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PRACTICAL IMPLEMENTATION GUIDE: ENERGY POVERTY

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Abbreviations and acronyms:

Acronym	Description
CN	Climate Neutrality
D	Deliverable
LPG	Liquefied Petroleum Gas
EaaS	Energy-as-a-Service
MW	Megawatt
NZ	Net-zero
NZC	Net Zero Cities
PPP	Public-private partnerships
PV	Photovoltaic
SHS	Solar Home Systems
UTM	Urban Transitions Mission
UTMC	Urban Transitions Mission Centre
WP	Work Package

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1 INTRODUCTION

This Implementation Guide on Energy Poverty delivers a set of practical recommendations tailored to, urban actors, city planners, policymakers and other stakeholders, emphasising the importance of effective energy poverty strategies including bundling technical retrofits with finance innovation, strong governance, active citizen engagement, and data-driven and long-term targeting, while tailoring the approach to the respective finance-, utility-, welfare-, or empowerment-led city context.

It draws on the rich insights gained through peer exchange sessions conducted with European Cities Mission cities and front-runner cities globally, leveraging replication and twinning activities under the NetZeroCities (NZC) framework. The core objective of this document is to provide actionable guidelines that demonstrate how cities can translate methodologies described in UTM Deliverable 3.3 - Comparative Methodological Review of Climate Neutrality and Net-zero Transition Pathways Comparative and Deliverable 3.4 - Practical Implementation Guide for Climate Neutrality and Net-zero Transition Pathways into tangible, on-the-ground results. It focuses on addressing critical challenges, overcoming systemic barriers, and fostering the systemic transformations needed to achieve climate neutrality and net-zero (CN/NZ) goals. By integrating lessons from global peer exchange sessions, the document serves as a bridge between theoretical frameworks and practical implementation strategies.

Energy poverty may be broadly conceptualised as the condition in which households are unable to secure sufficient energy services at a cost that is affordable relative to their income. The phenomenon is typically attributed to the interaction of three principal determinants:

The Global North

According to the article ‘10 ways cities can tackle energy security and energy poverty’ by C40 Knowledge Hub, cities can tackle energy poverty and accelerate a fossil-fuel phase-out using a combination of social, technical, regulatory, and collaborative measures. Key actions include targeting support at vulnerable residents by offering rent or tax reductions, debt relief, and ensuring access to national aid schemes, as well as banning utility disconnections where possible or lobbying for protections. Developing multi-year fuel poverty action plans, like London’s, helps structure long-term efforts. Retrofitting public buildings and social housing with renewable energy and high-efficiency systems can cut bills and reduce emissions, while reinvesting the resulting savings into programmes for low-income households, as Seoul demonstrates.

- low household income,
- elevated energy requirements stemming from inefficient or poorly insulated housing, and
- comparatively high energy prices.

Chen et al. (2025) highlight that recognising the health risks posed by indoor overheating and the consequences of cooling energy poverty during summer has become increasingly critical as anthropogenic climate change drives the intensification of heatwave events worldwide.

Heat risk stems from the interaction of hazards, exposure, vulnerabilities, and adaptive capacities. Evidence shows that indoor overheating disproportionately impacts marginalised groups facing poverty, inadequate housing, legacies of colonisation, and intersecting vulnerabilities related to gender and age. Inequalities in cooling access extend beyond household financial constraints to include broader physical, social, and infrastructural deficiencies. Addressing overheating and summer energy poverty therefore requires strategies that target all dimensions of risk, moving beyond monetary considerations to identify and support vulnerable communities through tailored interventions.

Effective responses include both technical and financial measures, such as passive retrofits, subsidies for cooling devices, and assistance with energy costs. Equitable solutions further depend on collaboration between professionals and community actors, integrating urban planning and building design to enhance resilience and promote thermal justice. Expanding access to climate-adaptive infrastructure such as cooling centres, public air-conditioned facilities, and green or blue spaces represents a crucial step toward safeguarding health and equity under rising heat conditions.



New housing projects should adopt zero-carbon design standards, as seen in **Milan**. To empower communities, cities should provide accessible and trusted guidance on energy efficiency and integrate support into frontline services such as health and social care. Public campaigns can also help reduce wasteful energy use through measures like lowering indoor temperatures or promoting better maintenance, making sure these initiatives do not increase hardship for vulnerable residents. Clean and affordable heating systems must replace fossil gas rapidly, through bans on new gas boilers, the scaling of heat pumps, district heating, and scrappage schemes, supported by strong installation capacity. Decentralised renewable power should be expanded via mandates, grants, and community energy projects that guarantee benefits for low-income groups, alongside investment in demand-side flexibility through smart controls, energy storage, and electric vehicle charging. To reduce oil use, investment in affordable, sustainable mobility is essential, with expansions in public transit, walking, and cycling, fare freezes for low-income riders, and restoration of pre-pandemic service levels.

