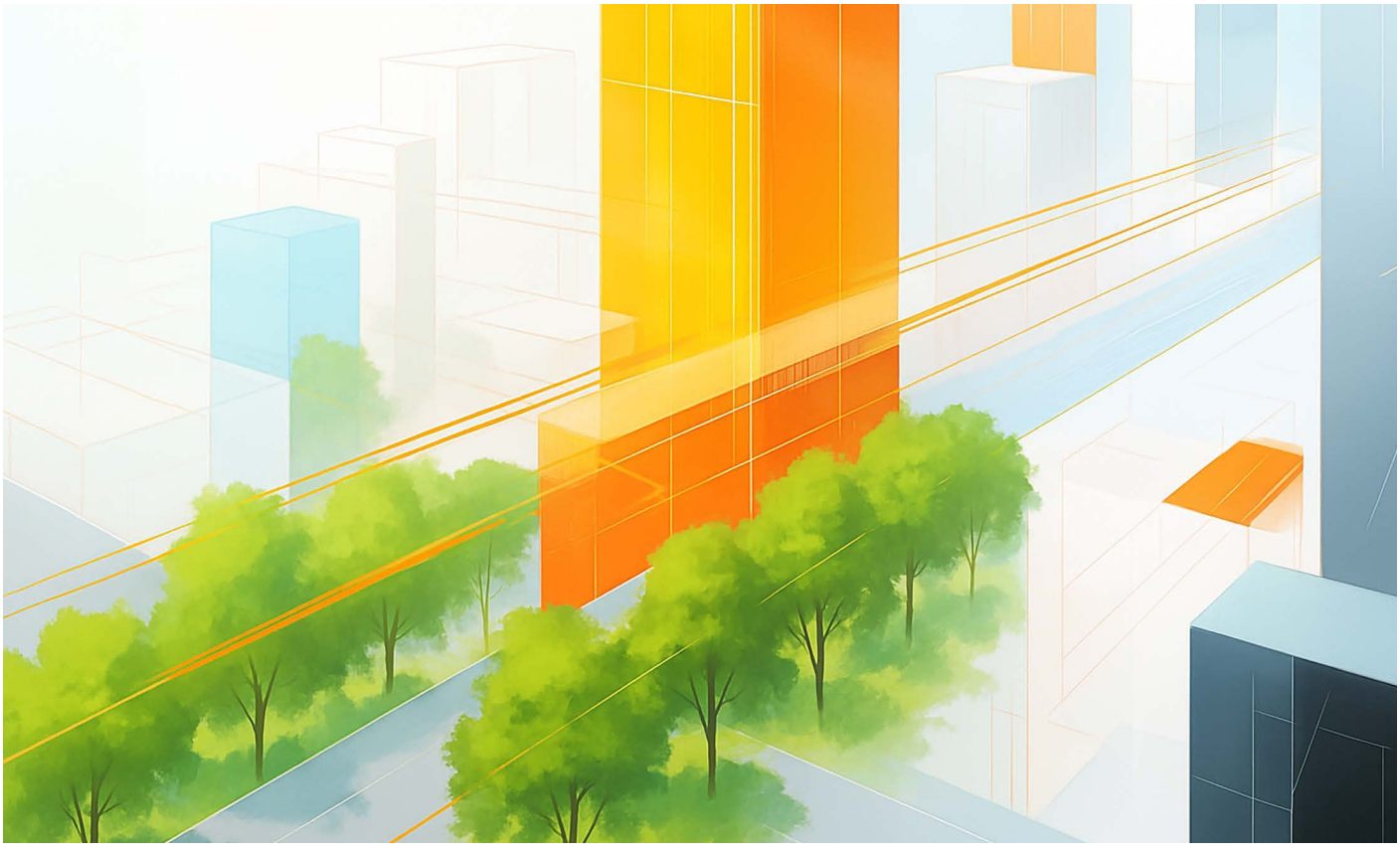
ClimateView

Designing for delivery

How cities can structure fundable climate transitions



ICLEI Local Governments for Sustainability

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How to Cite:
Shalit, T., Dixon, M., Corbett, D., Salehi, P., Schultz, L., Manner, M., Andrén, C., Wharmby, C., & Boertien, R. (2025). *Designing for delivery: How cities can structure fundable climate transitions* (Version 1.0). ClimateView AB. https://www.climateview.global/en/whitepaper/designing-for-delivery

Designing for delivery:

How cities can structure fundable climate transitions

Version 1.0 2025-06-18.

Executive summary

Cities today are no longer evaluated by the boldness of their climate goals but by their ability to achieve them. In an era where climate finance depends on operational credibility, the standard has shifted: vision alone is insufficient. A clear, structured, and viable delivery capability is now the benchmark.

To rise to this challenge, cities must go beyond conventional planning methods. What is required is not just better plans but improved planning logic and tools for implementing them, connecting high-level objectives to system realities and illustrating how interventions will function within, rather than against, the constraints of infrastructure, institutions, capital, and time.

This white paper presents the **Dual Lens of Transition Planning** as a structured, repeatable approach that operationalizes systems thinking to make delivery visible, measurable, and fundable from day one. It assists cities in designing transitions that funders can trust, governments can coordinate, and communities can support.

The Dual Lens consists of three interrelated components:

1. **The Shift Lens: What shifts are needed**
   The Shift Lens breaks down the systemic transformations a city must pursue to achieve its climate goals into specific shifts. They represent changes in how urban systems operate to meet the needs of their inhabitants, such as transitioning from combustion vehicles to clean public transit or from fossil fuel heating to electrified buildings. Each shift is analyzed from two perspectives: the system demands for it to be enacted, like infrastructure, workforce, capital, or social acceptance, and the system benefits it provides when achieved, such as emissions reductions, improved air quality, economic resilience, and more. This framework clarifies both what must be true for the shift to occur and what outcomes it will produce if successful. It ensures that planning is driven by the system's needs rather than pre-selected solutions.
2. **The Intervention Lens: What must be done to achieve the shifts**
   The Intervention Lens aids in designing targeted, sequenced strategic actions that address system demands and facilitate the necessary shifts. These actions include the policies, investments, and programs that actively create the conditions essential for each shift, such as expanding skilled labor, eliminating permitting bottlenecks, funding critical infrastructure, or reshaping public behavior. Interventions are not standalone projects; they form a coherent and investable response portfolio directly informed by the constraints and opportunities identified through the Shift Lens. The Intervention Lens provides cities with a structured framework to transition from diagnosis to delivery, from recognizing what is needed to implementing solutions, and from initiating action to data-driven refinement.
3. **The Transition Pulse: Is the system moving**
   The Transition Pulse offers a dynamic signal of early movement and system vitality. Drawing on a curated set of leading indicators provides cities with actionable insights into whether conditions are changing in the intended direction and if the system is beginning to meet the demands of the required shifts. These signals include

the uptake of subsidies, new workforce certifications, modal shifts in mobility, or the initial waves of infrastructure activation. Alone, they provide a snapshot; together, they create a composite feedback loop that helps cities sense progress, identify pressure points, and adjust strategies before gaps become failures. While emissions and energy use remain essential lagging indicators, the Transition Pulse offers planners and funders a crucial view of *whether interventions are effective and whether the system is starting to respond*.

When used together, the three elements of the Dual Lens create an integrated framework for driving urban transformation. The Shift Lens defines the system's direction and what it should deliver. The Intervention Lens outlines how to achieve that by designing interventions that unlock enabling conditions. The Transition Pulse indicates whether those interventions produce the desired effects, creating a continuous feedback loop among planning, delivery, and learning. This delivery logic connects ambition to action and vision to measurable progress.

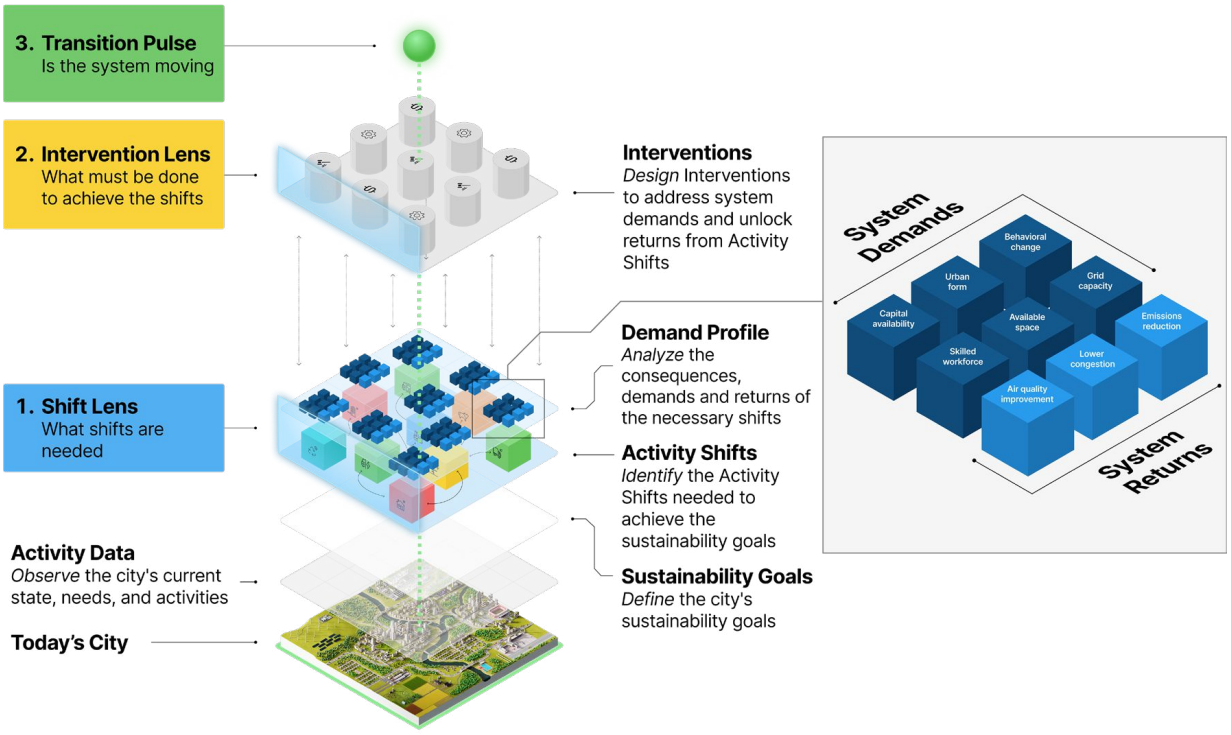
"When used together, the three elements of the Dual Lens create an integrated framework for driving urban transformation."

The Dual Lens helps cities move beyond disconnected projects and siloed planning toward a coordinated, fundable, and adaptable pathway for system-wide change. It transforms climate strategies from static documents into dynamic, responsive plans that can guide investment, coordination, and course correction. It enhances rather than replaces forecasting, backcasting, or scenario planning by integrating structural logic, real-world feasibility, and systems-based tracking into every planning process. It ensures that transitions are directionally correct (aligned with science-based targets and local goals), structurally supported (based on what systems can deliver), financially credible (meeting funder requirements), and politically sustainable (anchored in institutional roles and public trust).

This is not just an evolving theory of change. It is a method already in use.

Figure 1: The Dual Lens & Transition Journey

Transition Thinking
The Dual Lens approach

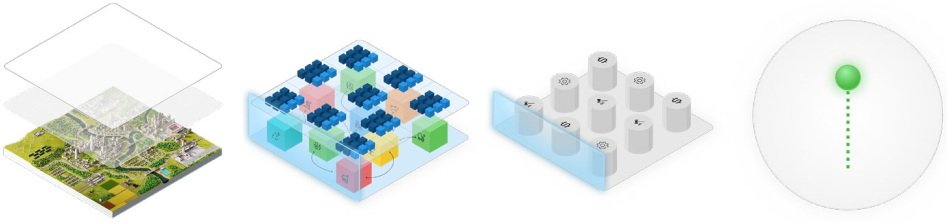


Transition Journey
The Dual Lens in practice

Transition Journey

Lay the Foundation •○○○	Set Targets •••○	Take Action •••○	Track Progress ••••
Defining the basics of our transition, from understanding current status to setting our overall goal.	Defining yearly targets to reach our goals.	Implementing policies and actions to reach our targets.	Monitoring the results of our action.

Dual Lens Element



Shift Lens
(System Demand Profiling)

Intervention Lens

Transition Pulse

Key Terms

Term	Definition
Capital, Funding, Financing, and Investment	These related terms describe how resources flow to support transition efforts, each with distinct implications. Funding refers to non-repayable support, such as grants. Financing includes repayable mechanisms like loans (debt financing) and equity financing, where capital is provided in exchange for ownership or future returns (investments). Investment generally involves higher risk and an expectation of financial, social, or environmental return. Capital is the umbrella term for the economic, human, social, or institutional resources needed to deliver shifts and interventions. Understanding these distinctions helps cities structure credible, fundable strategies aligned with the expectations of different actors.
Dual Lens of Transition Planning	A planning method composed of the Shift Lens and Intervention Lens, connected by a Tracking Line, that enables cities to turn systemic ambition into structured, fundable delivery.
Fundable Strategy	A transition plan that moves beyond aspiration to include apparent system shifts, sequenced interventions, defined roles, readiness tracking, and real-world feasibility, enabling funders to assess risk and invest with confidence.
Intervention Lens	The second lens of the method addresses “what must be done”, including redesigning, sequencing, and assigning roles for the interventions (e.g., policies, programs, and investments) required to make activity shifts viable. Interventions can be direct (Interventions with predictable, direct impacts on Activity Shifts, and thus emissions reduction and other outcomes), Indirect (Interventions that influence city attributes, indirectly affecting behaviour and Activity Shifts), or enabling (Interventions that provide opportunities or support for other interventions).
Multilevel Governance (MLG)	MLG is a governance model in which authority is distributed across local, regional, national, and supranational actors. It is essential to systemic transitions because it enables vertical and horizontal coordination and aligns roles, financing, and policies across levels and sectors.
Science-Based Targets	Quantitative emissions reduction goals aligned with the decarbonization level required to meet the Paris Agreement objectives to limit global warming to well below 2°C, preferably 1.5°C. These targets are grounded in the latest climate science and provide a transparent benchmark for climate ambition and accountability.

Shift Lens	The first lens of the Dual Lens method defines “what must become true.” It identifies the structural system shifts needed to meet societal needs sustainably and models what each shift demands (e.g., capital, labor, infrastructure) and delivers (e.g., emissions reductions, resilience).
Stress-Testing	A planning approach that simulates whether interventions can be delivered within existing system constraints. It helps identify bottlenecks, dependencies, and the need for alignment across actors or timelines.
System Demand Profile	A structured summary of the resources, capacities, and reforms required to make a shift successful, including capital, labor, infrastructure, governance, and social license demands.
Systems Thinking	Systems thinking is a mindset and methodology for understanding complexity by analyzing how system components interact through feedback loops, structures, and behaviors. It provides the foundation for developing strategies that are interconnected, adaptive, and aware of unintended consequences.
Tempo	The expected rate of system change over time is expressed as an annualized target (e.g., 1,000 homes retrofitted/year, or +3% modal share shift/year). Tempo includes both infrastructure or service delivery (e.g., km of bike lanes, number of retrofits) and behavioral uptake (e.g,. % of people switching transport modes), recognizing that behavioral change is itself a system demand. Technological and behavioral transitions do not follow a linear trajectory. Instead, they often follow S-curve dynamics, with slow initial uptake followed by rapid acceleration once enabling conditions are in place. Defining tempo should therefore account for these nonlinear patterns, ensuring targets are not only ambitious but grounded in the likely dynamics of adoption.
Transition Pulse	A mechanism for observing system readiness through leading indicators, rather than lagging outcomes. It helps cities adapt strategies in real time, track the pace of change (tempo), and build credibility with funders..
Transition Element Framework	An open-source initiative built on the foundation of IPCC climate mitigation strategies, the TEF transforms complex IPCC knowledge into a standardised, accessible framework. Already used by cities and governments worldwide, the TEF provides a shared language and transparent methodology for planning and measuring climate action, enabling cities to set KPIs and track real decarbonisation progress.
Transition Planning	The process of structuring and implementing a city’s climate strategy that connects societal needs to system-level changes, enabling credible delivery and investment readiness.

Who this white paper is for

This white paper is written for those at the intersection of urban planning, climate strategy, and implementation. Especially:

1. **Local and regional governments** seeking to structure and deliver on climate targets
2. **National ministries and public agencies** coordinating multilevel transitions
3. **Development banks, climate funds, and investors** scouting for credible, investable city plans
4. **Tech and advisory teams as well as incubators** supporting cities with innovation, modeling, planning, or finance alignment.
5. **Cross-sector coalitions** working to build capacity for system-scale climate action.
6. **Boundary organizations** that operate at the interface between science and policy, facilitating communication, translation, and collaboration between researchers, policymakers, and other stakeholders.

It is also relevant for researchers, policy designers, and funders who aim to close the gap between ambition and delivery in the urban transition. This document is organized around a core narrative that presents the method and its application across four parts. Sidebar boxes and shaded sections provide in-depth explorations of specific concepts, platform features, and practitioner case studies. This structure enables readers to follow the main argument while selectively engaging with technical or contextual details as needed.

How to read this white paper

This paper does not define or prescribe sustainability. Instead, it focuses on operationalizing it, regardless of how a city or government defines its goals. ClimateView's role in the ecosystem is not to dictate political objectives but to provide a structured, transparent method for reasoning about what it takes to achieve them. We assist cities and governments in translating vision into viable pathways and make those pathways clear to stakeholders across departments, regions, and financial institutions so that transitions can be coordinated, implemented, and scaled.

We recognize that climate change is inherently political. Like other global challenges, it affects communities unequally, and values, priorities, and power structures shape decisions about how, when, and where to respond. Technology, too, is not neutral: its design, deployment, and outcomes are influenced by the contexts in which it operates.

ClimateView operates as a transparent system model rather than a black box. It structures assumptions, exposes logic, and allows users to simulate the implications of decisions, not in place of political judgment, but in service of it. By making the structural requirements of a chosen future visible, such as infrastructure, workforce, capital, and public behavior, we enable actors to reason together in transparent, actionable terms.

ClimateView did not begin with a model. We started with a real-world challenge: cities often have targets, political will, and emerging access to finance, but lack a structured way to deliver. Efforts stall not due to a lack of planning, but because most tools fragment complexity or bury it beneath static forecasts. This makes coordinating, building funder confidence, or adapting to changing conditions difficult. That's why we developed a structural model, not to predict, but to help cities understand what their goals demand from real systems and whether the steps they take to build those systems are effective. While our model offers a clear structure, it does not prescribe goals. It provides an open foundation that separates political priorities from systemic consequences and enables each city to pursue its own path while working from a shared analytical basis. This clarity builds trust in a world where legitimacy and fundability go hand in hand. That being said, we acknowledge that cities should be the key levers for achieving shifts toward fulfilling human needs in less resource- and carbon-intensive ways that align with natural systems, and we intend for the resource model to be applied toward this goal.

The Transition Element Framework (TEF) and the Dual Lens methodology presented in this paper embody a systems-thinking approach designed for action. They are grounded in scientific logic (e.g., IPCC mitigation categories and MECE structuring) and built to be understood and utilized. These resource models help cities comprehend how context-specific, politically determined needs can be met through structural shifts in how energy and resources flow. They prompt governments to ask, "What shifts are needed?" and "What must be done to achieve the shifts?"

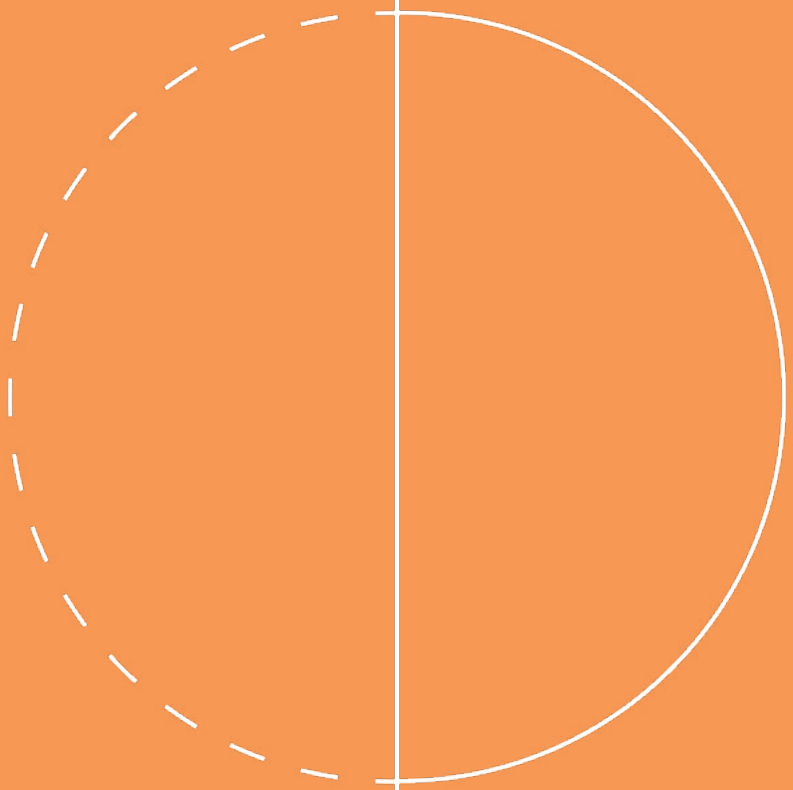
We view ourselves as a methodological infrastructure provider, building a common language and analytical platform for climate transition planning that scales, is interoperable, and promotes coordination across all levels of governance. This paper reflects that perspective. It offers a way to engage with systemic complexity and to turn it into a shared foundation for action.

List of figures

Table of contents

Introduction

The Dual Lens of transition planning



From complexity to clarity

Delivering a climate transition at the required speed and scale is an unprecedented challenge. It demands nothing less than the transformation of the systems that underpin everyday life, such as energy, mobility, housing, and capital, while ensuring that societal needs are met. These transformations must co-occur, in real time, and under mounting pressure, across every level of governance and diverse geographies.

