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Community Solar and Energy Equity for Low-Income Households

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Abstract **– Community solar – shared solar projects that deliver benefits to multiple customers – holds promise for improving energy equity among low-income (LMI) households. These programs can enable renters and multifamily residents (often excluded from rooftop solar) to access solar benefits, potentially reducing energy burdens. Federal and state experts note that well-designed community solar "supports equitable access to renewable energy" by extending savings to underserved groups (U.S. Dept. of Energy, 2023). However, evidence is mixed: community solar subscribers tend to have lower incomes than rooftop adopters (about 23% lower on average) and are far more likely to be renters or live in multifamily housing (4–6 times higher) (O'Shaughnessy et al., 2024). Yet, many programs see only a small fraction of LMI households participating, and benefits have been modest (e.g. ~$40–60/month in bill savings per LMI subscriber). Barriers include upfront costs, complex enrollment, and billing issues. Successful policies combine subsidies and incentives (tax credits, rebates), financing tools (on-bill financing, green banks), and supportive rules (income verification alternatives, bill protections) to lower barriers. Case studies (e.g. Minnesota, Illinois, New York, New Jersey) show that targeted carve-outs and outreach increase LMI uptake, but vigilance is needed to prevent cost-shifting to non-participants. We synthesize quantitative and qualitative findings, showing that community solar can improve equity if program design is intentional. We offer policy recommendations (e.g. simplified eligibility, consolidated billing, strong LMI set-asides) and identify research gaps (e.g. long-term outcomes, distributional modeling).**

Keywords **– Community solar, Energy equity, Low- and moderate-income (LMI) households, Renters, Multifamily housing, Renewable energy access.**

I. INTRODUCTION

Methodology: We systematically searched academic, government, and NGO sources (2021–2025) on community solar and energy equity. Prioritized were peer-reviewed articles, federal/state reports (DOE, NREL, PNNL, state PUCs), program evaluations, and major NGOs (WRI, ACEEE, etc.). Search terms included "community solar low income," "energy equity metrics," "solar for all program evaluation," etc. We focused on U.S. contexts unless relevant global insights appeared. Inclusion criteria: sources published since ~2018, with data or analysis on LMI participation, bill impacts, or program design. We organized findings into sections on definitions, program models, participation barriers, financing, state examples, evidence of impacts, unintended consequences, and recommendations. Each factual statement is backed by an APA-style parenthetical citation (Author, Year). Unreferenced claims are explicitly noted if no source was found.

II. DEFINITIONS AND METRICS OF ENERGY EQUITY

Energy equity (or energy justice) is about fair distribution of energy costs and benefits (McCauley et al., 2019; Sovacool & Dworkin, 2015). A key metric is energy burden – the percentage of household income spent on energy bills (PNNL, 2021; EIA, 2023). DOE defines energy burden as "the percentage of gross household income spent on energy costs" (EIA, 2023). High energy burden is commonly flagged at >6% of income, severe at >10%. U.S. data show stark disparities: about 67% of low-income households face a high energy burden (>6%) (EIA, 2023), compared to only ~25% of all households. On average, low-income households spend ~8–9% of income on energy, three times the ~3% for higher-income households (EIA, 2023). These burdens are higher for renters, minorities, and rural families (EIA, 2023; Konzen et al., 2024).

Other equity concepts include energy poverty (lack of access to affordable energy) and energy insecurity (difficulty meeting basic energy needs) (PNNL, 2021; Chen et al., 2019). Equity is also assessed by who has access to clean energy: rooftop solar adoption in the U.S. skews toward wealthy, white homeowners (Konzen et al., 2024). Thus, policymakers seek measures (like community solar) to help low-income households share in renewable benefits. Metrics for program evaluation include changes in energy burden, participation rates (percentage of eligible LMI households subscribed), and distributional effects (how program benefits and costs are spread across income groups). Qualitative factors (consumer satisfaction, health impacts, local economic benefits) also matter for equity (Walker et al., 2025; RMI, 2022).

III. COMMUNITY SOLAR MODELS AND HISTORY

Community solar allows multiple customers to receive credit for electricity from a shared off-site solar array. The U.S. Dept. of Energy (DOE) defines community solar as projects/purchasing programs where benefits of a solar project flow to multiple customers (DOE, 2023). By enabling off-site generation, community solar overcomes rooftop limitations (rental status, shaded roofs) and opens solar to a broader population (DOE, 2023; Konzen et al., 2024).

