MIT Computational Law Report

Reflexive Mutual Series-LLC (RMS-LLC)

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> *Zero Carbon, Resilience, Affordability, and Evolvability through Generative Design and Autocatalysis*

From Inanimate to Animate Mechanisms for Autonomous Value Generation and Retention

The Industrial Revolution and Capitalism were remarkable in reducing poverty and transforming mankind's relationship to Nature. However, the success of the extractive machines of industrialization transformed Nature from an adversary to be conquered to ally that must be cultivated. We have discovered that we are of Nature, and that its diminishment is our diminishment. We understand that the extinction of its creatures—from biomes to mega fauna—presages our own extinction. We simply cannot continue to fuel the addictions of consumption and acquisition without literally destroying ourselves. For the addicted capitalist, such curtailment might be seen as a deprivation. Instead it is a liberation: a transition from addiction to generation, and from the inanimate to the animate. Immediately, we will need to build social and economic forms of organization to be of Nature rather than over Nature. We need to transition from our current forms of social and economic ordering, derived from 17th century physics and mechanical principles, to those based on 21st century biological and generative principles.

Nature made this transition nearly 3.5 billion years ago, and in the course of that time, generated complex expressions of diverse and interdependent forms of life. Our engineering of complex systems, biology, and generative design are approaching the point where we can also make the transition from inanimate to animate forms of organization. There is a confluence of technological and scientific advancements making this feasible: self-organizing, self-deploying, self-healing networks, and IOT; crypto-tokens and blockchain, autonomous organizations and contracts; machine learning; synthetic biology; decentralized fintech, virtualization, and "digital twins."

The ability of these technologies to regulate certain behaviors within a system through code has opened up new possibilities for the ways that people collaborate and work together. Evidence of this change can be seen in the shift toward decentralized, agile, and evolving infrastructures across all sectors of society — from energy, transportation, finance, health and food to communication, architecture, and manufacturing. This is the benefit of computational law — instead of law inhibiting innovation, the combined knowledge of law and technology can be used to create new forms of organizations and produce new forms of value that are based on data and code.

These new forms of organization cannot be shoehorned into the antiquated vessels of industrial capitalism, or into the governance structures of classic industrial democracies. They will require new legal, operational, economic and financial frameworks, and the RMS-LLC represents an initial attempt at providing such a holistic and animated approach to the organization of firms and finance

Legacy of Free Market Capitalism

All ideas are creatures of their time. They are the offspring of the many intellectual and technological liaisons of their era; some of which were immediately seen as legitimate, and others of uncertain parentage. However, all necessary and transformative ideas in time, gain societal acceptance.

Market capitalism is such a child. In its inception, it was shunned as a blasphemous affront to the moral authority of the King and Church. Yet as both authorities began to waver and wane under the onslaught of fresh ideas and technologies, new principles of social and commercial organization emerged. These were imbued with the science and technologies of their time: the physics and calculus of Newton, and the pragmatic genius of Adam Smith in giving "natural explanations" to the commercial affairs of men and nations. Instead of the visible hand of King and Deity ordering commercial affairs, Adam Smith invoked a new authority: the "invisible hand" of the market. The reigning metaphors, then as now, are mechanical, borrowing from the pervasive and transformative technologies of steam and coal, to power mills and the massive engines of industrialization.

These transformations occurred nearly three hundred years ago. Science, technology, social and economic circumstances, as well as ecological challenges, are thoroughly different today. The science of the biological and behavioral basis of Human Nature has progressed dramatically, as have digital and computational technologies for energy, fabrication, transport, food, learning, communications, and control. And most pointedly, as a species, we are in entirely different circumstances - confronted by ecological and existential challenges entirely of our own making that must be addressed in relatively short order in order to avoid a cliff of ecological and societal catastrophe.

From Price to Value, Nature by Design

The defining mechanism for free market capitalism is price. It is this sole signal that directs economic behavior and acts as the lever of economic incentives. Price encourages full fungibility, and in doing so, rewards those who ruthlessly recognize and exploit arbitrage opportunities across asset types and all social circumstances. It is a winner-take-all, zero-sum game that favors scale and oligopoly, rewards expeditious exits and externalizes risk and cost. As a repeating game, it pits player against player and leaves to the discretion of the winner the option of redressing social or ecological costs and imbalances. Absent the willingness of a winner to redress such costs, it falls upon a "third party" - the government - to redress the inequities or costs. Yet in so many cases, the surpluses of the winner are used to "capture" such third parties and enlist them to their own interests.

