Bottom-Up Planning for Community Energy

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A Local Energy Future Is Both Necessary and Inevitable

Necessary => **Today's needs & societal goals require local energy solutions**

- Worsening climate disruption, grid vulnerability, energy inequities
- **Location matters:** Bulk system & market are needed, but not sufficient

Inevitable => **DERs keep improving in performance, cost & ease to deploy**

- Customers, businesses, cities, communities can see huge benefits
- The grid is now contestable — customers with DERs can defect

The big question for policy makers, the industry and all of us =>

What policies will maximize the benefits for all communities and manage the challenges of rapid DER proliferation?

For an equitable High-DER transition => **Bottom-up planning & investment**

- Plan to meet local energy needs from local supply as much as possible
- Create a framework to commercialize locally-owned electricity systems

Today's challenges require local solutions

Sustainability & Decarbonization => **Stop making climate disruption worse**

- Emissions result from human activities shaped by local systems & structures
- Urban planning => zoning; land use; housing; building codes; mobility services; economic development; habitat; urban forestry

Resilience => **Maintain local electric service when the grid fails**

- Carbon-free microgrids to power critical services & resilience centers

Energy Justice => **Democratize energy supply ownership & operation**

- Energy is a key social determinant of health, not just a commodity
- Local energy supply businesses build local wealth & economic vitality
- Mitigate historic harms & strengthen vulnerable neighborhoods

Local energy systems are essential for today's urgent needs

Legacy electricity system structure presents major barriers

DERs are cost-effective & competitive with the grid

Electric service can be a locally owned & operated enterprise

- DER cost-effectiveness trends are rapidly surpassing the grid
- Local electric services build stronger local economies
- Policies to suppress DER adoption raise incentives for grid defection
- Grid defection by affluent customers will worsen energy inequities

Needed => A distribution network & transaction platform that enables DERs to earn their full value to customers, communities & the grid

=> Policy & regulatory frameworks that facilitate & leverage local, non-utility DER investment in renewable energy supply

Some local energy possibilities

- **Compensate customers** to over-size BTM rooftop solar+battery systems and provide energy to their neighborhoods.
- **Enable locally-owned co-op businesses** to supply electricity & electric vehicle charging as integral components of the local economy.
- **Deploy municipal electrification projects** — public mobility fleets & school buses, powered by publicly-owned local renewable energy resources.
- **Retrofit neighborhood "resilience centers"** to provide emergency shelter, warmth, cooling, food, medical care, phone/internet service, & zero utility bills.
- **Build local energy planning capability** to integrate local power production with tree canopy, land use, public space, stormwater capture, etc. at neighborhood level.

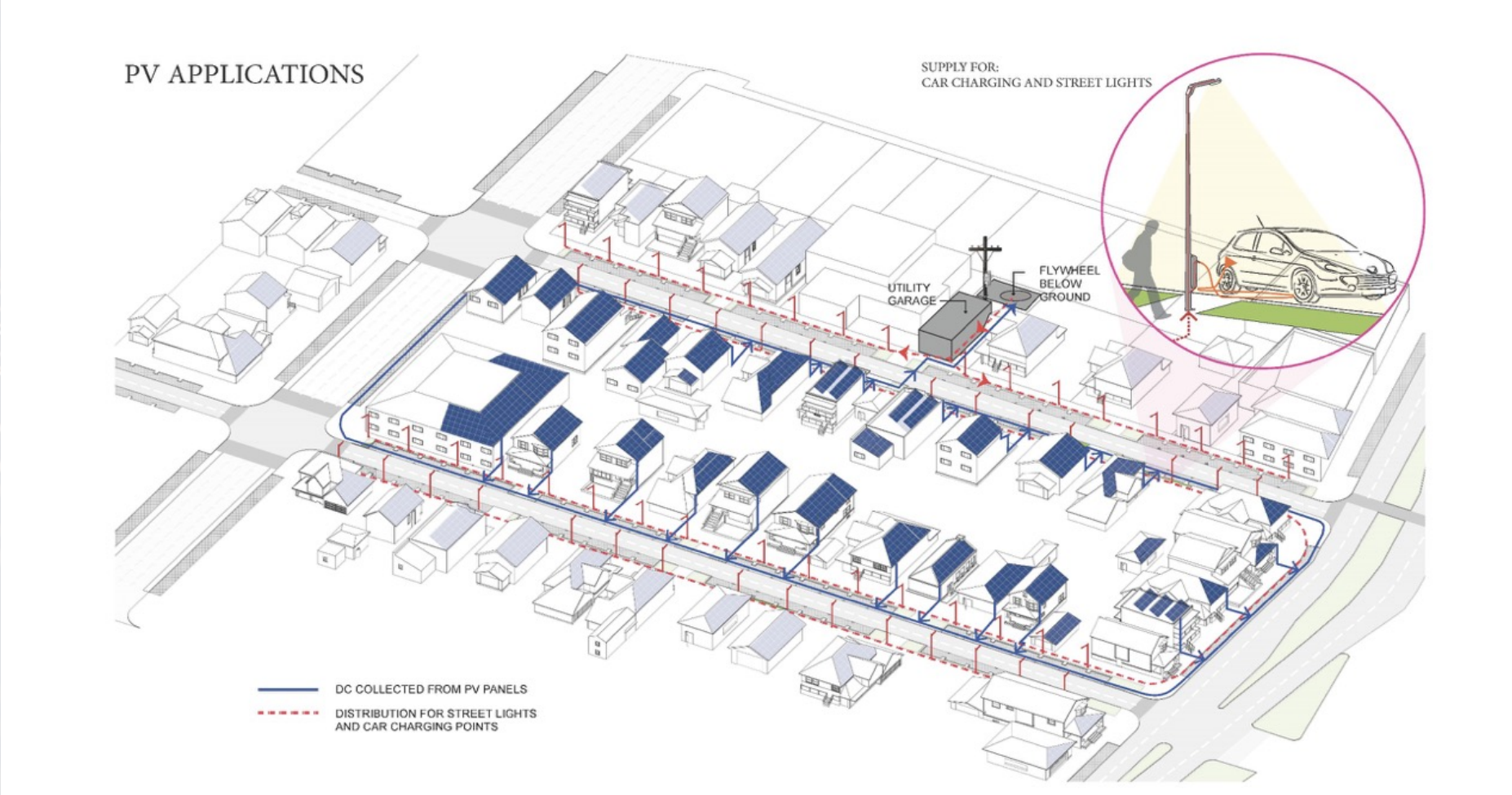
Local electricity systems are needed, feasible & cost-effective

