

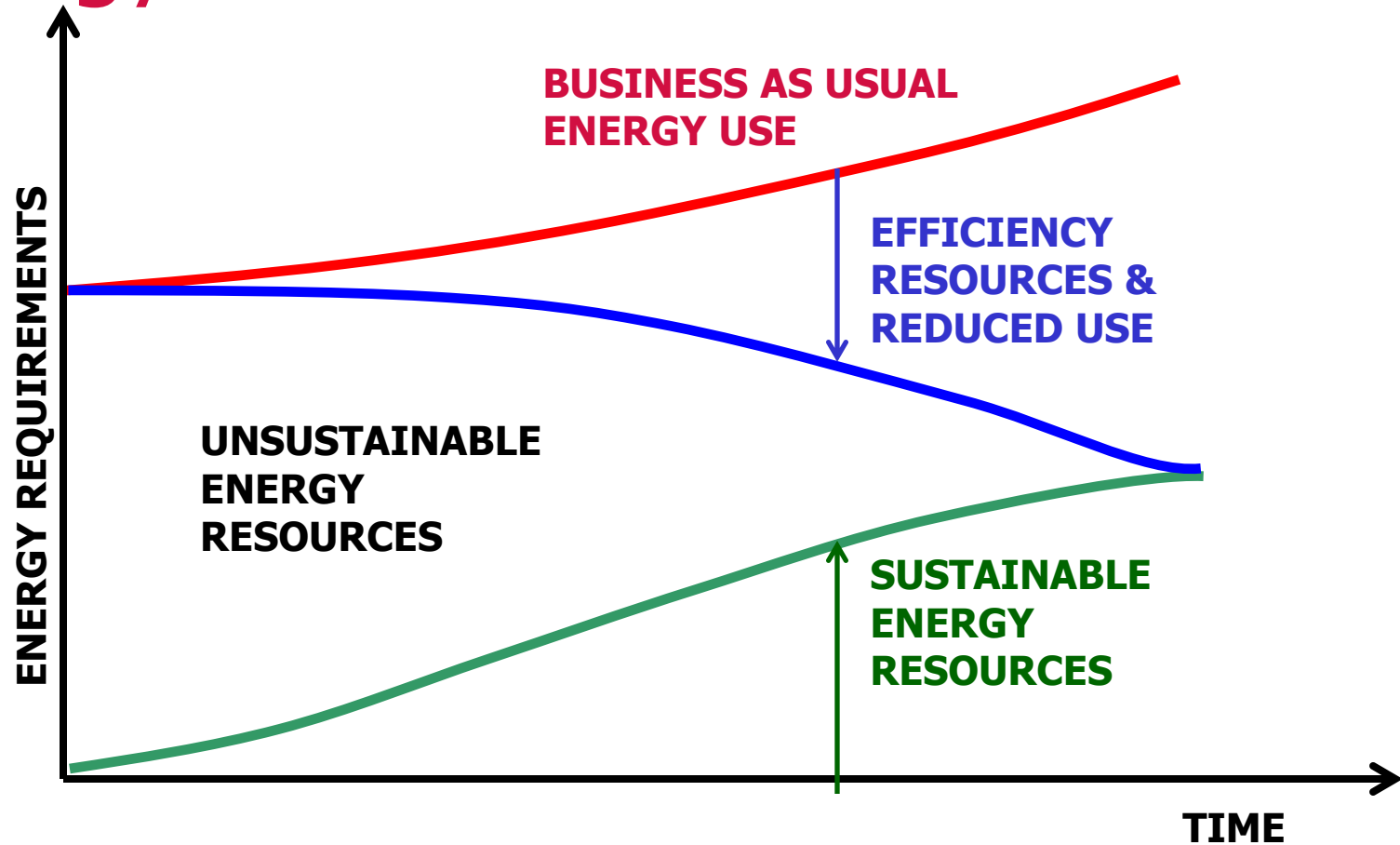


VERMONT ENERGY
INVESTMENT CORPORATION

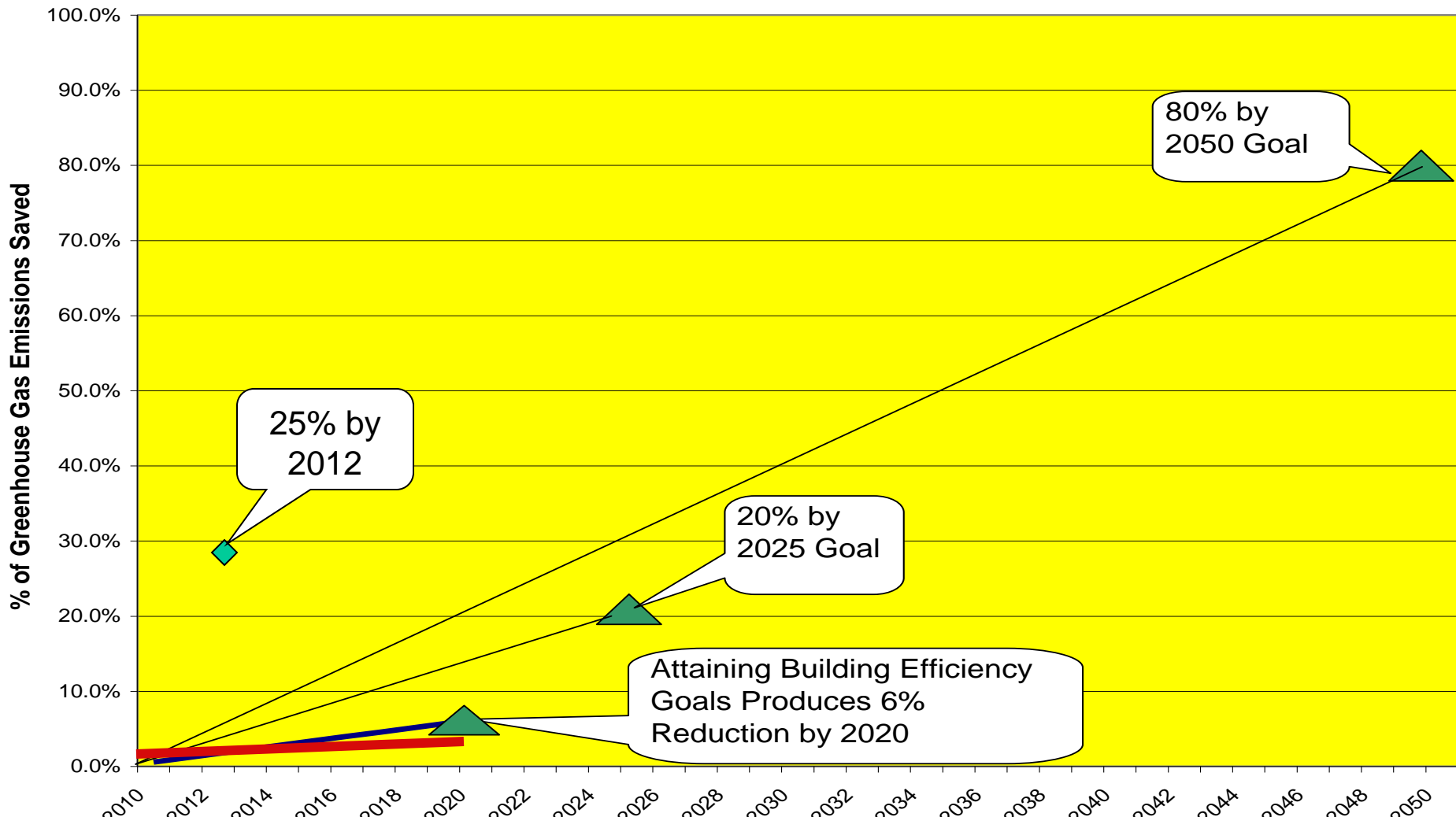
A Vermont Roadmap to a Zero-Carbon Building Sector by 2050

