



**CITIES
NETWORK**

ARUP

Distributed Renewable Energy: A pathway for resilient recovery in cities

Report



Contents

Foreword	03
Executive summary	04
1. The role of DRE in cities	10
1.1 DRE as an enabler of resilience	11
1.2 DRE and the global green recovery agenda	13
1.3 Matching investors and cities	13
2. Barriers to developing DRE in cities	14
2.1 Leadership and resources	14
2.2 Cities' technical capability	14
2.3 Energy market structure	14
2.4 Policy drivers and incentives	15
2.5 Project aggregation	15
2.6 Securing customers	15
2.7 Project development funding	15
2.8 Access to finance	16
2.9 Long term maintenance	17
3. Levers cities could use to develop DRE in cities	18
3.1 Soft powers for project enabling and shaping	19
3.2 Hard powers for project development and delivery	20
4. Project development programme examples	22
4.1 Lessons for enabling programmes	22
4.2 City project development fund	23
4.3 Regional and national project development funds	25
4.4 City capital expenditure	27
5. Developing your city DRE programme	28
5.1 Phase 1: Engage	29
5.2 Phase 2: Act	29
5.3 Programme timeline	30
5.4 Funding your programme	30
Conclusions	31
References	32
Acknowledgements	34

Foreword

The climate crisis and Covid-19 pandemic have brought a fresh set of challenges to cities around the world, on top of their traditional agendas to maintain resilient, thriving and healthy communities. The pandemic has revealed the deep inequities confronting cities worldwide and highlighted opportunities for new approaches. Even as the worst direct effects of the pandemic recede, the ‘new normal’ seems to be even more volatile and uncertain.

Across the Resilient Cities Network (R-Cities), city leaders are responding with bold and creative solutions, recognising they have a once-in-a-generation opportunity to put sustainability and equity at the heart of their economic recovery planning and energy transitions.

Among those solutions are distributed renewable energy (DRE) projects and programmes that produce carbon savings and other benefits. DRE can become the heart of a resilient, low-carbon energy system that provides a lifeline to better health and wellbeing, better jobs, better education and a better quality of life.

We believe cities should play a central role in realising the full potential of DRE. We have pooled our collective knowledge on project implementation and urban resilience to identify the success and failure factors in developing and scaling DRE more broadly through city programmes.

Recognising the benefits of DRE are already well documented, our focus here is on the practical steps cities can take to turn their DRE opportunities into resilient infrastructure that creates benefits. We hope this paper encourages cities, funders, and investors to develop successful, resilient DRE programmes for future energy planning.



Executive summary

Covid-19 and worsening impacts of climate change are putting resilience high on cities' agendas, alongside ambitious targets for greenhouse gas (GHG) emissions reductions; DRE deployment in cities will help deliver both.

The global scale of the opportunity and need for DRE is enormous, but the deployment of projects is far short of projections.

Most DRE technology is mature, and finance is widely available. Market rules and policies constrain some cities' power to act. Still, we observe that the lack of city resources and know-how to shape DRE opportunities into investable propositions is a universal barrier.

This paper sets out a project and programme development 'kit of parts' for cities to bring resilient DRE opportunities to market.





Cities and urban areas contain more than half the world's population, 75 per cent of global energy demand and 70 per cent of energy-related GHG emissions.¹ Recognising their importance to the global response to climate change, cities worldwide are committing to significant climate action.² However, cities have also been hard hit by the Covid-19 pandemic, uncovering inequities and prompting a drive for new and inclusive approaches to building a sustainable future. Now, as cities pivot from crisis response to long-term recovery planning, resilience must become a key priority for their energy transitions.³

Our drive for creating resilient energy infrastructure is about people – the households and communities who will benefit from a better quality of life.

While there are promising examples around the world, cities of all sizes and stages of development are struggling to integrate energy infrastructure investments and targets into long-term employment and growth goals.

DRE is a widely recognised essential part of the suite of solutions to deliver a resilient, net-zero future for cities. Local renewable generation assets, together with storage, smart controls, and demand reduction measures, can provide a range of resilience benefits for cities:

- GHG emissions reduction as distributed renewables displace fossil-dominated national electricity grids.

- Reduced energy system losses by providing generation close to centres of demand.
- System resilience through local generation to provide system balancing for grid stability.
- Back up supply from local generation and storage can act as local supply points during system outages.
- Local energy efficiency and demand management help reduce overall energy spending in the city, while local generation keeps more of that spending to support the local economy.
- Creating direct and indirect jobs in the power sector and across diverse small and medium enterprises.

While individual DRE installations can contribute to reducing emissions and increasing city resilience, it will be most impactful through an integrated, whole systems approach to DRE project design and development.

R-Cities and Arup have joined forces because we believe cities can play a central role in realising the full benefit potential of DRE. We have pooled our collective knowledge on project implementation and urban resilience expertise to identify the success and failure factors in developing and scaling DRE more broadly through city programmes.

We hope to encourage cities, funders, and investors to incorporate urban resilience frameworks and principles into future DRE planning.

Many cities lack the resources and technical expertise to effectively design and prepare bankable projects to accelerate their energy transitions.

Investment in DRE requires focused attention and resources

Although energy transition investment has been rising steadily, even greater acceleration is needed. Recent estimates indicate a need for average annual investment to double or triple from current levels.⁴ Estimates show that USD\$2.5tn of global investment in cities is required each year to achieve the United Nation’s Sustainable Development Goals (UNSDGs).⁵ Despite this consensus; however, investment in and delivery of DRE has fallen short of the required pace, leaving many cities struggling to meet decarbonisation targets and weakened by missed opportunities for clean, sustainable local energy solutions.

Many investors have green funds and access to funding tied to green investments, but they need viable projects that can return on investment. Many potential DRE projects in cities are too complex, too small, or too uncertain to gain development funding.

It is not because cities are not committed to global sustainability agendas. On the contrary, cities are at the forefront of climate action. Still, they lack the resources and technical expertise to effectively design and prepare bankable projects to accelerate their energy transitions and help them meet their sustainability targets.

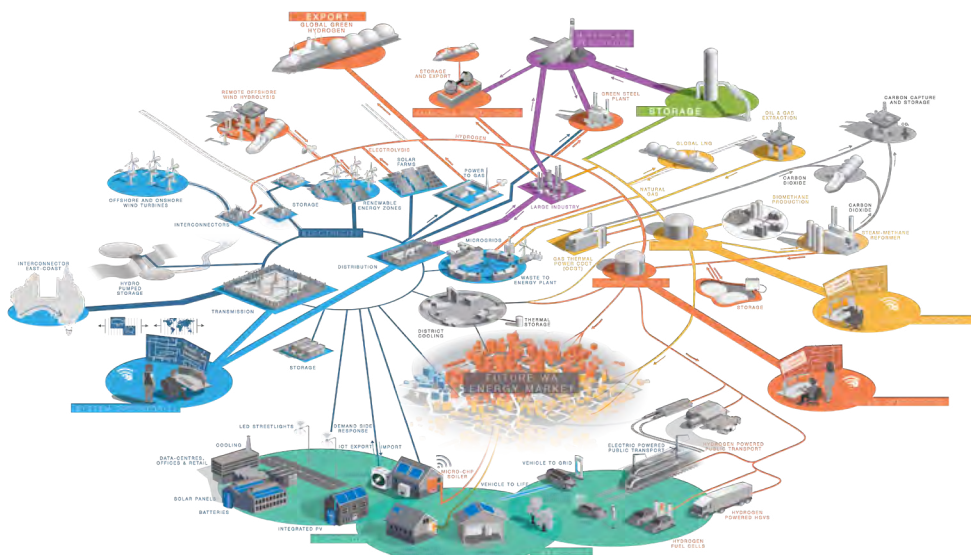
Seeking to understand this barrier better, R-Cities surveyed its 97 member cities across 47 countries and found that 80 per cent identified funding as a barrier to scaling DRE solutions. Arup’s experience in implementing DRE programmes in cities supports this finding, and offers important lessons for cities and funders to overcome these and other barriers to delivery.

Our research shows that an effective way to bridge the gap between investors who cannot find projects and cities who can’t find funders is through the role of the project promoter. A project promoter is an entrepreneurial actor (individual, organisation or group) working with the city to identify project opportunities and give them the shape and certainty they need to become bankable propositions.

While a promoter is necessary, it is insufficient to deliver a step change in DRE deployment. Instead, project development programmes are needed to unlock and accelerate DRE project investment finance in a city.

Although potentially replicable models of project development programmes are available to adopt, their effectiveness depends on how they are designed and set up in each city. The local context and enabling environment – the technical, governance, policy, and economic conditions – affect the suitability of potential models.

A view of the whole energy system context for DRE development



Challenges to scaling DRE in cities

While the cost of DRE technologies is falling and implementation experience is increasing, there are still scaling challenges to overcome, including:



Insufficient leadership and dedicated city resources

Due to cities' complexity and system interdependencies, DRE projects require sustained political support and project development resources.



Burdensome national policy and complicated energy market structure

In many markets, monopoly electricity network operators impose restrictions on DRE through a range of soft and hard measures. These measures include DRE connection limits, bureaucratic compliance requirements and uneconomic pricing for system use.



Limited technical capacity within city government for early-stage project preparation

Many cities lack the skills and experience to develop or critically evaluate DRE proposals.



Riskiness of project development funding

Project development funding is inherently risky because of long lead times, project complexity, demand uncertainty and relatively novel commercial models and technologies.



Complexities of project and customer aggregation

DRE programmes must bring together multiple parties, create incentives or even part-fund project aggregation to maximise rollout and secure a critical mass of customer demand.

City levers

Despite these challenges, cities can deploy several influence, policy and regulatory levers to realise the full benefit potential of DRE, including:



Using local leadership and their convening **powers to bring energy actors together** to coordinate investments.



Connecting energy actors with other city system actors to build a consensus on how DRE can enhance the resilience of other infrastructure and local communities in the city.



Leading formal local **energy systems planning processes** to build a spatially explicit plan for DRE investment.



Using cities' **assets and resources** to accelerate local DRE investment.



Applying powers to accelerate DRE, restrict fossil-based energy investment and build resilience principles into system design and operation (where government policy and legislation permit).



Shaping developer behaviour with planning and building regulations that require DRE adoption and support DRE deployment.

