

Land Battery

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Independent On-going Research & Proposal

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Preface

This document describes the independent on-going research and proposal entitled: Land Battery. This document will be regularly updated, including respective revision date at header and annotation of revised content through-out document.

Acknowledgments

This proposal, Land Battery, was initially conceived of by me during 2005 while performing independent research into human rights and industrial ecology; this was during my graduate architecture work at Rensselaer Polytechnic Institute and while performing sustainable building systems research and development with Materialab, which eventually became the Center for Architecture Science and Ecology. I wish to thank the Climate-Smart Agriculture Global Science Conference for accepting this proposal to its 5th gathering in 2019 under Sub-theme 5: Reshaping supply chains, food retail, marketing and procurement. As the ideation, research, and documentation of this proposal continues to be independently conducted, it is my hope to find interested collaborative partners to broaden this proposal's development and aid in realization of demonstration projects.

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I. Description

Land Battery is a proposal to 1) co-locate food and energy production systems and 2) locate such food-energy systems within urban building contexts, for broad and deep human benefit.

This is proposed as a global framework, not a one-off development, specific technology, nor discrete project; and, this is intended to improve both efficacy per unit of land area and energy as well as quality of life per person.

Food and energy are critical to human survival. Other human requirements, such as habitable space, natural environment, transportation, wildlife, communication, military force, currency, etc., exist in support of these two necessities – food and energy. Further, the provision of food and energy proposed herein tacitly includes water.

We are getting closer together – both physically and digitally. Population is continuing to grow, though at slower rates in some areas; with most of us moving to cities by all acknowledged populations studies. And, we are owning more and more communication devices.

Given varying current estimates and future projection of arable land, crop yields, and population growth, considered in context of varying energy sourcing and manufacture scenarios, including associated environmental life cycle requirements, there seems to be a need for improvement of overall food and energy yield per unit area of land area, as well as a need to compress production with consumption locations to put downward pressure on transportation.

Further, our usable land looks to be heavily constrained in coming decades by pressures of conservation, especially given frameworks such as 50% area for biological conservation.

Put simply, there just seems not to be enough productive terrestrial area as well as atmospheric green house gas uptake capacity available for each of our required life systems to be discretely deployed in a distant mono-cultural approach. The inefficiency of our traditional discrete mono-cultural arrangement of food and energy systems, as well as occupiable conditions, seems out of synch with projected population growth, even given high improvements in crop yield, maximum harness of arable land, and newest efficient building and transportation technologies.

As such, the concept depicted herein, Land Battery, addresses these broad interdisciplinary issues by proposing the developing of a framework for hybrid, mutually-reinforcing, co-located food-energy production systems including locating such integrated systems within our built environment / urban and peri-urban conditions; however, this proposal also seeks to identify 1) unique values presented by such hybrid system deployments, and 2) broad, deep societal changes and benefits endemic to such a co-systems.

This framework intends to identify synergistic configurations of food and energy production systems which, when co-located, effect improved mutually-reinforcing hybrid results beyond those which would be realized by individual deployments of like-scale food and energy production sites.

Co-locating such food-energy production systems tabula rasa could be assumed to produce beneficial synergies in community-building and operations-maintenance as many farm and hearth spaces typically do; however, when deployed in current context, turbulence seems reasonable due to disruptive impacts of change, as well as existing transportation inefficiency theoretically remaining constant due to distance from urban location of human consumers. As such, deployments and transitions sensitive to multivariate existent context conditions need to be evaluated to best ensure realistic efficient adoption as well as efficacy and durability.

In a most discrete physical deployment, Land Battery could be visualized simply as a local food producing site including self-sufficient on-site sustainable electricity-producing sources feeding on-site processes, possibly in an existing urban neighborhood. Various real-world technological arrangements could fit this deployment such as photovoltaic greenhouses or pole-mounted photovoltaic food forest either backfeeding a two-way electric meter or feeding a local microgrid, including a percentage of solar gain area for domestic water heating and on-site sewage processing via anaerobic digester (Living Machine), the residuals of which could be reused on-site for agricultural operations. This entire food-energy package being located within a distressed urban area containing non-performing lots – as an in-fill project.

In an expanded physical deployment, Land Battery could be visualized as a regional food producing site including self-contained sustainable electricity-producing sources feeding both on-site processes as well as regional legacy and/or new regulated electrical grids. This expanded sense of Land Battery can further be envisioned as a horizontal and vertical overlay network on existing urban and peri-urban built conditions. Deployment of this proposal at such a scale may best be understood within the theoretical framework of building ecologies.