Harms at an ecological or global scale have no effective, post hoc mechanism of redress. There is no entity of sufficient scale, force, or jurisdiction to redress such costs and imbalances. In broaching this obstacle, we must design the values of ecological resilience and social equity into the very fabric and "fitness functions" of the instruments of capital creation, aggregation and distribution itself. So, in

effect, no external party can exist that owns and potentially "exits" the "market," but rather the firm or "organism" itself is a self-contained entity that solely owns itself, and captures the value generated. This is what living organisms do; with their own metabolism of energy conversion, production and retention, living organisms convert raw external forms of energy into internal fuel through chemical reactions to enable a wide range of adaptations within the confines of their own homeostasis. The next phase of capitalism must accomplish this same task.

If there is to be a rapid transition to a global social and economic ordering that is designed *ad initio* to be z-carbon, resilient, and equitable, then a legal form of socio-economic organization and associated investment vehicles must also emerge.

The rapidly evolving decentralization, tokenization, certification, virtualization, and *autonomization* of finance can provide the necessary technological infrastructures and platforms to accomplish this reframing. The challenge is to create the interim bridging mechanisms, institutions, and incentives that enable the transition at sufficient speed without calamitous side effects. Hence, the endeavor here is to create a new form of corporate organization that leverages existing corporate, legal, and capital structures, but at the same time, by design, makes use of biological and ecological principles of organization and evolution. This venture requires an appreciation of the difference between markets and niches.

Alternative - Non-Correlated Asset Classes

A key factor in accelerating the transition to a z-carbon and equitable economy is the independent certification of asset classes and negative correlation with fossil fuel associated asset classes. By creating a broad market signal that verifiably identifies asset classes that are negatively correlated with fossil based industries and assets, investors gain the financially credible option for divesting themselves of fossil based assets and allocating portions of their portfolios to z-carbon and equitable asset classes.

The independent algorithmic certification of asset attributes and behaviors are rapidly maturing in blockchain applications for logistics, supply chain, renewable energy, and trading. These initiatives will pave the path toward z-carbon asset allocation options. As rating agencies, regulators, and insurance underwriters insist upon full environmental impact and risk accounting, the opportunity to direct investments into certifiably proven negatively correlated asset classes will represent a significant investment diversification and hedging opportunity for institutional investors.

Purpose: Mutualistic Compounding Value Generation and Retention

The designed and encoded purpose of a RMS-LLC is to act in the best interest of all its members to generate goods, services and assets, that singly, or in combination, achieve stable and measurable

value exchange within a member network furthering mutually agreed upon outcomes. In contrast to a C corporation or an LLC, which acquire investment capital to maximize shareholder value to achieve market liquidity, the RMS-LLC strives to *reflexively* generate value through internal liquidity and value generation within a mutual organization. The mutual organization defines the measurable outcomes it wants to achieve for different assets and services with respect to carbon emissions, affordability, equity, and resilience. RMS-LLCs can differ widely in their selection of assets and services, rights and permissions of members and non members, as well as outcome priorities.

To raise external capital the RMS-LLC sells *appreciation rights* to single asset classes - such as energy, housing, 5G, food, and mobility - for a market competitive rate of return, with an option to buy out such investors with a premium at the RMS-LLC's discretion. The RMS-LLC internally invests such capital in *combinations* of asset classes, such as "housing, energy and mobility" on a cost plus basis, which in turn, yields higher rates of return, reduces cost and time reduction, and complements value creation.

Members of the RMS-LLC purchase *access rights* over time to different asset classes and services for a fixed price, which when fully vested, gives members perpetual access to such assets and services. Members can sell such rights to other members, borrow against them to invest in other asset classes and services, or upgrade to other asset/service types. As the RMS-LLC achieves ownership of more and more diverse assets, it is able to collateralize a "reserve" basket of asset "tokens" and thereby, reduce the cost of capital and internally finance its acquisition of new assets. With the increasing value of its reserve tokens, members are able to build financial equity and resilience over time, and at the same time increase appeal to "outside appreciation" investors. By increasing its reserves and precisely calculating member credit risks, the RMS-LLC reduces counter party risks and hence cost of capital.

Over time, it is anticipated that the value of the RMS-LLC's reserve token will sufficiently appreciate in value and demonstrate stability and liquidity that outside investors will choose not to liquidate their appreciation rights tokens into fiat currencies, but instead convert into RMS-LLC tokens. These tokens can be thought of as a more stable and secure form of preferred stock, or a kind of debt with subordination rights designed to encourage the conversion of fiat into the tokens of the RMS-LLC.