Tactical actions to support DRE project development

Cities seeking to support DRE project development should consider a range of actions that create the right environment and drive forward project development and delivery. These actions include:

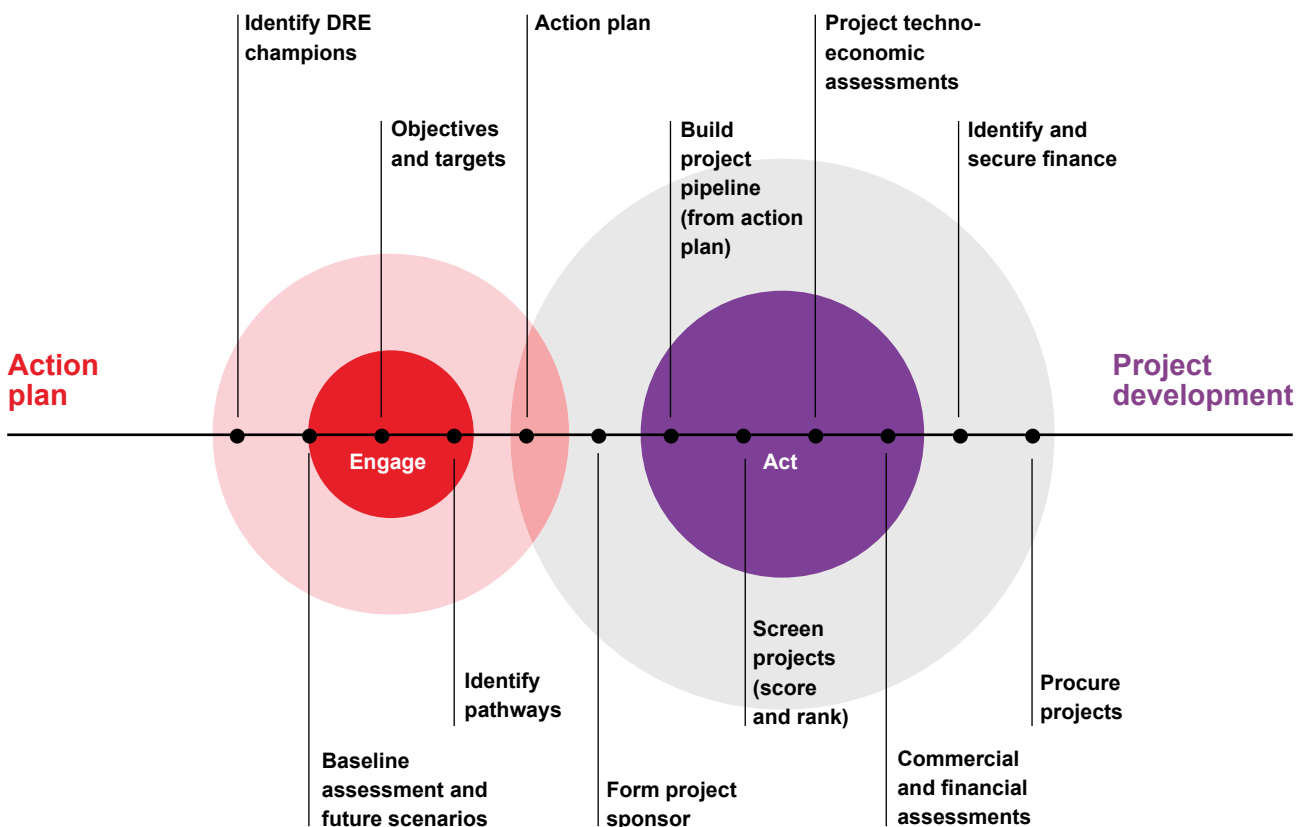
- **Identifying DRE champion(s) and project promoters** with full-time responsibility for delivery and empowering them to act.
- **Setting a target and planning** the city’s future with DRE at its heart.
- **Building awareness** and support with diverse stakeholders through inclusive planning approaches and regular communication and delivery of pilot and demonstration projects.
- Creating a **project development programme** to screen, evaluate and shape ideas into bankable propositions and develop a project pipeline that grabs investor and developer attention.
- **Setting up funds** to commercially **structure and provide finance** for DRE projects.
- **Developing a procurement programme** to streamline and support contracts and project implementation.



Aerial view of solar panels on rooftop

Distributed renewable energy can empower cities to recover from the Covid-19 pandemic and build a more resilient future centred on sustainability and equity. In this paper, we present findings from our collective experience working in cities around the world to help investors better understand the opportunity for scaling DRE in cities and practical guidance on how cities can leverage assets to turn their energy transition goals into robust project development programmes. Cities cannot do this alone, so bold partnerships and funding are needed if we are to take advantage of this once in a generation opportunity.

A range of measures are necessary to drive DRE project development and delivery

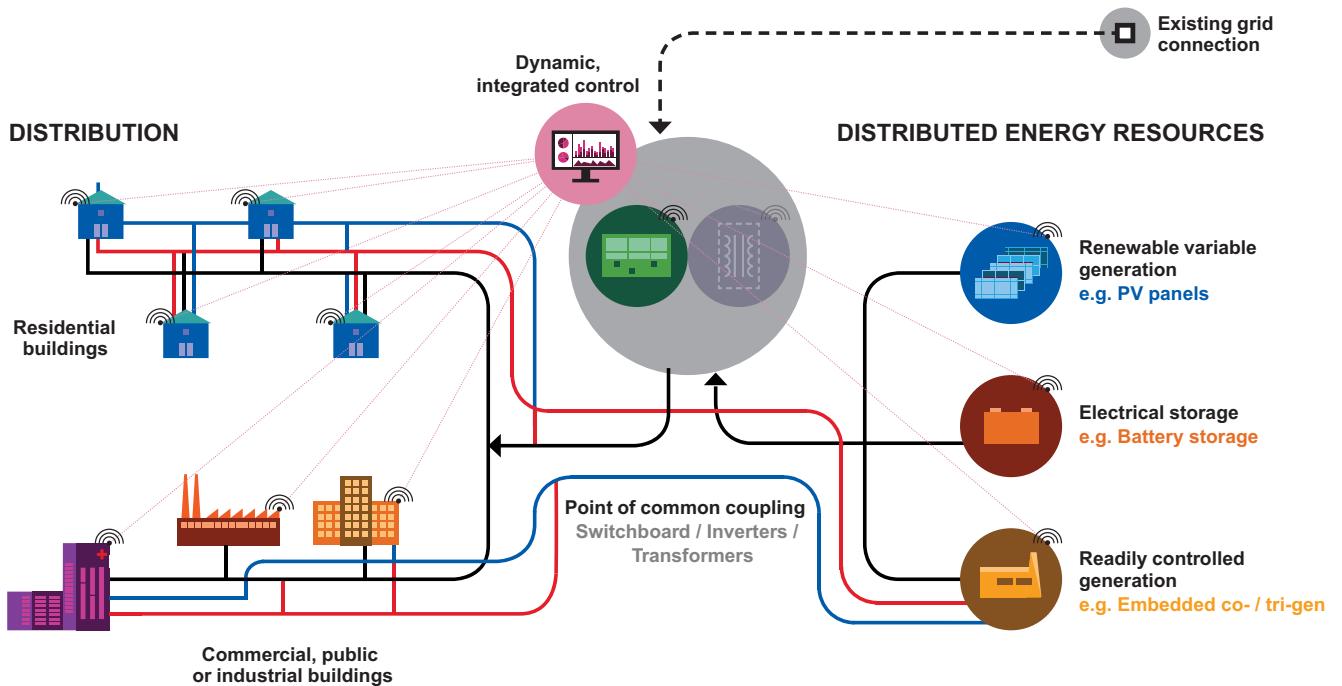




1. The role of DRE in cities

The global scale of the opportunity and need for DRE is enormous, but delivery has fallen far short of projections. This paper explores the reasons for the lack of deployment of DRE at scale in cities and offers solutions that cities can apply to realise DRE's full potential.

Energy in Cities (Adapted from Arup and Siemens' report on Distributed Energy Resources)



Defining DRE

DRE is a diverse class of energy generation, supply, storage and management assets that deliver local low carbon energy solutions for cities. DRE can be connected directly to building energy systems (e.g. rooftop solar PV) or into a city's distribution network (see diagram).

Investors characterise DRE by smaller capital cost per installation (from a few thousand to a few million dollars) and modular, scalable elements (e.g. heat pumps and containerised battery storage).

DRE is crucial in cities for many reasons. Firstly, cities have been the trailblazers for climate action but rarely control centralised energy generation, so DRE offers an opportunity for action at a city level. Secondly, many cities are in geographies prime for exploiting the significant rise in the capability of renewable energy technologies, most notable solar

DRE generation. In many peri-urban geographies the production and installation cost of DRE systems is significantly cheaper than connecting informal settlements to existing ageing grid infrastructure.

Finally, for citizens, DRE development accelerates system change and triggers the benefits of prosumers, who produce and consume energy, reducing the demand for centralised, typically fossil, solutions. In many cases, DRE allows citizens to choose a clean and reliable source of energy they can control over a centralised dirty solution to which they may not connect, or which only delivers an intermittent service.

DRE has a vital role in both developed cities with nearly universal access to the electricity network and in developing cities with large portions of the population struggling to get stable connections to an electricity network.

1.1 DRE as an enabler of resilience

Three factors make DRE increasingly important to the conversation about a resilient recovery in cities:

- Rapid urbanisation
- High levels of informality
- The effects of climate change on the frequency and severity of shocks and stresses for cities

To support the transition to net zero, cities need assistance to move away from traditional centralised systems to distributed renewable energy solutions that can accelerate systems change and future proof communities.

1.1.1 Rapid urbanisation

Many emerging markets, including Asia, Sub-Saharan Africa and Latin America are the fastest urbanising regions. As of 2019, around 2.3 billion people, around 50 per cent of the population in Asia and the Pacific, live in urban areas; this will reach 3.5 billion people by 2050.⁶ By 2050, 1.5 billion people will live in African cities, more than double the number today.

Meanwhile, with over 80 per cent of its population living in urban areas, Latin America and the Caribbean are the most urbanised region in the world. While their urban contexts are different, these regions represent a global trend: in the next 30 years, more people will live in cities than in rural areas.⁷ Given this anticipated growth, universal electrification and energy transition strategies must consider this shift as rapid urbanisation can reverse recent energy access gains if city-dwellers do not have access to reliable electricity.

1.1.2 High levels of informality

Globally more than 1.2 billion people live in slums and lack critical services such as access to affordable and reliable electricity.⁸ In African cities, more than 60 per cent of urban dwellers live in slum-like conditions, lacking electricity connections or experiencing frequent outages and voltage fluctuations.⁹

Estimates show that around one third of urban dwellers live in slums or slum-like conditions.¹⁰ Although urban electrification rates are much higher than in rural areas, almost 100 million people in urban centres in Sub-Saharan Africa live under the grid but lack an electricity connection.¹¹

As these regions continue to urbanise rapidly, city governments struggle to keep up with energy demand. Cities in South Asia can experience 25 outages per month, while some African cities face outages daily, which disproportionately affect informal settlements.¹² This results in city centres that have starkly different realities from their peripheries. Without a connection to the grid, urban dwellers in informal settlements and peripheries overly rely on diesel generators or kerosene lamps. These costly alternatives also contribute to adverse health outcomes.

Informal settlements and slums are generally characterised by a lack of formal tenure, insufficient public space and facilities, inadequate access to services and poor access ways. The lack of infrastructure in these areas perpetuates the poor conditions. Although both governments and investors have traditionally considered them unserviceable, DRE technologies represent a unique opportunity to deliver innovative, data-driven and community-led interim or transition service delivery models.

1.1.3 Climate change

Extreme shocks and climatic events threaten energy systems and pose downstream risks to the other urban systems and societal cohesion on which secure energy provision depends. Significant climate-related natural hazards such as droughts, heatwaves, flooding and landslides affect urban energy systems and impact the reliability of energy provision.

