Overview of a systems change approach to climate action

The foundation — Interconnectedness of problems and solutions
The starting point for a systems-based climate action approach is the recognition of the intersecting and interdependent relationships across a range of current crises — climate, biodiversity, public health, equity/social justice. Climate change is most usefully understood not as a problem itself, but a symptom or manifestation of underlying systems that are now incompatible with maintaining stable, flourishing planetary systems—environmental, social or economic.

Because climate change is inter-related in this way, effective analysis of the underlying causes and conditions driving climate change also provides an entry point to identify system-changing strategies that can simultaneously address other crises. For example, rapidly replacing the outdated methane (natural) gas infrastructure in cities with high efficiency electricity systems powered by renewable energy will not only significantly reduce carbon emissions, but it will also eliminate significant public health risks, create new mechanisms to balance renewable energy grids and create millions of new living wage jobs vital to the current economic crisis. Similarly, dramatically increasing the funding to support equity-based urban forestry development can create hundreds of thousands of high-dignity living wage jobs, improve public health and climate resilience outcomes in front-line communities[1], and add significant carbon sequestration capacity to support climate stabilization.

Shared understanding of the problem
A critical starting point in the development of a systems-change-oriented climate action strategy is precise identification of the problem being addressed. To date, climate change is framed as the problem, and carbon as the cause—human societies do things that produce too much carbon, this carbon causes global warming. This is reflected in terms like "decarbonization" or "carbon emissions reduction". While accurate in

Paradigm	Change
Carbon is a Problem	Carbon is a Solution

pointing to the consequences of excess carbon in the atmosphere, this approach has inadvertently reinforced a false notion that carbon is generally bad and that it is the source of the problem. Efforts like the "Post Carbon Institute" or books like "Life After Carbon" imply that the desired future is one with little or no carbon.

In reality, carbon is one of the most fundamental and essential elements for life on the planet. All living beings are made up of carbon, and most depend primarily on simple carbon chain

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[1] Through its involvement with Urban Drawdown Initiative, Boulder has helped launch a national campaign to dramatically increase federal funding directed to urban forestry with a substantial focus on creating new employment and business opportunities in underserved communities. More information about this campaign, including the Mayor's sign on letter signed by Mayor Sam Weaver can be found here.

compounds — sugars and carbohydrates — as one of their primary organic energy sources. Human society's current challenge is its reliance on the concentrated forms of carbon found in fossil fuels, rather than "current" forms of energy—either directly captured from solar and earth-based energies or derived from carbon captured in living systems.
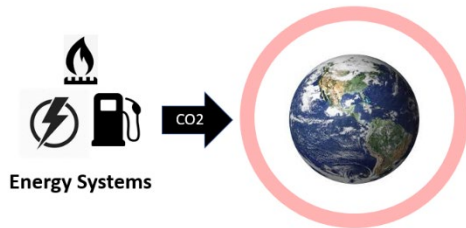
Carbon captured by living systems — both land-based plant-soil systems and aquatic algal/vegetative systems — can be used by these systems to dramatically enhance their biological productivity and resilience. These enhanced biological systems are then capable of capturing even more carbon. These dynamic forms the basis for the rapidly developing field of "natural climate solutions." The resulting living systems are also capable of producing enhanced levels of critical "ecosystem services" — more shade, increased soil water retention capacities, enhanced air and water filtration and increased nutrient density in foods.

The starting point for a transformative climate action strategy is a realization that the problem we need to solve for is how we have designed a system that turns one of the most essential elements of life —carbon — into a toxic pollutant that now threatens the viability of life on much of the planet. A starting point in this process is the identification of key causal factors that are helping to drive the symptoms of systems failure, most notably global warming and climate destabilization.
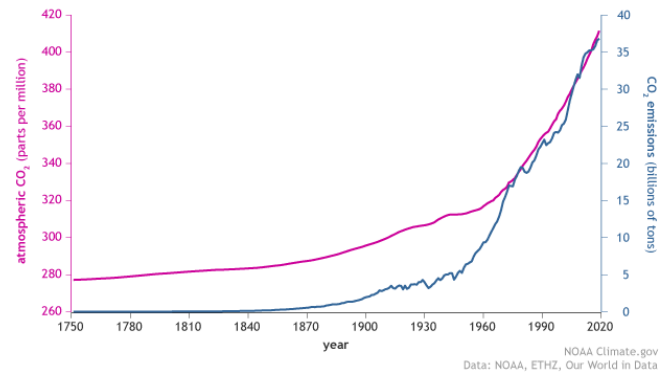
Evolving insights regarding the causes of climate change