By reflexively controlling the fungibility and flow of asset denominated tokens within its value exchange network, the RMS-LLC is able to capture, retain and leverage mutualistic value generation. This is unlike any standard C Corporation or LLC whose value is captured and controlled by major preferential share holders whose intent is exit and liquidation. It is also in contrast to a Benefit Corporation, a portion of whose profits are allocated to a designated social purpose. The RMS-LLC in *generatively designed* from the beginning as a *self-contained entity* to generate and retain value around its value proposition which is realized not through an exit or liquidation but through progressive participation.

Computational Techniques

There are a variety of ways to approach the computational implementation of an RMS-LLC. The foremost consideration is representing its output or boundary condition, or in classic cybernetic terms, its "essential variables". In all senses, an RMS-LLC is defined by a set of multidimensional constraints on its boundary or identity conditions. This teleological metric could be an "objective function" to be solved as in a case of evolutionary game theory, or it could be a Genetic Algorithm whose "fitness function' selects for a set of attributes over successive generations of outcomes. It can also be thought of as a governance or control function, similar to those used in Monetary Policy for regulating Special Drawing Rights (SDRs) between the credit-debit accounts of different nations, or in the case of an RMS-LLC, asset types. Another candidate is the concept of "Spatial Contracts," proposed by Verses (2019) and their Hyperspace Transaction Protocol. (HSPT). In all cases, the processes will be driven and regulated by machine learning and will entail a level of autonomy in the execution of smart contracts and the oversight of its processes. In some segments of the population, this allocation of oversight to a machine is seen as abhorrent[1] and an abdication of human responsibility. But the horse has left the barn long, long ago as autonomous aircraft, IOT, and automobiles are increasingly an everyday reality. There are well established processes for verifying processes and code that can and should be adopted and upgraded without having to involve humans. In many cases, inserting humans into the process introduces a security risk that itself has to be accounted for and defended against. One of the most challenging aspects of RMS-LLC design will be how to properly engage human oversight without introducing collusion and self-dealing. There are promising solutions to the "who guards the guards" problem which entails a combination of randomization and certification techniques for selection, participation and succession. Nevertheless, these solutions are in their infancy.

Another candidate technology are Non Fungible Tokens (NFTs). While much as been written about blockchain and smart contracts, the potential importance of NFTs has been overlooked, except for their use in the gaming world. As unique certifications of the proof of an attribute, permission or a right, NFTs could play an important role in the design of RMS-LLCs. Rather than sharing data or having fixed certifications, NFTs can leverage smart contracts that are linked to containers with set conditions, permissions, and limitations to define access rights in a highly dynamic and open manner. [2]

Member Rights and Capital/Token Structure

The RMS-LLC in many respects mimics traditional startup capital formation and liquidation. The principle distinction derives from the RMS-LLC's incentives and controls being designed and exercised to the benefit of value creation and retention for the *entire* mutual organization and not the external investors. The goal is *not* the exit for either the participating members or the investing/appreciating members, but rather to build up the value, diversity, resilience and purchasing power of the mutual

organization network and to attract and retain outside capital. The goal is to be marginally and competitively superior to other market investments, and provide greater resilience and appreciation over time, as well as the benefits of becoming a member participant. In this respect, the capital structure is similar to a venture capital-start up relationship, but "turned on its head" to be designed from the interest of the mutual organization rather than outside investors. Naturally, this power equation will depend upon the actual and perceived success of the RMS-LLC to other outside investors.

For each asset class that a RMS-LLC purchases and uses, a security token can be issued and backed by an NFT and the value assessment of the real cost of the asset plus a percentage markup. A participating member purchases "access rights" to that asset which are vested over time with a payment schedule, similar to a car loan or mortgage. In the case of a default, the asset is recovered by the RMS-LLC reserve fund.

For each asset class, appreciation rights tokens may be sold to external investors with a market competitive financial instrument (e.g., debt, equity, or convertible note). The purchase price to the external investor is at cost plus a percentage markup, depending upon market response. The appreciation investor has a fixed period to receive dividends, with a payback of principle with a coupon. Shadow pricing market mechanisms and exchanges are subsequently able to price the token asset value and provide for phased liquidity. The RMS-LLC would have the right to pay off a note or repurchase equity if certain "trigger liquidity" events occurred, such as a rapid appreciation to the point of payout of principal and coupon. In this way, the RMS-LLC would be able to capture the further appreciation value in its reserve tokens.

Earned Securities and Tokens

Members should be able to earn tokens in exchange for work that they created as determined by the community to be of value. These tokens could be used to pay down loans for assets or purchase in network services such as mobility, food, housing, and energy.

