



DENVER
THE MILE HIGH CITY

Green Roofs Review Task Force

City Council Meeting

April 2nd, 2018

FOR CITY SERVICES VISIT | CALL
DenverGov.org | 311

OVERVIEW OF THE AGENDA

Quick Review of the Last Meeting

The Task Force Process Since April 2nd.

The Task Force Proposal

Cost Comparison of the Ballot Initiative to the Task Force Proposal

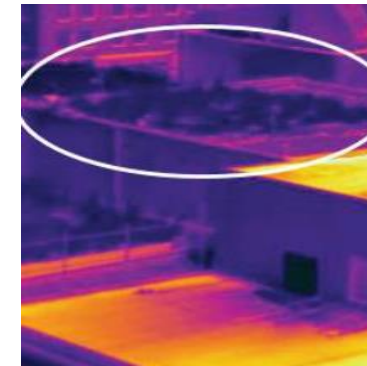
Public Input Process

Quick Review of the Last Meeting

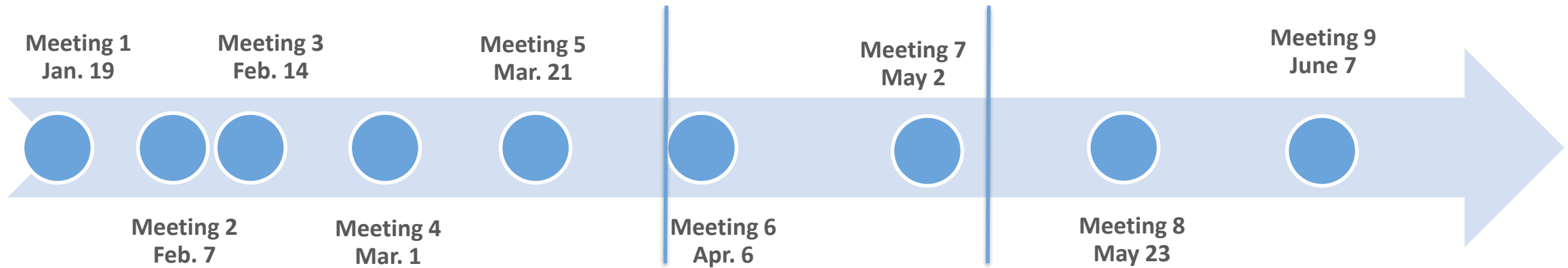
Ordinance that was on the Ballot Benefits

- Urban Heat Island
- Green Spaces
- Water and Storm Water Management
- Greenhouse Gas Emission Reductions

Costs and Unintended Consequences



Task Force Meeting Timeline



Green Roofs Review Task Force Proposal

Green Building Ordinance – Proposed Compliance Options **New Buildings**



Green Roof / Green Space

(roof, terraces, podiums, grade-level)

Green area equivalent to:
10% of roof area x no. of floors
(max 60% of roof area required)

Green

(roof, terraces, podiums, grade-level, off-site)
and Solar
(roof, building, site, community)

Green area equivalent to:
3% of roof area x no. of floors (max 18% of roof area required)
AND
On-site renewable energy or community solar total system production equivalent to:
7% of roof area x no. of floors (max 42% of roof area required)

Solar

(roof, building, site, community)

On-site renewable energy or community solar or Xcel Renewable Connect for a total system production equivalent to:
70% of roof area

LEED v4 BD+C Certification

Minimum Gold level certification

Financial contribution for off-site green space

Green area equivalent to:
10% of roof area x no. of floors
(max 60% of roof area required)
\$17/sf of required green area

Green

(roof, terraces, podiums, grade-level)
and Energy Efficiency

Green area equivalent to:
3% of roof area x no. of floors (max 18% of roof area required)
AND
Minimum 8% energy savings
vs current City of Denver energy code

Energy Efficiency

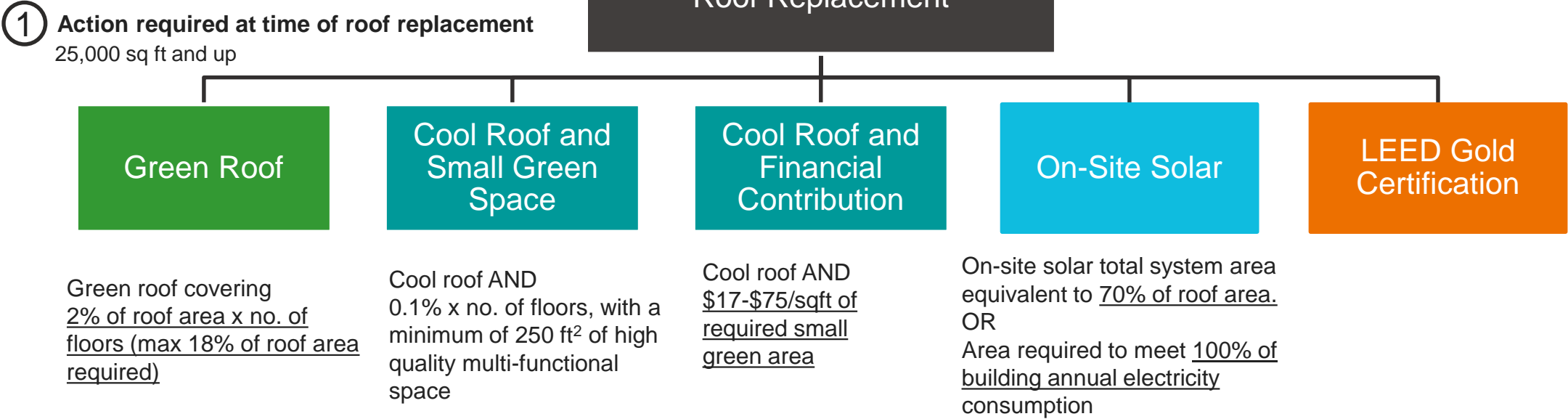
Minimum 19% energy savings
vs current City of Denver energy code