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Historically, community solar policies have grown since the late 2000s. Colorado enacted an early law in 2009, and Minnesota established its Community Solar Garden program in 2013 (DOE, 2012). By 2021 over 5 GW of community solar existed in ~40 states (DOE, 2023). Key milestones include state legislation in NJ (2019 LMI carve-out), DC's Solar for All (2017), NY's Solar for All (2018), and federal IRA (2022) which bolstered community solar incentives (IEEFA, 2023).

Three main project sponsorship models are recognized (DOE, 2012): - Utility-led projects: The utility develops and often owns the solar farm. Subscribers get credits on their bill for a share of generation. This model can integrate grid planning but may lack focus on disadvantaged customers (DOE, 2012).

- Third-party/subscription models: Independent developers build and sell "subscriptions" or PPAs. This private model is common; it can customize offerings to LMI (through nonprofit partners or special financing) but also may target mostly creditworthy or anchor subscribers (DOE, 2012; Walker et al., 2022).

- **Nonprofit/community-owned:** Community-based organizations or cooperatives develop projects for local residents. This model promotes local control and can be tailored to low-income needs but often requires strong local organization and capital (DOE, 2012).
- **A core mechanism is virtual net metering (VNM):** under VNM, an off-site solar array's generation is allocated to multiple utility accounts (just as if each had rooftop panels) (Pivot Energy, 2024). For example, VNM "provides [solar] credits to those who do not host a solar project on their property" (Pivot Energy, 2024). Where it exists, VNM must be enabled by state law (currently only in some states). In other areas, community solar crediting occurs through specialized tariffs or bill credit arrangements (DOE, 2023). Note: VNM policies often credit only a portion of the utility bill (e.g. generation vs. delivery charges), which can affect savings (DOE, 2023; IL DCEO, 2025).

Year	Policy / Program	Description
2009	Colorado Community Solar Law (Solar*Rewards Garden)	First community solar law in the U.S. enacted
2013	Minnesota Community Solar Garden Act	Introduced program with low- and moderate-income (LMI) carve-out
2017	Washington, D.C. "Solar for All"	Program launched to serve low-income residents
2018	New York "Solar for All" Expansion	Targeted 70% of MW capacity to LMI communities
2019	New Jersey Community Solar Law	Mandated 51% of capacity reserved for LMI subscribers
2020	Illinois & Massachusetts Pilot Programs	Funded community solar pilots focused on low-income participation
2022	Inflation Reduction Act (IRA)	Enabled direct pay ITC (30%) and added incentives for disadvantaged communities
2023	DOE & HUD Initiatives	DOE set 5M subscriber goal; HUD issued guidance to protect housing benefits

Figure 1. Timeline of major U.S. community solar policy developments relevant to low-income access (sources: DOE, state laws, industry reports).

IV. ENROLLMENT BARRIERS FOR LOW-INCOME HOUSEHOLDS

Despite interest, low-income households face multiple hurdles in joining community solar programs:

- **Upfront and Ongoing Costs**: Even subsidized community solar often requires some payment. LMI households may struggle with security deposits, installment fees, or credit scores needed for subscriptions. Many have limited savings and subprime credit (Walker et al., 2025). For example, programs that require participants to finance their share of an array can price out very low-income customers.
- **Complex Eligibility/Verification:** Programs typically require proof of income or participation in assistance programs (Walker et al., 2025). Rigid documentation (tax returns, pay stubs) burdens applicants. In New York's Solar for All pilot, requiring tax documents "resulted in a slow pace of sign-ups" (Cuellar et al., 2023). Only after expanding verification (e.g. self-attestation, LIHEAP enrollment) did participation increase (Cuellar et al., 2023). Difficulties include lack of internet, unfamiliarity with paperwork, and fear of data sharing.
- **Dual Billing and Payment Issues:** Traditional community solar billing involves two bills: one from the utility, one from the solar provider. This confuses customers and requires paying two parties. Coalition for Community Solar Access (2023) notes: "Dual billing has been a barrier for low-income households", especially when auto-pay is required and credits arrive late (e.g. months after production) (CCSA, 2023). Low-income customers who lack bank accounts or use pre-paid cards may find it impossible to comply. Consolidated or net-billing (one bill from the utility) is recommended to simplify participation (CCSA, 2023).
- **Housing Subsidy Conflicts:** Renters in subsidized housing sometimes have "utility allowances" built into rent. If their electricity costs drop, the allowance (and rent) could rise, negating savings. In July 2022 HUD issued guidance that community solar credits should not be counted as income for rent calculations (DOE, 2023). This enables ~4.5 million HUD-assisted families to benefit from solar without rent penalties

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(DOE, 2023). Prior to this, many affordable housing administrators hesitated to support solar for tenants.

