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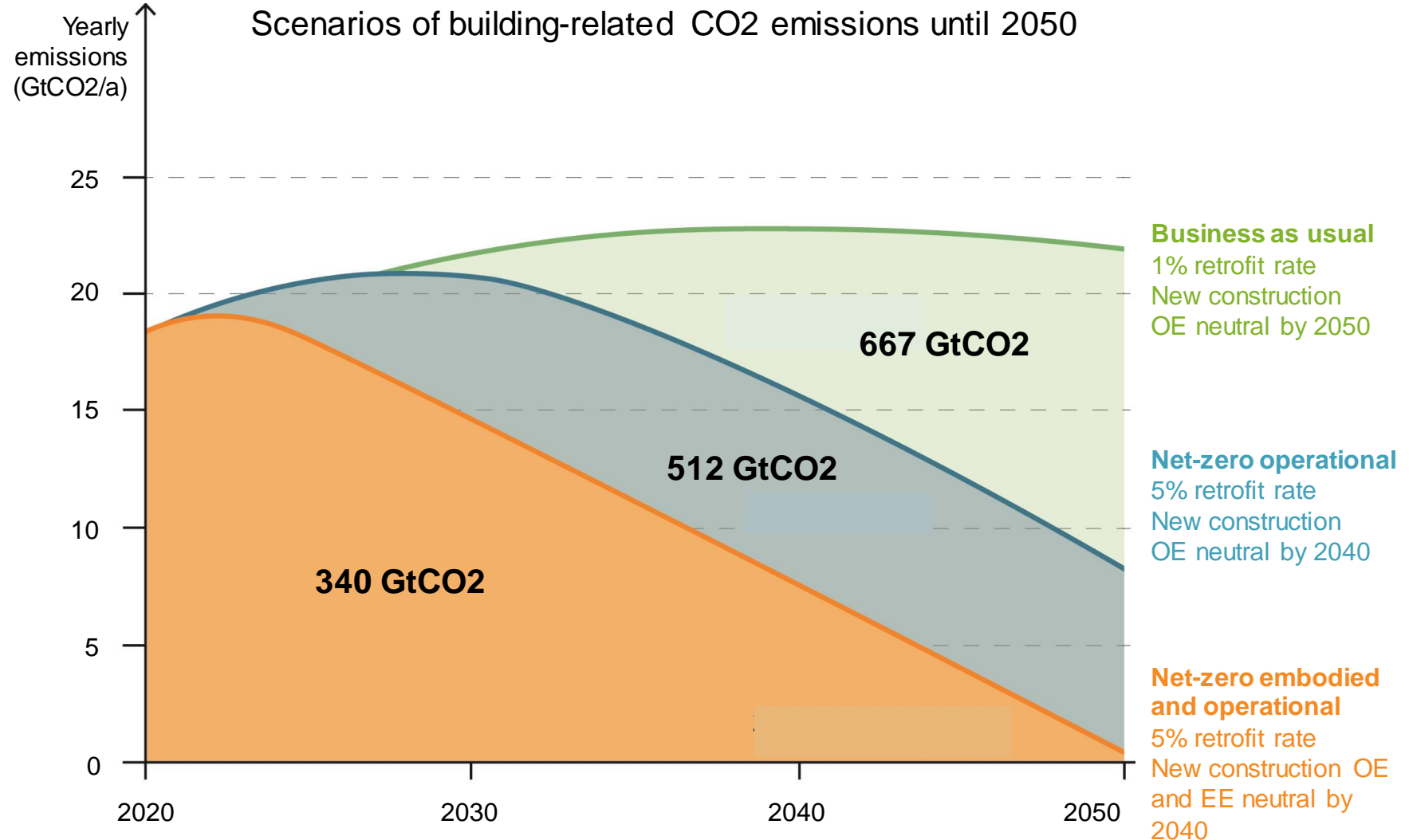
Building capacity for mass deep energy retrofit in Quebec: A systems perspective

PhiusCon 2023

Michael Jemtrud, Thomas King

The decarbonization challenge

- We have **30 years** and **300 GtCO₂** left to make the global building stock carbon neutral.
- More than **80%** of buildings that will be in use in 2050 are already built.

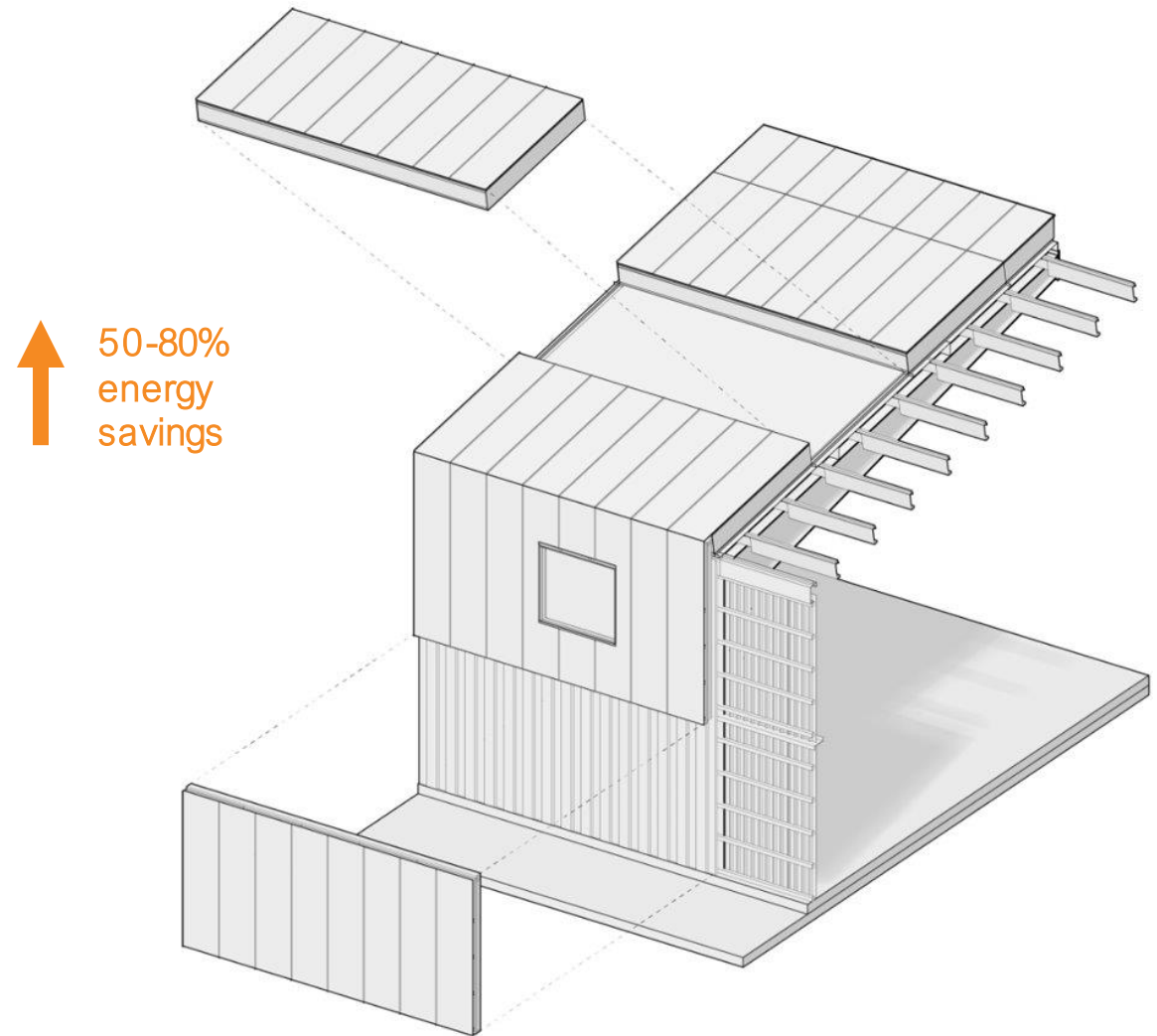


Presentation Outline

1. Introduction
2. Sociotechnical analysis of the deep retrofit market
 - a. Key concepts for system change
 - b. Market development challenges and opportunities
 - c. Quebec's sociotechnical context
3. Strategies for market development
 - a. Creating niches through pilot projects and pipelines
 - b. Transforming the DER workflow: value-case to turn-key
 - c. Canadian Deep Retrofit Accelerator Network

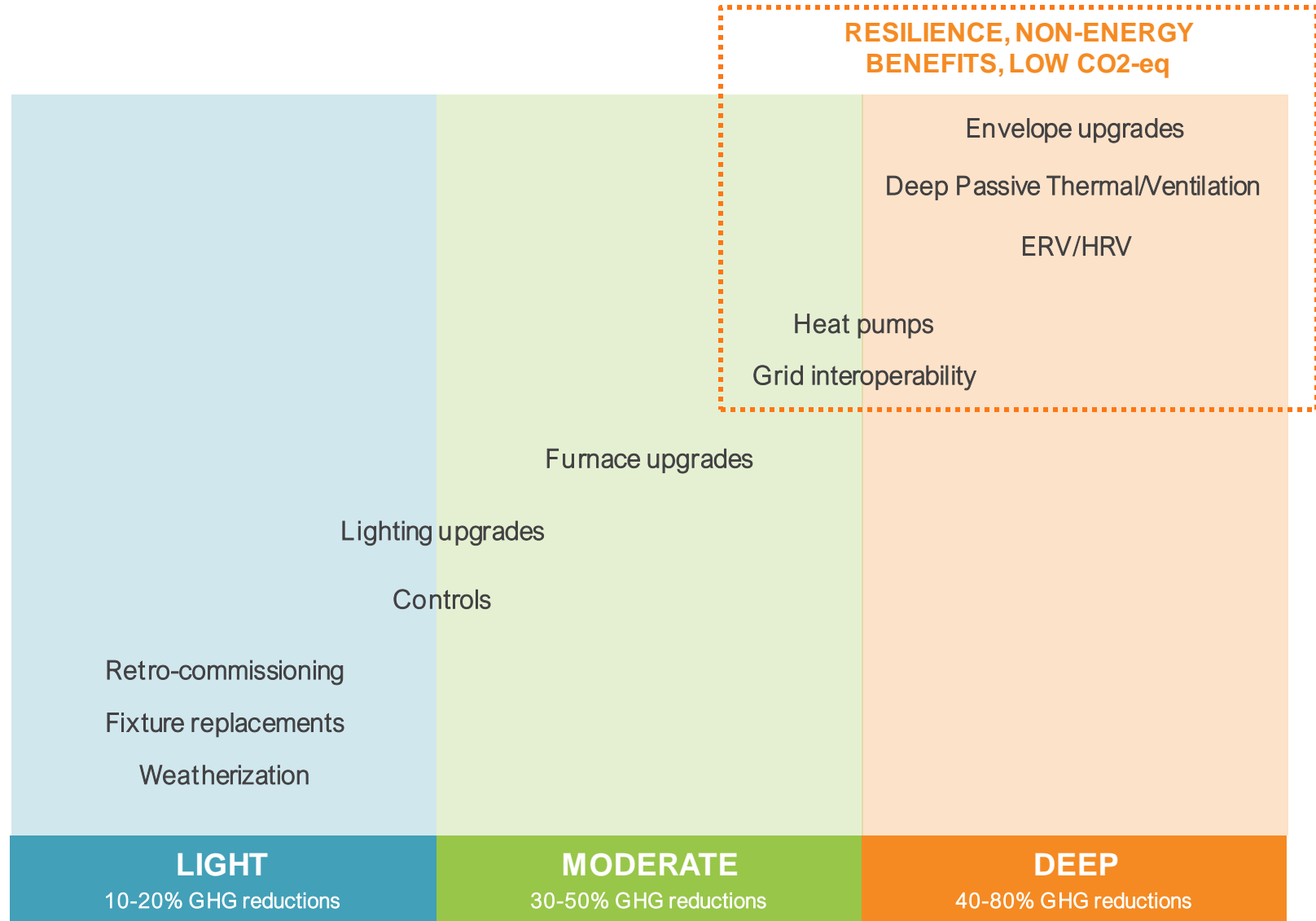
What are deep energy retrofits (DERs)?

- Significant airtightness, thermal performance, and HVAC upgrades.
- **Up to 80%** operational energy reductions.
- **Prefab panelized** exterior envelope solutions (over-cladding solution).



What are deep energy retrofits (DERs)?