Enterprise Green Communities Certification

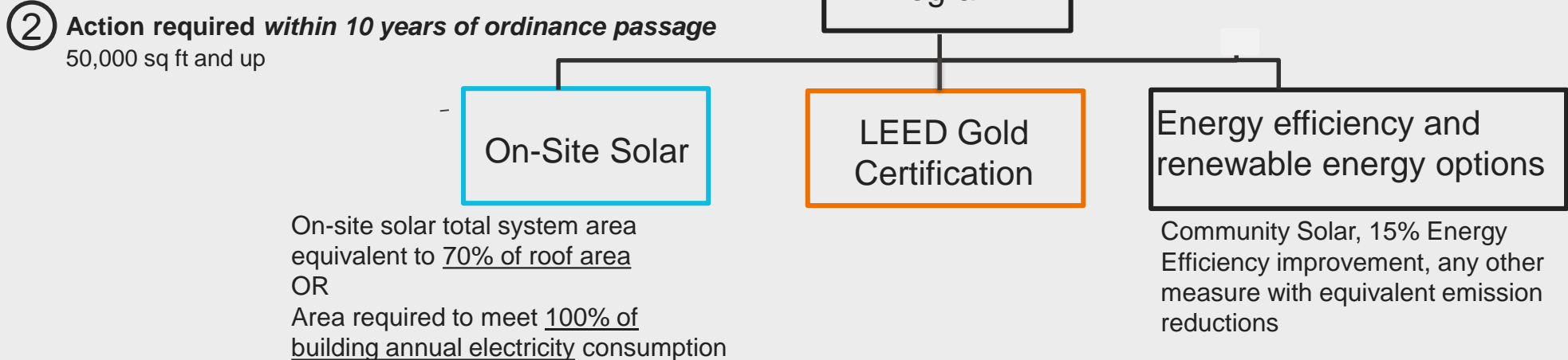
Minimum certification

* All buildings will require a Cool Roof unless the roof is a character defining architectural feature.

Green Building Ordinance – Proposed Compliance Options **Existing Buildings**



-AND-



New Building Policy Proposal

Cost Evaluation

Apartment New Building

55,000 square feet, 5 floors, roof is 11,000 sq ft.

Coverage requirement on the ballot: 30% or 3,300 sq ft.

New proposed coverage requirement: 50% or 5,500 sq ft

Description	Ordinance on the Ballot	New proposal with new proposed coverage requirement.
Cost (\$) to construct the building	\$6,990,500	\$6,990,500
Additional Cost (\$)	\$91,911-\$193,475	\$63,003-\$93,500
Percent Cost Increase	1.3%-2.8%	0.9%-1.3%

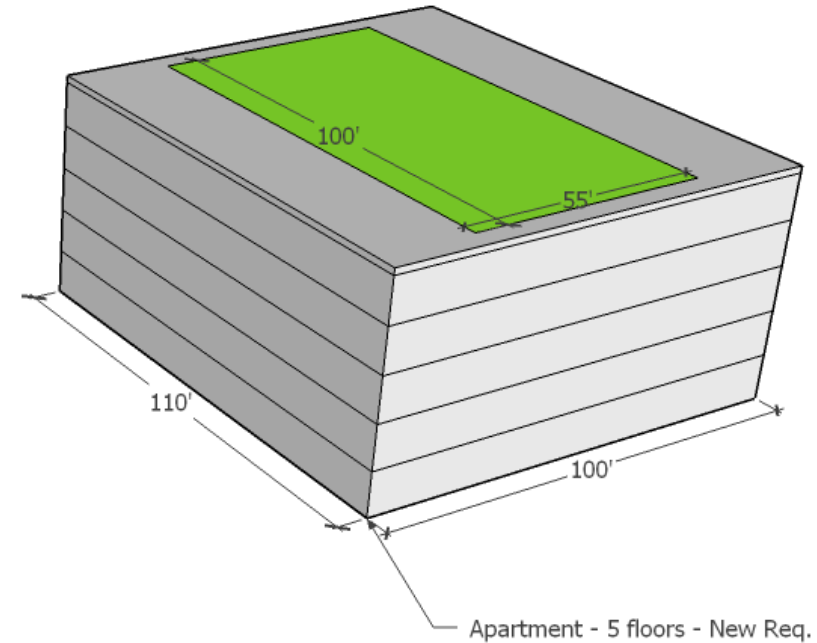
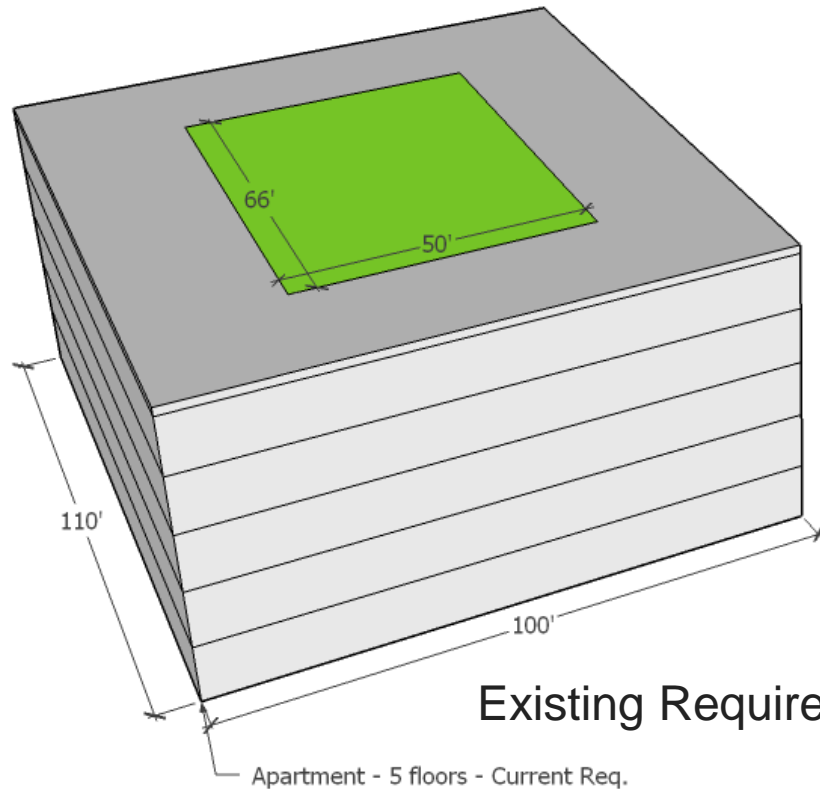
~45% reduction in average costs for the new proposal with the new proposed coverage requirement.