The Complexity and Biological Argument and Architecture for Compounding Returns

To anyone steeped in traditional financial and economic doctrine, the notion of a firm or mutual organization being able to generate compounding value and effectively, and autonomously, grow itself might seem fanciful. Similarly, the notion that any entity or network of entities could do so without incurring debt or inflating the value of a currency might also seem borderline preposterous.

Yet that is what living, animate things do—in contrast to dead or mechanical things. Mechanical things require and consume outside energy, be it fuel or capital and do not themselves internally generate food nor energy. When they run out of capital, mechanical entities require an "injection" of capital by a

third party at a price that warrants the risk associated with the return of the investment of the capital to the third party. The value of the investment totally rests upon it being liquid to the investor - not to the value generated and retained within the entity. There is nothing autonomous nor animate about it. The mechanical entity's very existence depends upon what can be achieved by the third party which is exogenous to the entity. The mechanical entity's survival rests upon how well it succeeds or fails in wholly fungible equity exchanges that aggregate and equate different kinds of investment value. The life cycle of the mechanical entity really is a creature of the exchange and is not in control its own fate. As such, it is not free to take full and autonomous advantage of the different ways it can internally generate self-sustaining value like all living things and ecosystems.

Autocatalytic Sets and Animate Organizations - Economies and Tokens

Our guiding principle in developing animate or self-organizing organizations and economies is understanding that one can abstract out from the biology of the living organisms the core philosophy of self-organization. In other words, there are principles of adaptation, organization, and replication which are independent of chemistry and can be given a formal representation. This is a well traveled field over the last 50 years, beginning with Ross Ashby's first representation of a "self-organizing system" in 1945,[3] to John Von Neumann (1951),[4] Norbert Weiner (1956),[5] Gregory Bateson, (1972)[6] to more recently, John Holland (1970, 1975, 1999, 2015),[7] Thomas Schelling (1978),[8] and Stephan Wolfram (2001).[9] More recently, scholarly work has built upon the rapid breakthroughs in genetics, bioinformatics, epigenetics, and systemic biology, including Robert E. Ulanowicz (2009),[10] Brian Arthur (2009),[11] Robert Rosen (2000),[12] Andreas Wagner (2014),[13] and Neil Gershenfeld, et. al. (2018).[14] (It should be noted that there are many other noteworthy contributors and apologies for any egregious omissions.)

Of particular relevance to the approach being taken here, however, is the work of Stuart Kauffman (1990, 2000, 2018)[15] a biologist, MD, and complexity scientist who, over the course of his long career, has been actively trying to model the processes involved in the spontaneous transition from inanimate matter to living organisms. In his most recent book, "A World Beyond Physics" (2018),[16] Kaufman provides a convincing model that, to this author, is especially amenable to modeling the manner in which different incentives (tokens) and asset classes can be combined to generate a form of social and economic autocatalysis and autonomy.

The primary thesis of the animate organization is *not* of analogue or metaphor. It is not that firms can be designed "like" Nature or autocatalysis—but rather that they can be designed by and performed with *identical* principles. This is too strong an assertion to be supported in this paper, but it is important to set a marker of this strength for future considerations. That said, even though the mapping between Kauffman's model of autocatalysis into an animate human organization enables some algorithmic and self-organizing behaviors, it is imperfect and has room to grow and improve.

Nonetheless, the argument will be made that in comparison with the current organizational, economic, and financial models, the RMS-LLC can be designed to generate novel forms of value and succeed in out competing traditional firms and business models. We are arguing for the preliminary transition from inanimate to animate, the formation of the self-replicating and bounded "proto-cell," not yet the full cell nor the multicellular organism.

Encapsulation and Autocatalysis by Design: Extern Capital and Tokens as Raw Energy and Tokens as Refined Energy

The oft-repeated requirement for the ignition, evolution, replication and perpetuation of life is the formation of a boundary. This membrane allows self-organizing systems to establish their "self." It is by regulating what is inside versus outside the membrane of the cell that defines its identity and what value or values are to be replicated. In the case of the RMS-LLC, it is the collection of certain assets—energy, food, mobility—that are within the defined values that the entity determines—zero carbon, resiliency, affordability. It is also the interactions or "reactions" among the assets or "molecules" that generate new forms of energy and in combination lead to less energy consumption, more efficient energy generation and value generation, as measured by the outcomes that define the mutual organization. These reactions can be defined by contracts that establish the behaviors and character of different asset types. For example, the production of solar energy can be defined through a formula based on: cost per kilowatt hour, storage costs, activation costs, maintenance costs, distribution costs, utilization costs, carbon footprint, lifecycle costs, and production verification. Note that these costs are not due to solar energy technology alone, but depend upon related technologies or "molecules" such as batteries, inverters, IOT devices, machine learning optimization, and overall patterns of miniaturization that affect the cost performance of computing, storage and transmission. Such variables affect the overall per kilowatt cost of energy. Similarly, the ability to achieve scale economies and performance in seemingly unrelated technologies (e.g. machine vision) may dramatically affect the performance and cost and demand for solar and autonomous vehicle technologies. Developments in adjacent technologies can therefore affect the affordability and suitability of housing technologies in terms of proximity to certain kinds of resources such as schools, healthcare, and food, as well in the cost of housing construction and utilization of space and resources.

