Reducing Emissions at Lower Cost with New Business Models

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CPI brings a finance perspective to evaluating policy options for reducing carbon emissions

We use financial and market models to address questions such as:

- How can my state deploy clean energy sources at the lowest financing cost?
- How much stranded power plant value does my state risk in the coming transition? How can states minimize stranding risk and best make use of existing electricity assets in a low-carbon electricity system?

Challenge: Reducing CO_2 emissions in the power sector at the lowest cost

Four "building blocks" suggested by EPA:

Improve fossil fuel plant efficiency	Switch from coal to gas	Renewable energy	Energy efficiency

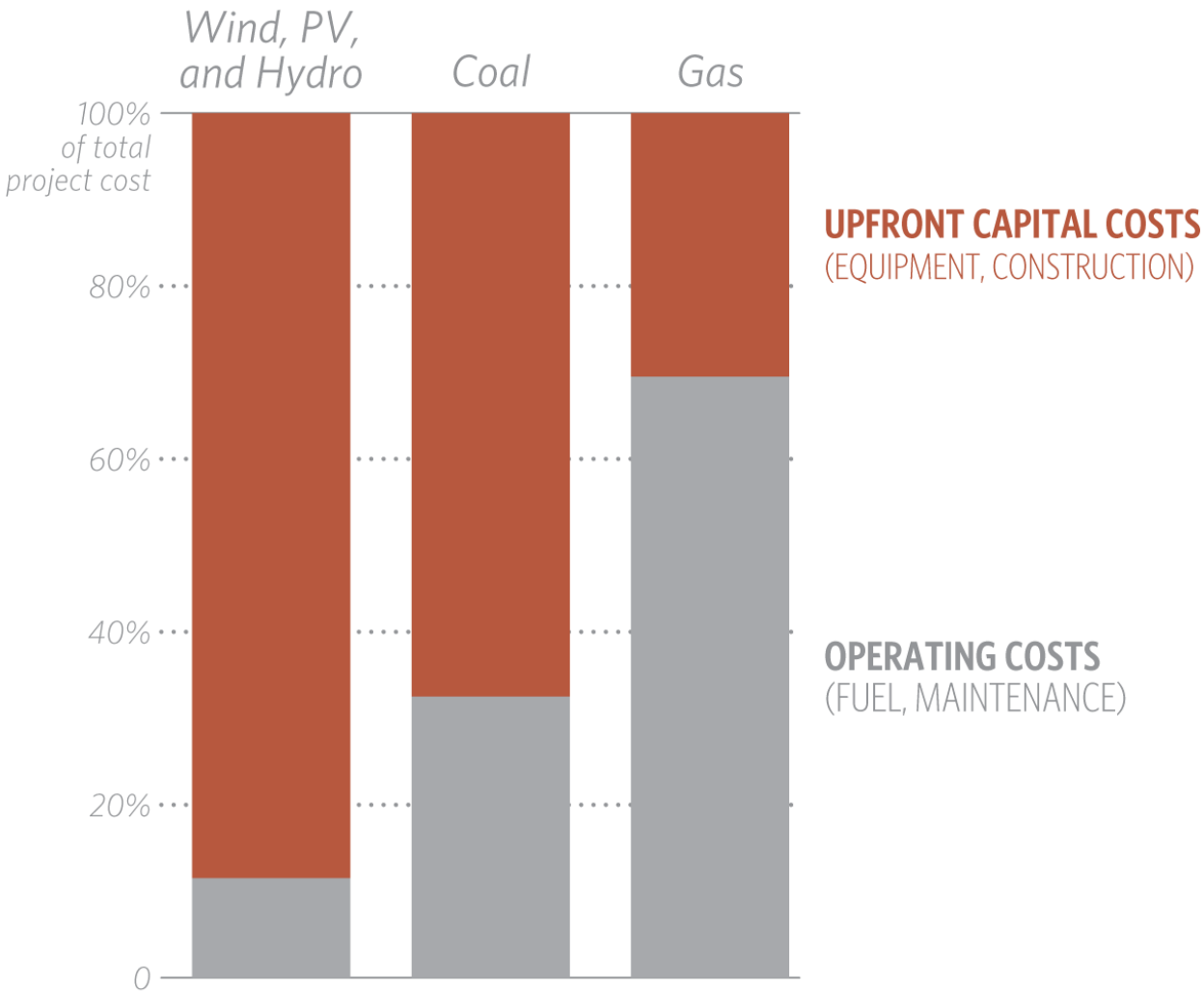
Our focus

Many suggested strategies(especially blocks 1 and 2) work at the margin of the existing system.

Our analysis shows that **states can see greater cost savings by making a long-term commitment to clean energy**.