A just transition also requires green job creation: large-scale energy retrofits represent one of the biggest opportunities, with examples in Italy showing hundreds of thousands of potential new jobs.

To ensure energy remains affordable, partnerships with utilities are crucial. Measures such as prepaid or smart meters, flexible payments, subsidies, and social discounts, as used in **Vienna and Barcelona**, can help shield vulnerable households from energy poverty, alongside legal protections against disconnections. Reliability must also be improved through careful network planning, maintenance, and risk management, since inconsistent supply undermines both household well-being and economic viability.

Finally, cities must act collectively by pooling procurement of renewable technologies, forming coalitions with unions, civil-society groups, and neighbouring governments, and using this collective voice to advocate for national and international action to accelerate the energy transition while protecting residents from poverty¹.

The Global South

The C40 Knowledge Hub policy brief ‘*10 ways to boost urban renewable energy access*’ also highlights the energy access gap in the Global South.

Clean energy is a fundamental resource that remains inaccessible to millions worldwide, posing a critical barrier to equitable development. Energy access must be understood not only as a physical connection to a power source but as a guarantee that energy supply is reliable, affordable, and sustainable. Currently, an estimated 176 million urban residents lack access to electricity, with approximately three-quarters located in sub-Saharan Africa.

Furthermore, over 2.6 billion people continue to rely on unsafe and polluting cooking methods due to the absence of clean cooking facilities. These challenges are particularly acute in rapidly expanding urban and peri-urban slums and informal settlements, where energy insecurity compounds existing social and economic vulnerabilities.

Cities can play a pivotal role in closing the global energy access gap by implementing a comprehensive set of policy measures that address affordability, reliability, and sustainability. The first step is to identify local barriers to energy uptake, which often relate less to grid coverage and more to cost, safety concerns, or inadequate infrastructure. Robust research and community engagement can provide the insights needed for targeted action. Once barriers are understood, cities should design the most effective and affordable interventions, as seen in **Johannesburg**, which developed a mixed approach combining electrification plans with independent renewable grids. Targeting productive uses of energy, such as income-generating activities, can enhance both household welfare and financial sustainability for cities. Municipal governments should also lead by example, piloting renewable projects on public assets to raise awareness, strengthen capacity, and demonstrate the business case for clean energy. At the same time, investment in enabling infrastructure, such as distribution

¹ https://www.c40knowledgehub.org/s/article/10-ways-cities-can-tackle-energy-security-and-energy-poverty?language=en_US

networks, ready boards for low-quality housing, and regulatory frameworks, remains vital to scaling access.

Where grid expansion is not feasible, mini-grids and decentralised systems can provide reliable service in underserved urban neighbourhoods, as demonstrated by **Rio de Janeiro's** Revolusolar project², which couples solar power deployment with local job creation. In parallel, cities should seize the opportunity presented by rapidly falling solar costs, enabling large-scale deployment through subsidies, loans, bonds, or aggregated financing mechanisms that reduce risks and encourage private-sector investment.

In the short term, Liquefied Petroleum Gas (LPG) can provide an alternative, but with falling renewable energy prices, electric cooking will soon become a highly efficient and sustainable solution that can drive wider electrification progress. By pursuing integrated actions, cities can address both immediate social needs and long-term climate and development objectives, ensuring equitable, reliable, and sustainable urban energy access³.

2 CASE STUDIES

This Practical Implementation Guide on Energy Poverty shall give valuable insights from four interviews conducted by GKEC/UTMC partner Eurocities and from the Peer-to-Peer Exchange organised by GKEC/UTMC partner ICLEI, connecting European Cities Mission cities and cities of the UTM cohort.

In preparation for the Peer-to-Peer Exchange and to further enrich the findings and recommendations four in-depth interviews were conducted with city experts involved in the climate neutrality and net-zero transition efforts in

- Dresden, Germany,
- Greater Manchester, UK,
- Klagenfurt, Austria,
- Vantaa, Finland.

Drawing on cities experiences, the perspectives shared in the four expert interviews helped to contextualise the peer exchange process and inform the recommendations included in this guide. These interviews served as a key resource for understanding the practical aspects of climate action and the importance of replication in achieving systemic transformations toward climate-neutral and net-zero cities.