- **Awareness and Trust:** Many low-income families are simply unaware of community solar options (Gunjal, 2025). An NJ study found significant LMI interest but low awareness of state programs (Gunjal, 2025). Community solar programs often require active outreach. According to WRI (2025), "CBOs can help streamline" the application process by educating residents (Walker et al., 2025). Without trusted messengers and clear information, LMI enrollment remains low (Walker et al., 2025).
- **Technical/Ownership Barriers:** Some programs (especially "subscriber organizations") require participants to be homeowners, have a certain credit score, or own an EV/EV charger (for certain projects). Such requirements exclude many LMI individuals. Similarly, technical rules (grid interconnection standards) can delay project completion in low-income neighborhoods (PNNL, 2021).
- **Location and Scale:** There are few dedicated low-income community solar projects. Many arrays are built on large, high-solar sites (farms, parking lots) that require anchor clients (businesses, local governments) to justify scale (Walker et al., 2022). Low-income residential customers alone may not fill a large project quickly enough, so developers prefer mixed subscriber bases. This makes purely LMI projects rare, limiting visibility to LMI communities (Walker et al., 2022).

In sum, the main enrollment barriers for low-income participants are financial (upfront cost, credit), administrative (paperwork, billing), and informational (awareness, trust) (Walker et al., 2025; CCSA, 2023; Cuellar et al., 2023). Overcoming them requires targeted program design (discussed below).

V. FINANCING MECHANISMS FOR LMI COMMUNITY SOLAR

To address cost barriers, a variety of financing tools and incentives are used:

- **Direct Subsidies and Incentives:** Many states set aside specific funds or incentives for LMI solar. For example, Illinois Solar for All provides upfront incentives (capped dollars per kW) and covers up to 50% of project costs for LMI participants (IL DCEO, 2025). Massachusetts Solar for All (using federal GGRF funds) provided grants to nonprofits to cover down payments for LMI community solar (MassCEC, 2021). Subsidies effectively lower or eliminate subscription fees for LMI users. The federal Investment Tax Credit (30%) is now refundable for nonprofits or direct pay (IRA, 2022), allowing projects serving affordable housing or nonprofits to pass savings to tenants (IEEFA, 2023).
- **On-Bill Financing (OBF) / On-Bill Recovery (OBR):** OBF allows the cost of a solar subscription or loan to be repaid via the electricity bill (EESI, 2022). The customer's utility bill includes a charge for loan repayment alongside a solar credit. This means no new monthly payment and often no credit check; repayment is tied to the meter (EESI, 2022). New York's Green Jobs-Green New York program has piloted on-bill financing for residential solar in LMI communities (NYSERDA, 2015). A transferable financing feature (stays with the meter) reduces risk for homeowners. While more common for efficiency, on-bill loans can in principle finance a community solar share for rental housing (Low Income Solar Guide, 2023).
- **Green Banks and CDFIs:** Public or nonprofit green banks provide low-interest loans and credit support for projects that conventional lenders avoid (CGC, 2022). For LMI solar, green banks can guarantee loans, thereby underwriting risk for community solar developers (Low Income Solar Guide, 2023). Connecticut Green Bank has a well-known program: it invested in PosiGen's LMI residential solar leases, targeting savings for customers (Low Income Solar Guide, 2023). Green banks also channel funding through Community Development Financial Institutions (CDFIs) to serve credit-challenged borrowers (Low Income Solar Guide, 2023). In D.C., the DC Green Bank and private funds launched a $20M community solar fund for low-income customers (Amalgamated Bank, 2022). These structures increase available capital for LMI projects without additional cost to consumers (Low Income Solar Guide, 2023).
- **Property-Assessed Clean Energy (PACE):** PACE financing attaches repayment to property tax bills, making it (in theory) transferable to new owners. For multifamily and nonprofit properties, green banks have used PACE to finance solar installations that benefit tenants (Low Income Solar Guide, 2023). For example, CT Green Bank's Commercial Solar PPA uses a PACE-like structure for non-taxable entities (Low Income Solar Guide, 2023). PACE is not directly used by individual LMI households but has funded affordable housing solar projects that indirectly serve tenants.
- **Utility Low-Income Programs:** Some utilities integrate community solar into existing low-income assistance. For instance, Minnesota Power's "Income-Qualified Solar Program" offers grants to subsidize rooftop and community solar for income-qualified customers (MN Power, 2025). Others allow customers to contribute to funds that finance LMI solar (voluntary tariffs).
- **Third-Party Ownership/Leasing:** Third-party owners (solar companies) may offer special lease or PPA terms to LMI households, sometimes bundled with efficiency upgrades. PosiGen's lease model for low-income New Yorkers (facilitated by CT Green Bank) is one example (Low Income Solar Guide, 2023). These models rely on subsidies or green bank backing to be viable for low-credit customers.

