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## Title Page

- ***Title*:** **Managing a Low Urban Emissions World**
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**Abstract**

We have largely ignored serious organization and implementation issues blocking greenhouse gas emissions reductions at the urban level. Most urban climate policy and financial measures treat decision-making as a black box, where sensible solutions will simply be implemented. Rarely is question asked: are current institutions actually up to the job? To understand this, we need to re-examine implicit theories of change that reflect how city governments and businesses actually behave and make decisions, and are current plans credible? Significant constraints affect both groups and also limit citizens' abilities to effectively shape needed policies and investments. These problems can be addressed by creating a trusted, independent organization to drive innovation and implementation to reduce emissions and moderate urban inequality. This "Lowering Emissions Economy Partnership (LEEP)" can be jointly owned by local stakeholders who could pool investments and recover a small share of the large energy, waste and water savings this approach will create. Any city could set this up, drawing upon a range of start-up capital options. The LEEP's professional, trusted, independent platform can foster more rapid, effective collaboration among government, business, and citizens groups. This reduces a number of political and financial risks, and it can accelerate emission reductions in a more just, sustainable way.

**Keywords:** Urban climate policy; sustainable cities; urban economics; urban governance; urban climate finance

**Highlights:** The paper unpacks theory of change assumptions behind much local climate change management, making explicit the constraints affecting how governments, businesses and citizens collaborate. The paper suggests why focusing on finance or technology will not address these constraints. Rather, a new kind of local partnership organization is needed to drive urban emissions reductions. The paper explains how this can operate, what it will cost, how it can be funded, and how all this responds to Covid pandemic, and other financial and geopolitical aftershocks.

**Declaration:** I am the sole author and point of contact for this paper and have no financial or other interests that affect or compromise the paper's writing, references, or conclusions.

# Managing a Low Urban Emissions World

> The real problem of humanity is the following:
> we have Paleolithic emotions,
> medieval institutions,
> and God-like technology.
> - Edward O. Wilson (2009)

## 1. INTRODUCTION

While Covid and Ukraine and Middle Eastern war shockwaves continue to reverberate, $100 Trillion, perhaps the largest concentrated spending in history, will be needed for global urban infrastructure investment through 2050, based upon a number of credible government and banking estimates.[1] Beyond supplying roads, water, mass transit, telecoms, more resilient health systems, and energy, this investment needs also to reduce greenhouse gas (GHG) emissions, and to support more equitable housing for hundreds of millions of people migrating to cities.

Especially after the Covid pandemic, trillions are available at reasonable though higher interest rates and yet accelerating the pace of climate and infrastructure spending continues to be difficult. The $2.5 Trillion currently spent globally per year is half of what is needed. Large new U.S. government infrastructure and climate spending is actually spread over 10 years and the measures will take time to implement. Some key coordination aspects, particularly permitting and grid expansion, remain unclear, as well as how temporary are slowdowns in electric vehicle and wind turbine sales. The U.S. Congress could still revise spending and other aspects related to potentially huge tax credits over time.[2] Actual disbursement of vast, approved public European recovery and development funds has lagged for years.[3] On the private side, investment managers constantly complain "there are simply not enough viable infrastructure projects out there", as noted for over 50 years since at least the creation of the International Finance Corporation.[4]

Meanwhile, we are on track to miss global emissions reductions targets to keep warming below 1.5° C by a wide margin, with many sectors needing an increase of effort of *5-10 fold* over the pace of their current reductions to stay near the target. The 1.5° C ceiling is likely to be at least breached by 2027, and several projections suggest the entire "carbon budget" remaining to have a 50% chance to stay at 1.5° will be exhausted by 2030.[5] Moreover, evidence is mounting that current long-term climate models underestimate the actual rate of warming, the rates of polar, glacier, and permafrost melting, the rates of release of GHGs (especially methane), how this may disturb movements of ocean currents, and how even the 1.5° target may risk triggering irreversible, cascading "tipping points" whose thresholds may be changing.[6]

Paradoxically, we are floundering despite having existing, affordable transition technologies, sufficient and cheap capital, extensive knowledge of what to do, and even a broad consensus on what it will cost.[7] What we do not have is a clear sense of *how on earth* a*ll this will actually get done?*

As a range of renewable and energy storage technologies become cheaper, market forces will increasingly underpin parts of the transformation.[8] But these need to be buttressed by policy and organization. At the moment, global emissions reductions emerge from a complex set of voluntary national commitments and industry agreements because at multiple levels, this *ad hoc* mix is what is politically acceptable.[9] To be effective, some measures, e.g. carbon taxes, carbon trading, better emissions reporting, carbon import tariffs, and a vast upscaling of inter-connected, load-balancing smart electricity grids, need to be implemented at the national, if not continental or global levels. Some measures will require a deepening of industry-wide agreements, common financial reporting, and shared development costs, especially to shift steel, shipping, aviation, plastics, cement and agricultural production (not merely the energy this uses, but also the production chemicals) to zero lifecycle emissions processes.[10]

Whatever emissions targets nations agree to, ultimately, this needs strong implementation at the urban regional level, which is held to "account" for up to 70% of global greenhouse gas emissions.[11] With many

national governments in political turmoil even before Covid, with international climate cooperation under strain, and with little consensus about how to manage these higher levels of climate governance, "cities" are increasingly seen as the front line to solve serious social and environmental challenges. A review of recent literature tell us that cities "should" design, finance and implement all sorts of integrated, inclusive, systems solutions.[12] To judge the realism of this view, we need a deeper look at how different urban regional actors actually behave, and how much influence they have over emissions.

## 2. THEORIES OF CHANGE

Emissions and energy modeling, policy, and finance work simply assumes that existing organizations which manage resource use are up to the tasks, tasks they just need to get on with. The models and policies show the effects of decisions made rationally and which are then implemented in some least-cost, utility-maximizing fashion.

Though rarely acknowledged, there are actually two implicit competing theories of change that describe decision-making to reduce urban greenhouse gas emissions:[13]

1. ***"Bright Lights, Big City":*** *Existing organizations-governments, businesses, citizens groups are fit for purpose****;*** we just need to tweak some prices, incentives or taxes, regulations and reporting standards, and the changes needed will occur organically, at the scale and speed needed. The transition is already occurring within progressive regions and organizations. These organizations behave and make decisions in rational ways that simply need better guidance and reinforcement. The necessary engineering and financing will come together in some coherent fashion. We need merely to encourage behavior via markets, or through the right policies, tax and lending incentives, and price signals, and then communicate, and replicate results.

2. ***"Darkness on the Edge of Town":*** *Governments, businesses, and citizens groups suffer from complex competing interests and deep structural constraints*, none of which will self-repair via markets and new finance, and all of which limit organizations from cooperating effectively. In addition, we need to integrate technical systems to a degree that has no historical precedent, and certainly not at the scale and speed needed. We have to do this within a very difficult political context dominated by polarization, inequality, medical and financial stresses, and a mistrust of experts, all of which affects how these groups behave and make decisions. This all argues for a new approach, and a new type of organization to rebuild trust and drive the rapid innovation needed.

Some cities may experience bits of both of these change theory archetypes, depending upon the particular department or branch of government or business, and local political and legal culture etc. But as explained below, a number of reasons suggest strongly that the second theory more accurately describes the situation at the urban level.

At the moment, this decision-making issue is largely ignored, treated just as a black box, and something that just needs tweaking to fix. We need e.g. "green funds", "a stronger enabling environment", and "more infrastructure deals", and "blended finance" so "cities" can do things. A strong, wise mayor commits to emissions targets and this makes it so. Citizens, businesses, and property developers rejoice using new smart technologies. Levels of government cooperate; building, land use and traffic regulations align. City governments take on more debt but manage risk, banks and businesses will swarm in, and viable low carbon infrastructure projects will be implemented, as carbon prices and markets will work their magic. Growth can become inclusive, and use nature-based solutions.

In almost all of the world's cities, these assumptions are completely unrealistic. They were unrealistic before the Covid disruptions; they are even more so, now. Given this, it is worth asking a question rarely asked: are our local institutions actually up to the job of managing a rapid, equitable transition to a low emissions world?

## 3. FACTS ON THE GROUND

Let us start with a closer look at how city governments and business organizations make decisions and collaborate. On a good day, most urban government departments operate in "silos", fighting over strategies, budgets and policies. Salaries and work environments struggle to compete with more attractive private sector conditions, leading often to politicized staff-churning, and even corruption. Complex tendering regulations work against least-cost, integrated solutions; e.g. even progressive Boston took over 5 years negotiating within its own government bureaucracy to approve least cost power purchase/energy efficiency agreements for a dozen of their city-owned buildings.[14] Building and zoning codes are often manipulated by local elites, even in developed economies.[15] Government is often not regarded as a competent, neutral party able to balance fairly technical, financial, and social interests.

In normal times, most city government revenues are hard-pressed to just keep the city running; the direct and indirect costs of Covid-triggered remote working, Ukraine and Middle East war-related supply disruptions, damages from extreme weather, and increased inflation and interest rate are dramatically stressing city governments' resources. Urban finance is rarely strategic, but rather an opportunistic mishmash of local property taxes, permit fees, loans, and a large dependency upon national transfer grants.[16] Capital market access remains difficult, even as cities are forced to spend more due to central government cutbacks. City government's ability to take on more (or in many places any) debt pushed by new "green" financing instruments face daunting obstacles.[17] All these political, financial, and management constraints are even more serious in smaller cities, where some models suggest up to ¾ of the global urban emissions abatement opportunities exist.[18]

There is a great deal of interest to develop new financing mechanisms and to increase the credit-worthiness of city governments to ease some of the strain on city budgets to try to boost investments in climate adaptation and mitigation.[19] While some of these measures mention the need to strengthen capacity and to provide "loan preparation facilities", these financing efforts understandably still concentrate efforts upon city governments, and implicitly view gaps as technocratic, regulatory problems. The assumption is if we provide city governments with more project finance, get national government policy to support this, strengthen the "enabling environment", etc., things will sort themselves out, many bankable projects will emerge, and bankers can deal with much higher volumes of bundled, standardized lending. However, such ideas have been around for decades.[20] A recent study noted that of 500 of the world's largest cities in developing countries, only 98 are of investment grade.[21] Given all the serious constraints discussed above, proposed financing changes are unlikely to result in a quantum leap in climate-related lending to cities

Governments also face fiscal pressures working against emissions reductions. Particularly in developing countries, significant city government revenues often depend upon selling government-owned suburban land or levying a surcharge on electricity tariffs. This creates huge disincentives to reduce urban sprawl and energy consumption. US and EU vehicle pump set taxes fund a fair bit of road maintenance; this will need to be re-thought when most vehicles are electrified and if the total number of vehicles eventually decreases due to car-sharing.[22]

We will return to finance shortly, but first there are issues about which emissions can city governments actually manage or influence? While cities "account" for up to 70% of greenhouse gas emissions, city governments have surprisingly limited influence over these emissions. The Stockholm Environment Institute (2014) modelled 600 cities implementing best practices in better building codes, densely settled transit hubs, energy efficiency retrofits and solar arrays on city-owned buildings, capturing waste dump methane, water and waste recycling, etc.[23] The results showed emissions are reduced by only 15% of the amount needed to keep warming below 2° C by 2030. More recent research suggests city "emissions commitments" might lower 2030 global emissions by 30% of the total target.[24]

A review of this data indicated urban governments can impact 17% of the emissions within their geographic boundaries, but they share responsibility with state, provincial and nation governments affecting an additional 19% of urban emissions.[25] Analyses (pre-Covid) of US state, local government,

and business current emissions reductions commitments suggest a reduction of 25% by 2030, with a *possible* 37% reduction if more subnational actors coordinate and intensify efforts.[26] A 2023 study of hundreds of European cities' plans suggests that together, these will reduce European emissions by 11-12%.[27] Finally to complicate things further, there are questions about the quality of city self-reported emissions data, which has been shown to be at variance with more rigorous air modelling and sampling.[28]

Often city government emissions plans are actually very dependent upon higher levels of government or business interventions, such as critically, regional/national grid electricity supply shifting to low or zero emissions sources, or national vehicle standards compelling zero emissions fuel sources and vehicle delivery. These may or may not occur in a timely fashion; if they do not, cities would be forced to offset emissions to meet targets.[29] City governments face complex regulatory, fiscal, and political constraints imposed by higher levels of government. Thus numerous studies show current city governments' efforts, under the best of conditions fully financing and implementing all plans and using best technologies, *might* get us to around a 25-30% reduction in global emissions (vs. the 50% needed to stay at the 1.5°C warming level) by 2030.