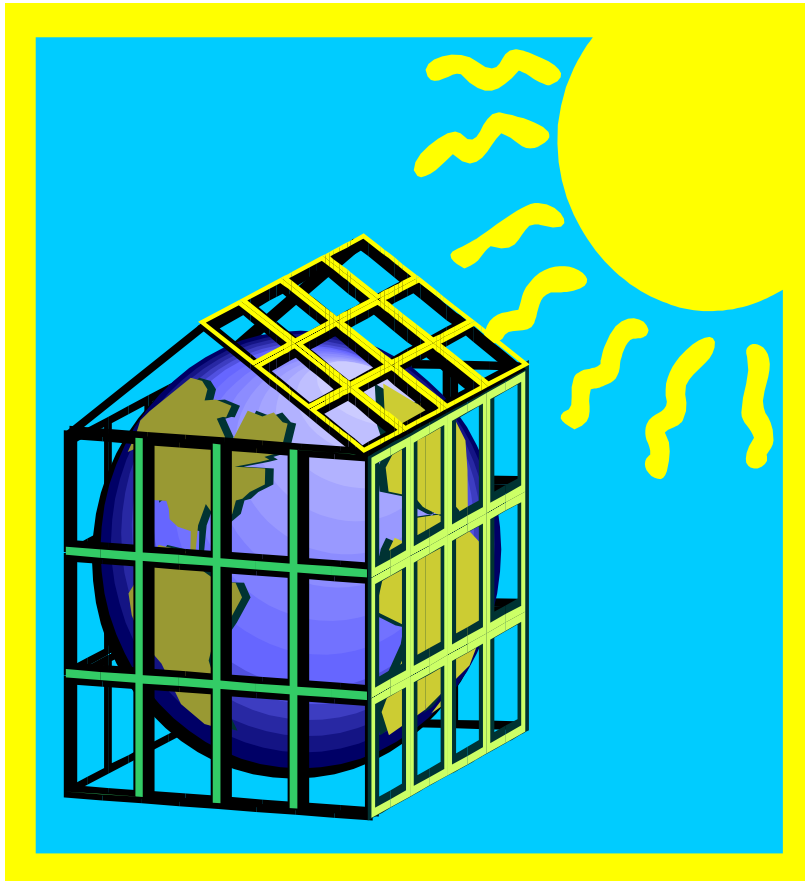
Blair Hamilton
NESEA – March 9, 2011

Moving to a Sustainable Energy Future



Vermont Climate Goals: 20 Years of Aiming Low and Achieving Lower





- What if we shift national, state and community energy planning, policy and decision-making to **focus on the climate results?**
- Shift from planning, regulating and investing based on current energy supply economics to least-cost achievement of climate goals (e.g., 80% reduction or 350 ppm by 2050)?