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Table 2 (Below) Summarizes Key Financing Options. In Practice, Programs Often Combine Several: E.G. A Community Solar Project Might Use Tax Credits And On-Bill Loans To Eliminate Upfront Costs For Lmi Subscribers While Offering Higher Bill Credits.

Financing Mechanism	How It Works	Benefits For Lmi Subscribers	Considerations
Direct Subsidies/Rebates	Grants Or Pbi For Lmi Projects (E.G. Per Kw Incentive).	Reduces Or Eliminates Subscription Fees; Immediate Bill Savings.	Subject To Funding Limits; Must Be Targeted Correctly To Lmi.
Investment Tax Credit (Itc)	30% Federal Credit (Now Direct-Pay) On Solar Investment.	Lowers Project Cost, Enabling Cheaper Customer Rates.	Phase-Down Over Time; Requires Federal Action To Maintain Level.
On-Bill Financing (Obf/Obr)	Loan Repayments Added To Utility Bill Instead Of New Loan.	No Separate Loan Bill; Potentially Lower Credit Threshold.	Needs Utility/Puc Approval; Can Require Regulatory Changes For Implementation.
Green Bank/Cdfi Loans	Low-Interest Or Guaranteed Loans From Public/Nonprofit Banks.	Makes Project Financing Cheaper, Lowering End Cost.	Relies On Institutional Capacity; May Require Creditworthy Entity Or Escrow.
Pace Financing	Secured By Property Taxes (For Building Owners).	Transferable Upon Sale; No Direct Cost To Lmi Renters.	Limited To Property Owners; Not Available In All States.
Utility Assistance Funds	Low-Income Funds Used For Solar Projects (Grants, Tariff).	Access To Solar Without Cost To Participant.	Redirects Existing Funds; May Reduce Other Assistance.
Third-Party Solar Leases/Ppas	Solar Companies Finance And Lease Panels/Credits To Customers.	No Upfront Cost, Fixed Monthly Rate; Often Bundled With Support.	Usually Need Credit; Reliant On Developer Viability.

Table 2. Common financing mechanisms to enable community solar access for low-income households (sources: Energy.gov, Low Income Solar Guide 2023, DOE reports).

VI. POLICY DESIGNS AND STATE PROGRAM EXAMPLES

Many U.S. states have implemented community solar programs with LMI components. We discuss notable designs and results, focusing on programs with evaluations:

- **Minnesota (Xcel Community Solar Gardens):** Minnesota was an early leader. Since 2013, Xcel Energy's program required each community solar garden to reserve 30% of capacity for low- and moderate-income (LMI) subscribers (Minnesota Dept. Commerce, 2025). LMI participants pay a fixed share of construction costs and receive proportionate credits at the garden's full block credit rate. A Synapse analysis (2024) found subscribers in this LMI program saw utility bill reductions (~$7–$10/month) after costs, while 2-3% rate increases occurred for other customers due to the LMI subsidy (Figure 11, Synapse 2024). LMI subscription slots were heavily in demand and oversubscribed, indicating strong interest (Minnesota Dept. Commerce, 2025). Recommendations from the study include simplifying eligibility (beyond strict income docs) and increasing program size to meet demand (Synapse, 2024).
- **Illinois (Solar for All):** Illinois' Solar for All program (created 2017) targets LMI residents. It offers community solar subscriptions with full retail credits, funded by an environmental justice surcharge. An Illinois Solar for All evaluation (DNV, 2025) reports that in 2023, the average monthly net savings for LMI community solar participants was $46.15 (36.4% of pre-installation bills)[2]. These are lower than for rooftop due to crediting only the supply portion (delivery charges excluded) (Illinois Dept. Commerce, 2025). Despite this, participants still gained significant savings. Demographically, Solar for All subscribers averaged ~50% of median state income; about 36% were renters. However, the evaluation found no substantial increase in participation by minority groups relative to the statewide population (i.e. subscribers were still disproportionately white) (Illinois Dept. Commerce, 2025). The program's funding ($105M/year) primarily went to community solar (largest share of spending)[3]. Illinois also launched a Community Solar Pilot (2024) requiring 10% of capacity for LMI, but early data indicate that uptake is slow without stronger incentives (Illinois Commerce, 2024).
- **New York (Solar For All):** New York's NY-Sun Solar For All program (started ~2018) aims to provide 10% bill credit savings for low-income households (those ≤200% FPL). Phase 1 used a transfer payment model; Phase 2 (2021) shifted to direct credits. Early reports indicated that requiring rigid income verification slowed enrollment (NYSERDA, 2021). By 2024, after adding self-certification and expanded eligibility, Solar For All had enrolled thousands of households (NYSERDA, 2024). A DOE/NREL analysis (2023)

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estimated that NY-Sun programs (including community solar) reached only a few percent of eligible households, far below the 2.4 million LMI target (DOE, 2023). On the positive side, credit payments achieved an average 10-20% bill savings for participants (NYSERDA, 2024). New York also launched Affordable Solar Carve-Outs for shared solar in utility procurements, but outcomes for LMI are pending.

- **New Jersey (Community Solar Pilot):** New Jersey's 2019 law required that 51% of each community solar project's capacity serve LMI customers (NJBPU, 2024). The board launched a pilot in 2022 allocating MW blocks for LMI projects. Early reports (NJBPU, 2024) show significant interest: in Program Year 1, 85 MW of community solar was approved, though only a portion were LMI projects. A Rutgers study (2025) surveyed low-income residents and found high enthusiasm but low awareness of the program (Gunjal, 2025). Many LMI subscriptions are expected to come through housing authorities and nonprofits (NJBPU, 2024). The strong 51% mandate is among the most aggressive in the nation. Monitor this year's results to see if the requirement drives actual low-income uptake (NJBPU, 2024; Gunjal, 2025).
- **Massachusetts (Solar for All):** Massachusetts developed Solar For All using greenhouse gas reduction funds. It offers $0 down subscriptions to income-qualified (≤150% FPL, expanded to 200%) residents via participating solar projects (MassCEC, 2023). Initial MW targets (6 projects, ~9 MW) were modest. A 2021 evaluation estimated participants saved about 9% of their electricity bills on average (MassCEC, 2021). The program was undersubscribed initially, so the state increased funding and relaxed eligibility (MassCEC, 2023). Boston's pilot with Solar Energy for All did reach about 3,500 customers, with high satisfaction reported (MassCEC, 2021).
- **District of Columbia (Solar For All):** DC's Solar For All (2017) provides almost free solar (rooftop and community) to LMI households. Funded by the DC Sustainable Energy Trust, it aimed for 100,000 homes by 2032. As of 2023, about 10,000 families were served (DOEE, 2023). Analysts report average bill credits of ~$25–$75/month for participants, depending on system size (DOEE, 2023). A 2023 DC auditor report recommended clearer tracking of who benefits (by income bracket) (DOEE, 2023). DC's model bundles job training and storage with solar, offering a comprehensive community approach.
- **Colorado (Solar Gardens):** Colorado's first-in-nation Community Solar Gardens (2010) had no LMI set-aside. Studies (McLaren et al., 2018; Greacen, 2019) found that only about 8–10% of subscribers were low-income; most were businesses or nonprofits. The program required developers to ensure projects delivered some proportion of benefits to underserved areas in later rules (HB 19-1193), but progress has been slow. Newer legislation (2021) started providing bonus credits for low-income subscribers, but it is too early for evaluation (Xcel Energy, 2024).

Other states (Hawaii, Oregon, Indiana) have modest LMI pilots, but little published evaluation exists. In general, states with explicit LMI requirements or carve-outs (MN, NJ, IL, NY, DC, MA) have better documented low-income enrollment than those without. However, even with mandates, actual enrollment is often driven by project availability and outreach. Table 3 (below) compares key program designs and outcomes for several states.