Moreover, city governments have little control over harder to decarbonize sectors (steel and cement, and long-distance transport) which cause up to 30% of global emissions.[30] If we count net emissions including cities' imports and exports, cities' effective "consumption-based" emissions go up 30-300%, with only limited ways to impact the supply chains involved.[31]

Finally, city government "climate action plans" are inherently political documents, and city governments are cautious about discussing sensitive details of climate actions that affect taxes, investment, living costs, long-term competitiveness and disposable income, and how these are borne by different interest groups. Of over 850 cities reporting emissions in 2020, less than half reported city-wide emissions reductions targets or emissions reductions plans.[32] A review of Swedish "climate city contracts" shows that these contracts are neither binding nor do they yet have detailed investment plans, which are put off until a later phase.[33] City climate plans often rely upon other levels of government or the private sector, whose funding and behaviour is by no means guaranteed.

Many city climate plans are often well-intentioned "spreadsheets of ambitions". Climate plans often show what needs to be done at a high level, what could be done, contain lots of energy and emissions data, and have a number of useful projects underway. But they remain very vague on details that investors and citizens need to know.

This is a disturbingly common problem. Upon a closer reading of a sample of plans from more than a dozen important cities, it is rarely clear how planned measures suggest detailed annual *ex ante* targets over time. More worrying, there are no cogent summaries of what are overall net annual costs of proposed measures, how all this gets paid for and by whom (so "buy-in" is literally clear), how dependant plans are upon other levels of government or companies, and who must do what to implement, enforce and verify all this.[34]

For example, Vancouver's climate plans (2020, 2021) repeatedly estimate there is at least a ~$100M financing gap constraining implementation. Critical choices are sometimes kicked down the road, e.g., London's plan (updated 2022) when the choice of whether to build decarbonized heat grids or a massive roll out of heat pumps may emerge by 2025. San Francisco's plan (2021, p. 323) suggests that a useful *next* step would be to "do detailed costing of all measures and how they might be financed". New York city plans to "start" doing detailed climate budgeting in 2024 (2023, p. 16). Bristol, UK admits its "One City Climate Strategy" is "not a delivery plan and does not plot the route to achievement…as city partners have been unable to find the resources to lead delivery action beyond their own responsibilities" (2023, p.4).

This is echoed in a 2023 survey of data based upon self-assessments from 362 European cities of all shapes and sizes, which concluded:

> "…over 70% of the cities have not yet estimated—not even roughly—the total investment needed to become climate neutral and the majority (i) have experience in financing only a few specific climate projects, (ii) are ill-equipped to tap capital markets, (iii) have developed only marginally co-financing with the private sector, and (iv) have taken no steps to establish an investor-ready pipeline of projects contributing to climate neutrality".[35]

As a result, many city efforts are slowly falling behind 2030 commitments, even before the effects of Covid and subsequent supply, property tax, and revenue shocks are included. The striking lack of easy-to-understand, credible summaries of all these issues, their financing, and lack of evidence of 3rd party verification undermines investor support and can only fuel citizen mistrust.[36] This lack of clarity increases the already all too likely odds that the 50% emissions cuts needed by 2030 will be very problematic to achieve.

There is much innovative, creative work occurring in cities and these efforts will continue to be important as national climate policy and international climate agreements remain insufficient to keep warming below the 1.5° C target. But there are simply limits to what traditional city governments can do, regardless of their enthusiasm, or their interest in deeper issues like reducing demand for materials flows to create a more nature-based "circular economy", to deliver ambitious emissions reductions.[37] To really have an impact on reducing greenhouse gas emissions, city governments have to go well beyond cooperation and instead *co-develop* solutions with external, private groups, whose separate activities and independent behaviour is beyond direct city government control and influence.

## 4. OTHER ACTORS

City governments and businesses talk constantly about cooperating to address climate change and to more effectively harness the vast power and capacity of business, and there of course numerous examples of how this has been done.[38] But more often, businesses and city governments circle each other warily, worrying about high profit margins, dependency upon sole source technologies, incoherent policies, and charges of cronyism or political meddling. Businesses are concerned about endless, excessive meetings to get city government departments to speak with a unified voice, with clear contractual obligations that will not change with a change of administrations. Businesses and investors have little interest in funding critical soft, upfront development costs that may never be recovered and which may potentially benefit competitors.

Due to conflict-of-interest perceptions and regulatory concerns, it is difficult for businesses to help shape the nature of an urban government's tender or request for proposal at the prefeasibility design phase, even when using private sector expertise would benefit all parties. Even amongst themselves, businesses find it difficult to cooperate to supply integrated, optimal "whole systems" vs. those which maximize the profits from their particular piece of the supply chain.[39]

All these conditions create what economists call a "Nash Equilibrium", where none of the players has sufficient incentive to cooperate or to move first to fix a problem.[40] This impasse, which probably explains a fair bit of the lack of progress reducing emissions, only increases citizen distrust and despair, risking ever more populist, even violent responses. Existing worries about uncertain employment, stagnant incomes, affordable housing, and now managing the financial effects of post Covid changes and two on-going wars, will all be turbo-charged by water, heat, flood, and crop stresses, prolonged supply chain issues, and likely additional disease waves from accelerating climate change.

Thus, we have seen an increase in populist backlashes against climate-related measures, such as the "*gilets jaunes"* protests against diesel price increases in France, Dutch farm protests over more stringent nitrogen use controls, and increased local opposition to shifting to heat pumps and approving wind turbine siting permits in Germany.[41] In progressive, innovative California, legislation was blocked for decades that would allow denser, more affordable housing development around transit hubs, due to a lack of consensus among citizens and property owners.[42] Even ignoring a range of related social problems, sky-rocketing central-city housing costs in almost any major city have pushed the poor and even middle classes to ever longer commutes, causing increased congestion, increased energy

consumption and emissions. Rather than providing affordable housing at scale, what should be walking, bicycling, or a simple mass-transit commute may compete with thousands-millions of electric, semi/fully autonomous vehicles with all the emissions associated with their production, use, and disposal, increased congestion, and a further undermining of public transport finance.[43]

A range of engineering and financial solutions that reduce emissions are of course a critical part of the mix of tools needed. But we are deluding ourselves if we think we can simply apply technology or finance in some vague technocratic fashion (the "plug and pray" method) to sort out complicated emissions problems that are intimately connected with deeper social issues.[44] Citizens have plenty of reasons to be wary of government and business and to demand more accountability and involvement in important policy and investment decisions.[45]

To accelerate emissions reductions while dealing with this mistrust of government and experts, we also need to overhaul public research and demonstration support systems that ostensibly create new markets, jobs, promote citizen participation, and stimulate urban innovation to manage climate change. Both the US government and the European Commission (EC) have together spent well over $2 billion on such activities over the past 10 years. It is difficult to find credible, third-party evaluations of these programs that show clear, verifiable results (using transparent, benefit-cost analysis) that show why the financed projects made strategic sense, why they needed central government funds vs. other sources, how citizens helped shape investments, and how these resulted in significant, permanent, replicable, long-term emissions reductions at affordable costs.

Instead, much of this money was and is being spent on disjointed research or engineering demonstration projects, rather than building any sort of permanent, professional long-term capacity to innovate, to trigger large-scale investments, and to create permanent markets and jobs. While obviously some of this vast R&D work is useful, too often, it supports conclusions such as: "Finally, the urgency and complex character of climate change require trans-disciplinarity *(sic)* and engagement with social movements, knowledge brokers, and change leaders."[46] The scattered, vague uses of these climate research and demonstration funds reflect a mind-set that needs to be changed fundamentally if we are to make real progress reducing emissions while strengthening local economies (discussed further in Annex A).

## 5. A TRUSTED INTEGRATION PLATFORM

We must avoid the mistakes of the 20th Century, where energy, water, sewage treatment, housing, transport, building codes and land use systems evolved from a haphazard, often brutal jockeying among electricity utilities, oil companies, automobile and mass transit companies, property developers and governments, all pushing their particular narrow solutions in ways that created the very problems we now need to solve.[47]

In many ways, this experience resulted from what Charles Lindblom described in his influential paper "The Science of 'Muddling Through'".[48] Lindblom and various "bounded rationality" colleagues argued that a disjointed, incremental approach is a useful, effective way of making decisions, investments, and policies given changing interests and the limits of what can be known in a complex world. This argument has been refined recently to include "experimentalist governance" and coalitions of the willing, especially at the sectoral level, as a way to manage emissions reductions.[49] However, the incremental "muddling through" approach reaches its limits when special interests can exercise veto power, and when confronted by complex long-term investment decisions or crises that require integrated solutions.

The alternative is not to call to for some sort of central planning, or complex unworkable international investment coordination, or to demean the important, needed work of sectoral technological innovation. Rather, we have to recognize that Incremental change will simply not deliver the profound, rapid restructuring needed to manage climate tipping point risks, nor to get to a 50% reduction in emissions within 7-10 years, nor is it likely to lead us to net zero emissions by 2050.[50] The changes needed require an important intervention, particularly at the urban regional level.

The new low-emissions world must integrate systems design far better to generate and use energy, manage water, and process food and wastes. Buildings, vehicles, farming and sanitation systems must generate and share electricity and probably hydrogen, supported by land use planning, to reduce costs and emissions. "Whole systems" design can potentially keep us below 1.5° C warming while accommodating economic growth and generating huge savings.[51] But the integration needed goes well beyond extending a sewer or light-rail line. It will not simply emerge by selling more electric cars and solar PV roof and home battery systems, or by working more from home (for those whose jobs might allow this). It will require a new mix of incentives and shared costs and benefits, and a new political consensus that is not occurring on its own or at the necessary speed.

Conventional top-down or back-room measures will not credibly address all the serious organization and implementation problems discussed earlier. Indeed, their presence is central in explaining why progress on reducing emissions remains so slow. We often hear vague calls to "strengthen capacity", to allow "cities" to make better decisions and lead to increased access to finance.[52] We need to think harder about what capacity, whose capacity, and how that capacity will actually get used. There is no shortage of studies, slogans, pledges, and commitments that suggest what should be done. What is missing is clear lines of responsibility and accountability that show who specifically will do what and when; who will manage design, finance, and implementation in specific locales, and making sure they have sufficient political, financial, and technical resources to implement the transition and bring all the necessary pieces together.

Fitting all the pieces together is complex and expensive. It took a 4-person team at the World Economic Forum over 6 months to help Melbourne, one of the most well-networked and respected cities dealing with climate issues, just to connect with financial institutions to discuss a financing a large battery storage project. The staff time involved approached 0.1% of the project's value, to manage transactions costs. Miami's climate adjustment planning is literally drowning in transactions costs.[53]

We need a proper strategy, based upon a credible theory of change, that addresses the difficulties governments, businesses and citizens groups face trying to collaborate. While a lack of finance is an issue, the deeper problem is to how to change the nature of decision-making. Even if national governments somehow allowed local governments to take on vastly more debt, all the deep, structural capacity problems (discussed above) and mistrust that constrains working with businesses and citizens groups will still remain. A new approach is needed to bring the players together, to professionalize work, to give citizens a more active, creative role, and to create a strategy and support innovation and projects that can be rapidly financed, implemented and scaled up. Neither businesses nor city governments can deliver this, on their own. We cannot use 19th Century organizations and management to solve 21st Century problems. Ignoring this is treating "inconvenient truths with a convenient fantasy".[54]

We can start by creating "Lowering Emissions Economy Partnerships" (LEEP): an urban-region group of business, local government, and citizens' organizations that jointly develop, cost out, and propose equitable, low-emissions solutions to private finance and government, and then help manage implementation. This is not to provide finance and management capacity, or push debt and risk off government balance sheets like a more traditional Special Purpose (financial) Vehicle, an Energy Services Company, or Private-Public Partnership.[55] Rather, a LEEP's purpose is to build trust, develop consensus, reduce transactions costs, and drive innovation.

A LEEP would be an independent office with a small, diverse, skilled management team. It can think and invest strategically to develop a fully funded implementation plan to enable an urban metropolitan region to meet needed emissions reduction targets: a 50% drop by 2030, and net zero emissions by 2050. A LEEP would raise seed capital, potentially manage large city innovation funds[56], and it would support needed legal and technical work. A LEEP would be governed by a diverse board comprised of a city's key public and private stakeholders (possibly including a representative from a regional or provincial government if helpful). Such diversity helps ensure that the investments in emissions reductions strengthen the local regional economy, its social fabric, and its finances.

