

Decentralized autonomous electric microgrids (DAEMs) summary. These grids pose opportunities for underprivileged communities that go well beyond the utility of replacing existing fossil fuel generators with a clean source of energy. As a blockchain-and smart contract-governed system for managing usage rights, one that both internal users and external investor/lenders can mutually trust, a DAEM opens the door to affordable financing in situations where the parties to a loan would otherwise be reluctant to enter into an agreement at an affordable rate. Access to more cost-effective funds should in turn empower and incentivize local households and businesses to invest in the modular expansion of the community's energy infrastructure in order to pursue local economic opportunities. A DAEM is thus best thought of as a platform for economic development and community empowerment.

The problem. Community-owned solar microgrids, although widely viewed as a potentially powerful driver of sustainable development for underserved regions, have not been widely deployed in low-income communities. Those that are installed are often subsidized by governments or NGOs, which inherently limits the potential scale of deployment. Most that exist are owned by outside investors or charitable entities. Put simply, the up-front capital costs are too high for private individuals and small local businesses to build and own these systems in low-income communities, largely due to a paucity of reliable financing. The problem is not that borrowers don't have assets that they're willing to pledge as collateral, it's that investors don't believe they can effectively secure those assets as protection against default. As such, interest rates on loans to such communities are set to prohibitively high levels.

Proposed solution. Technologies such as distributed ledger technology, digital currencies, smart contracts, smart power meters and kill switches, can be combined to create a unique financial and ownership structure that could overcome the uncertainty lenders face in financing solar microgrids. This approach poses an opportunity to reduce default risks for lenders and the cost of borrowing for individuals within a target community. With this model, we hypothesize that both investors and borrowers should be able to confidently and automatically exercise their contractual rights via software that responds to reliable, tamper-proof transaction data, without recourse to traditional judicial process. Moreover, access to precise, digitally gathered measurements of electricity flows and of payments within and outside the grid, could provide a rich source of information with which to assign value to a new type of negotiable crypto security.

Working model. Our solution works to address the following challenges: 1)*Grid Administration.* A microgrid would be installed in a low-income community where the provision of more power poses opportunities for business development. The system would be composed of an array of PV panels optimally placed to maximize solar generation, transmission lines, smart meters, battery storage and other devices to generate and distribute power. 2)*Financing.* To enable local ownership of the microgrid, a for-profit lender – for example, a microfinance institution – would be invited to provide credit to the cooperative. This parent loan would effectively be backed by inflows of digital-currency payments to the cooperative, both from shareholders -- a portion of whose payments automatically go to repaying the loan -- and from external businesses and households, which would consume excess power produced by the grid. 3)*Security.* Along with a combination of digital currency payments and kill-switch technology, the system would use smart contracts to trustlessly manage user access to power. Under this model, a payment opens the user's access to power delivered from the microgrid's battery storage for a set amount of kilowatt hours, much like a prepaid cellphone card grants access to amount of airtime. If an extra payment isn't made to "top up" the access rights before it expires, power access would be cut.