State/Program	LMI Focus	Key Features	Outcomes & Evaluations
Minnesota (Xcel CSG)	30% capacity for LMI subscribers	Utility (Xcel) tariff with LMI carve-out; block credit rate.	Synapse (2024): Subscribers saved ~$7–10/mo; non-subscribers saw ~2–3% rate increase[4]. High demand for LMI slots; rule adjustments recommended.
Illinois (Solar for All)	100% subscribers LMI (eligibility)	PBI and credits for community solar projects for LMI residents.	Illinois DCEO (2025): Avg. monthly net savings $46.15 (36.4% of bill)[2]. Participants ~50% AMI, 36% renters; racial diversity lower than general population. Majority of incentives to community solar; EJ carve-out not fully utilized[5].
New York (Solar For All)	70% benefit to LMI by capacity	Subsidies for rooftop and community solar for ≤200% FPL.	NYSERDA (2023): Thousands of LMI homes served; avg. bill reduction ~10–20%. Early issues: strict income docs hindered sign-ups (improved after 2021). Far below goal of reaching all LMI households.
New Jersey (CS Pilot)	51% capacity for LMI	Competitive pilot awarding MW blocks; LMI incentives.	NJBPU (2024): 105 projects awarded (~165 MW); many in LMI blocks. Rutgers (2025): LMI communities show strong interest, need more education on program. Program just launched; results pending.
Massachusetts (Solar for All)	Income ≤200% FPL (expanded)	$0 down subscriptions, funded by GGRF.	MassCEC (2021): About 9 MW procured (6 projects); ~3,500 customers reached. Avg. savings ~9% of bill. Initially supply exceeded demand with expanded outreach (MassCEC, 2023).

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State/Program	LMI Focus	Key Features	Outcomes & Evaluations
District of Columbia	Eligible residents ≤80% MFI	Subsidies for rooftop/CS; integration with weatherization.	DOEE (2023): >10,000 LMI families served (out of 100k goal). Monthly savings ~$25–75. Auditor (2023): recommended improved tracking of income levels. Program is ongoing.
Colorado (Solar Gardens)	No LMI requirement initially	Subscription model for all ratepayers; later added modest incentives for LMI.	Empirical studies (McLaren et al., 2018): Only ~8% of subscribers were low-income; no targeted LMI outreach. 2021 law adds bonus credits for LMI participants, but implementation ongoing.

Table 3. Community solar program designs and LMI outcomes in selected states (sources: state program reports, evaluations, academic studies).

In summary, robust LMI provisions (set-asides, higher credits) and active outreach appear necessary for reaching low-income participants. Evaluations generally find that without mandates or subsidies, the naturally market-driven community solar benefits flow to higher-income, creditworthy subscribers (O'Shaughnessy et al., 2024; McLaren et al., 2018).

VII. QUANTITATIVE EVIDENCE ON EQUITY IMPACTS

Bill Savings: Community solar can deliver tangible savings, though levels vary. The IL Solar for All evaluation quantified that LMI subscribers saved on average $60.79 per month in utility credits, which netted to $46.15 after paying the PV cost[2]. This was about 36% of their pre-solar bill. For a median LMI bill ($126), this meant $46 in reduced out-of-pocket expense (Illinois Dept. Commerce, 2025). Minnesota's modeling showed smaller absolute savings ($7–$10/mo) due to different tariff structure (Synapse, 2024). Massachusetts reported ~9% bill reduction on average (MassCEC, 2021). These savings are meaningful: a 10% bill cut can significantly lower the portion of income spent on energy for vulnerable households.

Participation Rates: Actual enrollment rates of LMI households remain low. DOE estimates that although ~43% of U.S. households are LMI, they account for only a small fraction of community solar subscribers (DOE, 2023). Nationally, most community solar capacity is subscribed by larger customers (municipalities, businesses) (Walker et al., 2022). Minnesota's program saw LMI subscribers fill only part of LMI slots at first, indicating untapped demand (Synapse, 2024). In Illinois, the Solar for All program (all LMI) reached thousands of families, but this is still a tiny portion of the 2.4 million LMI Illinois residents. Quantitatively, even very successful programs have reached at most a few percent of eligible LMI households (NYSERDA, 2023).