The LEEP can begin to manage emissions flows from the metropolitan region vs. only a city government's legal geographic boundary. A purpose-driven organization such as a LEEP can address regional resource flows in ways city governments cannot.[57] A LEEP provides a less formal work space and more options to involve citizens, to allow businesses to cooperate in early pre-feasibility planning, and to finance and fit the pieces together in a coherent way. Different regions and cultures will have different solutions about how best to configure a LEEP, how to select its members, how to make them accountable, and the degree to which a LEEP can act independently. Who sits at the table and who defines agendas are of course complicated, critical issues, as is the degree of openness and honesty of local political and economic cultures. These issues are always present in public and private institutions. But all urban areas have a clear sense of who are key local stakeholders, and a fair, public, transparent, accountable selection process can be developed if the fundamental choice is made to do so. A city government, a group of businesses, a university, or a citizens housing or environmental group can act as the initial catalyst or convener, starting informally, publicizing organizing events widely to encourage participation and a sense of legitimacy. Membership can become broader and more formalized over time, as the group sees fit and as confidence and finances grow.

As much as possible, the LEEP should be an independent, professional, neutral entity that all parties trust so it can reduce far greater emissions than those under government influence. Governments still retain final legal authority over many decisions, and would be an active member of a LEEP, so they will retain oversight and power over a variety of decisions. But if they are serious about stimulating the transformation needed, urban governments need to view themselves as a catalyst and *a* player vs. *the* key driving entity in local emissions reductions. As discussed earlier, there are a variety of organizational, legal, and asset ownership constraints that support this judgement. This somewhat nuanced view of political and economic power is the reality that local governments need to accept if we are to achieve rapid emissions reductions.

The LEEP would become a "one-stop shop" which provides open access to the latest current regional emissions data, inventory of related investments, knowledge of projects and funding options that government, business, universities, journalists, developers, and citizens could use to promote innovation and development. A LEEP would maintain a frequently updated local emissions abatement cost curve.[58] A LEEP would clarify which steps and investments need government support and regulation, and which efforts businesses and citizens can do on their own to maximize emissions reductions within their urban area. The LEEP is designed to absorb the "transactions costs" and soft, early investments needed to get parties to collaborate and attract finance. It would become a good listener and communicator to build trust and trigger experimentation and innovation.[59]

A LEEP would incubate new project ideas rapidly and flexibly, supporting difficult to finance up-front legal and engineering work to design mixed-use, affordable housing starting in central "zero-emissions" districts, or to enable building owners, utilities, financial institutions, and new energy and water supply firms to cooperate and accelerate investment. There are similarly complex issues involved in managing stakeholders' hourly, daily, weekly, and seasonal supply and demand with different scales of energy and temperature grids, managing unintended consequences, or how to close waste incineration-based power plants as waste streams decrease to promote circular economies.[60] There are other choices to assess, e.g. whether PV arrays and storage batteries are better sited with larger community or utility-sized energy farms vs. on individual houses or buildings, trade-offs between density and heat island effects[61], and complex financing issues arising from greater renewables supply in power grids.[62] Important recent work shows while there may be good economic arguments for these and other measures, the financial burden will affect different stakeholders in different ways with some gaining and some losing, and there will likely be local net employment losses in the automobile, steel, cement, chemical, and various fossil fuel-related industries.[63] Some mechanism to structure investment deals fairly will be crucial to sorting out these trade-offs. In any case, integrated, "whole systems" design will only happen if a dedicated, trusted, professional organization drives the integration and delivers it.[64]

Moreover, whole-systems design is not merely a set of green engineering and financing solutions; it includes bringing citizens into the design, finance, and operations in practical, effective ways. While a city region is unlikely to influence deeper economic forces such as the effect of AI on employment,

skyrocketing healthcare or energy costs, and changing terms of trade, it can ensure that sufficient resources are dedicated to deliver affordable, zero emissions housing at scale, centrally located. This concrete change would help moderate social tensions fueling populist movements, and build political support for further investments in emissions reductions.

Increasingly, we see the need for dedicated organizations to do the integrating to deal with complex social problems.[65] There is also now a large body of work that shows the critical importance of creating "safe spaces", pushing decision-making authority down to the lowest level possible line to maximize innovation and creativity,[66] and to use informal negotiating fora to resolve conflicts and explore solutions via so-called "track 1.5 and 2" negotiations.[67] Finally, there are practical, proven methods used in numerous countries that show how "citizen assemblies" can come together effectively to digest and discuss technical, financial, and legal issues that resolve complex problems.[68] This also includes recent tools to promote "robust decision-making" where policies can explore decisions made under deep uncertainty and even lack of consensus over assumptions, an important asset in polarized political systems.[69] This broad outreach and consensus-building would be a critical part of LEEP operations, and goes far beyond what governments and businesses can do on their own. Citizen participation in emissions and infrastructure investment and policy decisions can evolve from empty rhetoric into a real, useful, on-going contribution.

## 6. EXAMPLES AND FINANCING

Pieces of this new approach already exist. Interesting business-government collaborations can be seen in Boston's Green Ribbon Commission; the New York City Energy Efficiency Corporation and New York State Climate Action Council; the Leeds (UK) Climate Commission; Cape Town's GreenCape; Bristol, UK's "CityLeap" Collaboration; "Leuven2030", in Leuven, Belgium; the Columbus Ohio Partnership's Acceleration Fund; New York City's "AcceleratorNYC for buildings and Ireland's "One Stop Shop" programme for housing retrofits; Mannheim, Germany's "Climate Protection Agency"; and the "Energiesprong" integrated deep retrofit model pioneered in the Netherlands. Interesting financing examples are found in the Canadian Infrastructure Bank and den Haag, the Netherlands' "City Fund". Efforts to involve citizens more directly and deeply in policy and development include "participatory budgeting" in several US, EU and Latin American cities, and "citizens assemblies" such as those actually helping develop climate strategies in Ireland and France. The kind of permanent, long-term integrated planning capability needed is seen in the Urban and Spatial Planning Institute (IPPUC), Curitiba, Brazil. Innovative ownership and economic development models are found at the Mondragon Industrial Group (Basque region, Spain); the "community-based micro-grids" of Brooklyn NY, Feldheim, Germany; the planned Fruitvale "Ecoblock" in Oakland, CA, the Ecopower Cooperative that provides over 50,000 Belgian homes with renewable energy and energy efficiency services; and the 30+% of German renewable electricity generating capacity owned by private citizens and local cooperatives.[70] While none of these examples pulls everything needed together, they do show that the elements are viable.

Going forward, any city in the world could establish a LEEP-type innovation partnership. LEEP office costs would include a minimum staff of 5 professionals (director/energy economist, project/property finance, water and waste experts, and political/communications specialist), IT, rent, overheads, communications, and a €1 M project preparation-revolving fund to support pre-feasibility engineering, finance and legal costs, as needed.[71] This approaches a rough cost of €3.3 M per year, or €10 M total per city over 3 years, which is a minimum start-up commitment needed to retain staff, build trust, and achieve results. Start-up finance would come from a sharing of costs between private foundations, businesses, and governments.

Longer-term, LEEPs can become financially self-sufficient to help scale and replicate the approach in many cities. Each year, a typical middle to high income city region spends (very conservatively) about 5-10% of its gross regional income managing energy, waste and water.[72] Increases in energy and water efficiency and local generation would return tens of millions to consumers net of payments financing

capital investment, while providing the small funds needed to support a LEEP office. This is a matter of redirecting a fraction of money *already being spent*, as shown below in Table 1.

**Table 1: Urban Economic Flows, Net Zero Investment Financing and LEEP Costs**

| Item | Description | Millions (€) | Comment |
|---|---|---|---|
| A | Current regional income/year for city of 1M population | 50,000 | Assume per capita income of €50,000 x 1M |
| B | Assume 10% of income spent managing energy, water, waste flows | 5,000 | Conservative post Ukraine war prices adjusted, based on norms of A[i] |
| C | Assume €10,000 new, net incremental per capita investment needed to get to net zero emissions by 2050 x 1 M population | 10,000 | From McKinsey (2020) "Net Zero Europe" & Materials Economics (2019) |
| D | Annual savings from Net Zero tech and policies, conservative ignoring health benefits | 750 | Set at 15% x B from efficiency gains, local generation investments |
| E | Annual payment needed to finance Capex | 510 | C x 1M population, financed at 3%, over 30 years |
| F | **Net Savings after financing charges, per year** | **240** | D – E |
| G | LEEP Costs per year as % of net savings | 1.38% | €3.3 M annual operating costs (from text) / F |

[i] See Agora Energiwende (2019) *op. cit.*; Shell International (2001) *Energy Needs, Choices and Possibilities: Scenarios to 2050*. London, Shell International; and R Lichtman (2014) "San Diego Case Study" at www.eysfound.org/documents

LEEP costs are in-line with the 1-4% of total costs needed for feasibility, design, and contracting, observed in many large infrastructure projects.[73]

Sharing these costs and benefits can create powerful incentives to collaborate and align interests. A local public and private stakeholders could create and own shares in the LEEP entity, so that all could profit from recovered fees and savings from projects brokered by a LEEP. If e.g. 19 companies and the city government supplied the €10 M (3-year total) start-up costs, each share (1/20$^{th}$ of €10 M) would cost €500,000 (or 1/3$^{rd}$ of that, €167,000, per year). Using the example in Table 1 above, a region of 1 M people could over time generate a net savings of €100-250 M per year (the higher range reflects upside uncertainty over energy prices). This could entitle shareholders to redemption payments, with interest and a built-in profit margin if they so choose, within 5 years. In the example above, to realize a 10% rate of return on the €10 M invested, this would mean an additional €2 M paid in year 4 or 5 for a total of €12M, again taken one time out of the €240 M *saved per year*. Or, they could continue holding the shares to participate in possible on-going LEEP project's future fees. Alternatively, the capitalization could be simply treated as a loan with a fixed term and rate structure.

While arrangements will vary from city to city, the shareholders would agree that large supplier contracts would have a provision to provide a small finder or developer fee to keep the LEEP solvent and on-going. In any case, this can also be included as part of a long-term infrastructure or retrofit loan. The option chosen will respond to local conditions and interests. What is important is that are ways to capitalize the team needed to drive innovation rather than only relying upon very complex, burdensome, cumbersome government financing programs.

An example: Imagine a range of local interest groups wants to build a large $100 M zero emissions mixed-use, mixed-income development in a city, involving several thousand apartments, and a range of stores and services. This can be a group of citizens groups, property developers, circular economy engineering firms, financial institutions etc. These groups either form a LEEP, or work with one already set up. The LEEP helps sort out all up-front political, legal, engineering and financing issues. It facilitates extensive public discussions, and supports critical engineering, financial, or legal studies that can identify and unblock investment obstacles.

Energy, water, waste, food and mobility systems have to all fit together in some coherent, viable fashion. Zoning and permitting changes may be required. Complex issues and trade-offs need to discussed: how much electricity should be produced or stored on-site; are their opportunities to install larger ground-based heat pumps; do vertical growing systems have a role; can food wastes be digested locally, combined with heat recovery from local decentralized waste-water treatment to generate affordable energy on-site; what agreements are needed with regional or even national utility companies to balance

hourly electricity loads; will deep electrification permit all sorts of new reduced maintenance costs and how can those benefits be shared; what coordination is needed with other levels of government; how can tax credits be optimally allocated, what will be the role of demand management; how much car vs bicycle parking space should be allotted given vehicle-sharing and charging needs; who will finance and support vehicle charging stations; should a site-owned micro-grid be developed; what proportion of apartments need to be affordable to which income groups and will some units subsidize others; how can this investment support long-term inclusive growth, how can developers and citizens provide effective input throughout the process, and how best to sequence development to leverage a range of local, state/provincial, and national financing and tax programs to "crowd-in" investments, etc.

To arrive at politically acceptable solutions that can be financed, a LEEP team is critical to building the support needed amongst all these interests and systems. This process then leads to the compromises, consensus, agreements, permitting, and finance needed to implement the overall effort that balances politics, engineering, and finance.

In the example above, for all this integrated support, the LEEP would receive a negotiated fee, e.g. 2% (of $100M)=$2 Million, that could also be financed as part of construction loans. The LEEP has facilitated an effort and supported all the complex upfront discussions and negotiations that individual suppliers and local government could not do easily (if at all), and everyone wins. The LEEP shareholders can decide if the $2M fee is used to start to repay start-up capital. Or they can decide the funds remain with the LEEP entity because all the shareholders have found either its services or information flows useful and wish to build on this for future developments and projects. Over a decade, many such projects can be developed.