The World Bank estimates that approximately 600 million people in India are at risk from climate-related shock events, and a lack of action could shave off 1.12tn of the country's GDP by 2050.¹³ Meanwhile, Buenos Aires experienced its most intense heatwave late 2013 and early 2014, which prompted a series of power outages, leaving hundreds of thousands of Argentines without power, lighting and running water.¹⁴

For other cities in the region, like Rio de Janeiro or Salvador, which rely on hydropower, the increasing frequency and severity of droughts create vulnerabilities in electricity generation. Distributed power generation, micro grids and similar interventions could enhance supply reliability in the face of these continued and increasing climate shocks.

Urban electrification has long been the utility domain, but this is quickly changing with DRE solutions and the private sector entering the market to provide greater reliability or access to renewable sources of power. These solutions; however, are targeted toward a wealthier customer base and tend to exclude lower-income, more vulnerable consumers. There is a real and current opportunity to modernise the grid and address urban energy challenges because of new business models, falling prices and technological advances (e.g. battery storage).

DRE can make a significant contribution to the energy resilience of cities. By its very nature, DRE reduces the reliance upon central grids, which are often outdated and do not have the necessary capacity to provide reliable electricity. Furthermore, DRE can give consumers control over their energy supply and save costs in the long term thanks to the low marginal costs of generation of the primary renewable sources (i.e. solar, wind and hydro).

DRE offers the possibility of economic growth through small business development and more reliable industrial activities. Reliable energy will enable households to be more resilient to a changing climate, including extreme weather events. It will alleviate chronic stresses by contributing to the provision of clean water, sanitation and healthcare, and access to telecommunications.

The development of the DRE sector will require a new skilled and diversified workforce, creating jobs and reducing poverty. Scaling DRE in cities can directly address equity and inclusion goals, as improved energy access will also improve women's ability to work, study and access economic opportunities. City advances in DRE will also contribute to national objectives for renewable energy and air quality improvement.



Case study: Demonstration of the value proposition of localised solar and battery with an anchor load compared with diesel generation.

Location: Bihar State, India.

Key Figures: 280 kWh Batteries, 75kW Batteries Converter, 125kW PV Array, 75 kW Diesel Generator.

In rural communities with no grid connection, such as Bihar State, electricity is typically supplied using a diesel generator. This case study demonstrates that combining diesel generation with DRE systems can offer a cost-effective, environmentally favourable alternative. The study also demonstrates that the addition of an anchor load, typically a non-residential electricity user requiring constant power supply, to such a system can further increase the system's cost-effectiveness, through the benefits of economies of scale. The study concludes that the combination of localised solar photovoltaic (PV) and battery technologies with diesel generation could achieve a 10 per cent reduction energy costs versus a traditional diesel generator system with no anchor load, while the addition of an anchor load increased the potential reduction to 16 per cent.¹⁵

1.2 DRE and the global green recovery agenda

From the start of the Covid-19 pandemic, numerous local, national, and international actors began to conceive green and inclusive recovery interventions. The message is clear: if local governments want to promote economic stimulus to overcome this crisis, there is an opportunity to steer economic development towards a transition to a low-carbon economy. In addition, there is an opportunity to ensure that this energy transition is just, equitable and leaves no one behind. A recent study found that scaling access to DRE could create 25 million direct jobs, 61 per cent of which would be related to modest grid-tied systems that could service a medium-sized business or a cluster of small enterprises engaged in activities like milling, carpentry or tailoring.¹⁶

Covid-19 coupled with COP26 in Glasgow, also renewed focus and attention on global progress towards the United Nation's Sustainable Development Goals (UNSDGs). Philanthropic organisations and other actors in the development community are turning their attention to DRE delivery as a means to support multiple SDGs – specifically, SDG 7 (affordable and clean energy), SDG 13 (climate action) and SDG 11 (sustainable cities and communities). For example, the Rockefeller Foundation, IKEA Foundation, and Bezos Earth Fund recently launched the Global Energy Alliance for People and Planet (GEAPP) to leverage philanthropic capital to catalyse investment needed for countries to achieve their energy access and net-zero ambitions. The American Government's Power Africa initiative pledged to bring together nearly two dozen public and private sector partners to help realise universal, clean energy generation and access for Sub-Saharan Africa by accelerating new DRE and grid-based solutions.

1.3 Matching investors and cities

1.3.1 What are investors looking for

Although energy transition investment has been rising steadily, even greater acceleration is needed; recent estimates indicate that annual investment in clean energy will need to more than triple to USD\$4tn by 2030 to achieve net-zero global emissions by 2050.¹⁷ Despite this consensus, investment in and delivery of DRE has fallen short of the required pace, leaving many cities struggling to meet decarbonisation targets and weakened by missed opportunities for clean, sustainable local energy solutions. Investment in the mini grid sector in Sub-Saharan Africa is one example of how investment has fallen short: Between 2012 and 2019, donors committed USD\$1.6bn to help scale the sector. However, only 13 per cent (USD\$208m) of that capital has been deployed, according to a recent Sustainable Energy for All report.¹⁸ One reason for the lag is that the regulatory frameworks in many countries have not yet caught up with the sector's.

Many investors have green funds and access to other finance tied to green investments, but they need viable projects that can have a return on investment. Many potential DRE projects in cities are too complex, small or uncertain to gain development funding.

1.3.2 What cities need

Many cities have identified DRE among the suite of solutions to meet their goals for emissions reduction and increasing city resilience. However, converting those ideas into investable projects takes time and effort. Cities lack the resources and technical expertise to effectively design and prepare bankable projects to accelerate their energy transitions and help them meet their sustainability targets.

The opportunity to create a project development programme that converts a wish list of DRE opportunities into a compelling project pipeline for investors to consider seriously.

2. Barriers to developing DRE in cities

Although public and private investors are developing DRE in cities around the world, a gap remains between investors who cannot find projects and cities who cannot find funders.

2.1 Leadership and resources

Arup's research into the elements of city resilience – captured in the [City Resilience Framework](#) – highlighted the critical importance of the role of leadership and strategy in shaping the resilience or vulnerability of cities.

DRE projects are no different; their complexity and interdependencies on multiple systems mean that strong political support and project development resources are essential to making meaningful progress on project development. More specifically, DRE project development needs someone to make it happen – typically referred to as the project sponsor.

Getting deep decarbonisation requires people and organisations to care about achieving the rollout of DRE. A senior sponsor, politician or senior civil servant is necessary, but it also requires a team on the ground driving forward projects, developing a programme and engaging stakeholders. This is the most critical piece of the puzzle. DRE is being rolled out across many cities, but often only as rooftop solar where the market conditions are right. While this is a good first step, more DRE projects across a range of technologies and energy vectors will be needed to enable the full low carbon energy transition.

2.2 Cities' technical capability

One of the greatest barriers to the development of DRE is the capacity of a city to develop or critically evaluate DRE proposals. Too often the staff in city hall do not have the technical capability to undertake this critical thinking to support the journey project concept to construction. Although external experts can fill this gap through specific project studies, cities need a sustained core of technical capability to support sound decision making and to avoid repeat work and loss of time and focus. The private sector more typically has this capability but will be reluctant to deploy these resources early in project development lifecycle, when development risk is still very high.

2.3 Energy market structure

In many markets, monopoly electricity network operators (often state-owned enterprises) impose restrictions on DRE through a range of soft and hard measures. These include limits on connection of DRE, bureaucratic compliance requirements or uneconomic pricing for the use of systems. More liberalised markets or those with streamlined DRE connection processes enable the formation of independent power producers (IPPs), private wire connections and a range of grid resilience and response services that offer DRE developers a diversified revenue stack.

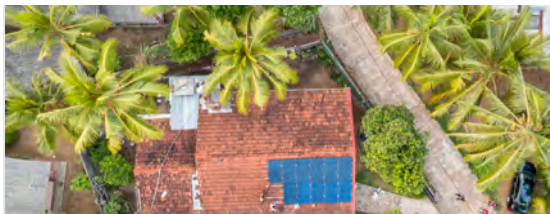
Below is an example of how restrictions imposed by monopoly electricity network operators can impede the development of DRE:



Darewadi Mini-Grid, Maharashtra, India

A 10kW mini grid powered by solar PV was installed to provide electricity in an area with no national grid connection. The mini grid was designed to be grid-ready, but at the time of the study, the process for interconnection with the national grid remained unclear due to several barriers: 1) the lack of national regulations on the interconnection process; 2) significant subsidies on-grid electricity likely to undercut mini grid generation costs; and 3) the federalised nature of India's political system.¹⁹

In contrast, here is an example of how a more streamlined DRE connection process can encourage investment:



Athureliya Community Village, Sri Lanka

A small-scale hydroelectricity fed mini grid was retrofitted to enable interconnection to the national electricity grid. Interconnection was enabled and simplified by developing dedicated grid interconnection standards from the Sri Lanka Sustainable Energy Authority for small-scale power producers. The mini grid was connected under a standardised PPA, established to encourage the connection of DRE to the national grid.¹⁹

2.4 Policy drivers and incentives

Although the cost of some DRE technologies is falling rapidly, policy drivers and incentives are often needed to foster rapid growth in DRE. There can also be barriers in the form of policy and incentives that either directly or indirectly hinder the development of DRE. These include:

- Sightlines/visual impacts: are there regulations that limit construction in particular locations or that have a certain visual impact?
- Digital/telecoms impacts: are there limits on DRE imposed because of impacts on telecoms or radar (e.g. near airports)?
- Glare/shadow flicker: are there limits on DRE imposed because of glare or shadow flicker (e.g. solar near airports or turbines near dwellings)?
- Local emissions (to air): are there limitations on DRE because of the impact on local air emissions (e.g. energy recovery from waste or biomass)?

2.5 Project aggregation

Often DRE involves the rollout of multiple similar projects separated by either location and or ownership. For example, some DRE companies can privately undertake the job of project aggregation, but only where the market conditions are favourable for that technology. There is often a need to bring together multiple parties, create incentives or even part fund project aggregation in order to maximise rollout and decarbonise cities.

2.6 Securing customers

Much like project aggregation, sourcing multiple customers across various public and private sectors can be a challenge, particularly in a nascent market (e.g. district cooling or heating systems). Again, securing customers at early project development stages is high risk given the project may not come together. The public sector may encourage customer collation through a requirement to connect (either directly or indirectly).

2.7 Project development funding

Before a project can be brought to market (i.e. a financier or contractor procured), resources are needed to develop a project from a great idea to a well-structured proposition with a credible evidence base that demonstrates the costs, benefits, value and risks of the project.

Project development funding is needed to bring a project forward to pay for the promoter's staff, project advisers, site investigations or pilot projects. Without it, a project cannot get on the drawing board. DRE project development activities typically include:

- Continually identify DRE projects for assessment
- Screen projects for pre-feasibility development
- Shortlist potentially viable projects
- Undertake technical, commercial and financial feasibility studies
- Identify suitable financing
- Assist with procurement
- Fund pilot or demonstration projects

Development funding is also the riskiest and only a few projects successfully get through the process. They are often subject to forces outside the control of the private sector in these early phases. Typically, the private sector will not invest project development funding without some assurance of at least recovering its costs.