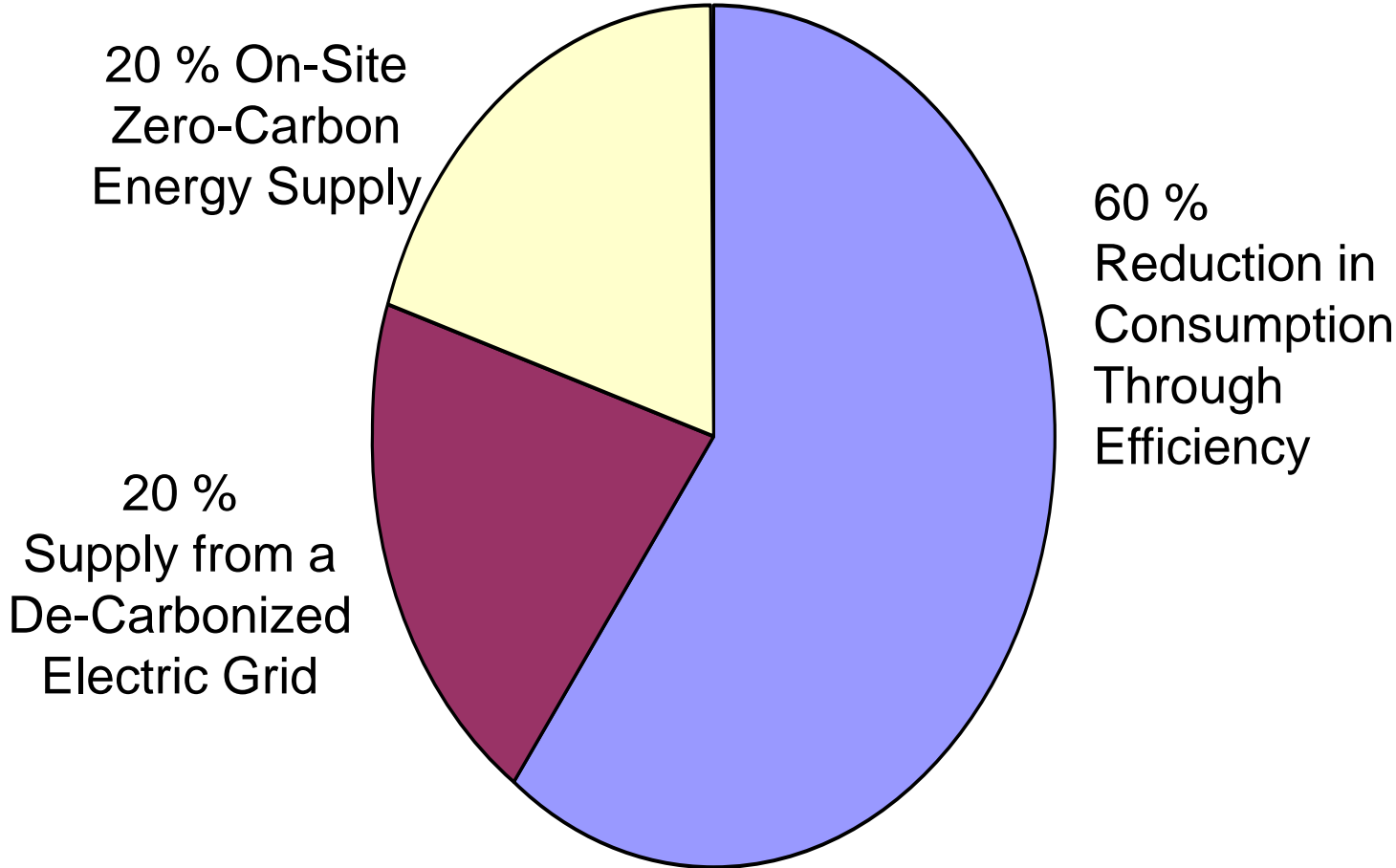


- A top-down and results-oriented approach to planning and policy is increasingly being used outside the US – particularly in Europe where carbon goals are considered by many to be “Legally Binding”
- This Vermont analysis is a work-in-progress, exploring what it might look like for Vermont to achieve 2050 climate goals, starting with the building sector.

Assume the following hypotheses, if you will:

- The building sector will need to be zero carbon by 2050 – or close to zero.
- Efficiency is the least-cost option to provide the bulk of building-sector carbon reductions.

A Reasonable Mix of Strategies to Achieve Zero Carbon in Buildings by 2050



Components of a Vermont Roadmap to 2050

1. New Technologies
2. New Delivery Strategies
3. Expanded Infrastructure
4. New Policies

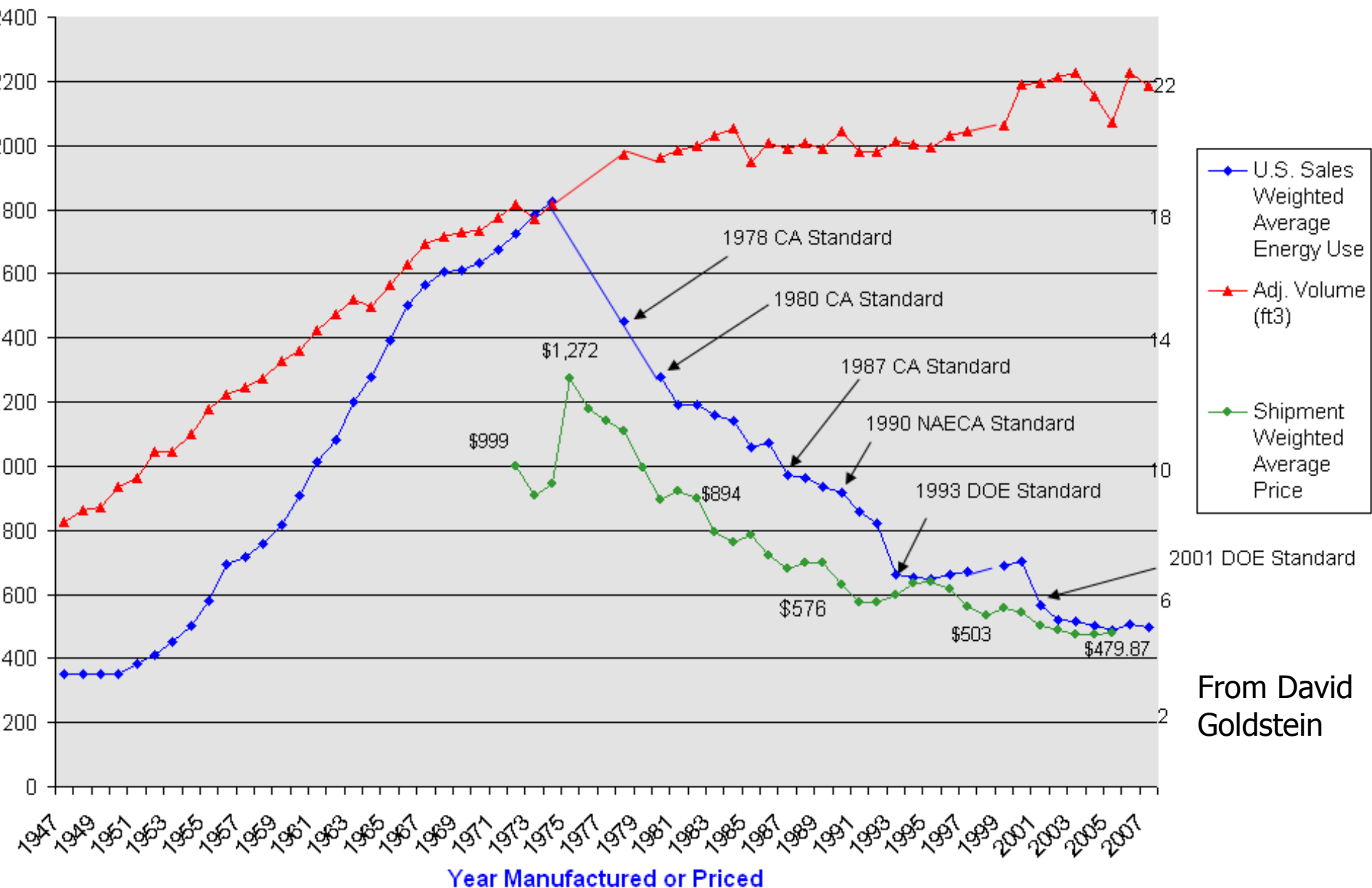
1. New Technology Examples

- Phase change material built-in to building components
- Windows with thermal performance equal to walls
- Easy and effective building air sealing systems w/associated ventilation
- User-aware, self-optimizing and self-diagnosing controls for equipment
- Improved heat recovery technology and controls for all sizes of loads
- Continued advances in solid-state lighting, including substrate growth improvements, AC compatibility, improved fixture design and thermoelectric generation from waste heat
- (Many more in full paper)