While individual parties could still enter into separate supplier contracts, it is likely such contracts would not have been possible without the LEEP group's efforts which absorbed many transactions costs, costs that companies and the city government would otherwise have to bear individually. In addition, firms and the city government would like to recoup their investment with a small return. Thus, cooperating (even between competitors) to make the LEEP successful is in everyone's interest. This could transform a set of competitive power relations into a collaborative sharing of risks, costs, and benefits. This joint ownership of a LEEP would incentivize co-operation, reduce the risks of conflicts of interest, moral hazard, free-riding, and even enable repaying the start-up investment within a few years.[74]

In Europe, start-up funding could draw upon a €500 M-1 Billion share of the €10 billion currently proposed for climate and energy research, part of the proposed €100 Billion research budget for the forthcoming EC "Horizon Europe" 2021-2027 program. This share could easily capitalize 3 years of LEEP operations in 100 European cities. Versus the current complexity, such an effort would be quite simple to manage, requiring only a few deliverables over several years: build the organization, deliver a funded plan, implement and verify emissions reductions, and release funds upon an agreed schedule as each step is begun and then successfully completed.

Much of this paper has focused on conditions and examples found in developed country cities. But there is no reason the model cannot be extended to cities in developing countries, where the problems of capacity, elite capture, and multiple financial and legal constraints are even more acute. There are constant discussions to create new facilities that support pre-feasibility work, and some of these can be helpful.[75] None of this is to suggest any of these public funding sources are easy to navigate or manage. To the extent possible, city stakeholders should develop mechanisms to marshal the resources needed from local sources, taping and leveraging the large spending on energy, waste, and water management *already occurring*, as discussed above. It will not be easy, there will always be difficult political conflicts to sort out, but ultimately, this is the way to move at the speed and scale needed.

Table 2 below summarizes why a dedicated local organization is needed to drive down urban GHG emissions:

**Table 2: Current Gaps and LEEP Response**

| Current Gaps | LEEP Entity Response |
|---|---|
| **CAPACITY**. Very uneven within city government departments: chaotic, siloed decision-making, post-Covid finance gaps, staff churn, political squabbling. Great difficulties faced designing "bankable" projects that are understood by financial institutions, and which fit together coherently. | Main purpose is build professional team to do the integration, raise finance, create longer-term stable presence. LEEP can hire and fire at will and draw quickly upon temporary and consulting resources to ensure projects fit together with adequate financial and political support. |
| **CREDIBILITY.** No evidence that current "climate action plans" or finance will trigger the 5% GHG reductions/year needed. Plans are rarely credible, and have not been subjected to rigorous 3rd party review and vetting. Financial sector remains deeply skeptical. | LEEP Team expertise will develop credible plans that clearly describe how projects, finance, implementation, citizen and business co-development will fit together, year by year. Informal discussions and consensus-building promotes buy-in from all stakeholders and more bankable projects. |
| **SPEED.** Need to move quickly off fossil fuels (especially in the EU, given geopolitics) yet lack of consensus, alignment of interests, regulatory constraints and political conflicts blocks this. | LEEP Team much more agile and able to look at all urban resource flows to move faster. Can proceed more quickly when possible in other sectors, while waiting for government consensus and regulatory approvals. |
| **FINANCE**. Greater capital investment still dependent upon and blocked by deeply flawed or limited plans and decision-making at the local level (even if cities try pool requests to scale up for big finance) Funding problematic for up-front soft costs and buying down transactions costs. | Professionalism and broader reach of LEEP Team will result in more bankable projects. Team will also be constantly fund-raising and have a quick use revolving fund to allow for engineering, legal, communications work as needed vs. lengthy government approvals. |
| **INTEGRATION.** No effective cross sector integration – so even basic energy & water efficiency, mobility vs. new supply, or e.g. food and water systems, or overall Scope 3 imports emissions-rarely considered together to seek least-cost solutions. | LEEP Team is built to integrate across sectors and allow thinking and negotiations to get least-cost solutions. Allows businesses across sectors to collaborate and share in benefits of integrated solutions. |
| **SCALE.** No clear demarking of what different levels of government can/must do vs. private actors. Now just assume these levels will coordinate and cooperate. | Key area of LEEP work is identifying what can be done privately vs. publicly (where/& by whom) and mapping financing strategy to reflect this. Shows and brokers higher levels of collaboration. |
| **ANALYTICS.** Urban emissions analytics are messy, relying upon self-reporting and uneven, out-sourced data. Data not well integrated, nor translated into verifiable investment plans. | LEEP will draw upon world class data support and constantly adjust and update without complex government tendering and approvals. Will update abatement cost curves, financing alternatives, pricing and fee recovery systems more quickly and rigorously than government. |
| **MISTRUST.** Deep mistrust remains amongst the stakeholders – increasingly fragile and polarized discussions in both the EU and the USA. Trust issue often simply ignored, further slowing down finance and implementation. Government not viewed as neutral. | LEEP creates "safe space" aided by independence, neutrality, competence and objectivity to allow business and citizen's groups to collaborate and build trust. Collective ownership & governance structure will also help reinforce this, while also providing accountability. Significant citizen input and discussion encouraged via citizen assemblies and an open "one stop shop" office. |
| **COOPERATION.** Stakeholder cooperation problematic: Firms complain about city government regulation, an inability to shape pre-feasibility discussions, and difficulty of firms working together. Government not viewed as a neutral player. Citizen input is token and superficial. | Mix of competence & "safe space" will allow informal discussions to identify and sort out conflicts. Will promote innovation and pre-feasibility joint development of projects. Sharing of benefits built into governance and ownership creating strong incentive for parties to cooperate. |
| **COMPREHENSION.** Almost impossible for citizens to understand city climate plans: too dense, too complex, and yet too simplistic. Plans do not show yearly reductions, yearly costs, yearly sources of finance, who bears burdens. | Clear, accessible communications and building public support a key aspect of LEEP plan development. Open "one-stop shop" will help design and deliver solutions to different stakeholders, also via citizen assemblies. |
| **MANAGEMENT OF COMPLEXITY.** City governments cannot manage all this while facing serious capacity, political, regulatory and financial constraints. | LEEP's professional staff, ability to move quickly and organize engineering, management, financial, legal expertise as and when needed will help fit pieces together. |
| **FINANCIAL SUSTAINABILITY.** City governments chronically short of funds; programming short term; new funds dependent upon complex negotiations with different levels of government, risk of political interference and too dependent upon a particular mayor or city council and electoral cycles. | LEEP capitalized with resources sufficient for an initial 3 years. Can constantly fund-raise & is not limited to complex public sector funding mechanisms (e.g. EC). Ownership structure will ensure fee recovery and sharing systems so effort becomes self-sustaining. Will be able to create e.g. Special Purpose Vehicles to handle large capital investments that exceed normal government capital spending. |

## 7. IMPLICATIONS

As envisioned here, a LEEP has a somewhat limited scope; to jump-start innovation, investment and implementation of urban emissions reductions in a way that promotes more inclusive economic growth. While a well-functioning LEEP will certainly help, by itself, it cannot cure a range of deeper political, social and economic issues plaguing many urban regions.[76] Nevertheless, these challenges set the context within which a LEEP operates, and to which it must respond to be successful.

With significant financial stimulus available, and with increased acceptance of government intervention in markets, there is now an opportunity invest in a greener, more resilient way. Yet current assessments of the $14 Trillion spent by G20 nations on Covid-triggered stimulus measures suggest only 6% went to measures that would also reduce emissions.[77] It remains to be seen how well these investments, and recent large US and EU climate-related subsidies will also address the longer-term revenue and employment losses triggered by the pandemic and subsequent financial and geopolitical upheavals.[78] These shocks are challenging climate-related spending in many countries and regions facing polarized electorates, stretched finances, and regional and ethnic tensions, all of which are only increasing.[79] The LEEP idea puts consensus-building, participation, and transparency front and center to try to reduce some of this increasing polarization and to show how climate investments can improve people's lives.

At the urban regional level, there are two immediate concerns. First, urban air pollution plays an important role in damaging lungs that weakens people's ability to resist *any* respiratory disease, including Covid. Airborne particulates may themselves help spread a virus, they may even trigger cancers, and have been described recently as "the greatest external threat to public health".[80] At a staggering cost, the pandemic may have bought us a little time, and some reduced commuting, working at home etc., may result in some small permanent emissions reductions.[81] But air emissions and air pollutants, from the single building level up to rapidly decarbonizing electricity generation and motor transport, need to be reduced far more forcefully. A recent study suggests the short-term health benefits from reduced emissions may even exceed reduced longer term damages from climate change.[82] Ignoring the difficulties of implementing carbon taxes and removing fossil fuel subsidies, cities could still do much on air pollutants and emissions with a more focused, integrated, and *inherently regional approach*, which is a cornerstone of the LEEP idea.

Second, particularly local governments' already constrained attention spans and finances will be stressed dealing with the effects of increased working from home, and then all sorts of supply, price inflation, and even migration effects from on-going wars in Ukraine and the Middle East. Increasing localized heat, flood, fire, and storm damage will only compound this financial pressure. Anecdotally, some early surveys suggest 2020-2021 Covid effects alone caused a 10% reduction in municipal revenues and a 5% increase in costs. Significant commercial property value and tax revenue losses are mounting.[83] At least for several years, local governments will be hard-pressed to let emissions reductions efforts drift to cope with financial pressures.

This could not happen at a worse moment. We have been warned for years that we have roughly until 2030 to cut global emissions by 50% to have a chance to stay under the 1.5 °C warming threshold. This implies a reduction of over 5% *per year*, almost as much as what resulted from the Covid induced economic contraction in 2020.[84]

Creating the suggested new LEEP partnership organizations quickly would at least give us a chance to meet the 2030 50% urban emissions reduction target. If a dedicated organization can drive emissions reductions strategies and their financing and implementation, this frees up limited local government resources to deal with managing many on-going financial shockwaves.

If there is one point this paper has tried to make, it is that we need to think much harder about what "implementing" actually means: developing the underlying political support; building and staffing an accountable, high-performance organization to drive innovation; getting financing in place; developing and approving a plan; and then begin to actually implement change. Just completing those up-front tasks at the city level would optimistically take at least a year, without simultaneously managing the after

effects of a global pandemic. All this is needed within, at the most, the decade remaining to slow emissions to have a chance at stabilizing projected warming below very risky levels.

If anything, the Covid experience has shown disturbing gaps in how democratic governments, businesses, and citizens are able to collaborate effectively. Without trivializing the remarkably rapid scientific work involved, or the massive, complex vaccine distribution effort needed, compared to slowing global warming, managing Covid required "relatively" straightforward changes in some behaviors and rolling out large vaccination logistics programs, using a variety of existing organizations at the local, national and global levels. All this has not gone especially well, with much needless expense, uncertainty, suffering, and death.[85]

To be fair, some of this was inevitable given the suddenness, speed, and scale of the pandemic, and all the politics surrounding it.[86] But we had been warned for many years that such a sudden, rapid event was probable. We were not prepared; indeed, we chose not to be prepared, and the warnings continue even now.[87] The Covid experience should deeply shake our confidence in the fitness of our current institutions to deal with long-term threats.

We have also known for many years that the far more complex challenge to slow global warming will require a profound, rapid re-tooling of many of our basic systems of agriculture, energy, transportation, and industrial production, and their financial and political underpinnings that we have used for well over a century. The Covid experience strengthens the argument that governments, businesses and citizens groups need to rethink how they can collaborate better and faster, and why all should be open to experimenting with new approaches.

We are facing profound security threats from climate change. Business needs to step up and move beyond a simplistic profit-making and proactively collaborate, even supporting up-front costs that can be recovered over time. City governments need to recognize their limits and share governance more collaboratively with business and citizens. We have seen there are proven methods, incentives, and experiences that can be drawn upon. At the urban level, the LEEP provides a structure to integrate all this, and move toward coordinated, coherent action.

## 8. CONCLUSION

In his 1934 poem "Choruses from 'The Rock'", T.S. Eliot warned against "dreaming of systems so perfect no one needs to be good". The dedicated, innovation partnership idea outlined here is not foolproof. If members allow, it can be corrupted, or rendered simply ineffective. But it does address an important gap that we are currently ignoring, at our peril. With sufficient transparency, and leadership, we can move beyond the disturbing lack of progress in reducing urban emissions. We cannot do much about the behavioral and technological parts of E. O. Wilson's lament, noted at the beginning of this paper. But we can do quite a bit about changing our institutions and how decisions are made. Rather than becoming mired in despondent, narrow political de-construction, we can start constructing the missing management capability needed to deliver trusted, effective solutions to build a more just and more sustainable world.

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## Annex A: Strengthening European Commission (EC) Support to Reduce Urban Emissions

While this paper has focused on strategy, there is also a need to strengthen oversight and management of large funding programs to support urban emissions reductions. These comments draw upon participation in several EC Horizon 2020 "smart and sustainable" cities and communities projects, interviews with dozens of participants and reviews of numerous proposals and projects in EC "FP7", "H2020" efforts (as well as in the USA).[88] These funds are important as they are both large in scale and relatively "soft" grants requiring little or no matching funds, repayment, or only notional "in-kind contributions".

