

## Sustainability Documentary

<https://www.youtube.com/watch?v=bjrPilem30g>

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Within the space of just a few decades, the term sustainability has made an extraordinary rise to fame, going from the fringes to the mainstream as it has become one of the defining features of 21<sup>st</sup>- century reality. Today, the term sustainability encompasses a whole paradigm shift in our understanding of the world and our place within it. This **new paradigm of sustainability** is set to have a fundamental and pervasive effect on how we manage and design systems in the 21st century, as it will affect all aspects of our economy. This short film explores the ongoing transformation in the structure of our economies as a new form of sustainable economy emerges.

The environment represents the whole ecosystem that society depends upon for various services such as water, materials, food, and energy. When we refer to the environment, we are really talking about a combination of natural ecosystem and human economy. What is called a socio ecological system? The nature of **socio ecological systems** has changed fundamentally over the course of human history as we have developed new technologies, institutions, and tapped into new energy sources. The development of the practice of agriculture some 8,000 years ago represented the first fundamental change in this dynamic as we created systematic processes for harnessing natural resources based around the technology of farming. At this point in history, humans were dispersed across the continents and the Neolithic revolution was ongoing. The **Neolithic revolution** was a fundamental change in the socio ecological systems of the time, where the shift from hunting and gathering to agriculture led to permanent settlements, the establishment of social classes, the eventual rise of urban living, and large civilizations. Before the modern era, people were very much aware of their environmental limitations. Interactions within socio ecological systems were local in nature. The majority of traditional societies are the net result of a long process of coevolution between a group of people and their natural environment, which created strong limitations to what was physically and biologically possible and what was not. The majority of people were small-scale subsistence farmers. Most of the agricultural production was for home consumption. Agricultural techniques were adapted to local environmental conditions. The amount of land that each family could cultivate was limited by the large amount of human or animal labour that was necessary for agriculture. For thousands of years, Agrarianism formed the foundations to many civilizations that rose and fell around the world.

The rise of the Modern era some 500 years ago in Europe created the context for a whole new dynamic in the relationship between humans and their natural environment. With a shift from a dominant pre-modern religious vision of the world to a modern scientific view came a whole new way of seeing the natural environment. This new scientific knowledge got directly applied to the engineering of our physical environment, giving rise to the explosive technological change, that was the Industrial revolution. The **Industrial revolution** that started in the late 1700s represented a

radical dislocation between society and the ecosystem. Agriculture changed in Europe when the Industrial Revolution made it possible to use machines instead of human and animal labor for work such as plowing fields and harvesting crops. Starting with mechanization, the chain of effects can be traced through as machines gave farmers the ability to cultivate larger areas of land. Farm sizes and worker productivity increased dramatically. As mechanized agriculture is more efficient on a larger scale, the mass of society moved from working the land into the newly industrializing urban centers where large markets for goods and labor came, the new organizational structure prevailing over their daily subsistence and a new way of life that was divorced from local ecosystems emerged. A major part of this changing dynamic was the harnessing of new energy sources that were greatly more powerful than anything humans had used to fuel their economies before. The large-scale combustion to the energy sources of coal, oil, and gas enabled the transition to new mass manufacturing processes as they shifted from manual to mechanical. These initial changes in technology, economy, society, and ecology set in motion a series of changes, such as increasing economies of scale, co modification, and urbanization that through interconnected feedback loops continues to this day in many countries around the world.

Although it is apparent that the industrial revolution assured in an unprecedented global human impact on the planet, it has since been dwarfed by the extraordinary exponential growth of human economic activity that began in the mid 20th century. Many of the processes of change that began with the industrial revolution reached a take-off point in the mid-to-late 20th century as almost all indicators for economy and ecosystem started changing at an exponential rate. From population growth to loss of species to energy consumption, this great acceleration of economic activity has given birth to a new geological era that scientists call the **Anthropocene**, as human industrial activity has become the primary driver of changes within Earth systems. The Anthropocene represents a new form of socio ecological system, one that is truly global in nature, with an unprecedented scale of alteration to Earth's core systems such as overall biodiversity, climate, or ocean acidity. After 1950, changes in major Earth systems became directly linked to changes largely related to the global economic system. This is a new phenomenon: a truly profound transformation in our socio ecological systems, one that we are far from understanding the consequences of. Within the course of just a few decades, we have transitioned from being a small world on a big planet to being a big world on a small planet and extraordinary transformation. A switch from making limited ad hoc interventions into ecosystems to becoming the primary drivers of change within the biophysical processes of the entire planet. These changes and their potential consequences are being made most explicit to us through the changes and climate that we are currently witnessing through human industrial interventions. The feedback mechanisms that stabilize and regulate Earth's systems have been significantly degraded, both within local ecosystems and increasingly on the global level. The breaking of these stabilizing negative feedback loops increases destabilizing, positive feedback that makes the system more unstable and thus generates more extreme events. What scientists call global weirding? We have benefited for over 10,000 years since the beginning of the holocene, from Earth regulating itself to create an environment conducive for human economic activity. The Anthropocene is a recognition that this stable geological era has ended, that because of human intervention in the Biosphere, it can no longer stabilize itself within the same equilibrium that has benefited societies in the past, that the global economy is now the primary driver of change within ecosystems.