Distributional Equity: Researchers assess whether community solar shifts benefits relative to costs. O'Shaughnessy et al. (2024) used detailed address data to compare community solar adopters with rooftop adopters. They found community solar adopters had substantially lower median income (by 23%) and were far more likely renters or multifamily tenants[6]. However, they also found that rooftop adopters were more likely to be non-White than community solar adopters (i.e. community solar did not on average increase racial diversity)[7]. The implication is that while community solar does reach poorer households than rooftop solar does, it still tends to miss many of the most marginalized groups.

In terms of utility system impacts, the Minnesota study noted non-participating customers faced slight rate increases, mostly for non-LMI class (~2-3%)[4]. Importantly, qualifying LMI subscribers were shielded from these costs. No studies to date have shown community solar failing to save LMI households money overall – the question is rather how much of the LMI population benefits.

VIII. QUALITATIVE BENEFITS AND COMMUNITY ENGAGEMENT

Beyond bills, community solar can yield non-energy benefits:

- **Community Wealth:** Reducing energy spending frees up income for essentials. Walker et al. (2022) discuss how savings, jobs, and tax revenue from community solar "can have a multiplying effect" in low-income areas. For example, Hoboken's pilot of a low-income solar garden dedicates savings toward a municipal affordable housing fund (Walker et al., 2022).
- **Job and Skill Development:** Many programs integrate local workforce training. DC's Solar for All funded solar installation and maintenance training in underserved neighborhoods (DOEE, 2023). Such efforts advance equity by providing high-quality green jobs to residents who need them.
- **Health and Environment:** Installing solar in disadvantaged communities can improve air quality and resilience. Community solar at schools or community centers can fund battery backup, aiding critical services during outages (WRI, 2022). Shading parking lots or brownfields and installing solar + storage creates community assets (Walker et al., 2022).
- **Democratic Participation:** When projects are community-owned or involve local nonprofits, residents gain governance roles. This increases community control over energy resources, addressing

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procedural justice (Sovacool, 2018). For instance, some co-op projects allow members to vote on subscription fees or reinvestment of profits, ensuring local priorities are met.

- However, realizing these qualitative benefits often depends on intentional design. CBOs have emphasized co-design of programs: energy planning led by the community yields more trust and uptake (Walker et al., 2025). For example, Walker et al. (2025) identified that involving trusted local organizations in outreach and application support is key to serving LMI households. Programs that neglect community engagement risk perpetuating mistrust.

Unintended Consequences

- No solution is without potential downsides. For community solar programs, equity-focused planners must guard against:
- **Cost-Shifting:** As noted, subsidies for LMI may come from ratepayer funds, which can shift costs to others. Though programs can protect other LMI non-subscribers (e.g. Minnesota shielded qualifying LMI customers from charges), without safeguards, poorer households could end up subsidizing slightly higher-income participants (Synapse, 2024; DOE, 2023). Utilities sometimes cite "cost-shift" as a concern (Solar United Neighbors, 2019). Independent analyses argue that benefits (reduced utility procurement costs, deferred infrastructure) often outweigh the small cost shift, but this remains debated (Mekhiche & Goetz, 2020).
- **Market Segmentation:** If voluntary, community solar can create a two-tier energy market. More engaged or well-resourced customers gain savings, while others remain on traditional rates. Policymakers must ensure community solar serves the broader public, not just those who are already proactive.
- **Gentrification Pressure:** The evidence on solar-induced gentrification is scant. One could worry that solar projects (especially large ground-mounted ones) might raise local land values or encourage investment that displaces low-income residents. So far, this is largely theoretical. Some studies of rooftop solar note that installations correlate with neighborhood gentrification (Darghouth et al., 2017), but community solar's off-site nature makes this less direct. Nonetheless, planners should ensure community solar sites do not displace community resources (e.g. by removing affordable housing for solar land).
- **Undue Complexity:** Ironically, adding too many eligibility layers can slow down programs. For example, overly stringent "one-for-one" LMI matching requirements caused backlogs in Minnesota initially (Synapse, 2024). Programs must balance accountability with user-friendliness.
- **Equity Greenwashing:** There is a risk that programs claim equity but deliver little. For instance, a developer could sign up a few LIHEAP participants to meet a quota while still selling the majority of project to commercial clients. Regulators should audit actual subscriber demographics, not just rely on theoretical carve-outs.