Over the past 10 years, these efforts have spent well over € 2 Billion supporting cities to become more sustainable. The actual spending is difficult to determine with infrequent topping up, sharing with other programs, etc. There is overlap with additional loan guarantees and overall structural development and regional cohesion funds of well over *60 times* this amount.[89] So what was actually done? Searching EC websites, one finds multiple further layers of webpage links describing "frameworks", "roadmaps" and lessons learned such as "develop sound business models", "engage citizens in projects", etc.

An example of how this plays out is the €25 M "Grow-Smarter" project, often viewed as one of the EC flagship efforts. This involved Stockholm, Köln, and Barcelona, and a number of follower cities. The project provides 1000+ pages of documentation, including financial and economic details, though these do require some digging to discover. However, what is missing is the fundamental strategic logic of these efforts. It is difficult to understand how developed projects would result in large emissions reductions that could be scaled, why these needed EC funds, what feasibility analyses showed projects' potential financial and economic results vs. what was actually realized (or projected) after completion, and how sensitive are many marginally viable projects (with IRRs of 1%-2.8%) to small changes in costs and revenues. In addition, these projects have significant large organizing and transactions costs that are not reflected in IRR calculations.[90]

Current thinking is to repackage the research and demonstration components to support greater policy coherence via "Missions", partly inspired by Project Apollo.[91] The relevance can be debated how NASA's massive focused engineering lessons can address the far more complex, multiple techno-socio-economic challenges of stopping global warming. Trying to get multiple overlapping programs and decision-making centers to coordinate better is laudable in any organization. But without fundamentally changing the underlying flawed systems of management design and accountability, this "mission" repackaging is unlikely to yield the results urgently needed.

Chronically, EC cities programs suffer from vague terms of reference in "proposal calls", the proposal work frameworks are incredibly complex, making both reporting difficult but also creating incentives for equally complex proposals that try to respond to or game the system. With the ostensible purpose of promoting learning and integration, it is common to have 20-30 research organizations, multiple cities in multiple countries, disparate businesses, citizens groups and universities "collaborating" together, despite obviously large differences in incentives, legal mandates, language, culture, political and economic systems, etc.

This process is being repeated in the EC "Net Zero Emissions Cities" effort in over 100 urban regions.[92] There is a great risk that these funds will be spread too widely and too thinly to achieve their purpose. The sums planned will only amount to several hundred thousand euros per year per city, and initial disbursements will stretch well into 2023.

Managing these EC projects is fraught with complexity, made even more daunting as many managers involved have fairly narrow government or research backgrounds. It has even spawned a small industry of highly specialized firms whose sole expertise is managing this bewildering process.

These sizable programs have had little outside review and accountability, mostly staying within the fraternity of project participants, their project officers, and the committees who draft the terms of reference and overall policy.

What is needed is a complete rethinking of all aspects of these funds: their purpose; their management; their reporting, with experienced businesses providing design inputs; and a far more rigorous system of accountability and reporting to member governments and the European Parliament. None of this will be easy. A useful start would be to insist projects are summarized in a short 1-2 page cover sheet (vs. the scores of pages currently), before being approved. This short summary should cover these points:

1. What will be done, using simple, clear, concise, descriptive language.
2. What specific gaps EC funds fill and why this makes strategic sense (how it contributes to long-term change that could not otherwise be funded-the counterfactual).
3. What emissions will be reduced (explaining how these are calculated, and by whom).
4. What will these reductions cost and how it will be financed (with a projected rate of return IRR calculation, or a levelized cost/tonne of $CO_2e$ avoided).
5. How many and what long-term jobs will be created.
6. How will government, businesses and citizens' costs be affected by the effort.
7. How can all this be independently verified.
8. How much of this will be directly attributable to the public EC funding obtained vs. other sources.
9. What key lessons will be learned to aid in scaling, replicating, and obtaining further finance.

This project summary would again be completed at the end of a project, so expectations can be compared with results. Then, this "before/after" document would be presented by the managers of these huge public programs, and individual project leaders to an external review board. This could be a mix of external management consultancies, communications firms, investment banks, relevant university departments, and some large trade union and citizen housing groups. Any project over a certain size, e.g. € 5 M, would need to be presented concisely in 15 minutes and then discussed by the group. This could be bundles of 5-10 projects per day on some regular monthly basis to use the group's time efficiently and make numerous reviews manageable. The feedback from a more diverse, independent review group would be publicly and easily available on EC project websites.

At the moment, nothing like this exists that would allow rapid scanning and evaluating of urban climate emissions reductions projects, and make these projects more accountable to an externally reviewed process. Interested readers can review the EC document references (see Endnotes) to judge the quality and accessibility of such critical, basic management information about this vast spending over decades.

We seem to demand more accountability from corporate "ESG" performance reporting than we do from public institutions' spending. Anyone concerned about supporting European integration should help rethink how these funds are managed so the planned €1 Billion spending for EC "Green Deal" cities will have the impact needed during 2021-2027, within possibly the last decade remaining to keep warming around 1.5° C.

## NOTES AND REFERENCES

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[2] Precise numbers are unavailable because much of the spending is based on estimates of funding authorized vs. what will eventually be actually appropriated, and the level of potential tax credits over a decade. The order of magnitude of direct *climate*-related spending in the 3 relevant signed US bills is ~$4-500 Billion. This is probably at most ~15% of what is needed to approach a "net zero emissions" state by 2050, based upon a bottom-up $10,000 per capita capital investment estimate, scaled to a US population of 320 M people. See McKinsey Global Institute (2022) "The Net Zero Transition: What It Could Cost, What it Could Bring"; at www.mckinsey.com/business-functions/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring-january-2022-final.pdf. Note that the McKinsey cost estimates are based upon 2020-2021 data and are likely too low, not reflecting current global inflation, supply chain disruptions, energy price effects, and higher interest rates. Useful overviews of overall spending and projected impacts are found at King, Ben *et al.* (2023) "Taking Stock, US Emissions Projections after the Inflation Reduction Act", Rhydium Group, Washington DC, at rhg.com/research/taking-stock-2023/ ; Bistline John, Mehrotra, Neil, and Wolfram, Catherine (2023) "Economic Implications of the Climate Provisions of the Inflation Reduction Act". Washington DC: TheBrookings Institution, at www.brookings.edu/wp-content/uploads/2023/03/BPEA_Spring2023_Bistline-et-al_unembargoedUpdated.pdf, Credit Suisse (2022) www.credit-suisse.com/treeprintusinflationreductionact, and Goldman Sachs (2022) www.goldmansachs.com/intelligence/pages/the-us-is-poised-for-an-energy-revolution.html which all project potentially far greater spending triggered by the tax incentives. On implementation complexities, and relative vulnerabilities of measures, see Federation of American Scientists (2023) "CHIPS and Science Funding Update", at fas.org/publication/chips-and-science-funding-update-fy-2023-omnibus-fy-2024-budget-both-short-by-billions/ ; Friedman, Lisa (2023) "A Republican 2024 Climate Strategy: More Drilling, Less Clean Energy", *The New York Times,* at www.nytimes.com/2023/08/04/climate/republicans-climate-project2025.html; Jenkins, J.D., et al. (2022) "Electricity Transmission is Key to Unlock the Full Potential of the Inflation Reduction Act," REPEAT Project, Princeton, NJ, September 2022. doi: 10.5281/zenodo.7106176 ; Meyer, Robinson (2022) "Not Even a Single Republican Voted for the Climate Bill", *The Atlantic*, at www.theatlantic.com/science/archive/2022/08/ira-climate-bill-house-vote-republicans/671133/; Meyers, Robinson (2022) "Congress Just Passed a Big Climate Bill. No, Not That One", *The Atlantic,* at www.theatlantic.com/science/archive/2022/08/chips-act-climate-bill-biden/671095/ Moreover, the climate bill spending has been modelled to trigger *a net ~10-15% reduction* in GHG emissions over what had been projected to occur anyway with current expected prices and policies. See Jenkins, J.D., *et al.* (2023) "Climate Progress and the 117th Congress: The Impacts of the Inflation Reduction Act and the Infrastructure Investment and Jobs Act ," REPEAT Project, Princeton, NJ, July 2023. doi: 10.5281/zenodo.8087805. To be fair, there will be numerous spill-over effects from the government spending which may increase its impact, strengthen and create markets, and crowd-in future investments. But still, a significant gap remains, even ignoring possible future political disruptions.

[3] Of the €723.8 allocated to the European Resilience and Recovery Fund, €112.7 has been disbursed as of September 2022. See ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/disbursements.html?lang=en For the larger issue, see European Commission (2019) "Strategic report 2019 on the implementation of the European Structural and Investment Funds", at ec.europa.eu/regional_policy/sources/docoffic/official/reports/asr2019/esif_asr2019_en.pdf

[4] See *The Economist* (2021) "Is a New Infrastructure Boom in the Works?" at www.economist.com/finance-and-economics/2021/01/02/is-an-infrastructure-boom-in-the-works ; Glaeser Edward. and Poterba, James, (2020) "Economic Analysis and Infrastructure Investment" at www.nber.org/papers/w28215 ; www.weforum.org/agenda/2016/09/the-world-is-awash-with-cash-so-why-arent-we-investing-in-infrastructure ; Authers, John (2015) "Infrastructure: Bridging the Gap" in *Financial Times*, November 9, 2015. and Global Infrastructure Outlook, "Forecasting Infrastructure Investment Needs and Gaps": outlook.gihub.org/.

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[13] These are based upon what I have observed over 30 years' working closely with cities, businesses, and donors in over 20 countries. I have bundled the "competent vs. problematic" characteristics into the two broad groupings, made easier to reference using relevant, well-known song titles by Jimmy Reed (1961) and Bruce Springsteen (1978), respectively. This limited purpose is not meant to reflect broader urban government theories of change, such as "Neighborhood Revitalization Theory", e.g. Kretzmann, J. P., & McKnight, J. L. (1993) "Building communities from the inside out: A path toward finding and mobilizing a community's assets", Center for Urban Affairs and Policy Research, Northwestern University; "Smart Growth Theory", e.g. Duany, A., Plater-Zyberk, E., & Speck, J. (2000) *Suburban Nation: The Rise Of Sprawl And The Decline Of The American Dream,* North Point Press; "Broken Windows Theory", e.g. Wilson, J. Q., & Kelling, G. L. (1982) "Broken windows: The police and neighborhood safety", in *Atlantic Monthly*, 249(3), 29-38; "Social Capital Theory", e.g. Putnam, R. D. (2000) *Bowling Alone: The Collapse And Revival Of American Community*. Simon & Schuster; "Housing First Theory", e.g. Tsemberis, S. J., Gulcur, L., & Nakae, M. (2004) "Housing First, consumer choice, and harm reduction for homeless individuals with a dual diagnosis". *American Journal of Public Health*, 94(4), 651-656; "New Urbanism Theory", e.g. Jacobs, Jane (1961) *The Death and Life of Great American Cities*, Random House, and Katz, P., & Scully, V. (1994) *The New Urbanism: Toward An Architecture Of Community,* McGraw-Hill; and "Place-Based Initiatives Theory", e.g. Chaskin, R. J. (2008) "Resilience, community, and resilient communities: Conditioning contexts and collective action", in *Child Care in Practice*, 14(1), 65-74.