The name **sustainability** is derived from the latin word 'sustainer', meaning to hold and sustain, meaning to maintain or endure. Sustainability then defines the ability of a system or process to endure over a period of time. How sustainable something is can be understood in terms of its overall efficiency in terms of how effective the whole organization is at operating within its environment. When a system becomes inefficient at operating within its environment, it consumes more of the available resources and produces more entropy or waste, rendering it unsustainable. Sustainability is, though not a property of a thing. Things in isolation cannot be sustainable. Sustainability is more what we call an emergent feature of whole systems. It is not so much about the parts as how the parts work together to enable effective overall outcomes. For example, an electric car is not really sustainable if the power system it is running on imports coal from the other side of the planet to provide it with electricity. Or likewise, if we build an eco home in the middle of suburbia where the inhabitants have to drive a long distance to do shopping or take their kids to the park.. this again, will not achieve sustainable outcomes because we are simply optimizing individual parts without optimizing the whole. It is precisely because sustainability is about a relationship between a whole system and its environment, that it cannot be achieved through optimizing individual parts, but instead requires us to look at how whole systems work, how all the parts are interrelated, to enable the emergence of an efficient overall system, and thus sustainable results.

This is to a large extent why sustainability presents such an intractable challenge to our existing institutional framework. Traditionally, we take a very analytical approach to management. We break system's down into their parts, analyze the parts, and try to optimize them, thinking that if all the parts are working, then the whole will be working in relatively simple systems. This kind of reductionist approach can work, but in something as complex as an entire economy or global supply chain, it comes to be more how the parts are interrelated into the whole. That comes to matter. If we wanted to try and make a supply chain more efficient, we can only get so far by getting each business to optimize their activity in isolation before we need to look at the coordination across the whole supply network. Often when we focus solely on the parts, we simply shift problems to the whole organization, and because of that, we stay getting the same overall ineffective outcomes and unsustainable results.

The Industrial age management methods and institutional structures that we inherit today are designed to take an analytical approach, breaking problems down, solving the parts and then putting them back together. Sustainability is, though a complex and holistic challenge that is not amenable to this method, although optimizing for the parts may be important in many circumstances. It is really designing and managing for the whole system that is ultimately required to achieve the end result of overall sustainability. Whether we are talking about sustainability with respect to the natural environment or with respect to social institutions, an unsustainable system is one where the value and integrity of the whole organization is being systematically depleted. All organizations require both effective parts and effective overall structures for integrating those part into a functioning whole. When the integrity of the whole becomes reduced, then the system becomes unsustainable.

When the social capital within a society, the trust within the social bonds of the community, becomes depleted, it is only a matter of time before an event occurs, creating a crisis. That would have easily been resolved given a normal level of trust within the community. And this is the essence of sustainability. It is not a thing, it is the value and integrity of the whole organization that is

required to maintain it over time. Whether this is the value of the social bonds within a society or the species diversity that forms the food web within an ecosystem, a sustainable system is one that is integrated into a functioning whole organization. We traditionally focus on the parts in an organization because they are much easier to touch, quantify, and manage, while the value in the connections that interrelates them into an effective whole typically cannot be touched or broken down into individual, discrete parts and is often much more difficult to quantify, making it difficult to manage through our traditional methods. This value of the whole is nonlinear, meaning it is distributed out across the whole organization. It is not one species that maintains the diversity within an ecosystem, it is all of them. It is not the closely knit bonds between people of a similar background that maintains a resilient, multicultural society. It is more the distributed weak ties between people of different backgrounds that ensures the overall integrity of the community, its resilience and sustainability. It is this integrity of the whole ecosystem or society that represents the infrastructure or fixed capital that supports and enables it to operate effectively and provide people with the derivatives they value. And in managing such capital, one cannot look at and measure one single connection or one single creature. One has to look at all of them. This is the nature of nonlinear phenomena. It is because these resources within an ecosystem, economy, society or culture that ensure the functioning of the whole and its sustainability are distributed that traditional centralized management methods are ineffective. Whenever we manage for the parts without managing for the whole, we eventually deplete the integrity that supports the whole and end up with unsustainable outcomes.