Cities are central to this challenge. They are where climate ambition meets implementation, global targets become tangible decisions, and the risks and realities of delivery (and failure) are most visible. This is a relatively new expectation for cities. The elevation of SDG11 and the recognition of the urban scale under the Paris Agreement reflect a profound shift in how cities are positioned within the climate transition, not just as implementers, but as systems orchestrators. To meet this challenge, cities must adopt systems thinking, not as a buzzword, but as a core planning logic.

Systems thinking provides a structured way to engage with complexity by shifting the focus from isolated problems and projects to the underlying dynamics that shape outcomes over time. It asks what needs to be done, how parts interact, where leverage exists, and what unintended consequences might follow. For cities, this perspective is vital: the climate transition is not a collection of discrete fixes but a deeply interconnected transformation involving infrastructure, institutions, behaviors, and capital flows.

Global institutions, national governments, and climate frameworks consistently urge cities to think and act systemically. But the "how" often remains unclear. This white paper does not simply add to that call; it responds to it. ClimateView offers cities both a methodology and a platform to operationalize systems thinking, turning abstract imperatives into structured strategies, coherent interventions, and trackable outcomes. In doing so, it bridges the persistent gap between systemic ambition and practical delivery.

"Cities are where climate ambition meets implementation, global targets become tangible decisions, and the risks and realities of delivery (and failure) are most visible."

Many prevailing tools, mandates, and governance models that cities rely on are not designed for this complexity. Most were developed for service delivery and incremental improvement, not for navigating profound structural change across interdependent systems. The result: many cities are stuck between vision and execution. They have bold targets, often aligned with national or global commitments, but lack a credible, coordinated roadmap and method for communicating the necessary steps with potential funders. Fragmented responsibilities, siloed planning, and short political cycles further erode continuity and slow progress before it begins.

Deepdive: Systems Thinking, P. 82

What is Systems Thinking and why cities need it

Systems thinking helps cities understand complex and interconnected urban challenges. This sidebar introduces key concepts and explains how a systemic perspective enables better decision-making in transition planning.

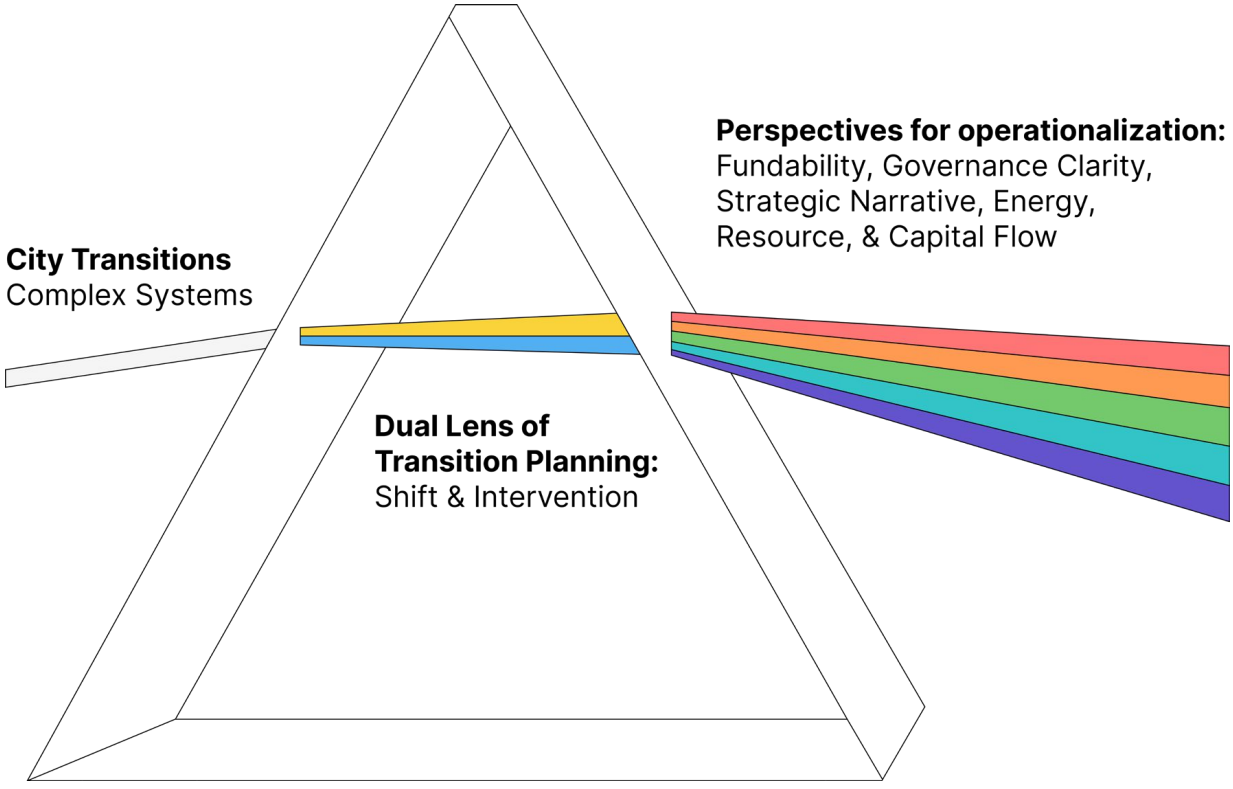
Cities seeking to deliver climate mitigation progress face a paradox. They are central to global decarbonization goals (responsible for over 70% of emissions) but receive only a fraction of the required finance to enact the shifts. Cities today can access climate finance through public, blended, and private channels, each with distinct requirements, constraints, and barriers, including:

- Fragmented responsibilities and a lack of clear mandates.
- Low project preparation capacity to make a costed, risk-assessed investment case.
- High perceived risks due to small or unproven concepts.
- A disconnection from national financial structures and indicators that focus only on end-state outcomes rather than progression/ readiness indicators towards that outcome.

To overcome these barriers, cities increasingly need to present not just “projects” or “visions” but credible delivery structures that aggregate and sequence interventions, track readiness, align with national NDCs, and leverage technology to create transparency and attract blended finance.

This paper introduces a method for changing that as part of a broader evolving theory of change captured in previous white papers produced by ClimateView. It offers a structured approach for engaging with complexity rather than avoiding it - one that makes strategies more coherent, delivery more visible, and transition more fundable. The goal is not to reduce complexity to linear steps, but to provide a way of working with it systematically and transparently.

Figure 2: Situating the Dual Lens within operationalization



The method presented here and the ClimateView platform built to support it enable cities to plan and implement climate transitions that are:

- **Structured enough to unlock investment**, by linking ambition to system readiness and costed interventions;
- **Coordinated enough for multilevel governance**, by providing a shared language for cross-sector and cross-scale planning;
- **Clear enough to build public trust**, by translating transition plans into narratives that people can understand, follow, and support.

At the heart of this approach is the Dual Lens of Transition Planning - a practical method, grounded in a computational modelling perspective, for turning systems thinking into strategies that are fundable, explainable, and grounded in delivery reality. On a broader level, the Dual Lens is a way to synthesize the many lenses that constitute planning and urban development into a systems perspective that can enable system-level transformation.

"The goal is not to reduce complexity to linear steps, but to provide a way of working with it systematically and transparently."

Rather than flattening complexity, the Dual Lens refracts it via two essential and complementary perspectives:

- The **Shift Lens** asks *what must become true*, helping cities define the systemic shifts required to meet societal needs (like mobility, energy, or comfort) and what those shifts demand from infrastructure, institutions, behavior, and capital to achieve a transition.
- The **Intervention Lens** asks *what must be done*, guiding the design of targeted policies, programs, and investments that enable those shifts while accounting for timing, dependencies, and feasibility.

A **Transition Pulse** connects these two lenses, monitoring system vitality and early signals of change. Rather than relying solely on end-state indicators, the Transition Pulse focuses on dynamic system activation: whether interventions create the conditions for shifts to take hold across sectors and over time.

Together, the Dual Lens provides cities with a clear, structured way to tell the story of their transition — a story that:

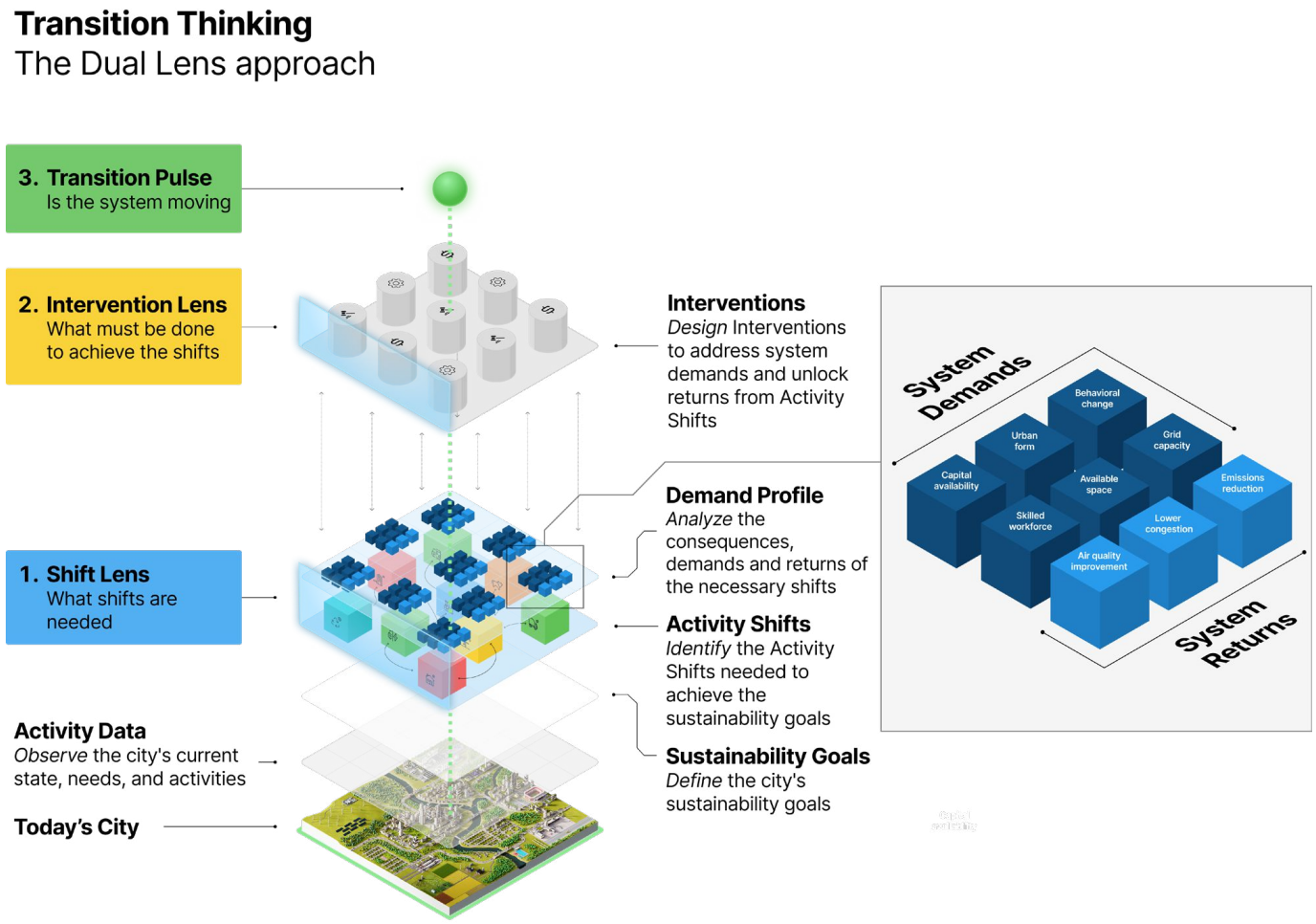
- **Funders** can trust because it connects investment to system needs, identifies early return indicators, and articulates value in social, environmental, and financial terms.
- **Governments** can coordinate because it clarifies roles, sequences interventions, and links interventions across governance levels
- **Communities** can follow because it explains what is changing, why it matters, and how daily life will improve.

Deepdive: Governance Alignment, P. 84

Systems Thinking and Multilevel Governance

Effective climate action requires coordination across all levels of government. This sidebar explores how systems thinking can strengthen vertical and horizontal alignment between actors and institutions.

Figure 3: The Dual Lens



Structure of this paper

The remainder of this paper is structured around the two components of the Dual Lens model, the tracking line that holds them together, and how they can be applied in practice. Each part explores one perspective of the method, including the shifts cities must aim for, the interventions needed to enable them, and the signals indicating the system is ready. These sections offer a structured path for cities to move from complexity to clarity and from ambition to delivery.

- **Part I: The Shift Lens: What shifts are needed?**
  It identifies the core structural shifts a city must pursue to fulfil societal needs sustainably and models what those shifts demand from infrastructure, institutions, capital, and behavior.

- **Part II: The Intervention Lens: What must be done to achieve the shifts?**
  It outlines how to design and sequence policies, programs, and investments that enable those shifts, aligning delivery across actors while managing feasibility, dependencies, and systemic risk.

- **Part III: The Transition Pulse: Is change taking hold**
  Introduces a readiness-based approach to tracking early signs of change, allowing cities to monitor progress, course-correct in real time, and demonstrate credibility to funders and stakeholders.

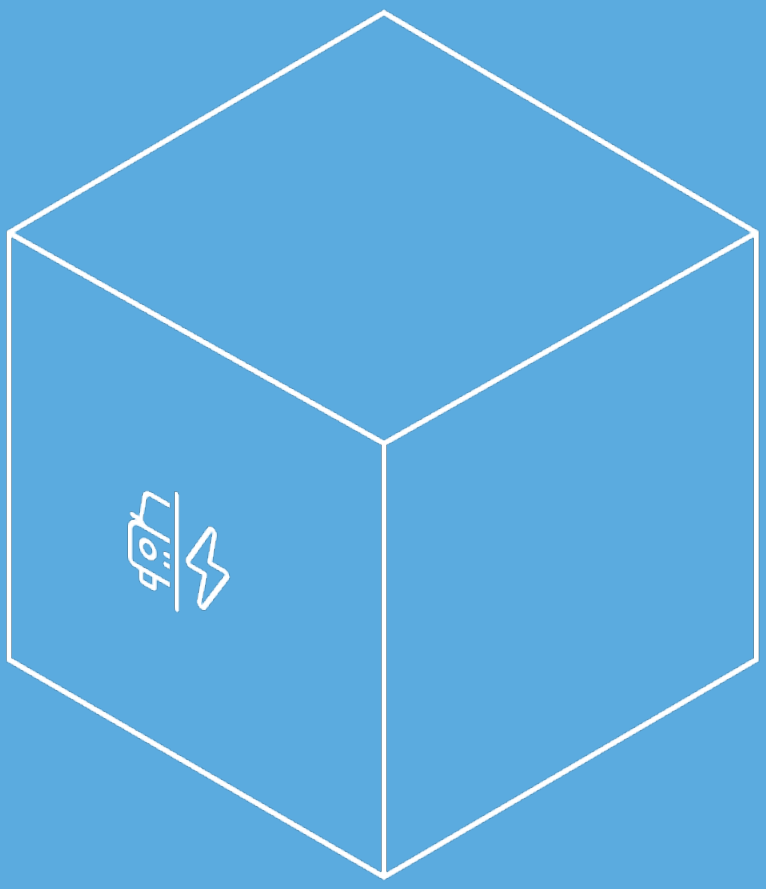
- **Part IV: Putting the Dual Lens into practice**
  It shows how this model is already applied through ClimateView's Transition Element Framework and platform, translating system logic into fundable, coordinated, and communicable transition strategies.


Transition Elements
Agriculture

Part I:

The Shift Lens: What shifts are needed

Before a city can plan what to do, it must understand what must become true. This section introduces the Shift Lens, which helps cities define the structural transitions required to meet societal needs in new, sustainable ways. The Shift Lens offers a flexible but rigorous planning approach by distinguishing needs from the activities that fulfill them. It reveals what the system must deliver, what that will require, and what it will return. It turns complexity into structure and provides the foundation for credible, fundable climate transitions.



From needs to shifts: making the transition modelable

Every transition plan ultimately points toward a future vision, but what that future looks like is neither fixed nor universal. It must reflect the values, priorities, and contexts of each place. The Dual Lens does not prescribe a singular future. Instead, it provides cities with the structure to define their own version of a sustainable future and to chart a path toward it through systemic, fundable change. By anchoring shifts and interventions in this broader purpose, planning becomes more than a technical exercise; it becomes a way to align local action with global ambition, understanding future resource usage, and integrating it into present strategies. Delivering a climate transition begins not with action but with clarity about what a city is trying to achieve and what its systems must be capable of delivering. Before a city can plan how to act, it must define what must become true and what needs to change.

This is the role of the Shift Lens, the first component of the Dual Lens model. It offers a structured way to surface the essential transformations required to meet societal needs, such as mobility, comfort, or access, in fundamentally different, low-carbon, and sustainable ways. It does not begin with technology or policy. It starts with needs, and with a model for how those needs can be fulfilled differently.

Every aspect of development and, in turn, the climate transition is rooted directly or indirectly in human needs. These are the reasons societies act: to stay warm in winter, to move through a city, to connect with others, or to express identity. While these needs are widely shared, they are fulfilled differently across contexts. History, politics, culture, and geography shape their expression. Therefore, according to our theory of change, they are inherently subjective.

The Shift Lens embraces this subjectivity, but introduces a critical distinction to make it operational. Therefore, needs are declarations of societal intent, whereas shifts are transformations in the dominant activities used to meet those needs.

This distinction makes the transition modelable. Cities can define needs on their terms, reflecting local priorities and values. Still, once shifts are identified, they can be quantified, sequenced, and evaluated structurally, enabling a standardized language and approach. A shift becomes a discrete system change unit that can be consistently measured and modeled with scientific rigor.

This unlocks alignment across stakeholders:

- **Funders** gain visibility into proposed transitions' scale, feasibility, and return profile.
- **Governments** can coordinate delivery across departments and levels by clarifying what must happen, when, and by whom.
- **Communities** can shape transition strategies without losing sight of what they are meant to achieve and what they will require.

By identifying system-level shifts instead of jumping directly to interventions, cities establish a transparent basis for planning. Shifts reveal what must become true before change can take hold. They expose the demands on the system and the conditions that must be met for transitions to be credible and investable.

Today, funders and decision-makers are not only asking *what a city aspires to,* but also:

- What exactly needs to shift?
- What resources will those shifts require?
- Is the delivery system ready, feasible, sequenced, and scalable?
- Can "success" be defined and measured?

This is where systems thinking becomes tangible and where fundability begins.

Each shift represents a stable change in how a need is met. It is not a policy or a pilot project. It is a new pattern of fulfilment — a different way of delivering something essential. For example:

- The need for indoor comfort → shifting from gas boilers to electric heat pumps
- The need for mobility → shifting from private car use to public transport, cycling, or shared mobility
- The need for cooling → shifting from individual AC units to district cooling systems
- The need for self-expression through clothing → shifting from fast fashion to reuse, resale, or longer-lasting garments

"This is where systems thinking becomes tangible and where fundability begins."

Each shift can be evaluated structurally in terms of its demands (e.g., energy, labor, infrastructure, and capital) and its returns (e.g., emissions reductions, resilience, health, or long-term savings). This indicates a change in how societal needs are fulfilled, bringing forth a specific set of system demands. These demands include quantifiable requirements across infrastructure, energy, labor, capital, and institutions. However, they also encompass something more easily overlooked: people. In many transitions, especially those related to mobility, heating, or consumption, a crucial system demand involves the number of people needing to change their behavior, such as moving from private car use to cycling or transitioning from gas heating to heat pumps. This behavioral dimension is not merely a side effect of system change; it is a prerequisite. Understanding these human-scale system demands is vital for making transition planning actionable. By acknowledging behavioral uptake as a system demand, planners can better align interventions with communication, incentives, and infrastructure to achieve these targets and monitor readiness and momentum through tempo. This approach provides more than just analytical clarity; it establishes a foundation for credible delivery. Since shifts are modeled at the systems level rather than in siloed sectors, they promote integrated planning. They also remain anchored in the values and lived experiences of the communities they are intended to serve because they are based on explicitly declared needs. In summary, the Shift Lens transforms ambition into structure. It offers cities a method to define their direction, not just in terms of targets but also regarding system change. It presents a neutral, scientific, and rigorous basis for designing, evaluating, and financing transition plans. Furthermore, it sets the stage for what comes next: defining the policies, investments, and programs that can make these shifts a reality.

Deepdive: Urban Metabolism, P. 86

Urban Metabolism - Linking needs, resources, and the goals we set

Urban metabolism frames cities as systems that transform resources into services and outcomes. This sidebar explains how energy flows help link needs to sustainability goals.


Transition Elements
Industry

A neutral structure for diverse futures

The distinction between what societies value (their needs) and how those values are fulfilled (their shifts) is more than a modeling choice. It is a structural design principle that gives the Shift Lens its strength.

By separating the *why* from the *how*, the Shift Lens offers cities a way to structure transition planning without prescribing ideology, technology, or lifestyle. It creates space for political diversity, strategic experimentation, and cultural specificity, without compromising analytical rigor. A transition plan, for example, can begin with the shared understanding that people need warmth, mobility, rest, or self-expression. These needs may be widely recognized, but how they are fulfilled through buildings, transport modes, energy systems, or production patterns is subject to change. They differ across contexts and evolve over time.

This framing allows cities to define their own values and priorities while still using a common structure to evaluate consequences. In this way, the Shift Lens provides a common planning language to clarify the implications of choices. Once cities define what matters in their terms, the model helps them ask: What must change to fulfill these needs? What will it require across infrastructure, labor, capital, and governance? And how quickly must it happen?

Because the needs are declared explicitly rather than assumed, strategies become explainable to funders, who want to understand return on investment, governments, coordinating delivery across actors and timeframes, and communities, who must see themselves in the future being built.

“This framing allows cities to define their own values and priorities while still using a common structure to evaluate consequences.”

By allowing space for political difference while anchoring strategies in system logic, the Shift Lens enables cities to design both locally grounded and globally aligned futures. This neutrality, not as the absence of values but as openness to many paths, makes the model applicable across geographies, political systems, and worldviews.