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[32] Climate Disclosure Project (2021) "Cities on the Route to 2030", CDP London, at www.cdp.net/en/research/global-reports/cities-on-the-route-to-2030

[33] Shabb, Katherine and McCormick, Kes (2023) "Achieving 100 climate neutral cities in Europe: Investigating", in *npj Climate Action* (2023) 2:6 ; doi.org/10.1038/s44168-023-00035-8 ; and Vanhuyse, Fedra; Piseddu, Tomasso; and Jokiaho, Julia (2023) "Climate neutral cities in Sweden: True commitment or hollow statements?" *Cities*, Volume 137, June 2023, 104267 doi.org/10.1016/j.cities.2023.104267

[34] To illustrate how difficult it is to find simple summaries of emissions reductions schedules and costing and financing, see a sampling from some leading cities: Government of New York City (2023) "PlaNYC: Getting Sustainability Done" at climate.cityofnewyork.us/initiatives/planyc-getting-sustainability-done/ and (2019) "OneNYC 2050: A Livable Climate, Vol. 7", pp. 32-33, at nyc.gov/OneNYC ; San Francisco Department of the Environment (2021) "San Francisco Climate Action Plan" at sfenvironment.org/climateplan"; Mayor of London (2018) "Zero carbon London: A 1.5° compatible plan) at www.london.gov.uk/sites/default/files/1.5_action_plan_amended.pdf (especially references to Element Energy, p.14); City of Toronto (2021) "TransformTO Net Zero Strategy", at www.toronto.ca/legdocs/mmis/2021/ie/bgrd/backgroundfile-173758.pdf ; City of Amsterdam (2021) "New Amsterdam Climate: Roadmap to Amsterdam Climate Neutral 2050" at assets.amsterdam.nl/publish/pages/943415/roadmap_climate_neutral.pdf ; City of Vancouver (2021) "Climate Emergency Annual Report: 2021 Indicator and Financial Dashboard", particularly pp. 3-5, at vancouver.ca/files/cov/2021-ceap-annual-report.pdf and (2020) "Climate Emergency Action Plan" at vancouver.ca/green-vancouver/climate-emergency-action-plan-in-depth.aspx ; City of Cape Town (2021) "Climate Change Action Plan", and "State of Energy and Carbon Report (2021)", at resource.capetown.gov.za/documentcentre/Documents/City%20strategies%2C%20plans%20and%20frameworks/CCT_Climate_Change_Action_Plan.pdf; resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/CT_State_of%20Energy_and_Carbon_Report_2021.pdf; City of Boston, "Climate Action Plan, 2019 Update", from www.boston.gov/sites/default/files/imce-uploads/2019-10/city_of_boston_2019_climate_action_plan_update_2.pdf; and Carbon Free Boston (2019) reports from sites.bu.edu/cfb/carbon-free-boston-report-released/; City of Durban-e Thtekwini (2019) "Durban Climate Action Plan", at www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/CAP/Documents/Durban%20CAP.pdf ; City of Seattle (2018) "Seattle Climate Action" at greenspace.seattle.gov/wp-content/uploads/2018/04/SeaClimateAction_April2018.pdf ; City of Melbourne (2018) "Climate Change Mitigation Strategy to 2050", at www.melbourne.vic.gov.au/sitecollectiondocuments/climate-change-mitigation-strategy-2050.pdf: and Victoria State Government (2022) "Building Victoria's Climate Resilience" at www.climatechange.vic.gov.au/__data/assets/pdf_file/0023/558140/BuildingVictoriaClimateResilience.pdf ; City of Barcelona (2018) "Climate Plan 2018-2030", at www.barcelona.cat/barcelona-pel-clima/sites/default/files/documents/climate_plan_maig.pdf

[35] The emissions estimates were calculated from data submitted to determine city readiness for large EC climate funding programmes. These are complicated by the inclusion of a number of Türk cities so a Europe wide vs. EU wide emissions baseline (6 Gt CO2e/year) should be used. See Ulpiani, Giulia *et al.* (2023) "Funding and financing the zero emissions journey: urban visions from the 100 Climate-Neutral and Smart Cities Mission" in *Humanities and Social Sciences Communications,* 2023, 10:647, Springer Nature, London and Berlin, at doi.org/10.1057/s41599-023-02055-5

[36] Similar criticism can be found in Sabel and Victor (2022) *op. cit,* pp. 164-165, and endnote 57, p. 203

[37] See World Economic Forum (2022) "BioDiverCities by 2030: Transforming Cities' Relationship with Nature", at www3.weforum.org/docs/WEF_BiodiverCities_by_2030_2022.pdf and Material Economics (2018) "The Circular Economy: A Powerful Force for Climate Mitigation", *op. cit.*

[38] See several case studies in Shaver, L., *et al.* (2021) "The Power of Collaboration: How U.S. Cities and Corporations Can Work Together to Advance Renewable Energy." Working Paper. Washington, DC: World Resources Institute, at doi.org/10.46830/wriwp.20.00012.

[39] See a similar (though city government-centric) review by 10 experts commenting on the experience of 90 European cities in Garcia-Fuentes, Miguel *et al.* (2019) "From dream to reality: sharing experiences from leading European Smart Cities", at

www.triangulum-project.eu/wp-content/uploads/2019/10/JointPolicyPaper_GrowSmarter-Remourban-and-Triangulum.pdf This section draws upon current participation in the World Economic Forum's "Net Zero Carbon Cities" project, and experiences from 2015-2018 as Senior Urban Advisor to the Sustainable Cities Program, World Business Council for Sustainable Development, during which we discussed these issues extensively with dozens of companies and a C40 Cities team.

[40] Nash, John (1950) "Equilibrium points in n-person games", in *Proceedings of the National Academy of Sciences* 36(1):48-49, and (1951) "Non-Cooperative Games", in *The Annals of Mathematics* 54(2):286-295.

[41] Buck, Tobias (2019) "Germans Fall Out of Love with Wind Power" in *The Financial Times*, 17 November, 2019, at www.ft.com/content/d8b9b0bc-04a6-11ea-a984-fbbacad9e7dd

[42] www.nytimes.com/2020/01/30/business/economy/sb50-california-housing.html

[43] The overall complex effects of ride-hailing companies such as Uber, Lyft, and DiDi (in China) are only beginning to be understood. See Ratti, Carlo and Rossant, John (2023) "Uber was supposed to help traffic. It didn't. Robotaxis will be even worse", *San Francisco Chronicle*, Sept 15, 2023, at www.sfchronicle.com/opinion/openforum/article/robotaxi-car-technology-traffic-18362647.php ; Nunes, A. *et al.* (2021) "Estimating the energy impact of electric, autonomous taxis: evidence from a select market", *Environmental Research Letters* 16 (2021) 064036 at doi.org/10.1088/1748-9326/ac1bd9; Ward, Jacob *et al.* (2021) "Air Pollution, Greenhouse Gas, and Traffic Externality Benefits and Costs of Shifting Private Vehicle Travel to Ride-sourcing Services", *Environ. Sci. Technol.* 2021, 55, 19, 13174–13185. doi.org/10.1021/acs.est.1c01641; and an overview in Hiltzik, Michael (2020) "Uber and Lyft increase traffic and pollution. Why do cities let it happen?" in *L.A. Times,* at www.latimes.com/business/story/2020-02-21/cities-traffic-uber-and-lyft, and Anair, Don, *et al.* (2020) "*Ride-Hailing's Climate Risks: Steering a Growing Industry toward a Clean Transportation Future". Cambridge, MA: Union of Concerned Scientists, at* www.ucsusa.org/resources/ride-hailing-climate-risks

[44] See the broader discussions in Acemoglu, Daron and Johnson, Simon (2023) *Power and Progress: Our Thousand-Year Struggle Over Technology and Prosperity*. Basic Books, New York; Landemore, Hélène (2020) *Open Democracy: Reinventing Popular Rule for the Twenty-First Century.* Princeton NJ: Princeton University Press; Rajan, Raghuram (2019) *The Third Pillar: How Markets and the State Leave the Community Behind.* London: Penguin Press; and Turner, Adair (2001) *Just Capital: The Liberal Economy.* London: Pan Books.

[45] See Acemoglu and Johnson (2023) *ibid.* for the general problem of how to channel technological change in an equitable fashion. For more detailed cases see Flood, Joe (2011) *The Fires: How a Computer Formula, Big Ideas, and the Best of Intentions Burned Down New York City--and Determined the Future of Cities.* NY: Penguin-Random House. Other obvious examples include: the suppression of data linking smoking and lung cancer; the thalidomide scandal of the early 1960s; the Bhopal chemical release; the mismanagement of nuclear power stations at Three-Mile Island, Chernobyl, and Fukushima; the overuse of antibiotics and opioids; the manipulation of emissions data from automobile diesel engines; decades of "climate change denial" research funded by fossil fuel companies despite their own scientists predicting accurately the rate and risks of climate change (Supran G. et al. (2023) "Assessing ExxonMobil's global warming projections", in *Science,* 13 Jan 2023, Vol 379, Issue 6628 doi: 10.1126/science.abk006) and Matthews Christopher, and Eaton, Collin (2023) "Inside Exxon's Strategy To Downplay Climate Change", Wall Street Journal, 14 Sept 2023, at www.wsj.com/business/energy-oil/exxon-climate-change-documents-e2e9e6af?page=1 ; the role of utility infrastructure maintenance in repeated catastrophic fires in California (Blunt, Katherine (2022) *California Burning: The Fall of Pacific Gas and Electric — and What It Means for America's Power Grid*. Portfolio Press *);* and the overleveraged lending that triggered the 2007-2008 financial crash. Avoidable Covid-19 deaths due to government policy missteps or poor logistics coordination with businesses particularly in the USA, UK, EU, and Brazil will be contended for years but are likely to exceed hundreds of thousands. See Sachs, J. *et al.* (2022) "The Lancet Commission on lessons for the future from the COVID-19 pandemic", *The Lancet*, September 14, 2022 doi.org/10.1016/S0140-6736(22)01585-9 . On Europe, see www.economist.com/europe/2021/02/03/how-europe-dodges-responsibility-for-its-vaccine-fiasco. On the USA, see Woolhandler, S. *et al.* (2021) "Public Policy and Health in the Trump Era" in *The Lancet*. doi.org/10.1016/S0140-6736(20)32545-9 uses a comparison of excess deaths per million to compare countries' relative performance. These are preliminary looks at what will take several years to judge fully, the net impacts of the large economic stimulus policies on both continents, all in flux as of this writing.

[46] Ott, Ilona *et al., op. cit.*, page 9, funded partly by the European Research Council.

[47] See Chapter 5 in Gordon, Robert (2017) *The Rise and Fall of American Growth.* Princeton NJ: Princeton University Press; Bloom, Nicholas (2023) *The Great American Transit Disaster: A Century of Austerity, Auto-Centric Planning, and White Flight*. Chicago, University of Chicago Press; and Norton, Peter (2011) *Fighting Traffic: The Dawn of the Motor Age in the American City*. Cambridge MA: MIT Press. The European experience is more positive due to the way denser, older cities evolved spatially, and by having a culture and tax regime more supportive of public transport investment. But much of the rest of the fast-urbanizing world in Asia, Africa, and Latin America is experiencing similar tensions.

[48] Lindblom, Charles (1959) "The Science of "Muddling Through", *Public Administration Review*, Vol. 19, No. 2 (Spring, 1959), pp. 79-88. This reflected years of observing government bureaucracies, the early days of computers and operations research, and was also partly a reaction to Stalinist collectivization, Nazi industrial mobilization, and Mao's "Great Leap Forward". See a useful overview of 40 years' subsequent reactions, refinements, and critiques related to Lindblom's initial paper (such as its limitations during crises or committing to large long-term capital expenditures) in Migone, Andrea and Howlett, Michael (2016) "The Science of Muddling Through" in *The Oxford Handbook of Classics in Public Policy and Administration, at* doi: 10.1093/oxfordhb/9780199646135.013.33 and Atkinson, Michael (2011) "Lindblom's lament: Incrementalism and the persistent pull of the status quo", in *Policy and Society*, 30:1, 9-18, doi:10.1016/j.polsoc.2010.12.002

[49] See Sabel and Victor (2022) and Ghosh *et al.* (2022) *op cit*.