1. New Technologies

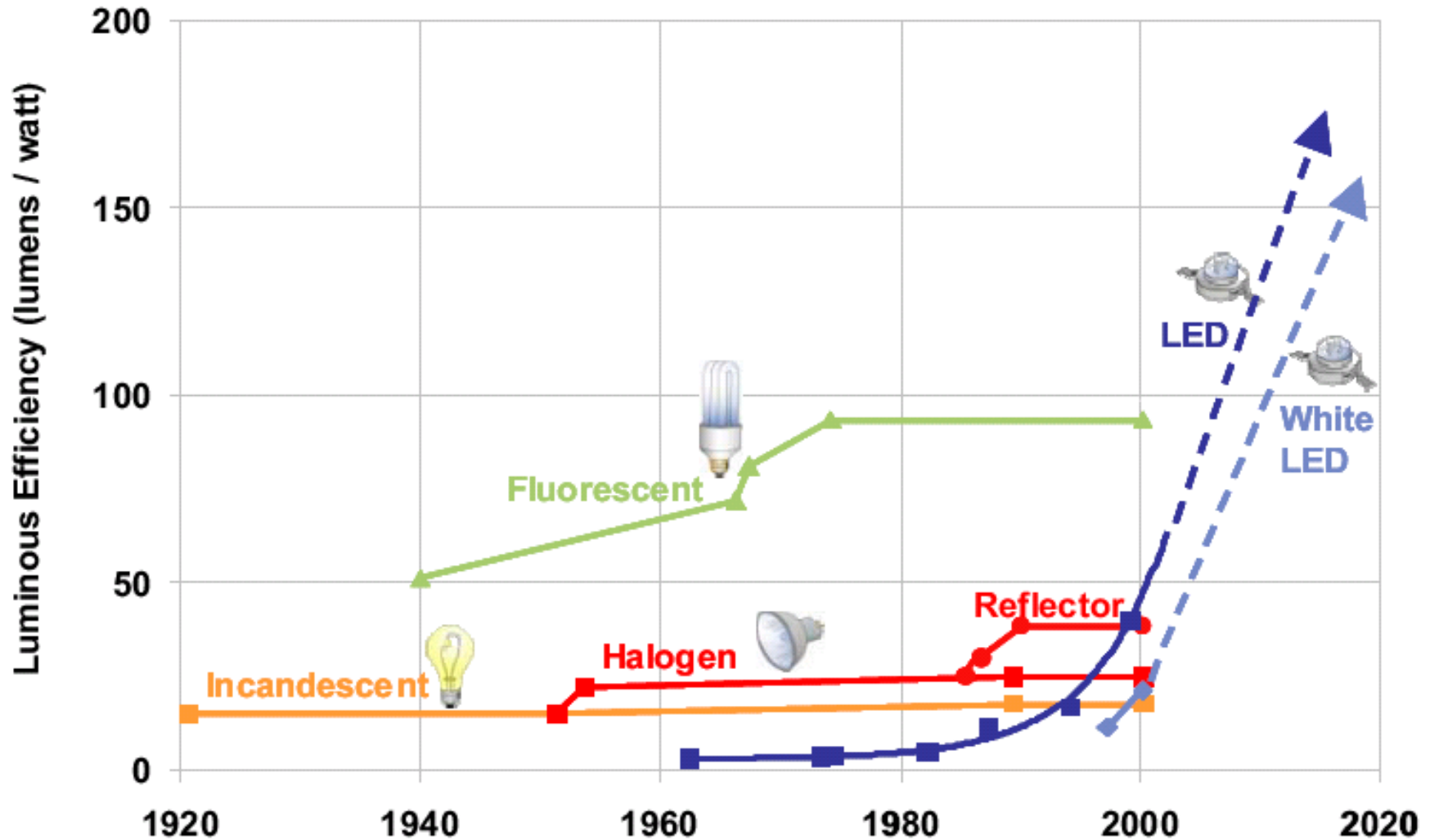
- But it's important to remember that many technologies, if not most of them, that we will rely upon to meet 2050 goals are not, as yet, known.
- Our energy forecasts and plans should not be constrained by our limited ability to account for new technologies.
- We tend to assume new technology will cost more and save less, but what is our experience?

U.S. Refrigerator Energy Use v. Time with Real Price



From David Goldstein

Lighting Technology Development



2. New Delivery Strategies to get to 2050

- More relationship-based strategies
- Individualized building retrofit roadmaps
- More community-based strategies
- More upstream strategies
- Widespread new financing essential
- Smart-meter enabled strategies

3. Expanded Infrastructure to get to 2050

Potential Infrastructure Components:

- Expanded Sustainable Energy Utility
- New Vermont Green Energy Bank
- New Vermont Sustainable Energy Loan Guarantee Fund
- More and Better Skilled Contractors – and more who can do the whole job

4. Policies to get to 2050

- Current incremental and voluntary strategies are far too slow to meet necessary climate goals.
- When it comes to climate, **Time Matters**.
- We will need to transition to massive market-based investment driven by public policies (e.g. building energy requirements).

4. Policies to Get to 2050

Policy Strategy: **New Regulatory Guidance**

- Transition to a focus on achieving carbon goals from current government and regulatory policy focused on reducing energy use and cost.
- The least-cost planning paradigm that has served Vermont well in the utility sector will now need to be applied to determining the least-cost path to achieving carbon goals.
- This is a major shift from currently constrained energy resource least-cost planning based on minimizing costs using current and near-term supply costs.

4. Policies to Get to 2050

Policy Strategy: **New Construction**

- New construction codes should require net-zero carbon emissions starting in 2020.
- Ramping up to this will require significant technical assistance and subsidies over the next decade.
- Policies addressing the definition and boundaries of “net zero” will require further development to assure that they address least-cost and other objectives for carbon reduction, with attention to avoiding sub-optimization to inappropriate objectives

[\[1\]](#)