Apartment New Building

55,000 square feet, 5 floors, roof is 11,000 sq ft.

Coverage requirement on the ballot: 30% or 3,300 sq ft.

New proposed coverage requirement: 50% or 5,500 sq ft



Industrial New Building

150,000 square feet, 1 floor, roof is 150,000 sq ft.

Coverage requirement on the ballot: 10% or 15,000 sq ft.

New proposed coverage requirement: 10% or 15,000 sq ft.

Description	Ordinance on the Ballot	New proposal with new proposed coverage requirement.
Cost (\$) to construct the building	\$19,642,500	\$19,642,500
Additional Cost (\$)	\$303,604-\$1,739,897	\$174,713-\$255,000
Percent Cost Increase	1.5%-8.9%	0.9%-1.3%

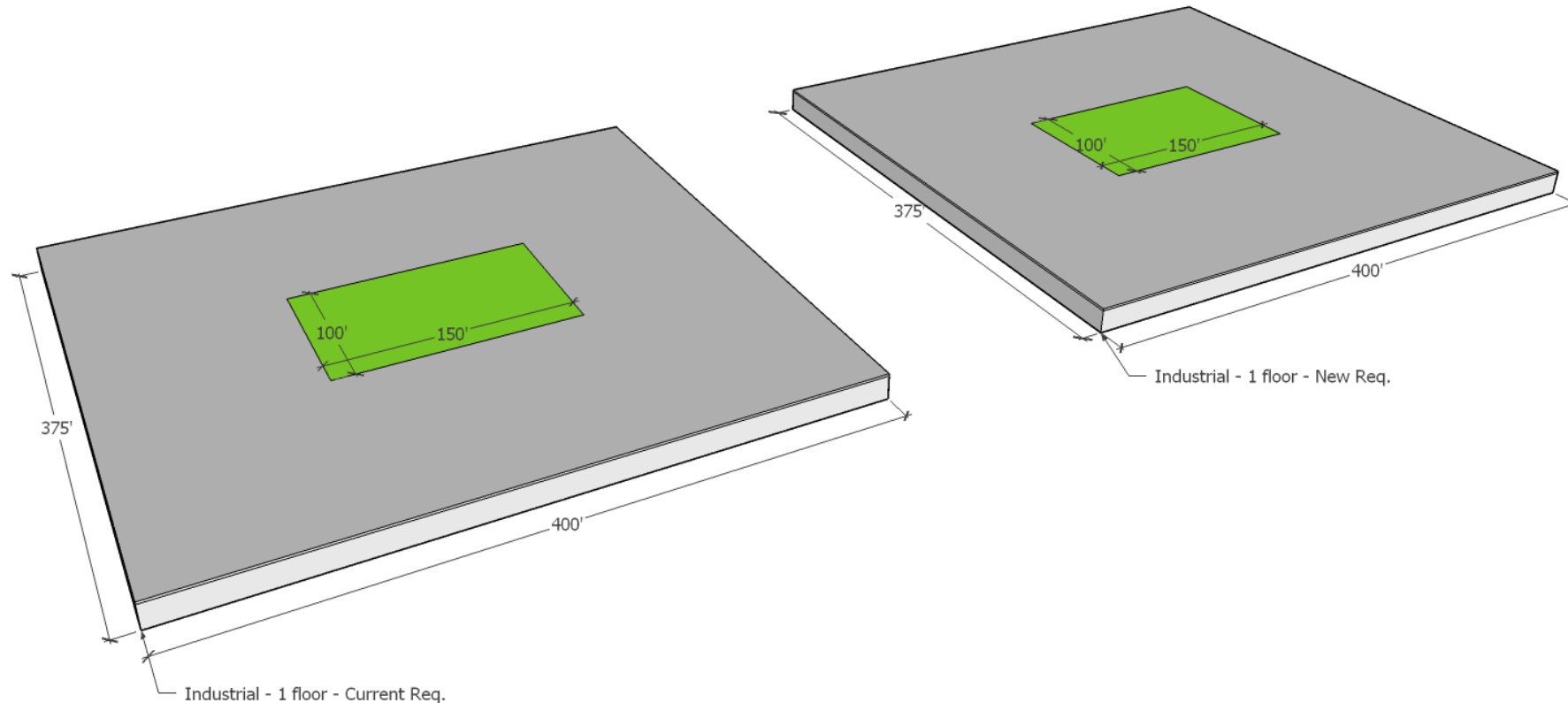
~80% reduction in average costs for the new proposal with the new proposed coverage requirement.

Industrial New Building

150,000 square feet, 1 floor, roof is 150,000 sq ft.

Coverage requirement on the ballot: 10% or 15,000 sq ft.

New proposed coverage requirement: 10% or 15,000 sq ft.



Existing Requirement

Proposed Requirement

Retail New Building

70,000 square feet, 1 floor, roof is 70,000 sq ft.

Coverage requirement on the ballot: 50%, or 35,000 sq ft.