[50] See Lenton, T. *et al.* (2020) "Climate Tipping Points-too risky to bet against" *op. cit.*

[51] See Kalehbasti P. *et al.* (2022) "Integrated Design and Optimization of Water-Energy Nexus: Combining Wastewater Treatment and Energy Systems", *in Frontiers of Sustainable Cities* 4:856996. doi: 10.3389/frsc.2022.856996; Lovins, Amory *et al.* (2019) "Recalibrating climate prospects" in *Environmental Research Letters,* 14 120201, at doi.org/10.1088/1748-9326/ab55ab. The whole question of which technologies are being included in GHG models is a constantly moving target. PV panel and Li-Ion battery prices have declined faster than expected, and there are new promising systems in development such as quantum dot PV systems that could be printed or sprayed, new combinations of non-silicon semiconductors, perovskites, protein

based "air generation" of electricity, Li-Metal batteries, and cellulosic membranes for large flow batteries that offer large potential cost reductions. See summaries and references in cleantechnica.com/2020/02/20/3-reasons-why-cheap-abundant-electricity-is-getting-closer-to-reality/ ; "Solar's New Power", *The Economist*, May 23, 2020 edition; and "Novel Lithium Metal Batteries Will Drive the Switch to Electric Cars", in *MIT Technology Review*, Feb. 24, 2021, at www.technologyreview.com/2021/02/24/1018102/lithium-metal-batteries-electric-vehicle-car/

[52] See e.g. unfccc.int/news/join-the-paris-committee-on-capacity-building-network

[53] From detailed discussions with staff involved (2022). On Miami, see *The Economist* (2022) " Lexington: Miami's Submarine Future" at www.economist.com/united-states/2022/06/09/miamis-submarine-future

[54] Phrase borrowed from Tariq Fancy's critique (2021) of green/ESG finance at medium.com/@sosofancy/the-secret-diary-of-a-sustainable-investor-part-1-70b6987fa139

[55] Overviews of this vast subject include www.oecd.org/gov/world-bank-public-private-partnerships-reference-guide-version-3.htm; www.worldbank.org/en/topic/publicprivatepartnerships ; www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/PPP ; World Economic Forum Strategic Infrastructure Initiative (2013) "Steps to Prepare and Accelerate Public Private Partnerships", p.9, at www3.weforum.org/docs/AF13/WEF_AF13_Strategic_Infrastructure_Initiative.pdf ; www.weforum.org/agenda/2019/11/how-public-private-partnerships-must-evolve-to-create-social-impact/

[56] Independently managed city funds are discussed in www.fi-compass.eu/sites/default/files/publications/MRA-RICE_booklet.pdf

[57] See Quinn, R. and Thakor, A. (2018) hbr.org/2018/07/creating-a-purpose-driven-organization, and Sneader, K. and Sternfels, B. (2020) "From Surviving to Thriving: Reimagining the post-Covid Return", at www.mckinsey.com/featured-insights/future-of-work/from-surviving-to-thriving-reimagining-the-post-covid-19-return

[58] Abatement cost curves are helpful in starting discussions between government, business, and citizens about how much it is reasonable to pay, and when, for different levels of emissions reductions. Too often, both the marginal and absolute costs of proposed measures and targets are not discussed transparently making trade-offs difficult to assess. The curves do have their limitations: unclear assumptions, clouding issues of optimal sequencing, inter-dependencies among options, omission of co-benefits and externalities, "lock-in" dependencies, and ignoring the relative ease of implementation, etc. But they are a useful way to begin thinking more strategically about emissions reductions options. See a useful overview in *The Economist*, (Feb. 27 2021) "Giving up carbs"; Friedmann, S. Julio *et al.* (2020) "Levelized Cost of Carbon Abatement: An Improved Cost-Assessment Methodology for a Net Zero Emissions World", from the Center of Global Energy Policy, School of International and Public Affairs, Columbia University; Gillingham K, and Stock J.H., (2018) "The Cost of Reducing Greenhouse Gas Emissions", *Journal of Economic Perspectives*. 2018;32 (4) :53-72; Vogt-Schilb, A. *et al.* (2018) "When starting with the most expensive option makes sense: Optimal timing, cost and sectoral allocation of abatement investment", *Journal of Environmental Economics and Management* 88 (2018) 210–233 doi.org/10.1016/j.jeem.2017.12.00 and Kesicki F. *et al.* (2016) "A Methodology for Constructing Marginal Abatement Cost Curves for Climate Action in Cities", in *Energies 9*, 227; doi:10.3390/en9040227. The Material Economics and McKinsey work cited in this paper relies heavily upon these types of cost curves.

[59] The critical need for local experimentation is discussed in more detail in Sabel and Victor (2022) *op. cit*

[60] Mayers, Kieren *et al.* (2021) "The Limits of the 'Sustainable' Economy", in *Harvard Business Review*, Cambridge Ma, at hbr.org/2021/06/the-limits-of-the-sustainable-economy?

[61] Caparros-Midwood, Daniel *et al.* (2019) "Low Carbon, Low Risk, Low Density: Resolving choices about sustainable development in cities" at doi.org/10.1016/j.cities.2019.02.018

[62] Energy Transitions Commission (2021) "Making Clean Electrification Possible: 30 Years to Electrify the Global Economy", at www.energy-transitions.org/wp-content/uploads/2021/04/ETC-Global-Power-Report-.pdf

[63] See Thomas, Helen (2022) "Workers need more than platitudes about 'green jobs', in *Financial Times*, 7 Dec 2022, at www.ft.com/content/8f2212ac-5142-499b-a324-ad18f32065b5; Material Economics (Dec. 2020) "Understanding the Economic Case for Decarbonizing Cities: Why Economic Case Analysis for City Decarbonization is Crucial", from materialeconomics.com/publications and McKinsey Global Institute (2020) *op. cit.*

[64] See the pioneering work of the Dutch "Energiesprong" model, in Brown, D. *et al.* (2019) "An energy leap? Business model innovation and intermediation in the 'Energiesprong' retrofit initiative", Energy Research & Social Science 58 (2019) 101253, at doi.org/10.1016/j.erss.2019.101253

[65] ssir.org/articles/entry/collective_impact (2011) and ssir.org/articles/entry/defining_quality_collective_impact (2014) See also the "fusion cell", originally a military concept, but now with broader use to integrate across organizations and interests, in www.mcchrystalgroup.com/uploads/2020/04/15/Fusion_Cell_Playbook.pdf

[66] Hamel, Gary and Zanini, Michele (2020) *Humanocracy: Creating Organizations As Amazing as the People Inside Them.* Cambridge MA: Harvard Business Review Press; Edmondson, Amy (2018) *The Fearless Organization: Creating Psychological Safety in the Workplace for Learning, Innovation, and Growth.* Hoboken, NJ: John Wiley & Sons.

[67] Jones, Peter (2015) *Track Two Diplomacy in Theory and Practice,* Palo Alto, CA: Stanford University Press and www.economist.com/international/2020/01/21/conflict-resolution-relies-increasingly-on-diplomatic-back-channels

[68] See The Center for Deliberative Democracy's work at cdd.stanford.edu/what-is-deliberative-polling/ ; Landemore, Hélène (2020) *Open Democracy, op. cit.;* Chwalisz, Claudia (2022) "A movement that's quietly reshaping democracy for the better "at www.noemamag.com/a-movement-thats-quietly-reshaping-democracy-for-the-better/ ; OECD (2021) "Eight Ways to Institutionalize Deliberative Democracy", OECD Paris, at www.oecd-ilibrary.org/docserver/4fcf1da5-en.pdf?expires=1652605597&id=id&accname=guest&checksum=9B1223C89418DEBB01A3AE64B9421837 ; OECD (2020) *Innovative Citizen Participation and New Democratic Institutions : Catching the Deliberative Wave* at https://www.oecd-ilibrary.org/sites/339306da-en/1/3/8/index.html?itemId=/content/publication/339306da-en&_csp_=07698b7c924c319dbb92a6500bf563da&itemIGO=oecd&itemContentType=book ; Fishkin James and Mansbridge Jane, editors (2017) *The Prospects & Limits of Deliberative Democracy* in *Daedalus* Vol. 146 No. 3. Cambridge MA, at

www.amacad.org/sites/default/files/daedalus/downloads/Su2017_Prospects-Limits-of-Deliberative-Democracy.pdf ; and Barber, Benjamin (2003) *Strong Democracy*. Berkeley CA: University of California Press.

[69] See Popper, Steven (2019) "Reflections: DMDU and Public Policy for Uncertain Times", in Marchau, V. *et al.* (eds.), *Decision Making under Deep Uncertainty*, doi.org/10.1007/978-3-030-05252-2_16; Kalra, N. *et al.* (2014) "Agreeing on Robust Decisions: New Processes for Decision Making Under Deep Uncertainty", World Bank Policy Research Working Paper 6906, World Bank Climate Change Group, Office of the Chief Economist, at hdl.handle.net/10986/18772

[70] References for programs and projects: www.greenribboncommission.org/; https://accelerator.nyc/ll97 and www.nyceec.com/; cbcny.org/research/getting-greener; www.leedsclimate.org.uk/about-leeds-climate-commission; www.bristolcityleap.co.uk/wp-content/uploads/2022/12/Bristol-City-Leap-Summary-of-Initial-Business-Plan-2022.pdf ; www.greencape.co.za/; sustainablecities.eu/transformative-actions-database/?c=search&action_id=7pv84o3m ; one stop shop examples include Ireland see www.seai.ie/grants/home-energy-grants/one-stop-shop/ ; on Mannheim, see www.klima-ma.de/die-agentur; Brown, D. *et al.* (2019) "An energy leap? Business model innovation and intermediation in the 'Energiesprong' retrofit initiative", *op. cit.* ippuc.org.br/; www.fi-compass.eu/sites/default/files/publications/MRA-RICE%20booklet.pdf;smart.columbus.gov/funding-sources/acceleration-fund;cib-bic.ca/en/about-us/frequently-asked-questions/; siteresources.worldbank.org/PSGLP/Resources/ParticipatoryBudgeting.pdf; Giraude, Louis-Gaëtan *et al:* (2022) "'Co-construction' in deliberative democracy: lessons from the French Citizens' Convention for Climate," in *Humanities and Social Sciences Communications* (2022) 9:207 doi.org/10.1057/s41599-022-12126 ; www.newstatesman.com/politics/environment/2019/11/are-citizens-assemblies-really-answer-climate-crisis; www.resilience.org/stories/2020-01-17/convention-citoyenne-pour-le-climat-what-can-we-learn-from-the-french-citizens-assembly-on-climate-change; "Citizens' Assemblies Are Increasingly Popular", *The Economist*, Sept 19, 2020 Edition; Whyte, William F. and Whyte, Kathleen (2014) *Making Mondragón: The Growth and Dynamics of the Worker Cooperative Complex* (2nd Edition) Cornell NY: Cornell University Press ; and ecoblock.berkeley.edu . Micro-grid expansion changes daily but some useful overviews include; www.brooklyn.energy/about; Warneryd, Martin et al. (2020) "Unpacking the complexity of community microgrids: A review of institutions' roles for development of microgrids", *Renewable and Sustainable Energy Reviews*. doi.org/10.1016/j.rser.2019.109690; minigrids.org/wp-content/uploads/2020/06/Mini-grids_Market_Report-20.pdf; openknowledge.worldbank.org/bitstream/handle/10986/31926/Mini-Grids-for-Half-a-Billion-People-Market-Outlook-and-Handbook-for-Decision-Makers-Executive-Summary.pdf ; IRENA (2020) *Innovation landscape brief: Community-ownership Models*, International Renewable Energy Agency, Abu Dhabi ; www.ecopwer.be; www.irena.org/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Renewable_mini-grids_2019.pdf ; www.cleanenergywire.org/factsheets/citizens-participation-energiewende and www.energiequelle.de/en/the-energy-self-sufficient-village-of-feldheim/

[71] While a LEEP is envisioned as an innovation engine and deal broker, it would share many of the operating characteristics and challenges facing PPPs. These are summarized well in World Economic Forum Strategic Infrastructure Initiative (2013) "Steps to Prepare and Accelerate Public-Private Partnerships", *op. cit*., especially pp. 22-26.

[72] See discussion how this can range from 3% to over 10% of income, in Agora Energiewende (2019) "European Energy Transition 2030: The Big Picture. Ten priorities for the next European Commission to meet the EU's 2030 targets and accelerate towards 2050", p. 48, www.agora-energiewende.de/fileadmin2/Projekte/2019/EU_Big_Picture/153_EU-Big-Pic_WEB.pdf

[73] World Economic Forum Strategic Infrastructure Initiative (2013) *op. cit.,* p.9.

[74] The complex question of what "needs to pay for itself" is far beyond this paper's scope and spans issues of what becomes defined as a public good, the roles of state and market, and who defines these boundaries. However, in passing, note that we never ask organizations addressing profound, existential security threats to somehow recoup their costs from cash benefits (military, police and fire fighting units being obvious examples). It is highly unlikely that all the massive sums to be spent managing the Covid pandemic will be repaid. Ultimately whether an organization should pay for its costs from monies saved becomes a political choice. See Sandel, Michael (2012) *What Money Can't Buy: The Moral Limits of Markets*. New York: Farrar, Straus and Giroux; Turner, Adair (2001, *Just Capital, op. cit.*; and Lindblom, C. E. (1977) *Politics and Markets*. New York: Basic Books. There is a larger issue here of priorities. Table 3 below shows some examples of global spending whose costs are not covered by savings:

**Table 3: Selected Global Spending Data**

| Spending Item | Current Spending ($) | Projected Spending | Data Ranges |
|---|---|---|---|
| Cosmetics | 530 Billion | 800 Billion | 2017 / 2023 |
| Smart Phones | 715 Billion | 1.35 Trillion | 2019 / 2023 |
| Cigarettes | 888 Billion | 1.24 Trillion | 2018 / 2024 |
| Alcoholic Beverages | 1.58 Trillion | 1.86 Trillion | 2019 / 2026 |
| Fossil Fuel Subsidies | 700 Billion/ 7 Trillion (explicit/Implicit) | | 2023 |
| Total Global Military | 2.24 Trillion | | 2023 |

As explained earlier, operating a LEEP costs about €3.3 Million per year, per city. 1,000 cities together would need to spend €3.3 Billion ($3-4 Billion) annually. The resources needed to support this are available and for large middle- or high-income cities, the cost would be equivalent to foregoing 3-4 specialized coffees or beers per person, *per year*, during a start-up phase. With what we are learning about the health impacts of cleaner air, which could be greatly increased by a LEEP's regional focus, the charges for merely one less visit to a doctor per person per year would more than cover a LEEP's annual cost.