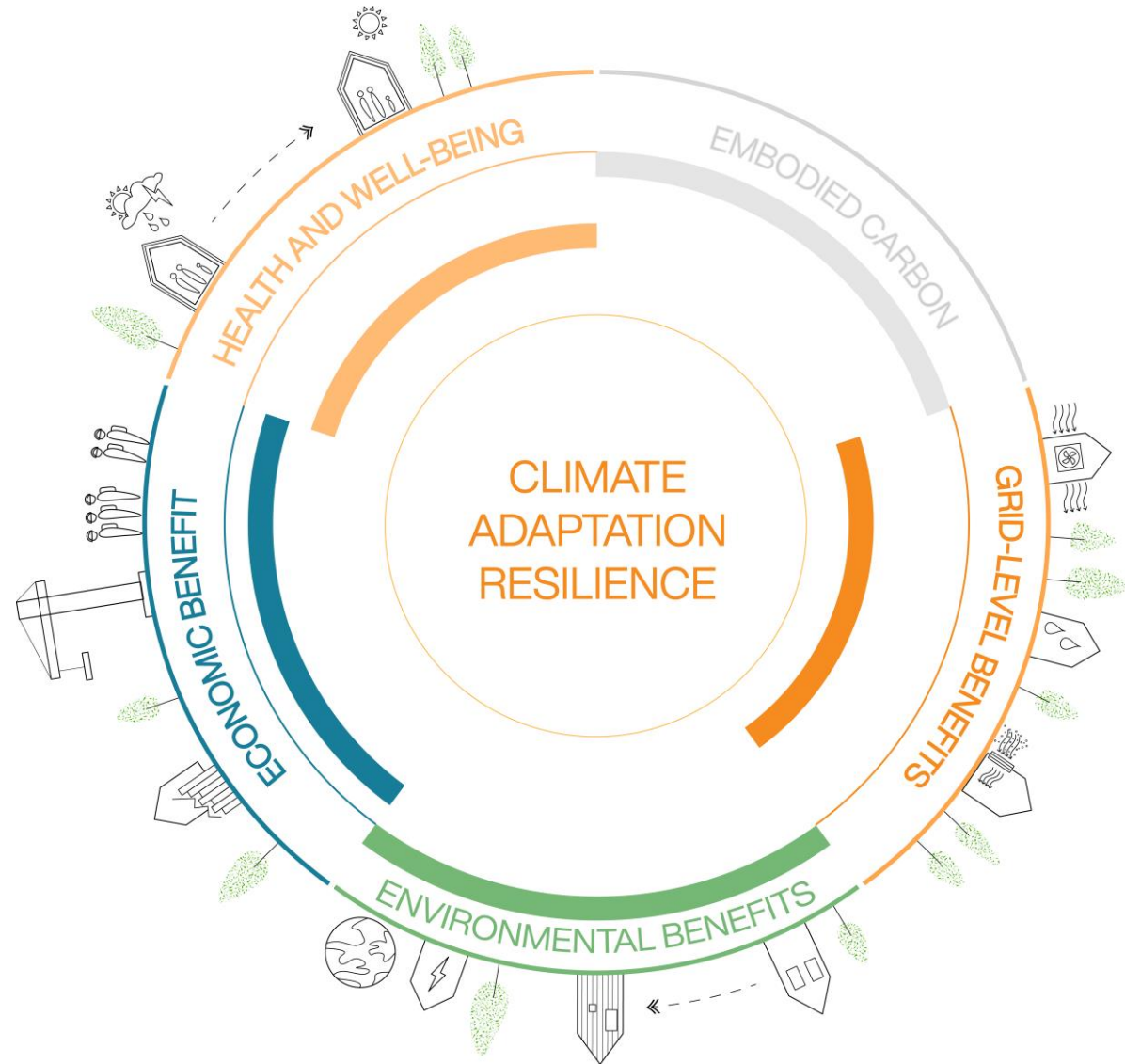
- Moving beyond operational energy to account for **embodied carbon and climate resilience**.



1. Introduction

Benefits of deep energy retrofits

- Adaptation
- Resilience
- Building as Carbon sinks
- Indoor air quality (health)
- Comfort (productivity, well-being)
- Energy security/grid resilience
- Aesthetic upgrade (community pride)
- Affordable housing
- Job creation
- New supply chain opportunities



Market uptake is slow

- **Only 0.07%** of the US housing stock was retrofitted in 2018 with additional insulation.¹
- Need to increase rate to at least **2.5%** (IEA).²
- Recent studies have suggested **5.6%** retrofit rate to meet net-zero targets.³



**Current rate (US):
0.07%**

**Required rate:
Up to 5.6%**

Construction sector challenge

- Canada has more than 14.5 million residential/commercial buildings—**must retrofit 1 building every minute** by 2050.
- Productivity of the construction industry has increased by **only ~5%** in the last 20 years.

Challenges facing the decarbonization of the construction sector

1

Lacking tools, products, services, and capacity to address carbon impact of construction industry.

2

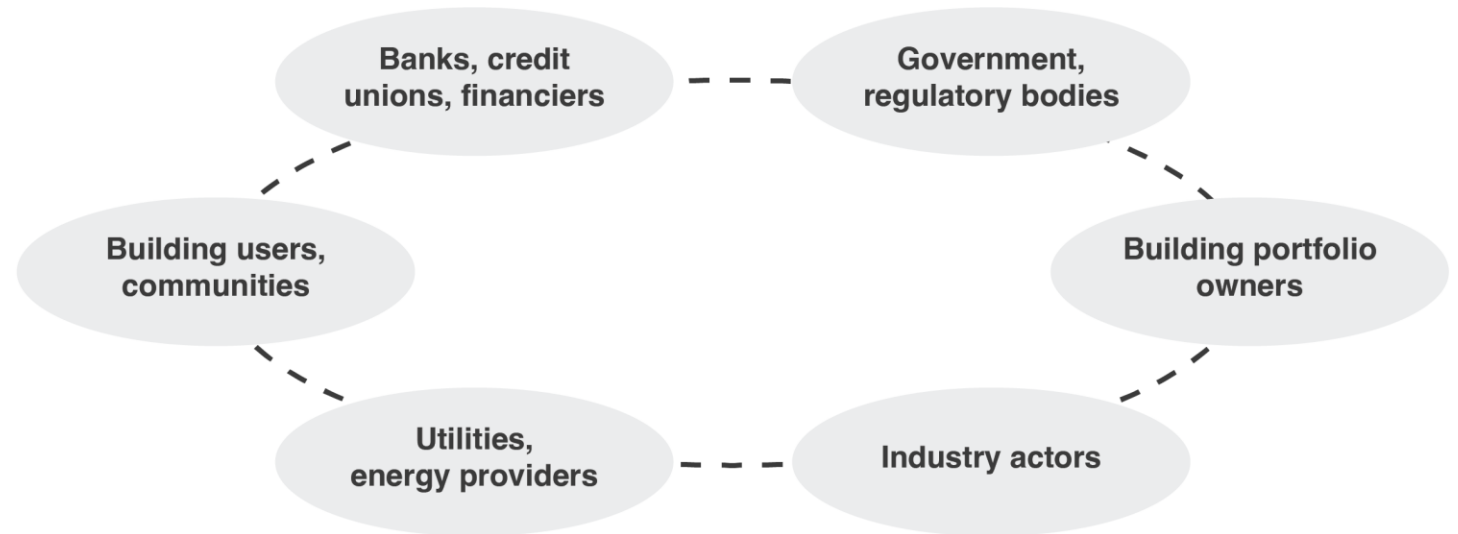
Not equipped to rapidly respond to need for mass retrofit, while reducing cost and time for new low-carbon construction.

3

Chronic low productivity, weak innovation, long construction times from inefficient practices, labor shortages, lack of automation.

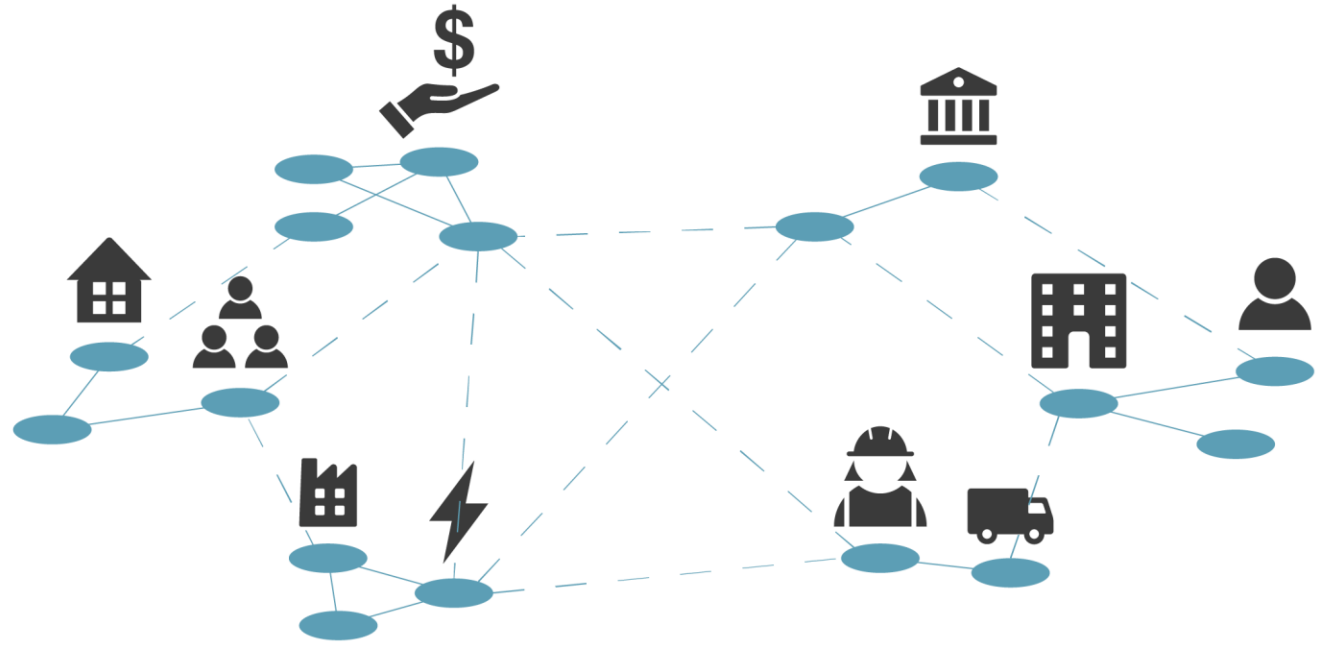
The need for system-wide transformation

- Scaling DER requires coordinating:
 - diffusion of existing technologies;
 - coordinating systemic innovations and cross-sectoral inputs;
 - **mobilizing key stakeholders.**
- Goal is to **build capacity** for mass DER implementation.



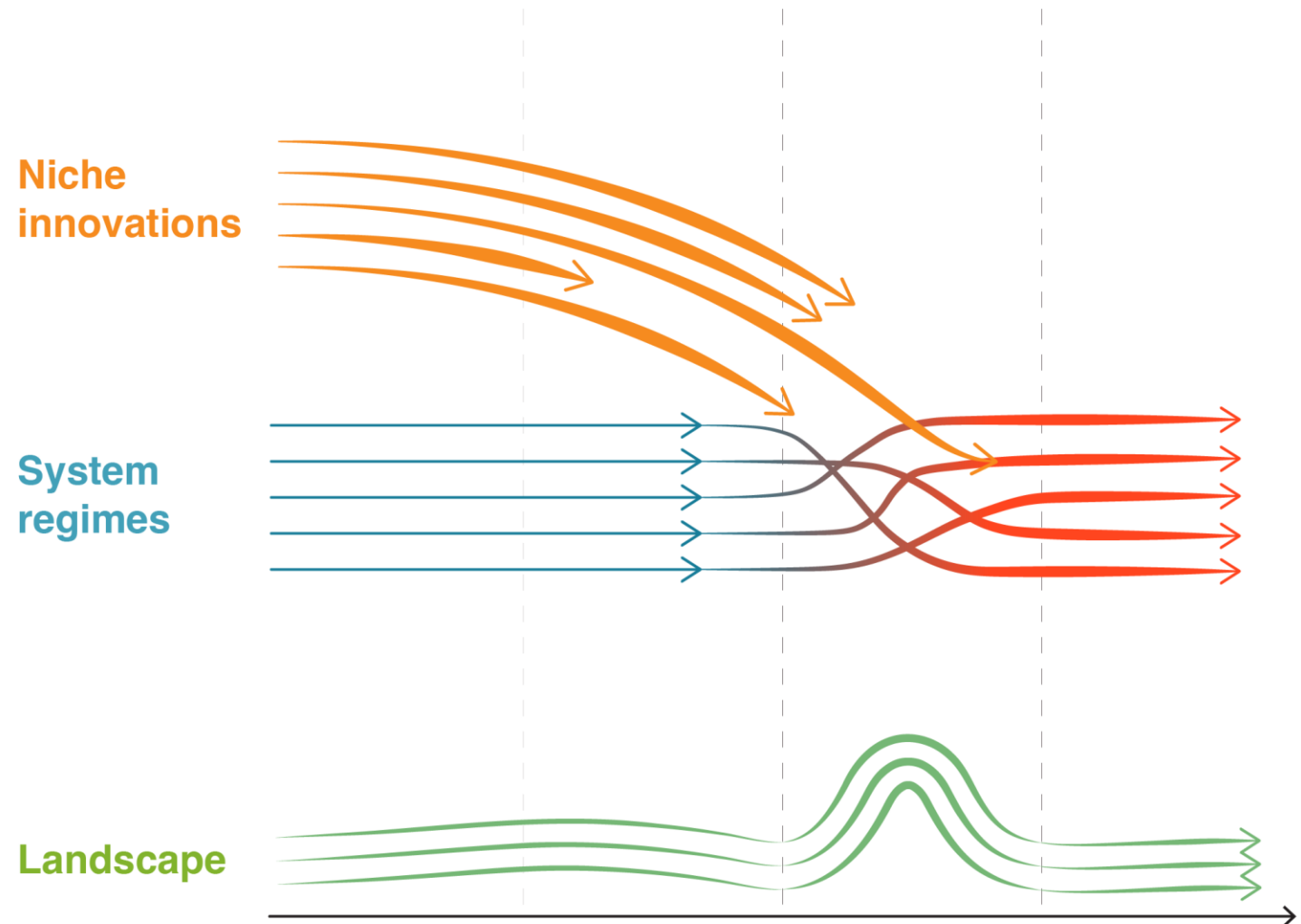
Understanding system change

- Literature on sustainability transitions provides theoretical frameworks for addressing **sociotechnical systems**.
- ‘Sociotechnical’ implies that technology developments are entangled with social structures and norms.