New Proposed Coverage Requirement: 10% or 7,000

Description	Ordinance on the Ballot	New proposal with new proposed coverage requirement.
Cost (\$) to construct the building	\$7,000,000	\$7,000,000
Additional Cost (\$)	\$648,702-\$1,107,275	\$70,700-\$119,000
Percent Cost Increase	9.3%-15.8%	1.0%-1.7%

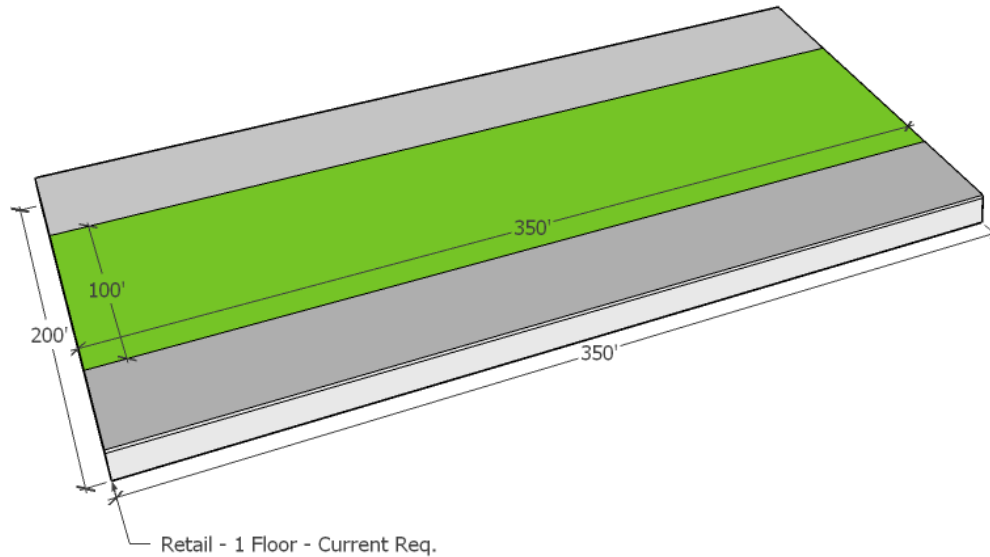
~90% reduction in average costs for the new proposal with the new proposed coverage requirement.

Retail New Building

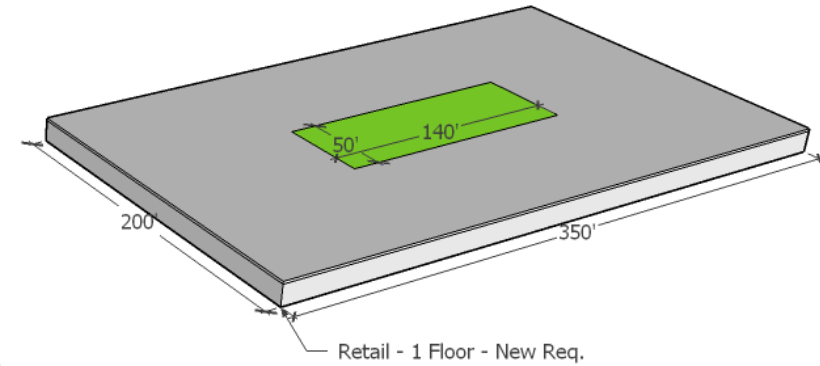
70,000 square feet, 1 floor, roof is 70,000 sq ft.

Coverage requirement on the ballot: 50%, or 35,000 sq ft.

New Proposed Coverage Requirement: 10% or 7,000



Existing Requirement



Proposed Requirement

Office New Building

300,000 square feet, 15 floors, roof is 20,000 sq ft.

Coverage requirement on the ballot: 60% or 12,000 sq ft.

New Proposed Coverage Requirement: 60% or 12,000 sq ft.

Description	Ordinance on the Ballot	New proposal with new proposed coverage requirement.
Cost (\$) to construct the building	\$56,007,000	\$56,007,000
Additional Cost (\$)	\$275,315-\$405,562	\$204,000-\$341,235
Percent Cost Increase	0.49%-0.72%	0.4%-0.6%