4. Policies to Get to 2050

Policy Strategy: Existing Buildings

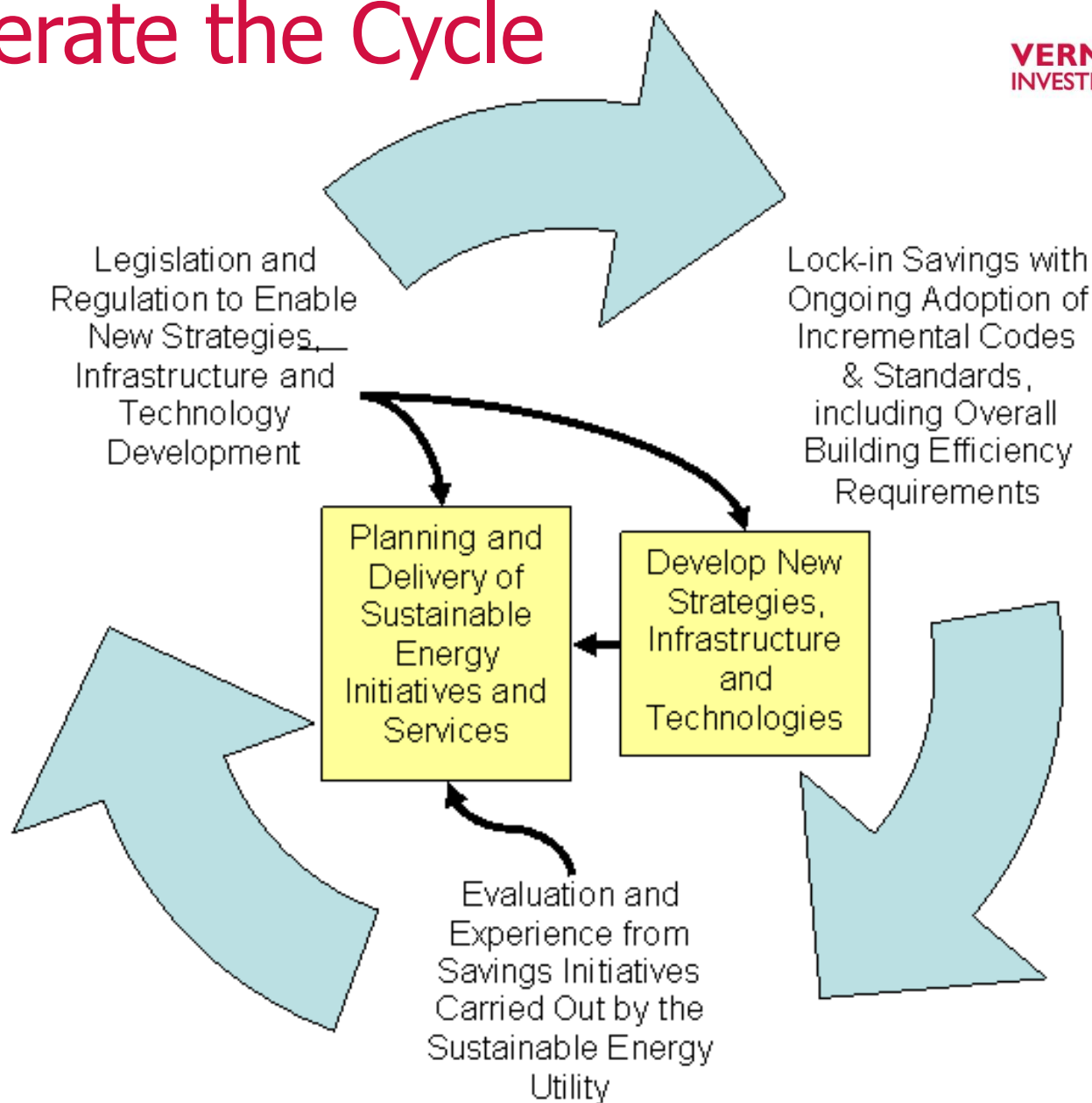
Time-of-Sale Building Efficiency Requirements

- Phase in from 2015 to 2025 as a condition of property transfer
- Relies on long-term mortgage financing, a known financial mechanism with existing infrastructure, to spread out costs over up to thirty years at relatively low interest rates
- Necessary improvements can be made by seller or buyer
- Expanded incrementally - more types of buildings and deeper efficiency
- Greatly reduces need for public subsidies

Other Supporting Strategies for Existing Buildings

- Building rating and labeling
- Delivery infrastructure development
- Innovative financing and loan guarantees

Accelerate the Cycle



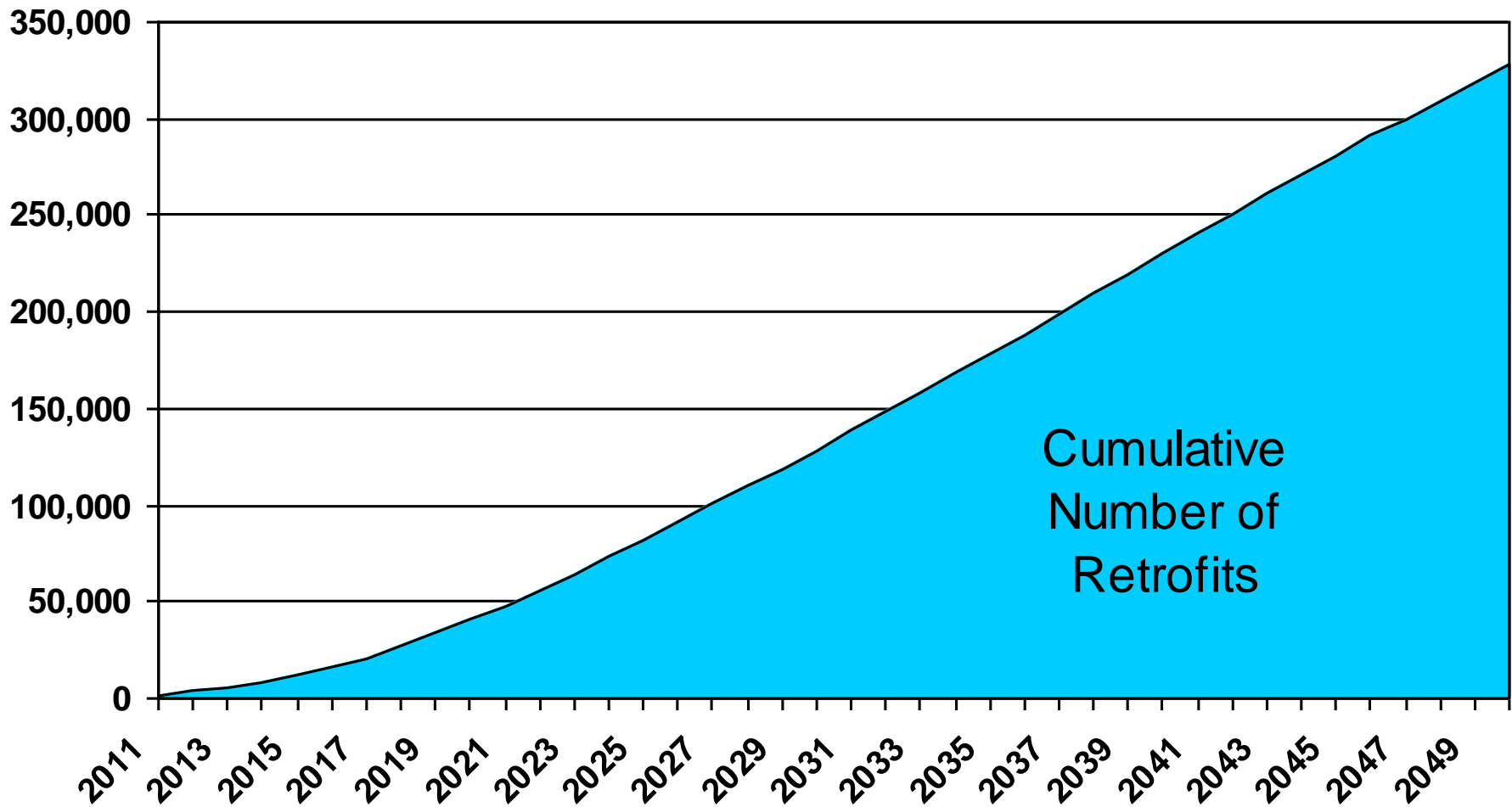
Putting it All Together – Year-by-Year to 2050

- Assume all new buildings will be net zero carbon starting in 2020
- Focus on achieving 50% reduction through the retrofit of existing buildings: 240,000 residences and 51,000 businesses.
- Assume policies and programs can achieve another 10% savings in the natural replacement market (equipment, appliances and other products), bringing total carbon reduction from efficiency to 60% (to be further explored).

