State of the U.S. ESCO Industry

Market Characteristics and Project Performance: 1990-2017

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- All remaining errors are the responsibility of the authors.

KEY TAKEAWAYS

Key takeaways

- U.S. ESCO industry annual revenues estimated at $7-8 billion (2017). ESCOs are active in geographic markets that do not have significant utility-funded EE incentives programs (e.g. KY, IN, VA, MO, TN, KS).

- Aggregate market share of K-12 schools and state/local government projects in LBNL/NAESCO database grew from 40% to 75% (since 1990)

- In general, ESCO projects…
  - …are becoming more complex
  - …involve a more comprehensive mix of capital-intensive measures
  - …rely less often on utility EE program incentives
  - …report increasing dollar savings-levels, especially non-energy
  - …have average measure lifetimes shorter than contract lengths

Key takeaways (cont.)

- Sources that contribute to dollar value of savings have changed significantly
  - Non-energy benefits are increasing, particularly in K-12 schools where they comprise 40% of total measurable benefits
  - Electric demand charge savings are becoming more prevalent
  - Decreases in gas/oil prices are reducing savings for these types of resources

- Project investment levels and dollar savings—corrected for inflation—are increasing
  - Investment levels increased 100%-500% since earliest vintage—depending on market; dollar savings levels have increased 50%-70% over the same time frame
  - Median simple payback time has increased from 7 to 13 years since 1990
  - Contract lengths have increased from 9 to 13 years
  - Contract lengths that extend beyond measure lifetimes increase the risk of under-performance of ESPC

BACKGROUND AND DATA SOURCES

About this document

- This is the first time that an LBNL ***State of the U.S. ESCO Industry*** analysis has been produced as a set of slides

- A companion paper—***Evaluating Project-level Investment Trends for the U.S. ESCO Industry: 1990-2017***—will be released in-parallel with this set of slides

- We hope to update these materials annually to provide ESCOs, their customers, and other stakeholders with useful and timely information about this important industry

The U.S. ESCO industry: an overview

- U.S. energy service company (ESCO) industry has produced significant energy savings, largely in public buildings, by installing and maintaining energy efficient equipment and other cost and resource-saving measures

- We define an ESCO as:

"A company that provides energy-efficiency-related and other value-added services and for which performance contracting is a core part of its energy-efficiency services business. In a performance contract, the ESCO guarantees energy and/or dollar savings for the project and ESCO compensation is therefore linked in some fashion to the performance of the project."

-Larsen et al. (2012)

Selected LBNL U.S. ESCO industry research

Goldman et al. 2002

- First study to document savings, costs and economics from large sample of ESCO project results

Goldman et al. 2005

- Decrease in use of utility incentives
- Enabling policies have supported growth of ESCO industry

Bharvirkar et al. 2008

- Characterize ESPC and energy efficiency activity in the state government market
- Estimate market indicators

Satchwell et al. 2010

- Sustained ESCO industry growth and focus on performance contracting

Larsen et al. 2012

- K-12 schools and other public buildings are installing capital-intensive, low-energy savings measures to address maintenance backlogs

Carvallo et al. 2015

- Industry-wide electricity and fuel savings at around 1% of U.S. commercial building consumption

Stuart et al. 2016

- ESCO industry revenue plateaued for the first time

Larsen et al. 2017

- Remaining market potential estimated at $92-$333 billion depending on extent of future industry barriers

Data sources

- LBNL/NAESCO database
  - Contains project-level energy and financial performance data for ESCO projects
  - Populated primarily through NAESCO accreditation submissions
  - Contains ~6,000 projects installed from 1990 to 2017

- eProject Builder
  - ESCO industry project development and tracking system
  - Used by ESCOs and customers for reporting, benchmarking, and project tracking throughout performance period
  - Contains measure-level data on ~500 projects

- *Most comprehensive sources of ESCO projects in the world*
  - *Results are not statistically representative of industry due to the possibility of self-selection bias occurring during accreditation submissions*

Key project data fields and coverage

COMMENTS:

- Not all projects contain the data fields necessary for a given analysis
- Accordingly, sample sizes will vary throughout the figures that follow

		Project count	Share of total projects
Full LBNL/NAESCO database	Pre-screening (raw data)	6,314	100%
	Post-screening (clean data)	5,510	87%
Key project data fields	Date completed	5,510	87%
	Project investment levels	4,957	79%
	Floor area	4,204	67%
	Total energy savings (actual, guaranteed, or projected)	3,429	54%
	Dollar value of savings	4,385	69%
	Contract type	5,329	84%
	Contract length	4,587	73%
	Installed measure(s)	5,510	87%
	Contains all key data fields	2,649	42%

Data adjustments

- Screening
  - Remove projects that are missing key fields (e.g., state, year) and that are true outliers according to statistical analysis
- Dominant Retrofit Strategy (DRS)
  - Projects classified by measures that significantly influence savings and costs (see next slide)
- Vintages
  - Projects grouped by time periods that reflect stages in ESCO industry development (1990-1997; 1998-2003; 2004-2007; 2008-2011; and 2012-2017)
- Dollar Savings
  - Energy and water savings re-calculated with standardized state-level retail prices for commercial/institutional and industrial customers to estimate dollar value of savings

Classifying projects into Dominant Retrofit Strategies (DRS)

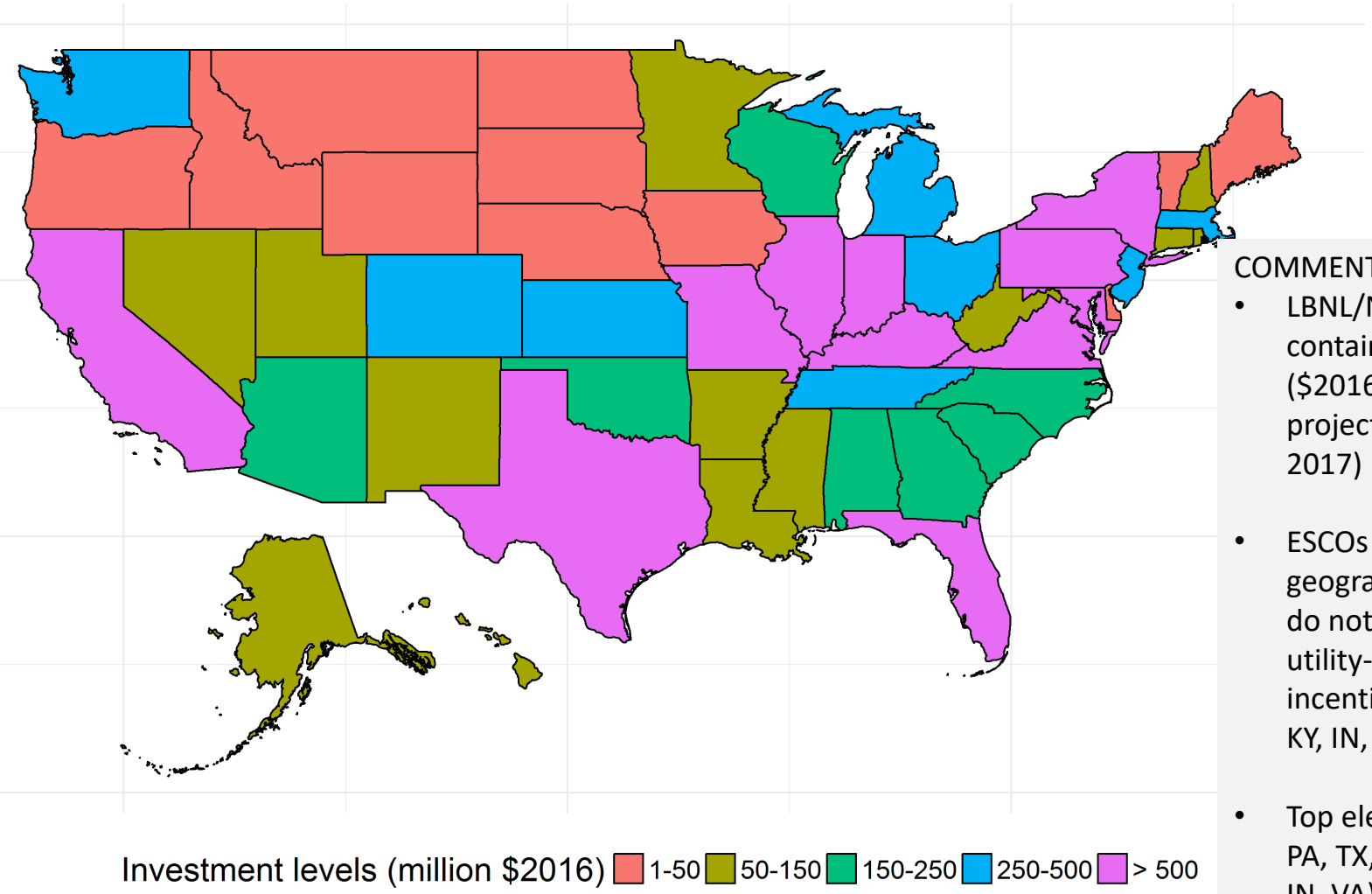
COMMENTS:

- DRS identifies the type of measure that drives project investment levels and savings.
- ESCO projects typically include several-to-many measures (e.g. a roof replacement may also include lighting and HVAC retrofit), but DRS allows us to classify projects for benchmarking

DRS	Criteria	Example of ECM and/or NEM included in this category
Lighting-only	Projects include only this type of measure	Lamps, ballasts, and lighting controls
Minor HVAC	Normalized project investment of $5/ft^2 or less.	Smaller HVAC measures and controls (eg. modifications and upgrades to larger equipment)
Major HVAC	Normalized project investment of $5/ft^2 or more.	Major HVAC equipment replacements (e.g., boilers, chillers, cooling towers, HVAC dist. improvements)
Onsite/renewable generation	Projects include onsite generation technology	Diesel backup generators, PV systems, and biomass gasifiers
Motors and drives	Normalized project investment of 5 $/ft^2 or less.	Industrial process equipment not directly related to HVAC, such as variable speed drives, pumps and priming systems, and electric motors.
Water conservation	Majority of dollar savings are from water savings	Low flow showers, faucets, urinals, and toilets, as well as meters and leak detection equipment.
Non-energy	Normalized project investment of $7/ft^2 or more and majority of dollar savings are non-energy savings.	Measures installed for reasons other than their energy savings (roof or ceiling replacement, asbestos abatement
Other	Projects include only these types of measures	Vending machines, laundry or office equipment, high-efficiency refrigeration, staff training and utility tariff negotiation.