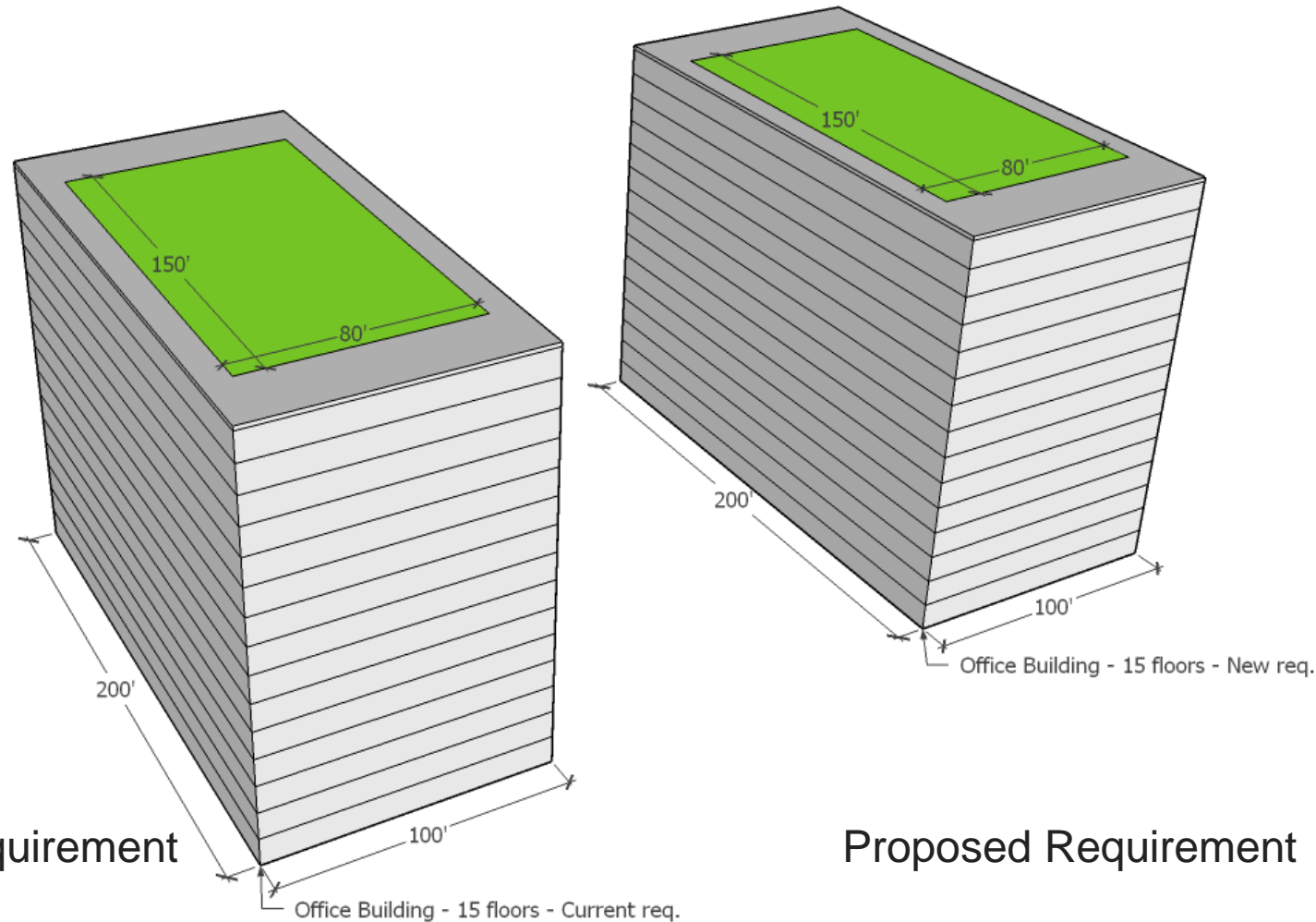
~20% reduction in average costs for the new proposal with the new proposed coverage requirement.

Office New Building

300,000 square feet, 15 floors, roof is 6,000 sq ft.

Coverage requirement on the ballot: 60% or 3,600 sq ft.

New Proposed Coverage Requirement: 60% or 3,600 sq ft.



Existing Building Policy Proposal

Cost Evaluation

Apartment Roof Replacement

55,000 square feet, 5 floors, roof is 11,000 sq ft.

Description	Green Roof 30% of required area*	Cool Roof & Small Green Space**
Conventional Roof Replacement Cost (\$)	\$137,700	\$137,700
Additional Cost (\$)	\$52,581	\$19,300
Cost Increase (%)	38%	14%

*Green Roof on 30% of 30%, as required on the ballot.

** Require 5% of and green square footage as compared to what would have been required (a 0.1 across the board percentage x number of floors or RAR), with a minimum of 250 ft² of high quality multi-functional space (or the minimum effective sizing necessary based on UDFCD and CCD Green Infrastructure guidelines). If more than 250 ft² is required, then the additional space could be ornamental.

Industrial Roof Replacement

150,000 square feet, 1 floor, roof is 150,000 sq ft.

Description	Green Roof 30% of required area*	Cool Roof & Small Green Space**
Conventional Roof Replacement Cost (\$)	\$1,539,900	\$1,539,900
Additional Cost (\$)	\$160,589	\$26,250
Cost Increase (%)	10%	2%

*Green Roof on 30% of 20%, as required on the ballot.

** Require 5% of and green square footage as compared to what would have been required (a 0.1 across the board percentage x number of floors or RAR), with a minimum of 250 ft² of high quality multi-functional space (or the minimum effective sizing necessary based on UDFCD and CCD Green Infrastructure guidelines). If more than 250 ft² is required, then the additional space could be ornamental.

Retail Roof Replacement

70,000 square feet, 1 floor, roof is 70,000 sq ft.

Cost Evaluation

Description	Green Roof 30% of required area*	Cool Roof & Small Green Space**
Conventional Roof Replacement Cost (\$)	\$769,950	\$769,950
Additional Cost (\$)	\$348,370	\$22,250
Cost Increase (%)	45%	3%

*Green Roof on 30% of 30%, as required on the ballot.

** Require 5% of and green square footage as compared to what would have been required (a 0.1 across the board percentage x number of floors or RAR), with a minimum of 250 ft² of high quality multi-functional space (or the minimum effective sizing necessary based on UDFCD and CCD Green Infrastructure guidelines). If more than 250 ft² is required, then the additional space could be ornamental.

Office Roof Replacement

300,000 square feet, 15 floors, roof is 20,000 sq ft.

Description	Green Roof 30% of required area*	Cool Roof & Small Green Space**
Conventional Roof Replacement Cost (\$)	\$337,500	\$337,500
Additional Cost (\$)	\$132,300	\$20,855
Cost Increase (%)	39%	6%

*Green Roof on 30% of 60%, as required on the ballot.

** Require 5% of and green square footage as compared to what would have been required (a 0.1 across the board percentage x number of floors or RAR), with a minimum of 250 ft² of high quality multi-functional space (or the minimum effective sizing necessary based on UDFCD and CCD Green Infrastructure guidelines). If more than 250 ft² is required, then the additional space could be ornamental.