According to the expertise and information received by the four city representatives, the main challenges in tackling energy poverty in cities lie in **the high costs and complexity of retrofitting ageing housing stock and the limited effectiveness of market-driven approaches**, which leave cities constrained by insufficient funding, weak legal mandates, and governance gaps. Progress is further hindered by **data shortages, underused behavioural and community tools, and uneven citizen engagement**, despite innovative city-level initiatives showing that integrated strategies combining finance, outreach, and climate action can deliver scalable solutions.

2 <https://www.revolusolar.org.br/>

3 https://www.c40knowledgehub.org/s/article/10-ways-to-boost-urban-renewable-energy-access?language=en_US

2.1 Challenges and main practices

The main challenges faced in the cities of Dresden, Greater Manchester, Klagenfurt and Vantaa are as follows:

1. Technical and Social Challenges

- Retrofitting old housing stock remains the largest technical and social challenge.
- District heating and PV (solar) initiatives are important but face practical barriers (e.g. high upfront cost, long return-on-investment, ageing housing stock).

2. Limits of Market Solutions

- Market-driven approaches alone cannot solve energy poverty.
- Structural financial constraints and lack of legal/local authority limit cities' ability to act independently.

3. Funding and Governance Challenges

- Lack of EU/national funding and legal mandates remain primary barriers.
- Cities call for direct, stable, long-term funding mechanisms.
- PPPs need to be more actively promoted and structured for energy poverty solutions.

4. Data and Monitoring gaps

- Better household-level data and monitoring are needed to accurately identify and support vulnerable groups.
- Current data gaps limit tailoring of measures and slow down interventions.

To meet the identified challenges, three main practices have been identified in the four cities:

1. Integrated, Multi-Dimensional Approaches combining

- Targeted outreach to households most in need,
- In-person support to guide decision-making,
- Clear communication to overcome trust and knowledge gaps, and
- Innovative public-private partnerships (PPPs) to unlock funding and expertise.

2. Social and Behavioural Dimensions enabling

- Behavioural change initiatives and community involvement are underused but essential for durability.
- Citizen engagement and long-term political commitment are critical for sustained progress.
- Public trust and awareness (e.g. Finland's campaigns during 2022 energy crisis) enable rapid responses.

3. Innovative City-Level Strategies

- **Dresden:** Linking climate action with energy poverty reduction via renewable heating solutions.
- **Greater Manchester:** Scaling integration and long-term financing, offering lessons replicable across EU cities.
- **Klagenfurt:** Pursuing district heating and PV projects, but hindered by high costs, long ROI, and citizen capacity limits.
- **Vantaa:** Strong welfare system cushions energy poverty, but data gaps, winter energy price volatility, and immigrant vulnerability remain critical issues.

A cross-city comparison of the results gained in the Peer-to-peer exchange shows that tackling energy poverty is at least noticeable in Vantaa city due to its welfare safety net. The problem seems to be largest in Manchester city due to a mass retrofit need that was addressed. The following results are related to the governance model, citizen engagement strategy as well as scaling and replication across the four cities:

Governance Model:

- **Greater Manchester:** Multi-council coordination + PPP exploration.
- **Dresden:** Utility-led transition, reliant on EU funds.
- **Vantaa:** Welfare-backed with city focus on data/peer learning.

- **Klagenfurt:** Local advisory + behavioural emphasis, constrained by city budget.

Citizen Engagement:

- **Greater Manchester:** Local outreach & tailored advice.
- **Dresden:** Dialogue labs and design thinking.
- **Vantaa:** Peer-to-peer clubs, training.
- **Klagenfurt:** Energy consultants, low-threshold behavioural support.

Piloting and Replication:

- **Greater Manchester:** Exploring finance innovation and end-to-end retrofit pathways.
- **Dresden:** Replicating geothermal pilots, reliant on strong municipal utility.
- **Vantaa:** Mainstreaming pilots, but exposed to emerging vulnerabilities.
- **Klagenfurt:** Needs more external funding/authority; vision is trust-based empowerment.

2.2 Recommendations

Overall recommendations to tackle energy poverty in urban areas are being derived as follows according to the cities in question:

1. Prioritise retrofit programmes for ageing housing stock, with social support measures.
2. Develop city-led integrated strategies combining welfare, energy, and climate goals.
3. Secure sustainable, long-term funding frameworks at EU and national levels.
4. Strengthen public-private partnerships to share risks and resources.
5. Introduce robust monitoring systems for household vulnerability data.
6. Invest in awareness, participation, and behavioural change to ensure equity and uptake.