Deepdive: Human Needs, P. 88

Human needs: From philosophical debate to science-based modeling

Cities must serve human needs, but how can this be done more sustainably? This sidebar traces the evolution of need-based approaches and their relevance for structuring urban transitions.

Shifts & modeling system demands

A transition changes how core needs are fulfilled, both in terms of which technologies are deployed and how the underlying system operates. These structural changes in how needs are met are called Activity Shifts.

An Activity Shift is not a policy or a pilot project. It is a sustained change in the dominant way a societal need (such as heat, movement, or shelter) is met towards a more sustainable way of fulfillment. For example:

- From gas boilers → to electric heat pumps
- From private car travel → to walking, cycling, or public transit
- From inefficient building shells → to retrofitted, low-energy homes

Each represents more than a technological upgrade. It reconfigures a system's performance to fulfill a shared need. When cities define transitions in terms of shifts, they anchor their strategies in system-level logic, revealing what the system must be able to deliver and when, based on what the shifts require.

This turns systems thinking into structure, translates ambition into concrete outcomes, and creates a bridge between planning and financing by defining the real-world demands of change. Shifts provide the building blocks for delivery that align with global standards from the IPCC and other international bodies, emphasizing the importance of planning at the system level, not just through isolated interventions.

The Transition Elements Framework is the core mechanism through which ClimateView establishes a taxonomy of shifts based on IPCC mitigation options. The Transition Element Framework white papers provide further information on this approach. The framework's role in operationalizing the Dual Lens approach is outlined further in Part IV.

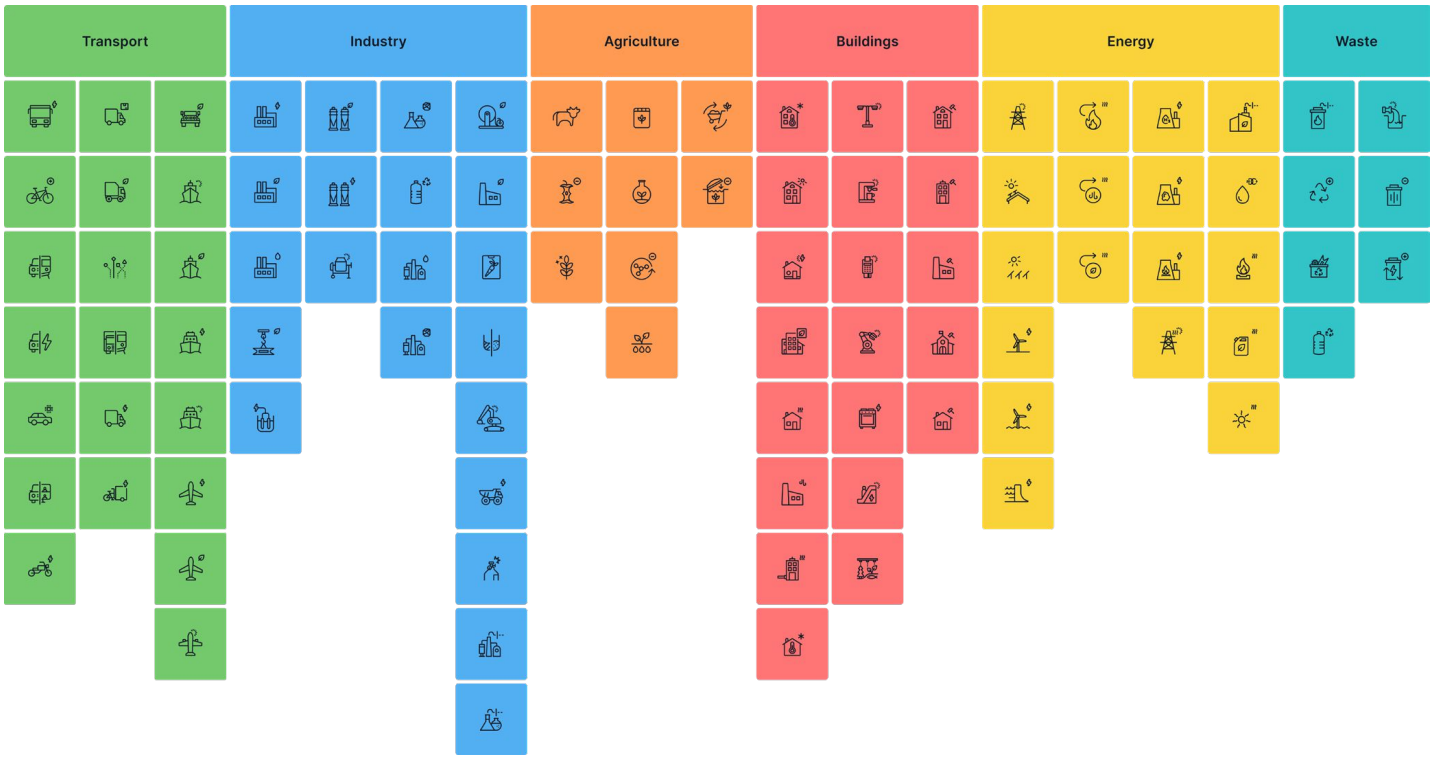
Through the Shift Lens, cities assess what shifts are needed, whether the current system can support the demands of these shifts, and, if not, what capacities must be developed to enable them and thereby achieve sustainability goals. This means evaluating both system requirements and system returns. Every shift places new demands on infrastructure, labor markets, capital flows, and regulatory frameworks, and every shift also delivers measurable value in emissions reductions, job creation, resilience, and social outcomes, for example. By modeling both sides of this equation, cities create a System Demand Profile: a structured view of what each shift requires, and what it unlocks in return.

Deepdive: Transition Elements, P. 90

The Transition Element Framework: Encoding clarity, enabling global action

The Transition Element Framework (TEF) is the foundation for ClimateView's platform. This sidebar explains how TEF structures data and logic that cities can use locally and align globally.

Figure 8: The Transition Element Framework Periodic Table



System Requirements	System Returns
Capital expenditure: upfront investment in infrastructure, technology, or services	**Operational savings**: reduced energy costs, lower lifecycle costs, long-term fiscal stability
Infrastructure and spatial upgrades: grid reinforcement, mobility networks, housing stock, land use	**Improved service access**: enhanced mobility, energy access, indoor comfort, and inclusion
Regulatory and institutional reform: standards, permitting, procurement, governance	**Governance efficiency**: reduced delays, more transparent accountability, streamlined coordination
Time and coordination: multi-year delivery sequencing across departments and actors	**Delivery credibility**: increased investor confidence, risk reduction, ability to absorb finance
Public engagement and social license: public support for shifts that change behavior or urban space	**Policy durability and legitimacy**: sustained support, reduced resistance, and inclusive outcomes

This profile transforms planning into a financing tool. It enables cities to:

- Identify delivery constraints and address them early.
- Sequence interventions based on system readiness.
- Justify investments by tying needs to outcomes.
- Make strategies legible and investable for funders, policymakers, and communities alike.

System demands can be expressed not just as totals, but as tempos: the annual pace at which change must occur. This could include the number of buildings to retrofit each year, the number of new transit users needed annually, or the workforce required to sustain infrastructure delivery.

Shift	System Demand
Modal shift to cycling	X km of bike lanes, Y% modal share, Z% of residents shifting to a different transport mode
Building electrification	Electrical capacity upgrades, workforce training, and % of households switching to electric heating or appliances
Dietary change (if relevant)	Local food sourcing, policy changes, # of residents reducing meat consumption

Deepdive: Tempo Explained, P.91

What Is Tempo?

Tempo is how we measure the speed and scale at which enabling conditions must develop to facilitate a shift. This sidebar explains how tempo renders system demands visible and trackable, assisting cities in aligning planning and monitoring with what the system genuinely requires.


Transition Elements
Transport

Seeing the system: The interdependency of shifts

Shifts do not occur in isolation. Each represents a structural change in how a societal need is met, but those changes exist within a shared system. They interact, reinforce, compete, or depend on each other. This interplay is not incidental. It shapes the real-world feasibility of any transition.

Some shifts are complementary. For example, expanding public transit reduces demand for private cars, lowering the scale of investment required in electric vehicle infrastructure. Others are competitive, drawing on the same constrained resources, like electricians or grid capacity, and must be phased to avoid bottlenecks. Still others are dependent: shifting to electric heat pumps, for instance, requires prior improvements in building insulation to prevent energy inefficiencies or grid strain. In the context of this white paper, *prioritize* means identifying which shifts must happen first to enable others (often due to technical dependencies); *phase* means spacing interventions over time to avoid resource conflicts or delivery overload, and *sequence* means arranging shifts to maximize synergies, reduce costs, or align with readiness signals across the system.

Managing these interactions is a condition for deliverability. For funders, it demonstrates realism and credibility. For governments, it clarifies responsibilities, timing, and sequencing. For communities, it shows that complexity is being engaged with, not ignored or oversimplified.

This is the transition from identifying the system demands of shifts to meeting them. Understanding what each shift requires is only the first step. The next step is assessing whether those requirements can be met, and in what order. Readiness is not static. It is shaped by institutional capacity, political will, infrastructure status, and social acceptance. Furthermore, it varies widely across cities, sectors, and timeframes. The Shift Lens, therefore, helps cities answer a critical planning question: What must become true for this transition to succeed?

“Managing these interactions is a condition for deliverability. For funders, it demonstrates realism and credibility. For governments, it clarifies responsibilities, timing, and sequencing. For communities, it shows that complexity is being engaged with, not ignored or oversimplified.”

By surfacing both the requirements and the returns of each shift, it provides a structured foundation for technically credible and institutionally grounded planning. It makes delivery dependencies visible. It allows planners to align sequencing with capacity. It also gives funders the confidence that proposals are ambitious and feasible.

Interaction Type	Example	Planning Implication
Complementary	Expanding public transit reduces car dependency and lowers EV infrastructure needs	**Sequence to amplify synergies** and reduce overall system costs
Competitive	EV charging networks and building retrofits both increase grid demand and require skilled electricians	**Phase to avoid resource conflicts** and manage delivery risk
Dependent	Deploying electric heat pumps requires pre-existing building insulation to prevent energy waste	**Prioritize enabling shifts early** to ensure downstream effectiveness

Equally important, this framing holds space for plural futures. The model avoids prescribing a single path forward because it distinguishes the *why* of a transition (the societal need) from the *how* (the shift in activity). It allows strategies to be shaped by local values and conditions, while still being evaluated with consistency, precision, and systemic rigor.

This distinction prevents the transition from being reduced to a binary between "techno-utopia" and "austerity." Instead, it opens up space for real agency:

- Which needs are most urgent in this context?
- Which shifts are most politically viable or socially desirable?
- What trade-offs must be considered, and who decides?

The Shift Lens does not prescribe which needs are most important or which shifts are most desirable. Instead, it provides cities with the structure needed to ask those questions clearly and the tools to evaluate their answers in practical, system-aware terms. By distinguishing between values and activities, decision-makers can develop locally defined yet analytically consistent strategies.

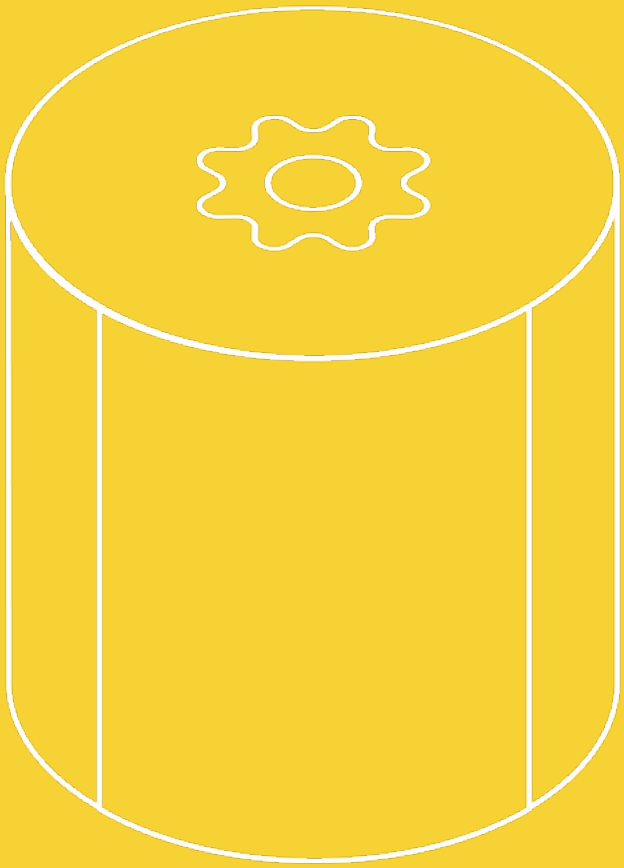
The Shift Lens lays the foundation for the next transition planning phase: designing targeted interventions, including the policies, programs, and investments required to turn structural shifts into real-world outcomes. These interventions must operate within the constraints of existing systems while unlocking new capacity. They must be sequenced, resourced, and communicated in a way that attracts funders, aligns institutional actors, and earns the public's confidence.

The following section focuses on this transition from system shifts to system delivery.

Part II:

The Intervention Lens: What must be done

Having identified what shifts are needed and their demand on the system, the next step is to design how that change will happen. Part II introduces the Intervention Lens, which helps cities move from system demands to targeted delivery strategies. This section explores how to craft interventions that address specific constraints, shape enabling conditions, and distribute responsibility across institutions. It also examines how sequencing and stress-testing can turn a collection of interventions and activity shifts into a credible, coordinated delivery plan. The result is a practical pathway from ambition to execution that funders can trust, governments can coordinate, and communities can experience as tangible progress.



From system demands to strategic interventions

The Shift Lens shows what shifts are needed, what they demand from the system, and what they offer in return if achieved. The Intervention Lens asks a more practical question: How do we make them happen?

Understanding what the system needs to deliver is just the starting point. To foster long-term progress and secure substantial investment, cities must create interventions that are strategic, sequenced, and rooted in system logic. This involves planning interventions not as isolated actions but as targeted responses to system demands. The aim is not merely to act but to act purposefully and to establish a credible delivery structure for funders, practical for institutions, and meaningful to communities.

The initial step is the System Demand Profile. These profiles are not just theoretical. In the ClimateView platform, many have already been modeled explicitly, enabling cities to quantify and visualize essential infrastructure and capital needs for an increasing number of system shifts. This aids teams in pinpointing bottlenecks, stress-testing interventions, and anchoring proposals in real-world limitations and systemic logic.

Importantly, these profiles are dynamic and not exhaustive. As our understanding of transitions deepens, additional factors—such as workforce capacity, health co-benefits, land use implications, and social readiness—are continually integrated. The platform is designed to develop alongside this growing body of knowledge. It assists cities by offering structured models for current demands and allowing them to adapt and expand these profiles as new insights arise. Thus, demand profiling evolves into a collaborative, living capability—growing richer over time as more cities implement it, refine it, and contribute to the shared framework.

When designed according to the System Demand Profile, interventions are purpose-built to shape the conditions that make system shifts viable. Furthermore, they are how intent becomes credible for funders: a measurable bridge between vision and delivery.

Strong interventions do more than respond to a need. They transform the context in which decisions are made. A well-designed intervention makes the sustainable choice easier, cheaper, and more attractive by targeting the right constraint, such as cost, convenience, trust, or infrastructure. Interventions that focus not only on a shift but also on the system's ability to support that shift make transition possible and increase the likelihood of success.

The following sections explore how to design interventions that address key constraints and connect to broader outcomes, clarify roles across governance levels, and sequence delivery to manage risk and build public trust.

Shift	Key Demand	Intervention Example
Heat pump adoption	Skilled installers	Workforce training, permitting reform, and installer subsidies
EV uptake	Grid capacity	Substation upgrades, smart charging incentives
Modal shift to cycling	Safety perception	Protected bike lanes, traffic calming, and public awareness campaigns

“When designed according to the System Demand Profile, interventions are purpose-built to shape the conditions that make system shifts viable. Furthermore, they are how intent becomes credible for funders: a measurable bridge between vision and delivery.”

Outcome Logic: Connecting action to impact

Interventions succeed when they deliver outputs and change the conditions that shape the systems' behavior. A retrofit program, for example, is not just about insulating buildings. It is about lowering energy costs, improving comfort, increasing uptake, and ultimately enabling a shift toward low-carbon heating. This chain of influence is what we refer to as Outcome Logic: the causal sequence through which interventions create change. Rather than treating outcomes as distant results, this logic brings them into the design process, helping cities shape interventions that influence the drivers of system readiness. The outcomes are the returns of the successful activity shifts. The success of the activity shifts depends on the effectiveness of interventions to create an enabling environment for them to occur. The causal chain of outcome logic follows:

Intervention
→ shapes **enabling conditions** (e.g., cost, safety, convenience, trust)
→ shifts **behaviours and perceptions**
→ delivers **system-level change** (the shift itself)

This structure enables cities to move from action lists to system impact pathways. It offers a transparent method to explain how a proposed program or policy will facilitate a transition and why it deserves funding. For public decision-makers, it clarifies the reasons for intervention. For funders, it showcases intentionality and alleviates perceived risk. The ClimateView platform reinforces this logic by allowing users to connect interventions to anticipated enabling conditions and monitor their influence over time. It links strategy to system outcomes with transparency and traceability.

Consider a city aiming to accelerate the adoption of heat pumps. It cannot directly mandate this shift, but it can make it the most viable option by investing in training programs to expand the installer workforce, simplifying permitting processes, and reducing upfront costs through targeted subsidies. Together, these interventions improve affordability, availability, and convenience. By shifting the enabling conditions, they shift behaviour. In this way, interventions become levers. They operate at the surface of a system and within its logic.

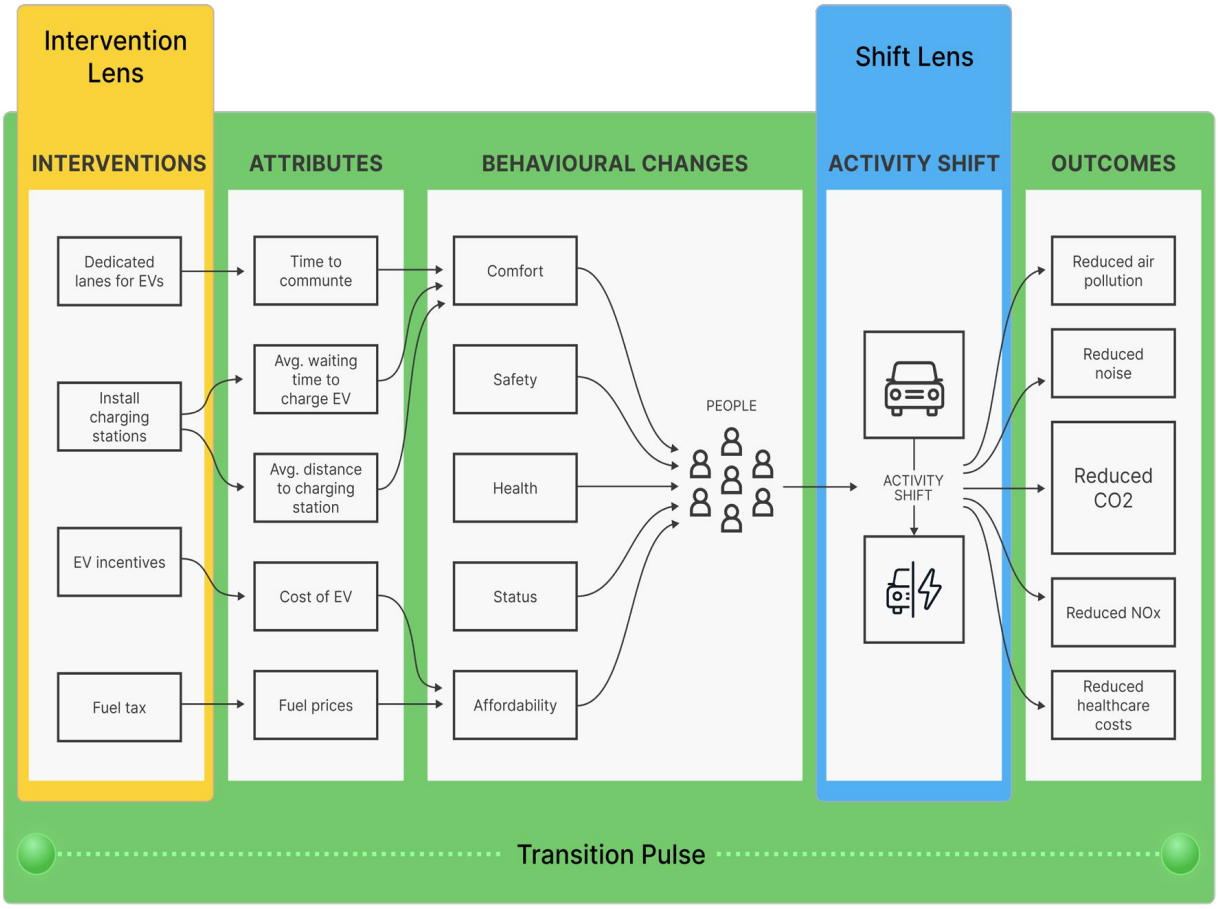
Designing interventions through the lens of Outcome Logic ensures that strategies are not just technically sound, but system-aware. It supports adaptive planning, strengthens the investment case, and helps cities target effort where it matters most: the conditions that make systemic change possible.

Deepdive: Ecological Limits, P. 92

From outcomes to sustainability:
Applying Planetary Boundaries to urban transitions

Cities play a vital role in sustaining global ecological balance. This sidebar examines how the Planetary Boundaries framework can inform outcome logic and synchronize interventions with environmental limits.

Figure 10: Outcome Logic and the Dual Lens



Who does what: Clarifying roles for delivery

A single actor rarely delivers transitions. Systemic change requires coordinated effort across jurisdictions, sectors, and institutions, each with distinct mandates, capabilities, and constraints. However, too often, climate plans assume that responsibility will emerge organically, or that the presence of a strategy implies the presence of a delivery system.

The Intervention Lens helps cities move from assumption to clarity. It provides a framework for mapping delivery responsibilities in line with the demands of each shift. Doing so shows where action must occur, who is best positioned to lead it, and where collaboration, co-financing, or new mandates may be needed.