Energy Program for Existing Buildings

Cost Benefit Analysis Challenges:

Building Age, Code Baseline

Building Type, Space Types (Lighting)

Building Class

Access, Phasing

Labor, Consulting, Demolition, Disposal

Unintended Issues during Retrofit

No retrofit will look exactly the same, making forecasting costs and savings nearly impossible. Project Drawdown, Paul Hawken

Net Present Value (NPV)

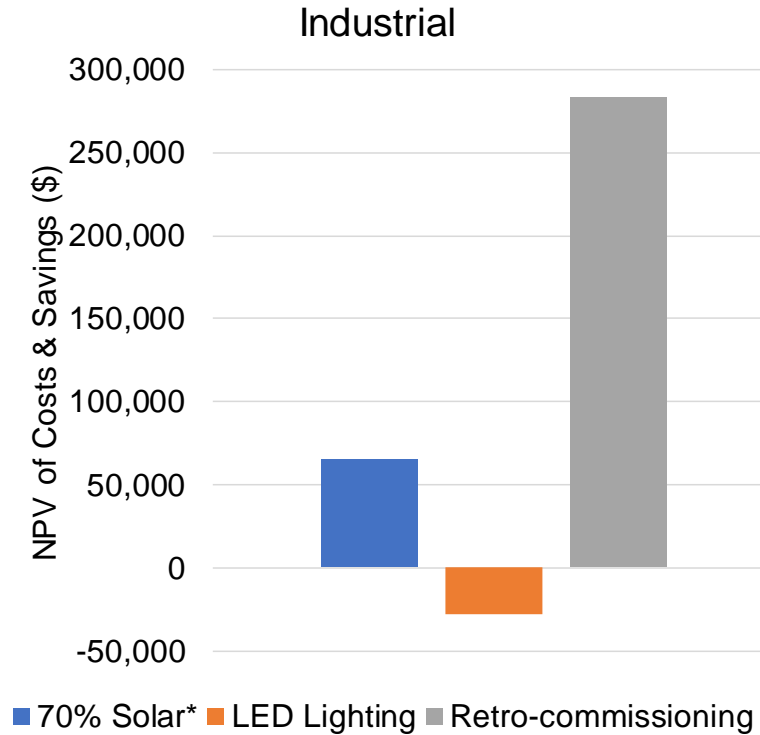
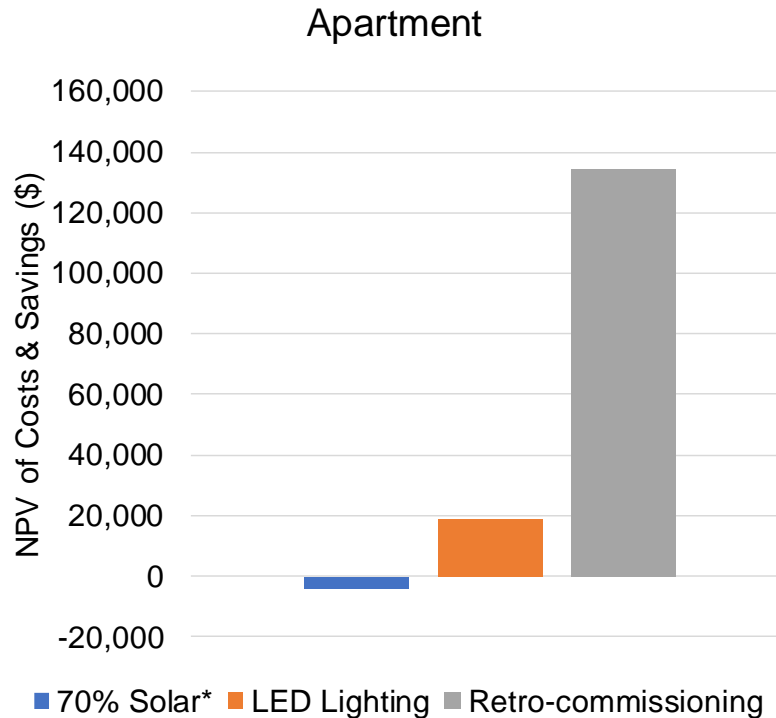
Positive Value

Revenues are greater than the costs

Negative Value

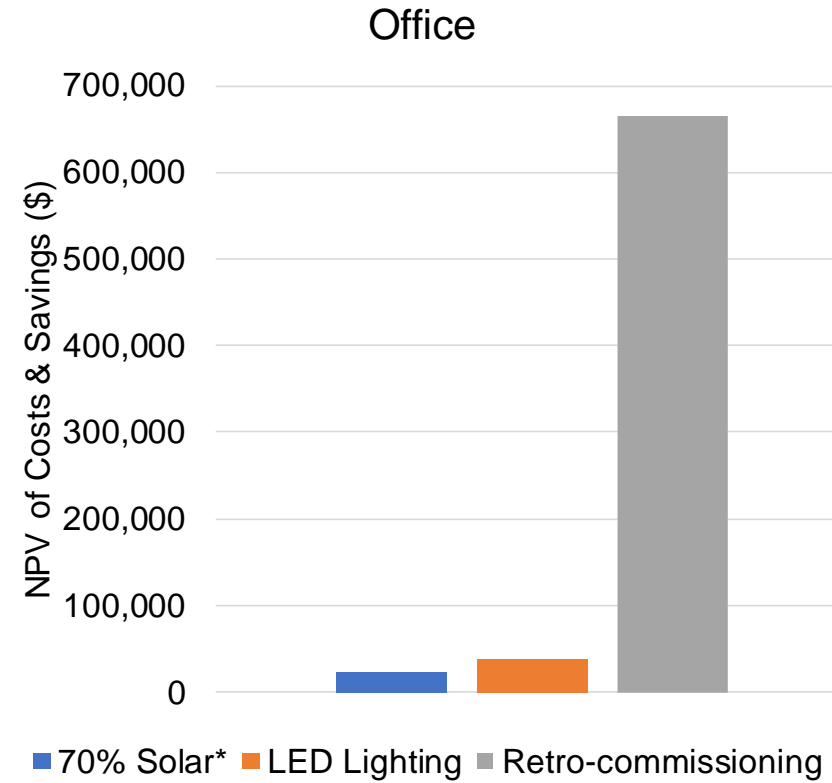
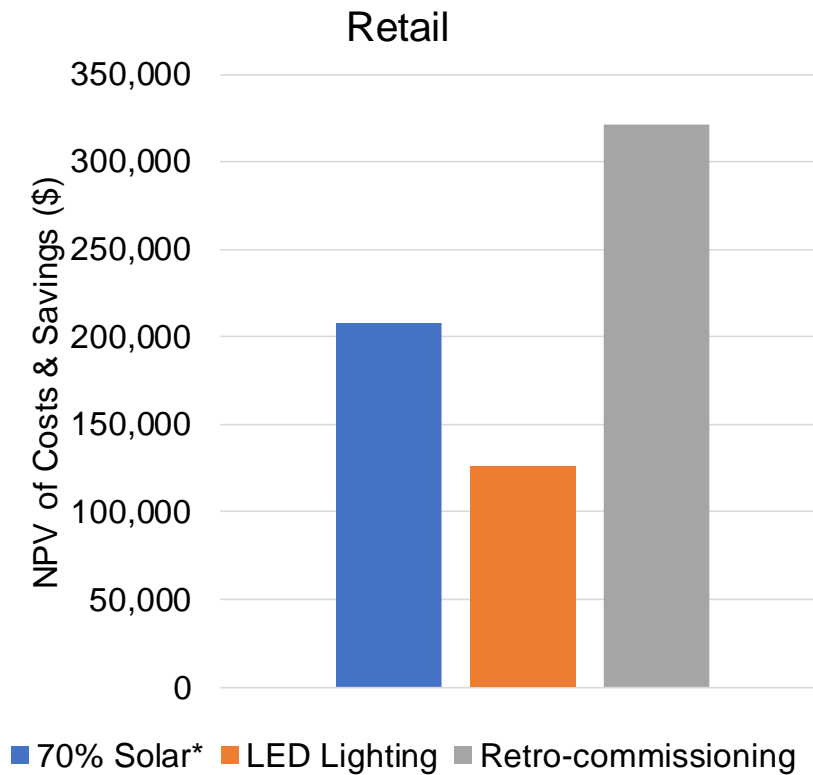
Costs are greater than the revenues