Policy recommendations are the following:

1. Prioritise Retrofitting and Renewable Heating

Upgrade ageing building stock through large-scale retrofit and district heating/PV initiatives, supported by social measures to overcome affordability and ROI barriers.

2. Move Beyond Market Solutions

Strong public intervention, national/EU funding, and clear legal mandates are needed to empower cities. Pure market mechanisms are insufficient.

3. Adopt Integrated Approaches

Combine targeted outreach, in-person support, clear communication, and innovative PPPs to ensure inclusive, effective delivery across vulnerable groups.

4. Strengthen Funding and Governance

Establish stable, direct, long-term financing mechanisms for cities, while encouraging more active and structured public private partnerships.

5. Leverage Social and Data Tools

Invest in behavioural change, community participation, and robust household-level monitoring to better identify vulnerable groups and build resilience against energy price shocks.

3 CONCLUSIONS

3.1 Europe

An effective energy poverty strategy requires bundling technical retrofits with finance innovation, strong governance, active citizen engagement, and data-driven targeting, while tailoring the approach to city context (finance-, utility-, welfare-, or empowerment-led).

The following conclusions around tackling energy poverty in cities have been derived following the four interviews and the Peer-to-peer exchange between the four European cities:

1. Match Solutions to City Context

- **Finance-led (Greater Manchester):** Where retrofit scale is massive, develop integrated finance pathways — combine national schemes, devolved budgets, and PPPs. Aggregate household demand (e.g. group buying) to reduce costs and unlock private finance.
- **Utility-led (Dresden):** Where strong municipal utilities exist, use renewable heating transitions (district heating, geothermal pilots) to align climate goals with affordability, ensuring social co-benefits.
- **Welfare-led (Vantaa):** Where welfare systems cushion households, focus on data collection and emerging vulnerabilities (immigrants, elderly, low-income) to prevent “hidden” poverty. Support peer-to-peer learning models for lasting resilience.
- **Empowerment-led (Klagenfurt):** Where city resources are limited, invest in trust-building, advisory centres, and behavioural nudges. Seek stronger cooperation with higher government levels for financing and mandates.

2. Improve Financial Frameworks

- **Create end-to-end support models:** from diagnostics --> advice --> finance access --> trusted installers.
- **Expand accessible finance:** low-interest loans, revolving funds, and subsidy schemes especially targeted at single-family, low-income households.
- **Support aggregated demand models** (e.g. group retrofits, heat pump clubs) to improve affordability and uptake.

3. Strengthen Governance and Legal Mandates

- **Empower cities** legally and financially to act on energy poverty (currently constrained in Dresden & Klagenfurt).
- **Formalise multi-level governance:** connect cities with state and EU-level programs for scaling.
- **Ensure stable, direct funding streams** rather than project-based (short-term EU programmes).

4. Prioritise Citizen Engagement and build Trust

- **Combine advisory services,** in-person support, and peer-to-peer models, e.g. Housing Company Clubs (Vantaa) and Energy Consultants (Klagenfurt).
- **Use community labs and design-thinking approaches** (Dresden) to co-develop solutions adapted to local realities.
- **Provide clear information** in multiple languages and formats (as in Greater Manchester’s LEAD project).

5. Data and Monitoring

- **Address household-level data gaps** (Vantaa) to effectively identify vulnerable groups.
- **Develop early-warning systems** to monitor energy price shocks and protect at-risk groups (prepayment meter users, immigrants, elderly).

6. Link Energy Poverty with Climate Action

- Design energy transition measures (retrofits, renewable heating, PV uptake) to deliver **social co-benefits** by reducing bills and inequalities.

- Use climate policies as an entry point for funding energy poverty mitigation (e.g., Dresden's renewable heating strategy).

7. Long-Term Political and Social Commitment

- Secure **cross-party continuity** and stable city strategies (avoid stop-start funding).
- Make **citizens co-owners** of energy transition through empowerment, awareness, and shared responsibility.
- Treat community participation not as a support tool but as a structural driver.

3.2 Sub-Saharan Africa

Roughly 1.2 billion people are in “energy poverty” globally and cannot afford or meaningfully use basic electricity services. Around 2.1 billion still lack access to clean, modern cooking fuels and technologies⁴.