However, project development risk can be overcome by securing grant funding or developing a project development programme that spreads the risk of project failure across multiple opportunities. In any case, careful selection of projects to support and a willingness to 'fail fast' are essential ingredients to the prudent and ultimately successful use of project development funds.

For example, the European Investment Bank's EUR\$180m European Local ENergy Assistance (ELENA) facility provides project development funding to cities in the form of a grant, but with the condition of a target to achieve a multiple of the grant value in the form of capital projects brought to market (e.g. EUR\$20 in investments procured for every EUR\$1 of grant). This arrangement provides some assurance of prudent project development funding spending without the cost of project development costs themselves becoming a drag on the viability of the projects brought to market.²⁰

From experience, a lack of project development funding is often why the private sector does not step in as project development funding is inherently risky. As evidence, the importance of this type of funding for developing a pipeline of bankable renewable projects in sub-Saharan Africa has been highlighted by infrastructure funds InfraCo Africa and Africa50, as well as the Belgian Ministry of Climate, Environment, Sustainable Development and Green Deal and the Africa EU Renewable Energy Cooperation Programme.^{21 22 23}

At present, the scale of early-stage financing is well short of the level needed to meet the need for project development resources.

2.8 Access to finance

Access to suitable financing for DRE assets is often cited as a key barrier. However, experience shows that finance is always available for suitable projects. Some good examples include:

Mid to large-scale:

- The C40 Cities Finance Facility provides cities with the technical expertise needed to develop climate action plans and projects to be finance ready while also building the capability of cities to access finance.²⁴

- In the United Kingdom, the GPD\$320m Heat Networks Investment Programme (HNIP) provided gap funding and lending for heat network projects to leverage significant private and other investment in the commercialisation and construction of such projects.²⁵
- In 2018, in Victoria, Australia, the Renewable Communities Program (RCP) provided grant funding for community-led distributed renewable energy projects. The most significant project investment was USD\$500,000 to support a hybrid facility with 3MW solar PV and 4.1MW wind generation.²⁶
- The Urban Resilience Fund Global Platform (TURF) is a blended finance instrument launched by the Meridiam in partnership with the Rockefeller Foundation and the UN Capital Development Fund. The Catalytic Capital Fund complements TURF, providing early-stage project development finance to bring up to EUR\$10bn in private investment in resilient urban infrastructure.^{27 28}

Small-scale:

- In New York, the NY-Sun solar PV incentive programme provides per watt financial support for residential and non-residential distributed solar PV systems in New York, contributing to a goal for six GW of installed solar PV capacity by 2025.²⁹
- In London, the Community Energy Fund provides grants of up to GPD\$50,000 to support up to a third of community energy project capital costs, with solar PV systems representing the most common project type.³⁰
- In Australia, the Small-Scale Renewable Energy Scheme issues installers of small-scale renewable energy systems (<100 kW) with certificates redeemable for a discounted system installation rate on an open certificate market.³¹

Finance is not so readily available for marginal projects or projects with a low or negative financial return, even where social and environmental benefits are evident. Projects are typically categorised into three distinct project types:

- Financially viable projects: those that return a project internal rate of return (IRR) of typically eight per cent or more (although this threshold value will vary from place to place). These projects are typically suitable for private investment.
- Economically viable projects: projects that deliver a net economic return on investment for the public sector but are not financially viable for private investment. These projects will usually only attract private investment with some public sector or philanthropic support, such as gap funding, demand guarantees or other forms of insurance to limit investor exposure to losses.
- Sub-viable projects: projects that deliver some social or environmental benefits but fall below these financial or economic hurdle rates, or cannot demonstrate a net benefit. There may yet be good reasons to develop these projects, such as a case based on wider benefits that are demonstrably significant, but cannot be quantified as economic or financial values (non-monetisable benefits). They may also be investments designed to stimulate supply chain investment, leading to a sustainable market in the future. Alternatively, they may need further project development efforts to shape them into a more viable form.

With public or philanthropic support, sub-viable DRE projects can be brought to market. Still, cities should ensure that the ongoing costs for operation and maintenance are affordable. Otherwise, the project can become a permanent drain on city finances, and the project's full potential benefits may never be realised.

The sub-viable project type can be sub-divided into:

- Socially beneficial projects: provide social benefits but do not meet the public sector's minimum economic performance requirements.
- Unviable projects: those that do not provide sufficient returns, even when considering social benefits, to be considered viable by the public sector.

An additional challenge is that cities in emerging markets do not always have the systems to access capital to invest in energy interventions at the scale that could revolutionise city health, quality of life and economic opportunities. Limited access to finance at the local and national levels is a key barrier to developing energy solutions for the urban poor.³² Before accessing capital; however, cities must identify the barriers to DRE and identify feasible projects for development in coordination with project stakeholders.

2.9 Long-term maintenance

Some DRE projects, such as rooftop solar, need little maintenance and the long-term liability with suitably managed. However, more complex, multi-stakeholder assets, such as district heating and cooling or electricity microgrids, require long-term contracts with significant operational and maintenance costs. Even where there are available qualified suppliers in the market, such projects can take considerable time and effort to establish a satisfactory project governance, operation and maintenance regime.

3. Levers cities could use to develop DRE in cities

Where the barriers described above are hindering the rollout of DRE, there is a need to consider the specific levers a city can use to help implement or accelerate DRE integration.



Even where they lack direct responsibility for energy systems, cities have a range of soft and hard powers to develop DRE projects and programmes.

Key soft powers include:

- Advocacy and collaboration: although cities don't always have formal power over key energy decisions, they can stimulate change through pilot demonstration projects, stakeholder consultations and feasibility studies, and dissemination of information to advocate for change.
- Planning: as demonstrated above, planning is an opportunity that can be used on relatively high-quality land development but will be less effective for informal or low-cost building development.

Relevant hard powers include:

- Regulation: municipal building codes (waiving height restrictions for rooftop solar systems, simplifying requirements for building permits, imposing energy efficiency and renewable energy requirements, etc.)
- Land assembly and development:

often cities either own land or act to assemble land for development and so can mandate the use of DRE on future land development.

- City-owned building portfolio (housing, schools, etc): most cities have a building portfolio, which in some cases might be extensive if it includes housing and schools as well as public buildings such as community centres, libraries, leisure centres etc. A DRE programme across this portfolio can stimulate a wider programme by creating city technical and commercial capability and identifying project sponsors who can drive DRE into the wider city.
- Innovative financing instruments: municipal green bonds and subsidised low-interest loans, can provide municipal governments with access to low-cost capital to meet their energy investment needs.

The use of both soft and hard powers, particularly if coordinated to push in the same direction, can provide some very significant levers that can be used for the development of DRE in cities. These are discussed further below.

3.1 Soft powers for project enabling and shaping

3.1.1 Engagement

To start any form of DRE rollout in a city, engagement with city leadership, civil servants, wider stakeholders and the community is key to making progress. Without wide engagement, DRE may be fragmented and slow to develop.

Cities have the opportunity to place equity at the centre of their engagement efforts. Equity means addressing social and economic inequalities and empowering multiple stakeholders, particularly the most vulnerable ones, to engage in planning efforts. It includes thinking about group-based disparities such as gender or race, and creating opportunities for different stakeholders to participate in the process.

Although engagement can be undertaken concurrently, successful DRE rollouts generally follow this order:

1. Engage city leadership to support the development of DRE (though this is often helped by grassroots community activism by voters).
2. Engage civil servants to collate data, allocate staff and set a baseline.
3. Use the wider context to agree on appropriate targets with city leaders and civil servants.
4. Engage the wider community to buy into targets.
5. Identify and engage a project sponsor(s) to own those targets.
6. Engage the private sector to help meet those targets, either through obligation, incentivisation or paid assistance.

Key private sector stakeholders include:

- Technical advisers: most cities do not have, and cannot afford, to have full-time technical expertise that can provide the necessary insight to screen projects and assess technical, commercial and financial viability developed into investable projects. It is necessary to engage this support and the funding to develop a DRE programme, at least in the early stages until it becomes self sustaining.
- Suppliers: all DRE programmes will need suppliers in some form, and a careful engagement strategy is needed to ensure the best results. Some cities lacking technical expertise and funding to receive direct, impartial support, engage suppliers too early. This can lead to inappropriate solutions skewed to a particular supplier's solutions catalogue. Conversely, if suppliers are not engaged, identified solutions can be undeliverable or do not take advantage of the latest innovation.
- Installers: like suppliers, installers are key to the rollout of any DRE programme. A well thought out engagement strategy is vital to ensuring skills are available when projects begin to come forward. Signalling likely rollout dates can help the market invest in scaling up the necessary skills and resources.
- Operators: in many cases, skilled operators will be needed to ensure the ongoing success of DRE assets. Some DRE, such as rooftop solar, requires limited operation and maintenance. Other systems such as district heating or cooling, require very skilled ongoing operation to remain efficient and provide customers with good service. Engaging with operators at the appropriate point in the development of a DRE programme has been proven to be vital.
- Utilities: even if a city does not have direct control or influence on utilities, it is crucial to meet their needs and identify and mitigate any potential roadblocks. This may include the engagement of industry associations that directly represent utilities or the utility regulators.

3.1.2 Planning

Most developed city administrations have control over planning regulations and have successfully incorporated DRE into their regulations.

Some good examples include:

- In 2000, the City of Barcelona introduced Europe’s first Solar Thermal Ordinance, obligating all new or renovated buildings to generate 60 per cent of hot water requirements from solar. Other Spanish cities followed this before similar legislation was introduced nationally in 2006.³³
- In 2003, Merton District Council (London, United Kingdom) introduced the requirement for all new planning applications to demonstrate how ten per cent of the development’s energy requirement will be met by onsite renewable energy equipment.⁶¹
- In 2017, San Francisco introduced the Better Roofs Ordinance, obligating 15 to 30 per cent of roof space on new developments to incorporate solar panels, living roofs, or both.³⁴
- In 2017, Los Angeles introduced the Renewable Energy Ordinance (REO), introducing a streamlined permitting process for small-scale distributed renewable energy projects and more detailed planning regulations for utility-scale solar PV, aimed at minimising the environmental and social impact of such projects.³⁵
- Since 2020, all new residential buildings less than three stories high in California are required to have solar PV roof panels installed, in line with the California Solar Mandate.³⁶
- Berlin is planning to mandate the installation of solar PV panels on all new buildings from 2023, pending final approval of the senate-approved law by the house of representatives.³⁷
- Amsterdam aims to phase out natural gas by 2040, with plans to relax specific regulations to encourage localised renewable energy projects and connections to district heating systems.³⁸

3.2 Hard powers for project development and delivery

3.2.1 City project sponsors: ownership to drive DRE in cities

By appointing a single full-time person to drive DRE development, a city change starts to build momentum towards a very significant impact. A number of the programme examples below give some evidence of this, but what has been key in all of those is the ownership by one or a few people to drive DRE development.

Key tasks of the Project Sponsor or Project Promoter role include:

- Securing project development funding
- Managing DRE programmes
- Undertaking capacity building within city local authorities
- Developing teams of DRE enablers across city local authorities
- Conceiving of and setting up city DRE development programmes
- Identifying potential projects for development
- Stakeholder engagement

3.2.2 City DRE development programmes

To create the sustainable rollout for DRE across a city, the Project Sponsor is likely to need to set up a specific DRE project development programme, with the key tasks of:

- Establishing a DRE programme delivery team (often in large part undertaken by private sector consultants through project development funding gained, but accountable to the city project sponsor).
- Development of detailed project development programmes owned and managed by the city.