<u>Climate change and fossil fuels</u> —The relationship between burning fossil fuels and potential climate change was recognized as early as the 1800s. The advent of the industrial age drove massive increases in highly visible emissions. The demand for higher density fuels like coal for manufacturing dramatically increased both coal use and related pollution. The industrialization of oil and gas extraction in the 1900s then enabled the explosion of fossil fuel-burning transportation and other uses for internal combustion engines. The potential consequences of an exponentially growing population and associated demands for these powerful but, in many ways, polluting energy sources began to be noted. This relationship between fossil fuel use and climate change is often validated by showing the striking similarity between atmospheric carbon and fossil fuel emissions.

Initial Understanding of Climate Change Causes

CO_2 in the atmosphere and annual emissions (1750-2019)

NOAA Climate.gov
Data: NOAA, ETHZ, Our World in Data

As human societies started to recognize and take seriously the potential dangers of climate change in the late 1970s and 1980s, the initial area of focus were emissions generated in the production of electricity — given the substantial reliance on coal for this process. It was also a relatively easy sector in which to estimate emissions because of the relatively small number of energy generation facilities in operation. Transportation-based emissions were also an easily recognized and relatively easily quantified emissions source. Energy use in buildings became a third primary focus. These three sectors became the primary locus of climate action focus for the first 20 years of conventional climate action efforts.
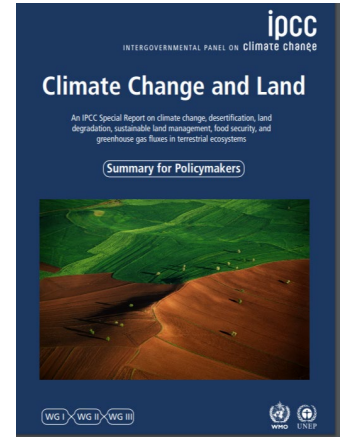
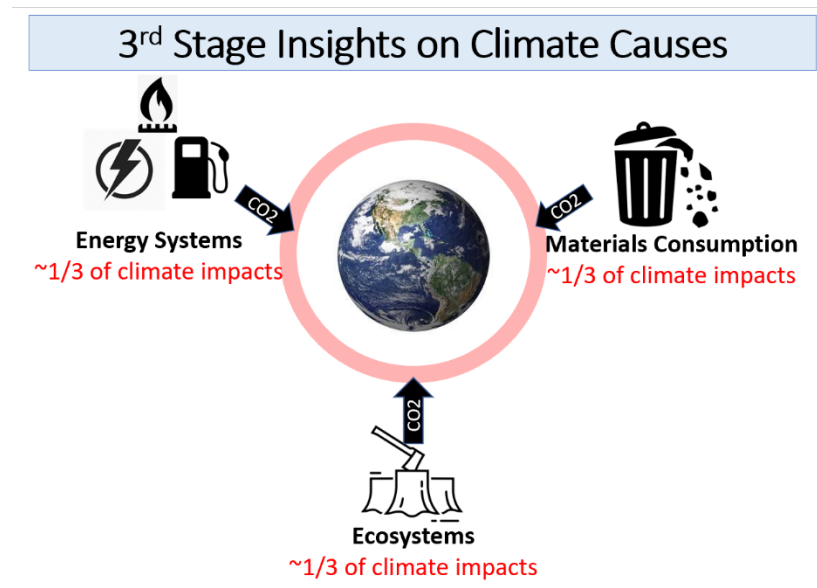## 2nd Stage Insights on Climate Causes