PROJECT ACTIVITY

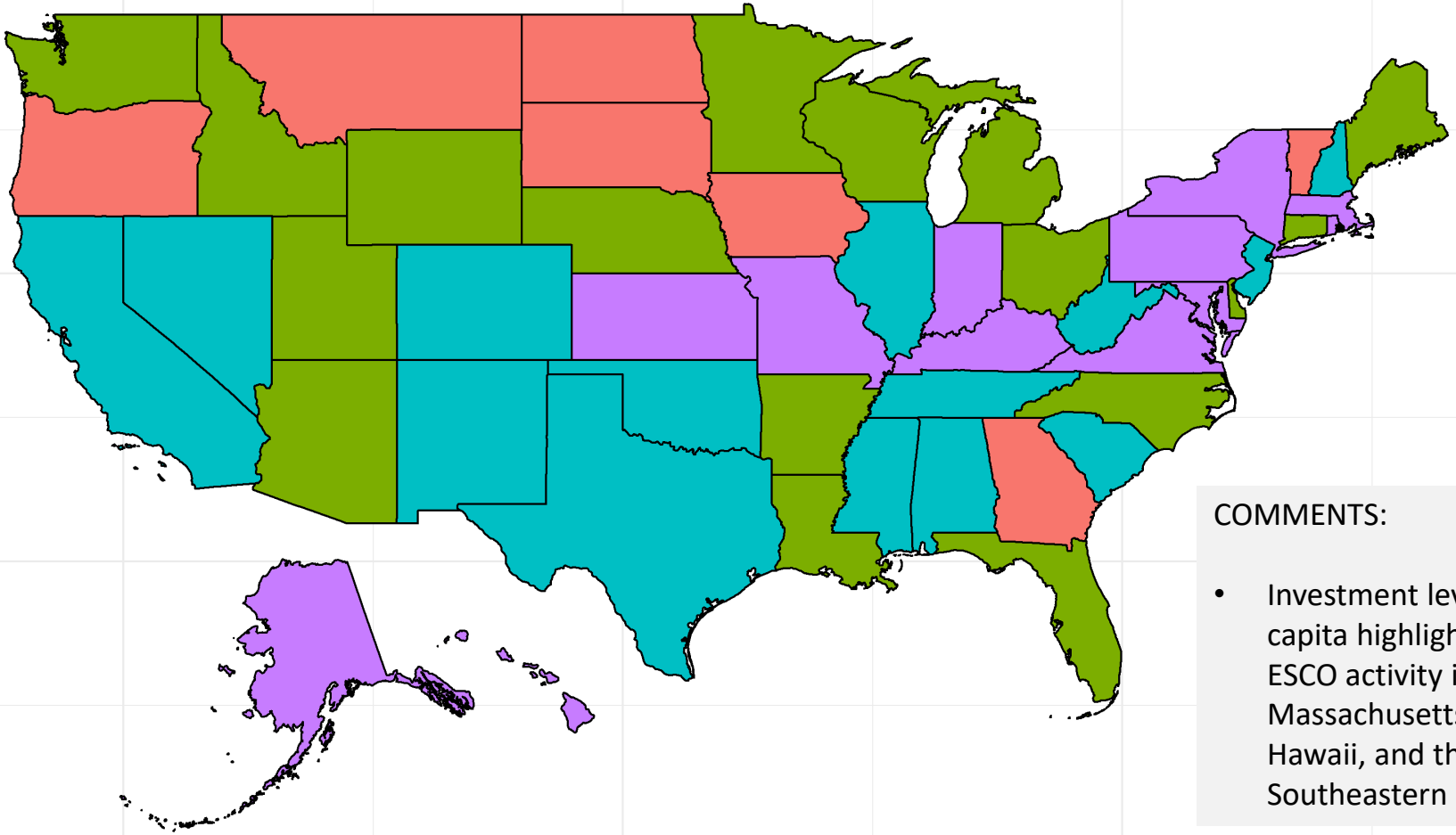
Total investment level of reported projects by U.S. state



COMMENTS:

- LBNL/NAESCO database contains $17.3 billion ($2016) of aggregate project investment (1990-2017)
- ESCOs are active in geographic markets that do not have significant utility-funded EE incentives programs (e.g., KY, IN, VA, MO, TN, KS).
- Top eleven states (CA, NY, PA, TX, MD, IL, FL, MO, KY, IN, VA) account for 60% of aggregate project investment

Total investment level per capita of reported projects by U.S. state

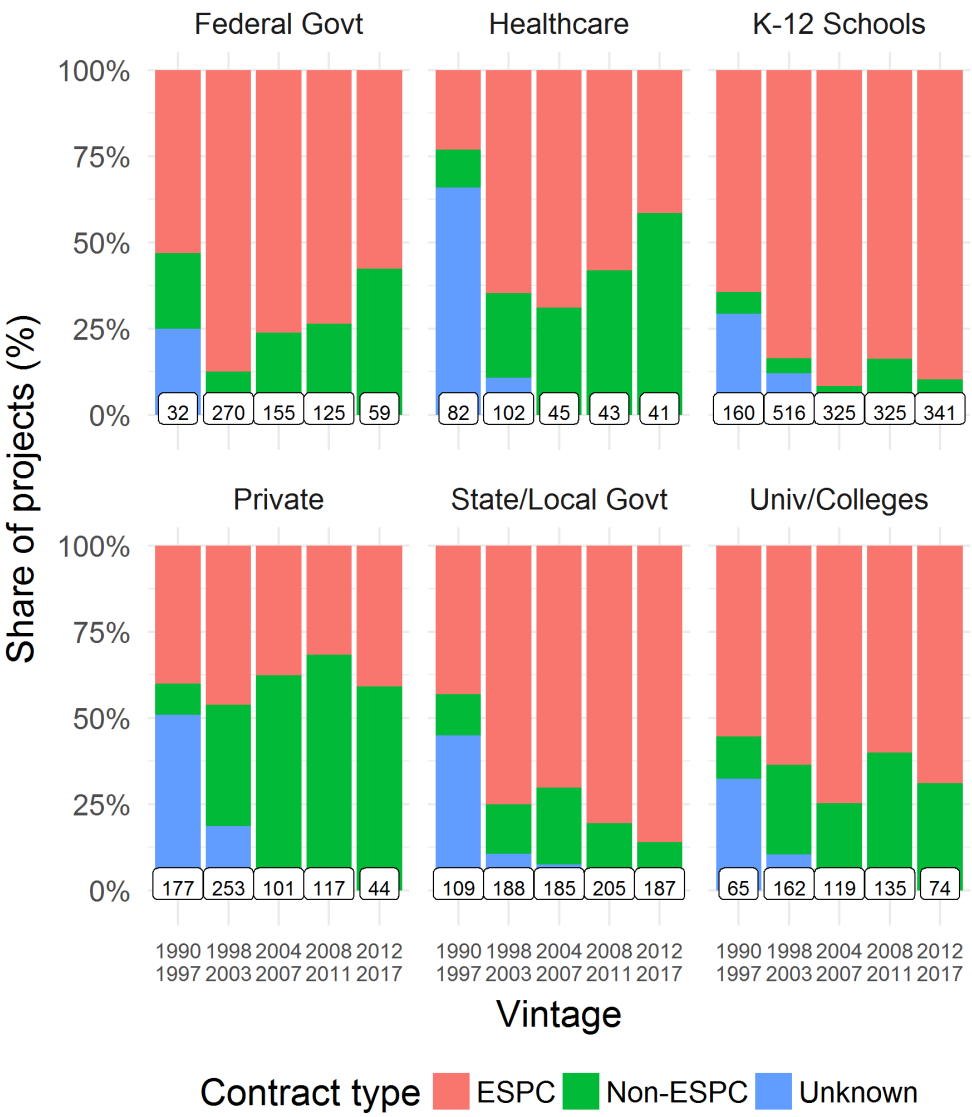


COMMENTS:

- Investment levels per capita highlight increased ESCO activity in Kansas, Massachusetts, Alaska, Hawaii, and the Southeastern region.

Investment levels per capita ($2016/person) 1-20 20-40 40-60 > 60

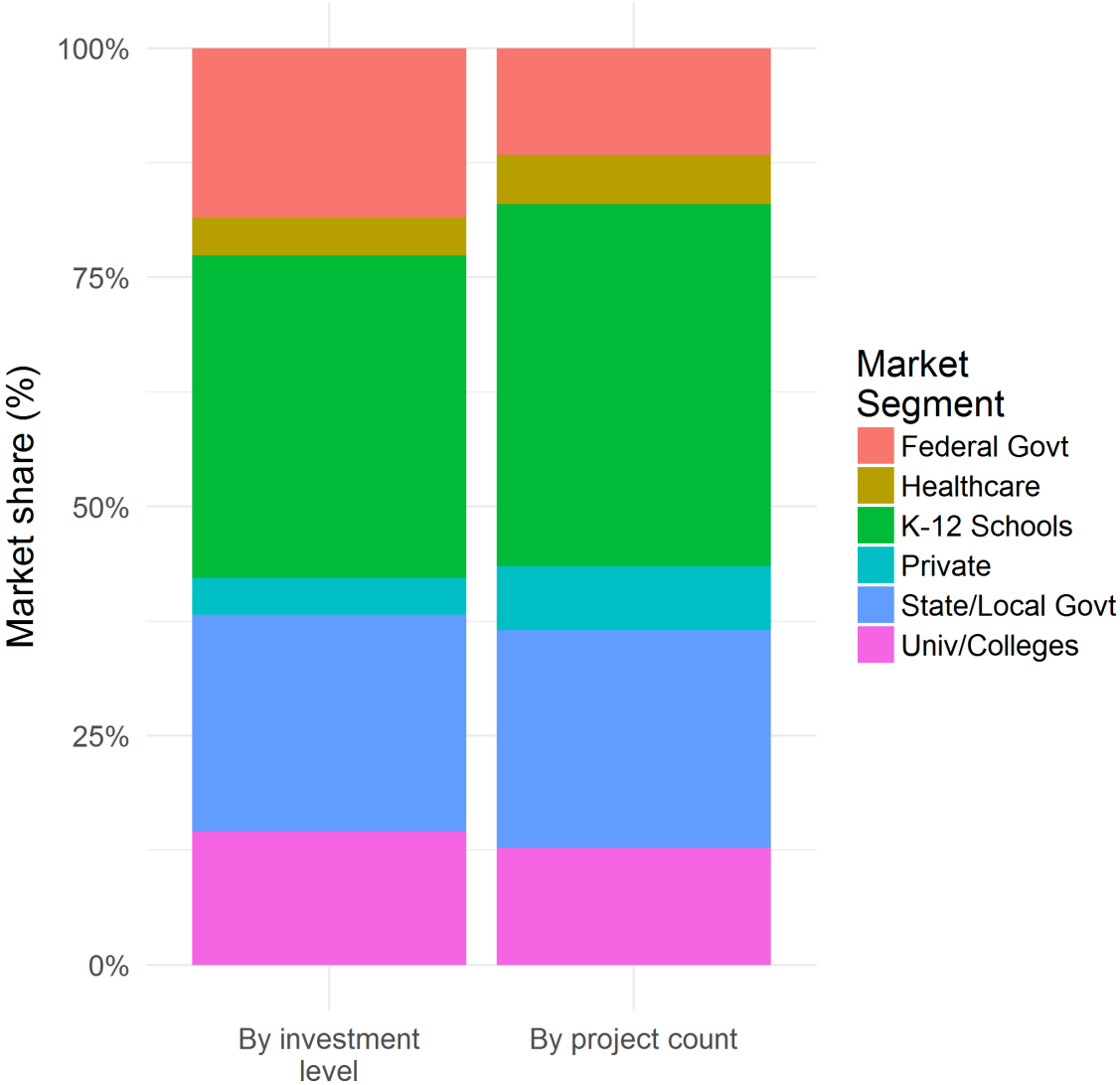
Performance-based contracts are used in over 65% of projects



COMMENTS:

- Contracting types typically used by ESCOs:
  - Energy savings performance contracting (ESPCs)
  - Design/build (contracting)
  - Fixed fee (equipment sale)
- Non-ESPC projects are becoming more prevalent in federal government
- 85% of projects in K-12 and state/local govt. markets are ESPC
- About a third of private sector projects use ESPC; most activity is design/build
- Prevalence of ESPC projects in LBNL database is consistent with industry survey results (Stuart et al. 2016)