This diversity of roles is not a challenge to be resolved, but rather a reality to be organised. Mapping roles explicitly allows cities to:

- Identify delivery gaps or overlapping mandates.
- Align institutional responsibilities with shift demands.
- Clarify accountability and risk ownership.
- Coordinate public–private investment.

This clarity is essential for implementation. Funders and investors need confidence that delivery pathways are operational, roles are understood, and no critical shift is left unsupported. Policymakers must know where action is expected and how it can be enabled. Communities benefit from knowing who is responsible for delivering change that affects their lives. Without role clarity, even the best-designed interventions risk stagnation. With it, cities can build stronger coalitions, unlock shared capacity, and distribute effort in line with real-world institutional structure.

The Intervention Lens does not dictate who should do what. It provides the structure to ask and answer those questions systematically, laying the groundwork for coordinated, multi-actor delivery. Delivery roles are only part of the picture. Executing transitions at scale depends on knowing not only who does what, but also when and with whom. This framing of delivery from a checklist to a choreography is essential for moving toward dynamic planning. Effective implementation must incorporate how actors interact under real constraints, where sequences may falter, and which institutional partnerships or enablers are needed to unlock bottlenecks. For example, a local government may lead on workforce development but rely on timely national subsidies and private-sector deployment. The entire sequence can stall if one component lags (e.g., if subsidies are delayed or skilled labor is unavailable). Mapping roles in this broader context enables cities to anticipate these interaction points and design delivery pathways that are both institutionally grounded and operationally feasible. ClimateView supports this process by helping cities visualise delivery roles, align timelines, and surface interdependencies early, turning static plans into coordinated pathways.

Deepdive: Effective Interventions, P. 93

What makes a good intervention

Not all interventions are equally effective. This sidebar outlines the characteristics of high-quality interventions that unlock system change and deliver meaningful results.

Actor Type	Example Responsibilities	Multilevel Governance Type
Local Government	Permitting, workforce development, municipal infrastructure (e.g., bike lanes, district heat networks)	Vertical
Regional Authority	Managing transport networks, energy grids, and regional financing instruments	Vertical
National Government	Tax incentives, regulatory frameworks, large-scale subsidies, and grant programs	Vertical
Private Sector/ Industry	Delivering products and services (e.g., vehicles, heat pumps), and infrastructure deployment	Horizontal
Civil Society / NGOs	Public engagement, awareness campaigns, and co-design with communities	Horizontal
Financial actors and Institutions	Providing debt capital, investment capital, blended finance vehicles, and outcome-based financing structures. Includes both private sector entities (e.g., banks, impact investors, asset managers) and public financial institutions (e.g., national development banks, multilateral climate funds).	Horizontal

Sequencing and stress-testing: Managing system delivery

Designing the right interventions is insufficient in isolation. To turn a set of well-targeted interventions into a coherent and credible transition strategy, cities must also address a fundamental systems question: What happens when these interventions interact?

Transitions unfold within shared systems. Infrastructure, labor, capital, political attention, and institutional capacity are not infinite. They are shared across sectors, over time, and between actors. As a result, the success of one intervention may depend on or constrain the success of another. This makes sequencing a core element of transition design.

Interventions must be sequenced and prioritised to reflect the dynamic relationships between shifts and the real-world limits of delivery capacity. Poor sequencing can lead to:

- Resource bottlenecks, such as shortages of skilled labor or grid capacity
- Policy confusion occurs when overlapping interventions send mixed signals or contradict one another.
- Delays and fragmentation, where implementation stalls or public confidence is eroded

By contrast, well-sequenced plans create clarity. They spread investment over time, avoid unnecessary competition for scarce resources, and generate visible early wins that build credibility with funders, political leaders, and communities.

Different shifts interact in various ways. A few common interaction types are included in the table on page 55.

Understanding these interactions allows cities to use the Shift and Intervention Lenses together as a planning tool, not just for strategy development but also for risk management.

Sequencing is a form of stress-testing: it allows planners to anticipate capacity constraints, align delivery timelines, and identify when parallel efforts may support or undermine each other. Stress-testing is about making that complexity visible and designing around it.

When used effectively, sequencing becomes a strategic tool for fundability:

- Funders are more likely to invest in phased plans with clear delivery logic and bottleneck management
- Policymakers can build realistic roadmaps with early milestones that show progress.
- Communities benefit from smoother transitions, reduced disruption, and greater transparency.

Deepdive: Transition Finance, P. 94

Financing the transition:
Matching systemic ambition with finance mechanisms

Systemic transitions need finance mechanisms that match their complexity. This sidebar discusses how cities can align intervention portfolios with emerging funding models and investment criteria.

Interaction Type	Example	Temporal Implication	Spatial Implication	Planning Action
Complementary	Transit expansion reduces car dependency and EV infrastructure demand	Transit should be expanded *before or alongside* the EV rollout	Focus on high-density commuter corridors where both shifts intersect	Sequence to amplify shared benefits
Competitive	EV charging infrastructure and building retrofits both require grid upgrades and skilled labor	Cannot scale simultaneously without increasing delivery capacity	May compete in the same districts for contractors and grid headroom	Phase delivery to avoid resource conflicts
Dependent	Heat pump adoption requires sufficient building insulation to ensure performance and efficiency	Insulation and heat pump installation can be co-delivered, but insulation must be in place for the system to function optimally	Target the same building stock or residential zones through coordinated campaigns	Prioritise enabling conditions early to avoid lock-in or underperformance

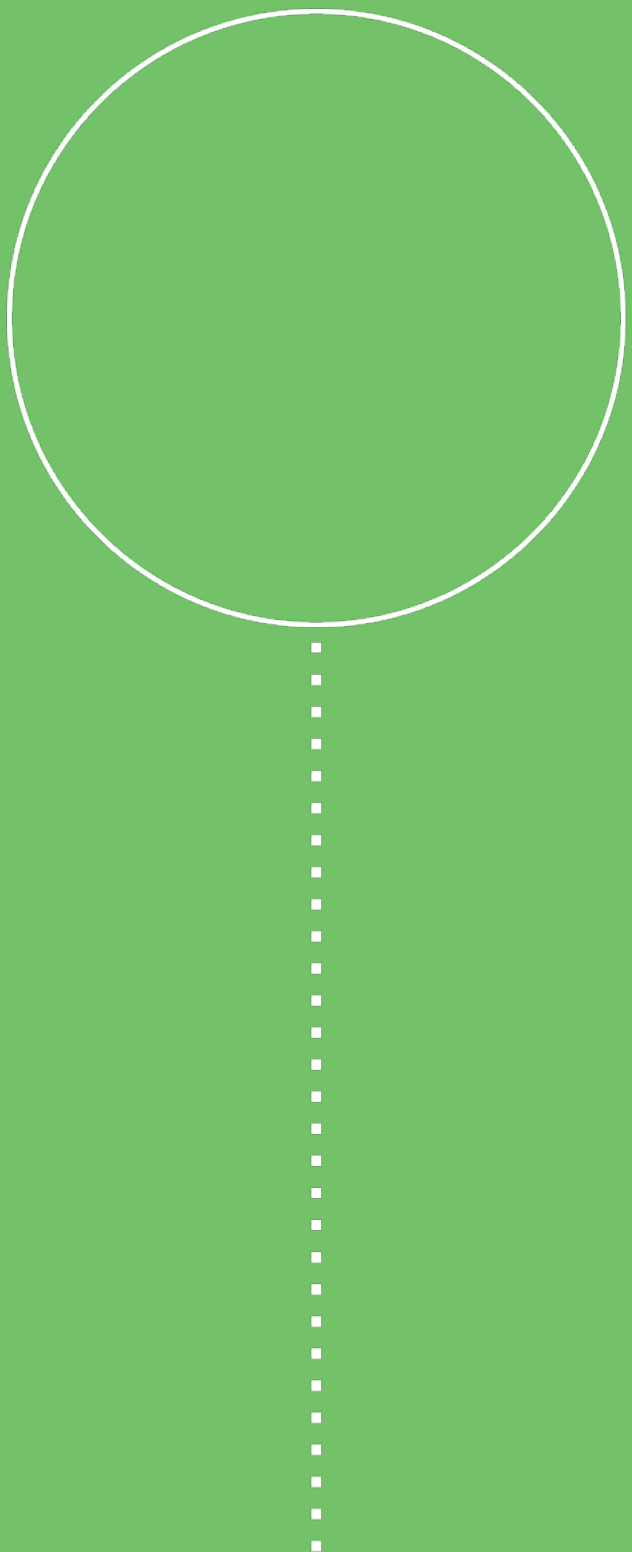
"Interventions must be sequenced and prioritised to reflect the dynamic relationships between shifts and the real-world limits of delivery capacity."

Ultimately, sequencing helps cities turn intent into action. It ensures that transitions are not just well-designed on paper, but are ready to unfold in today's systems at the speed and scale that the climate crisis demands. Consider a city aiming to scale heat pump adoption as an example of stress-testing applied in action via the Dual Lens, operationalized by ClimateView. ClimateView enables planners to model this intervention alongside related shifts, such as workforce training, grid reinforcement, and insulation campaigns, while assigning delivery roles across local, regional, and national actors. Using the platform, the city can identify that insulation must precede heat pump rollout to ensure efficiency. However, the available labor force is already committed to a simultaneous EV charging expansion. This visibility allows teams to adjust timelines, reallocate resources, or seek external support before bottlenecks emerge. In this way, ClimateView supports stress-testing not as an abstract exercise but as an operational planning function that makes the interdependencies of system delivery visible, negotiable, and fundable.

Part III:

The Transition Pulse: Is change taking hold?

Even the best-designed strategy is only the beginning. To navigate complex transitions, cities need to move beyond static plans to see whether the system is ready to change and, if not, what steps can be taken to increase readiness. Part III introduces the Transition Pulse: the mechanism that monitors early signals of system vitality. By focusing on leading indicators, comparing progress to expected tempo, and revealing delivery risks before they escalate, the Transition Pulse helps cities connect ambition to evidence and strategy to credibility. It enables coordination across governance levels, builds confidence with funders, and provides the feedback loop needed to manage delivery in real time.



The role of the Transition Pulse: From monitoring to meaning

Even the best-designed transition strategy is only a starting point. Real-world change does not happen all at once. It emerges gradually, unevenly, and often unpredictably across constantly evolving interdependent political, social, economic, and environmental systems. For cities navigating this complexity, having a clear plan is essential, and having a way to see whether that plan is taking hold is equally vital.

Whereas traditional monitoring indicators focus on outcomes, the Transition Pulse provides a mechanism for observing whether the system is becoming ready for the structural shifts it must achieve. It is forward-looking, tracking early signals of activation and end-state outcomes. These signals emerge in infrastructure development, institutional reform, behavior change, or capital flows, providing a dynamic window into system readiness.

The Transition Pulse performs three essential functions:

1. **It connects interventions to impact.**
   It helps cities answer the critical question: *Is what we are doing actually preparing the system for the needed shift?*
2. **It reveals delivery risks early.**
   Detecting where progress is stalling or failing to start, allowing for proactive adjustment before momentum is lost.
3. **It builds credibility with funders and stakeholders.**
   It provides tangible evidence that the transition is not just planned but already underway, making it easier to justify and de-risk investment, maintain political support, and coordinate across governance levels.

In this way, the Transition Pulse is more than a monitoring tool. It is a source of strategic feedback that enables cities to respond at a systems level to changing conditions, adapt their delivery pathways, and reinforce progress where it matters most.

The Transition Pulse integrates the two core perspectives introduced in this paper. It allows cities to determine whether the Intervention Lens facilitates the system shifts defined by the Shift Lens, i.e., whether interventions are being implemented and whether they create the conditions for more profound structural change to emerge. In a dynamic transition, what matters is not only where a city claims it is going but whether the system is starting to move in that direction. Rather than focusing solely on outcomes, the Transition Pulse is informed by the system demands of the Activity Shifts necessary to achieve a city's sustainability goals. ClimateView operationalizes the Transition Pulse through leading indicators embedded in its analytics layer, which monitor permitting flows, infrastructure activation, and behavioral adoption over time, providing planners with actionable insights on system readiness.

Measuring what matters: Leading indicators of readiness

Traditional monitoring approaches rely on "lagging" indicators tied to individual outcomes, such as tonnes of CO_2 avoided, policies adopted, or long-term targets achieved. While these metrics are essential (especially for justifying investments and demonstrating long-term impact), they provide confirmation only after outcomes have materialised, often years after the interventions were introduced. By then, funding may have been misallocated, political capital exhausted, or delivery momentum lost.

The Transition Pulse broadens the approach to monitoring. It focuses on leading indicators: measurable signals that show whether the system is preparing or starting to move and whether enabling conditions are taking hold, not hypothetically, but in practice. These indicators do not wait for final results. They capture incremental progress, making systemic readiness visible across infrastructure, institutions, behavior, and finance. This does not replace traditional metrics like avoided emissions; rather, it enhances them by clarifying whether the conditions for those outcomes are forming.

Leading indicators of readiness help cities answer questions such as:

- Are training programs producing a skilled workforce at the right pace?
- Is capital flowing into enabling infrastructure, such as transit, heat networks, or grid upgrades?
- Are permitting and procurement systems being reformed to support delivery?
- Are public perceptions and behaviors beginning to align with the intended shifts?

These signals are not peripheral. They are structural clues that the transition is taking root as the system responds to interventions in tangible, observable ways. For the three primary audiences of climate delivery, these indicators provide critical insights:

- **For funders**: Can this system absorb capital effectively? Can the shift be delivered? What is the early evidence that investment will have the desired impact?
- **For governments**: Are institutional actors fulfilling their roles? Where are delivery bottlenecks or coordination breakdowns emerging?
- **For political leaders and communities**: Can visible momentum be shared, communicated, and used to build support?

Deepdive: Tempo & Tracking, P. 96

Tempo: Linking shifts to tracking

Tracking transition progress requires more than emissions data. This sidebar shows how aligning shift logic with tempo enables dynamic monitoring and timely course correction.

One of the strengths of explicitly defining Activity Shifts is that it clarifies and strengthens outcome expectations. For instance, once a shift like moving 100 passenger kilometers from car to bike is defined, the resulting emissions reductions can be estimated with fairly high certainty. What remains less certain are the early interventions needed to facilitate that shift. This is where leading indicators play a crucial role in detecting whether those enabling factors are emerging.

“The Transition Pulse transforms monitoring from a backward-looking exercise into a dynamic capability that strengthens coordination, supports and de-risks investment, and sustains public and political confidence.”

Significantly, these indicators are not limited to yes/no checklists. One powerful way to track progress is by comparing observed trends to the modeled change tempo. For example, if a city plans to increase active travel by 30% over a decade, is the year-on-year rate of cyclist uptake on track for this goal? Are new EV chargers being installed at the scale required to match demand? Are retrofit programs training the necessary number of installers each year?

By embedding leading indicators and tempo expectations into transition planning, cities create a feedback loop to detect whether interventions produce the required enabling conditions and adapt delivery strategies as needed. The Transition Pulse transforms monitoring from a backward-looking exercise into a dynamic capability that complements conventional metrics like avoided emissions. It helps connect early systemic goals to expected impacts, strengthens coordination, de-risks investment, and sustains public and political confidence.

Readiness in practice: Leading versus lagging indicators

Readiness is not an abstract concept. It is the visible evidence that a transition is beginning to take hold, not in theory, but in practice. The Transition Pulse helps cities observe and communicate this readiness by surfacing early structural signals via long-term interdependent trends: institutional changes, infrastructure, behaviour, and capital flows that indicate momentum is building. Fundamentally, this allows cities and funders to shift from reactive to proactive approaches. This approach reduces investment risk and increases the opportunity to invest and scale through a portfolio approach by demonstrating how interventions collectively contribute to system readiness to support Activity Shifts.

For example, consider a city aiming to electrify its building stock. Emissions may decline gradually, but readiness becomes visible much earlier, through oversubscribed installer training programmes, streamlined permitting processes, and an uptick in retrofit activity. These signals indicate that interventions are not just being implemented, but are actively reshaping system dynamics.

Alternatively, take a modal shift strategy. While behavioural change is gradual, the enabling conditions, such as protected bike lanes, increased perceptions of safety, and rising usage rates, can be tracked immediately. These markers reveal whether interventions align with shift behaviour or whether additional action is needed.

These are not “soft” signals. They are structural clues confirming whether the transition is underway and can be scaled.

System Shift	Early Indicators of Readiness	What It Shows
Building Electrification	1. High uptake of installer training 2. Reduced permitting time 3. Uptake of early retrofits	System capacity is forming; demand is activating
Modal Shift to Cycling	1. Infrastructure rollout 2. Improved safety perception 3. Growing user base	Behaviour is responding; enabling conditions are working

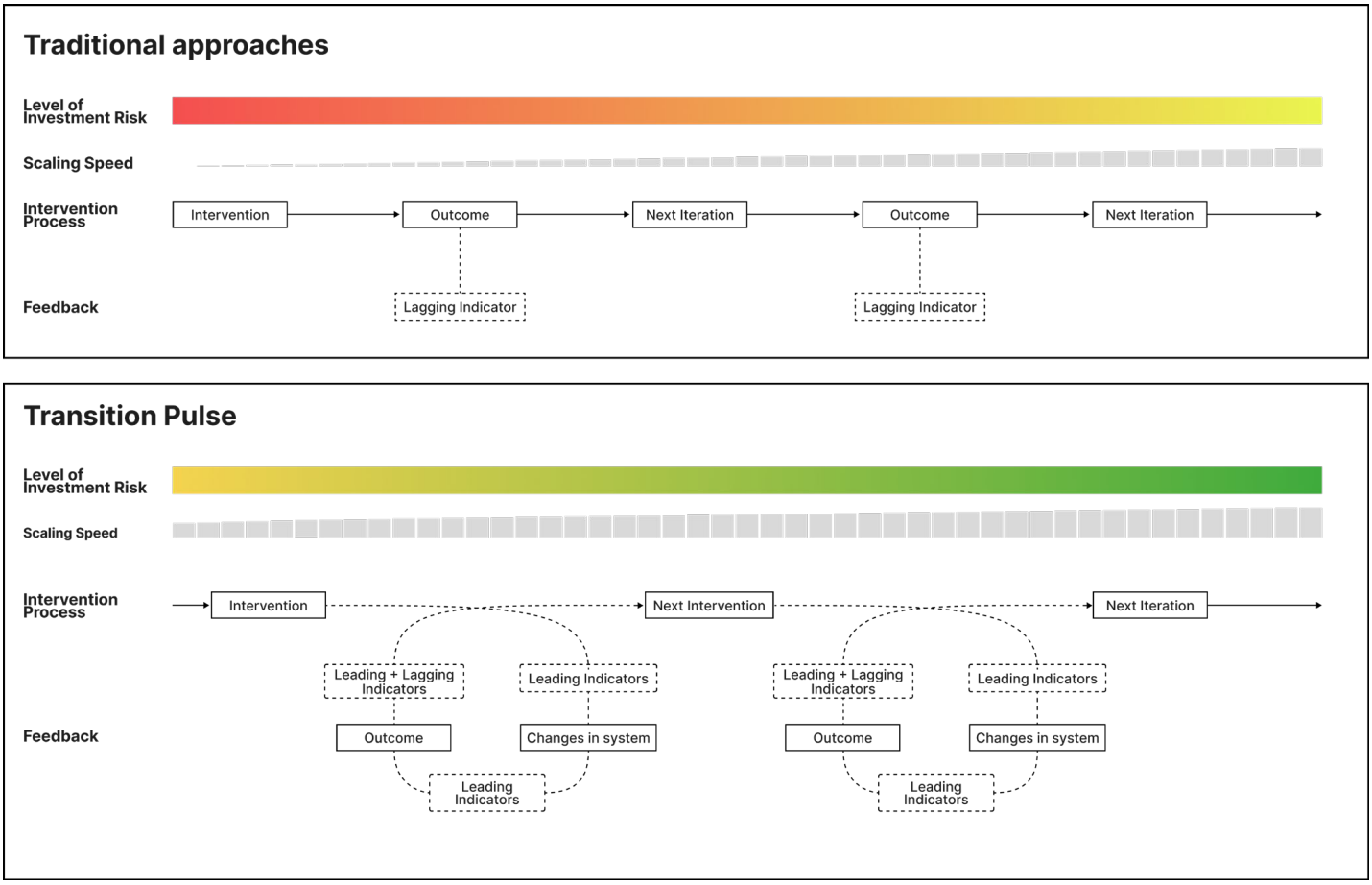
This visibility matters for three reasons:

1. **It unlocks investment and scaling**.
   Funders and financial institutions increasingly require reliable and current indicators of feasibility, system readiness, and catalytic potential — not just long-term outcomes. Readiness tracking reduces delivery risk and supports confidence in the system's ability to absorb and deploy capital effectively.
2. **It enables multilevel governance.**
   Systemic interventions often rely on local, regional, and national coordination. Readiness indicators offer a shared evidence base that actors at all levels can use to align decisions, allocate resources, and monitor progress. They create a common language for delivery rooted in system behaviour rather than policy commitments alone. A transition to multilevel governance cannot happen if finance does not transition in parallel.
3. **It supports the fundability of systemic approaches.**
   Many interventions that take a systems lens, such as heat decarbonisation, transport modal shifts, or circular economy strategies, are challenging to fund through conventional project pipelines because they cut across sectors and evolve. The Transition Pulse provides funders with the confidence that such interventions are already activating key enabling conditions, even if outcomes are not yet fully realised.

In short, readiness tracking transforms systemic ambition into investable credibility. It allows cities to design for delivery and show that delivery is happening. This is why global institutions, from the IPCC to multilateral development banks, are shifting from project-based evaluation toward systemic readiness. They increasingly ask: Can this transition be implemented across governance levels? Is it coordinated? Is there early evidence that it is working?

Cities that can answer "yes" to these questions with clarity, data, and structure are better positioned to attract investment, scale their strategies, and align local action with national and global goals. The Transition Pulse provides that answer. The mechanism connects the system logic of transition planning to the practical implementation logic. It makes progress visible, coordination possible, and climate transitions fundable at scale.