Generative Design: Catalytic Reactions and Phase Shifts

In contrast to established democratic principles based on means (such as voting, trial by jury, and elected representatives), generative design principles are based on outcomes. The goal is to achieve and avoid certain outcomes, not presuppose that certain means, such as "equal participation," or certain materials, will lead to desired outcomes. A prevalent theme in the complexity sciences is the notion of "emergent order" arising from complexity. Given certain initial conditions and sufficient iterations, complex forms of ordering can emerge, resulting in complex life forms such as ourselves.

Importantly, the goal is not that *a* form of complexity should emerge, but that *many* different kinds of complexity emerge, each with its own boundaries, conditions, reactions, and products. In other words, each animate form evolves its own method of energy production, which in the case of RMS-LLCs, we represent as different types of tokens and their related "smart contracts".

Neil Gershenfeld, a physicist and computer scientist, and the founder of the global Fab Lab network, describes complexity as "a sequence of detecting and correcting errors in the assembly of a small set of discrete designs being represented as developmental programs rather than construction plans (Hox genes)."[14] He also defines "Declaration design" as "the name for a design process that lets you describe what you want something to do, but not how it should do it."[17]

Stuart Kaufman makes a similar point about what constitutes "life" from the perspective of a computational molecular biologist. Kaufman concludes: "Life is a fundamentally new linking of non-equilibrium processes and boundary conditions constraints on the release of energy into a few degrees of freedom that thus is thermodynamic work. But stunningly, the work done can construct constraints on the release of energy in further non-equilibrium processes. In reproducing systems such as cells a closure is achieved linking these processes and constraint construction in an organization that closes in on itself. The system in doing its work constructs its own constraints, and also reproduces, achieving catalytic task closure.

Through the combination of different asset types (energy, housing, IOT), an RMS-LLC generates new forms of value, attains its defined outcome or constraint conditions in a self-replicating manner, and discovers more efficient (hence competitive and fit) means for achieving the outcomes that give definition to the RMS-LLC.

Another purely formal property that Kaufman cites gives credibility to the notion that new forms of fitness and organization can be discovered simply through crossing a complexity threshold by increasing the number of connections in a graph. Citing the work of Paul Erdos and Alfred Renyi (1959) on random graphs, Kaufman shows that when the number of edges (lines) in a graph of vertices (V) exceed the ratio of E/V=0.5 "suddenly a large collected cluster or "giant component" forms with a diversity of cycles. As E/V increases further, remaining isolated nodes become tied into the giant component."[18]

This phase shift in organization creates new types of categories of "polybrids" or "complex molecule" forms of assets. One can imagine a kind of robotic building that uses new materials, AI, IOT, and sensors to provide adaptive spaces that change according to time, circumstance, energy, use, and occupant. (The new startup, Ori Systems, expresses seeds of this idea). Similarly, the cluster of machine vision, sensors, solar energy, battery tech, geodata, and electric vehicles can result in a "giant component" which completely transforms the spatial layout of cities, their carbon footprint and

affordability. These combinations are generated and selected for by virtue of the "declarative design" of the RMS-LLC.

At this early phase of exploration and development, testing of an RMS-LLC will require "hand testing," managed intervention, and evolution. However, during a more mature phase, the entire process would be governed by the type of genetic algorithms first developed by John Holland in 1960, but subsequently modified and available in a number of code libraries and versions.[19]

Shadow Pricing Arbitrage, Repayment Triggers, and Reflexive Investment

The RMS-LLC lives in a highly competitive and hostile world in which it must compete for capital against more traditional firms and business models. If it cannot achieve more competitive value for investment capital and if it cannot achieve outcomes that matter to outside investors, it will perish. The essential premise is that a living, animate organization, by virtue of declarative design and appropriate incentive structures, can more rapidly discover and realize innovative value generation than the mechanical business models of traditional firms.