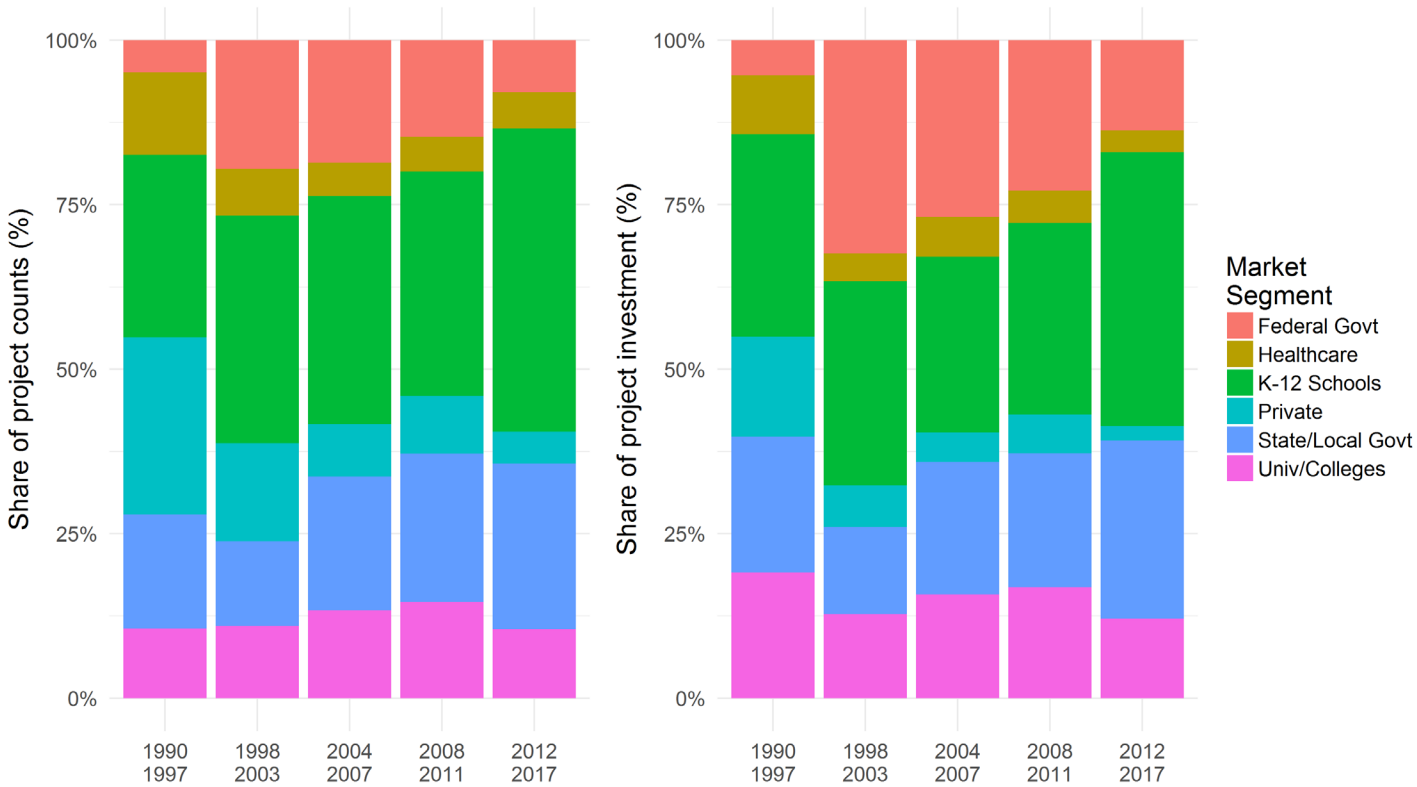
K-12 schools and state/local government projects account for half of market share



COMMENTS:

- Federal government share of revenues are larger than share of project count, because federal projects typically have many facilities and are comprehensive retrofits
- K-12 projects account for a smaller share of revenues than they do projects, because these projects tend to be smaller in size

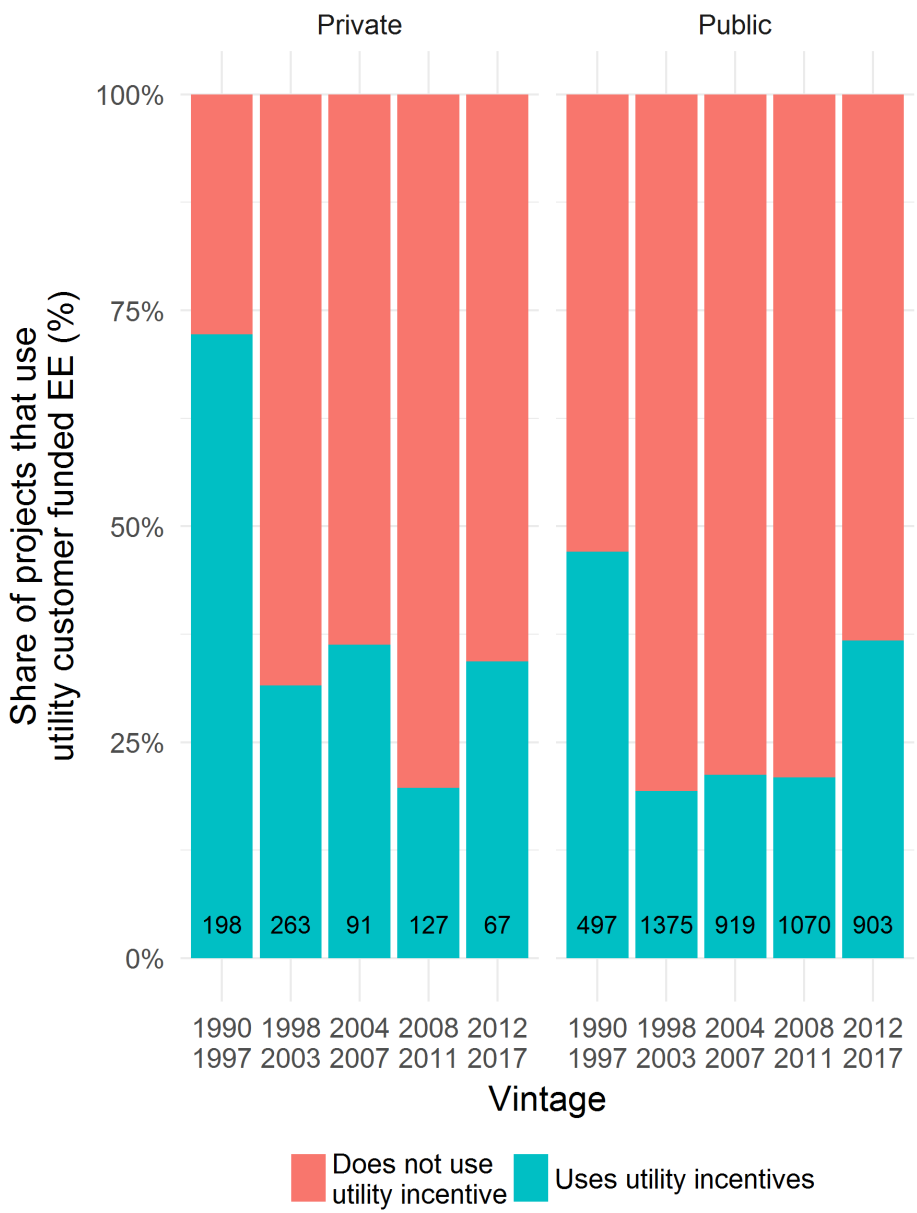
Share of federal govt. and private sector projects are declining



COMMENTS:

- Federal government share since 1997 declined from 20% to 5% by project counts and from 30% to 15% by investment level. Private sector share declined from 25% to less than 5%.
- Aggregate K-12 schools and state/local government share increased from 40% to 75% since the earliest vintage

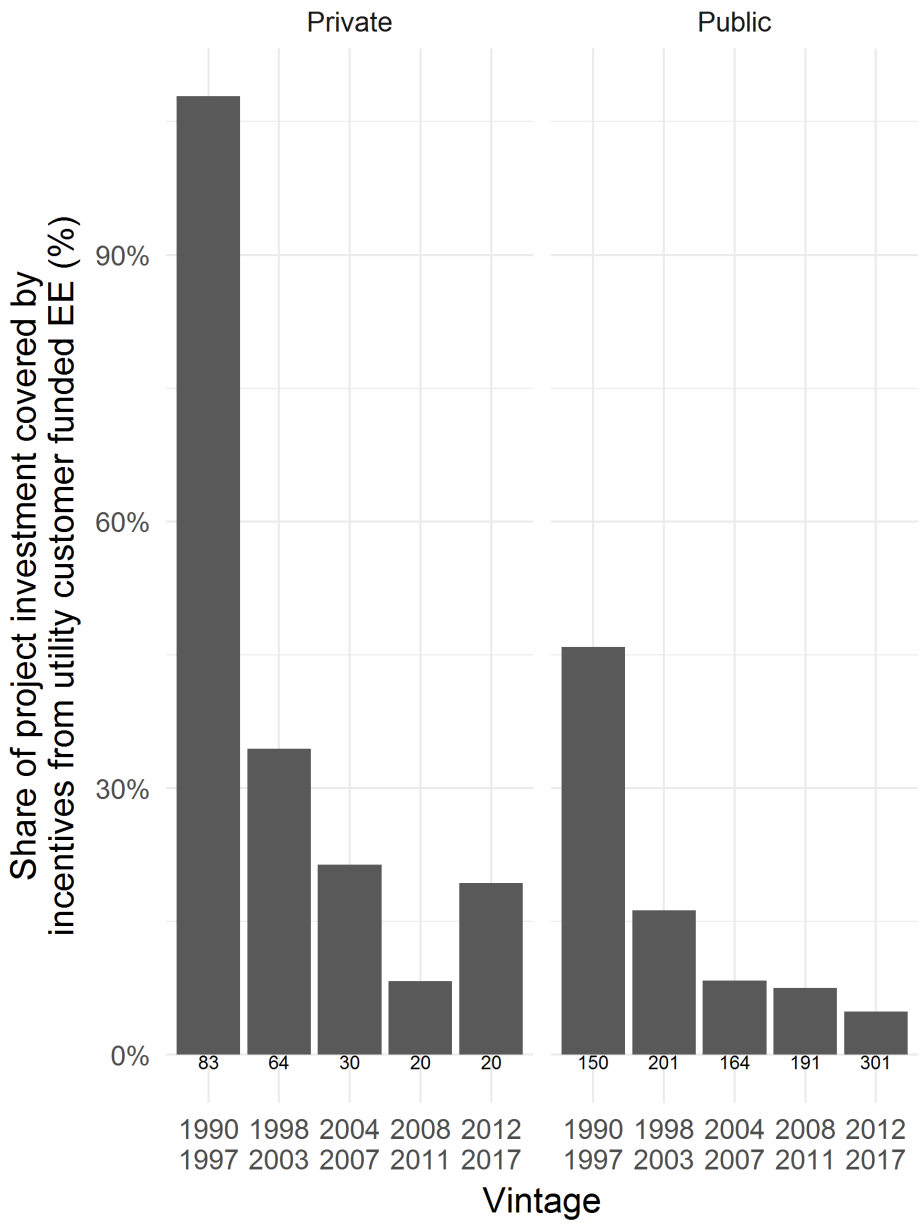
Decline in use of utility incentives



COMMENTS:

- We show the share of projects that report using utility customer-funded EE incentives
- Public and private market use of incentives declined over time; recent rebound in both public and private sectors