Figure 12: The impact of the Transition Pulse and Dual Lens on investment risk and scalability

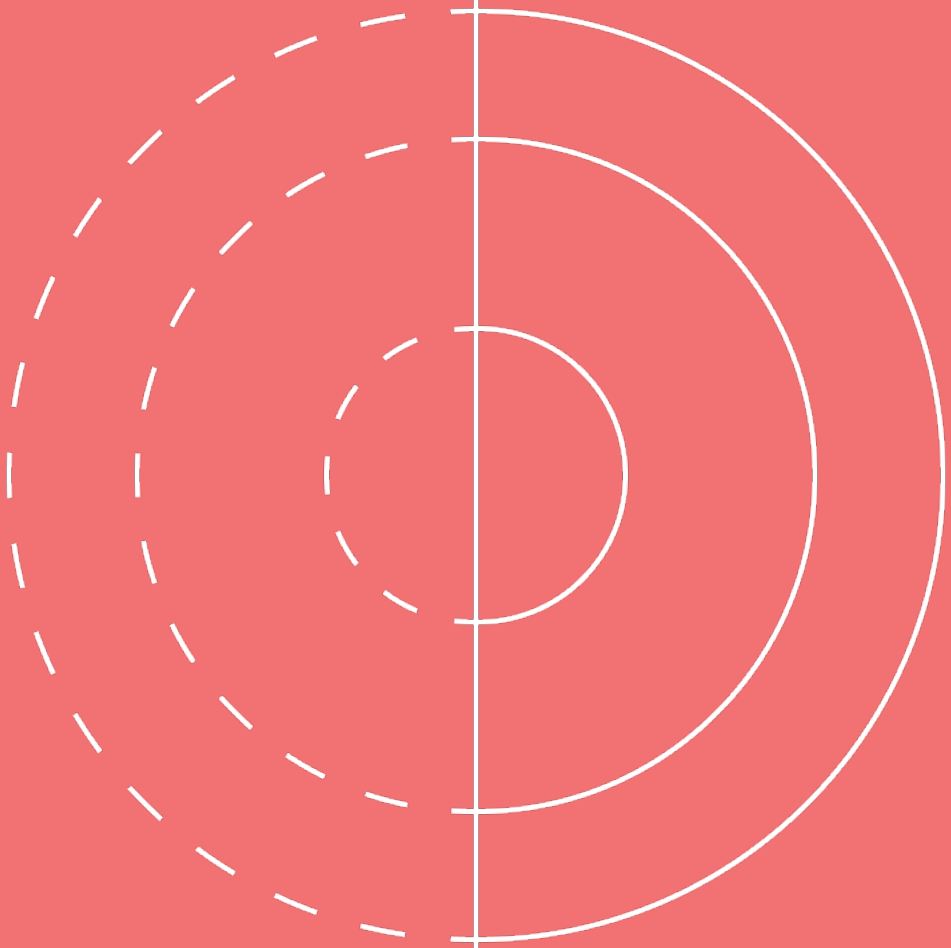



Transition Elements
Transport

Part IV:

Putting the Dual Lens into practice

Systems thinking delivers value only when it informs real decisions. Part IV explores how the Dual Lens of Transition Planning is applied in practice, turning abstract strategy into structured, fundable delivery. Through examples from Scotland and Germany, this section shows how a shared systems logic, enabled by the Transition Element Framework and the ClimateView platform, is helping cities and regions design more credible plans, align across governance levels, and unlock the confidence needed to invest at scale.



Bridging strategy, finance, and delivery

The ambition to achieve climate neutrality is growing across cities and regions, but so is the gap between strategy and implementation. Many cities have sectoral plans, targets, or long-term roadmaps in place. However, they often lack the delivery logic to bridge high-level goals with system-wide execution, investment mobilisation, and stakeholder coordination.

This is the gap the Dual Lens of Transition Planning is designed to close. It introduces a structured method to align system logic with delivery feasibility that helps cities not only define what must become true, but also understand what it will take, design how it will happen, and track whether it is beginning to take hold. The Dual Lens is an approach to “Transition Thinking” and structuring transition efforts that builds upon existing approaches and capacities, from scenario planning and forecasting to financing strategies and climate budgeting.

To operationalise this approach, two core enablers are already in use:

1. **The Transition Element Framework (TEF)** – a system-based classification of activity shifts grounded in global science and planning practice.
2. **The ClimateView Platform** is a software environment that helps cities apply the complete dual lens method in practice, from modelling to monitoring.

Together, they allow cities to plan not just individual projects but whole-system transitions that are fundable, accountable, and coordinated across governance levels - as captured in the Transition Journey.

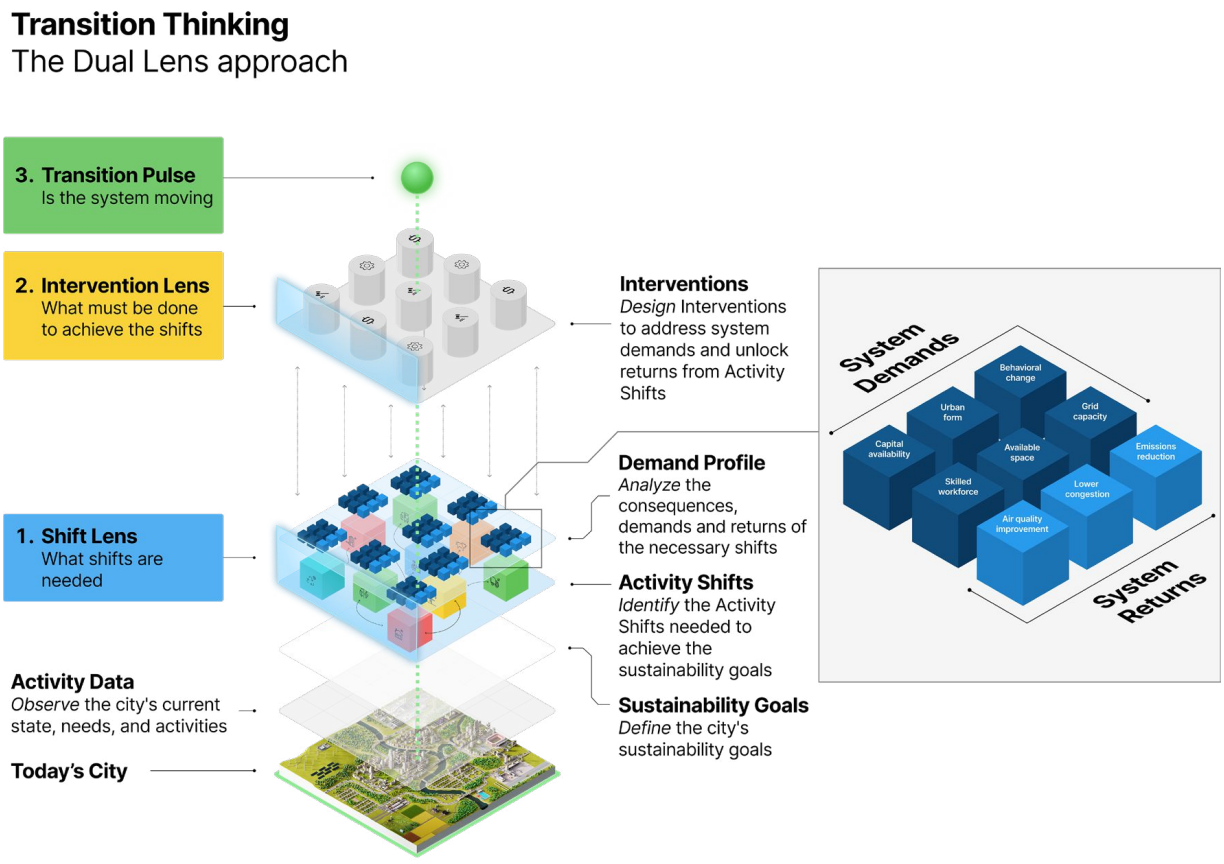
This structure enables cities to:

- See the system they are trying to change
- Align planning across institutions and sectors.
- Communicate strategy in ways that funders understand
- Track implementation across both infrastructure and institutions

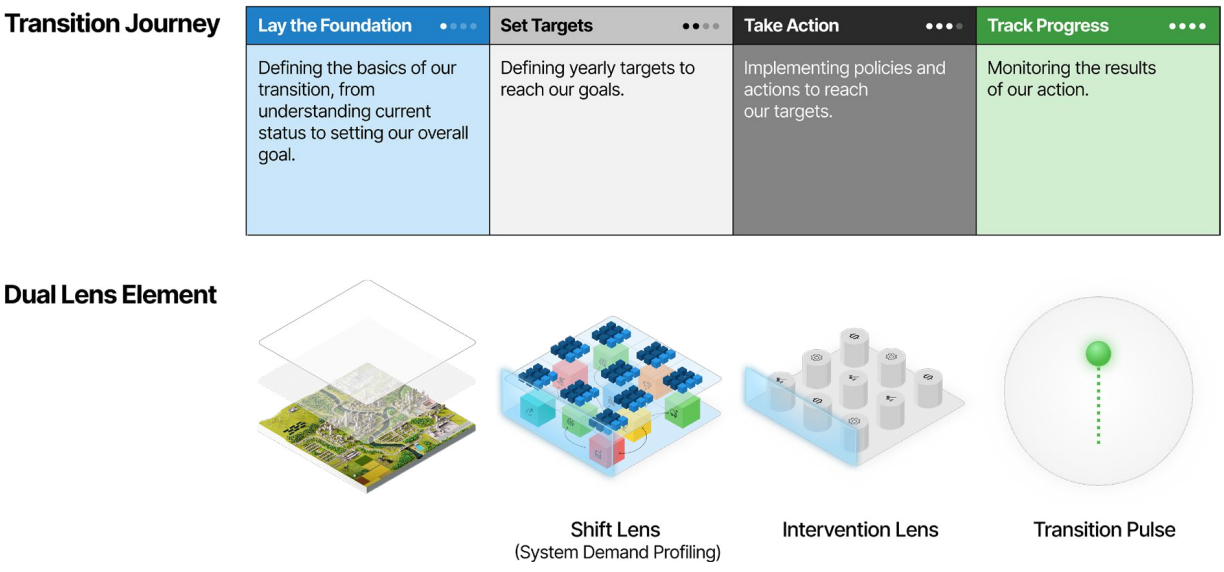
In combination, the Transition Journey, Dual Lens, and ClimateView software environment provide a common methodology, taxonomy, and toolset for cities to navigate their transition. The approach aligns with existing finance and compliance mechanisms. The ClimateView platform is designed to be compatible with green budgeting protocols, and emerging standards for blended finance and investment tracking. Therefore, cities can use it to structure their transitions and show they are investment-ready. Cities need new tools and structure in a world where credibility and coordination matter as much as ambition. The Dual Lens offers that structure. The TEF provides coherence, and the ClimateView platform makes it usable.

Together, they turn systems thinking into delivery capacity and delivery capacity into investment confidence.

Figure 13: The Transition Journey Meets the Dual Lens



Transition Journey
The Dual Lens in practice




Transition Elements
Transport

Operationalizing the Dual Lens: Examples from Scotland and Germany

Cities and national partners across Europe are already applying the dual lens of transition planning. In this section, we explore how two very different contexts—**Scotland's national-local coordination through the Scottish Climate Intelligence Service (SCIS)** and **regional planning in Germany's Ruhr metropolitan area**—use the Dual Lens to structure strategy, support delivery, and strengthen findability.

These examples illustrate how a shared systems logic, supported by tailored planning tools and processes, can turn diverse climate ambitions into structured, investable pathways.

Example 1: Scotland: Building a shared structure across 32 local authorities

Context

Scotland's 32 local authorities operate within a devolved national government structure. While councils deliver key aspects of the climate transition, such as transport and housing, national frameworks and funding streams define many enabling conditions. Recognising the need for better coordination and evidence-based planning, the Scottish Government and all 32 Local Authorities funded and supported the creation of the Scottish Climate Intelligence Service (SCIS).

Approach:

SCIS, in partnership with ClimateView, introduced the Dual Lens as an approach to convert individual and disparate Local Area Climate Action Plans into a live action agile platform that enables consistency of language and standardization of data, while being able to customize the combination of shifts best suited to their location and communities. As a significant part of this approach, a shared Transition Element Framework (TEF) was introduced to standardise how system shifts are defined and modelled across councils.

Key Practices:

- Development of a standardised Scottish area-based inventory for use within the platform, and working towards tailoring socio-economic parameters and indicators for each area
- Use of the TEF to structure local climate strategies around activity shifts (e.g., decarbonising heat, shifting to active transport)
- Application of Outcome Logic in workshops and co-design sessions to develop meaningful interventions
- Investigation of Tempo to translate long-term ambitions into annual delivery expectations
- Deployment of a shared platform environment to monitor progress and facilitate communication between local authorities, with the national government and other stakeholders, and ultimately with communities.

Emerging Impacts:

- Number of councils currently applying the TEF and Dual Lens method
- Examples of interventions redesigned using Outcome Logic
- Evidence of improved funding alignment or cross-council collaboration


DUGALD STEWART

Example 2: Ruhr Region, Germany: Coordinating delivery across 53 municipalities

Context:

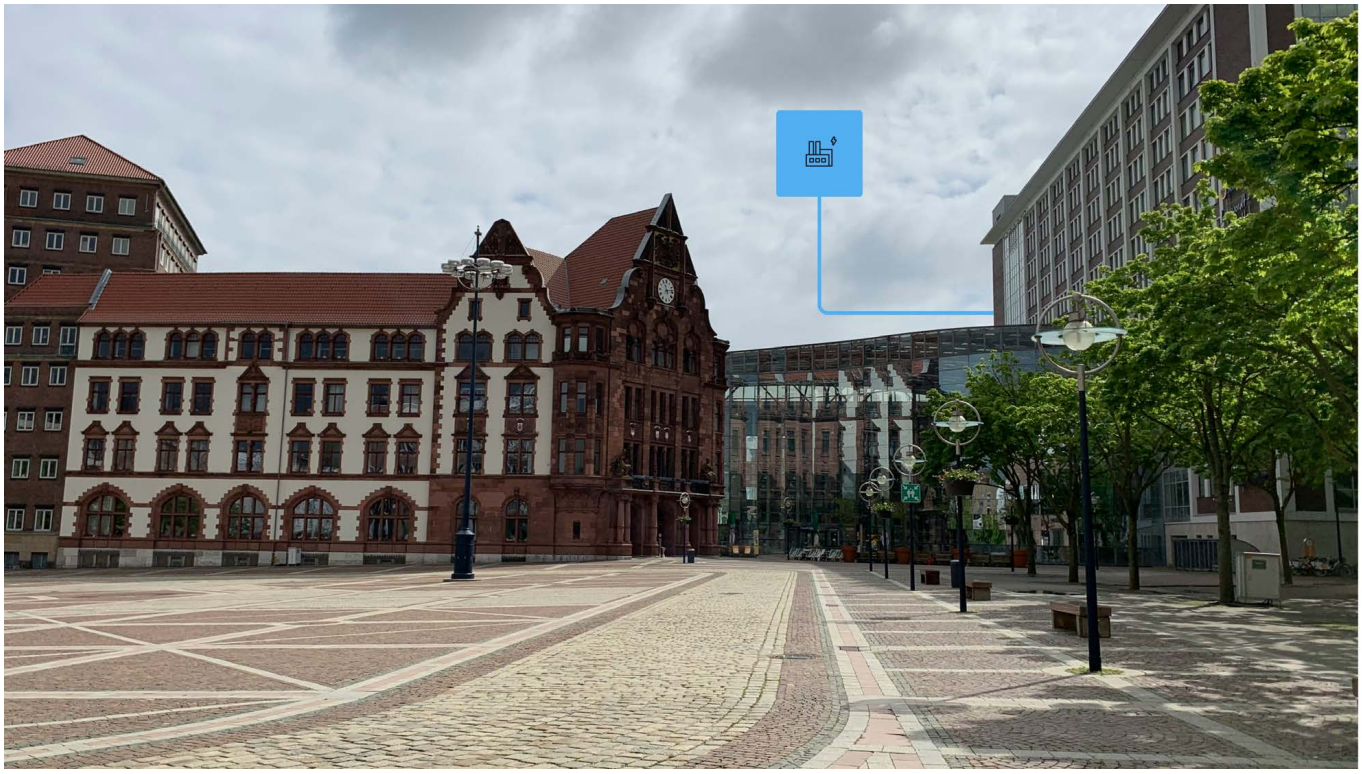
The Ruhr metropolitan region – Germany's largest urban agglomeration – is home to over 50 municipalities and a historically carbon-intensive industrial economy. Today, it is positioning itself as a frontrunner in the green industrial transition, with the shared ambition of becoming the world's greenest industrial region by 2040. This transformation requires coordinated action across local governments, infrastructure providers, and industry.

At the heart of this effort is the Ruhr Regional Association (RVR), a statutory regional planning authority responsible for spatial development, infrastructure planning, and environmental coordination across the region. RVR provides the formal planning framework to align municipal strategies with regional and national decarbonisation goals, while acting as a convening platform for joint planning and investment. As the region retools its industrial base for a net-zero future, RVR's role has expanded from long-term land-use planning to include orchestrating the systems-level transition across transport, energy, and industrial innovation, e.g., around hydrogen.

Approach:

The Dual Lens approach was introduced to connect the bottom-up view of municipal climate planning with the top-down perspective of regional strategy to support a more integrated and dynamic planning process. On the one hand, the 53 municipalities are using the platform to digitize and structure their own climate action plans, creating a transparent, real-time picture of their interventions, readiness, and local ambitions. On the other hand, RVR is developing a regional climate plan that includes cross-cutting emission reduction targets and key interventions within its statutory mandate, such as spatial planning, green infrastructure, and local transport.

The Dual Lens enables both perspectives to be viewed simultaneously: the Intervention Lens captures what local actors are planning and capable of delivering, and the Shift Lens expresses what the system requires to achieve regional targets. This combined view provides powerful new insights into where policy and delivery gaps exist, highlighting who is best placed to act, where coordination is needed, and what support mechanisms are missing. Importantly, this approach also supports RVR's ongoing dialogue with higher levels of government and, in particular, the State of North Rhine-Westphalia (NRW), where the regional planning body advocates for targeted policy and funding support. The structured visibility into system-wide gaps and cross-jurisdictional needs offers a strong evidence base for communicating where higher levels of government must step in to unlock delivery at scale – be it through regulatory changes, fiscal tools, or new enabling programmes.

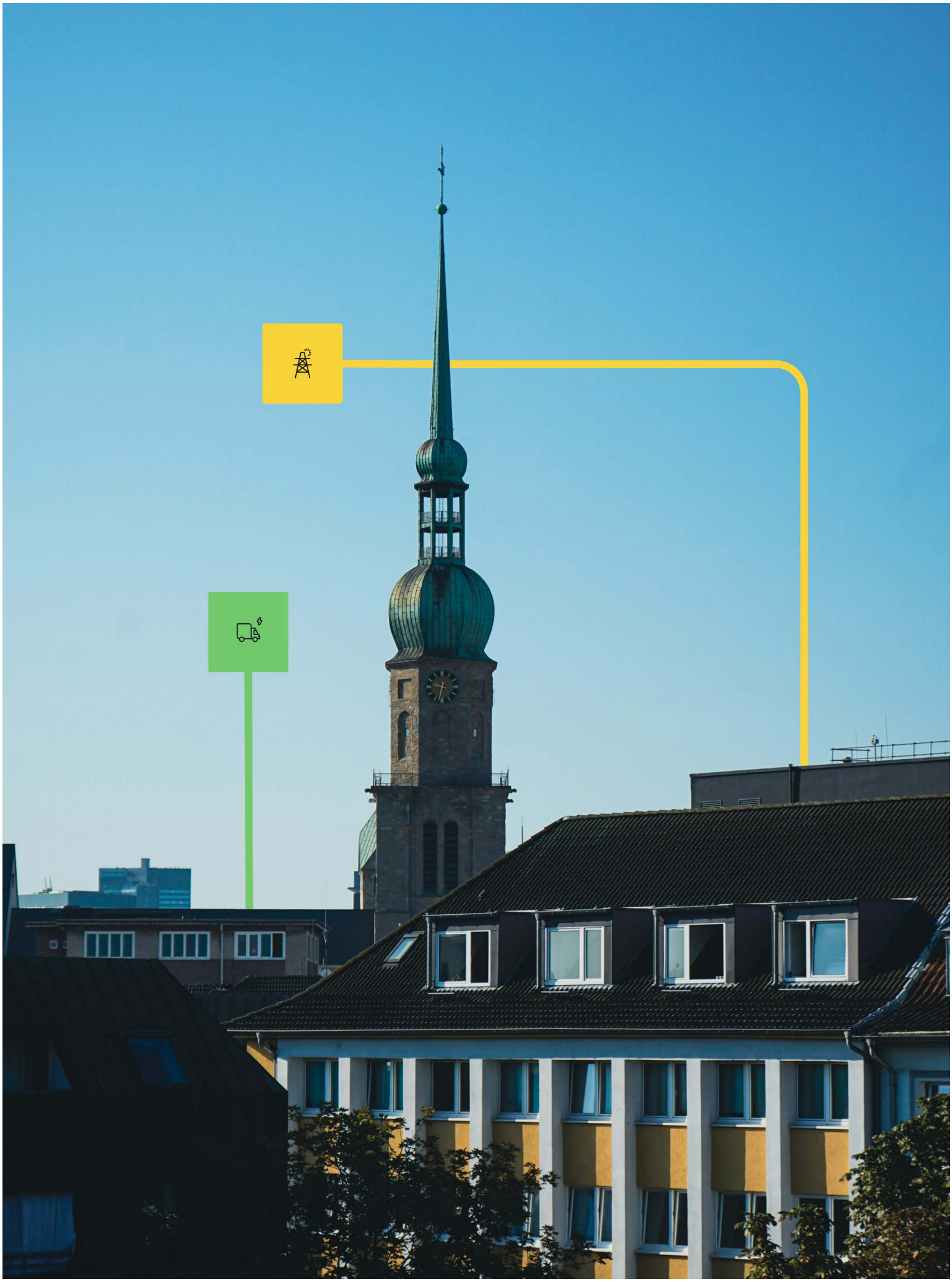


Key Practices:

- Use of the Transition Element Framework (TEF) – especially Outcome Logic – as the foundation for structuring and digitising municipal climate action plans, as well as the regional scenarios and regional-scale interventions.
- Development of a data playbook to support impact monitoring through readiness indicators (KPIs) and enable future outcome-based assessment of interventions
- Integration of intervention by business actors and industry into municipal dashboards to align public and private sector efforts
- Ability for municipalities to share interventions with one another and draw from a curated intervention library to accelerate local planning
- Application of the Dual Lens to bridge local interventions with regional targets and system-wide shifts

Emerging Impacts:

- Municipalities are aligning local plans with regional targets and sharing interventions across jurisdictions
- Enhanced visibility into system-wide delivery gaps supports clearer role allocation between local, regional, and state actors
- Structured data and readiness insights are strengthening RVR's dialogue with higher levels of government on needed policy and funding support
- Growing use of dashboards by cities and business actors is fostering more integrated, evidence-based decision-making



Example 3: Netherlands: Dutch Metropolitan Innovations (DMI) Ecosystem

Context:

In the Netherlands, cities play a crucial role in reaching national, regional, and local climate goals; however, efforts to reduce emissions across energy, mobility, and housing sectors have often been fragmented, lacking unified and transparent methodologies and consistent data structures. Public and private organisations, operating on multiple geographical scales, have developed climate policies and strategies without a common and standardised language on how to measure urban sustainability progress from an integral perspective, resulting in variations in calculations, no common standard to align with national ambitions, and limited comparability of progress across municipalities.