This argument is supported by the deflationary effect of rapid technological innovations such as Moore's Law and Dennard's Scaling Law upon the cost versus performance versus size of digitally dependent components and processes. For example, a resource such as electricity that might cost $10 at time t will cost $2.5 after two years and after four years, will cost roughly $0.70. Through generational innovation, costs decline so rapidly that a price arbitrage opportunity emerges to repay contracts over a five year period. Currently equity and bond markets do not properly price the appreciation value of certain "exponential assets" over time. Hence, a trigger point exists at which it makes more sense for a party to buy out their contract, pay back their loan to own the asset, and use the savings to nullify the debt. This strategy is applicable to the deflationary effects of single assets, such as electricity, which the traditional market prices individually. However, if our argument for the generative value of new combinations and forms of combined asset classes is correct, then the relative savings and value will be all the greater.

Therefore, it makes sense to have exogenous market shadow prices for internal assets and tokens. When the spread between the RMS-LLC cost and the external market price is sufficiently great, the RMS-LLC can buy out its contract with the projected savings and exercise its right to buy out or pay off a contract. An RMS-LLC is in effect an "innovation engine" by declarative generative design which rapidly iterates and reflexively reinvests in itself, reduces costs and impediments, and achieves its self-identified mission.

We see similar mechanisms attempted through traditional corporate, forms where companies like Amazon, Google, and Tesla assume debt or forgo profits and dividends to reinvest in themselves for successive generations of innovation. The old measure of price to earnings ratios and quarterly

dividend calls work against the interests of the firm and inhibit its ability to innovate. This would not occur in the RMS-LLC.

Equity Appreciation, Phased Evolution, and Recycled Waste

If the RMS-LLC is successful in competing for fiat dollars and demonstrating its capacity to provide external financial returns at competitive rates, then it should become a magnet for additional capital. Institutional capital will be drawn to the RMS-LLC as a lower risk and higher return asset class which has measurable impacts on socially and economically valued outcomes. Under this scenario, the reserve asset tokens of the RMS-LLC would become highly valued over time and seen as a safe asset class that minimizes counter party risk and preserves purchasing power. The assets would be liquid, allowing combinations of assets that generate value for those members of the network. It becomes, in effect, its own shadow economy.

As noted previously, and in contrast to more traditional organizational forms, the RMS-LLC is designed to rapidly evolve through stages of innovation and asset acquisition. Most large enterprises are faced with Clay Christensen's "Innovator's Dilemma": how to innovate without destroying the current business? As mechanical systems are often optimized and standardized around a particular sector, technology or asset class, they are extremely vulnerable to technological disruption and often become prey to the larger platform companies. These mechanical entities can attempt acquisitions and mergers, but often the expected synergies do not materialize.

As a hyper-innovative entity, the RMS-LLC goes through many product service generational changes and, therefore, has the potential to generate an enormous amount of waste. One needs only to think of the rapid depreciation of computer storage components, screens, and mobile phones to appreciate that a crucial outcome condition for a RMS-LLC is to generate waste that is an energy source for other future animated entities. In other words, depleted components of product life cycles must have value for other forms of organization. Hence, both organismic and ecological constraints are necessary. Components should be designed to be readily broken down into base components that can be recombined in new forms of catalysis. Here, we can take an example from Nature, a system creative in repurposing its base components.