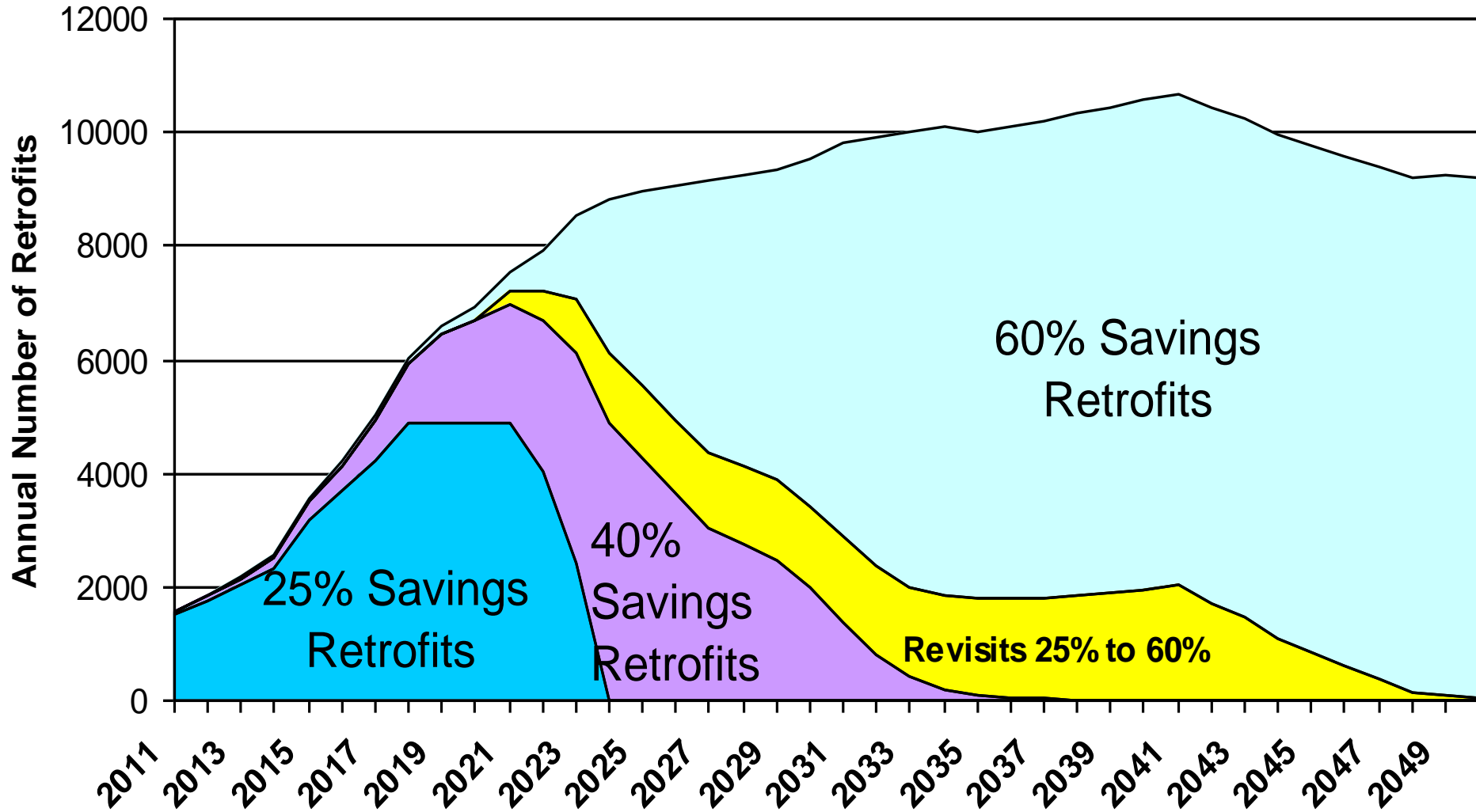
Estimated Average Costs for Deep Retrofits of All of Vermont's Building Stock

Building Type	Level of Retrofit Savings		
	25%	40%	60%
Single Detached	\$10,100	\$18,800	\$27,500
Commercial/Industrial	\$27,900	\$52,300	\$76,600

Path to Retrofitting All Buildings in Vermont by 2050

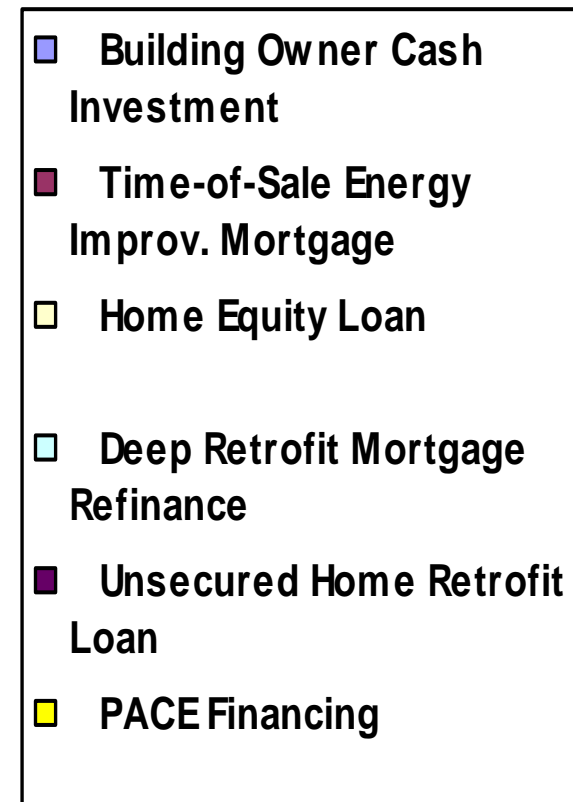
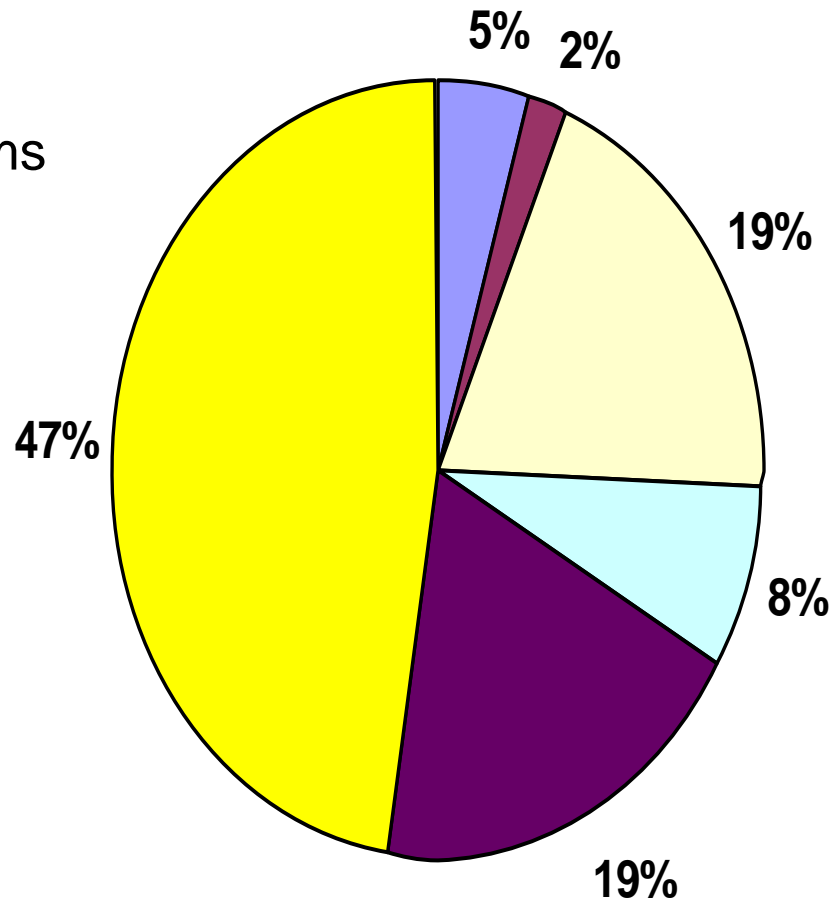