Measurement of urban sustainability progress is one of the pivotal and policy-driven activities in the Dutch Metropolitan Innovations ecosystem (DMI-ecosystem) program. Public, private, and knowledge organizations work together to make this operational from an integrated and data-driven perspective. In this context, the route to climate neutrality has been one of the anchor points where the DMI-ecosystem focuses.

Recognizing this challenge, the Dutch Ministry of Infrastructure and Water Management, through and as a Participant of the Dutch Metropolitan Innovations (DMI) ecosystem, initiated a pilot project to improve standardization and systemic planning among cities by utilizing ClimateView's Transition Elements Framework (TEF). Based on these efforts, the DMI-ecosystem can provide the organizational strength and the knowledge base to dive sufficiently in-depth into the fundamental questions related to pathways to reach climate-neutrality. These questions, mainly determining the quantitative relations between climate-neutral transition pathways and interconnected interventions, are currently asked by public, private, and knowledge organizations in light of the above context-setting.

Approach:

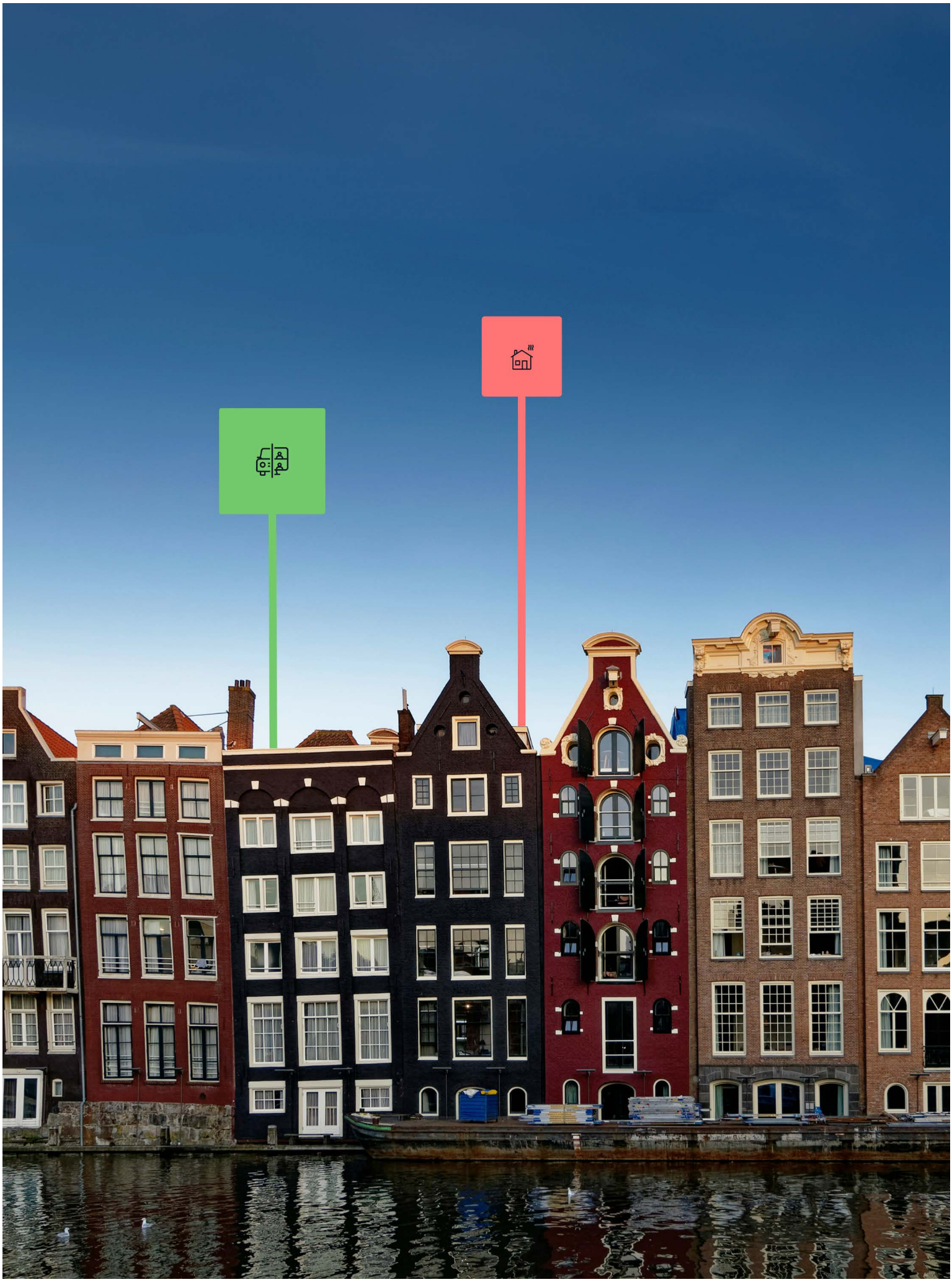
Working with ClimateView and Dutch consultancy agency HetEnergieBureau, the DMI ecosystem introduced the Dual Lens of Transition Planning across ten Dutch municipalities. The platform enables cities to model system shifts based on scientific parameters and develop, compare, and track plans in a standardized and transparent manner. The focus is on facilitating local delivery that aligns with national priorities by aligning policies, employing shared metrics with data and calculation methods, clearly defined system demands, and comparable dashboards, including educational material for self-learning.

Key Practices:

- Introduction of a shared, science-based Transition Element Framework to model climate strategies across municipalities.
- Use of a national data playbook for housing, energy, mobility, and waste plans, integrated with Climate City Contracts (CCCs), Sustainable Urban Mobility Plans (SUMPs), and Regional Mobility Plans (RMPs).
- Tracking of behavioral shifts and infrastructure changes using clearly expressed tempo indicators (e.g., number of people shifting travel modes or adopting EVs annually).
- Deployment of intuitive dashboards that enable political decision-making and increase public understanding.
- Adjustment of plans based on local feasibility, system capacity, and adoption dynamics.

Emerging Impacts:

- Insights for policy alignment between national, regional and local governments through a common language and methodology.
- Participating cities (e.g., Haarlem, Emmen, Rotterdam, Groningen) now have standardized data and comparable progress tracking.
- Clear articulation of annual delivery expectations (e.g., 1,600 people per year shifting to EVs in Haarlem).
- Increased confidence in local plans and awareness among city leadership and departments due to improved feasibility analysis.
- Enhanced potential for cross-city and public-private collaboration (national and international).
- Early signs of replication interest in other regions and internationally.



Example 4: United States: Transitioning from ClearPath 1.0 to 2.0

Context:

For over a decade, ClearPath 1.0 has functioned as the most widely used platform for U.S. cities, with more than 1,200 cities, towns, counties, and Tribal nations using the tool to inventory emissions and comply with reporting frameworks, including the U.S. Community Protocol (USCP) and the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). However, as cities pursue more ambitious climate goals and seek funding for implementation, modernized features, particularly around advanced data visualization and action modeling is needed. A significant number of U.S. cities still rely on static spreadsheets, siloed datasets, and a lack of delivery logic, making transitioning from planning to action challenging. And while a growing group of cities and counties are aligning their municipal budgets to achieve climate outcomes, no single platform marries emissions data and planned goals with finance options. Uncertainty surrounding federal support only complicates matters further..

Recognizing this, ICLEI USA and ClimateView partnered to develop ClearPath 2.0: an upgraded platform designed to reflect the complexity of systemic transitions. ClearPath 2.0 connects emissions planning with the necessary enabling conditions for delivery and integrates real-time data with transparent system logic — and allows U.S. cities to publish a public dashboard of their ClearPath-monitored progress for the first time. Building on ClearPath 1.0's foundational grounding in trusted frameworks, the 2.0 version of the platform incorporates the Dual Lens of Transition Planning, including Activity Shifts, Interventions, and the Transition Pulse, to guide local governments from ambition to execution.

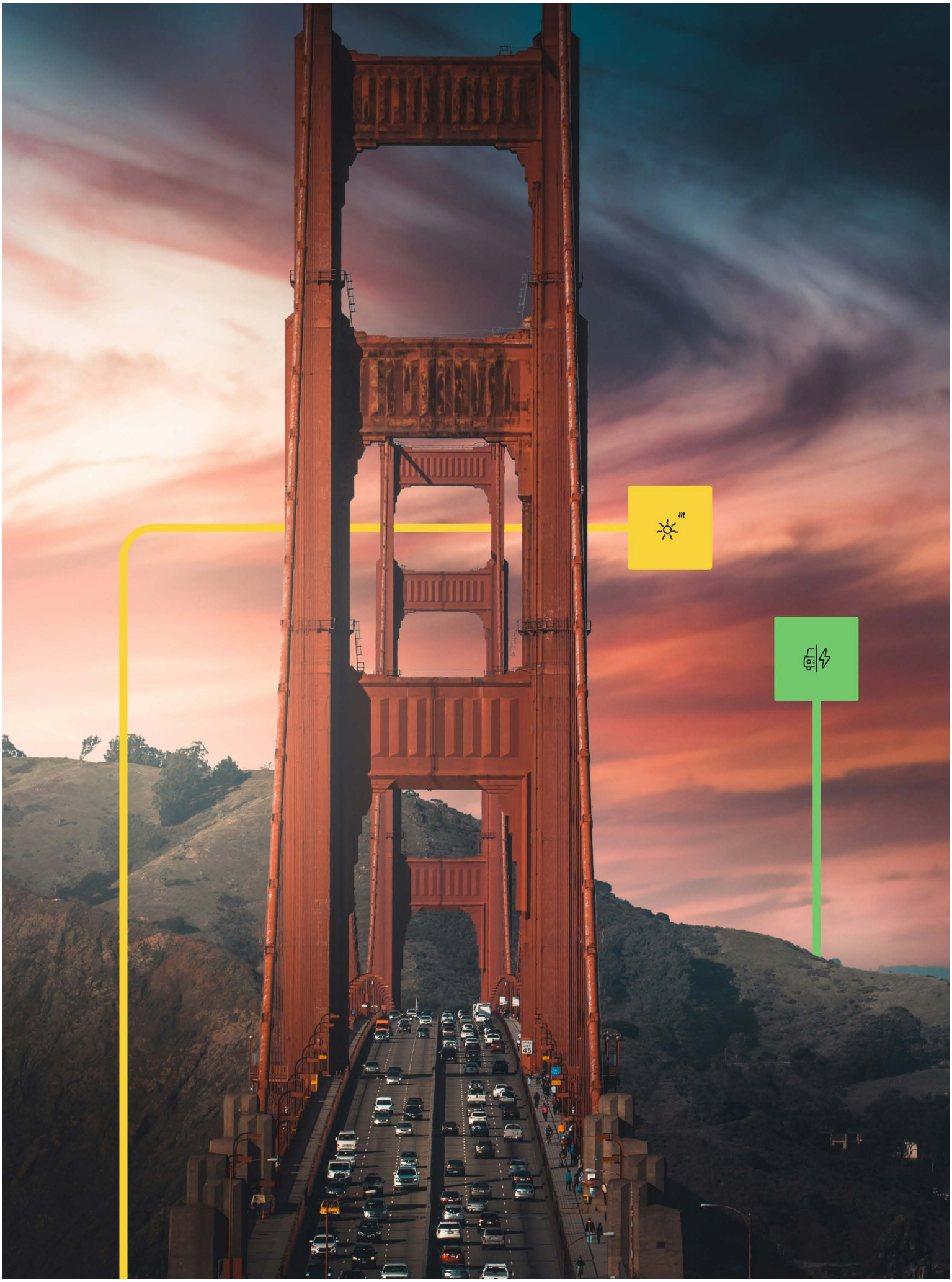
Approach:

ClearPath 2.0 supports local and regional governments well beyond calculating baseline emissions inventories, by helping them design, test, and finance credible transition pathways. It allows cities to define necessary system shifts (e.g., decarbonizing transport or electrifying buildings), assess the enabling demands of those shifts (e.g., capital, workforce, infrastructure), and structure interventions accordingly. The platform moves U.S. cities even further beyond static planning with a dynamic, transparent model that cities, funders, and residents can understand and trust.


Emissions
Transitions
Energy
Interventions
Indicators
Emission pathway
Emission pathway for New York
68,2 Mt
Reported emissions 2020
0%
Assumed emission change 2045
-100%
Emission goal 2045
Transport
Industy
Agriculture
Energy
Waste
Emissions from New York
A Transparent Approach

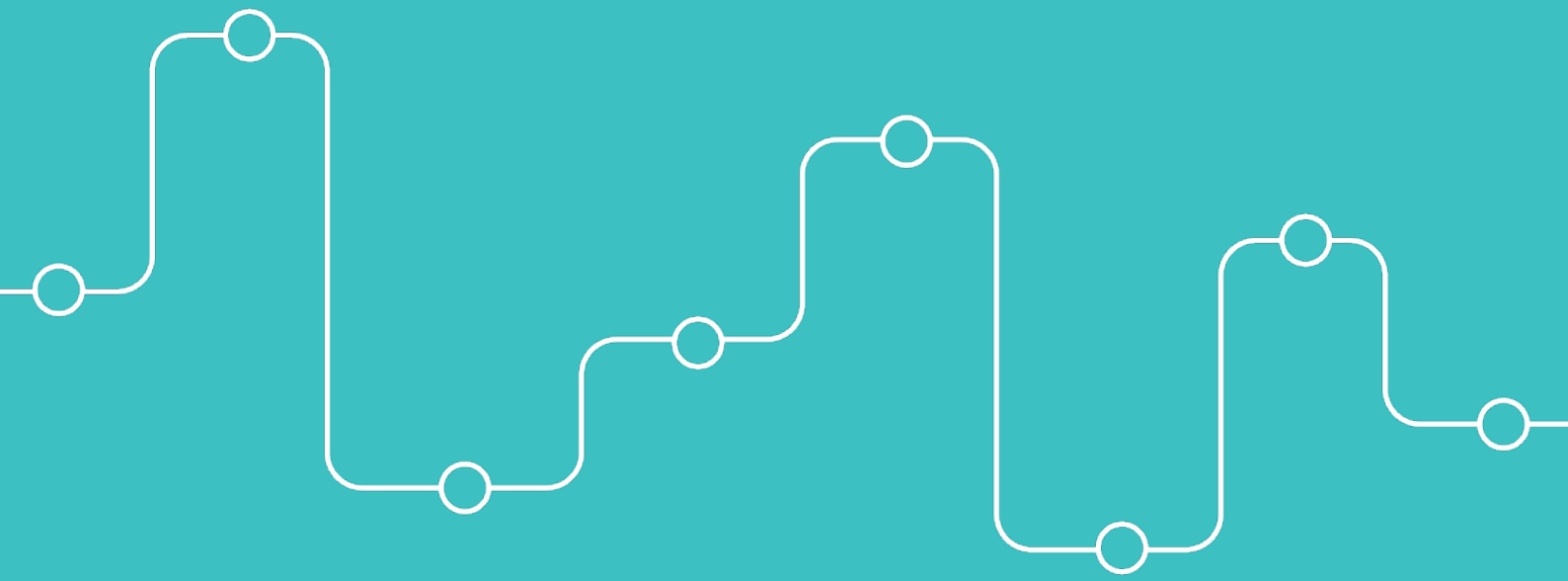
Key Practices:

- Moves cities from relying mostly on inventories for planning to more holistically informed, systemic transition planning using the Shift/ Intervention/Pulse framework.
- Provides open, inspectable models that expose assumptions and logic, avoiding the “black box” critique.
- Built-in tools for cities of all sizes, providing reliable defaults for small municipalities to advanced simulation for large urban systems.
- Dashboards for elected officials, residents, and staff that visualize progress and co-benefits.
- Shared platform that enables cross-jurisdictional collaboration, particularly useful for regional planning councils.
- Emerging Impacts:
- The City of San Antonio, Texas, uses ClearPath 2.0 to replace static planning with real-time progress tracking and delivery-aligned implementation, improving communication across city departments and between city staff and leadership.
- The East Central Florida Regional Planning Council uses the platform to align multiple local governments, utilities, and transportation agencies on joint climate goals. For years, the council has convened its cities, including Orlando, Daytona Beach, and dozens more, in peer-learning cohorts; ClearPath 2.0 will help the region advance in even more coordinated ways.
- The Village of Hastings-on-Hudson, New York, the platform supports adaptive planning and public transparency, equipping elected leaders with data-backed messaging that increases local engagement and confidence. From modeling the emissions-reduction capabilities of modern, carbon-absorbing concrete to putting youth activism at the center of its climate work, the Village uses the platform to unite the data and people aspects of climate action.
- Cities are now better positioned to access climate funding by presenting structured, credible, and trackable strategies, with the option for cost-benefit analysis for climate actions, beyond emissions accounting.
- ClearPath 2.0 represents a shift in both mindset and the tools to enact it: from planning as documentation to planning as a dynamic, operational practice grounded in systems thinking and delivery logic.



Conclusion:

A roadmap for a complex journey



This white paper introduces the Dual Lens of Transition Planning, a structured, systems-based method that helps cities design and deliver fundable climate transitions. It rests on two key components:

The Shift Lens defines the structural changes needed to meet societal needs sustainably and quantifies each shift's requirements and returns.

The Intervention Lens identifies and sequences the enabling interventions necessary to prepare the system for those shifts, clarifying roles, interactions, and timing.

The Transition Pulse is a dynamic monitoring approach that connects the two lenses by identifying and focusing on leading indicators of system readiness. It helps cities detect early signs of progress or risk, adapt implementation, and demonstrate delivery capacity to funders, policymakers, and communities.

Together, these elements form a repeatable delivery logic that aligns ambition with structural feasibility, investment credibility, and multilevel coordination. This logic transforms climate strategies from static documents into operational plans ready to guide implementation at scale.

Importantly, this is not just a conceptual model. It is a method already being utilized by cities and regions through the Transition Element Framework (TEF), the ClimateView platform, and the Transition Journey. These tools enable cities to surface interdependencies, assign delivery roles, manage bottlenecks, and align planning timelines with real-world constraints.

As climate action moves from vision to execution, cities will be held to a higher standard that demands both ambition and readiness. Structured delivery planning is no longer a nice-to-have; it is a prerequisite for unlocking finance, coordinating across governance levels, and building the public confidence needed for sustained transformation.

The Dual Lens offers cities a way to meet that standard by engaging with and organizing it rather than just simplifying it. This, in turn, makes systems visible, interventions governable, and transitions fundable from day one.

Climate change necessitates action at a speed and scale unlike anything we have seen before. Meeting this moment requires more than ambition. It requires cities to plan, coordinate, and deliver in fundamentally new ways. The Dual Lens provides the structure and tools to support that shift: from reactive to proactive, from fragmented to systemic, and from isolated action to multilevel strategies ready for funding. It empowers cities to move with clarity and confidence, building transitions that are not only visionary but also deliverable.

About the co-authors' organizations

ClimateView

ClimateView is a mission-driven technology company from Sweden, founded in 2018. It was founded on a simple yet urgent realization: cities are crucial to climate action, but the tools available for planning, implementing, and funding their transitions are fragmented, outdated, or entirely lacking.

Rather than becoming a consultancy, an NGO, or a traditional software vendor, we chose a different approach. ClimateView is a mission-driven climate technology company dedicated to creating a shared operating system for the climate transition.

We aim to equip cities with the framework, tools, and confidence necessary to move from ambition to action. Our platform and methodology combine scientific principles, systems thinking, and multilevel governance to help cities transform their goals into actionable, fundable, and trackable strategies.

Systemic change demands collective infrastructure and a shared taxonomy and ontology. That's why we make essential components, such as the Transition Element Framework, open and interoperable. This supports a growing ecosystem of advisory firms, public agencies, and local partners working towards aligned outcomes. At the same time, we continue to invest in powerful shared technology, encompassing data models, coordination environments, and visualization tools. By distributing development costs across hundreds of cities worldwide, we can deliver a more robust, scalable, and effective solution than any single organization could achieve on its own. Our for-profit model is a deliberate choice, allowing us to maintain independence, reinvest in long-term platform development, and focus on building infrastructure that cities can rely on at scale, not just in pilot projects but everywhere.

We are part of a broader movement for systemic and credible climate action. Our role is distinct yet complementary: we provide the shared logic, structure, and digital foundation that enable cities, partners, and funders to align and accelerate the transition.

ICLEI - Local Governments for Sustainability

ICLEI – Local Governments for Sustainability (known as ICLEI) is a global network working with more than 2500 local and regional governments committed to sustainable urban development. Active in 125+ countries, we influence sustainability policy and drive local action for zero emission, nature-based, equitable, resilient and circular development. Our Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

Scottish Climate Intelligence Service

The Scottish Climate Intelligence Service (SCIS) works with all of Scotland's local authorities to help deliver climate action at the scale and pace needed to deliver Scotland's Climate Change Plan.