New business models – with help from policy – can make clean energy the lowest-cost solution

Clean energy is capital-intensive, so financing costs have an outsize impact on cost of electricity

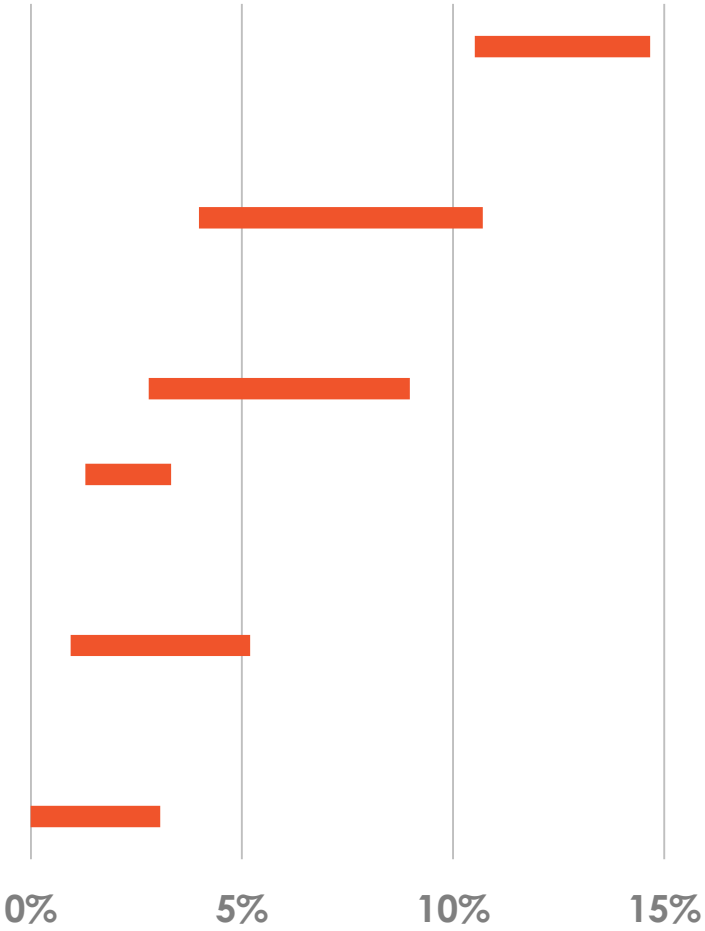


Breakdown of lifetime costs for new power plants

(Data source: EIA)

Reducing policy-related risk is critical to unlocking low-cost financing

Policy Barrier	Impact on Cost	Solutions
Duration of Revenue Support 10-year vs. 20-year contract		RPS with long-term targets Public authority as counterparty / intermediary
Revenue Certainty Electricity sales subject to market price risk		Pull contracted renewables out of spot market PPA/feed-in tariff with price collar or minimum price
Risk Perception: Equity Higher cost of equity		Clear commitment to consistent policy direction: Good state policies can help overcome history of fluctuating tax credits
Risk Perception: Debt Higher required debt coverage		
Completion Certainty 1-year construction delay		Simplify planning and permitting processes
Cost Certainty 5% cost overrun		Limited control by policymakers



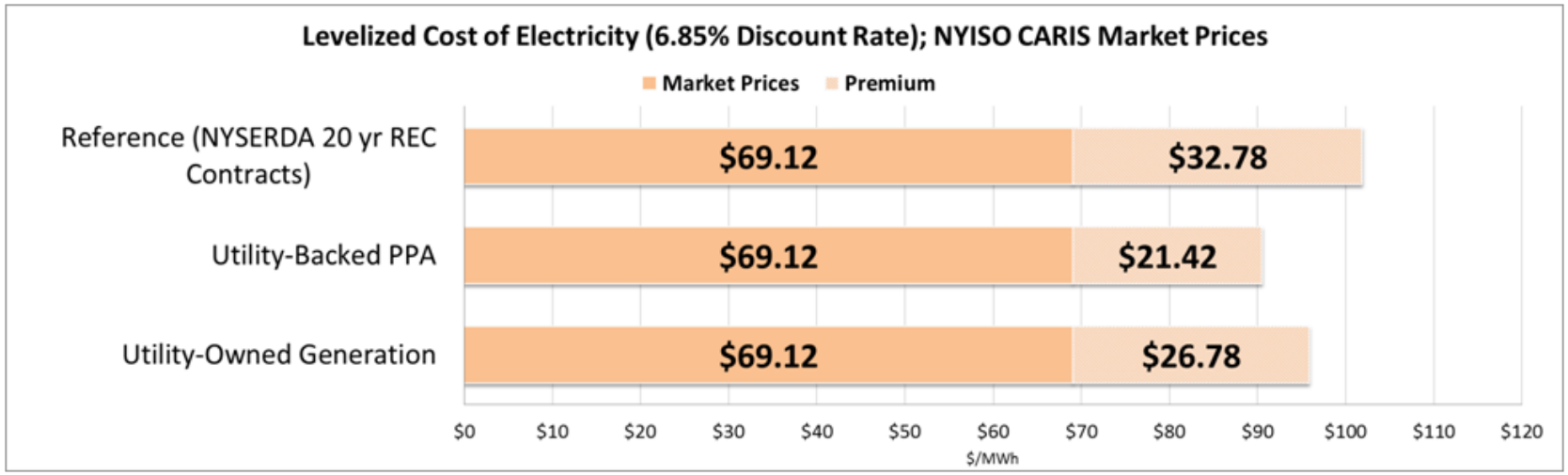
Investors in IOU / IPPs are looking for greater risks and returns than renewable energy projects offer; this raises financing costs for renewables