85 % of the world's population without electricity lives in Sub-Saharan Africa, meaning roughly 580–600 million Africans lack electricity. For clean cooking, estimates converge that about 80–83 % of people in Sub-Saharan Africa (roughly 900–1,000 million people) lack access to modern, clean cooking options, and this absolute number is still rising⁵.

Decentralised and alternative energy access models have been introduced in Africa. These models focus on affordability by removing upfront costs, speed by deploying infrastructure rapidly at scale, and sustainability through long-term service and maintenance arrangements, often facilitated by public-private partnerships and innovative financing mechanisms. The following alternative energy access models are targeting especially rural and underserved communities:

- 1. Off-Grid Solar Home Systems (SHS):** Individual household solar systems with pay-as-you-go financing to reduce upfront costs. These systems compete with traditional fuels and enable affordable energy for basic needs without grid extension.
- 2. Mini-Grids:** Community-level localised power networks up to around 10 MW capacity, suitable for villages or towns where extending the main grid is not feasible. They provide reliable electricity for entire communities more cost-effectively than individual systems alone.
- 3. Community Solar:** Subscribers access solar power from a shared solar facility without needing their own rooftop panels, spreading costs and benefits broadly.
- 4. Subscription Models:** These include services like battery storage subscriptions, lighting, heating and cooling, and energy optimisation through digital management systems, providing energy services bundled with maintenance and optimisation.
- 5. Rural Energy Cooperatives:** Community-owned and managed energy schemes that harness local resources and ensure equitable benefit-sharing while promoting decentralised, low-carbon energy systems.
- 6. Cleaner Cooking Solutions:** Technologies such as electric, solar, biogas, LPG, and improved cookstoves replace traditional polluting fuels, integrated often into broader energy access programs.
- 7. Energy-as-a-Service (EaaS):** Customers pay for energy as a service (such as monthly fees) without owning equipment. Service providers install, maintain, and manage systems like solar panels or batteries, ensuring long-term sustainability without high upfront costs.

⁴ <https://www.who.int/news/item/25-06-2025-energy-access-has-improved--yet-international-financial-support-still-needed-to-boost-progress-and-address-disparities>

⁵ <https://www.who.int/news/item/12-06-2024-progress-on-basic-energy-access-reverses-for-first-time-in-a-decade>



The Rural Energy Access Lab (REAL)⁶ is a non-profit partner to Sub-Saharan African governments, pioneering Energy-as-a-Service programs that treat solar as shared infrastructure to connect whole communities quickly and affordably.

REAL's approach removes upfront costs through smart subsidies and low monthly fees, deploys standardised solar systems at scale as infrastructure rather than one-by-one consumer products, and secures long-term performance through an Energy-as-a-Service model that keeps operators cash-flow positive and incentivised to maintain durable systems and reduce e-waste.

3.3 Vulnerable Urban Populations

The Global North and the Global South face differing energy challenges and responses.

The Global North focuses on addressing energy poverty mainly among vulnerable urban populations through social support (fuel subsidies, tax relief, and protections against utility disconnections), energy efficiency upgrades in public and social housing, and accelerating fossil-fuel phase-out with investments in renewable retrofits, district heating, and electrification of heating and transport. Efforts emphasise just transitions with green job creation, collective city actions, and innovations like smart meters and demand-side flexibility to ensure reliability and affordability for residents in advanced grids.

In contrast, the Global South grapples with fundamental energy access deficits. Millions lack electricity or clean cooking fuels, especially in rapidly growing informal urban settlements. Energy access strategies prioritise closing access gaps by overcoming affordability, safety, and infrastructure barriers. Solutions focus on combining grid expansion with decentralised renewables, mini-grids, and pay-as-you-go models. Rapid adoption of solar and renewable energy is driven by falling technology costs and addressing energy insecurity broadly. The Global South leapfrogs fossil fuel dependence, pursuing direct transitions to renewable energy, often supported by community engagement, local job creation, and scalable investment models. Liquefied petroleum gas (LPG) serves as a short-term alternative while electric cooking gains trajectory. These measures aim to provide reliable, affordable, and sustainable energy access while supporting socio-economic development.

In summary, the Global North works primarily on improving energy equity within mature infrastructure and accelerating decarbonisation, while the Global South navigates initial universal access challenges with rapid renewable deployment and decentralised solutions to both social and climate goals. The Global South's faster growth in renewables adoption, driven by necessity and absence of fossil fuel infrastructure legacy, contrasts with the Global North's systemic transformations aimed at deep decarbonisation and energy justice.

⁶ <https://www.realenergyaccesslab.org/home#our-projects>

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