We also know that climate change is not just about emissions, and that understanding and delivering the wider benefits of climate action, notably for adaptation, nature, health and inequality, are vital to society and critical to net zero delivery.

Our service is building capacity within local authorities. By working within and across local authorities, we support collaboration and help to share skills, knowledge, insights and common approaches which support and accelerate effective local climate action.

Dutch Metropolitan Innovations Ecosystem

DMI is a platform of public and private partners, as well as knowledge institutions, focused on fully leveraging the opportunities that data and emerging technologies offer to accelerate sustainable urban densification and transform mobility. We believe in an integrated, digital approach that connects challenges in urban development, mobility, climate, the social domain, and energy.

Data provides cities with both visibility and actionable insight into what is truly happening on the
ground. This enables more targeted and effective management of limited urban space. Based on our shared Framework Agreement – signed by all participants – and the Product Data Exchange (PDX), DMI enables the safe, trusted sharing, integration, and (re)use of data.

With a strong focus on system integration and scalability, DMI empowers participating companies to develop new, smart products and services. Owing to our agreements on standardization, proven solutions can be scaled and brought to market faster, both nationally and internationally.

Governments involved are supported in implementing these solutions, helping them to accelerate progress on major societal challenges. An increasing number of cities are using DMI, both to enhance their ability to manage existing urban environments and to realize new developments in a fully integrated, data-driven way.

In short: DMI connects supply and demand, drives scale, develops standards, and makes data and solutions discoverable and transferable. For efficient collaboration. To accelerate transitions. For tangible results on the ground.

Want to know more?
Visit www.dmi-ecosysteem.nl/en.

Stockholm Resilience Center

At the Stockholm Resilience Centre, we explore how people and nature can live and develop on a planet under pressure. Founded in 2007, the centre is a collaboration between Stockholm University and the Beijer Institute of Ecological Economics at the Royal Swedish Academy Sciences.

Today, we bring people together from around the world to research, study and collaborate, with a vision of thriving and resilient biosphere that enables well-being for all. Our science addresses the sustainability challenges facing humanity, such as climate change and biodiversity loss. Our research ranges from local food systems to global financial markets. We train the next generation of sustainability researchers and leaders, and co-create knowledge with communities, artists, organisations, corporations and governments.

Knowing that people and nature are deeply intertwined, we recognise the importance for humanity to reconnect to the biosphere — to thrive within planetary boundaries.

RISE Research Institutes of Sweden

RISE Research Institute is Europe's third largest research institute and a renowned partner for industry, academia and the public sector. With our holistic approach and unique expertise, we help customers and partners solve complex issues, adapt to and meet systemic challenges and strengthen their competitiveness. Our almost 3300 employees engage in and support all types of research, systems transformation and innovation processes. RISE is an independent, State-owned research institute, which offers a breadth of expertise; from urban planning and development to bioeconomy, circular finance and AI, to mention but a few areas, including over 130 testbeds and demonstration environments for future-proof technologies, products and services.

What is Systems Thinking and why cities need it

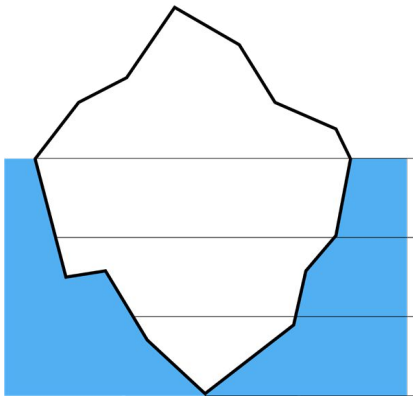
Systems thinking is a framework for understanding complexity by examining how activities that fulfill societal needs interact through feedback loops, dependencies, and dynamic relationships. Instead of isolating interventions or sectors, it focuses on the broader system of activities, such as how mobility, heating, or consumption are collectively shaped by infrastructure, behavior, policy, and resource flows. By recognizing these interconnections, cities can identify where structural shifts in activity are necessary to achieve sustainability goals. This understanding enables planners to anticipate co-benefits (like improved health from active transport), mitigate unintended consequences (such as rebound effects), and plan for long-term outcomes that may materialize beyond the immediate intervention horizon. With this perspective, interventions can be designed to create systemic leverage rather than isolated change.

"When applied to cities, systems thinking is a framework for understanding complexity by examining how activities that fulfill societal needs interact through feedback loops, dependencies, and dynamic relationships."

Donella Meadows, one of the most influential systems theorists, defines a system as "an interconnected set of elements that is coherently organized in a way that achieves something" (Meadows, 2008). She argues that persistent policy failure often stems from addressing symptoms rather than underlying structures, creating a mismatch between the level of intervention and the level at which the problem arises.

A widely used conceptual tool to illustrate this is the Iceberg Model, which suggests that deeper patterns, systemic structures, and mental models underpin observable events (like traffic congestion). Long-term change, therefore, requires interventions at the event level and the structural and mindset levels that generate them (Boylston, 2019; Senge, 2006).

One example that illustrates this dynamic is the paradox of road expansion. Building an additional traffic lane to reduce congestion may offer temporary relief, but it often leads to increased vehicle use, more trips, and ultimately worsened traffic via a phenomenon known as *induced demand* (Duranton & Turner, 2011; Goodwin, 1996). These outcomes are not anomalies but are consistent with system behavior: by reinforcing automobile dependency, the intervention strengthens the structure producing congestion. Shifting behavior sustainably requires changing the more profound system logic, for example, by investing in attractive alternatives such as frequent, reliable public transport, active mobility infrastructure, or even lessening the demand for trips via increased opportunity for online access to meetings and services.



	Problem	Siloed Approach	System Approach
Events	Daily traffic jams during rush hour	Add a new traffic lane to reduce congestion	Invest in public transport, cycling, and walkability
Patterns	Traffic congestion keeps returning despite expansion	A cycle of road widening followed by increased traffic volumes	Long-term shift toward multimodal transport uptake and reduce car dependency
Structures	Car-centric urban planning and infrastructure	Prioritization of road infrastructure in budgets and policies	Integrated transport planning; land-use policies supporting compact cities and mobility alternatives
Mindsets	"More roads = less traffic" "Driving is the default mode of transport	Reinforces car-dependence and short-term fixes	"Mobility = choice" "Transport systems should serve people, not cars"

Figure 4: The Iceberg Model of Systems Thinking

Systems thinking urges planners to move beyond siloed sectoral responses in urban settings. Cities are complex socio-ecological systems, with deeply interlinked infrastructure, governance, behavior, and ecological processes. Advancing sustainability in this context requires a systems approach that aligns planning and decision-making across scales, sectors, and societal functions (Bai et al., 2016). Systems thinking becomes essential for tackling "wicked problems" like climate change—challenges that are dynamic, cross-sectoral, and too complex for any single actor to resolve in isolation (Levin et al., 2012).

Major institutions now call for systemic approaches to guide urban transitions. The IPCC Sixth Assessment Report (2022) emphasizes that effective climate action requires integrated strategies spanning energy, land, infrastructure, and behavior. The EU Cities Mission (2024) and the World Bank (2021) similarly promote whole-system perspectives to design transition pathways that are both sustainable and just.

However, despite the growing consensus, a persistent gap remains between the intention and implementation of systems thinking in urban planning. This paper aims to bridge this "implementation gap" by turning systems thinking into fundable, coordinated strategies.

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Systems Thinking and Multilevel Governance

To make systems thinking actionable in the real world, cities need governance structures that reflect the same logic of interconnection, feedback, and distributed influence that defines complex systems. Systems thinking enables planners to identify cross-sectoral dependencies, cascading effects, and leverage points for intervention. However, institutional arrangements must support coordination across jurisdictions and actors to act on these insights at scale. This is where multilevel governance (MLG) becomes essential.

MLG refers to the dispersion and interaction of authority across different levels of government — from local to regional, national, and supranational — and between public, private, and civil society actors (Hooghe & Marks, 2003; 2020). It offers a framework to align efforts vertically (across governance levels) and horizontally (across sectors and jurisdictions), making it possible to translate systemic understanding into delivery pathways. In climate planning, this is particularly crucial: local governments often bear responsibility for implementation, yet depend on national policies, regulations, and funding to act. At the same time, national governments require local contributions to meet international obligations such as Nationally Determined Contributions (NDCs) under the Paris Agreement.

Embedding systems thinking into MLG practices enables a two-way flow: national targets can be grounded in local realities, while local activity shifts can be systematically aggregated to demonstrate national progress. Without such alignment, city-level innovation remains fragmented and under-resourced, and national ambitions risk stalling without local delivery mechanisms. Ehnert et al. (2018) argue that a transition to sustainability requires governance architectures that support coordination, learning, and alignment across scales, not simply the coexistence of actors at different levels.

However, financing systemic interventions is one of the most significant barriers to this alignment. Today's climate finance is structured around siloed, sector-specific projects with clearly bounded outcomes, favoring easy interventions to isolate, measure, and de-risk. However, systems thinking often calls for bundles of interdependent interventions and activities. For instance, combining land-use regulation, public transport investment, and behavioral incentives to shift urban mobility patterns. These do not fit neatly into conventional funding structures. The result is a persistent translation gap: cities may understand what needs to change, but struggle to package those insights into finance-ready proposals that resonate with national or international funders.

This is where MLG becomes not just an enabler of coordination but also a mechanism for unlocking finance. When mandates, responsibilities, and support mechanisms are clearly defined across governance levels, financing arrangements can also be structured to reflect shared accountability and integrated outcomes, as the IPCC (2022) notes, well-designed multilevel governance is necessary for mobilizing finance toward systemic transitions, especially in urban mitigation and adaptation. In this way, systems thinking provides the method for understanding and managing complexity, MLG is the mechanism for organizing action across levels and actors, and finance is the critical enabler — one that will only flow if interventions can be framed in a structure that matches both systemic ambition and institutional feasibility.

"Today's climate finance is structured around siloed, sector-specific projects with clearly bounded outcomes, favoring well-established, standalone interventions to isolate, measure, and de-risk."

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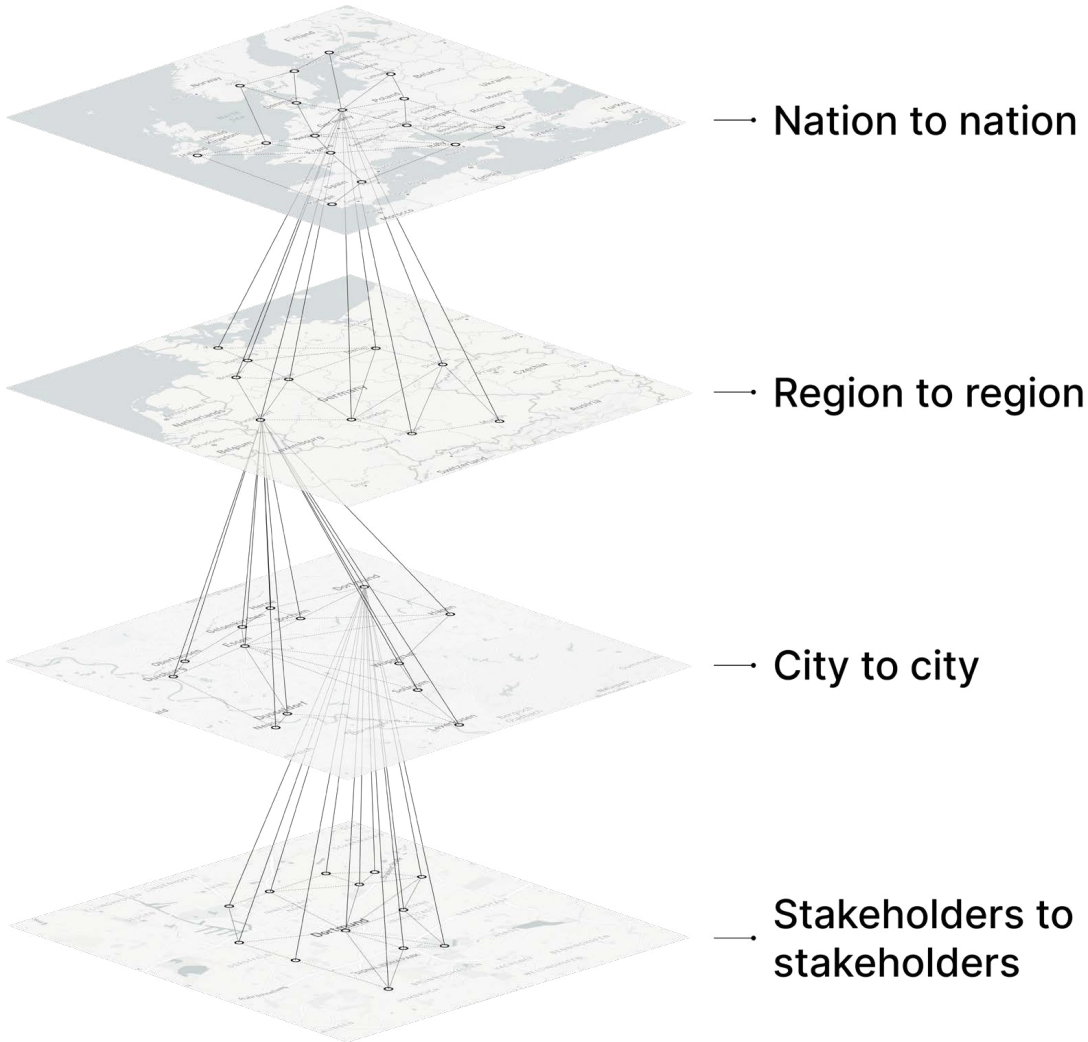
Figure 5: The dimensions of multilevel governance



Urban Metabolism - Linking needs, resources, and the goals we set

Cities are complex and dynamic resource systems where energy, materials, capital, and labor are converted to meet societal needs such as shelter, mobility, and nourishment. The concept of cities as systems in motion, characterized by flows of people, materials, and energy, has deep historical roots, tracing back to urbanist Sir Patrick Geddes (1915), who emphasized the city as an evolving organism shaped by ecological and social processes. His call to "think of a city not as a thing, but as a process" foreshadows contemporary urban metabolism frameworks, which conceptualize cities as systems of resource inflow, transformation, and outflow. Urban metabolism was first referred to by Wolman (1965), who described cities as organisms that ingest resources and produce waste through human activity and infrastructure. Today, this metaphor remains a powerful way to conceptualize systemic urban change.

Over time, urban metabolism evolved from a metaphor into an analytic framework that assesses how cities convert resource inflows into outcomes and how those processes relate to broader environmental goals. In this sense, the city becomes a "machine" for transforming energy, materials, and labor into well-being, or conversely, emissions, inequality, and environmental degradation. By viewing urban systems through this metabolic logic, we gain insight into how shifts in activity affect resource flows and how sustainable transitions might be achieved.

This thinking has evolved into more sophisticated frameworks that connect metabolic flows to urban planning, governance, and sustainability (Kennedy, Cuddihy & Engel-Yan, 2007). These frameworks emphasize the importance of understanding interconnected material and energy systems as prerequisites for designing effective interventions and tracking whether our actions bring us closer to or further from desired outcomes, such as net-zero emissions or resource equity. More recently, Ramaswami et al. (2016, 2021) identified key provisioning systems, including food, water, energy, buildings, mobility, connectivity, waste, and public access, as essential levers for shaping sustainable, healthy, and equitable urban outcomes.

When utilized within the ClimateView platform, the TEF facilitates a computational metabolism model that simulates how changes in dominant activities influence resource use, system demands, and outputs over time. The core modeling logic is already functional, based on structured data and causal reasoning. As the TEF continues to evolve, incorporating additional Transition Elements, defined interventions, and readiness attributes, and as more cities provide data and contextual insights, the computational capabilities of the platform increase proportionately. Each new dataset, TE, or logic enhancement improves the system's ability to model feasibility, evaluate delivery pathways, and support informed decision-making.

What remains consistent throughout is the shared foundation: a scalable, transparent framework that links activity shifts to structural change, resource reconfiguration, and investment credibility.

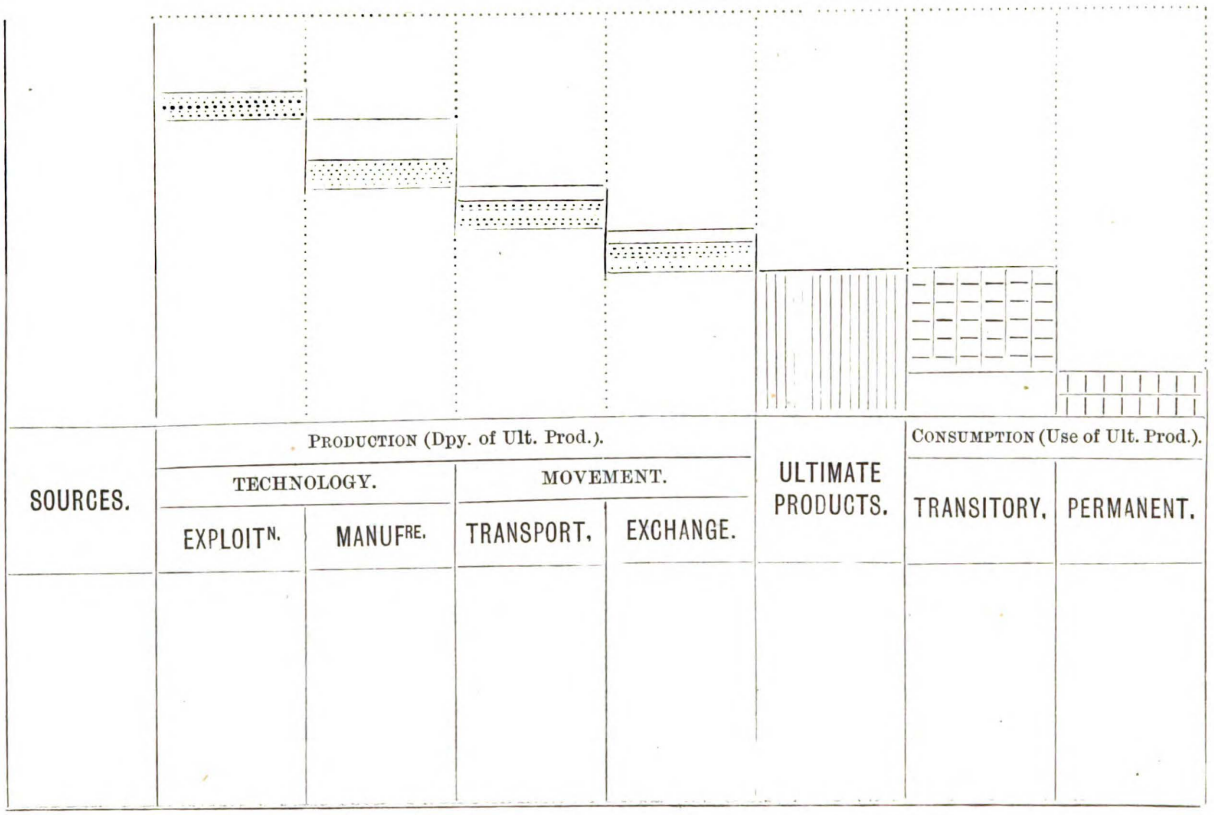
- Every activity (e.g., heating, transport, construction) consumes resources, including energy, materials, capital, and labor, and produces both resources and outcomes (such as electricity, mobility, emissions, comfort, and cost).
- A shift is a change in the dominant way a societal need is met, and that shift is represented as a quantifiable reconfiguration of resource usage across time and scale.
- Activities are not isolated. They are daisy-chained through systemic dependencies. One activity's output (e.g., electricity supply) may be another's input (e.g., building electrification).
- Each activity is assigned a capital stock, cost trajectory, and tempo, allowing cities to model how changes propagate through the system and what is required to enable them.

This foundation provides a resource-based simulation environment to model how city systems transform over time. Rather than simulating the city, the platform models transition dynamics, which describe how shifts in activity reconfigure resource use, generate system demands, and produce measurable outcomes.

Cities can establish their own goals (e.g., net-zero, circular economy) and simulate, year by year, the requirements for achieving those goals within real-world constraints: infrastructure readiness, capital availability, workforce capacity, institutional roles, and behavioral adoption.

In short, the TEF does not just mirror urban metabolism; it embeds its logic into a structured, evolving model for real-world application. It transforms systemic complexity into a quantified foundation for strategy, finance, and delivery, enabling cities to move beyond vision and into credible, measurable action.

Figure 6: An early approach to an analytical model for urban metabolism by Sir Patrick Geddes (1885)



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Human needs: From philosophical debate to science-based modeling

The concept of “human needs” has long shaped philosophy, psychology, and development studies thinking. While often treated as a stable foundation for ethics or policy, needs are not universally defined or ranked.

As one of the most widely known frameworks, Maslow’s hierarchy of needs (1943) proposes a progression from physiological survival needs to self-actualization. However, its validity has faced repeated challenges. Cross-cultural empirical research by Tay and Diener (2011) demonstrated that people in low-income contexts often prioritize social belonging or esteem, even when basic physiological needs are unmet. Others, such as Neher (1991) and Hofstede (1984), have argued that Maslow’s framework reflects Western, individualistic values and cannot be applied universally.

Alternative frameworks have attempted to address these limitations. Manfred Max-Neef (1991) proposed a set of fundamental needs - subsistence, protection, participation, and identity - considered universal but fulfilled differently across societies. Doyal and Gough (1991) offered a more structured approach to basic needs based on physical health and personal autonomy while also acknowledging the influence of cultural and institutional factors.

These approaches agree on one key insight: while some needs may be biologically grounded, the way they are expressed, interpreted, and fulfilled is socially and politically constructed. This creates significant complexity when defining needs in policy or modeling terms. As sustainability scholar Spangenberg (2011) argues, the challenge is identifying needs and evaluating how they are fulfilled, whether efficiently, equitably, or excessively.

This ambiguity presents a design challenge in climate transition planning: How can system models support decision-making without embedding contested value judgments about which needs matter most or how they should be met?

A practical solution is to treat needs as declared inputs, accepted at face value within the modeling process, rather than as fixed or hierarchical categories. This allows needs to be defined locally by policymakers, communities, or stakeholders, reflecting their specific priorities, cultural norms, and governance realities.