Energy Program: Options with Positive NPV



*Solar panels on 70% of required area
Note differences in vertical scale

Energy Program: Options with Positive NPV



*Solar panels on 70% of required area
Note differences in vertical scale

Existing Buildings

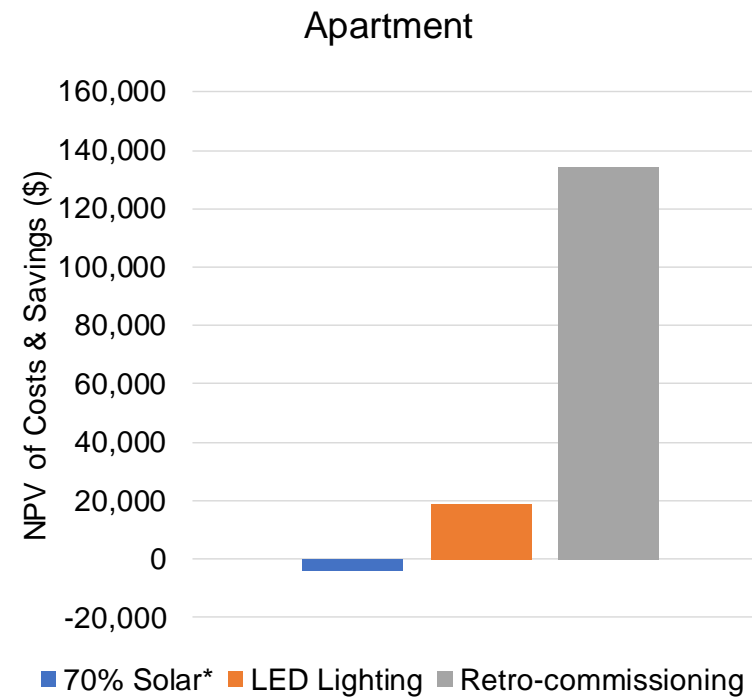
Appendices

NPV Parameters

Parameter	Assumption	Source
Analysis Period (years)	32 (i.e. till year 2050)	
Discount Rate (%)	7	Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs (https://www.wbdg.org/FFC/FED/OMB/OMB-Circular-A94.pdf)
Energy Escalation Rate (%)	2	Energy Escalation Rate Calculator (https://energy.gov/eere/femp/energy-escalation-rate-calculator-download): Colorado, 1.5% Inflation, Commercial
Electricity Blended Rate (\$/kWh)	0.098	U.S. Energy Information Administration (https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a): Colorado, Commercial
Energy Savings	12% for LED 16% for retro-commissioning	Calculated based on site energy use intensity (EUI) of DOE Commercial Reference Buildings in Denver, Post-1980 Construction. Building types used were Mid-rise Apartment, Warehouse, Stand-alone Retail, and Medium Office.

Existing Buildings: Apartment

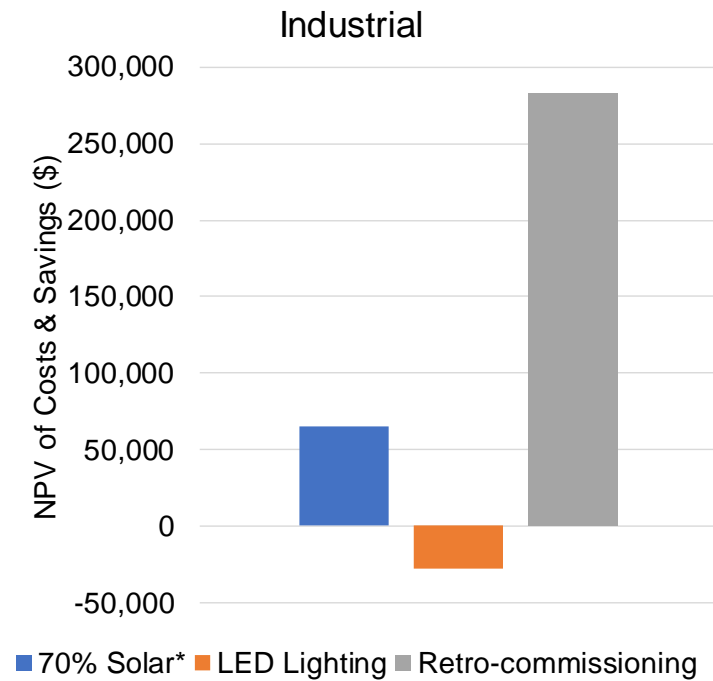
Description	70% Solar*	LED Lighting	Retro-commissioning
Conventional Roof Replacement Cost (\$)	\$137,700	N/A	N/A
Additional Cost (\$)	\$54,173	\$85,000	\$3,750
Cost Increase (%)	39%	N/A	N/A
NPV (\$)	-\$4,087	\$18,608	\$134,393