The programme should:

1. Continually identify DRE projects for assessment
2. Screen projects for pre-feasibility development
3. Shortlist potentially viable projects
4. Undertake technical, commercial and financial feasibility studies
5. Identify suitable financing
6. Assist with procurement

3.2.3 Procurement

Cities can use procurement to assist in the rollout of DRE in their cities using a variety of procurement processes:

- Firstly, they can procure DRE on their assets such as open land, offices, housing or other non-energy infrastructure.
- Secondly, cities can set standard procurement terms, for anything from paper to large waste collection contracts, to contain clauses requiring suppliers to meet certain standards, including efforts to procure renewable or low carbon energy
- Finally, and perhaps most importantly, cities can set up and manage framework panels that streamline the procurement process for DRE and enable other potential procurers to use the panel of suppliers and installers (a good example is the RE:FIT programme, refer to section 4.2.3).

3.2.4 City owned assets (land or buildings)

Cities own land and buildings, both of which can be leveraged to develop DRE. Some imaginative solutions are used around the world include:

1. In London, waste heat from ventilation shafts owned by Transport for London (TfL) is used in Islington Council's Bunhill Heat & Power district heat scheme, providing low cost and low carbon heating to residents.³⁹ This could be a world-first and provide a template for heat capture from underground ventilation shafts across the city.
2. TfL has also launched its first fleet of electric buses for London. As part of this initiative, stationary battery energy storage was installed at TfL's Walworth Depot to support the charging of the buses and provide additional revenue by providing services to the national grid.⁴⁰
3. The City of Cape Town, South Africa, undertook a programme of installing PV on local authority-owned buildings. In 2017, 257 kW of PV had been installed on municipal buildings, with over 2 MW more capacity in the pipeline.^{41 42} The city authority maintains four mini-hydro turbines of 2.8 MW total capacity

on its municipal water treatment sites.⁴²

4. By 2030, the City of Dakar, Senegal, plans to equip over half of municipal buildings with grid-connected PV systems.⁴³
5. Public Utilities Board (PUB) Singapore tendered for Design Build Own Operate (DBOO) floating solar on its reservoirs.⁴⁴
6. Aberdeen, Scotland, ran a procurement for the rights to use the city's street furniture (e.g. lighting columns, kiosks, bus shelters and benches) as objects to mount wireless network transmitters.⁶²

3.2.5 Project finance

During the project development phase, it is important to consider the type of funding that is needed (see section 2.8). There are examples of cities helping in several ways:

- City established private sector funding programmes: there are several examples of city or national governments setting up private sector funding routes for projects to use to get competitive private finance.
- Public financing/lending: typically, public finance is provided to a project at lower rates than the private sector, so if a project or projects achieve a social benefit, then public funding may be a way to unlock 'economically viable' and even 'socially beneficial' projects.
- Securing capital grants: cities have often helped secure capital grants from international finance institutions such as the World Bank, Asian Development or the European Investment Bank.

Some projects can become more commercially viable if they can be aggregated and streamlined access to finance, as in the United Kingdom's HNIP programme.

4. Project development programme examples

This chapter provides a selection of example programmes and investment funds that have accelerated investment in DRE in cities. The details highlight success factors for programme design and operation*.



4.1 Lessons for enabling programmes

The first steps for a city starting a DRE journey is to create the right enabling framework to support DRE project development and build the capacity and resources for project development and delivery. The purpose of the enabling framework is to change the signals to the market and make it easier or cheaper to deliver DRE (while potentially making fossil-based alternatives to DRE more difficult or costly).

4.1.1 Target setting

A mayoral commitment to DRE development is a great place to start. Ideally supported by evidence such as a citywide climate action plan, resilience strategy or local area energy plan, a target for DRE development in a city will help mobilise leadership attention and send an important signal to the market that the city is a suitable place to develop DRE.

4.1.2 Planning and building regulations

Cities can use local planning powers to set requirements for new developments to incorporate or connect to DRE and to ensure a supportive regulatory environment for developing DRE infrastructure and assets. Even where a city cannot mandate the adoption of DRE in new development,

even a requirement to consider DRE (and provide evidence why it has not been adopted) can act to change the conversation over time.

4.1.3 Demonstration projects and other communication efforts

There is nothing as convincing as the evidence of a completed and successful project. Pilot and demonstration projects provide tremendous learning opportunities, but they also perform a powerful advocacy role. DRE development can be a long journey spanning multiple political cycles, so communication and promotion efforts should emphasise a sustained campaign in favouring of significant one-off events. For instance, an annual DRE conference or quarterly progress reporting can provide a steady rhythm of events and communications and maintain awareness and build public support over time.

4.1.4 Building capacity

A core project sponsor team is a critical success factor to maintain momentum. The team should consist of at least three to four people with a core responsibility for DRE development. This critical mass will help sustain the team as other individuals come and go. DRE's cross-cutting and complex

* Authors were directly involved with several projects included as examples in Section 4. Information for these projects was compiled based on this experience.

nature means that the core team should seek to form a wider community of stakeholders, both internally within the municipal organisation and externally with utilities, developers, investors and community representatives. Regular conversations with these stakeholders will help propagate communications and awareness while also providing the core team with important information and ‘reality checks’ on what is practicable at each journey stage.

4.1.5 Project Development Funding

As explained above, DRE projects cannot get going without the resources to support project investigation, analysis and design. Accessing such funding – from local, national or international sources – should be an early task of the core team to ensure it has a sustainable foundation to support project development.

4.1.6 Cape Town Energy2040 and Municipal IPP Procurement

Energy2040 saw the City of Cape Town update its energy vision through energy modelling and engagement with stakeholders.

- **Policy development:** Energy2040 set new city-wide energy and carbon targets for 2040 and a five-year action plan to roll out at least 220 MW of renewables including 120 MW of rooftop PV. The City targeted sourcing 20 per cent of energy from renewables by 2020.⁴²
- **Capacity building:** The city of Cape Town created a new Energy and Climate Change Directorate, merging two existing energy-related divisions.⁴⁶ This clearly assigned a group to take ownership and drive DRE rollout to meet targets.

To meet Cape Town’s energy targets, in 2017 the city began a court challenge against the National Government to allow it to procure renewable electricity from IPPs rather than the coal-reliant state-owned electricity provider Eskom.⁴⁷ In 2020, this pressure saw the national government introduce new regulations enabling local authorities to procure power from IPPs and develop power generation projects.⁴⁸ The City of Cape Town is now exploring introducing its own Renewable Energy IPP Procurement Programme, a scheme that would significantly drive DRE rollout in the city.^{41 46}

4.2 City project development funds

4.2.1 London Decentralised Energy Masterplanning Programme

The Decentralised Energy Masterplanning Programme (DEMaP) ran from 2008 to 2010 and was set up to map decentralised energy project opportunities across London. Although it focussed almost exclusively on district heating, the example has several key elements that are important in the development of sustained DRE development in a city:

- **Capacity building:** DEMaP undertook a broad range of capacity building exercises within the City of London’s local authorities, upskilling stakeholders and establishing buy-in to the programme.
- **Local authority buy in:** the programme helped establish a project sponsor in over 50 per cent of the city’s 33 borough.
- **Project identification:** a key output of the programme was a long list of potential projects that could be developed.
- **Technical and commercial advice:** specialist technical and commercial advice was provided by specialist energy experts from Arup.

District heating is particularly complex, and the length of time to identify a sufficiently large pipeline of projects (many of which will fall by the wayside for various viability reasons) should not be underestimated.



4.2.2 Decentralised Energy Programme Delivery Unit

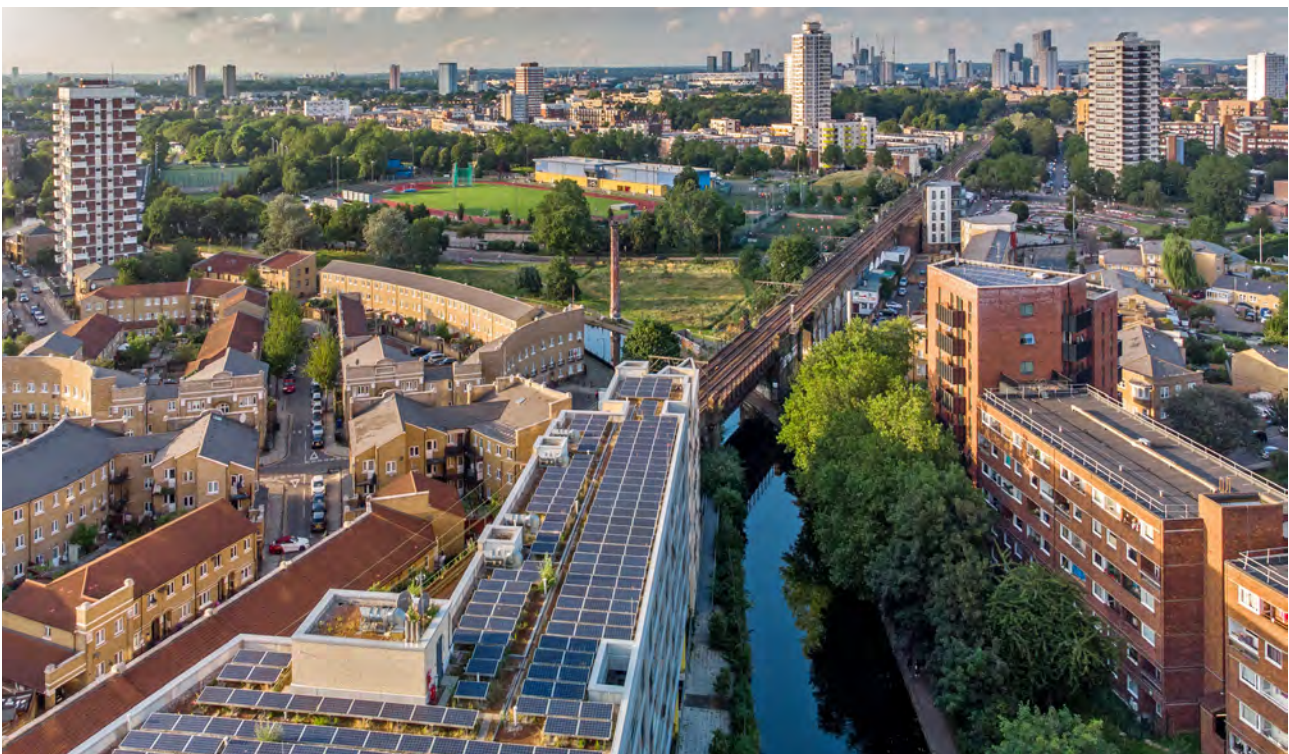
The Decentralised Energy Programme Delivery Unit (DEPDU), later known as the ‘Decentralised Energy for London Programme’ ran from 2011 to 2015 and was the direct follow-on from the DEMaP programme to deliver district heating project across London. The key elements that are important in the development of sustained DRE development in a city:

- Project selection: the city appointed project sponsor remained the focal point for stakeholder engagement and project identification.
- Project development technical assistance: continuous technical, commercial and financial advice was provided by specialist energy experts from Arup. The important element of this programme was the consistency of technical input and continuity of the team throughout the project development programme (instead of procuring new advisers at each project stage).
- Project procurement: local and city authorities have extensive procurement capability in many aspects; however, specialist procurement support, particularly with complex DRE solutions such as district heating, was required to steer projects. Failure rates were much higher where there was no support.