Sources for spending data:

www.marketwatch.com/press-release/cosmetics-products-market-2019-global-industry-trends-share-size-demand-growth-opportunities-industry-revenue-future-and-business-analysis-by-forecast-2023-2019-07-11);
www.researchandmarkets.com/reports/4856120/smartphones-market-growth-trends-and-forecast?utm_source=dynamic&utm_medium=BW&utm_code=mhmwms&utm_campaign=1320074+-

+Global+Smartphones+Market+Growth%2c+Trends%2c+and+Forecast+Report+2019-2024%3a+Online+sales+of+Smartphones+may+be+Challenged+by+Offline+Push&utm_exec=chdo54bwd; www.prnewswire.com/news-releases/global-cigarette-market-2018-2019--2024-the-market-was-worth-us-888-Billion-in-2018-and-is-projected-to-reach-a-value-of-1-124-Billion-by-2024--300797851.html; www.statista.com/outlook/10000000/100/alcoholic-drinks/worldwide https://www.imf.org/en/Topics/climate-change/energy-subsidies www.sipri.org/media/press-release/2023/world-military-expenditure-reaches-new-record-high-european-spending-surges

[75] www.citygapfund.org/what-we-offer

[76] See Acemoglu and Johnson (2023) *op cit.* and Rajan (2019) *op.cit.* There will also be further, more immediate challenges to continue financing open plan" office space, denser housing settlements and preserving the viability of mass transit systems and commercial property, as these seek to find ways to overcome on-going changes in working from home, and higher interest rates.

[77] Nahm, Jonas *et al*. (2022) "G20's US$14-trillion economic stimulus reneges on emissions pledges", *Nature* 603, 28-31 (2022), doi.org/10.1038/d41586-022-00540-6

[78] See Engel H. *et al.* (2020) www.mckinsey.com/business-functions/sustainability/our-insights/how-a-post-pandemic-stimulus-can-both-create-jobs-and-help-the-climate and International Energy Agency (2020) "Sustainable Recovery: World Energy Outlook Special Report", at www.iea.org/reports/sustainable-recovery# and Glaeser Edward and Poterba, James, (2020) "Economic Analysis and Infrastructure Investment", *op. cit.*

[79] See *The Economist* (2023) "The global backlash against climate policies has begun" www.economist.com/international/2023/10/11/the-global-backlash-against-climate-policies-has-begun

[80] European Environment Agency (2023) "Harm to human health from air pollution in Europe: burden of disease 2023" doi: 10.2800/721439 ; Greenstone, Michael and Hasenkop, Christa (2023) "Air Quality Life Index 2023: Annual Update", Energy Policy Institute at the University of Chicago, available from qli.epic.uchicago.edu ; Swanton, C. *et al.* (2022) "LBA1 'Mechanism of action and an actionable inflammatory axis for air pollution induced non-small cell lung cancer in never smokers", *Annals of Oncology*, Volume 33 Supplement 7, September 2022; Setti, Leonardo, *et al.* (2020) "SARS-Cov-2 RNA Found on Particulate Matter of Bergamo in Northern Italy: First Preliminary Evidence", at www.medrxiv.org/content/10.1101/2020.04.15.20065995v2 and Wu, Xiao *et al.* (2020) "Exposure to air pollution and COVID-19 mortality in the United States" at projects.iq.harvard.edu/files/covid-pm/files/pm_and_covid_mortality.pdf: Dedoussi, I.C. *et al.* (2020) "Premature mortality related to United States cross-state air pollution", *Nature* 578**,** 261–265 (2020) doi.org/10.1038/s41586-020-1983-8. Air pollution mortality rates may also be higher than thought previously. See Vohra, K. *et al.* (2021) "Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem", in *Environmental Research.* doi.org/10.1016/j.envres.2021.110754. For linkages between energy policy, indoor air quality, and quantifiable health co-benefits in buildings and larger spatial scales, see Salimifard, Parichehr *et al.* (2023) "A novel method for calculating the projected health and climate co-benefits of energy savings through 2050", *Building and Environment,* Volume 244, 1 October 2023, 110618, at doi.org/10.1016/j.buildenv.2023.110618

[81] The reduced energy demand effects of the disease caused unprecedented annual global emissions *drop* of over 7% compared to 2019 levels, as well as striking reductions in airborne particulates. Note this is a preliminary estimate of total 2020 $CO_2$ emissions primarily from the energy sector, not $CO_2e$ emissions globally, which would also include a wider range of gasses. The short-term Feb-April drop was even more abrupt, approaching 17-24%. But as economies rebounded, this has already reversed on an annualized basis. See www.iea.org/articles/global-energy-review-co2-emissions-in-2020; www.iea.org/reports/global-energy-review-2020 and Le Quéré, C. *et al.* (2020) "Temporary reduction in daily global $CO_2$ emissions during the COVID-19 forced confinement" in *Nature: Climate Change,* doi.org/10.1038/s41558-020-0797 However, direct measurements of atmospheric concentration of $CO_2$ reached *an all-time high* of 417 ppm in May 2020. See research.noaa.gov/article/ArtMID/587/ArticleID/2636/Rise-of-carbon-dioxide-unabated

[82] Shindell, Drew, *et al.* (2021) "Temporal and spatial distribution of health, labor, and crop benefits of climate change mitigation in the United States", in *Proceedings of the National Academy of Sciences*, Vol. 118, No. 46. Washington, DC, doi.org/10.1073/pnas.2104061118

[83] It is too soon to assess the complex impact of Covid (and its continuing mutations) on urban finances where revenues have declined as costs increase across a range of sectors. The medium and longer effects on property values, employment, mass transit, tourism, tax revenue etc. will be increasingly difficult to untangle from the additional supply shocks triggered by the war in Ukraine, and interest rate increases. Municipal financial effects will vary depending upon how stable central and regional government transfers and emergency support will remain. As of early 2023, mid-week office occupancy in 10 major US cities continues to hover around 50% of pre-Covid levels. See chart in Editorial Board (2023) "Downtowns are lifeless. It's a once-in-a-generation chance to revive them", *Washington Post*, Jan. 19, 2023. For other preliminary assessments, see Cevat Giray *et al.* (2022) Working from Home Around the World", NBER Cambridge MA Working Paper No. 30446, September 2022, at www.nber.org/system/files/working_papers/w30446/w30446.pdf ; Gupta, Arpit *et al.* (2022) "Work From Home and the Office Real Estate Apocalypse" (September 26, 2022), at dx.doi.org/10.2139/ssrn.4124698 ; UCLG, Metropolis and LSE Cities (2021) "The Impact of the Covid-19 Pandemic on Subnational Finances", Analytics Note '03, at www.uclg.org/sites/default/files/an03_-_the_impact_of_the_covid19_subnational_finances.pdf ; Alessandrini, M. *et al.* (2021) Local and regional finances in the aftermath of
Covid19", European Committee of the Regions, at cor.europa.eu/en/engage/studies/Documents/Local%20and%20regional%20finances%20in%20the%20aftermath%20of%20COVID-19/CoR_Local_and_regional_finances_after_Covid-19.pdf; The World Bank (2021) "The Impact of the Covid-19 Pandemic on Municipal Finance" at openknowledge.worldbank.org/bitstream/handle/10986/37205/P176128097ea630e50b4620c15a0ad7d9fd.pdf?sequence=5 ; and McKinsey and Company (2021) "Urban Transportation Systems of 25 global cities", especially "Impact of the Covid Pandemic, pp.
85- 99, at www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/building%20a%20transport%20system%20that%20works%20new%20charts%20five%20insights%20from%20our%2025%20city%20report%20new/elements-of-success-urban-transportation-systems-of-25-global-cities-july-2021.pdf

[84] See Henderson *et al.* (2020) *op. cit.;* Arup/C40 (2017) "Deadline 2020", *from* www.arup.com/-/media/arup/files/publications/d/deadline_2020_report_final_v2.pdf and Harvey H. and Agarwal, S. (2011) "The Costs of Delays" from energyinnovation.org/wp-content/uploads/2015/03/ClimateWorks-Costs-of-Delay1.pdf

[85] See the WHO convened Independent Panel for Pandemic Preparedness and Response (2021) "Covid-19: Make It the Last Pandemic" at theindependentpanel.org/wp-content/uploads/2021/05/COVID-19-Make-it-the-Last-Pandemic_final.pdf and Castillo, Juan Camilo *et al.* (2021)" Market design to accelerate COVID-19 vaccine supply", *Science* 12 Mar 2021: Vol. 371, Issue 6534, pp. 1107-1109. doi: 10.1126/science.abg0889

[86] See Wolf, Martin (2021) "Vaccinating the world is a test of our ability to cooperate" *Financial Times* at www.ft.com/content/a835f7a4-3877-4e3d-832a-2f286c936925 .

[87] See Meadows AJ, Stephenson N, Madhav NK, *et al.* (2023) "Historical trends demonstrate a pattern of increasingly frequent and severe spillover events of high-consequence zoonotic viruses" *BMJ Global Health* 2023;8:e012026, at dx.doi.org/10.1136/bmjgh-2023-012026. Earlier warnings include Bill Gates's (2015) www.ted.com/talks/bill_gates_the_next_outbreak_we_re_not_ready? ; Morse, Stephen (1996) *Emerging Viruses*. London: Oxford University Press; Quammen, David (2012) *Spillover: Animal Infections and the Next Human Pandemic.* NY: W.W. Norton and Company; and www.nytimes.com/2020/03/19/us/politics/trump-coronavirus-outbreak.html which discusses earlier government reports warning of pandemic outbreaks and even results from outbreak simulation gaming exercises that were all ignored.

[88] See www.epa.gov/sites/production/files/2014-08/documents/partnership-accomplishments-report-2014-reduced-size.pdf for the USA. EC examples: www.concertoplus.eu/impacts/business-models/ smartcities-infosystem.eu/experiences/lessons_learned ; ec.europa.eu/research/evaluations/pdf/brochure_interim_evaluation_horizon_2020_key_findings.pdf ; smartcities-infosystem.eu/sites-projects/projects ; and new programs e.g. www.climate-kic.org/programmes/deep-demonstrations/#deep-demonstrations

[89] See European Commission (2019) *op. cit.*, p.4.

[90] See grow-smarter.eu/fileadmin/editor-upload/Reports/Smart_City_Market_Introduction.pdf and the "Conclusions", pp. 407-412 in grow-smarter.eu/fileadmin/editor-upload/Reports/GrowSmarter_Validation.pdf

[91] ec.europa.eu/info/publications/100-climate-neutral-cities-2030-and-citizens_en ; ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme/missions-horizon- europe_en ; and ec.europa.eu/energy/sites/ener/files/documents/002_niels_ladefoged_seif_copenhagen_14-05-2019.pdf, part of the overall €500 Billion in discussion for the "EC Green Deal" as proposed in ec.europa.eu/info/sites/info/files/communication-europe-moment-repair-prepare-next-generation.pdf and ec.europa.eu/commission/presscorner/detail/en/fs_20_40 . For critical looks at this, see Storm, Servaas (2020) "The EU's Green Deal: Bismarck's 'What is Possible' vs. Thunberg's 'What is Imperative' ", Institute for New Economic Thinking, at doi.org/10.36687/inetwp117 ; Bruegel Institute (2020) "A Trillion Reasons to Scrutinise the Green Investment Deal Plan", at www.bruegel.org/2020/01/a-trillion-reasons-to-scrutinise-the-green-deal-investment-plan/ and Runkel, Matthias *et al.* (2019) "Climate Change and the EU Budget 2021-2027: Synthesis Report" at www.euki.de/wp-content/uploads/2019/10/2019_MFF-and-Climate_background-report.pdf. There are also at least 16 other programs such as LIFE, ELENA, etc. that overlap with some of this, usefully summarized at www.eumayors.eu/support/funding.html. For a useful related overview, see Darvas, Zsolt *et al.* (2019) "How to improve European Union cohesion policy for the next decade" in *Policy Contribution*, at www.bruegel.org/2019/05/how-to-improve-european-union-cohesion-policy-for-the-next-decade/

[92] netzerocities.eu/nzc-partners/