Further, visualized less physically but nonetheless having physical implications, Land Battery could be understood as an alternative basis for exchange in its focus on the real flow and state change of energy. Food is energy at a certain time scale and physical vehicle. As well, property is also energy at a certain time scale and physical vehicle. So, energy at varying time scales and carried via various physical matrices can be understood as a non-abstract, non-fiat universally valuable medium for its extreme functional efficacy – dependent nearly entirely on its resistance and storage. Likewise, blockchain are digital decentralized energy system validating ledger units – energy unit tracking systems. So a Land Battery deployment, in its food-energy systems aspect, as it processes, stores, and circulates energy in its various forms, could be represented and tracked for exchange in blockchain.

Various public-private funding scenarios should be available to achieve a proposal such as this – a proposal which sees two basic human activities of food production and energy production carried out in an integrated, mutually-reinforcing manner with each other as well as the built environment – for deep and broad human benefit.

Further, such systems would best be deployed and operated globally in an equitable, distributed, resilient network. Such a system of systems responds to the pressure of climate challenges, land scarcity, population growth, and consumption trends with a positive proposal.

Land Battery and its implication of Positive Food-Energy-Water Systems (PFEWS) integrated into built environment would require an explicit set of design and performance protocols, ie. Building Codes.

PFEWS may also be understood simply as Food-Positive given the current context of already-established protocols for Energy-Positive, Carbon-Neutral, and Water-Neutral; food, being the next logical framework or protocol to be established. However, as synergetic co-locating of systems herein focused on, PFEWS should theoretically outperform Food-Positive.

While we push ourselves to meet current horizons of minimum building performance criteria conceived in the context of complying with glide paths to zero, we should look beyond those horizons toward frameworks / paradigms which see our building ecology as a “land battery” which actively balances positive energetic and resource flows for terrestrial biosphere regeneration well-within planetary and regional boundaries.

This Proposal functions at the building, planned unit, neighborhood, city, urban, peri-urban, and regional scales with leave-off points between traditional Building and Planning Disciplines.

Similar to Transit-Oriented Design (TOD), this proposal could be understood as Agriculture-Oriented Design (AOD).

As modern society does not espouse the building of cities without explicit agreed-upon planning frameworks, we should no longer build the world without a similar explicit and agreed-upon planning framework – better, an interconnected explicit global planning framework which cooperatively aligns regional and sub-regional planning frameworks.

Explicitly, the proposal functions at three scales:

- Planetary Frameworks – similar to current Planetary Boundaries research which seeks to develop safe global boundaries well-within associated worst-case tipping points, this proposal seeks to identify coordinated mapped planning of terrestrial building ecological activities which satisfied current and future needs for safe, just, and inspiring human life.
- Regional Ecologies Approaches – as regional zones have unique functional synergies outside of larger and smaller scales, positive-food-energy-water-systems shall be

assessed at this scale for focusing on issues such as regional water basins, peri-urban systems, road networks, and topographic weather systems.

- Urban Buildings Protocols— food-systems-positive and food-energy-building-systems shall be assessed including associated required building protocols for realization of such systems.

This Proposal sees the our various human silo-ed disciplines as getting more closely aligned for improved efficiency, such as the AEC community getting more closely aligned with the Agricultural (Food) Sector – given the work which must be done to meet food system climate change pressures, and given that AEC (buildings) is the 3rd largest contributor to global greenhouse gas emissions after Agriculture and Transportation.

This is a Proposal in-line with various leading-edge frameworks for the built environment such as UN SDG2 and the New Urban Agenda, International Code Council Glidpath to Zero, International Living Future Institute Living Building Challenge, Passive House Institute Zero Source Code.

This Proposal recognizes that buildings and building systems are already finance, material, and engineering intensive, and as such seeks to layer added capacity and return onto such building systems in the form of food production.

This Proposal is in part routed in a recognition that some urban conditions contain beyond-service-life utility infrastructure which is sometimes found in economically disadvantaged areas; and so proposes agriculture could be integrated into various urban existing fabrics as a means to counteract such infrastructural and economic problems.

This Proposal posits that we will never have perfect knowledge nor maintenance of our global carbon balance, and so seeks to set a framework / protocol / standard which is reasonably far beyond our current expectations in a manner which is inspiring to urban spaces – such as the growth of food.

This Proposal also acknowledges that growing food is good for childhood development as compared to childhood without exposure to the knowledge base and empowerment that growing food provides.

This proposal identifies a need for a collected volume chronicling completed projects of similar goal, including situating of such projects in agricultural, cultural, energetic, geographical, economic, and other germane contexts. This volume should enable better understanding of viability.