At the beginning of the modern era, we inherited a natural environment and a set of social and cultural institutions that evolved over millennia without our full understanding or appreciation of them. With the accelerated growth during the 20th century, we came to affect the structure and makeup of these whole systems that were providing the natural and social capital supporting our modern economy. So much so that today they are no longer self-managing. The requirement today is in understanding these macro structures, how they work, their value, and developing organizational structures that can appropriately manage them. Sustainable development is a form of development where we manage both on the level of the individual technologies and organizations, but also on the level of the system as a whole. This is why achieving a sustainable form of global economy will take us into a new world of complexity, because we have to look at, account for and manage whole, interconnected, socio ecological systems in order to achieve overall sustainable outcomes.

What gets measured, gets managed, and managing for the whole means accounting for the whole, what is called full cost accounting. Our traditional approach to macroscale environmental management has been exercised through a top-down centralized model driven by government institutions and based on a paradigm of environmental conservation. But this is no longer relevant. In an age when industrial activity has become an embedded part and central driver of change within virtually all ecosystems around the planet, ecosystems management can no longer be an ad hoc solution patched into the side of the economy. This new context requires that it become a central part of what the economy is and does, and this requires accounting for and incorporating both social and natural capital. In market structures, economies function as distributed management systems through the negative feedback loops of the market. They manage whatever it is that people value can quantify and exchange. Until very recently, we have only really valued the derivatives of ecosystems, the water, food, minerals, etc in terms of their utility, to which we could ascribe a

financial value. Through industrialization, industrial and financial capital has grown and ecosystems have become degraded. Today, the limits and scarcity are not in lack of human engineered systems, but in natural capital. In the industrial age, we had a scarcity of people and capital, but an abundance of natural capital. Today, we have an abundance of people and goods, but scarcity of natural capital. So it is now not industry and people that need to be economized, but natural capital that we need to be using more efficiently and creating an economy to do that. Completing the process of industrialization means people's value change subtly but importantly. At this stage in economic development, the scarcity is no longer in the derivatives of ecosystems, but instead the functional integrity of those ecosystems. This integrity of the ecosystem can't be fully measured in terms of monetary utility. Rather, it requires a different kind of capital called natural capital. Using economic and business models to manage ecosystems means firstly understanding those ecosystems and the value of their integrity, and then developing accounting and exchange mechanisms based around this. Ultimately, this means building a new dimension to the economy, a new value system for the quantifying, exchanging, and accounting for natural capital. This process of incorporating the inherent value of ecosystems into economic metrics has already begun and will likely intensify in the coming decades. Since economies are always about people and what they value as the context changes, as those values change, and as the nature of the resource that needs to be economized changes, so does the economy adapt? But this adaption won't simply fit into our current economic model. It will require that industrial age economic structures evolve into a more complex, multi-dimensional form.

Managing for the whole means managing for the connections between things. A central part of the rise of environmental awareness over the past few decades has been a growing recognition of the linear model to our existing economy. Indeed, today, this linear model is probably the most often identified and criticized structural feature to our existing industrial economy, driving unsustainable results. This linear economic model is captured in the popular description of the economy as a process of take, make and dispose. But, as the economy has grown and reached planetary limits, inputs are appearing more limited and outputs have become increasingly detrimental to ecosystems. As limits are increasingly met, the emphasis is shifting from gross throughput of material and energy to the internal organization through which those resources are utilized. This new form of economy is called the **circular economy**. Built on the idea of feedback loops that things don't just disappear, materials and energy go on existing after we use them, and this can be a massive source of value. The circular approach is a concept that has risen to prominence and takes its central insights from living systems. It considers that our systems should work like organisms, processing nutrients that can be fed back into the cycle. From this perspective, a sustainable economy is one without dead ends, with solutions in a sustainable economy built on closing loops between different energy and material flows and converting them into cycles.

This nonlinear lifecycle view to products and processes necessitates a more complex, holistic view of the systems we design and manage. One that looks for the synergistic connections works with feedback loops and whole systems instead of discrete one-off products. Developing a truly circular economy requires diversity and the interconnecting of different systems, systems and processes that are all the same, consume the same resources, and produce the same outputs, without the capacity to cycle them between the different elements. It is only by connecting different systems in the right way that we can harness their differences to create synergies between them. Diversity has to be built into the structure of the economy with different processes and systems coexisting and thriving

off of each other's differences. A sustainable economy is one that does not just manage for things, but for how those things are interconnected and interrelated to form synergies that enable the continuous cycling of resources.