Fossil fuels and material consumption — By the early 2000s, an increasing number of climate activists began demanding greater attention to the role of the consumption-based, growth-oriented economy that was rapidly becoming the dominant economic system throughout the world. A growing number of assessments began to suggest that "consumption-based emissions" could represent as much as 40% of the emissions driving climate change. Leading climate action cities like Portland, Oregon and Washington, DC began developing consumption-based emissions accounting that indicated that, when these "scope 3 (see p. 12)" emissions are taken into account, urban areas were responsible for a much larger share of emissions than when only considering direct fossil fuel combustion. Preliminary estimates of Boulder's consumption-based emissions indicate that fully accounting for these emissions could increase Boulder's actual emissions from approximately 1.4M tons of CO2 to more than 2.2M tons of CO2 — a 40% increase in Boulder's actual emissions responsibilities.

Ecosystem impacts – By 2016 or so, an additional area of atmospheric impacts was beginning to be recognized. Parallel to the industrialization of urban life and material culture, the dramatic expansion in the use of machines in agriculture, forestry and livestock management dramatically changed the scale of human impact on the now nearly 5 billion acres of land being managed for agriculture and forestry. Following a curve almost identical to the use of fossil fuels was the expansion in land management practices that stripped off living vegetation, exposing billions of tons of carbon to oxidation and release into the atmosphere. These impacts have been further magnified by the industrialization of food production such as feedlots and confined animal feeding operations (CAFOs) that also produce huge quantities of methane from animal waste. As the 2019 IPCC report "Climate Change and Land" reported *"If emissions associated with pre-and post-production activities in the global food system are included, (agriculture, forestry and other land use)* ***are estimated to be 21-37% of total net anthropogenic GHG*** *emissions."*

Together, these new realizations point to three primary systems driving the carbon cycle in ways that are destabilizing climate. Each — energy systems, material economy/consumption, and ecosystem management — are likely contributing roughly a third of the emissions driving climate change.
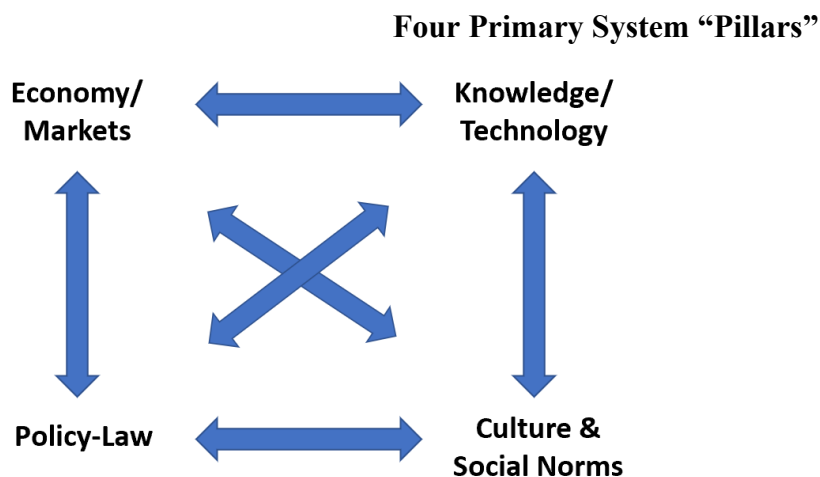

System "pillars"
How, then, are we to change these three primary sources of emissions? As noted earlier, much of urban climate action to date has been focused on trying to change individual behavior. This approach is based on a theory of change that believes that once individuals — or cities — demonstrate that a more "sustainable" lifestyle is possible, it will serve as a compelling example that will result in many other individuals (or cities) taking up similar behaviors/practices.