The 'multi-level perspective'

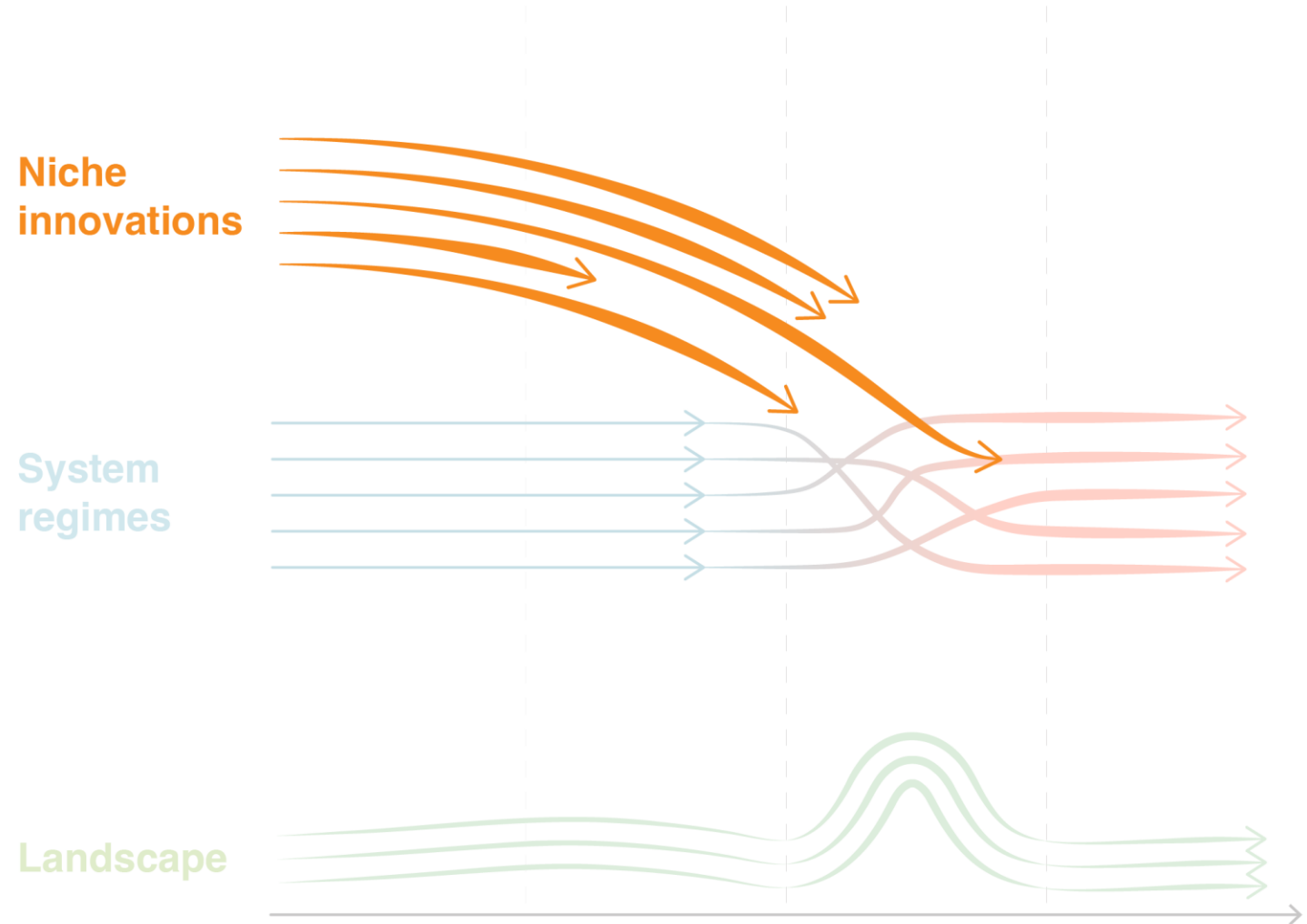
- Depicts sustainable transitions through three levels:
 - Niches
 - Regimes
 - Landscape
- MLP's primary stance is that transitions occur through the **strategic alignment** of processes across these three levels.



2. Sociotechnical Analysis

Niches

- Spaces where new technologies emerge and develop that **can replace established practices.**
- Sociotechnical transitions gain momentum **when multiple innovations are linked together.**

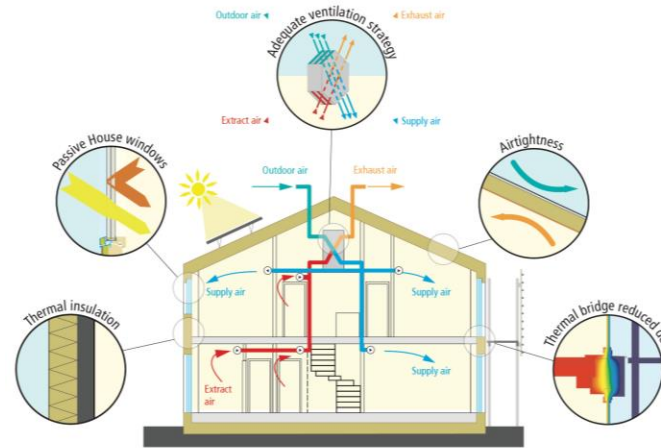


Examples of niche innovations

- For DER, niche innovations can include novel processes, tools, workflows, technical solutions, financing mechanisms, legislation and business models.



Products, technologies
Wood fiber insulation¹



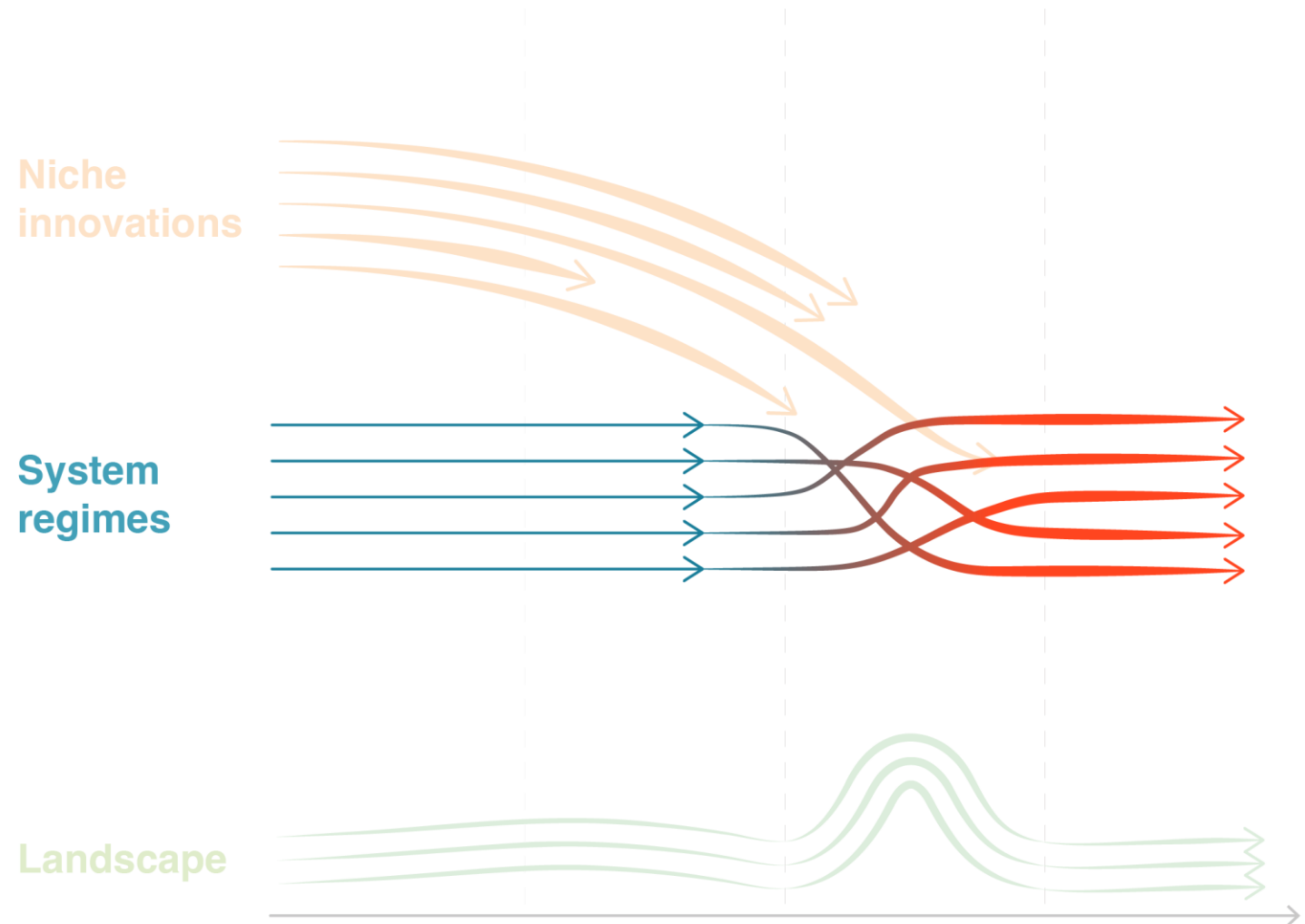
Practices, processes
Passive House design principles²



Tools, mechanisms, workflows
Laser scanning³

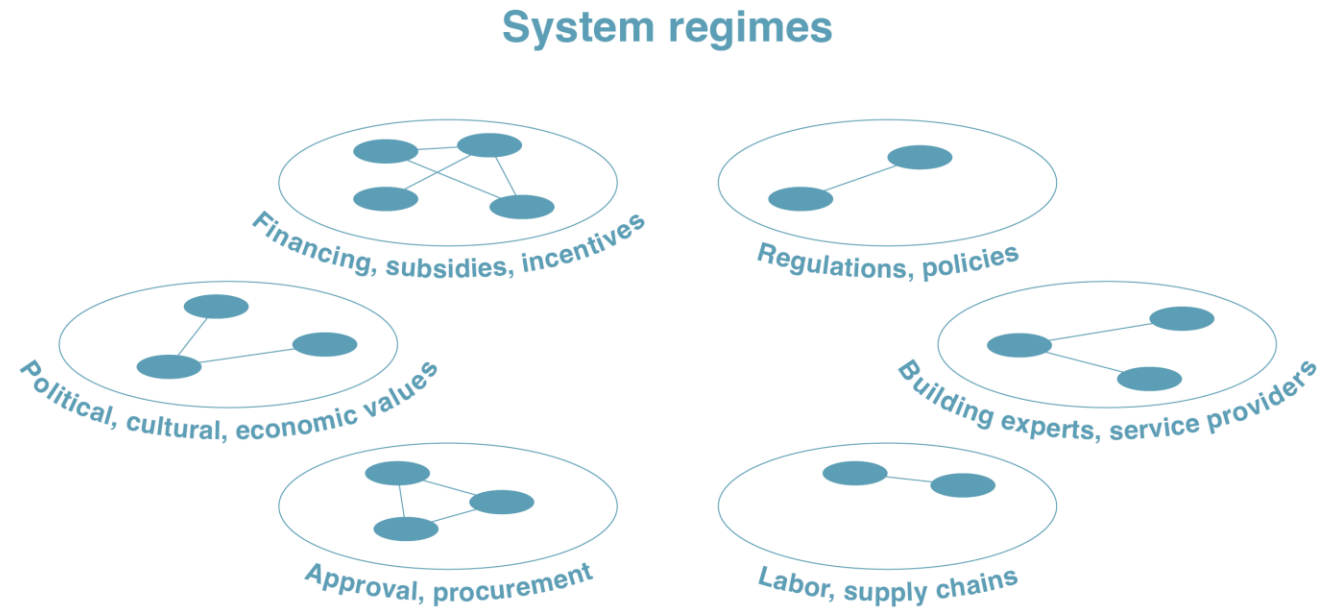
Regimes

- Regimes refer to the dominant systems and actors at play that are stabilized in networks and **often resist change.**



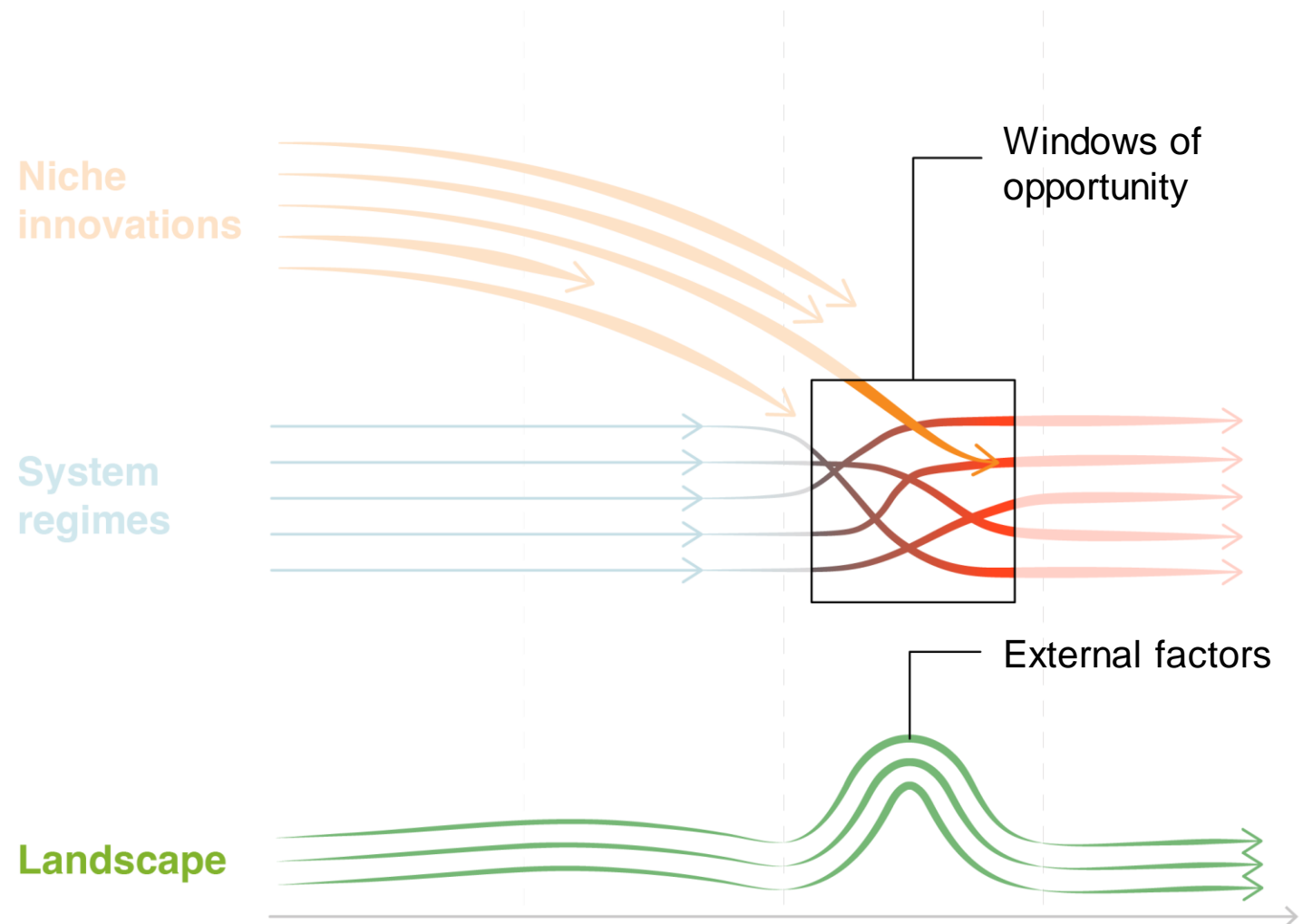
Regimes

- For DER, regimes can include regulations and policies, building experts and service providers, labor and supply chains, market practices, financing, and political, cultural, and economic values.