*Solar panels on 70% of required area

Existing Buildings: Industrial

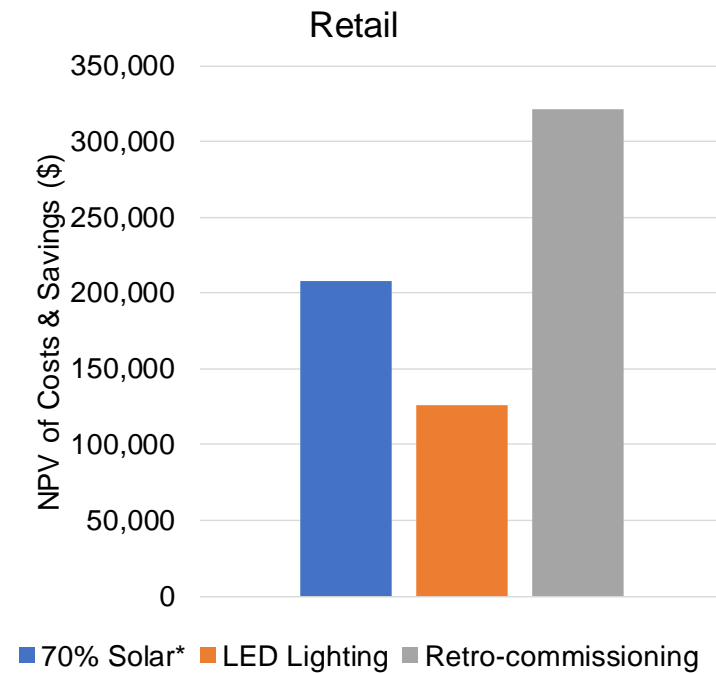
Description	70% Solar*	LED Lighting	Retro-commissioning
Conventional Roof Replacement Cost (\$)	\$1,539,900	N/A	N/A
Additional Cost (\$)	\$162,390	\$255,000	\$20,000
Cost Increase (%)	11%	N/A	N/A
NPV (\$)	\$65,282	-\$27,687	\$283,100



*Solar panels on 70% of required area

Existing Buildings: Retail

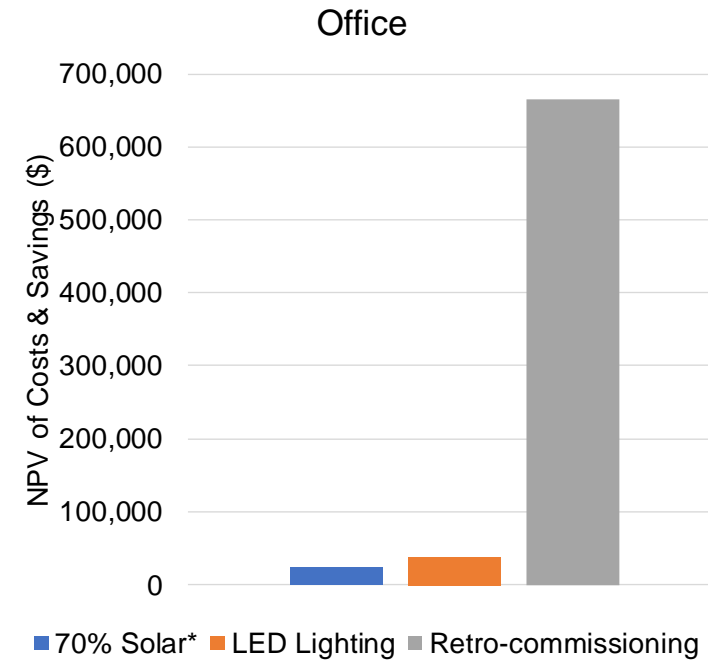
Description	70% Solar*	LED Lighting	Retro-commissioning
Conventional Roof Replacement Cost (\$)	\$769,950	N/A	N/A
Additional Cost (\$)	\$323,457	\$119,000	\$5,250
Cost Increase (%)	42%	N/A	N/A
NPV (\$)	\$207,761	\$125,645	\$320,938



*Solar panels on 70% of required area

Existing Buildings: Office

Description	70% Solar*	LED Lighting	Retro-commissioning
Conventional Roof Replacement Cost (\$)	\$337,500	N/A	N/A
Additional Cost (\$)	\$158,203	\$510,000	\$65,000
Cost Increase (%)	47%	N/A	N/A
NPV (\$)	\$23,934	\$37,425	\$664,906



*Solar panels on 70% of required area

PUBLIC INPUT PROCESS

Dates:

Noon on May 18th - any comments received by this date will be shared with the task force ahead of their meeting May 23rd.

Noon on June 3. The comment period closes. The remaining comments will be sent to the task force.

How to Comment:

[Fill out our comment form.](#) Commenting in the form helps us group comments by topic. Comments may also be sent via email to katrina.managan@denvergov.org.

Two public briefings and input sessions will be held:

Friday, May 11th, 9:00 a.m. – 10:30 a.m. in the Wellington Webb Municipal Building room 4.G.2

Monday, May 14th, 9:00 a.m. – 10:30 a.m. in the Wellington Webb Municipal Building room 1.B.6