	Typical Renewable Energy Project Characteristics	Typical IOU / IPP Investment Profile
Cash flows	**High upfront** capital costs followed by small ongoing costs; output relatively fixed as will be price and income (depending on regulation)	**Moderate upfront** capital costs followed by significant maintenance, operating and fuel expenses over project life; income varies depending on dispatch and energy prices
Opportunities for outperformance	**Relatively limited**, particularly with feed-in tariffs or fixed-price contracts	**Several**, including fuel contracting, energy trading, operation, availability and efficiency improvement
Risk	**Limited**; some regulatory and performance risk Beta can be 0 with appropriate regulation	**Moderate**, including fuel price, dispatch, market demand, regulation Beta ~ 0.5 – 1.0 or higher
Return	**Should be low**, as lower risks and predictable cash flows are more analogous to corporate bonds than equity	**Moderate**, justifies equity-type returns to manage risks and provide incentives for outperformance
Growth	**Limited** at the project level, unless the tariffs or contracts have indexation provisions	**Moderate**, as natural fuel price inflation and performance and availability enhancement could lead to growing revenues

Clean energy is a much better fit for investors seeking low-risk, long-term investments

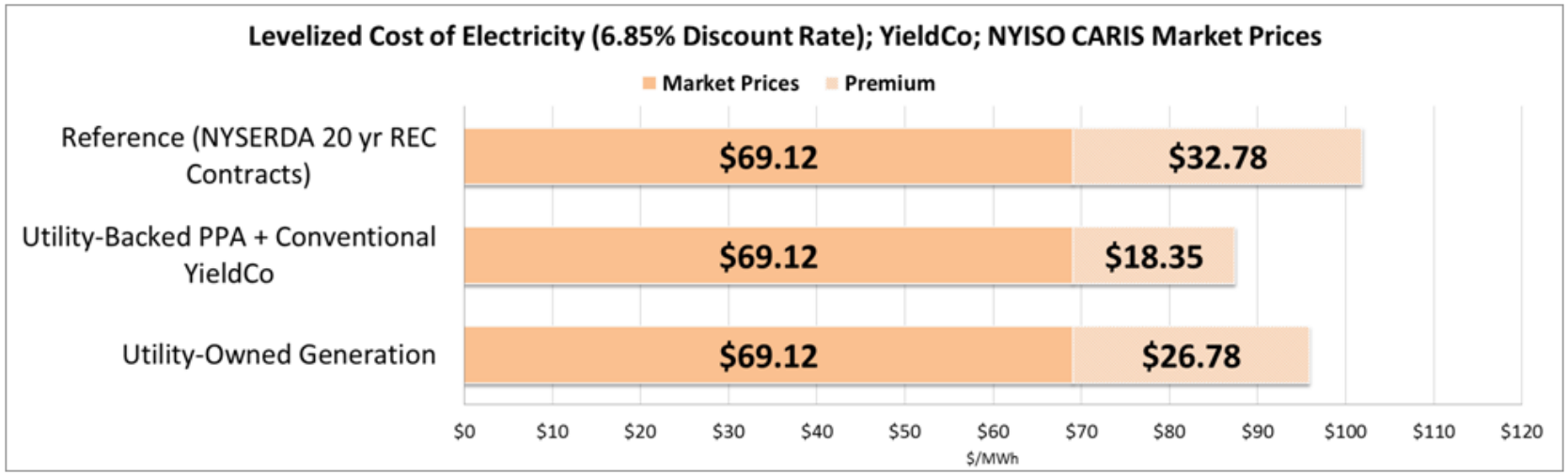
Ownership model	Policy approaches	Examples
Institutional investors	RPS with long-term targets Contracted renewables not subject to spot market prices Public authority as counterparty / intermediary in competitive markets	Greater Sandhill (CO) Catalina Solar (CA) Mountain Wind (WY)
Municipalities and state governments	Build renewable energy as public infrastructure with state or local bonds (including "green bonds") Conduit bonds for non-government entities Direct ownership by municipal utilities or public authorities	Connecticut Green Bank Southern California Public Power Authority
Energy customers	Less data/experience to draw on Options include virtual net metering, green power programs, community renewable energy programs, opening markets to behind-the-meter resources	Minnesota community solar