The 2019 staff memo to city council documents the growing body of evidence indicating that this theory is incorrect. The climate damaging behaviors of individuals (and communities) are encouraged, supported and in some ways almost required given current policy/law and market signals. While it would be ideal if all individuals rode to work in electric mass transit, were housed and clothed in completely recycled materials produced or maintained by 100% renewable energy, and ate food produced by regenerative agricultural practices, most of these actions or life choices are currently more expensive, more time consuming, less aesthetically pleasing and or simply unavailable. We are not experiencing a mass movement to more climate compatible lifestyles because our current system incentives the exact opposite. Until and unless we change the underlying systems to make the "right" choice (most climate friendly, biodiversity compatible, equity/justice supporting) the easy (or only) choice, we will not have the broad scale change now essential to stabilizing climate and retaining a livable world.
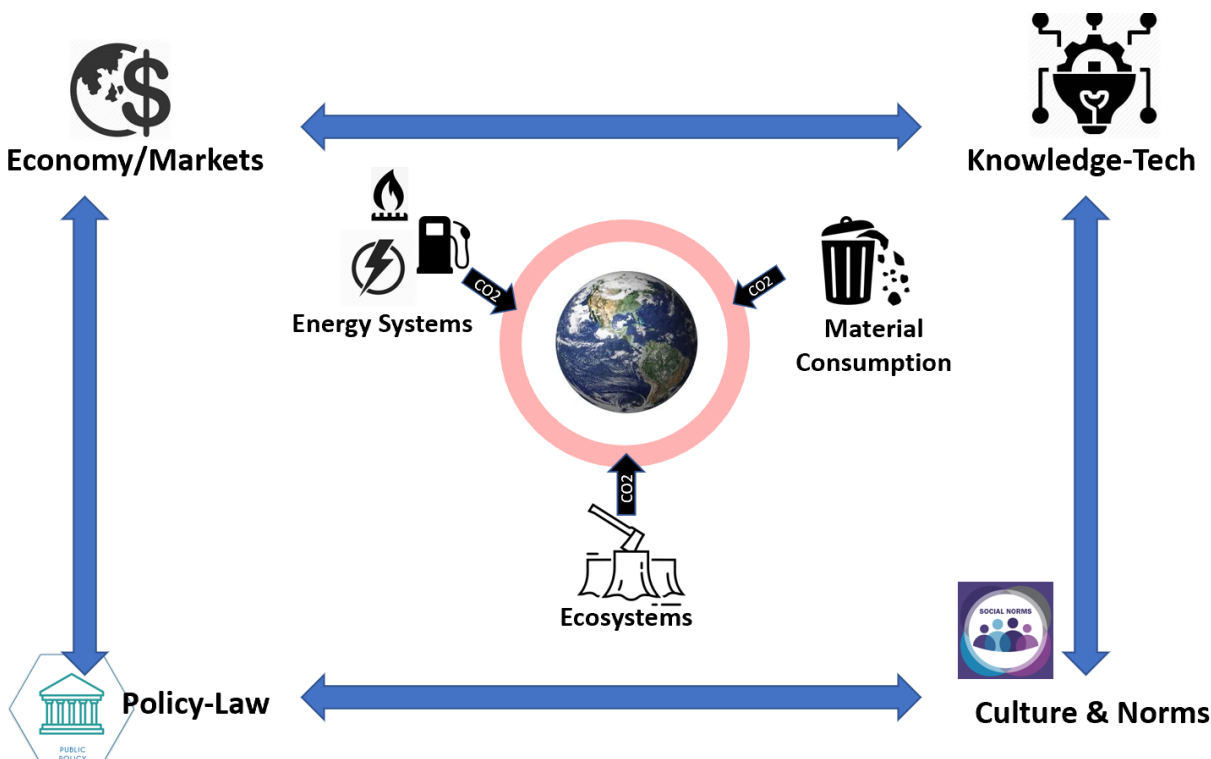
What then drives how the overall system functions and how it enables or disables "sustainable" choices?

The field of systems change frequently identifies four primary forces that shape the larger context within which individuals and communities make choices: the social rules (policy, law), the market (economic structure and policies), the state of knowledge and technology, and social norms and culture.