A sustainable economy is a de-materialized economy where innovation is focused on delivering greater functionality with ever less material demand, one that can deliver more services with less stuff one of the most environmentally destructive elements to the linear economic model has been its incentive structure that drives businesses to over produce and people to over consume in what has come to be called the consumer society. The industrial model was based on the mass production of tangible products that were pushed out to end-users. Mass production meant that companies had to sell on mass, which gave rise to mass marketing and the creation of a consumer culture that went global with Globalization. In this product based transactional paradigm, there was a strong divide between the producer and consumer around the point of transactions due to the fact that both customer and producer had different incentives and motives that ran largely contrary to each other. Over the past couple of decades, with the rise of information technology, has come a new model to value delivery called the Services economy. A Services economy is one where the focus is on the service delivered, the actual outcomes of a process. It is based on the systems delivered functionality, instead of the amount of resources consumed in the production of the product. By shifting the producers revenue stream away from the production of products and focusing it on the delivery of functionality, **servicisation** is a powerful approach for breaking the core dynamic driving the consumerist economic model. With servicisation, ownership of the product stays with the producer and it's maintenance likewise remains their responsibility. In such a way, they are incentivized to produce less while delivering more functionality. The end result is an alignment of the interests of the end-user with producer and sustainable outcomes for the overall system. Services are really about access, the idea that people want access to services instead of simply the ownership of products. This is why the Services economy goes hand in hand with networked information technology. Information technology and online platforms enable us to easily and cheaply coordinate the exchange and temporary usage of resources, thus working to make access easier and cheaper than ownership. In this way, extra capacity can be created through more effective organization instead of actually producing more products. A sustainable economy would be one that is able to focus its innovation and resources, not on producing more products, but on delivering greater functionality through the intelligent coordination of existing resources.

A sustainable economy would be one, where we manage for the whole lifecycle, where systems are adaptable and resilient, capable of evolving in response to major changes in the environment. Our economies have co-evolved with the natural environment over centuries and millennia. Many of our industrial systems are adapted to normal operating environments, but these normal environmental conditions may not be present in the future. The natural environment is changing in very profound, unpredictable, and most likely irreversible ways. Within this context, there is a manifest need to shift from systems that are optimized for efficiency within stable and predictable environments, to those that have a much greater level of adaptive capacity, resilience, and are capable of evolving to meet new requirements. Whether we are talking about technology, infrastructure, or social institutions, the centralized systems of organization we developed during the industrial age are inherently static. They are built once and then go through a linear lifecycle with limited capacity to renew themselves. They were not designed to evolve. The challenge of achieving a sustainable form of development is shifting the emphasis from discrete one-off products to looking increasingly at how they can evolve

through their full lifecycle. This is a fundamental switch in paradigm from designing systems that are inherently degenerative over time to systems that are inherently regenerative. A central challenge that sustainability presents today is in developing organizations and technology infrastructure that have built-in mechanisms to enable the evolution of their overall structure. Sustainable organizations are organizations that can evolve over time. They do not just develop on the micro level of the parts changing, but they are also able to successfully navigate change on the macro level, allowing for the whole system to change. Responding to systemic change requires building evolutionary mechanisms into the fabric of organizations. Unlike our traditional centralized mechanisms for regulation that can respond effectively to relatively small scale changes, evolution is the only way for a whole system to respond to a macro level change. Evolution is a distributed process. No one is in control or can be in control. It is a process whereby many diverse possible solutions have to be tried before the best solutions can be identified. It is a process that involves both diversity, but also interaction between the system and its environment in order to identify the best options. Much of our systems of organization are built on a linear model where we try to externalize any form of non-linearity as it is inherently uncontrollable in the process. Diversity is dumbed down and pushed outside of the organization. The end result is a short term efficient system, but one that no longer has the diversity and mechanisms for generating overall transformation, thus resulting in a linear lifecycle and unsustainable solutions. Developing solutions that can endure over several life cycles means recognizing the need for this evolutionary process and the need for the diversity that fuels it.

The challenges presented by the Environmental crisis and sustainable development are of a kind that we have not seen before and we do not currently have coherent solutions to. As a famous person once said, we can't solve problems by using the same kind of thinking we used when we created them. Traditional thinking, institutions, and management methods that created the Sustainability crisis will not solve it. As such, the development of truly sustainable global economy would involve a transformation in the deep structure of post-industrial economies to exhibit new functional capabilities. One thing is for sure though, the development of our socio ecological systems will continue to evolve rapidly in the coming decades. Building this new form of sustainable economy will be a massively disruptive transformation, and there will be many surprises and pitfalls along the way, with many widely divergent outcomes remaining possible.