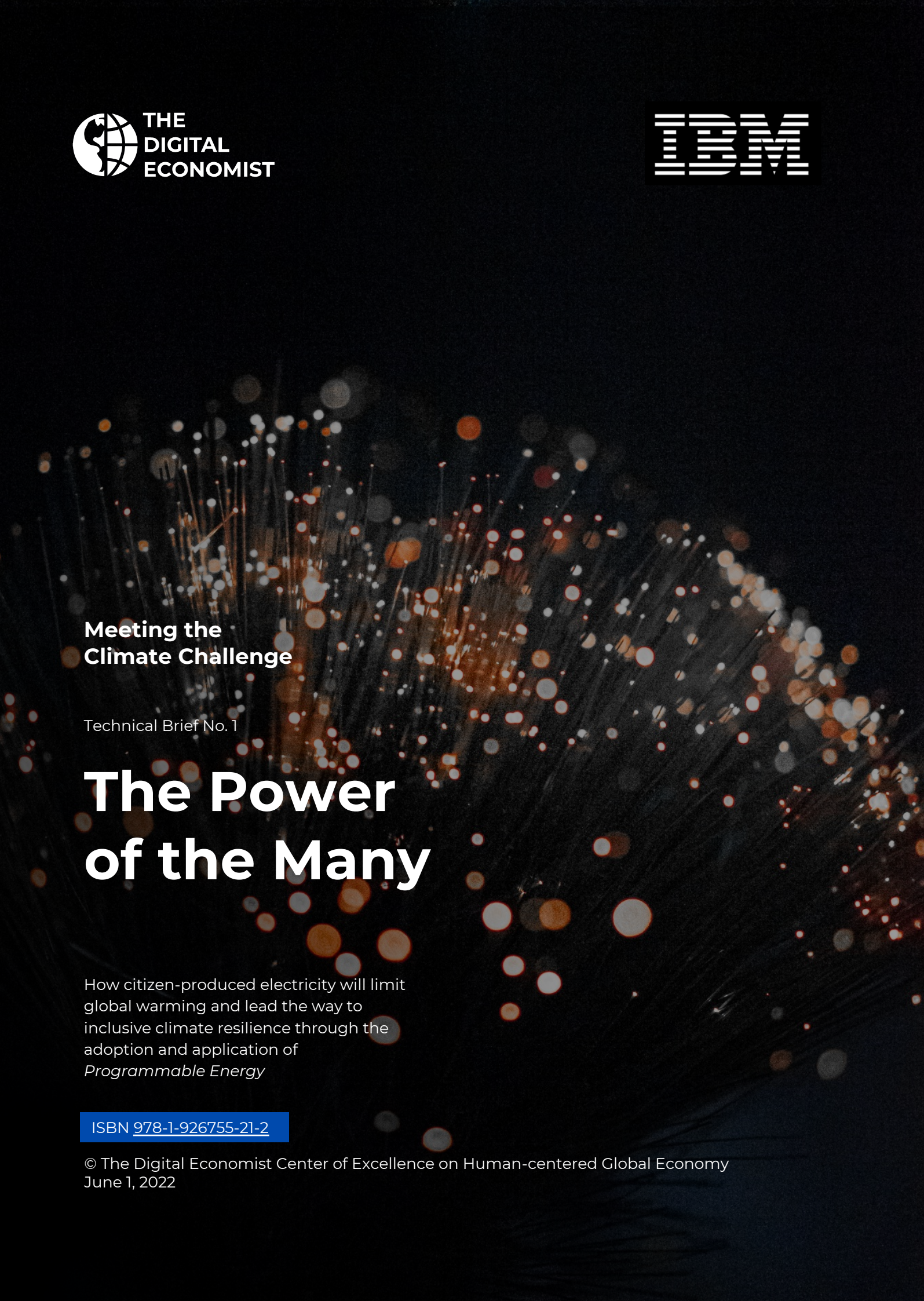

THE DIGITAL ECONOMIST

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Meeting the Climate Challenge