Annual Number of Retrofits and Depth of Savings

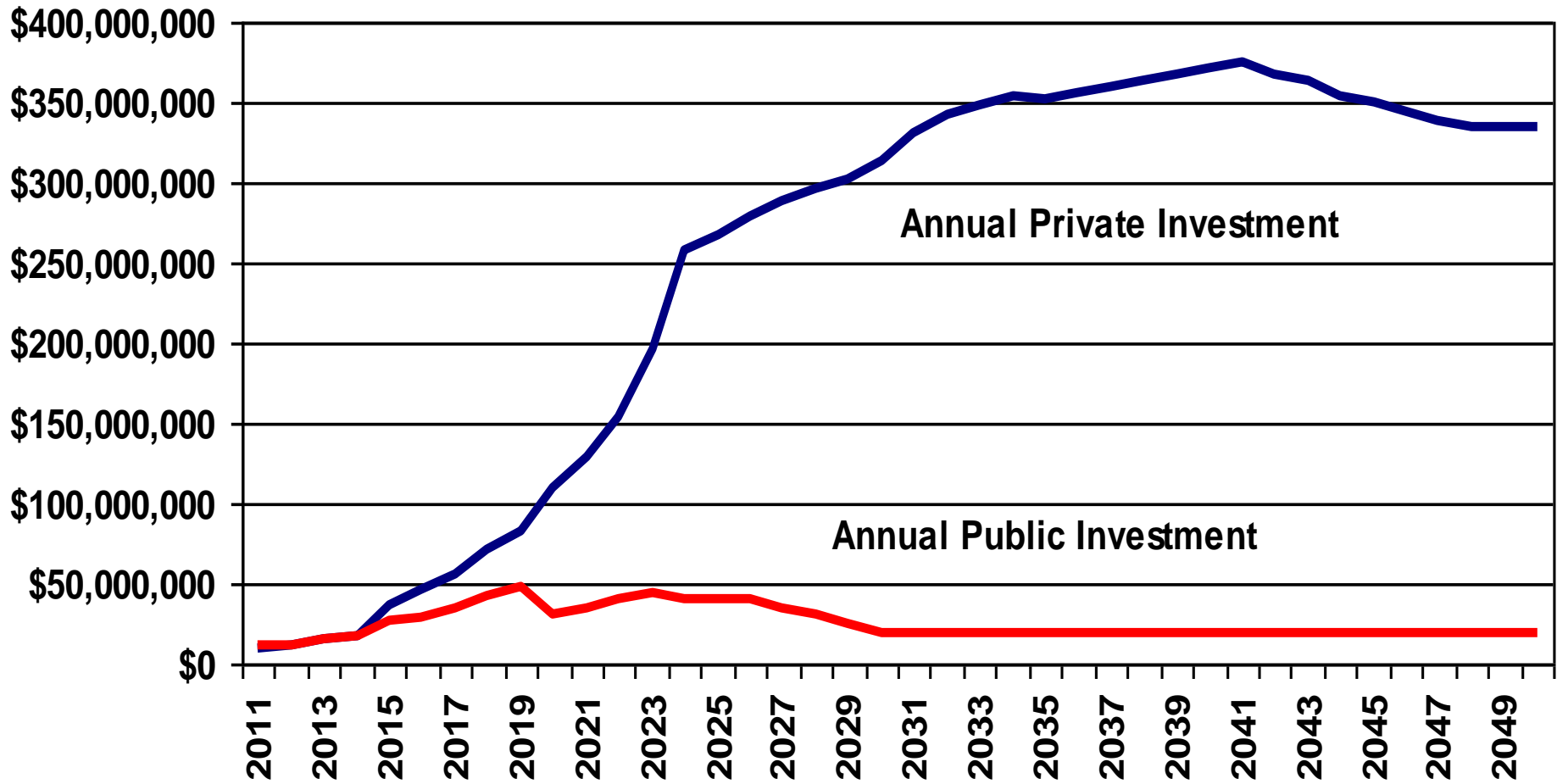


A Portfolio of Financing Tools, Evolving Over Time

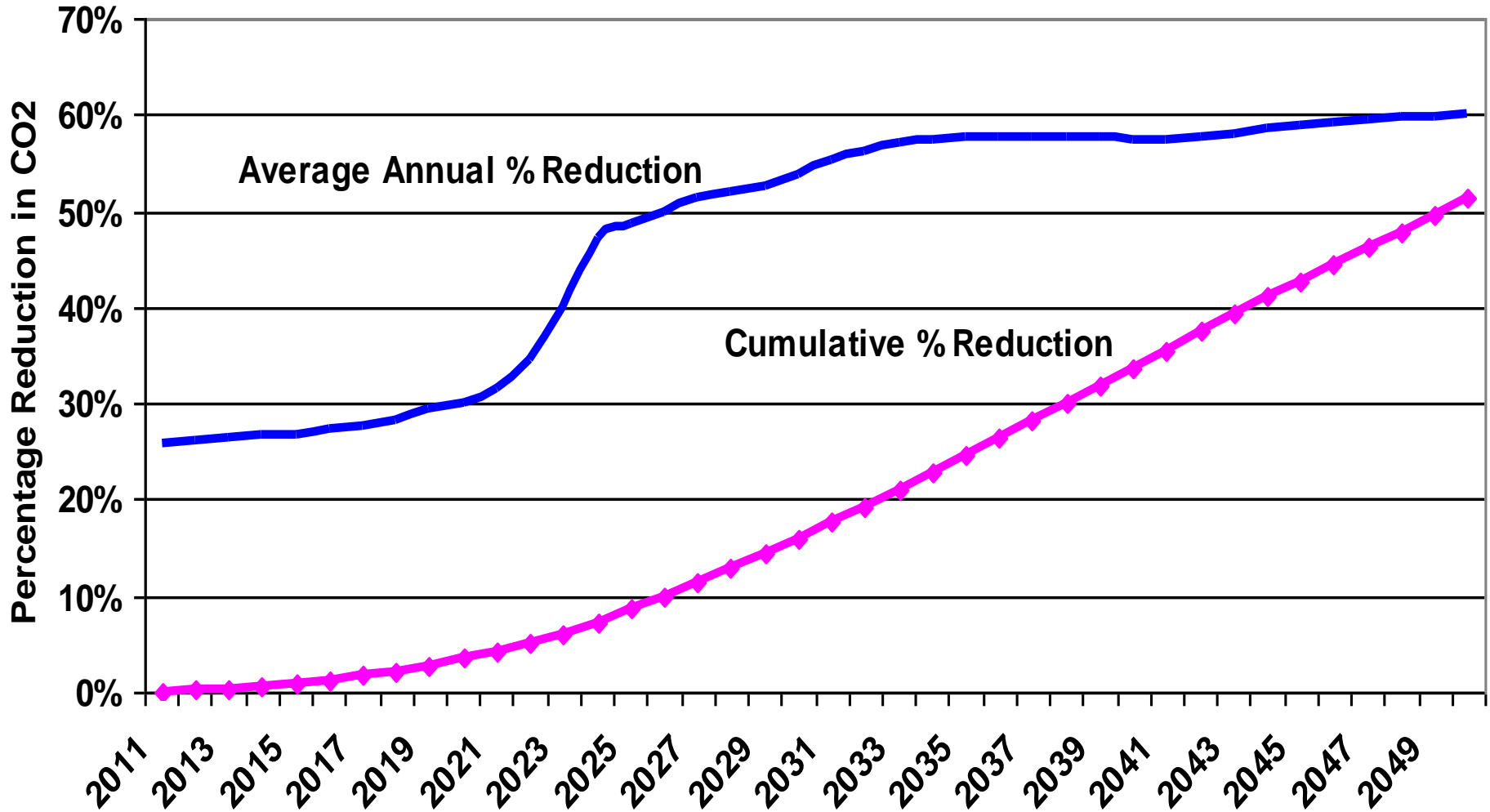
Mix of Financing Mechanisms in 2013