Four Primary System "Pillars"

As the arrows indicate, each of these forces is itself a system that is in dynamic relationship with the others. Policy and law sets the boundaries for what is allowed or disallowed in markets. Social norms and culture shape what types of laws are created or maintained. The existing state of knowledge and technology shape options and capabilities, and markets — and the marketing systems created to support them — can in turn shape public perspectives and preferences in ways that lead to changes in the rules governing the markets. Therefore, to make fundamental systemic change to the factors currently driving climate change, we will need to focus society's attention

on changing the underlying rules, market dynamics, available knowledge and technology, and social norms and larger culture that ultimately enable or disable climate stabilizing actions. Since these are in many cases the same factors driving other crises we face—social inequity, biodiversity, public health—this systems approach has the potential to be an intersectional solution to multiple social challenges.

The integration of the both the causal factors identified earlier and the system pillars just described can then be portrayed in this way:

Together, the system pillars and their subsidiary human systems (energy, ecosystems, material flows) give rise to climate change and other crises. By creating this systems map, we can start to see the "<u>where</u>" and begin planning transformative intervening actions.

The underlying theory of change driving this climate action strategy is that climate stabilization — and addressing a number of other emerging existential crises (biodiversity/extinction, equity/social justice, toxics escalation) — depends on changing the underlying system pillars in ways that drive subsidiary systems to produce the outcomes we want. For example, non-recyclable plastics must become expensive to produce or illegal to use. Food and other products produced through regenerative, carbon capturing practices should become less expensive than those from conventional practices as the full costs of these unsustainable practices are brought into their product prices. Electric-based transportation must become the cheapest, most readily available, and highly appealing transportation options, while fossil fuel-based systems must pay an increasing tax for their continued use.

Innovation to drive change

In many cases, this means dramatically accelerating the development cycle of new approaches in each of the three major emissions sources. Boulder, and other well-resourced communities, can play an important role in leading in the innovation around new approaches.

Changing law/policy (the "rules")

These innovations then provide the basis for changing underlying policy/laws that provide the appropriate incentives for accelerating their adoption through compatible market signals (prices, fees, etc.). Boulder and Boulder County's work with the Colorado Communities for Climate Action (CC4CA) is an example of this sort of innovation-to-policy pathway. Many of the significant policy initiatives that CC4CA has helped champion adoption for at the state level have grown out of early-stage innovations developed by the city, county and other early innovators.
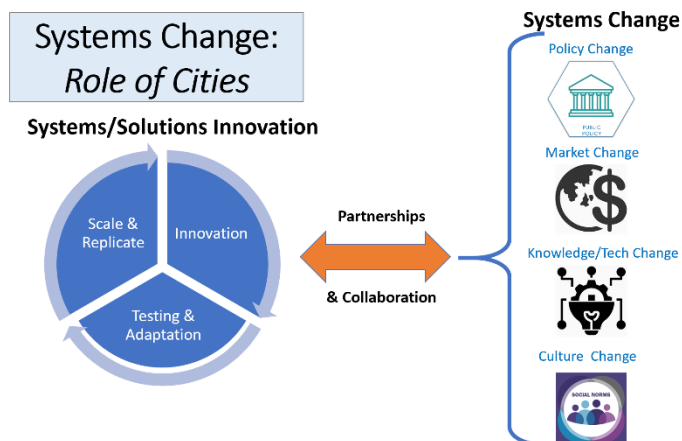
Changing markets

We live in a society largely driven by the signals we receive from the market — what something costs, how easy/hard it is to access, whether its use/consumption is supported by available services etc. These market signals and choices are largely determined by the rules (law/policy) that ultimately shape the costs of production and distribution of these products and services.

Fossil fuels are cheap because the current policies and laws enable the many externalities their continued production and use create can be avoided by those who produce and distribute them. Plastics are the norm in packaging because their many long-term impacts have not been accounted for. Food production dependent on the widespread use of toxic chemicals in agriculture continues because the rules both allow it, and in many cases, almost require it.

Changing the causal factors of climate change — fossil-based energy systems, consumption-based material use, ecological degradation — will require new market signals that are, in turn, created by establishing different rules within which the economy must operate. Examples of local jurisdiction market impacts include large scale multi-government EV purchasing, solar procurements, and energy services contracting. When exercised in consortiums of other local jurisdictions, joint local governments procurements have potentially significant abilities to shape both product availability and specifications.