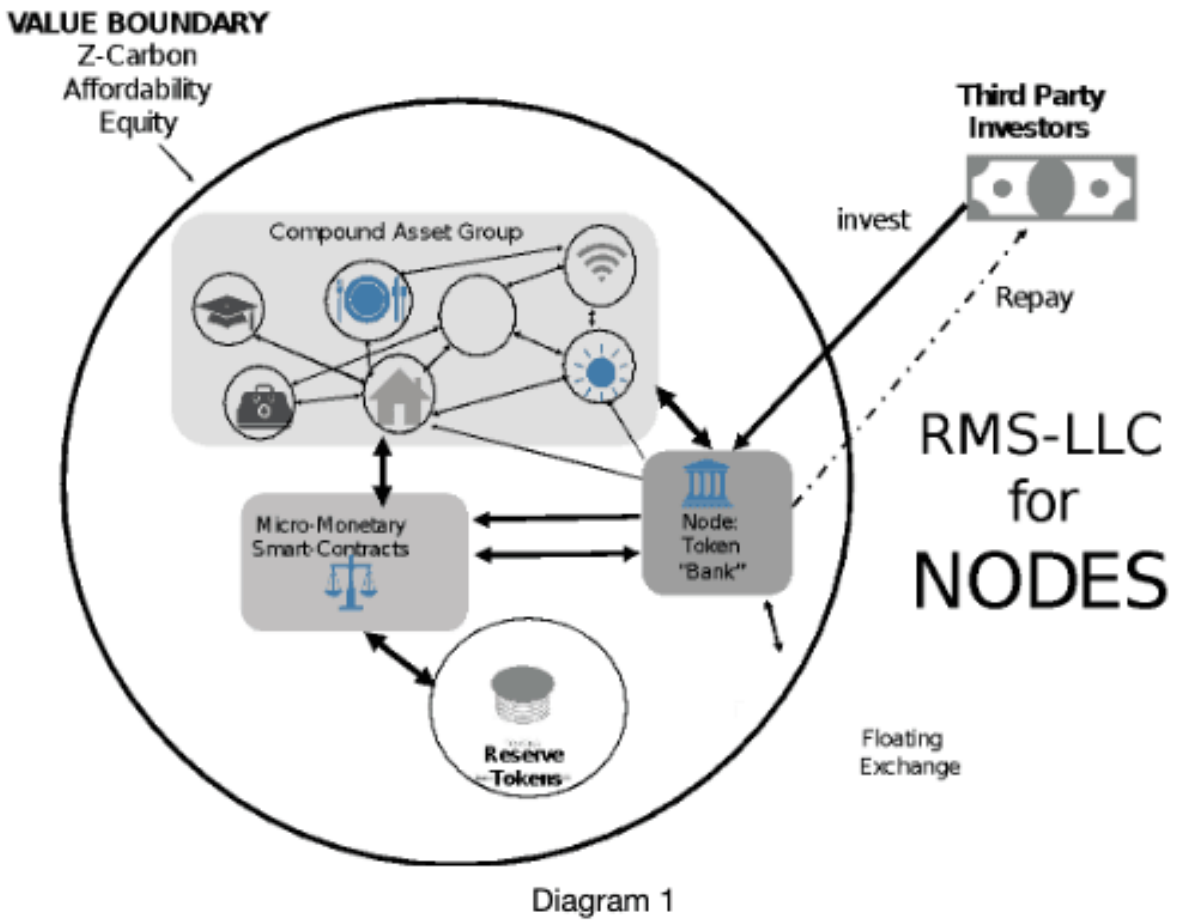

Diagram 1

This diagram illustrates the essential conditions and processes that constitute a RMS-LLC. The border, called the "Value Boundary," is like the membrane of a cell, which in this case is defined by the outcomes of Z-carbon, Affordability and Equity. The RMS-LLC is in this example a Node in a network of RMS-LLCs that takes outside raw energy (fiat currency) and converts it into different kinds of token related asset classes whose character and liquidity is controlled by the "smart contracts" of the banking component. The overall issuance, convertibility and liquidity of the different asset classes is controlled by the Micro-Monetary Component which acts to attain the overall outcomes of the Value Boundary. Over time, through repayment of fiat investments and loans, a reserve token pool is built up which is backed by the collateral of tangible and marketable assets. The role of the Floating Exchange is to have an index value for liquidation to investors. The Compound Asset Group represents the additional value generated through the combination of different asset classes.

Governance Council

The RMS-LLC will be governed by a Governance Council (GC) of members representing the different asset classes and participating members in a manner similar to the way a mutual organization for insurance, investment, purchasing, credit, ownership, land and real estate. This council will set the

goals and outcomes for the overall RMS-LLC on a quarterly basis and determine "micro-monetary policy" for the issuing, fungibility, and supply of different asset/token types. It is the duty of the GC to ensure privacy, security and opportunity for value preservation and generation, as well as access to the assets and services provided by the RMS-LLC exchange network, and to minimize operational costs. It also has the duty to provide oversight for the Management Unit (see below), hire and fire its officers, and contract with third party services through routine Service Level Agreements (SLAs) for the management and execution of its policies.

Voting and Selection of Governance Council Members

The Governance Council will be formed through a process whereby members establish their "standing" as determined by their ownership of different asset tokens and their reputation or expertise in relevant areas. It is intended that a pool of candidates with the requisite standing and reputation would compete in a democratic election. It is also expected that a certain portion of the council would be *randomly* selected from a pool of candidates. Council members would be compensated for their work in tokens and be subject to term limits. There would be an Executive Chairman, Financial & Monetary Chairman and an Operations Office. These could be rotating positions to ensure accountability and shared understanding.

Management Unit

The objective is to staff a highly trained management team that is effective in executing the policies of the council. A CEO would have principal contact with the Governance Council and a Community Officer would maintain ties to the overall community. A CTO, CFO and Chief Monetary Officer would analyze and model token flows, asset values, liquidation, and exchanges. Vanguard Mutual Funds, a $6.5 trillion mutual organization owned by its funds and shareholders, works on a similar set of principles. It is given a considerable latitude as long as it realizes its investment objectives.