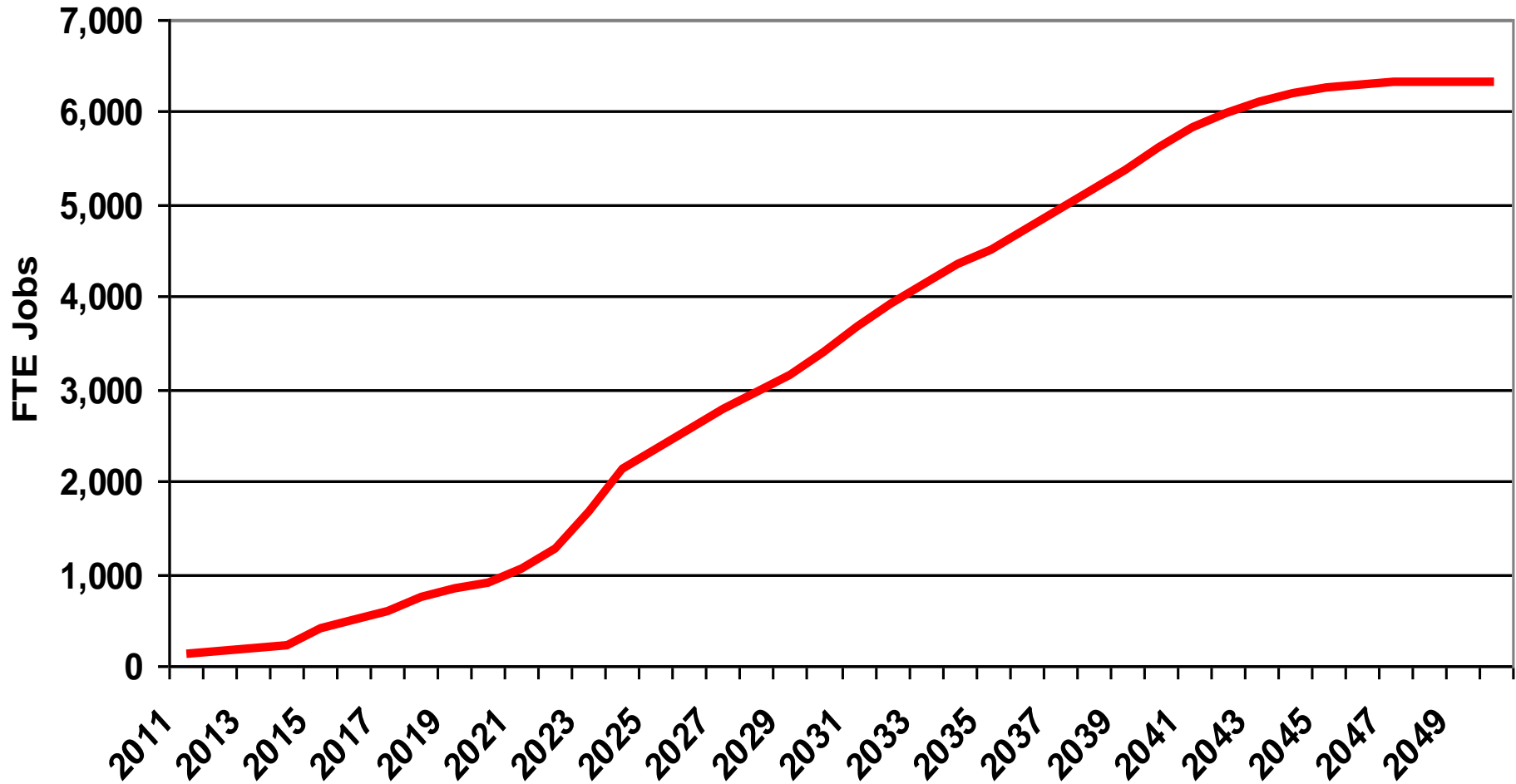
Annual Investment in Retrofits



Annual CO2 Reduction from Retrofits



Annual Direct Employment in Building Retrofit



Thank You!

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