Changing knowledge and technology

Cities and other local jurisdictions can often play a significant role in developing and testing new approaches that build critical knowledge and, in some cases, pioneer the use of new

technologies. During the 2008 economic crisis and associated economic stimulus funding, cities and counties we significant players in the development of new knowledge and technology deployment associated with energy efficiency. The market for these technologies and services was substantially transformed by both the early-stage piloting and later coordinated market demand for a wide range of both residential and commercial energy efficiency. Boulder has again been a pioneer in this approach using strategies like its "Boulder Energy Challenge" and other mechanisms to catalyze technology and services development that are now being deployed in many other places around the Country.

Changing norms

Changing systems will also require the public sector to engage in even more vigorous and robust efforts to initiate the social dialogue that begins to influence broader cultural and social norms. If the innovations and new behaviors that must be adopted to stabilize climate (and address a host of other system-induced breakdowns) are not widely understood, embraced and accepted, the social resolve to adopt and maintain the policy that drives markets will not be sustained.

Systems change is a community-wide opportunity

A key distinction from past climate action approaches is the shift from focusing on expecting individuals to assume these new practices or behaviors and instead recognizing that large-scale adoption will require more fundamental changes to the forces shaping individual (and community) choices and behaviors: law/policy, markets, availability of knowledge and technology, and norms and culture. While local governments have a unique and potentially powerful role to play in shaping systems, there are equally important roles for the other major sectors of our local community. *Table 1*, below, illustrates opportunities for system change actions across a range of community sectors — individuals, businesses, academic/educational institutions, and non-governmental organizations.

The development of a systems-change-oriented climate action strategy arises from the increasingly obvious failure of past approaches to stabilizing climate. It is clear that a new approach is needed to avert increasingly catastrophic climate change impacts. At the same time, we are at the very beginning stages of trying to understand and articulate this new approach. There remains a huge amount of both strategic and practical work to build on the systemic approaches already emerging and begin to codify and expand their application. Boulder is once again on the leading edge of this work, particularly in recognizing that this is work that must be done in coordination and alliance with many other actors — other local jurisdictions, state and federal agencies, the business community, and our academic and non-profit partners. It is our community's foresight and appetite for bold initiatives that will enable us to engage in what must become a system transforming field of action.

Table 1: Opportunities for system change actions across sectors

	SYSTEMIC CHANGE ACTIONS MATRIX				
	PUBLIC SECTOR	**PRIVATE SECTOR**	**NGO**	**ACADEMIC**	**PERSONAL**
Public Policy	• Local codes-ordinances • State and federal legislative advocacy	• Collaborative policy development • Advocacy for even playing field policy change e.g., carbon tax	Policy engagement • Analysis and education • Policy development • Monitoring and reporting	• Policy analysis • Data gathering/analysis	• Participate in policy development • Communicate with other residents • Vote • Participate in movement organizing and political campaigns, and demonstrations
Financial Systems	• Investments (municipal, employee pension) • Procurement • Financial services (who we do business with) • Funding innovation	• Investments (municipal, employee pension) • Procurement • Financial services (who we do business with)	• Investments (municipal, employee pension) • Procurement • Financial services (who we do business with)	• Investments (municipal, employee pension) • Procurement • Financial services (who we do business with)	• Investments (municipal, employee pension) • Values-based purchasing • Financial services (who we do business with)
Culture Story Beliefs/values	• Public education • Facilitation of dialogue	• Communicate values	• Create cultural programing	• Create educational programing • Research social values & narratives	• Communicate values through media engagement • Support initiatives aligned with cultural change
Innovation	• Pilots • Ongoing programs • Funding of innovative startup business, specifically in the phases of ideation and concepting	• Implement climate "smart" internal policies e.g., efficiency, energy sources etc. • Research and development (product materials, manufacturing processes, etc.)	Program implementation • Design • Management • Evaluation	• R&D around technology or services • Pilot project development	• Communicate with fellow residents • Participate in pilots/actions • Serve as an early adopter of new technologies