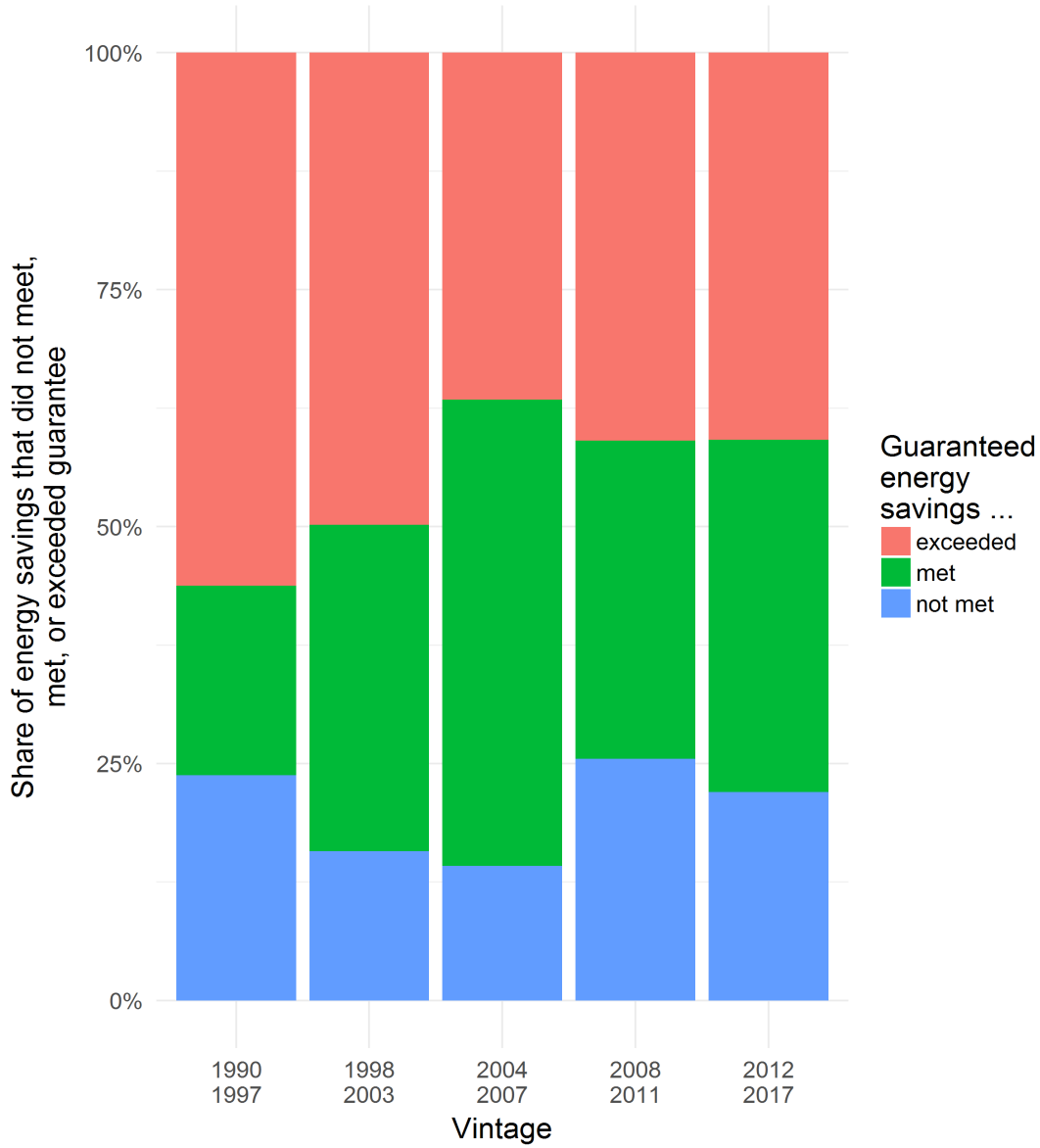
Decline in contribution of utility incentives to project investment



COMMENTS:

- We report the share of project investment that is offset by utility customer-funded energy efficiency incentives
- Private sector has historically used these incentives more frequently
- ~8% of public investment levels (2012-2017) impacted by incentives
- Early 1990s—abnormally large share of project investments offset by PSEG's Standard Offer program

ESPC trends in guaranteed vs actual savings

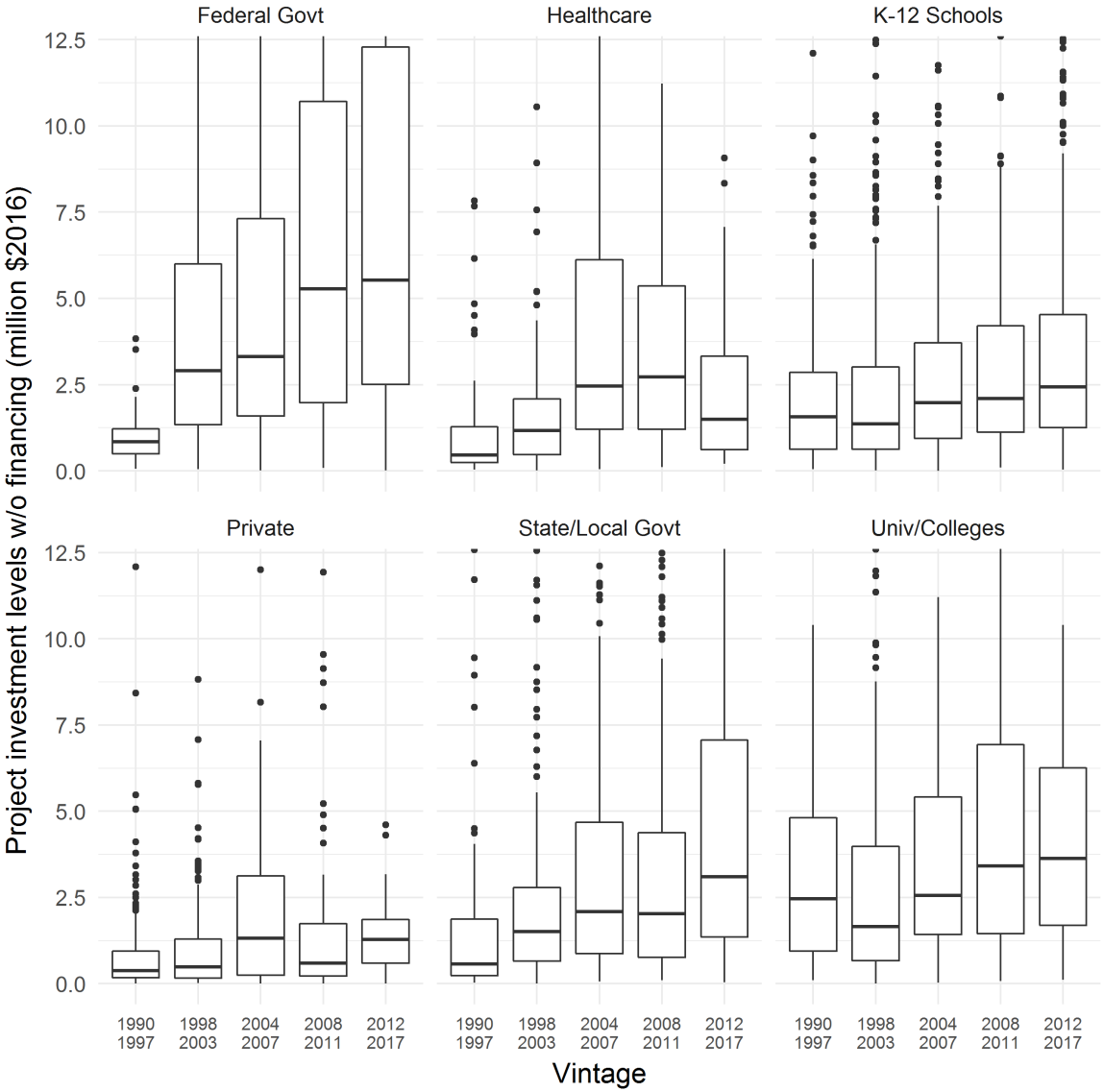


COMMENTS:

- Vast majority (75%-80%) of ESPC projects have met or exceeded their guaranteed energy savings
- Number of ESPC projects that exceeded their guarantee declined from 60% to 40% between 1990 and 2004 – has remained stable since

PROJECT INVESTMENT LEVELS AND MEASURES INSTALLED

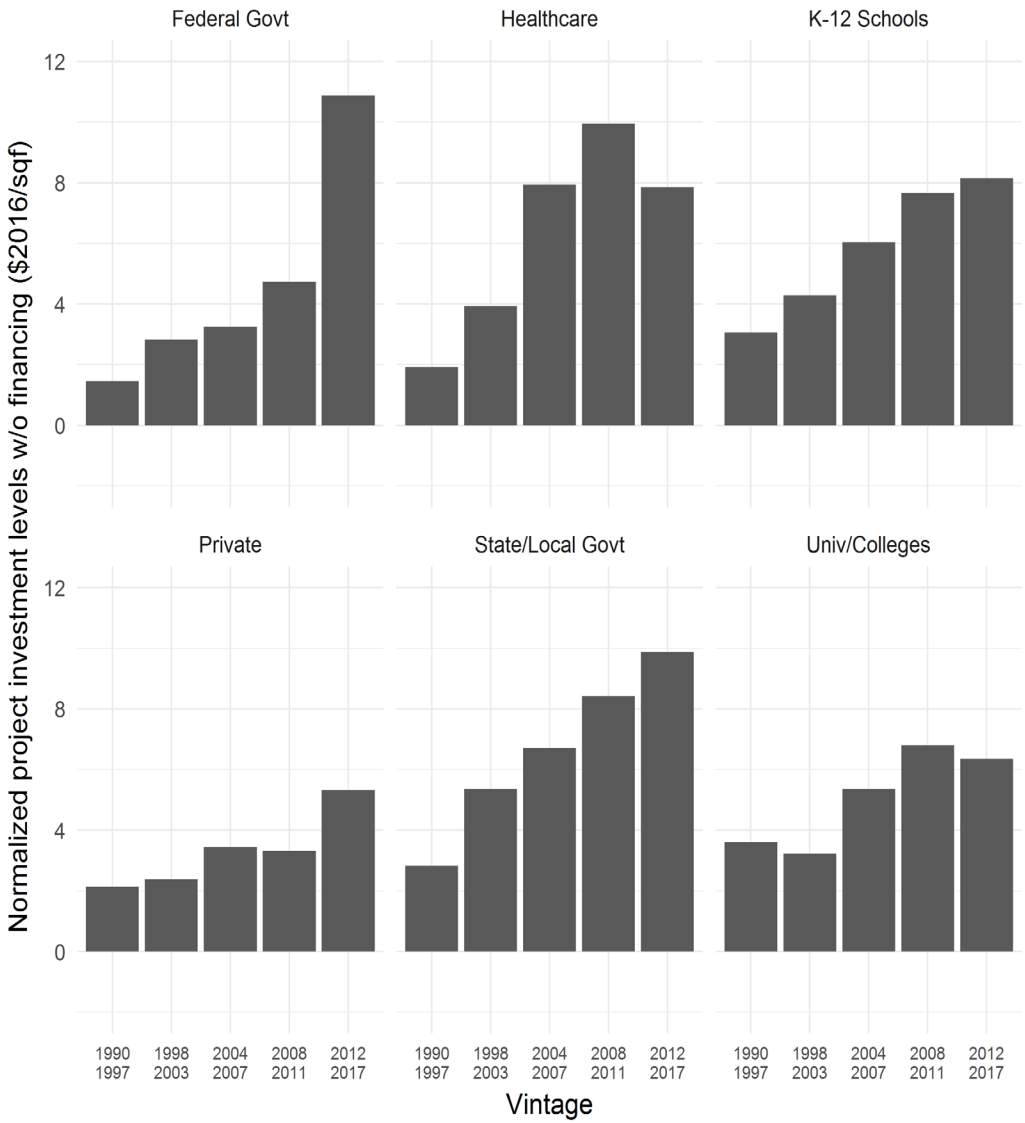
Absolute project investment levels increasing over time



COMMENTS:

- Line within boxplot represents the median; top and bottom of box represents 80th and 20th percentile of projects, respectively
- Project investment is growing over time across markets
- Range of project investment is also growing.
- In recent years, 80% of federal govt. project investment levels are $3M-$12M

Investment levels per sqf have increased *significantly*



COMMENTS:

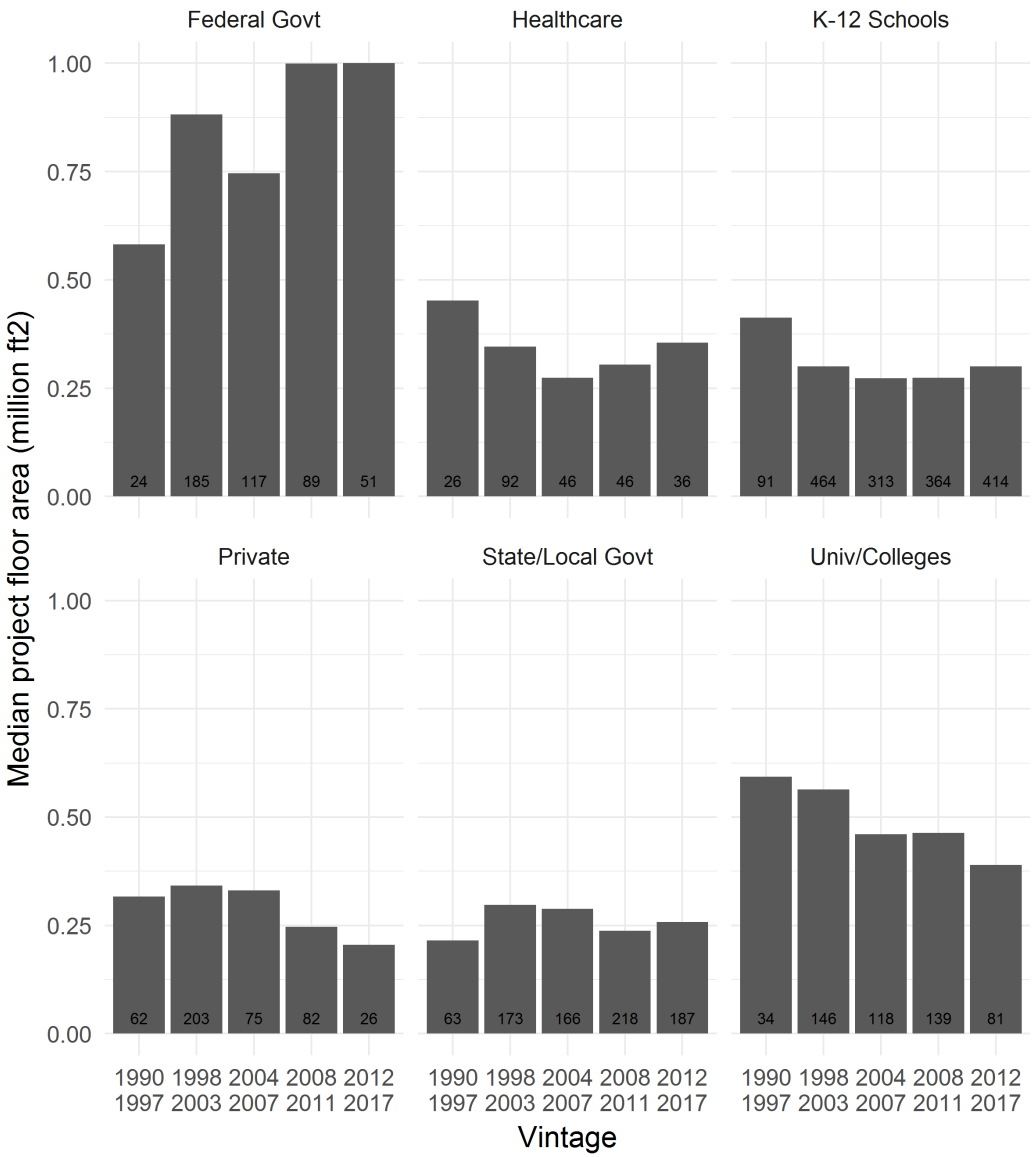
- Investment levels per sqf increasing in all markets
- Recent investment levels range from $4.50/sqf in the private sector to over $10/sqf in the federal and state/local government markets
  - Federal government may suffer from reporting bias in last vintage.
- In a companion paper, we explore factors which may be correlated with industry-level increases over time. We are only able to explain 35%-45% of the increase.

ECM investment levels increasing *significantly*

COMMENTS:

- We report ECM investment levels per sqf using eProject Builder
- Most ECM investment levels increased 200-300% over past 10 years
- Suggests that there are expenses directly related to ECMs—labor and materials—that may explain some of the broader increases to project investment levels

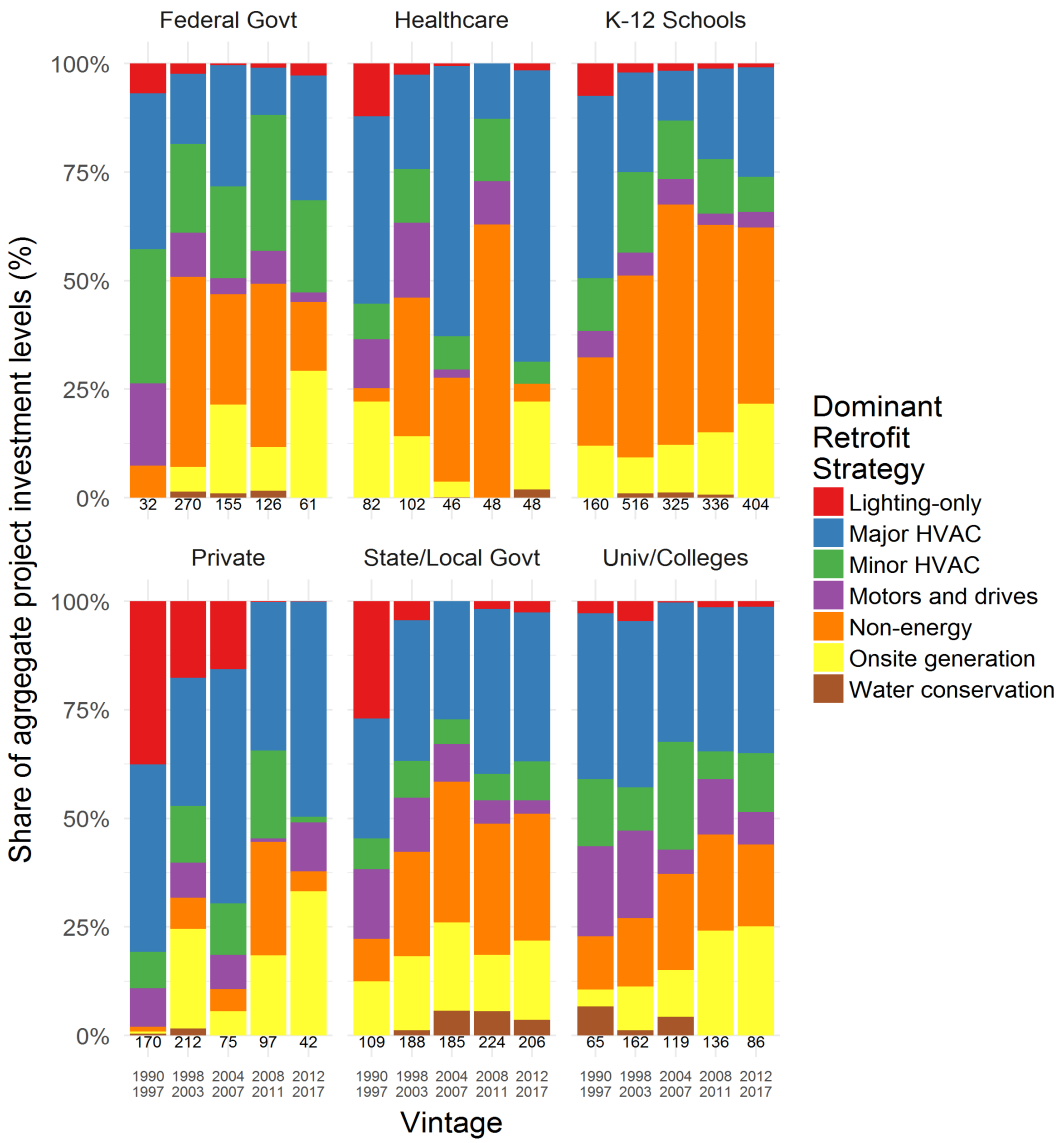
Project floor area stable in recent years



COMMENTS:

- In past decade, project size—expressed as floor area—has been relatively stable
- Typically, ESCO retrofits span numerous buildings within a single project
- Federal government projects facilities are the largest, followed by universities and colleges
- Increase in federal government project floor area may reflect ESCO activity in large military facilities

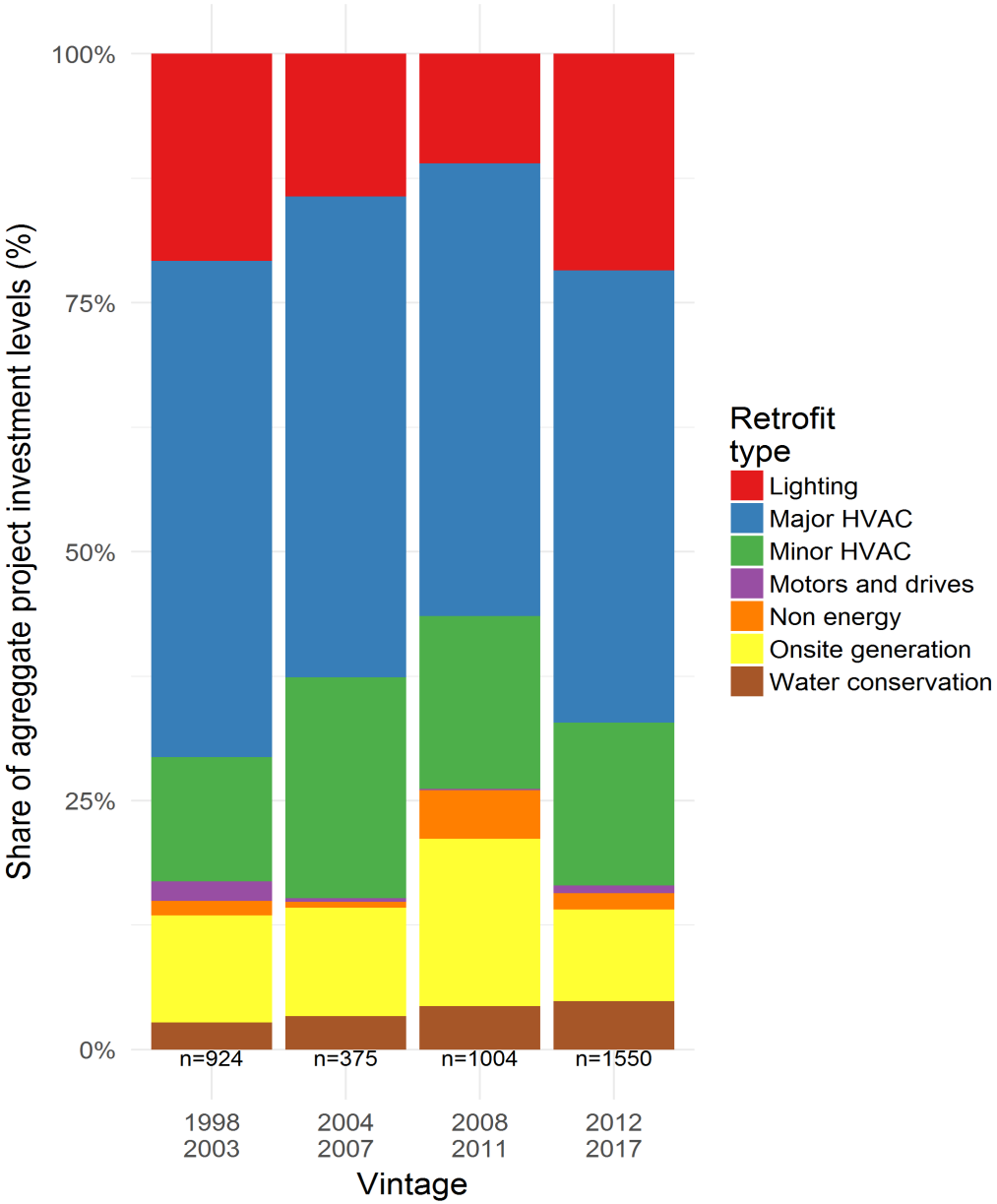
Increased adoption of capital intensive DRS in recent years