II. Research

A. Similar

- UN FAO Issue Paper: Energy Smart Food For People and Climate, 2011
 - <http://www.fao.org/3/a-i2454e.pdf>
- UN FAO Report: The Water-Food-Energy Nexus, 2014
 - <http://www.fao.org/3/a-bl496e.pdf>
- UN FAO Global Agro-Ecologic Zones
 - <http://www.fao.org/nr/gaez/applications/en/>
- UN FAO State of Land and Water Resources
 - <http://www.fao.org/nr/solaw/the-book/en/>
- US National Science Foundation INFEWS
 - <https://www.nsf.gov/pubs/2018/nsf18545/nsf18545.htm>
- American Society of Agronomy
 - <https://www.agronomy.org/science-policy/white-papers/browse/>
- World Agroforestry Centre Climate-Smart Landscapes
 - <https://www.asb.cgiar.org/climate-smart-landscapes/>
- International Institute of Applied Systems Analysis ISWEL
 - <https://www.iiasa.ac.at/web/home/research/iswel/ISWEL.html>
- Global Environment Facility
 - <https://www.thegef.org/publications>
- Anthropocene
 - <http://anthropocene.info/index.php>
- Future Earth
 - <https://futureearth.org/>
- Elementa Journal
 - <https://collections.elementascience.org/food-energy-water-systems>
- Metabolic
 - <https://www.weforum.org/agenda/2018/09/these-dutch-microgrid-communities-can-supply-90-of-their-energy-needs/>
 - <https://www.metabolic.nl/publications/side-systems/>

B. Agriculture

- CGIAR CCAFS, Working Paper No. 271, Transforming food systems under climate change: Local to global policy as a catalyst for change
 - "Policymakers will need to grapple with developing international trade rules to clarify the circumstances in which 'environmental tariffs' can be justified." - Page 27
 - "Transformation in food systems under a changing climate – to ensure food and nutrition security for all, today and tomorrow – will demand action from all actors." - Page 29
- PV Greenhouses
 - <https://news.ucsc.edu/2017/11/loik-greenhouse.html>

- <https://www.sciencedirect.com/science/article/pii/S030626191630294X>
- https://www.researchgate.net/profile/Alessandra_Scognamiglio/publication/271522951_PHOTOVOLTAIC_GREENHOUSES_A_FEASIBLE_SOLUTIONS_FOR_ISLANDS_Design_operation_monitoring_and_lessons_learned_from_a_real_case_study/links/54cb5ced0cf2240c27e7be1e/PHOTOVOLTAIC-GREENHOUSES-A-FEASIBLE-SOLUTIONS-FOR-ISLANDS-Design-operation-monitoring-and-lessons-learned-from-a-real-case-study.pdf?origin=publication_detail
- Rockland Farm Alliance:
 - <https://www.rocklandfarm.org/>

C. Energy

- Microgrids > Berkeley Laboratories Microgrids
 - <https://building-microgrid.lbl.gov/>
- Exergy, Entropy, Low Intensities, High Intensities

D. Conservation

- Conservation Biology, Rewilding, Costa Rica's 1000 Year Plan, Lake Washington, Indonesia – Borneo, Africa's 3-Park System, Land Grant vs Endowment vs Traditional Annual Grants

E. Habitable Space

- Earthship Bioteecture
 - <https://www.earthshipglobal.com/>

F. Law

- International Environmental Law & Internal/External Regulation

G. Currency

- Fiat Currency, Financial Mechanisms, Blockchain, Cryptocurrency, Exergy, WePower
- Blockchain & Green Energy
 - <https://www.linkedin.com/pulse/blockchain-green-energy-tracking-distribution-shivanand-hiremath>
 - <https://reader.elsevier.com/reader/sd/pii/S1364032118307184?token=12FCD6C417F0D758E0654615E9E6955AC0CA5D8BE14CD60559CAC0F844937217E1BF6A6E14EE64AC8E09B36BD1BBD03C>
 - <https://www.technologyreview.com/s/609077/how-blockchain-could-give-us-a-smarter-energy-grid/>
 - <https://www.energyweb.org/>

H. Property Rights

- Euclidean Property Definition, Property Rights & Boundaries, Planning Frameworks

I. Design Tools

- Generative Design Software
 - <https://www.autodesk.com/redshift/daiwa-house-industry/>
- Open Source Software

J. Other

- Publication > Earth's Future
 - <https://agupubs.onlinelibrary.wiley.com/journal/23284277#pane-01cbe741-499a-4611-874e-1061f1f4679e01>

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