Operating Agreement

The operating intent of the RMS-LLC is to attain resilient value generation outcomes to the mutual benefit of its members. In order for this to be achieved, the following rules and operations need to be put into practice. The first order of operations is to form a provisional Governance Council (GC) which in turn, forms and contracts with a Management Unit.

As a duty of the GC is to minimize costs and preserve value, it will create a basket of reserve assets collateralized by tangible assets to reduce reserve and equity requirements for the RMS-LLC.

The GC will also set and oversee policies that achieve the definitional outcomes for the RMS-LLC, and thereby form, oversee, and contract with the Management Unit to achieve results as cost effectively as practically possible. Whenever possible, contracted processes, rules would be algorithmic, secure and

auditable by an independent third party. The intent is to reduce costs and increase revenues through the use of service templates and API services.

The organizational structures of the GC and Management Unit are proposed as follows:

1. Formation of a Provisional Governance Council: Minimum of 3 members with the election of a full council one year upon full financing of initial project.
2. Formation of Provisional Management Unit. Contract for services for an initial Management Unit with sufficient staff to execute performance contract as agreed to by the Governance Council. With completion of project financing, full SLA with Management Unit either with third party or retained management and staff.

The recurring duties on a project by project basis of the Governance Council in concert with the Management Unit are:

1. Identify target populations: location, member criteria, people and entities.
2. Identity outcome priorities: carbon reduction, affordability levels, equity and others.
3. Identify asset classes, attributes, and behaviors.
4. Identify relationships: flows and *spatial* contracts between asset classes.
5. Identity cost methods for different asset classes.
6. Set Access Rights: proportions, terms and conditions for different assets for participating members.
7. Set Appreciation Rights: instruments, terms, and conditions for investors of specific asset classes.
8. Model cash flows and payments streams for asset class and token circulation, fungibility and liquidation.
9. Develop Pro Forma Model for Project Financing of Assets for access and appreciation.
10. Construct Token Governance Policy (Model) for Project.
11. Identify and contract with potential service providers, partners and developers.
12. List Project and financing instruments on platform.
13. Execute the initial project and timely pay off debt and repurchase equity and assets for appreciation rights investors.
14. Issue asset reserve tokens for project asset classes.
15. Identify new asset classes and combinations for purchase to extend the diversity and liquidity of services for members.
16. Identify activities and behaviors for which participating members can earn tokens, convertible into additional services and reserve tokens.
17. Identify other RMS-LLCs to achieve interoperable services and token exchanges.

Conclusion

The firm is the atom of capitalism. It is the principle unit, the corpus, that is imbued with all the legal and financial means to mitigate risk, assign rights and duties, structure incentives, and aggregate and distribute proceeds to its owners and operators. In its current form, the firm is an artifact of the Mercantile and Industrial eras. It is a conceptual "body" whose personhood is conceived in mechanical terms, and which is operated solely for the benefit of its owners, regardless of its impact on its workers, community, or environment. When it fails to extract value, or its owners want to realize it value through more fungible means, its parts – shares – are traded on an exchange. When its shares fail to have sufficient value to its owners – regardless of the impact on others or its environment, it is dissolved and sold for its break up value. Such an arrangement is "free" only for its owners, not those stakeholders, human and ecological, from which the value has been extracted. The environmental and human cost of this wanton strip mining of social and ecological resources is no longer tenable. Our conclusion has been acknowledged by some of capitalism's most successful players: Ray Dalio of Bridgewater, Marc Benioff of SalesForce, as well as some of its Central Bankers, such as Mark Carney, Governor of the Bank of England. As financial markets start to fully price the social and environmental costs of fires, floods, species extinction, climate change, and desertification, the impetus for change will be realized. Carbon based energy, manufacturing, and transportation-based assets will be deemphasized in favor of those assets and forms of economic and social organization that are inherently Generative: zero-carbon, affordability, equity and resilience.

The notion of a Reflexive Mutual Series Limited Liability Company is proposed here as a means of organizing capital, people and assets to intrinsically address the defining existential challenges of our time. It is based upon time tested principles of cooperation and mutualism, as well as the New Sciences of complexity: synthetic and evolutionary biology, ecology, as well as the technologies of cryptography, decentralized computation, machine learning, tokenization, AR, smart contracts, blockchain, IOT and 5G. In this respect, the harmonization of legal requirements, new technologies, and generative design principles represents part of the future computational law offers. We now have a real prospect to engineer social, economic and financial institutions based upon scientific principles, evidence, and realized successive generations of technologies focused on humane and ecological principles. We have no other choice.

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