Technical Brief No. 1

The Power of the Many

How citizen-produced electricity will limit global warming and lead the way to inclusive climate resilience through the adoption and application of *Programmable Energy*

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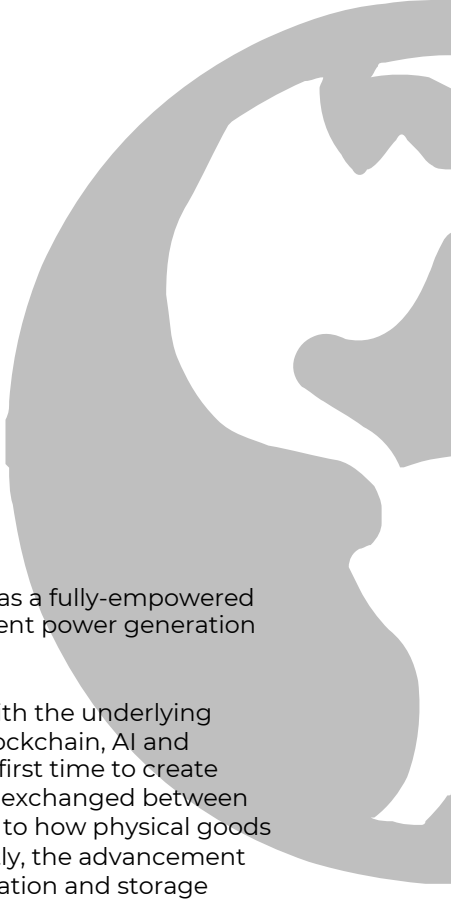
Executive Summary



As the climate emergency intensifies, and good tech empowers, everyday citizens rightly wonder how they can be part of the solution in adaptation and mitigation, and impelling inclusive climate resilience that will limit planetary warming to 1.5 degrees from pre-industrial norms. In this technical brief, we explore how *Programmable Energy*, a concept developed by one of this paper's authors, Jos Röling, will play a significant role in the energy transition and inclusive climate resilience. Programmable Energy consisting of electricity generated by individual citizens, with its value assured by tokenization and protected by blockchain, can be convened and converged to advance the sustainable generation of renewable electricity, while assigning value to sustainable behaviors.

Indeed, recent military action has provoked a significant price surge in fossil fuels even while disrupting global supply chains and the whole industrial complex that depends on fossil fuels. This is compounding challenges already present as a consequence of the pandemic. The global economy is in flux, as the transition to more sustainable energy production gathers momentum at a pace unforeseen even five years ago.

A key part of the accelerated transition is the rapid growth in distributed generation of electricity, principally through photovoltaic and geothermal installations. The widespread adoption of autonomous power generation by citizens who both produce and consume electricity (the prosumer) can be a significant asset in building climate resilience. Power grids were built and designed to link and serve large generators of electricity, leaving inherent systemic risk and increasingly so with mounting climate disruptions.

IBM and its partners have already begun to posit blockchain as a means of enabling prosumers to actively participate in generating and trading electricity. In this paper, The Digital Economist's Center of Excellence on Human-centered Digital Economy and IBM Consulting's Global Center of Excellence on Energy & Resources offer an actionable overview of use cases and technologies which offer the potential to incorporate the prosumer as a fully-empowered participant in climate-resilient power generation and distribution.

Token technology, along with the underlying smart technologies (IoT, Blockchain, AI and analytics), allows us for the first time to create digital assets which can be exchanged between market participants similar to how physical goods are exchanged. Concurrently, the advancement of renewable energy generation and storage technologies allows us to complement the traditional capacities of the grid, including developing independent micro-grid systems and a variety of energy aggregator business models. These new business models promote the economics of development for renewable energy developers, increase climate resiliency of an aging grid and reduce our collective carbon footprint.

Fundamental to leveraging tokens for the energy market is what L. Molkema, Program manager sector strategy at Enexis Customer and Markets, describes as a new way to package energy. Different from the grid's physical continuous flow of energy, thinking of energy as a package creates the potential for market participants to transfer and trade kWh in the market. Jos Röling, further defines this as Programmable Energy as blockchain offers us the ability to slate its use for new market models.