Rather than classifying needs as “objective” or “subjective” or survival-based versus socially constructed, this approach acknowledges all needs as valid and shifts the analytical focus to fulfilling the need. Modeling tools can then assess the consequences of that fulfillment across emissions, energy use, infrastructure demand, and material intensity, without prescribing which needs are more valid. This has several advantages:

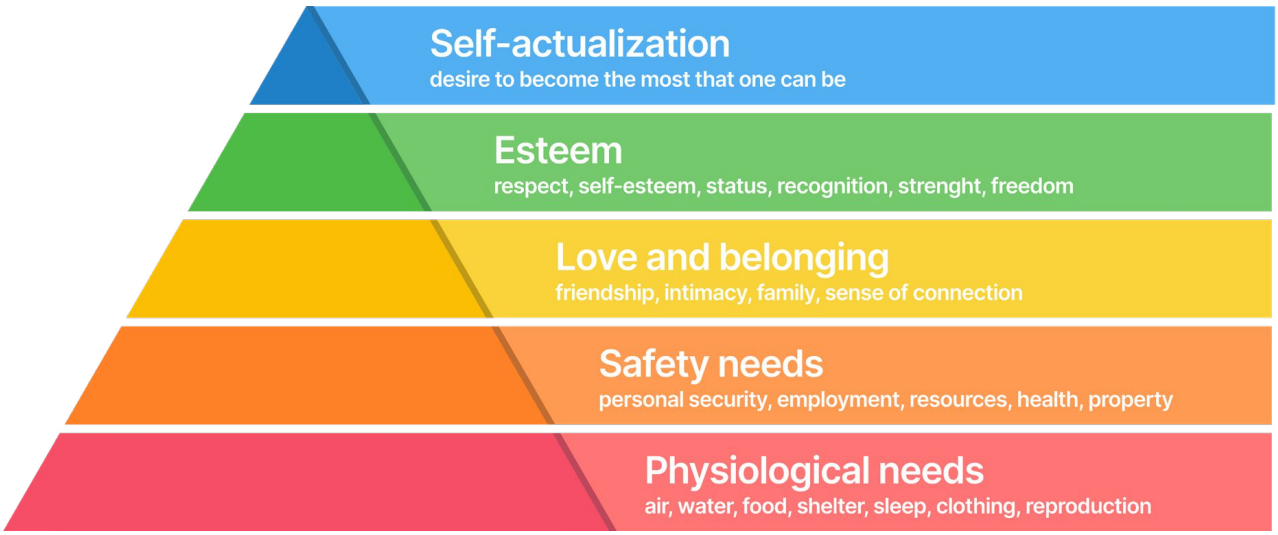
- It allows for context-sensitive planning while preserving scientific neutrality.
- It enables comparisons between alternative strategies for meeting the same need (e.g., mobility through private vehicles vs. public transit).
- It avoids the normative pitfalls of deciding whether a given policy addresses “supply” (provision of services) or “demand” (underlying need or behavior).
- It supports democratic deliberation by allowing political systems, not models, to define what matters.

This principle is essential in ClimateView’s work to support cities and governments in climate transition planning. The platform does not distinguish which needs are legitimate or which policies are more “sustainable” by default. Instead, it provides an empirical foundation for understanding how declared needs, regardless of origin, are being fulfilled and the system-level consequences of those choices.

For example, suppose a city declares a need for warmth in winter. In that case, the platform enables analysis of multiple ways to sustainably fulfill that need: improved insulation, heat pumps, district energy systems, or other alternatives. The model quantifies each path’s resource, emissions, and infrastructure implications. Importantly, the sustainability of a shift is not assumed, but rather, modeled.

By distinguishing between needs (as declared) and shifts (as measurable changes in fulfillment), ClimateView helps decision-makers transition from political priorities to system evidence. This supports a key function in the transition ecosystem: clarifying what interventions lead to which outcomes, without pre-empting value-driven choices. It allows cities and nations to remain accountable to their values and policy contexts while grounding their decisions in scientifically modeled consequences.

Figure 7: Maslow's hierarchy of needs (1943)



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The Transition Element Framework: Encoding clarity, enabling global action

The Dual Lens distinguishes between subjective societal needs, which are communities' declared intentions and priorities, and objective, measurable Activity Shifts, which refer to the structural changes necessary to meet those needs sustainably. A crucial practical question remains: How can cities systematically encode and operationalize this clarity into practical knowledge?

This is precisely the purpose of the Transition Element Framework (TEF). Directly derived from IPCC mitigation options, the TEF is an open-source taxonomy and ontology designed to rigorously structure and standardize how cities worldwide define their climate transitions. Central to the TEF is a robust Mutually Exclusive, Collectively Exhaustive (MECE) categorization, clearly defining each Activity Shift within exactly one of six categories:

- **Type Shift:** substituting one activity entirely with another (e.g., private cars → public transit).
- **Resource Shift:** substituting energy or material inputs (e.g., fossil fuels → renewable electricity).
- **Utilisation Shift:** reducing the frequency or intensity of activities (e.g., fewer or shared trips).
- **Work Efficiency Shift:** improving the efficiency of converting inputs into outcomes (e.g., better insulation).
- **Resource Efficiency Shift:** reducing resources per unit of outcome (e.g., higher fuel efficiency).
- **Carbon Shift**: enhancing sequestration or carbon capture (e.g., reforestation, carbon storage).

The TEF's greatest strength is its detailed, structured definitions of Activity Shifts, which capture system demands (resources, infrastructure, capital, and labor required) and returns (emission reductions, resilience, and economic and social benefits generated). However, from its inception, the TEF was intentionally designed to extend beyond Activity Shifts, systematically expanding into comprehensive definitions that cover the complete Dual Lens approach.

Looking ahead, the TEF will further expand, developing structured data and detailed definitions for:

- **Interventions:** clearly defined investments, policies, and technologies that shape enabling conditions for shifts.
- **Attributes:** measurable indicators that define system readiness and enabling conditions.
- This expansion includes structured data that explicitly populates the causal **Outcome Logic**, covering the relationships mapping causal pathways from Interventions through Attributes to Activity Shifts.

Notably, the TEF's taxonomy, ontology, and Outcome Logic have already been adopted in the DIN SPEC 91468 standard, validating the framework's robustness, practical applicability, and suitability for wider international standardization. The platform supports emissions reporting requirements such as the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) by following the same foundational principles of the IPCC Guidelines for National Greenhouse Gas Inventories, which underpin many reporting frameworks.

The TEF is fully open-source, ensuring transparency, scientific credibility, and equitable global access. This openness enables cities worldwide to collectively contribute, refine, and expand this structured knowledge base, accelerating global learning and systematic improvement.

The TEF's transparent taxonomy, rigorous ontology, and open structured data also provide a strong foundation for emerging AI-driven approaches to transition planning. As more cities contribute to and adopt this shared structure, the TEF facilitates machine-readable learning across geographies, fueling new tools to recommend interventions, identify patterns, and support decision-making with explainable logic rooted in a shared system understanding.

Distinct from the publicly accessible TEF, the ClimateView platform computationally operationalizes these structured definitions through dynamic modeling, scenario analysis, and leading indicator tracking toward actionable, credible, local transition pathways. The TEF systematically encodes the clarity defined by the Dual Lens into stable, openly accessible knowledge. The TEF's structured openness accelerates credible transition planning, sequencing, readiness monitoring, and global collaboration, enabling cities everywhere to rapidly translate clarity into collaborative, investable, and impactful climate action.

What is Tempo?

Transitions are, by nature, long-term. However, to deliver them, cities need short-term clarity. That is where tempo comes in.

Tempo refers to the annualised pace of change needed to achieve a structural shift by a target year. It translates system demands into year-by-year expectations, turning a complex model into practical guidance for delivery.

For example:

- A shift from gas boilers to electric heat pumps may require 2,000 installations annually.
- A 30% modal shift to active travel may mean 1,250 new cyclists each year.
- Retrofitting 15,000 buildings by 2035 requires ~1,000 retrofits annually.

This approach allows cities to:

- Align internal planning cycles with long-term strategy
- Communicate expectations in human-scale terms.
- Prepare delivery actors for what must be done and when

Tempo makes system demands tangible, not just in total, but in time.

In Part III, we return to tempo as a tool for modeling and tracking, providing a dynamic signal of whether the system is changing at the required pace.

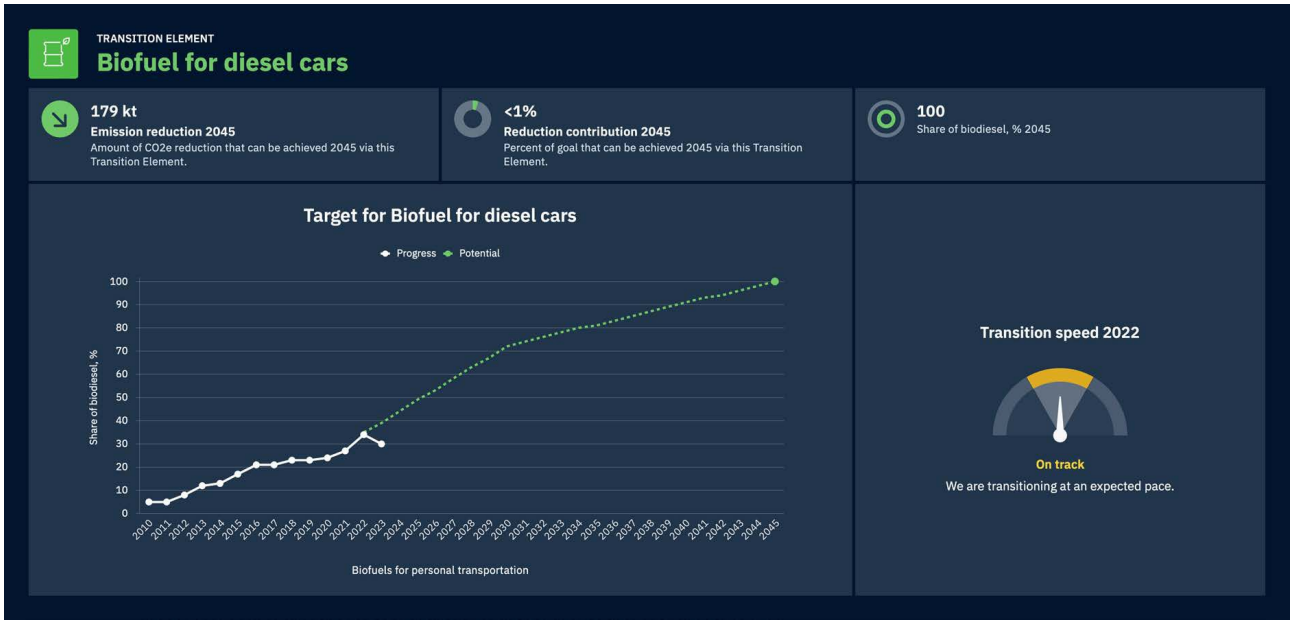

Figure 9: Visualization of “Tempo”

From outcomes to sustainability: Applying Planetary Boundaries to urban transitions

Systems thinking encourages cities not only to plan interventions and model outcomes but also to pose a deeper question: Are these outcomes sustainable in the long run? To answer this, we need a method to evaluate whether the outputs of a city's transition strategy remain within the Earth's ecological limits.

This is where the concept of planetary boundaries becomes useful. Introduced by Rockström et al. (2009) and refined by Steffen et al. (2015), planetary boundaries define a safe operating space for humanity by identifying key Earth system thresholds that must not be crossed, such as climate change, biodiversity loss, and biogeochemical flows. Although global in nature, these boundaries can be translated into local decision-making through a systems-oriented planning approach (Bai et al. 2024).

The urban metabolism logic embedded in ClimateView's Transition Element Framework (TEF) provides a valuable entry point. Each shift modeled in the TEF reflects a change in how societal needs (such as heating, mobility, or housing) are met, along with the related resource demands, including energy, materials, labor, and capital. When cities simulate their transitions over time using the TEF, they measure progress toward emissions or equity goals and create a structured view of resource usage.

This way, TEF-based planning can evaluate whether a city's chosen pathway is compatible with planetary boundaries or other sustainability thresholds. For instance, a city could model the material demands of housing retrofits or the land use impacts of expanded transit networks and assess whether cumulative effects align with circular economy goals, a localized carbon budget, or a city-level translation of planetary boundaries.

The value of this approach lies in separating the planning framework from the normative goal. The framework does not prescribe a singular vision of sustainability. Instead, it gives cities the structure to define their goals and assess whether their intervention pathways will achieve them within acceptable environmental limits.

By bridging systems thinking with outcome logic and resource modeling, this approach enables a new form of climate governance where local interventions are guided by global responsibility and cities can plan transitions that are fundable, feasible, and sustainable in a more profound, planetary sense.

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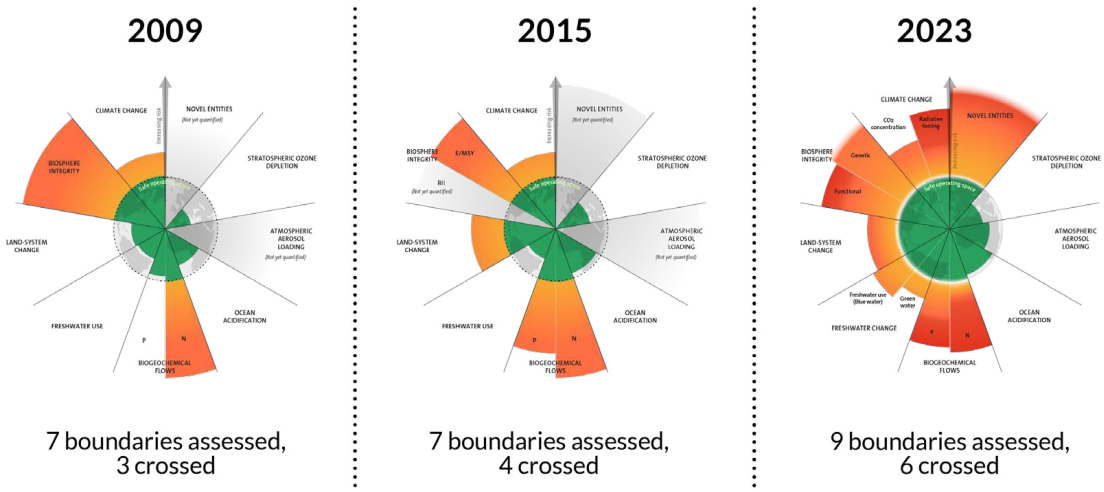

Figure 11: Planetary Boundaries over time (Azote for Stockholm Resilience Centre, based on analysis in Richardson et al. 2023)

What makes a good intervention

Designing interventions for climate transitions is not just selecting from a list. It is a structured design process rooted in system logic, responsive to local conditions, and transparent about the mechanism of change. In this sense, a "good" intervention is targeted, enabling, deliverable, and measurable.

In the Transition Elements Framework context, an intervention is defined as the action, policy, or project required to close the gap between current conditions and a desired system shift. For example, if a city seeks to shift from fossil fuel heating to district energy, a relevant intervention might be: "*Review and designate heat network zones*."

At the heart of this design process is a practical framework adopted by the Scottish Climate Intelligence Service (SCIS), which helps local governments systematically define and assess interventions across seven dimensions:

1. **What?** A clear description of the intervention, typically beginning with an active verb (e.g., install, retrofit, regulate) and defining how we know when we have delivered it successfully.
2. **Why?** The system attribute is being changed, and the shift is being targeted. This often has to be rigorously challenged and refined to enable interventions.
3. **How?** The mechanism by which the intervention will bring about change.
4. **Where?** The spatial scope of the intervention: a location, infrastructure type, or geographic area.
5. **When?** Timing of the intervention: start date, completion, and expected onset of impact.
6. **Who?** The lead delivery organisation, partners, and key stakeholders involved.
7. **How much?** The scale and cost of the intervention, including both volume and estimated expenditure.

This structured approach is helpful for local coordination and aligns closely with academic literature on effective intervention design in sustainability transitions. Studies by Rogge & Reichardt (2016), Howlett et al. (2015), and Köhler et al. (2019) emphasise the importance of clear causal logic, institutional feasibility, and the ability to monitor and evaluate outcomes over time.

Promising interventions also share a few cross-cutting characteristics:

- They enable unlocking one or more constraints identified in the System Demand Profile (e.g., skills shortages, capital access, regulatory inertia).
- They are sequenced and positioned appropriately within a delivery timeline to prepare the system for subsequent shifts.
- They are context-specific, reflecting local values, capacities, and readiness, rather than one-size-fits-all solutions.
- They are governable with clear ownership, financing strategy, and pathways for coordination across government levels and sectors.

In Scotland, these principles are being applied systematically. In a recent workshop hosted by SCIS, 60 officers from 29 councils engaged in identifying what makes an intervention not only well-designed but deliverable. The workshop underscored the importance of grounding ambition in operational detail — the bridge between strategy and real-world implementation.

As funders increasingly assess proposals based not just on projected impact but on the plausibility of delivery, intervention quality is becoming a defining feature of credibility. Good interventions do not just describe what needs to be done. They show how, by whom, when, and at what cost, and do so in ways that reflect both the logic of the system and the lived realities of delivery.

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Financing the transition: Matching systemic ambition with finance mechanisms

Implementing systemic transitions at the city scale demands more than a well-structured strategy and well defined projects and goals. It also requires a corresponding financial architecture. However, most existing finance mechanisms were not designed to support bundles of interdependent interventions, much less transitions that span across silos and unfold over decades.

The climate transition demands integrated, long-term investment portfolios, but funding flows often remain fragmented, short-term, and risk-averse. As a result, cities often face challenges translating systemic plans into financeable projects (Noels et al., 2024), even though there are some exceptions like the City of Gothenburg, which has been very successful with its green bond program. Cities can articulate what must change, but often struggle to package that into financeable, credible propositions that resonate with funders and financiers due to the extensive workload of calculating the outcomes of such projects.

Traditional climate finance, particularly from multilateral development banks or green funds, tends to prioritize discrete, easily isolated projects with predictable outcomes (OECD, 2018). However, effective urban transitions often require bundles of enabling and direct interventions: investments in housing retrofits, grid upgrades, and active mobility infrastructure may only deliver impact when implemented together and sequenced over time. ClimateView's Intervention Lens helps cities make these interdependencies visible and actionable, but financing them requires new structures.

"Effective urban transitions often require bundles of enabling and direct interventions: investments in housing retrofits, grid upgrades, and active mobility infrastructure may only deliver impact when implemented together and sequenced over time"

Emerging mechanisms that better align with system delivery include:

- **Programmatic and portfolio-based approaches**
  Instruments like ICLEI's Transformative Actions Program (TAP)[1] and the Green Climate Fund's Simplified Approval Process (SAP)[2] promote funding for aggregated interventions aligned with long-term transition plans. These provide cities the flexibility to combine direct and enabling interventions into fundable portfolios over time.
- **Blended finance and first-loss instruments**
  Blended finance, where concessional public or philanthropic capital reduces the risk for private investors, can help bridge the gap for enabling or early-phase interventions. First-loss capital, in particular, allows cities to attract investment for riskier yet systemically essential projects (Bhattacharya et al., 2022).
- **Transition and sustainability-linked bonds**
  Beyond green bonds for asset-based projects, newer instruments link bond terms to performance metrics. This approach enables cities to finance their transition in a comprehensive manner while showcasing their commitment to measurable outcomes. These methods may align with ClimateView's Tempo and Transition Pulse to establish triggers for improved financing terms.
- **Subnational pooled finance**
  Particularly relevant for smaller or less creditworthy municipalities, pooled financing mechanisms enable cities to combine their borrowing capacity, reduce transaction costs, and access capital markets, often through municipal development funds or national financing facilities (World Bank, 2021).

1 https://iclei.org/tap/
2 https://www.greenclimate.fund/projects/sap

Understanding the complex mix of non-repayable funding, repayable financing, and return-seeking investment, commonly referred to as a capital stack, is essential. Systemic transitions require cities to go beyond a grant-seeking mindset and develop investment-grade strategies that effectively blend these various forms of capital.

Credible transition strategies must align system logic with financing logic. By stress-testing interventions, sequencing delivery, and tracking readiness (e.g., workforce capacity, permitting efficiency), cities can structure proposals that not only address *what* needs to be done but also explain *how* it can be financed and *why* it's investable.

Ultimately, platforms like ClimateView do not replace financial expertise but bridge the translation gap by making systemic ambition clear to investors and investment constraints apparent to planners. By structuring interventions with defined demands, timelines, and enabling conditions, the ClimateView platform assists cities in developing investment-grade strategies that resonate with both public and private funders.

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Tempo: Linking shifts to tracking

Defining a transition's tempo is just the beginning. The critical question is whether the system is *keeping pace*.

In Part I, tempo was introduced to express system demands over time. In practice, it becomes a tracking benchmark — a signal of system activation or lack thereof.

When paired with the Transition Pulse, tempo allows cities to compare observed progress with modeled expectations. For example:

- Are heat pump installations meeting the annual target?
- Are cycling rates rising fast enough to support the modal shift?
- Is installer training scaling at the required pace?

By monitoring tempo in real time, cities can:

- Detect bottlenecks before they escalate
- Build delivery confidence with funders and stakeholders.
- Adapt strategies without losing sight of the bigger goal.

Tempo connects the model to momentum, illustrating what needs to happen and whether it is occurring quickly enough. However, in practice, many transition plans lack a clear expression of tempo. When targets are defined solely by end states, we often revert to a simplistic linear interpretation of progress. Yet, most systemic transitions (particularly those involving new technologies or behaviors) follow nonlinear patterns that frequently resemble an S-curve. Understanding the distinction between implied and actual tempo is essential: it facilitates more accurate planning, supports the necessity for early ramp-up interventions, and helps sustain investor and public confidence by aligning expectations with the probable dynamics of adoption and scale-up.

Shift	Annual Target (Tempo)	What to Track
Heat pump deployment	2,000 installs/year	Permit applications, subsidy disbursements, and municipal program uptake
Modal shift to cycling	+% of trips completed by bicycle/year	New km of bike lanes completed, bike share usage, and cyclist counts
Home retrofits	1,000 homes/year	Building retrofit permits issued, local program participation rates