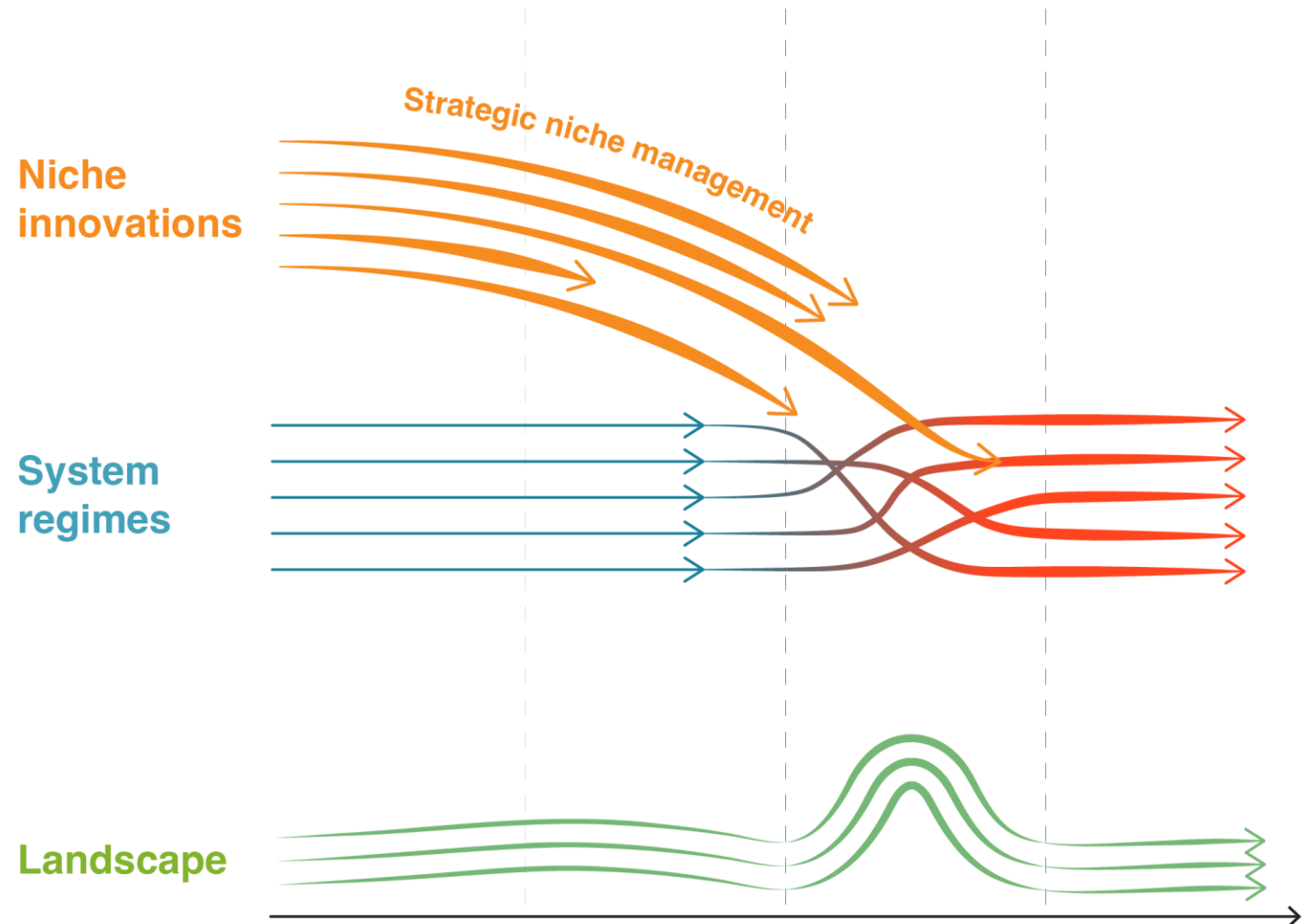
Landscape

- Landscape represents the **broader context** in which niches emerge and regimes adapt.
- Includes societal values, cultural norms, market conditions, policy frameworks, and global trends.
- Accelerating transitions involves increasing momentum of niche innovations, weakening existing systems, and strengthening exogenous pressures to create windows of opportunity.



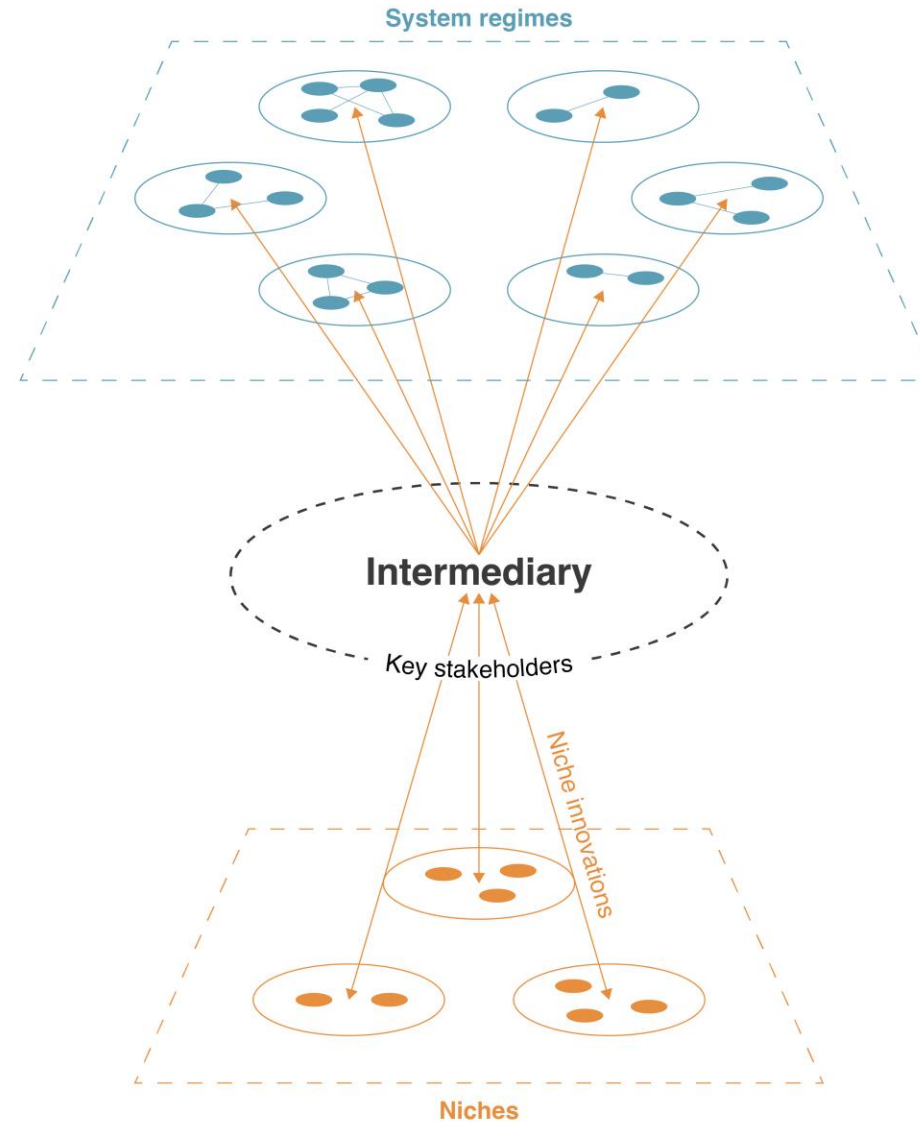
'Strategic niche management'

- Focuses on creating protective spaces to cultivate niche innovations through **real-life experiments**.
- Two stages:
 - Execution of projects in isolation.
 - Execution of progressive interrelated projects over time.



Intermediaries

- Actors who create spaces and opportunities for emerging technologies or systems.
- Broker niche innovations between across key stakeholders to alter system regimes.
- Public or private organization, or otherwise.



The 'Energiesprong' intermediary approach

- €45 million to address barriers to **capacity for mass DER** in the Netherlands.
- Implemented an innovative business model of net-zero energy performance contracts, integrated supply chains, and a singular customer interface.
- Market development team composed of key stakeholders across value chain.
- Highlighted need for **regional** market development teams.



Market development challenges

- Array of studies has been conducted to understand deep retrofit market development barriers in Canada.

- **Regulations and policies**
 - Risk-averse
 - Lack of market transformation initiatives
 - Zoning by-laws are restrictive
- **Labor and supply chains**
 - Shortage of skilled tradespeople
 - High labor costs
 - Information mismatch for products
- **Building experts and service providers**
 - Lack of coordination between individual firms and levels of government
 - Disconnect between retrofit industry and public
 - Insufficient data-collection and sharing
- **Approval, procurement**
 - Procurement and delivery process for public projects are restrictive
 - Trades are disjointed
- **Financing, subsidies, incentives**
 - High capital costs
 - High risk
 - Long return-on-investment periods
 - Disjointed financing programs
- **Political, cultural, economic values**
 - Unwillingness to outsource certification standards, manufacturing, labor, and materials from overseas
 - Reluctance due to a lack of predictability for a return-on-investment

Quebec's market opportunities

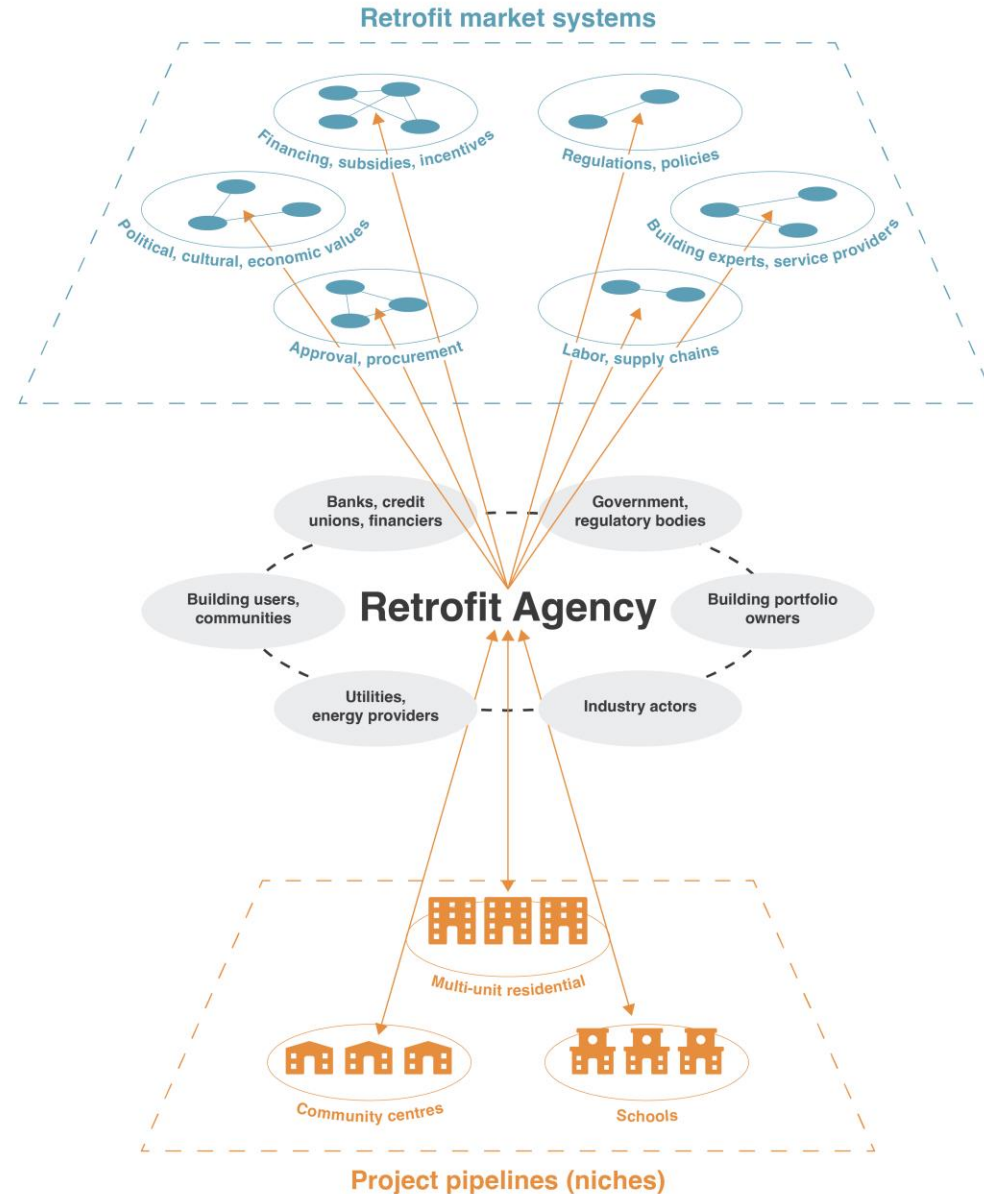
- Need for a **regional** market development strategy.
- Quebec provides an exemplary case study for mass DER.