IX. RECOMMENDATIONS FOR PROGRAM DESIGN

Drawing on lessons and literature, key design principles include:

1. **Clear LMI Quotas or Incentives:** Set-asides (e.g. percentage of capacity) or bonus credits for LMI participation directly allocate benefits (Minnesota, NJ models). If carve-outs are not feasible, at least provide financial incentives (higher bill credits or lower subscription rates) for LMI customers. Ensure these incentives are large enough to attract developers (e.g. >$0.02–$0.05/kWh adders) (Synapse, 2024).
2. **Simplified Eligibility:** Use categorical eligibility (presence in any means-tested program) or self-certification to reduce paperwork (CCSA, 2023; Cuellar et al., 2023). Avoid burdensome tax returns or strict income tests. Outreach materials should clearly list alternative proofs (e.g. Medicare, SNAP).
3. **Consolidated Billing:** Require or strongly encourage utilities to do net-crediting. That means subscribers pay one bill that includes their solar credit and any subscription fee (CCSA, 2023). This eliminates dual-billing confusion and allows unbanked or prepaid customers to participate.
4. **No Credit Checks/Deposits:** For LMI-qualifying subscribers, programs should explicitly prohibit credit checks or upfront deposits. Instead, consider co-signers, escrowed payments from subsidy funds, or micro-loans (Walker et al., 2025).
5. **Maximize Incentive Monetization**: Allow project developers to monetize federal and state tax credits, then pass on savings. For example, Iowa and Ohio require a portion of tax credits to be redeemed as cash refunds (Roth & Frazier, 2020). Or offer tradeable credits. This reduces financial barriers.
6. **Robust Outreach and Partnerships:** Fund CBOs to conduct outreach (flyers, workshops, door-to-door). Encourage partnerships with housing authorities, social service agencies, and local contractors (Walker et al., 2025). Transparency about program benefits (e.g. "community solar for $0.05/kWh") is crucial to build trust.
7. **Consumer Protections:** Require transparent contracts with fixed discounts. Limit participant contributions to a small fraction of savings (e.g. 20–50%). Ensure that leaving a program (moving out) is handled gracefully (credits transferable, etc.). (Illinois caps participant payment at 50% of savings, for instance).
8. **Monitoring and Evaluation:** Collect demographic and geographic data on subscribers. Evaluate yearly whether goals are met. If participation is too low, consider policy adjustments or increased funding.

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X. RESEARCH GAPS AND FUTURE AGENDA

While growing, research on community solar equity has gaps:

- **Long-term Impact Studies:** Few studies follow LMI subscribers over time to measure actual energy burden reduction and co-benefits. Longitudinal surveys could track if savings reduce bill arrears, health expenditures, etc.
- **Distributional Modeling:** More rigorous modeling of community solar's system-wide distributional impacts (rate effects, decarbonization equity). Tools like NREL's REEOs (Renewable Energy Equity Opportunity Study) are emerging, but detailed state models are needed.
- **Qualitative Insight:** More case studies on community co-design process (e.g. how did a CBO-led project affect community trust?). Success stories or failures should be documented (Do certain marketing messages work best?).
- **Technology Integration:** Evaluations of pairing community solar with storage or EV charging specifically in LMI contexts. Does adding resilience (backup power) change uptake?
- **Finance Innovations**: Pilot analysis of on-bill financing for solar shares. Would a PAYS model for community solar be feasible?
- **Equity vs. Efficiency Trade-offs:** Analysis of how aggressive LMI requirements (set-asides, high credits) affect total program size and economics. Need to quantify the balance between fairness and costs.

Addressing these gaps will inform better policy. For now, the consensus is that community solar can support energy equity for low-income households when coupled with targeted policies. It is not a silver bullet, but an important tool in a portfolio of solutions to reduce energy poverty and democratize clean energy.

XI. CONCLUSION

Community solar offers a meaningful pathway to advance energy equity by extending renewable energy access to low- and moderate-income households, particularly renters and those in multifamily housing who are often excluded from rooftop solar. While current participation and financial benefits for LMI groups remain limited, evidence shows that thoughtfully designed programs can significantly improve outcomes. Addressing barriers such as upfront costs, complex enrollment, and billing challenges is essential.

Policies that integrate targeted subsidies, accessible financing, simplified eligibility, and strong consumer protections have proven effective in increasing LMI participation. However, careful program design is also necessary to avoid unintended cost burdens on non-participants. Overall, community solar can contribute to a more equitable energy transition, but its success depends on intentional, inclusive policy frameworks and continued research into long-term and distributional impacts.

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