This energy token offers the ability for trading energy either ex ante for trading in the spot, futures or balancing markets or post ante between counterparties trading excess generation with demand. This means the current way of selling energy can shift from the traditional model of power purchase agreements to bundling energy, either by consumption (ex. community renewable energy assets), flexibility or appliances (ex. buy hot water as a service). Energy tokens also support business models and use cases to track sustainability and offer green signals, achieve net zero targets through issue of carbon certificates and achieve efficient allocation, clearing and settlement of energy units. It is this transition that allows customers to draw a blueprint to becoming an energy responsible party.

In this paper, we recommend that leaders and innovators in the energy marketplace use platform agnostic token taxonomies which will allow the digital framework to be outcome and impact based rather than platform specific. Gradual introduction of these tokenized models should accelerate the energy transition, ensure affordability, enable new funding models and stabilize energy supply.

Over the last few years, we have seen a proliferation of innovative use cases leveraging different blockchain technologies to demonstrate the economics of energy token models. The energy use cases are well past proof of concept, beginning to demonstrate potential scalability. For example, Equigy's crowd balancing platform aims to leverage consumer invested batteries as a resource for grid balancing and strives to become a marketplace for TSOs and DSOs in Europe. Solstroem enables off-grid solar projects to access the carbon market thereby supporting the roll-out of solar energy to the less privileged in off-grid rural environments with additional benefits of reducing deforestation activities, and access to mobile and banking services. In Africa, Irene Energy has successfully deployed a multi-cloud deployment strategy to accelerate access to electricity and the back office infrastructure for electricity roaming services. Power Transition in the UK is an innovative microgrid management platform that enables peer-to-peer energy trading and a microgrid management system that will begin with granting consumer homes the ability to establish a local grid that can operate independently, and create a marketplace between residences during times of excess or power outage. Restart Energy Democracy (RED), an independent EU electricity and gas supply company, operates a decentralized energy supply platform to reward green energy certificates to consumers of renewable energy.

Blockchain is also enabling new financial models for local renewable energy from carbon credits, peer to peer and the potential for aggregation into investing mechanisms and green bonds. For example, The Green Digital Finance Alliance's report on Green Bonds and debt products observes that blockchain technologies can enable the aggregation of smaller scale renewable energy projects into investable traceable financial instruments with 10x the efficiencies of traditional mechanisms. These findings were expanded in the Bank of International Settlement's Project Genesis report and pilots. In addition, organizations such as Evercity.io and Blockchain Triangle are actively building platforms automating issuance, management and impact monitoring including aggregated small scale renewable energy projects.

Examples of successful supporting initiatives abound, but enabling the token economy in the power market will not happen overnight. Recently, IBM participated with 2Tokens on a roundtable to address the current challenges related to tokenizing energy. Participants arrived at preliminary recommendations around:

1. standardization of the token taxonomy and investment frameworks around smart grids, packaged energy, carbon markets and financing models with 2Tokens to follow up and deliver demonstration projects;

2. coordination across regulators overseeing investment, utilities, energy and tax policies to effectively remove barriers to adoption and;

3. construction of decentralized marketplaces for energy.

While the use cases elaborated on in this technical briefing reflect the successful tokenization of energy across a variety of business models, there remains much work to be done to leverage the prosumer as a core stakeholder of the new energy paradigm.

Some of our key recommendations:

1. Work toward the barrier-free access to new models of trading transactions in power grids for electricity produced by citizens who are also consumers (the prosumer).

2. Align governance, regulation, safety standards, and access rules on common grounds and common purpose.

3. Develop common international standards relating to any and all aspects of consumer-generated electricity, with the aim of reducing barriers and democratizing grid access.

4. Apply tokenization and tokenomics to optimize economic value for the prosumer, taking full advantage of all the possibilities of distributed ledger technology.

5. Use best practices from known and established use cases to convene the alignment and development of international standards and norms.

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