- **Building stock**
 - Oldest building stock in Canada
 - Relatively low home ownership rates
 - Consistency of building type and construction across residential buildings, schools, and institutional facilities
 - Substantial amount of publicly owned social housing
- **Political, cultural, economic values**
 - Culture of cooperative management of civic assets and funds
 - Social solidarity economy among public and private enterprises
- **Energy providers and infrastructure**
 - Hydro-Québec, a crown corporation, operates the province's entire electricity production, transmission, and distribution systems, primarily powered by hydroelectricity (94%)
- **Labor and supply chains**
 - Low electricity costs
 - Incentive to reduce local demand as Hydro-Québec sells energy to other provinces and states at higher rates (net exports of 35.6 TWh in 2021)¹
 - High need for improved grid resilience, peak shaving, and load management
- **Labor and supply chains**
 - Mature prefabricated manufacturing industry, supply chain, and training infrastructure
 - Relationships between local manufacturers and social enterprises can be leveraged towards job creation and supply chain and factory development for retrofit solutions

3. Strategies for Market Development

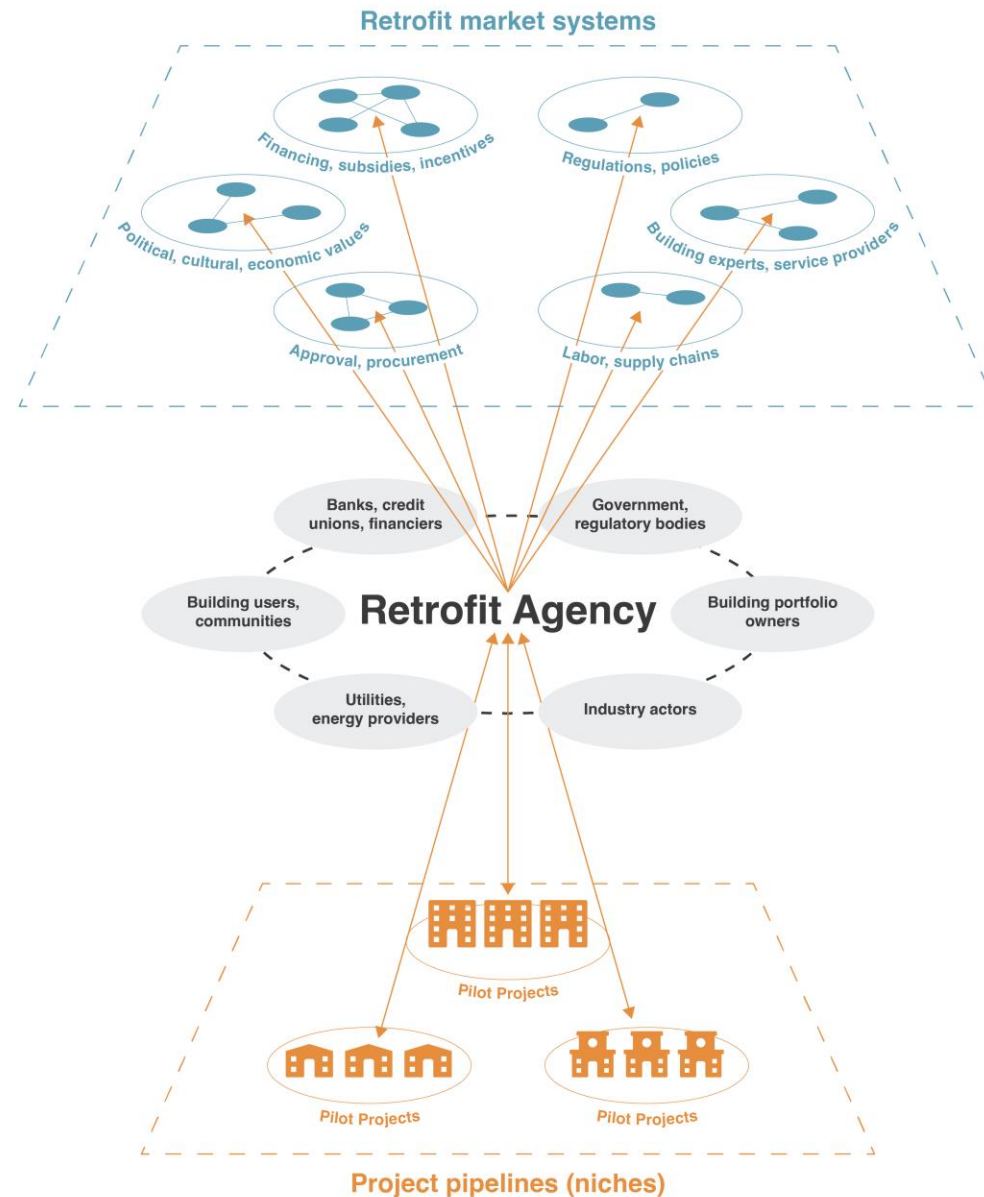
Quebec Climate and Resilience Retrofit Agency

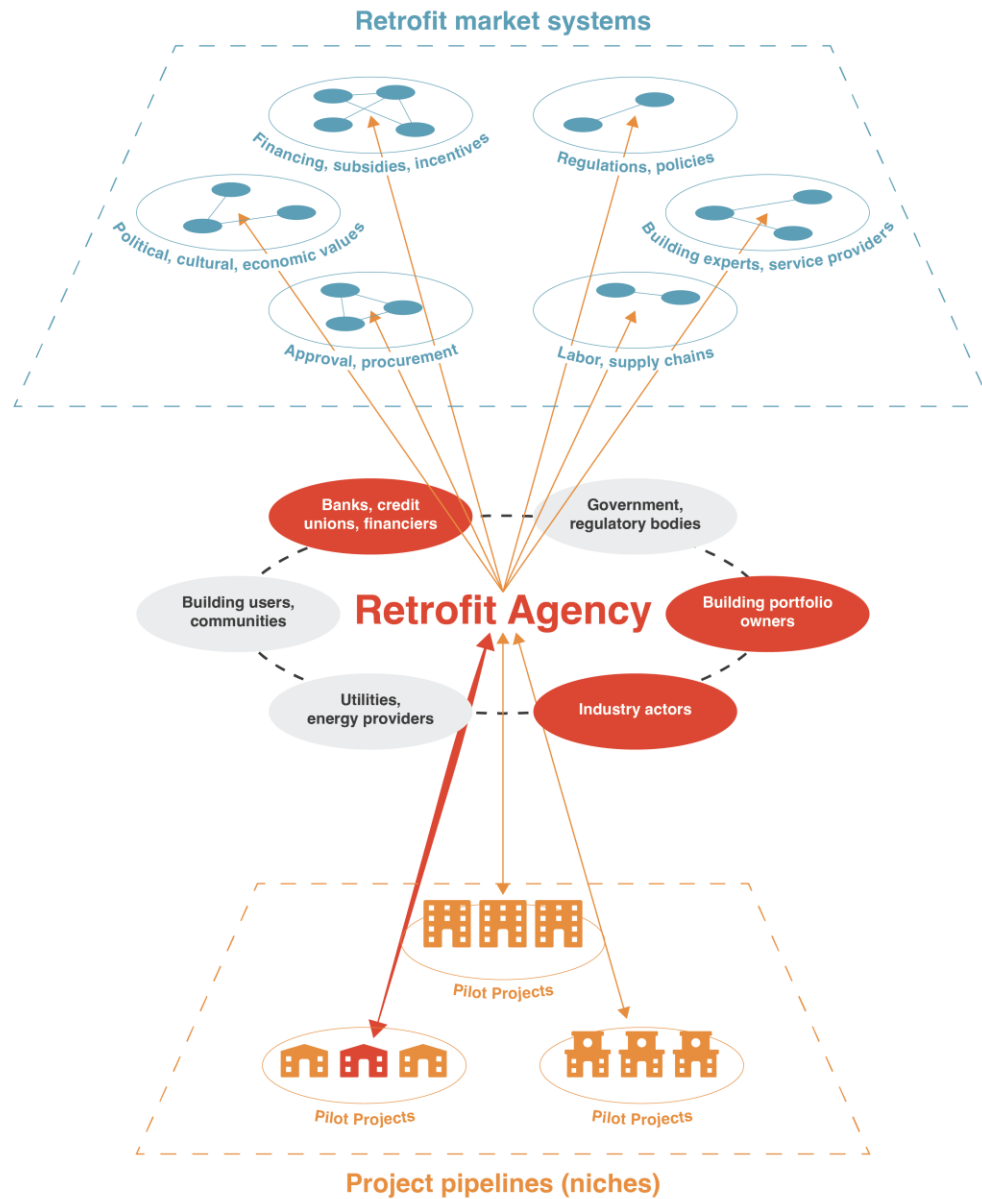
- Intermediary is critical to building mass retrofit capacity.
- Focuses on creating strategic niches.
- Aims to facilitate the implementation of novel DER processes and products within niches.

