	Savings	Kibera Measure	Sunk Cost	New Cost	Action	Actor
1	Refrigerant Management	Materials	89.74	N/A	-\$902.77	# refrigerators; #heat exchangers; Volume of Refrigerant: Residence, Commercial; Industry;restaurant, ; age;			replace; refuel;	
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 Kibera; 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, school; distance to source; butcher shops;				

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5	Tropical Forests	Land Use	61.23	N/A	N/A	Number of trees; species; Botanical Garden; Ngong Forest; Fairgrounds; Eucalyptus				
6	Educating Girls	Women and Girls	59.60	N/A	N/A	School Stats; weekly progress; Olympic School, Kibera Primary, 500 schools in Kibera				
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				

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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 leafL Partner with Kenya Power on grid design				
11	Regenerative Agriculture	Food	23.15	\$57.22	\$1,928.10	Food production in Kibera; number of animals; vertical gardens				
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				

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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 Kibera; source; whole rice; rice substitutes				
25	Concentrated Solar	Energy	10.90	\$1,319.70	\$413.85	Inventory				

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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;				
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;				
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	Kibera dock; ferry stop costs;				

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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;				
37	Mass Transit	Transport	6.57	N/A	\$2,379.73	Increase diversity of terminal feeders; Calthorpe;				
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	Viz. African Court on Human and People's Rights: Mau Ogiek ruling				

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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;				
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				
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				
45	Building Automation	Buildings and Cities	4.62	\$68.12	\$880.55	sensors, eliminate SCADA;				
46	Water Saving - Home	Materials	4.61	\$72.44	\$1,800.12	leak detection; 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;				

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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;				
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 Kibera?				
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				

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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				
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 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;				

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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	follow protein streams, oil streams, chapati, ugali, : maize inputs				
66	High-speed Rail	Transport	1.52	\$1,040.98	\$368.10	repurpose Kibera rail bed for bus transit for Kibera workers				
67	Farmland Irrigation	Food	1.33	\$216.16	\$429.67	Use sewer construction for vertical garden irrigation				
68	Waste-to-Energy	Energy	1.10	\$36.00	\$19.82	Solid trash treatment with Janicki (Gates Foundation) pyrolysis machine; redo all Nairobi trash collection; Use Dandora as storehouse of gigawatts				

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69	Electric Bikes	Transport	0.96	\$106.75	\$226.07	motorize all wheelbarrow transport of dead bodies, water for fire fighting, ambulance service, furniture moving; use motorized water jerry can transport				
70	Recycled Paper	Materials	0.90	\$573.48	N/A	Plastic energy conversion in Janicki heat engine				
71	Water Distribution	Buildings and Cities	0.87	\$137.37	\$903.11	Redo vertical water distribution: SHOFCO 100,00 liter aerial tank distribution				
72	Biochar	Food	0.81	N/A	N/A	Household product from today's charcoal brazier				
73	Green Roofs	Buildings and Cities	0.77	\$1,393.29	\$988.46	Complete rooftop replacement; PV vs green				
74	Trains	Transport	0.52	\$808.64	\$313.86					
75	Ridesharing	Transport	0.32	N/A	\$185.56	Redo Matatu structure; boda boda for each HH				
76	Micro Wind	Energy	0.20	\$36.12	\$19.90					

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S u b b y c o l u m n			1050.99	\$29,638.96	\$73,874.44	0	0	0	0	0
T o t a l s f r o m w e b s i t e			1050.99	\$29,638.96	\$73,874.44					