4.2.3 RE:FIT & RE:NEW

The RE:FIT and RE:NEW programmes were set up by the Mayor of London to roll out energy efficiency programmes in non-domestic and domestic buildings. The programmes had two main functions:

- Project development/technical assistance: unlike DEMaP and DEPDU, limited project identification was part of these programmes (though in the later years, that did form a part of RE:FIT). Instead, any public sector organisation could seek technical assistance to help develop energy efficiency projects. This assistance was again provided by a single consulting entity, providing consistent and uninterrupted support.
- Project procurement: the main effort of the RE:FIT programme was to set up and administer a framework of Energy Performance Contractors, providing end-to-end service for energy efficiency investment by public sector organisations. RE:NEW also introduced a framework of suppliers for procuring building retrofit works.⁴⁹



4.3 Regional and national project development funds

4.3.1 Heat Network Delivery Unit

The Heat Network Delivery Unit (HNDU) was set up by the Government of the United Kingdom's (UK) Department for Business, Energy and Industrial Strategy (BEIS) to create a national version of London's DEPDU programme for district heating. The national unit has a significant team, many of whom are ex-industry specialists with technical knowledge and prior project experience. The HNDU's support included:

- Project selection through applications for project development funding: regional representatives supported cities and other local government units to apply for project development support.
- Project development technical assistance: the local authority procured specialist project development support from external consultants, raising the capability and built capacity in the consulting sector. However, it also meant different consultants often completed different stages of work on the same project, resulting in inconsistency and loss of momentum compared to DEPDU.
- Project procurement: specialist procurement support was also provided by HNDU staff directly and specialist external consultants.
- Capacity building: HNDU staff issued a wide variety of guidance, along with training and stakeholder engagement that undoubtedly resulted in a significantly increased understanding of the specialist issues around district heating.⁶³
- Project finance: HNDU set up HNIP. This programme was managed by a private sector fund manager, supported by technical, commercial and legal sub-consultants. The programme successfully allocated over GPD\$100m of grants and loans to projects across the United Kingdom, developing the country's district heating market.⁵⁰ Following the success of HNIP, the GPD\$270m Green Heat Network Fund (GHNF) was introduced in 2021 to provide grant funding to low carbon district heating projects.⁵¹

4.3.2 European Energy Efficiency Fund

The European Investment Bank set up the European Energy Efficiency Fund (EEEF) to provide funding for a wide variety of public sector decarbonisation projects in European Union member states, with a focus on city projects. Around EUR\$130m of capital was committed to projects, with a target size of over EUR\$350m. A private fund manager administers the fund and provides:

- Project finance: the programme's main aim is to fund a broad range of aggregated initiatives across a city. Direct investments are between EUR\$5m and EUR\$25m, may include debt or equity instruments, and fall into three categories: energy saving and energy efficiency, renewable energy, and clean urban transport. Example investments include a biomass plant in the City of Orléans, France, and an upgrade of a hospital's heating and cooling systems in Bologna, Italy. The fund also invests in financial institutions that invest in projects.
- Technical assistance: the fund had EUR\$5m of technical assistance support. Initially, this was not deployed but was later found necessary to mobilise specialist technical and commercial project development to get projects suitable for finance.⁵²

4.3.3 Global Climate Partnership Fund

The German state bank KfW set up the Global Climate Partnership Fund (GCPF) in 2009 to provide funding for a wide variety of decarbonisation projects in developing countries worldwide. The current total size of the fund is USD\$547m. The fund was administered by a private fund manager and provides:

- Project finance: this is the programme’s primary aim and typically provides funding to local financial institutions (retail banks) to on-lend to projects. The great value of this was that it could provide finance to small projects, sometimes just a few hundred dollars, by using retail banks’ in-house capability.
- Some technical assistance: given the aim of small-scale project investment, technical assistance was provided via specialist software to retail banking clerks, who would use a simple set of questions to determine if a project was eligible. Due diligence of the effectiveness of these loans, given their size, was provided on a sampling basis (typically five per cent of projects and five per cent of funding).⁵³

4.3.4 Green Climate Fund (GCF)

The Green Climate Fund (GCF) was established in 2010 to fund climate change mitigation and adaptation projects in developing countries. As of 2020, the fund has received a total funding pledge of USD\$10.3bn from 49 national and regional governments. The fund is obliged to invest 50 per cent in mitigation projects and 50 per cent in adaptation projects, with developing countries given ownership of GCF implementation in their country.⁵⁴

- Project finance: GCF aims to leverage private investment at scale by providing financial instruments such as equity, grants, and loans. GCF also invest in innovative new technologies and business models to expedite climate action innovation. For example, GCF supports Acumen’s USD\$110m KawiSafi Ventures fund with USD\$20m equity and USD\$5m grant support. This fund aims to provide development funding for start-up companies investing in distributed off-grid renewable energy projects in East Africa.⁵⁵

- Capacity building/technical support: GCF support developing country governments with integrating of climate adaptation measures into their nationally determined contributions (NDCs). A readiness programme provides technical and financial support for states governments to develop their capacity to utilise and take ownership of GCF implementation in their country.⁵⁴

4.3.5 EBRD Green Cities Programme

The EUR\$3bn European Bank for Reconstruction and Development (EBRD) Green Cities Programme supports municipal infrastructure investment across energy, water, waste, transport sectors and green space and nature-based solutions. As a development bank committed to aligning its investment with the Paris Agreement, DRE systems that support the decarbonisation of energy in buildings represent a key investment category under the programme.⁵⁶

- Project identification/development/finance: EBRD Green Cities Programme combines project identification support (through green city action plans) from a variety of donor funds with additional project development funding and project financing from EBRD’s resources and grant and lending capital from the Green Climate Fund.⁵⁷
- Technical assistance/capacity building: aside from the development of green city action plans (GCAPs) and investment in sustainable infrastructure, the final key component of the programme is to provide technical expertise to cities and their stakeholders to build the capacity needed to develop and implement the actions identified in their GCAP.⁵⁶

4.3.6 Federal Energy Management Program (FEMP)

The Federal Energy Management Program (FEMP) supports federal agencies in The United States of America (US) to comply with energy management standards, leveraging private funding and implementing projects to reduce energy and water consumption.⁵⁹

FEMP's Distributed Energy Program additionally aims to support federal agencies in implementing on-site renewable energy and energy storage solutions.⁵⁸ The federal government represents the single largest energy consumer in the US.⁵⁹

- Project development/technical assistance: procurement and technical expertise are provided to federal agencies for performance contracts, such as energy savings performance contracts (ESPCs) and distributed renewable energy projects. Under the Distributed Energy Program, further technical support is provided for the development of DRE projects, including project screening, feasibility analysis and development of procurement documentation.
- Capacity building: a key aim of the FEMP is to build the capabilities of federal agencies through the provision of the information, guidance and tools needed to achieve their energy reduction goals. Federal agencies are also provided accredited training across various subjects.
- Project finance: FEMP leverages private-sector financial investments with no initial capital cost by using energy savings performance contracts (ESPCs) and utility energy service contracts (UESCs). This involves a private company financing the upfront costs, with repayment from the federal agency through the resultant cost savings.^{58 59}

4.4 City capital expenditure funding

4.4.1 London Energy Efficiency Fund and Mayor's Energy Efficiency Fund

The London Energy Efficiency Fund (LEEF) and its successor, the Mayors Energy Efficiency Fund (MEEF), were established by the Greater London Authority (GLA) to provide project finance to projects coming out of the DEPDU, RE:FIT and RE:NEW programmes.

- Project finance: the fund was set up using the European Commission (EC) JESSICA fund, on the understanding that it would provide limited returns to the city and the EC. Both funds were run by a private investment fund, Amber Infrastructure. Given the existence of project development programmes in London, it could finance projects developed by others; however, it also needed to undertake separate project development. This was perhaps more of a structural issue in that the project development programmes had no formal link (and were managed by different teams within the GLA).
- Technical support: although the project development programmes in London should have provided technical support, the fund manager had to retain external technical support to help develop some projects and screen criteria for eligibility.

4.4.2 Sustainability incentives scheme

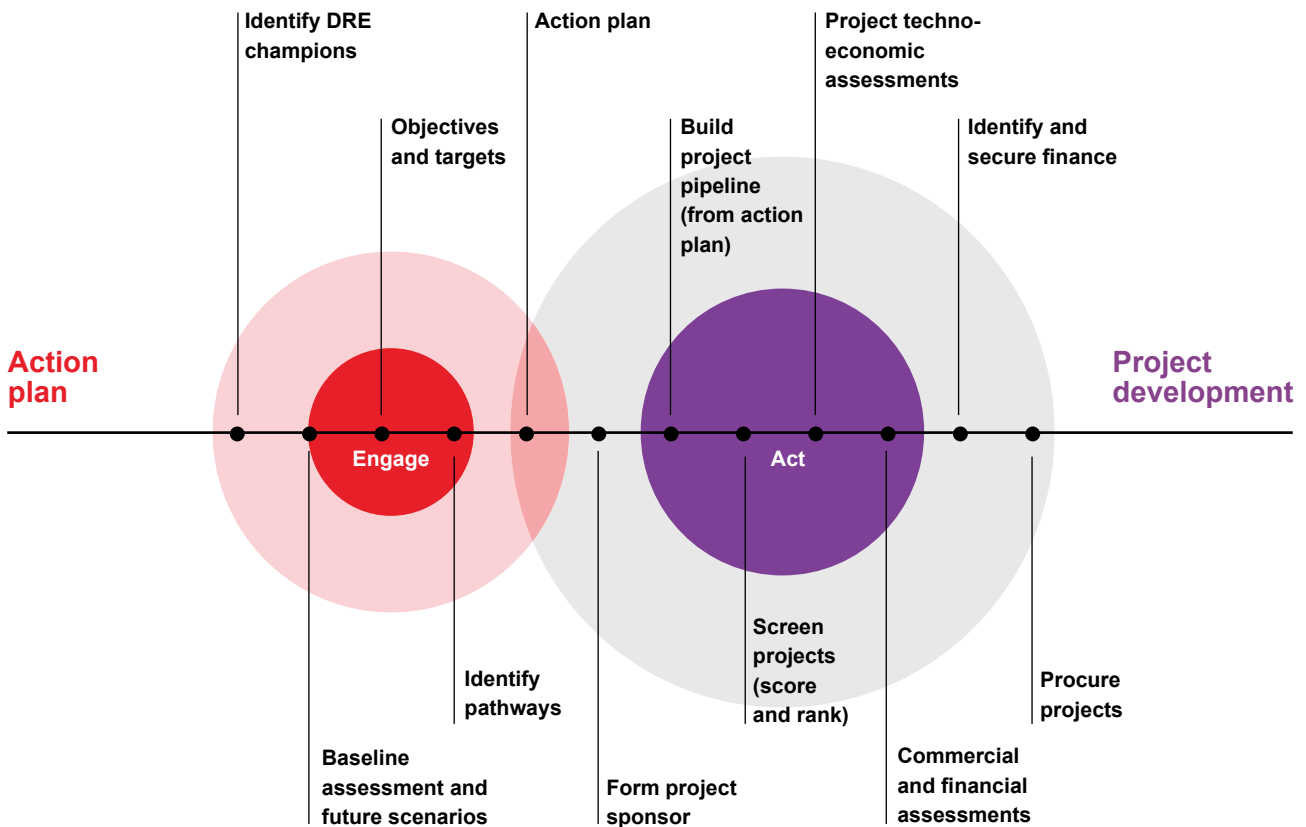
The City of Adelaide established the Sustainability Incentives Scheme in Australia to provide financial support for commercial and residential renewable energy projects within the city.