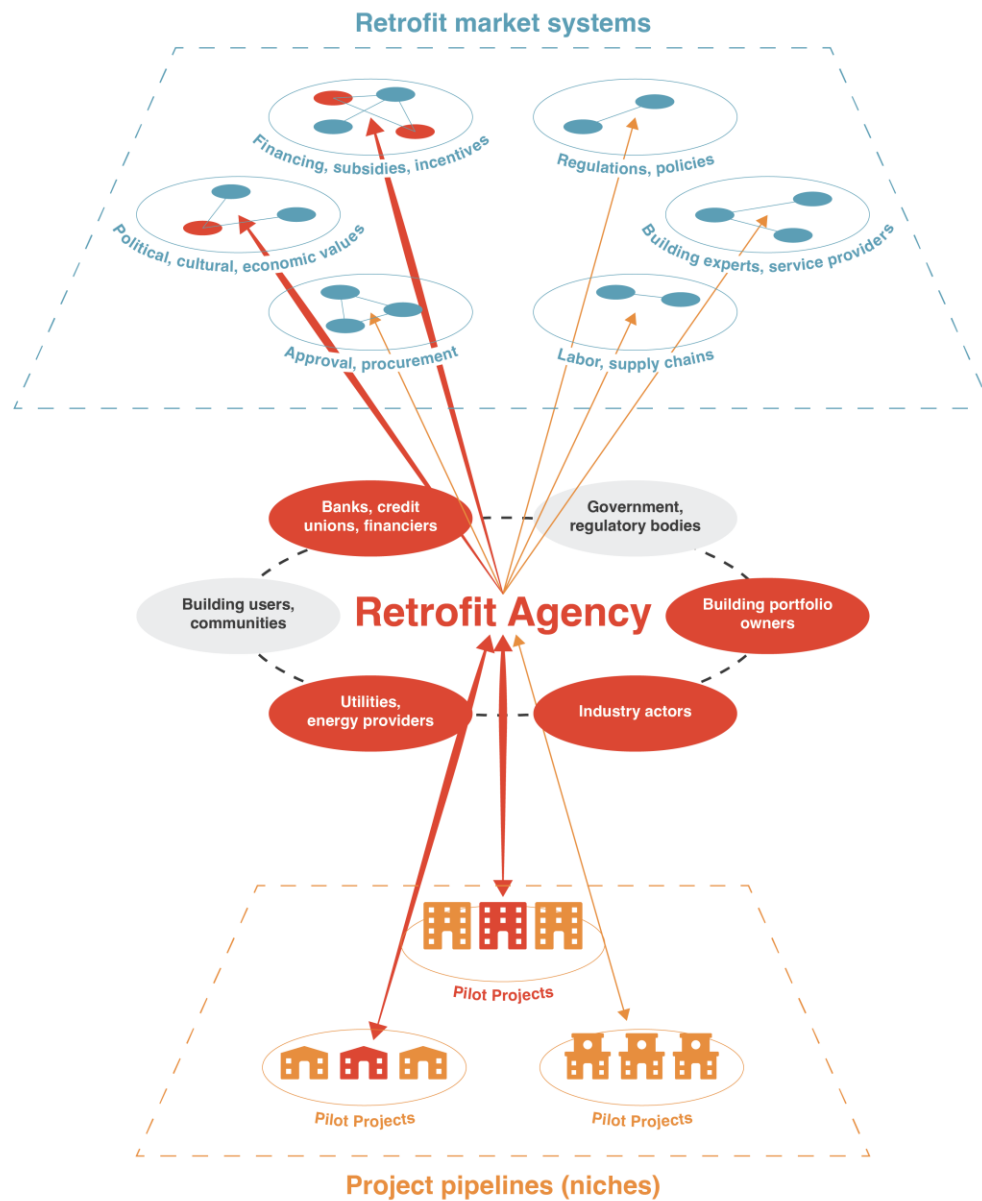


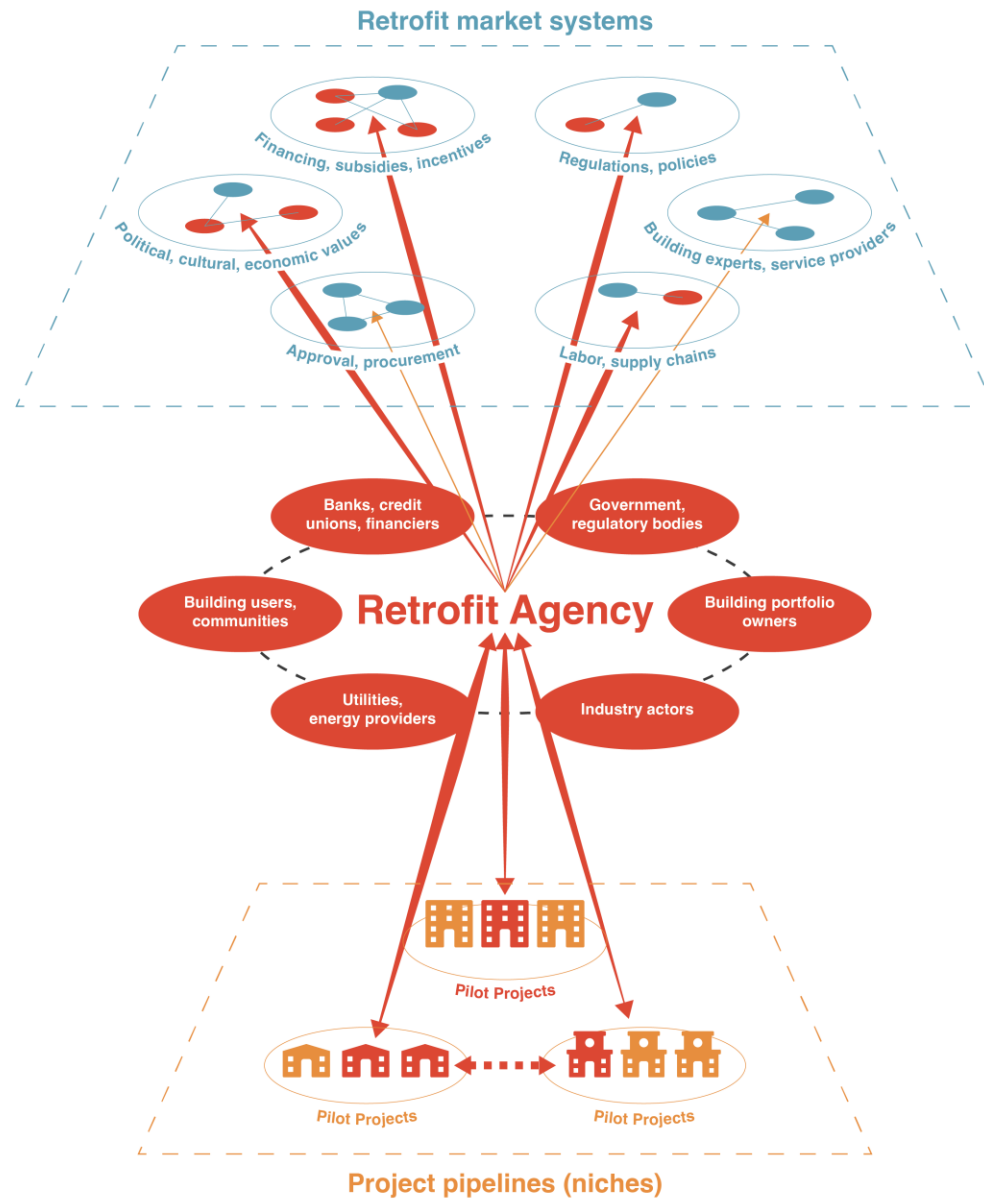
3. Strategies for Market Development

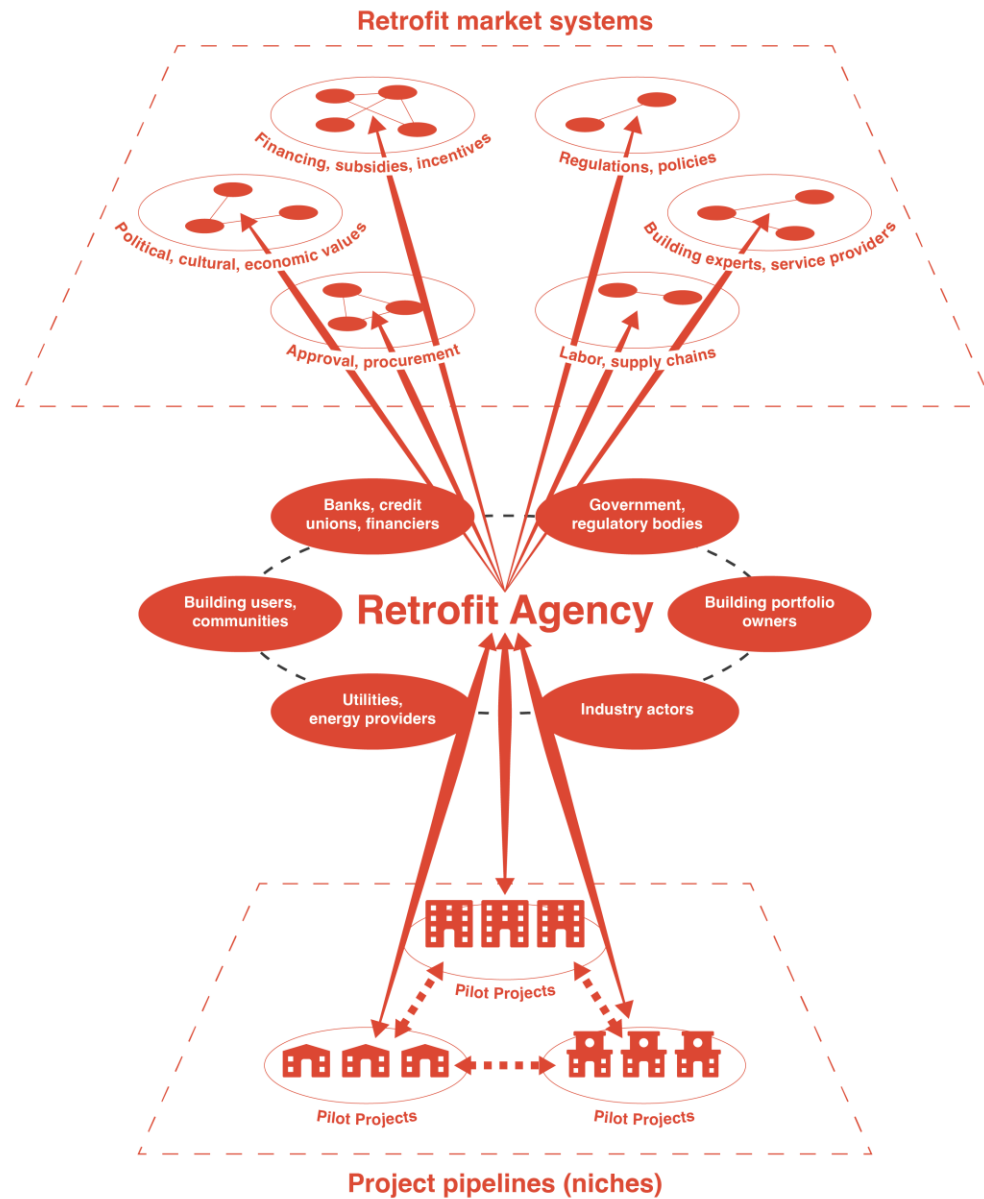
Creating niches through strategic pilot projects—pipelines









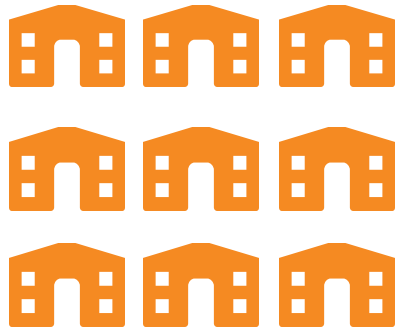


Creating niches through strategic pilot projects—pipelines

- **Proactive mandate** to facilitate pilot projects and create pipelines of projects of high societal value and environmental impact that expedite innovation and build capacity.

Strategic criteria for pilot/pipeline selection

- 1** **Structural and tectonic consistency**
conducive for repeatable over-cladding solutions
- 2** **Substantial volume**
of buildings across the province to establish a pipeline
- 3** Ripe vintage and type for high number of **“anyways” renovation** scenarios
- 4** Societal and **public sector importance**
- 5** Stable **public sector investment** opportunities



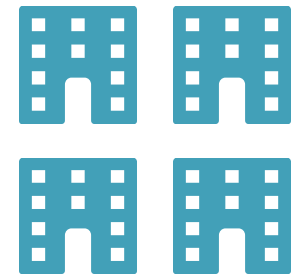
900
COMMUNITY CENTERS

Prefabricated steel superstructures



300
PRIMARY AND SECONDARY
SCHOOLS

Masonry superstructures



400
SOCIAL HOUSING MULTI-UNIT
RESIDENTIAL BUILDINGS

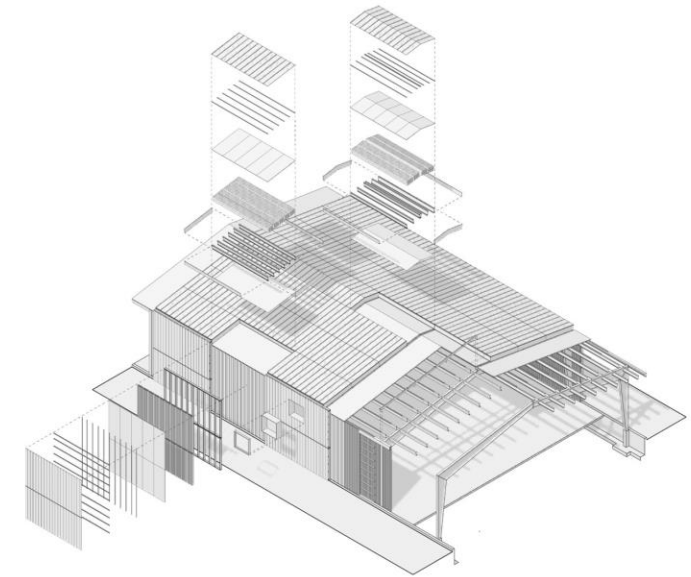
Light-framed and masonry
superstructures

3. Strategies for Market Development

Pilot Project #1

Île-Bizard Community Centre

- Prefab steel “Butler barn”-style buildings exist in the thousands across Québec and Canada
- High social, cultural, community value
- Important for building adaptive capacity (emergency shelter in face of climate and other disasters)
- Major building deficiencies, in need of renovation “anyways”



2022



1. Building study
2. Project approval by the Île-Bizard City Council

2023



1. Project Financing
2. Public consultation, occupant wellbeing studies
3. Feasibility and technical studies, life cycle analysis
4. Launch of call for tenders

2024




Project Realisation

The normative retrofit workflow

- Programs such as **Renoclimat** in Quebec and **Greener Affordable Housing** aim to simplify and subsidize the retrofit process by providing energy efficiency evaluations and recommendations for renovation measures.
- Renoclimat's funding structures typically promote **piecemeal retrofits of shallow to medium ECMs**.

Rénoclimat



Choose energy efficiency and renovate your home with assistance from the Rénoclimat program.

Is your heating bill too high? Are your floors cold and do you feel drafts? Rénoclimat can guide you in your home renovation projects to improve your home's energy performance.

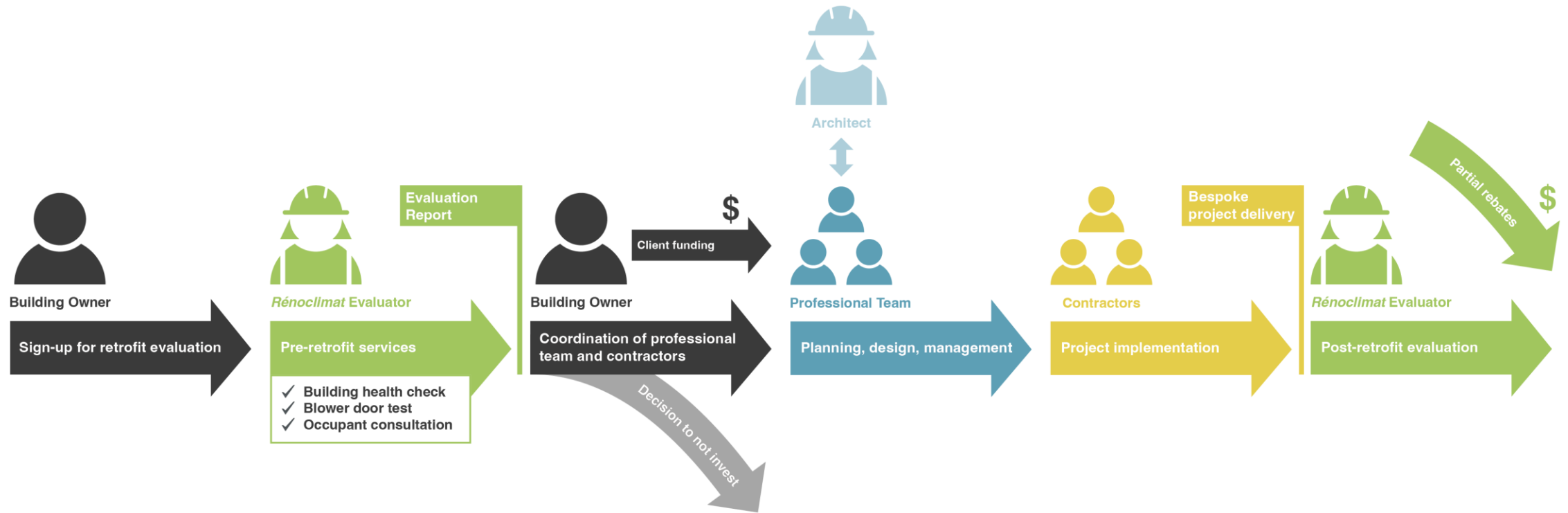
- > Receive personalized advice on how to improve the energy efficiency of your home from a Rénoclimat advisor during a free home visit
- > Reduce your energy consumption over the long term while improving your comfort at home
- > Receive financial assistance

You can be eligible for **financial assistance** under the Rénoclimat program if you are:

- > carrying out insulation work;
- > carrying out work affecting your home's air tightness;
- > replacing doors and windows;
- > installing or replacing mechanical systems (ventilation system, water heater, heat pump, geothermal heating system).