COMMENTS:

- Measure mix varies by market, which reflects different opportunities and customer preferences
- Non-energy measures are still very common in K-12 schools
- Onsite generation becoming more frequent in most markets—this reflects demand for resiliency and opportunities from net-metering
- Since 2012, Major HVAC retrofits account for 30-35% of project investment in state/local govt, universities and federal market and over 50% in health care
- Increased prevalence of some DRS explains some increased investment levels
    - Non-energy and onsite generation in K-12 schools and federal/local/state government
- Lighting-only projects are extremely rare

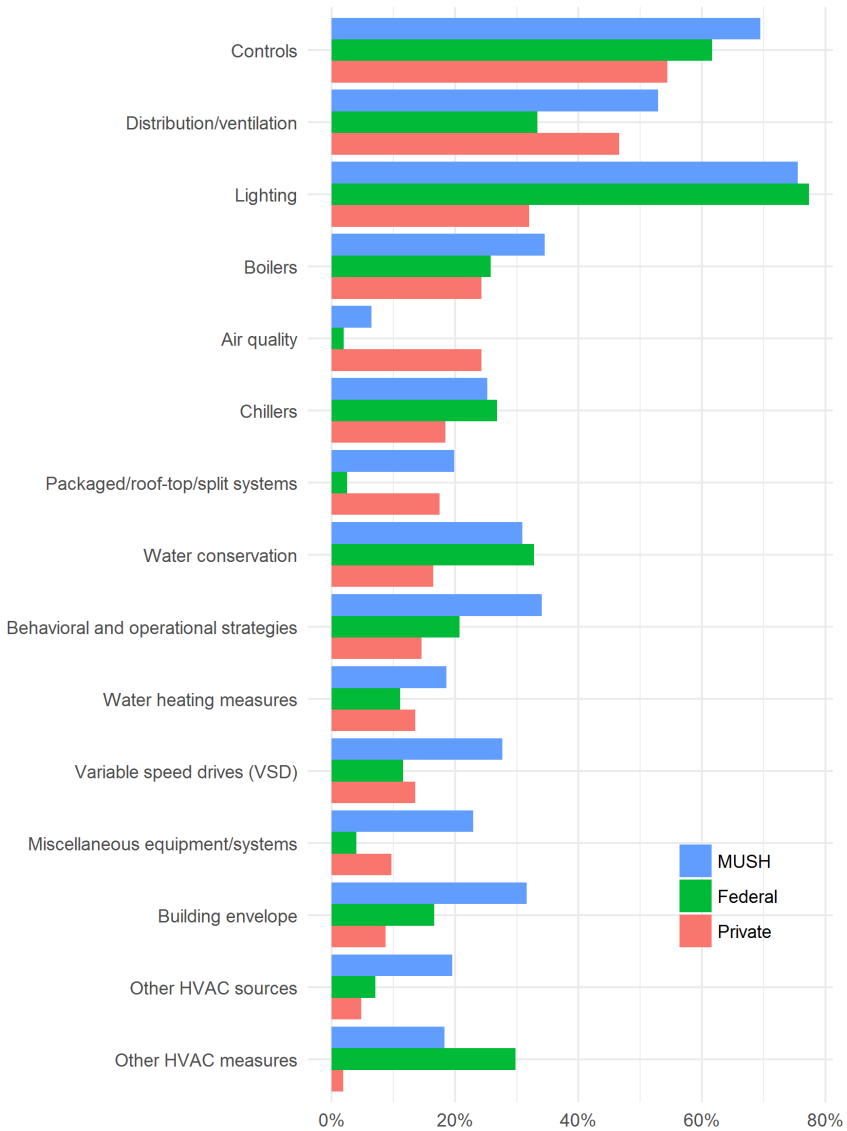
ECM level analysis supports extensive use of HVAC



COMMENTS:

- We use ePB data to estimate the share of investment by energy and non-energy conservation measures. ePB data mostly reflects federal government dynamics
- Major HVAC measures are the most prevalent across projects, with over 50% of the investment.
- Lighting measures capture between 15% and 25% of project investment
- Onsite generation accounts for about 15% of investment

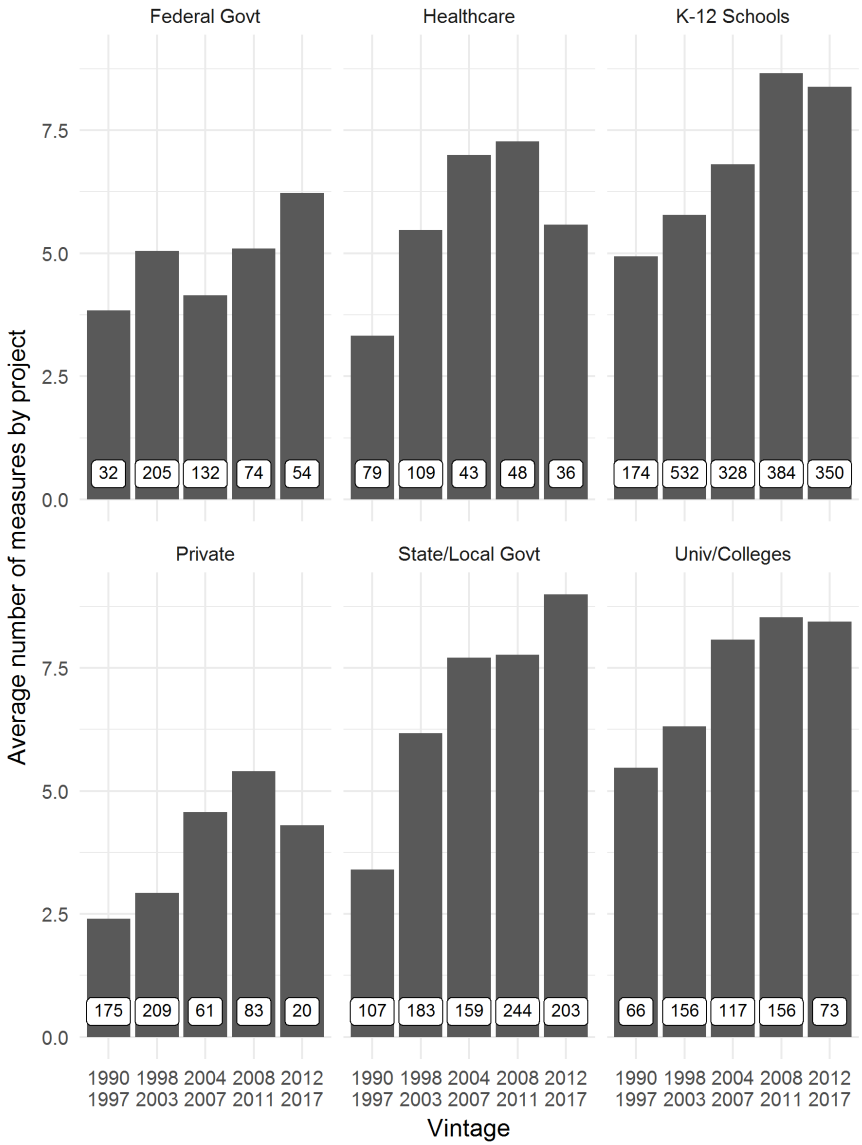
Lighting and controls are the most prevalent measures



COMMENTS:

- We report the share of projects that install a given measure over 2008-2017 by market category (MUSH, Federal, Private)
- Ventilation, lighting, and controls are the most common measures
  - However, less than 40% of private sector projects are installing lighting
- Large percentage of MUSH projects install all of the most common measures. This reflects that MUSH market projects are more comprehensive

Projects are becoming more comprehensive across markets

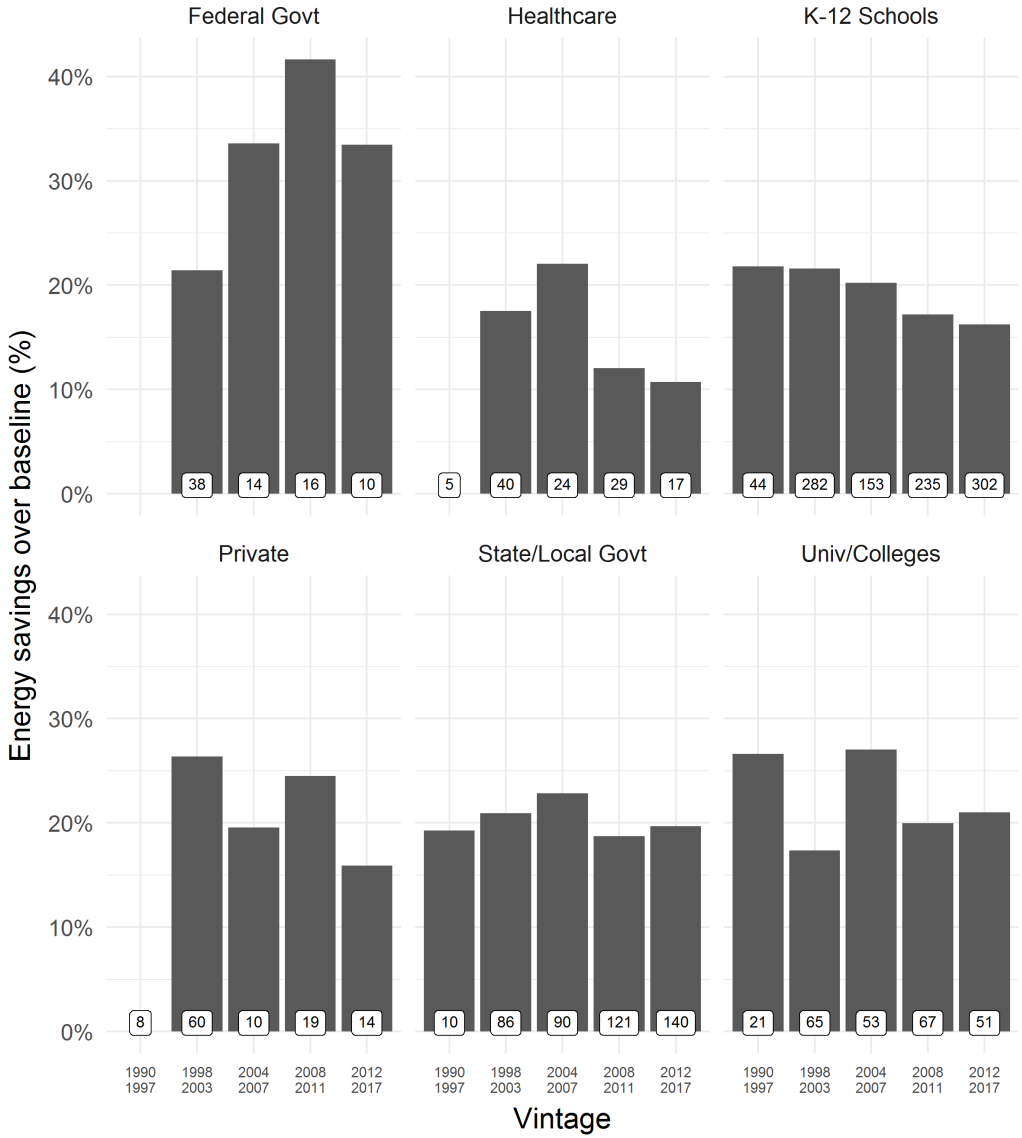


COMMENTS:

- We calculate the average number of measures installed in projects by market sector--a measure of "comprehensiveness"
- Projects in the ESCO industry are becoming more comprehensive—3.7 to 8.1 average measures installed since earliest vintage
- K-12 schools and state/local govt. have doubled or tripled the average number of installed measures
- Comprehensiveness reflects desire for deeper retrofits and increased savings

PROJECT SAVINGS LEVELS

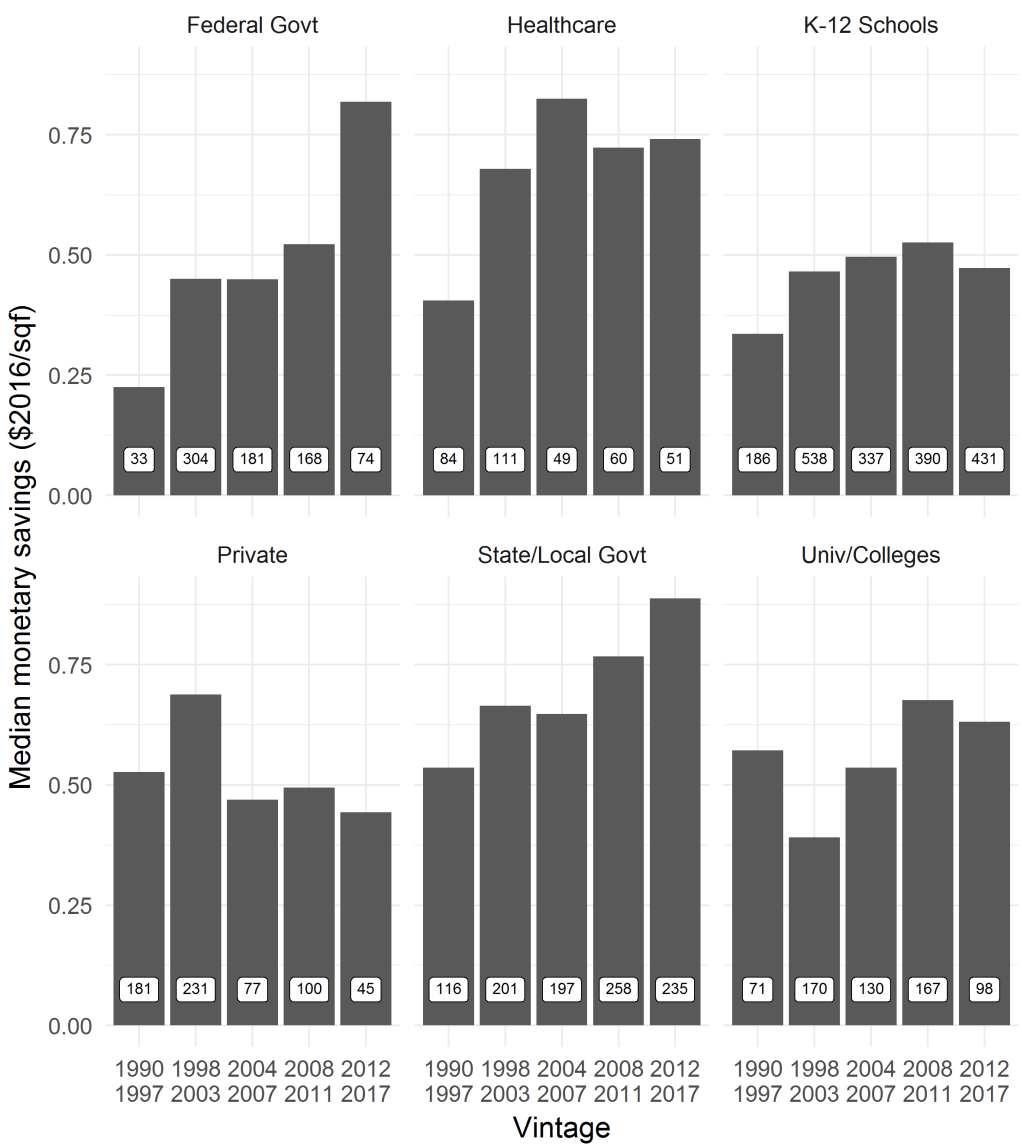
Annual energy savings (%) have stabilized over time



COMMENTS:

- In recent years, projects typically save about 20% of utility bills annually
- Federal government projects achieved as much as 40% savings during the ARRA period.
- Saving levels declining or stable in many markets. This dynamic may increase demand for more comprehensive projects that search for savings wherever they exist

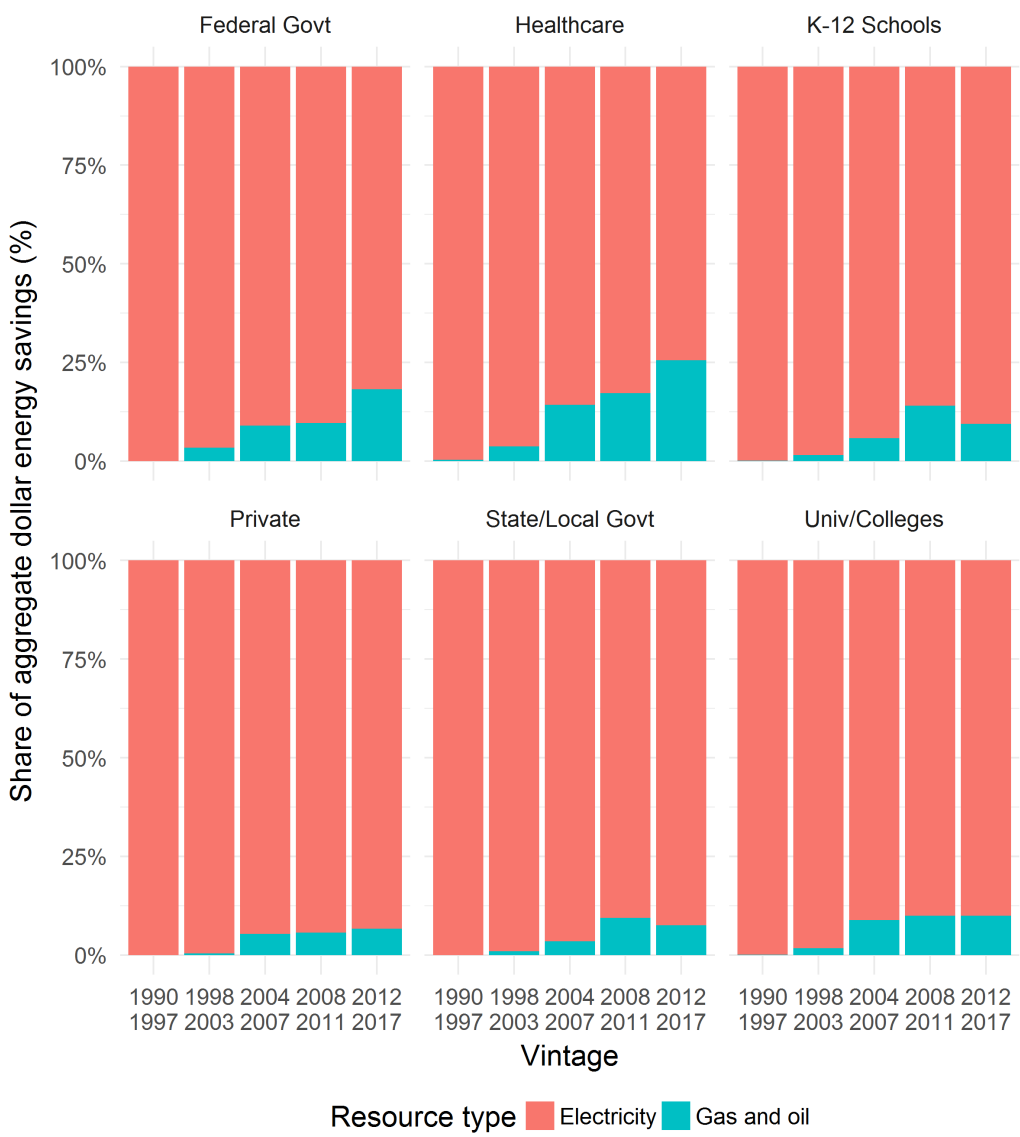
Dollar savings per sqf are growing slowly or remaining stable



COMMENTS:

- 'Normalizing' involves dividing investment levels by square footage to remove the impact of floor area (i.e., project size)
- Typical project dollar savings increased 50% from $0.42/sqf to $0.62/sqf since 1990
- Federal government normalized dollar savings tripled since 1990; state and local governments dollar savings doubled in the same period

Majority of energy savings from electricity



COMMENTS:

- We calculate aggregate dollar savings for electric energy and gas & oil
- Electric energy remains the main source of ESCO dollar savings across markets
- Gas & oil savings increasing in federal govt. and healthcare markets, despite decrease in commodity prices

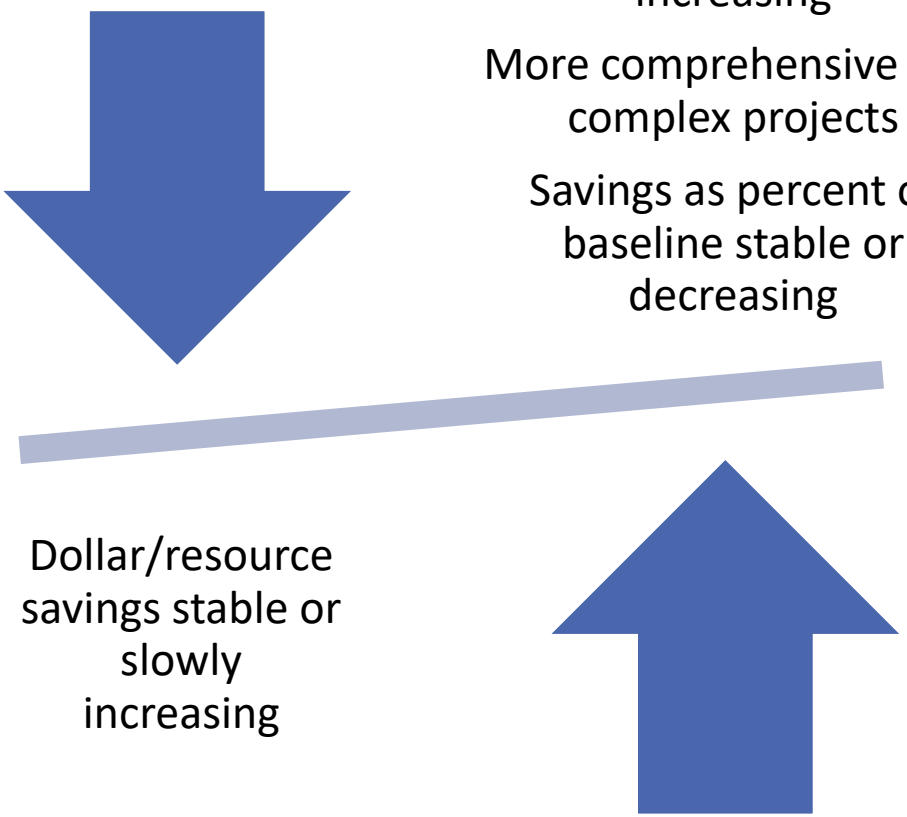
Non-energy savings account for significant share of the dollar savings in K-12 and federal government market

COMMENTS:

- Reported non-energy savings include savings in O&M expenditures and deferred capital costs from energy efficiency investments
- Non-energy dollar savings are significant and increasing in federal and K-12 Schools

KEY PROJECT PERFORMANCE METRICS

Countervailing forces of project performance



COMMENTS:

- Project savings have been increasing more slowly than investment levels
- ESPCs continue to meet and exceed guarantees
- If projects are requiring more capital-intensive projects to achieve deep savings, then other project characteristics are likely to reflect this trend (e.g., contract length, simple payback time)

Project economic performance—from customers' perspective

- Simple payback time (SPT) as a project economic performance metric
  - SPT is calculated by dividing project investment levels (net of subsidies and financing costs) by annual monetary savings
  - More appropriate for evaluating a single project than NPV of net benefits
    - Net benefits analysis is more appropriate for comparing investments
    - SPT does not consider the time value of money
- SPT compared against two related metrics:
  - Contract Length (CL)
    - Number of years over which savings are guaranteed
  - Mean Measure Lifetime (MML)
    - Simple average of expected useful life of each measure installed on a given project
    - Reflects the number of years we expect a project's energy savings to persist, regardless of contractual conditions

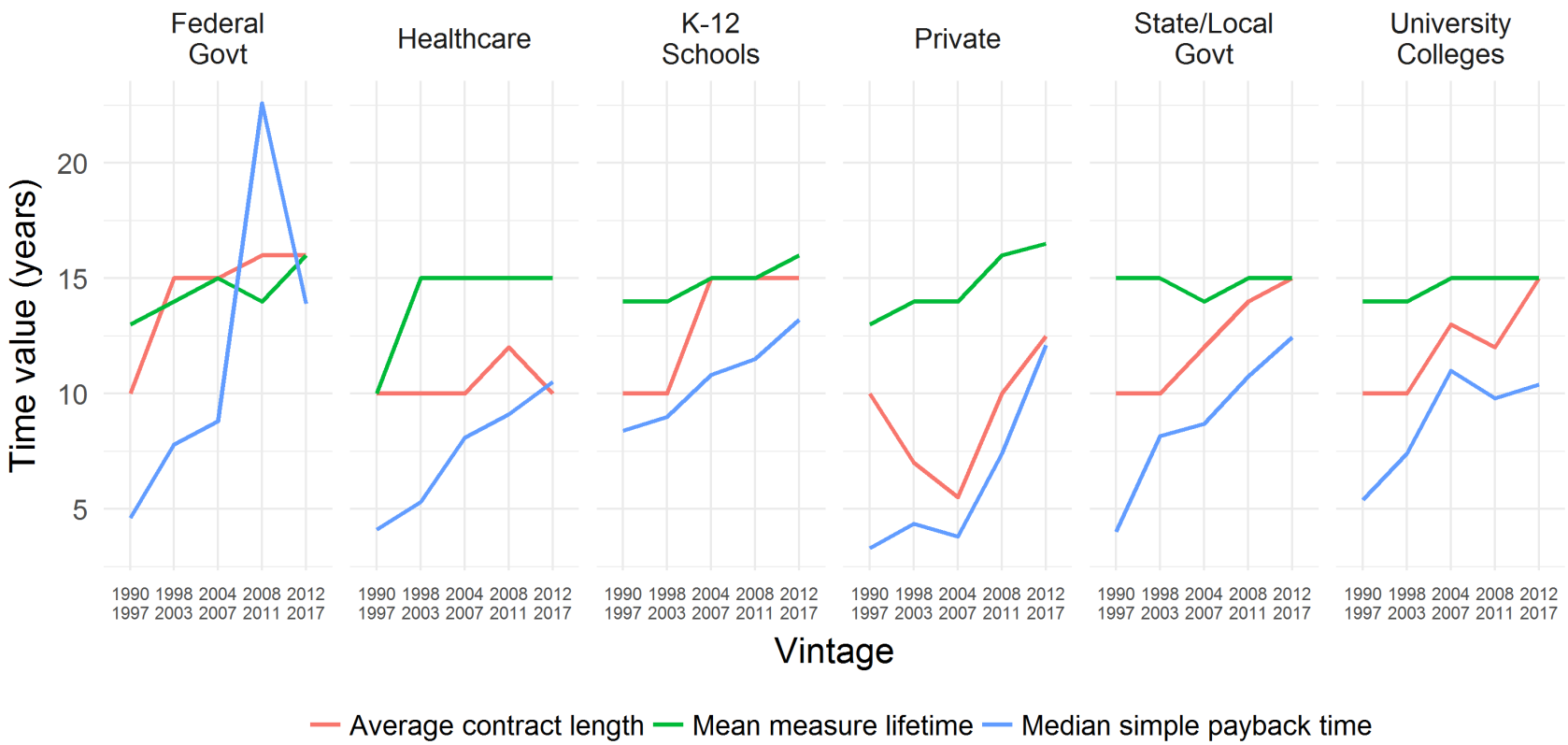
Median SPT increasing over time across markets

	Federal Govt	State/Local Govt	Healthcare	Private Comm./ Indust.	K-12 Schools	University/ Colleges
1990-1997	5.0	4.2	4.2	3.7	8.4	5.0
1998-2003	7.3	7.7	4.6	3.9	8.4	6.5
2004-2007	8.6	8.0	7.4	5.3	10.0	8.7
2008-2011	11.9	10.7	9.2	9.3	11.7	10.1
2012-2017	12.9	12.5	8.5	8.2	13.2	11.4

COMMENTS:

- Median SPT has more than doubled across markets since the earliest vintage
- Private sector SPT is ~8 years; public sector SPT is ~12 years in most recent time period.
- Increase in SPT can be driven by desire for more comprehensive projects, reduced savings, higher share of more expensive measures installed (i.e. changes in DRS), and higher project investment levels

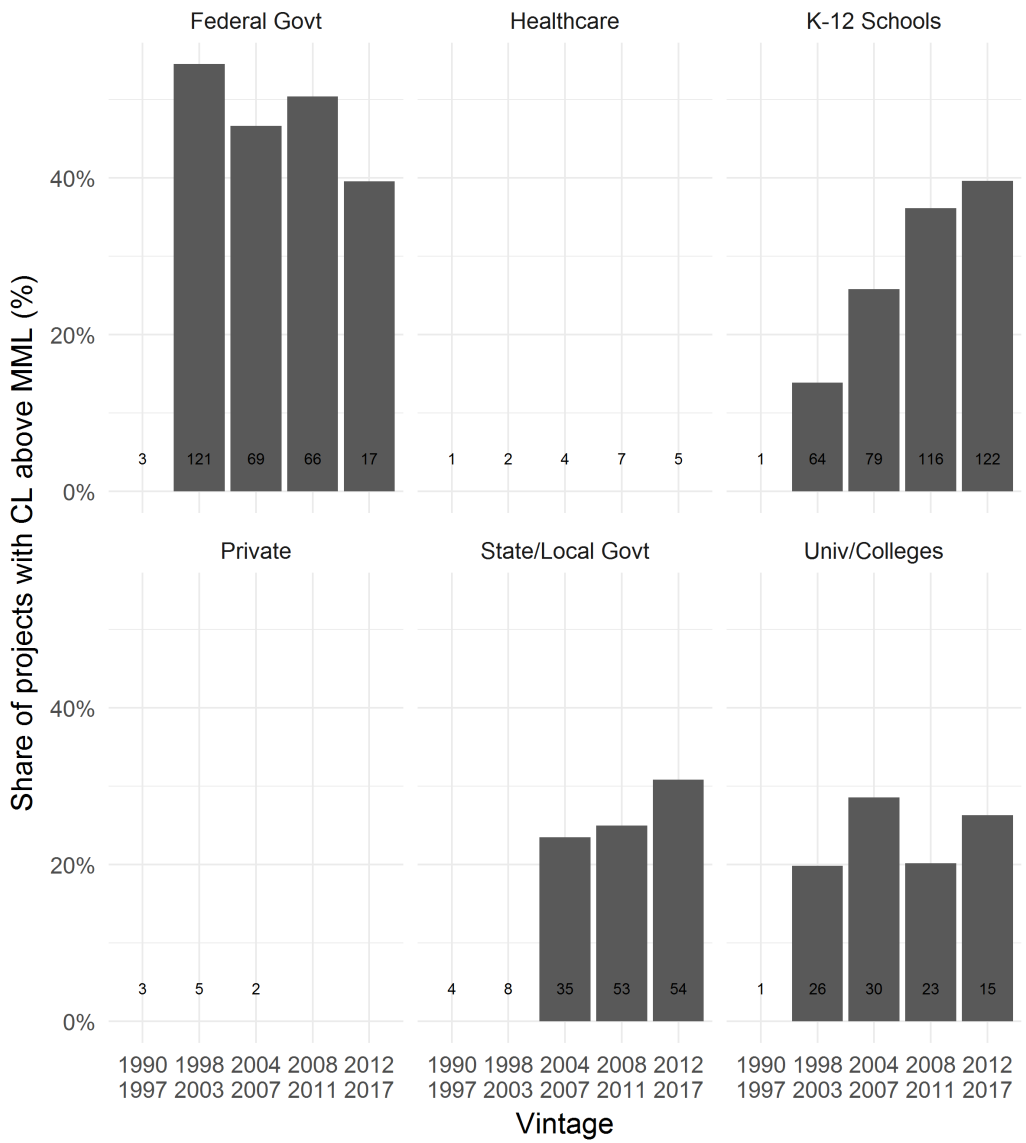
SPT increase correlates with increase in CL



COMMENTS:

- MML stable over time across markets reflects no major changes in measure useful life
- Growth in SPT is correlated with increase in contract lengths. CL may be increasing to allow for project payback during the performance period.
- The convergence of SPT and MML may increase the risk in project non-performance

Increase in number of projects whose CL exceed MML



COMMENTS:

- We calculate the share of projects whose contract length exceeds the mean measure lifetime.
- Some projects are at risk of non-performance, as contracts extend beyond the average operational lifetime of the measures
- Largest increase in K-12 schools and state/local govt. to 40% and 30%, respectively
- About 40% of federal govt. project CL exceed their MML
- Small sample sizes outside K-12 school projects limit our conclusions about overall trends

Conclusion: overview

- U.S. ESCO industry annual revenues estimated at $7-8 billion (2017). ESCOs are active in geographic markets that do not have significant utility-funded EE incentives programs (e.g., KY, IN, VA, MO, TN, KS).
- Market share for K-12 schools and state/local government, which are largest markets for ESCOs, grew 40% to 75% since 1990, respectively
- Over two thirds of ESCO projects use ESPCs. About 80% of ESPC projects met or exceeded savings guarantee
- Decline in contribution of utility incentives to project investment: less than 5% of project investment was reduced by incentives in recent years

Conclusion: investment and savings levels

- Project investment levels and dollar savings—corrected for inflation—are increasing
  - Investment levels increased 100%-500% since earliest vintage—depending on market
  - Dollar savings levels have increased 50%-70% over the same time frame

- Source of dollar savings has evolved over time
  - Reported non-energy benefits are increasing, particularly in the K-12 schools markets where they comprise 40% of total benefits
  - Electric demand charge savings are becoming more prevalent
  - Decreases in oil and natural gas prices lead to reduced savings for projects using these resources

Conclusion: economic performance

- Simple payback time for U.S. ESCO projects has increased from 7 to 13 years over the last three decades
  - Contract lengths increase from 9 to 13 years following the dynamics of payback times
  - Contract lengths less than the average measure lifetime increase the risk of project non-performance

- Trends in investment levels and savings can be attributed to changes in project characteristics
  - Projects are becoming more complex and comprehensive
  - Average number of measures installed per project more than doubled between 1990 and 2017
  - Increasing deployment of capital-intensive measures such as onsite generation, non-energy, and major HVAC
  - Longer contract terms required to pay off projects with higher investment levels

For more information

- LBNL research into the U.S. ESCO industry can be found by visiting:

https://emp.lbl.gov/projects/energy-saving-performance

- The eProject Builder system can be accessed at:

https://eprojectbuilder.lbl.gov/

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