- Project finance: the scheme offers rebates for various DRE projects. Solar PV and electric vehicle charging facilities are supported across residential and commercial buildings, with rebates up to USD\$5,000 for each. Additionally, rebates of up to USD\$20,000 are available for shared solar PV systems that serve multiple spaces for commercial buildings and apartments.⁶⁰

5. Developing your city DRE programme

The previous examples have demonstrated that concerted action is needed to achieve a set of DRE, the culmination being a sustainable project development programme that assesses potential opportunities and develops them into investable projects.

A range of measures are necessary to drive DRE project development and delivery



Through our own experience and analysis of a variety of DRE development programmes around the world, we have identified the key ingredients of a successful DRE programme. Our two-phase, 12-point plan of action, shown in the figure above, provides a template for each city to adopt and

customise to their own local circumstance. For each city typology, different elements may be more important than for others; and whether each element is led or delivered by the city depends on the context and project conditions.

5.1 Phase 1: Engage

Engaging your city, stakeholders and community in DRE is essential to building and sustaining political and community support for DRE. The most successful DRE programmes tend to occur where the following are achieved:

- Identify DRE champions: secure leadership commitment and establish a core team or individual with a mandate for DRE delivery.
- Baseline assessment and future scenarios: assess your current energy demand and renewable energy supply resources and undertake scenario planning to evaluate future opportunities and scenarios, by identifying desirable and plausible end states.
- Target setting: using plausible shortlisted scenarios, set challenging targets for the rollout of DRE, both internally for the city institutions as well as for the city as a whole. This requires considerable engagement with both leadership within the city, civil servants who will have to deliver on these targets, and the wider community (and electorate) who will judge these targets – it is important that a majority can sign up to them.
- Identify pathways: having identified plausible scenarios to achieve the challenging targets, developing implementation pathways is important. In some cases this might mean the delivery of infrastructure that in the short or medium term is commercially challenging, but those that have been able to focus on the end goal have often been able to overcome such issues.
- Action planning: once a pathway to the end goal has been identified, a concrete set of actions, set out in policy or legislation (e.g. planning policy, building regulation, minimum energy efficiency standards), has proved to create a pathway that is less easy to get diverted from by political whim or short-termism. This may also include early identification of a pipeline of projects.
- Project sponsor: as the last part of the engage phase, it has proven vitally important to identify a project/programme sponsor or sponsors whose full-time role is to follow through on the agreed action plan. While leadership support is vital, it is city programmes that have identified civil servants that are employed and have a clear passion for the full-time delivery of the DRE action plan – without them, many programmes falter.

5.2 Phase 2: Act

- Many cities have stalled at the engage phase, hoping that private finance would come in and fund their pipeline of ideas. However, a gap remains to be filled. As we have seen, private finance is often unable to undertake project development activities given the risks associated with a pipeline that may not reveal many investable projects.
- Many cities have found a programme to be the best way to deliver DRE projects at scale. Although many cities may have undertaken some of these, the most successful DRE programmes tend to occur when there are undertaken consistently.
- Build a project pipeline: a pipeline of projects often starts from the action plan or even the baselining process identified above. Building this pipeline often requires building capacity or procuring capacity to assess this pipeline. To make a DRE programme self-sustaining and ensure the widest range of projects are identified at lowest cost, it is also important to empower project owners to come forward, often with the offer to support to develop their project should it pass the screening process.
- Project screening: a pipeline of projects often contains every opportunity, hope and dream, and requires quick and efficient screening to ensure projects meet the requirements set out in the target setting stage.
- High level assessment: a high-level techno-economic assessments (that assesses payback period or high-level project IRR rather than down to commercial structures or finance solutions) are needed to further screen projects. Many cities have found themselves bogged down by projects that a particular stakeholder wants to hold onto, but successful programmes have been brave and ‘failed fast’ in order to move forward.
- Commercial and financial assessment: if projects pass the high-level assessment, it may be necessary to undertake a more detailed commercial and financial assessment, particularly for complex projects such as renewable energy combined with energy storage or district heating and cooling.

- Identify and secure finance: even once commercial and financial viability has been assessed, city programmes often identify socially beneficial projects that would not get 100 per cent private finance. It has often proven necessary to help projects identify finance sources for viable DRE projects and assist projects in obtaining finance. In other cases, cities have needed to set up dedicated finance or even grant funding to make projects viable.
- Procure projects: finally, helping to create innovative commercial structures and ensure successful procurement, many cities have found they need to provide programmes that provide procurement support by creating supply frameworks, undertaking market testing and or providing standardised procurement documents (e.g. tender documents, contract documents, tender scoring templates etc.)

5.3 Programme timeline

Initiating DRE rollout, from concept to delivery, including building capacity, setting targets, identifying a project sponsor, and creating a self-sustaining programme for delivery, can take many years. Complex DRE, such as district heating or cooling, take many years. Simpler DRE programmes like rooftop solar can be launched relatively quickly and then build momentum from a foundation of early and well-publicised successes. In the United Kingdom, it took around ten years from the first decentralised energy opportunity mapping activity in London, to create a national heat network delivery programme. This paper may help shorten that timeline, but it is important to plan around a realistic timeline, and to keep your eyes on the long-term goal.

5.4 Funding your programme

The gap between a wish list of opportunities and financeable projects is the leverage ratio that can be achieved and the risk of identifying only limited projects. There are funds available for project development, for example, the ELENA initiative set up by the EIB and EC under the Horizon 2020 programme. Many of these require a leverage ratio; for example, the DEPDU programme in London had a 25:1 requirement, achieved only after the programme's extension to allow sufficient projects to come forward.

While the DEPDU programme focussed on the larger scale DRE investments (USD\$5m plus), it also took more effort to get projects through the project development stages. Other DRE programmes might focus on much smaller investments like rooftop solar, and the programmes will have to consider the leverage ratio. Under GCPF, project finance was provided at such a small scale that the detailed assessment found only five per cent of projects were viable.

6. Conclusions

The climate crisis and pandemic have threatened progress in meeting the United Nation's Sustainable Development Goals and reducing poverty in cities. They have also revealed how fragile and ill-equipped traditional electricity networks are.

DRE can help cities build a more sustainable and equitable future by providing critical last-mile services to vulnerable communities/urban poor.

This paper evaluates the barriers to scaling DRE and finds that some of the most critical challenges include strong leadership from the city and access to finance.

Cities have many levers at their disposal to advance DRE programmes, but they cannot implement them without support from a constellation of actors, including the philanthropic and development community (to help de-risk and bridge the early-stage project preparation gap) and investors (to fund projects).

By providing practical guidance on how to approach DRE programmes, we hope that cities are empowered/encouraged to take action that will attract the critical investment they need.



References

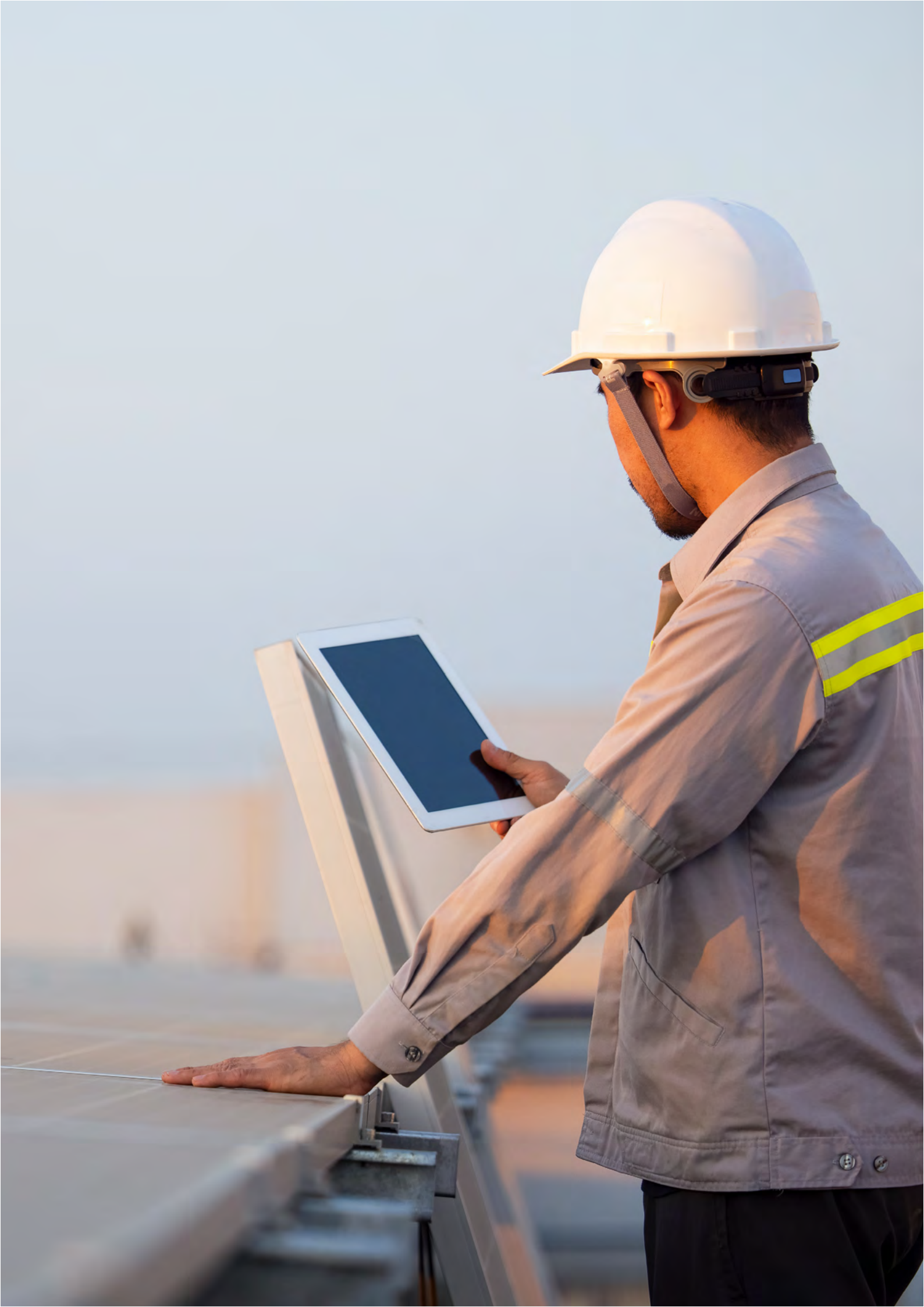
- 1 IEA (2021). Empowering Cities for a Net Zero Future: Unlocking resilient, smart, sustainable urban energy systems. International Energy Agency. [Available online](#). Accessed 10 October 2021.
- 2 GCoM (2021). Global Covenant of Mayors for Climate and Energy Home Page Dashboard. [Available online](#). Accessed 10 October 2021.
- 3 IRENA (2020). The post-COVID recovery: An agenda for resilience, development, and equality. International Renewable Energy Agency. [Available online](#). Accessed 11 October 2021.
- 4 BNEF (2021). Bloomberg New Energy Finance - New Energy Outlook 2021.
- 5 Business and Sustainable Development Commission (2016). Valuing the SDG Prize in Cities.
- 6 United Nations (2019). The future of Asian & Pacific cities. Transformative pathways towards sustainable urban development.
- 7 United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations
- 8 World Bank (2018). Poverty and Shared Prosperity 2018: Piecing Together the Poverty Puzzle. Washington, DC: World Bank.
- 9 United Nations (2015). Millennium Development Goals Indicators. Indicator 7.10 Proportion of Urban Population Living in Slums. [Available online](#). Accessed 25 November 2021.
- 10 Asian Development Bank (2014). Urban poverty in Asia.
- 11 World Bank (2021). World Bank Global Electrification Database from “Tracking SDG 7: The Energy Progress Report” led jointly by the custodian agencies: the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the United Nations Statistics Division (UNSD), the World Bank and the World Health Organization (WHO). [Available online](#). Accessed 24 November 2021.
- 12 Westphal et al. (2017). “Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment.” Working Paper. Washington, DC: World Resources Institute.
- 13 Mani et al. (2018). South Asia’s Hotspots: Impacts of Temperature and Precipitation Changes on Living Standards. South Asia Development Matters. Washington, DC: World Bank. [Available online](#). Accessed 24 November 2021.
- 14 Merco Press (2013). Heat wave in Argentina collapses power grid: thousands with no energy or water. Article. [Available online](#). Accessed 24 November 2021.
- 15 Arup & Siemens (2016). Distributed Energy Systems: Flexible and Efficient Power for the New Energy Era. [Available online](#). Accessed 24 November 2021.
- 16 The Rockefeller Foundation (2021). Transforming a Billion Lives: The Job Creation Potential from a Green Power Transition in the Energy Poor World. [Available online](#). Accessed 24 November.
- 17 IEA (2021). Net Zero by 2050. IEA, Paris. [Available online](#). Accessed 24 November 2021.
- 18 Kitwa, Daniel (2020). Donors: where’s your money promised for minigrids? Article. [Available online](#). Accessed 25 November 2021.
- 19 Arup & Vivid Economics (2015). Opportunities to enhance electricity network efficiency. [Available online](#). Accessed 24 November 2021.
- 20 EIB (2020). ELENA – Frequently Asked Questions. [Available online](#). Accessed 24 November 2021.
- 21 InfraCo Africa (202Q1). InfraCo Africa website. [Available online](#). Accessed 24 November 2021.
- 22 Africa50 (2021). Investing for Growth – Investment Vehicles. Webpage. [Available online](#). Accessed 24 November 2021.