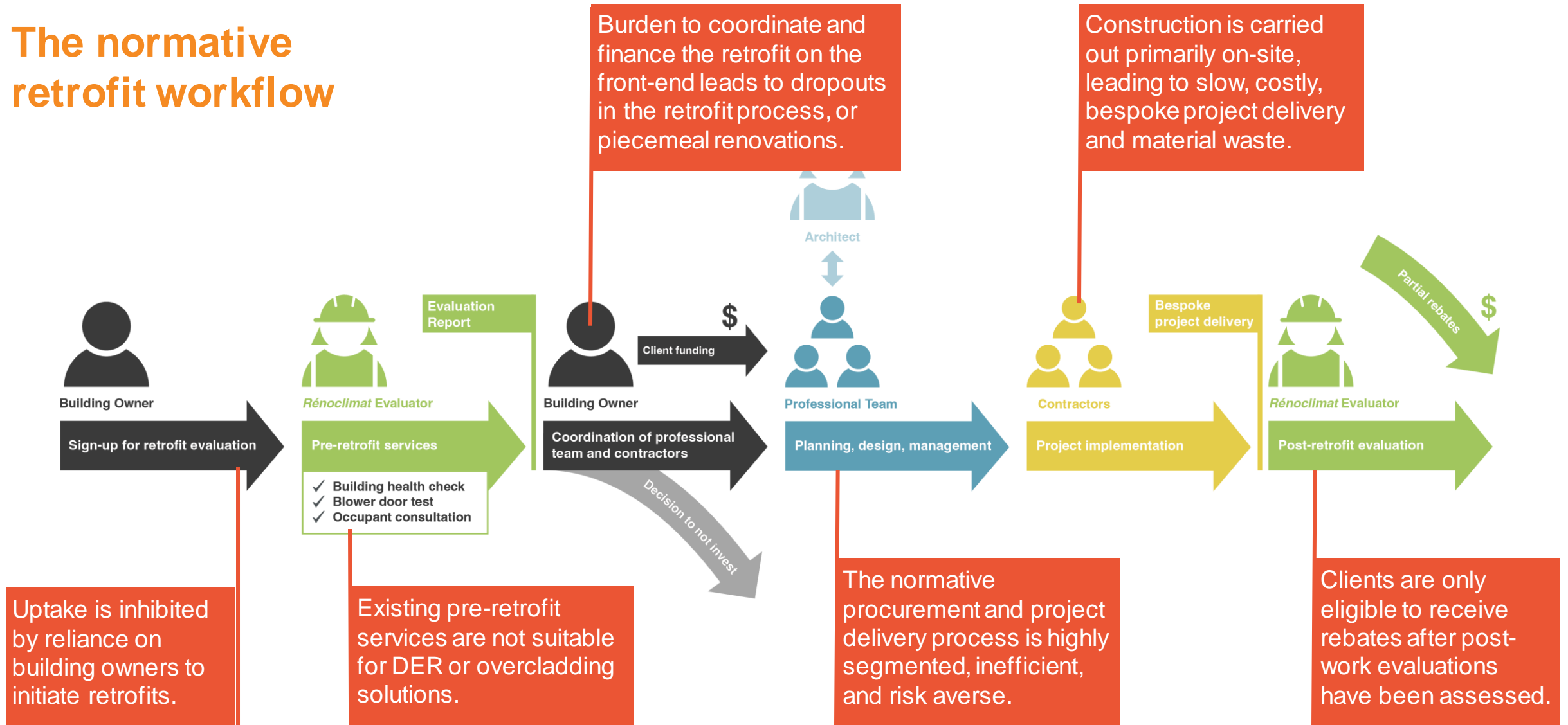
3. Strategies for Market Development

The normative retrofit workflow



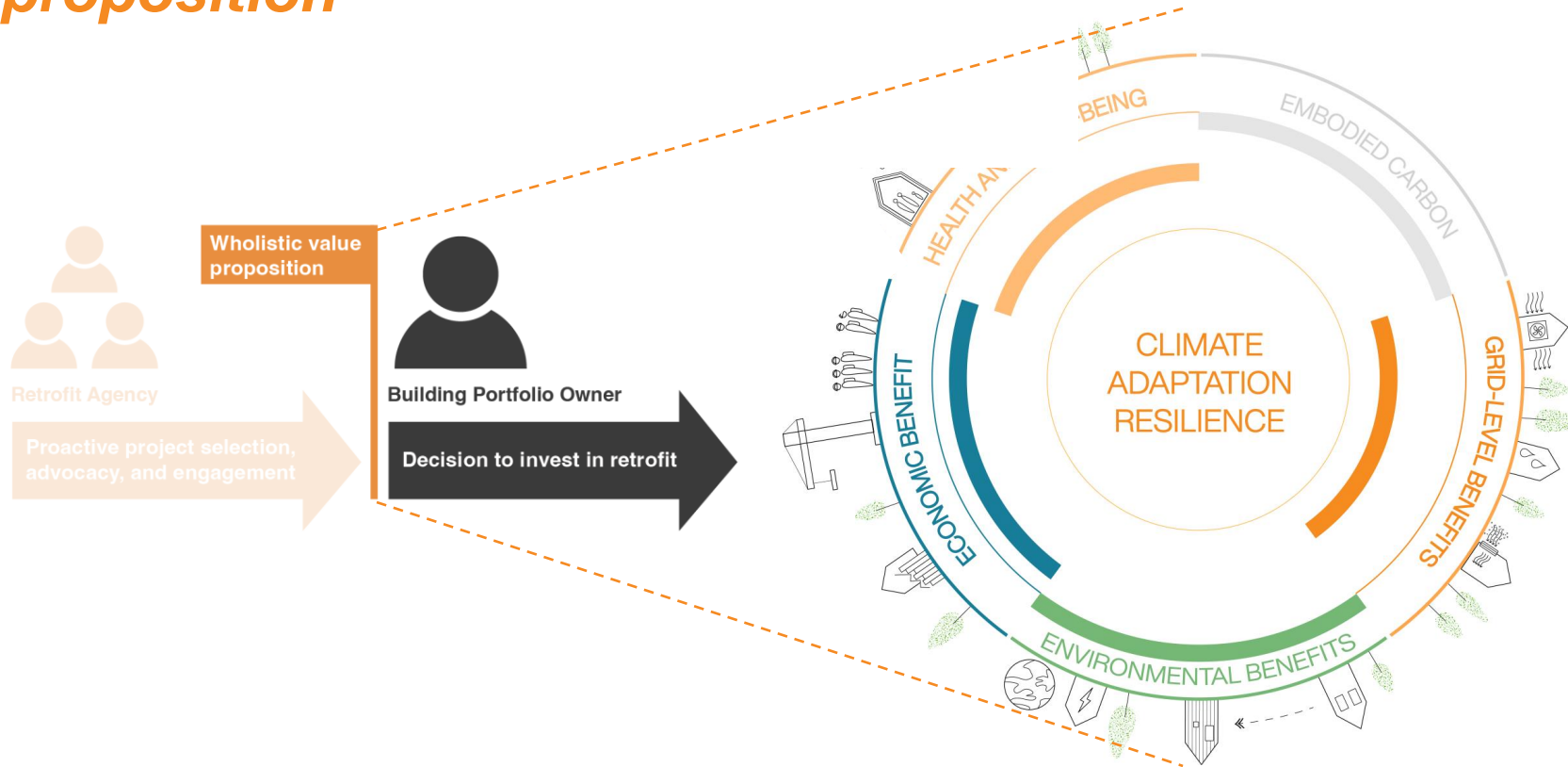
3. Strategies for Market Development

The normative retrofit workflow



3. Strategies for Market Development

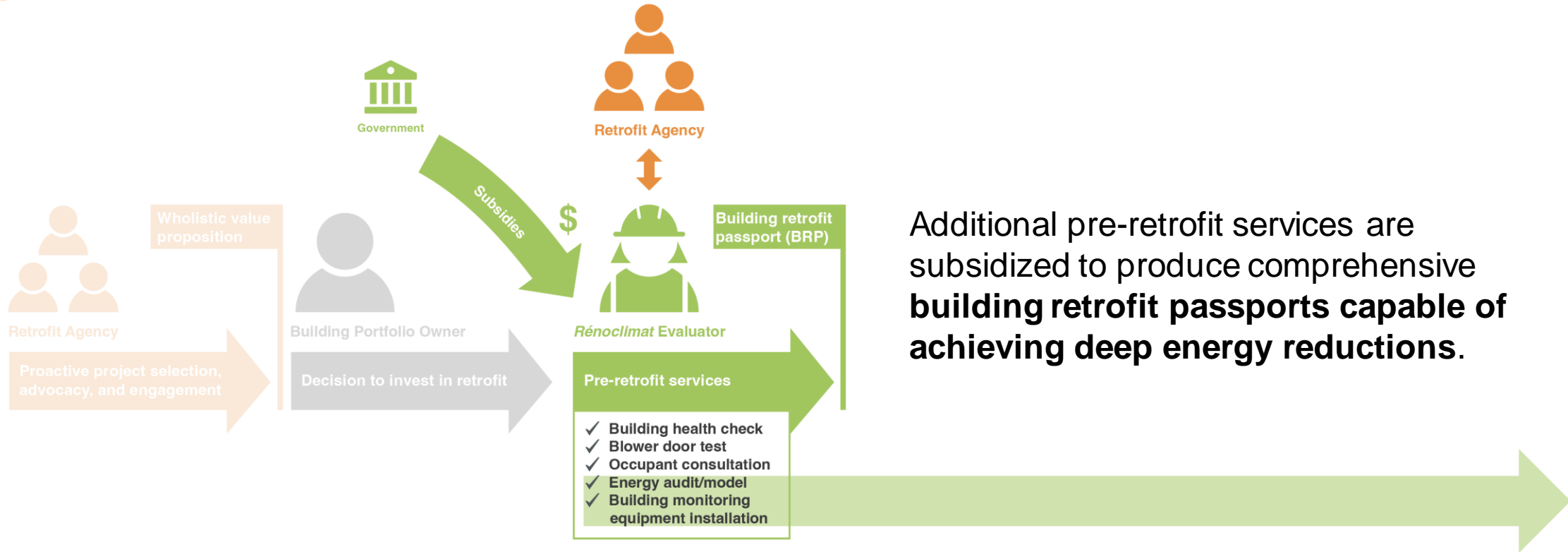
Niche development: *wholistic value proposition*



Making tailored cases for 'co-benefits' beyond simplistic ROI will help **cultivate buy-in** among building owners.

3. Strategies for Market Development

Niche development: *pre-retrofit services*



Additional pre-retrofit services are subsidized to produce comprehensive **building retrofit passports capable of achieving deep energy reductions.**

3. Strategies for Market Development

Niche development: transforming the DER workflow



Retrofit Agency

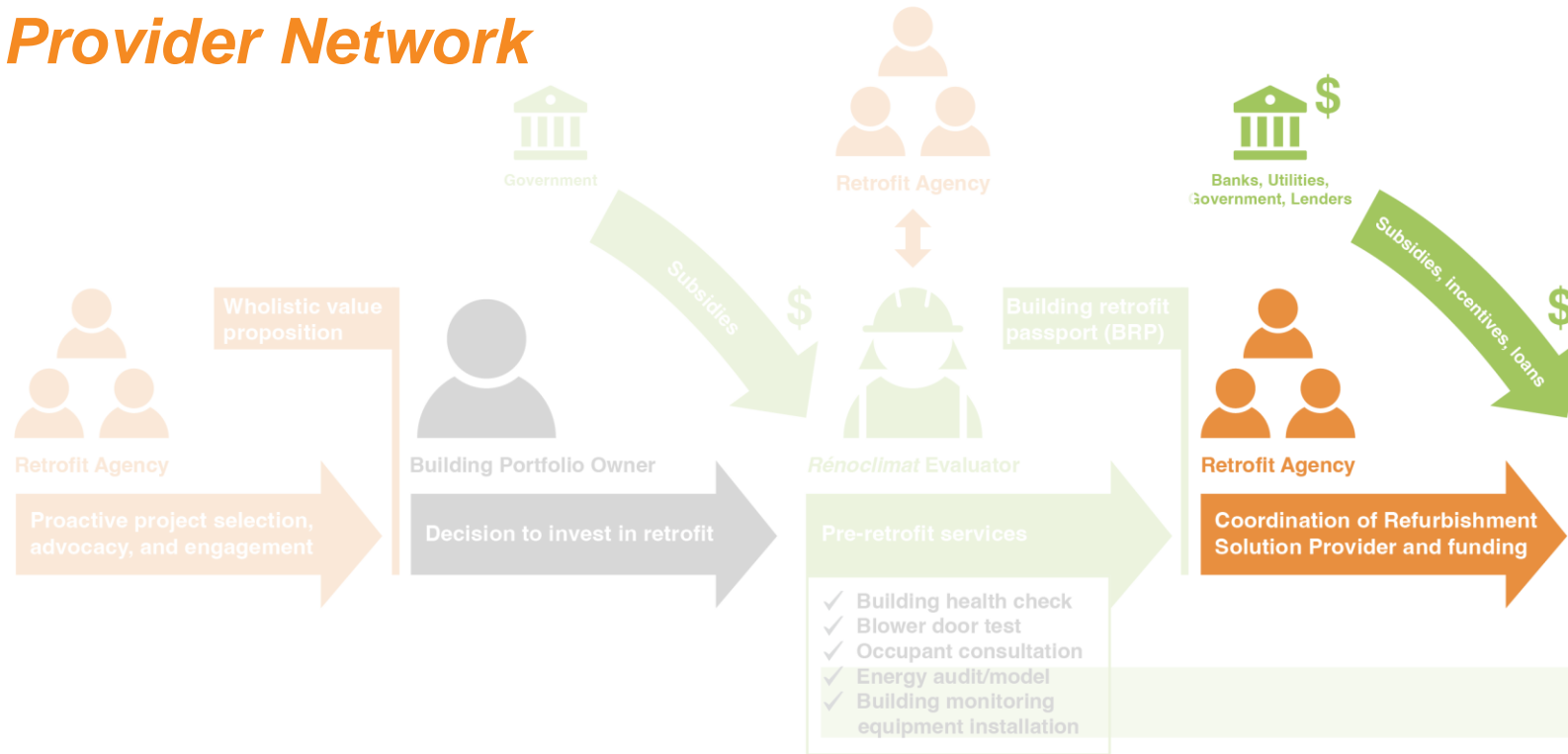
Proactive project selection,
advocacy, and engagement



The Agency **proactively identifies** early adopter projects that will build large-scale capacity.