We need policy frameworks & planning approaches to enable them

Oakland EcoBlock: retrofit model for urban neighborhoods

Community microgrid serves all customers on the block; integrated with grey water, stormwater capture, EV charging, food production, broadband …

- Community & rooftop solar
- Community energy storage (flywheel + battery)
- Dynamic load management
- Shared EVs & coordinated charging
- Microgrid structure allows seamless islanding
- Single interconnection point to the utility grid
- CEC-funded demo project by UC Berkeley & Berkeley Lab
- **Existing laws & regulations reduce commercial viability & prevent replication of "multi-property microgrids"**



Bottom-up planning for a local energy future

Bottom-up planning to maximize distribution-connected supply

- **Start from local energy needs & priorities** => geographically granular demand forecast at the level of a neighborhood, subdivision, district of a larger city, tribal community, campus, rural town
- **Plan supply using a "local first" principle** =>
  - On-site on customer premises (behind the meter)
  - **Community-level resources (front of meter)**
  - Design assets to maximize production & supply surrounding community
- **Maximize PV + storage systems on the built environment** — warehouses, shopping malls, schools, parking lots, irrigation canals, etc. — ignored in most planning studies
  - NREL (2016) rooftop potential: https://www.nrel.gov/docs/fy16osti/65298.pdf
  - US 39% of annual electricity consumption; California 74%
  - No land-use conflicts; no transmission needed; supports community microgrid
- **Plan transmission system & wholesale market to meet residual demand**

How traditional top-down planning works today

Top-down demand forecasting — 10-20 year horizon

- Level of individual utility service area & ISO/RTO footprint (multiple utilities)
- Forecast macro-economic & demographic factors driving system-wide demand
- Forecast customer "behind-the-meter" adoption of EE, rooftop PV, EVs, storage, electrification, by extrapolating recent & historic trends
- Subtract BTM adoption & impacts from system-wide demand to get forecast of **metered demand** (may have multiple demand scenarios)
- Use historical "load distribution factors" to get greater geographic granularity

Apply capacity expansion modeling to generate supply scenarios (IRP)

- Input forecast of metered demand + resource types with attributes (fuel type, cost, performance attributes, etc.)
- **Distributed generation is not considered as a distinct resource type — new supply is assumed to be transmission-level**

Use IRP supply scenarios to plan transmission

Building Bottom-up Planning Capability

Bottom-up demand forecasting

- Start from local energy needs & priorities, level of neighborhood, subdivision, rural town, tribal community, district of a larger city.
- **Shorter time horizon: 5-10 years**
- Identify likely load growth — needs for new housing, new large loads, urban infill projects, large development projects, city electrification projects

Integrate energy planning into city/county planning

- State must invest in city/county energy planning capability; develop partnerships between state agencies and local governments, tribes, school districts, CBOs
- **"Local first" electricity supply principle: planners aim first to identify sites for local renewable energy supply (city buildings; school campuses; warehouses)**
- Design local energy projects to support local Climate Action Plans
- **Partner with neighboring cities & counties to develop shared supply resources**
- Partner with housing developers to plan innovative energy self-supply & resilience

Building Bottom-up Planning Capability

Crucial role of distribution utility (DSO)

- Distribution utility is reformulated as "**open access distribution system operator**" (DSO) to provide network services for local energy supply & transaction platform for participating DERs to transact energy and grid services
- DSO functions include support for local energy project planning & deployment by providing distribution system data & engineering expertise
- DSO earns fee-for-service revenues & is regulated for performance

Near-term improvement to capacity expansion modeling

- Traditional top-down planning can be improved by including a new resource type in the capacity expansion model:

Distributed generation & storage on the built environment

- Specify benefits of this resource type in the model: avoiding land-use conflicts; no need for transmission; ability to support a community microgrid; faster cheaper decarbonization; opportunity for non-utility ownership (not added to rate base).

References on Bottom-Up Planning

Lorenzo Kristov (2025) book chapter

- **“Bottom-up system planning for an electrified future”**
- https://shop.elsevier.com/books/electrification-and-the-future-of-decentralized-electricity-supply/sioshansi/978-0-443-34268-4

Maine DSO Study (2025)

- Section 5.5 discusses bottom-up system planning
- Lorenzo Kristov co-author
- https://www.maine.gov/energy/sites/maine.gov.energy/files/2025-01/DSO%20Study%20Final.pdf

Thank you

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