- 23 Belgian Ministry of Climate, Environment, Sustainable Development & Green Deal and the Africa EU Renewable Energy Cooperation Programme (2017). Public Sector Support for Early-Stage Renewable Energy Project Development in sub-Saharan Africa – Roundtable Report. [Available online](#). Accessed 24 November 2021.
- 24 C40 Cities (2021). C40 Cities Finance Facility website. [Available online](#). Accessed 24 November 2021.
- 25 UK Department for Business, Energy & Industrial Strategy (2018). HNIP – Delivering Financial Support for Heat Networks. [Available online](#). Accessed 24 November 2021.
- 26 Victoria State Government (2020). Renewable Energy – Community Energy. Webpage. [Available online](#). Accessed 24 November 2021.
- 27 Rockefeller Foundation (2021). “Meridiam, The Rockefeller Foundation and the Private Infrastructure Development Group (PIDG) Announce the Closing of the Catalytic Capital Fund,” Rockefellerfoundation.com, 16 September 2021. [Available online](#). Accessed 25 November 2021.
- 28 EIB (2021). “The Urban Resilience Fund (TURF) B LCFP Environmental and Social Data Sheet.” European Investment Bank. [Available online](#). Accessed 25 November 2021.
- 29 Database of State Incentives for Renewables & Efficiency (2019). NY-Sun PV Incentive Program Residential, Low-Income, and Small Business. Webpage. [Available online](#). Accessed 24 November 2021.
- 30 Greater London Authority (2021). London Community Energy Fund Prospectus. [Available online](#). Accessed 24 November 2021.
- 31 Australian Government Clean Energy Regulator (2019). Small-scale systems eligible for certificates. Webpage. [Available online](#). Accessed 24 November 2021.
- 32 Hivos (2019). A lobby & advocacy approach to promote decentralised renewable energy solutions to achieve universal energy access. [Available online](#). Accessed 24 November 2021.
- 33 C40 Cities (2011). Case Study – Barcelona’s Solar Hot Water Ordinance. Webpage. Accessed 11 October 2021.
- 34 City & County of San Francisco Planning Department (2017). San Francisco Better Roofs. Webpage. [Available online](#). Accessed 24 November 2021.
- 35 Los Angeles County Department of Regional Planning (2017). Renewable Energy Overview. Webpage. [Available online](#). Accessed 24 November 2021.
- 36 California Energy Commission (2019). Building Energy Efficiency Standards for Residential and Non-residential Buildings for the 2019 Building Efficiency Standards. [Available online](#). Accessed 24 November.
- 37 Solar Power Europe (2021). City of Berlin plans to install solar on all new buildings. Webpage. [Available online](#). Accessed 24 November 2021.
- 38 City of Amsterdam (2020). Policy: Phasing out Natural Gas. Webpage. [Available online](#). Accessed 24 November 2021.
- 39 Islington Council (2021). Bunhill Heat and Power Network. Webpage. [Available online](#). Accessed 24 November 2021.
- 40 Zenobe Energy (2021). Case Studies – Abellio London Bus Depot. Webpage. [Available online](#). Accessed 24 November 2021.
- 41 IRENA & ICLEI (2018). Mitigating Climate Change Through Renewable Energy Development – Cape Town, South Africa. [Available online](#). Accessed 24 November 2021.
- 42 Sustainable Energy Africa (2017). Sustainable energy solutions for South African local government: a practical guide. [Available online](#). Accessed 24 November 2021.

- 43 REN21 (2021). Cities 2021 – Dakar. Webpage. [Available online](#). Accessed 24 November 2021.
- 44 Singapore Public Utilities Board (2020). PUB appoints Sembcorp to build Singapore’s largest floating solar farm on Tengah Reservoir . Press release. [Available online](#). Accessed 25 November 2021.
- 45 City of Cape Town (2016). Cape Town Energy 2040 Vision and Associated Energy and Carbon Targets. [Available online](#). Accessed 24 November 2021.
- 46 REN21 (2021). Cities 2021 – Cape Town. Webpage. [Available online](#). Accessed 24 November 2021.
- 47 City of Cape Town (2017). The facts about the City’s electricity tariffs. Webpage. [Available online](#). Accessed 24 November 2021.
- 48 South African Government (2020). Municipal procurement of IPPs critical to energy-led economic recovery. Webpage. [Available online](#). Accessed 24 November 2021.
- 49 Greater London Authority (2021). RE:NEW Webpage. [Available online](#). Accessed 25 November 2021.
- 50 Triple Point Heat Networks Investment Management (2021). Funded Projects. Webpage. [Available online](#). Accessed 24 November 2021.
- 51 UK Department for Business, Energy & Industrial Strategy (2021). Green Heat Network Fund (GHNF) Transition Scheme. Webpage. [Available online](#). Accessed 24 November 2021.
- 52 EEEF (2021). EEEF Website. [Available online](#). Accessed 24 November 2021.
- 53 Global Climate Partnership Fund (2021). GCPF Website. [Available online](#). Accessed 24 November 2021.
- 54 Green Climate Fund (2021). Green Climate Fund Website. [Available online](#). Accessed 24 November 2021.
- 55 Green Climate Fund (2021). GCF: Financing Climate Action. [Available online](#). Accessed 24 November 2021.
- 56 European Bank for Reconstruction and Development (2021). EBRD Green Cities Website. [Available online](#). Accessed 24 November 2021.
- 57 Green Climate Fund (2021). Projects and Programmes: FP086 – Green Cities Facility. Webpage. [Available online](#). Accessed November 24 2021.
- 58 US Department of Energy (2018) FEMP’s Distributed Energy Program. Webpage. [Available online](#). Accessed 24 November 2021.
- 59 US Department of Energy (2019). Federal Energy Management Program. [Available online](#). Accessed 24 November 2021.
- 60 City of Adelaide (2021). Sustainability Incentives Scheme. Webpage. [Available online](#). Accessed 24 November 2021.
- 61 WWF (2012). Merton London Climate Rule. Webpage. [Available online](#). Accessed 24 November 2021.
- 62 Wireless Infrastructure Group (2020). City of Aberdeen paves the way for 5G. Webpage. [Available online](#). Accessed 24 November 2021.
- 63 UK Department for Business Energy & Industrial Strategy (2021). Heat Networks Delivery Unit. Webpage. [Available online](#). Accessed 24 November 2021.

Acknowledgements

Lead Authors: Thomas Briault (Arup), Stephen Cook (Arup), Dana Omran (R-Cities).
Research team: Daniel Gallagher (Arup) and Max Sarch Thomas (Arup).





**CITIES
NETWORK**

ARUP

Contact:

Thomas Briault

Energy Advisory Leader, Southeast Asia, Arup
e: thomas.briault@arup.com

Stephen Cook

Associate Director, Urban Energy, Arup
e: stephen.cook@arup.com

Neil Walmsley

Director, Advisory & Planning, Arup
e: neil.walmsley@arup.com

For over 75 years, Arup has been recognised for its vision, talent and tenacity.

Dedicated to sustainable development, the firm is a collective of 16,000 designers, advisors and experts working across 140 countries. Founded to be both humane and excellent, we collaborate with our clients and partners using imagination, technology and rigour to shape a better world.

www.arup.com

Dana Omran

Global Director Strategy & Operations,
Regional Director Africa, Resilient Cities Network
e: domran@resilientcitiesnetwork.org

Lauren Sorkin

Executive Director, Resilient Cities Network
e: lsorkin@resilientcitiesnetwork.org

Resilient Cities Network is the world's leading urban resilience network. Present in more than 100 cities, 40 countries, and 6 continents, R-Cities is a global city-led nonprofit organisation that brings together knowledge, practice, partnerships, and funding to empower cities to build a safe, equitable, and sustainable future for all.

www.resilientcitiesnetwork.org