3. Strategies for Market Development

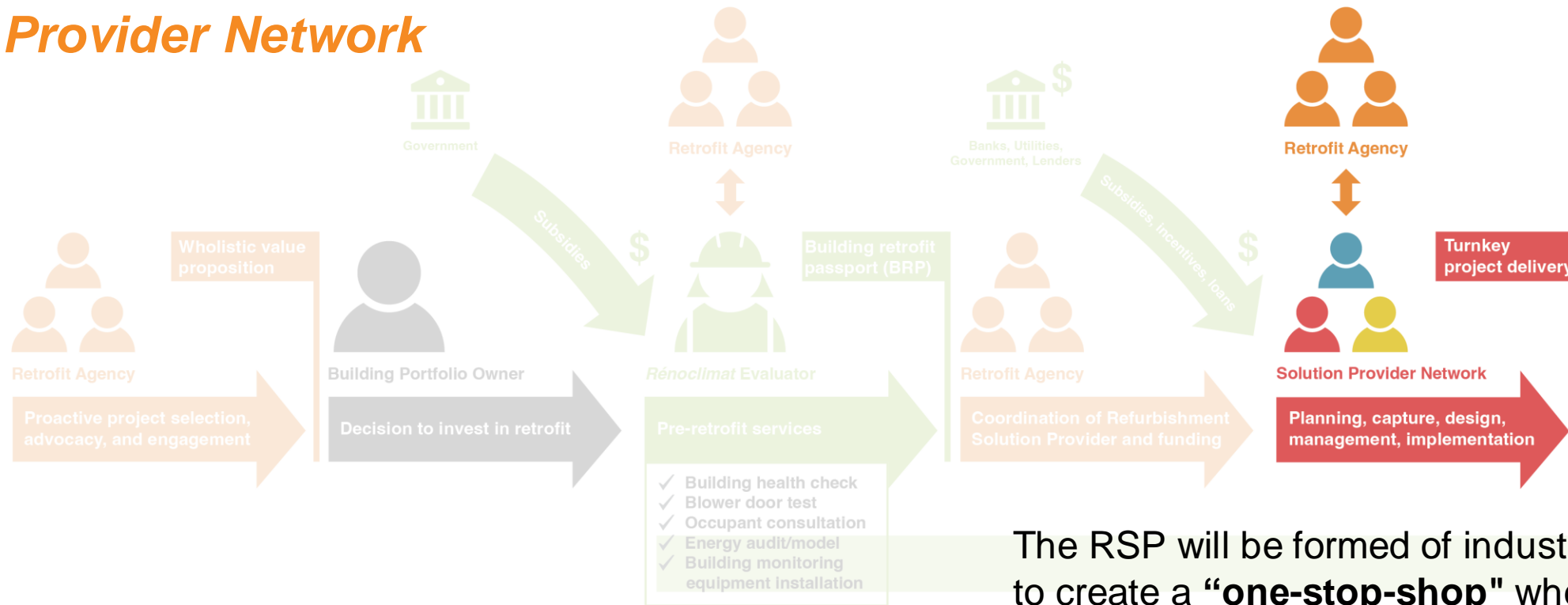
Niche development: Refurbishment Solution Provider Network



The Agency will develop, operationalize, and provide third-party oversight of a Refurbishment Solution Provider Network (RSP): **integrated groups of product manufacturers, prefab industry, and building professionals.**

3. Strategies for Market Development

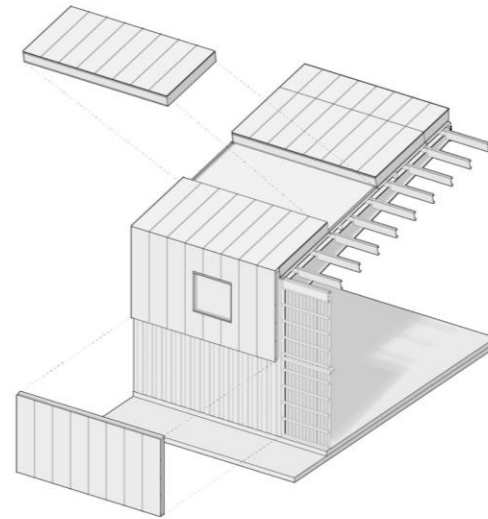
Niche development: Refurbishment Solution Provider Network



The RSP will be formed of industry stakeholders to create a **“one-stop-shop”** where a client deals with one certified contractor as the single point of contact throughout the retrofit process.

Niche development: *Turnkey product, integrated design process*

Over-cladding solutions must be seen as a turnkey product; must get away from normative design, procure, construct bidding process. **Pre-approved envelope and active system solutions.**



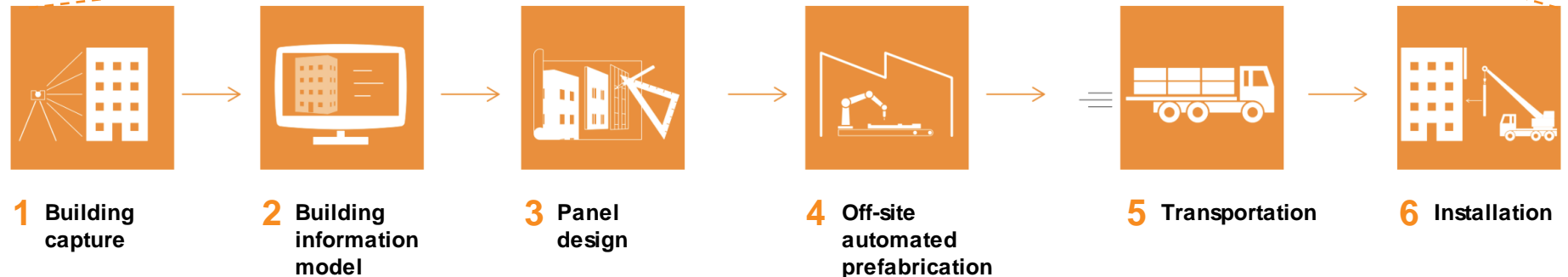
Retrofit Agency



Solution Provider Network

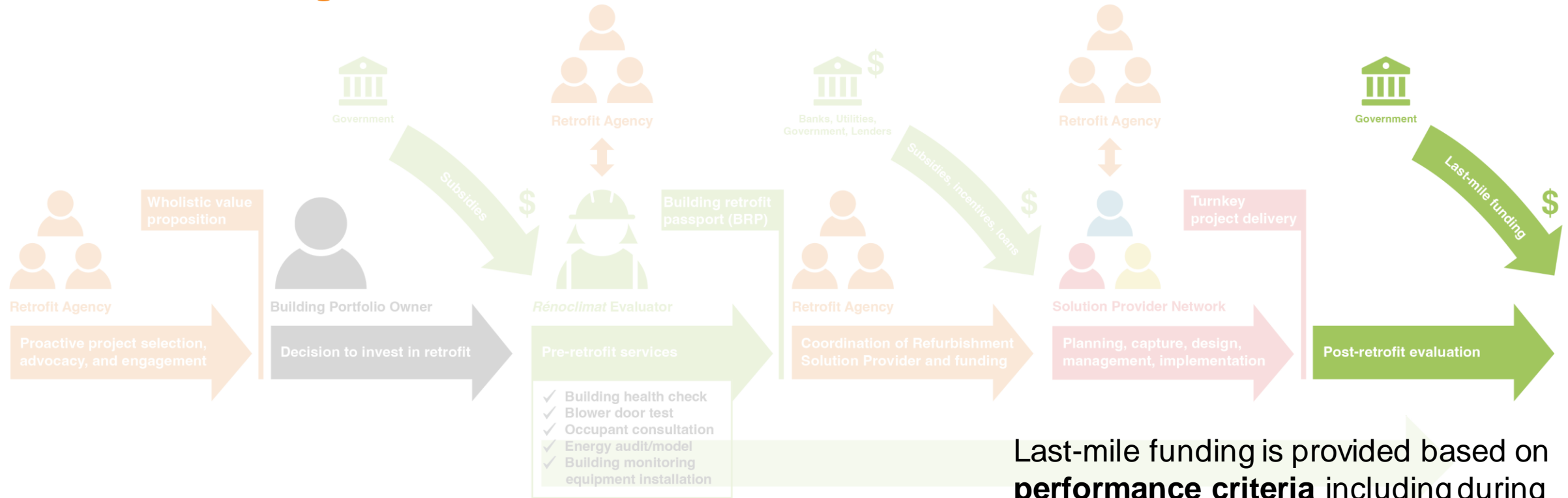
Turnkey project delivery

Planning, capture, design, management, implementation



3. Strategies for Market Development

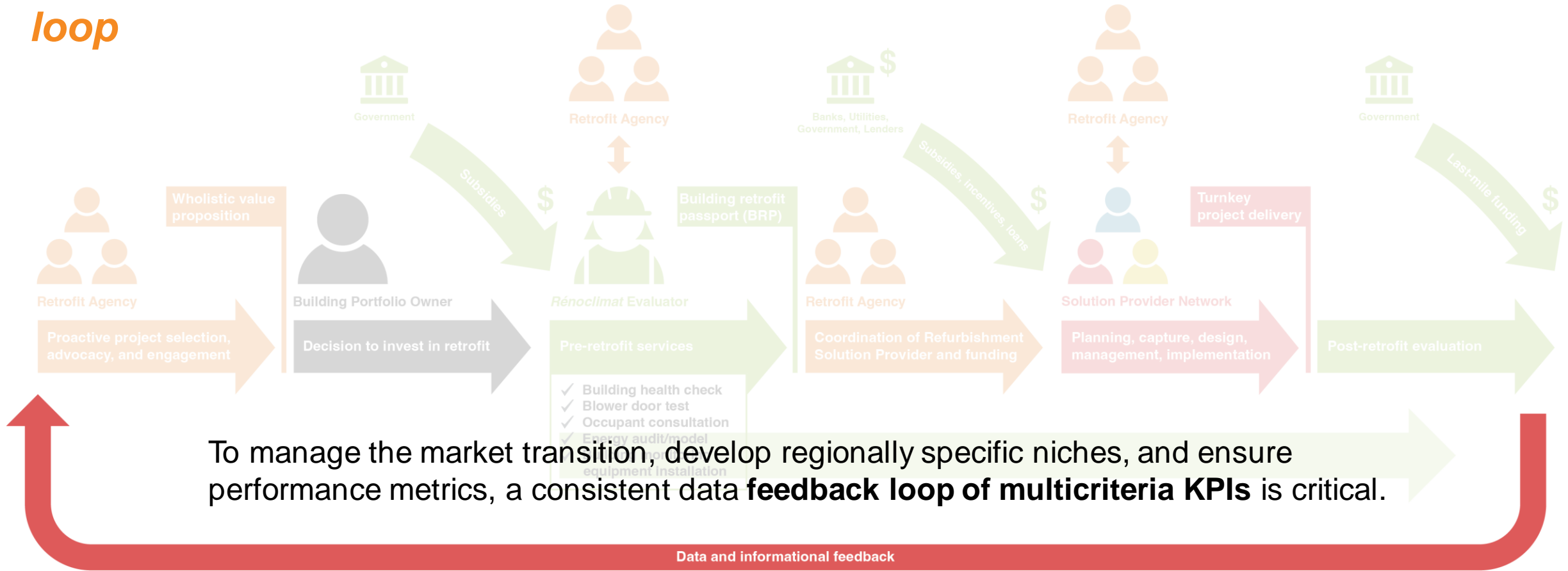
Niche development: *last-mile funding*



Last-mile funding is provided based on **performance criteria** including during and for construction results and after a year of measurement.

3. Strategies for Market Development

Niche development: *informational feedback loop*



To manage the market transition, develop regionally specific niches, and ensure performance metrics, a consistent data **feedback loop of multicriteria KPIs** is critical.

Data and informational feedback

Key takeaways

- Overarching objective of niche developments together is to build **technical and implementation capacity** for mass retrofit.
- **Theoretical frameworks** provide methods for understanding regional contexts and making interventions and investments specifically and strategically.

6 P's of capacity-building

- 1 Proactive** mandate to facilitate projects to build capacity for mass retrofit across sectors.
- 2 Proposition (value)** that illustrates DER's wholistic benefits beyond energy savings to induce mass adoption.
- 3 Pilot** projects that present scalable traits, high societal value, volume, and need for renovation.
- 4 Pipelines** of projects that can nurture industry buy-in, efficiencies, supply chains, and expertise necessary to lower cost for mass retrofit.
- 5 Product (turnkey)** that aligns supply chains physically and legislatively as an industrialized process.
- 6 Procurement (IDP)** to streamline the DER process, mitigate risk, and reduce costs for industry actors which will accompany turn-key solutions.

3. Strategies for Market Development

Canadian Deep Retrofit Accelerator Network

- **Deep Retrofit Accelerator Initiative (DRAI)** has earmarked **CAD \$200 million** to support intermediaries that will assist building owners in adopting DER across commercial, institutional, and multi-unit residential buildings.
- The network intends to foster a self-sustaining retrofit market through capacity-building activities and retrofit support services.



3. Strategies for Market Development

Canadian Deep Retrofit Accelerator Network

As the R&D collective for the network, ReCONstruct is supporting the network by developing shared tools and strategies for harmonizing capacity building efforts:

- Pilot project to pipeline identification, design, procurement
- Novel low-carbon envelope solutions
- Decision-making toolkit and digital platform
- Case Study & Technical Repository
- Protocol for Monitoring & Verification
- Equity, Diversity and Inclusion (EDI) policies and resources





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Thank you.