NY Example: 20-Year PPA Can Cut Cost for Wind by $12/MWh; Utility-Owned Generation by $6/MWh



- Results from NYSERDA (2015) "Large-Scale Renewable Energy Development in New York: Options and Assessment"
- No PTC extension assumed
- Premium is relative to discounted NYISO CARIS projected market prices

NY Example: If the PPA enables YieldCo financing, this benefit could increase to $14-15/MWh



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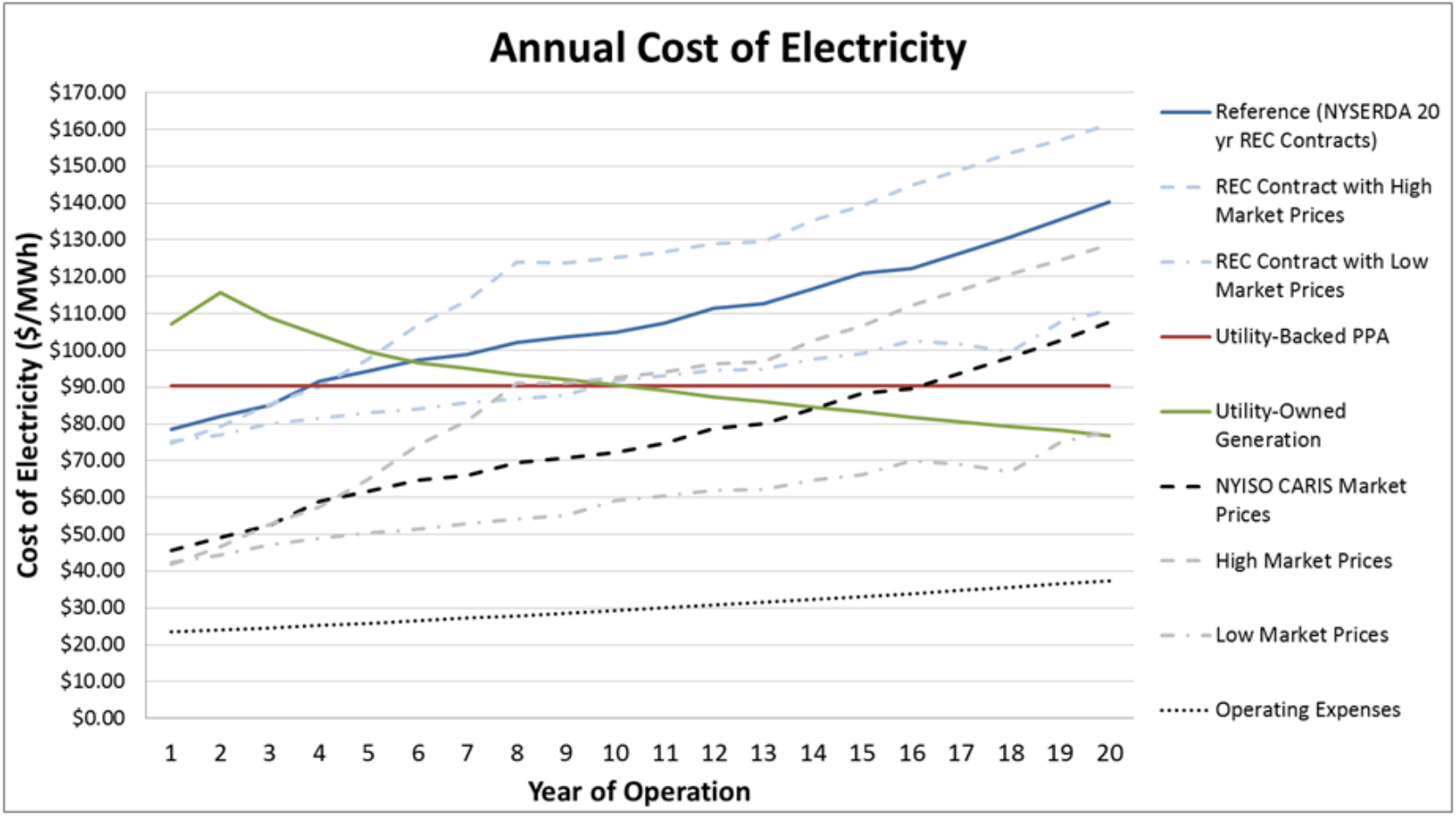
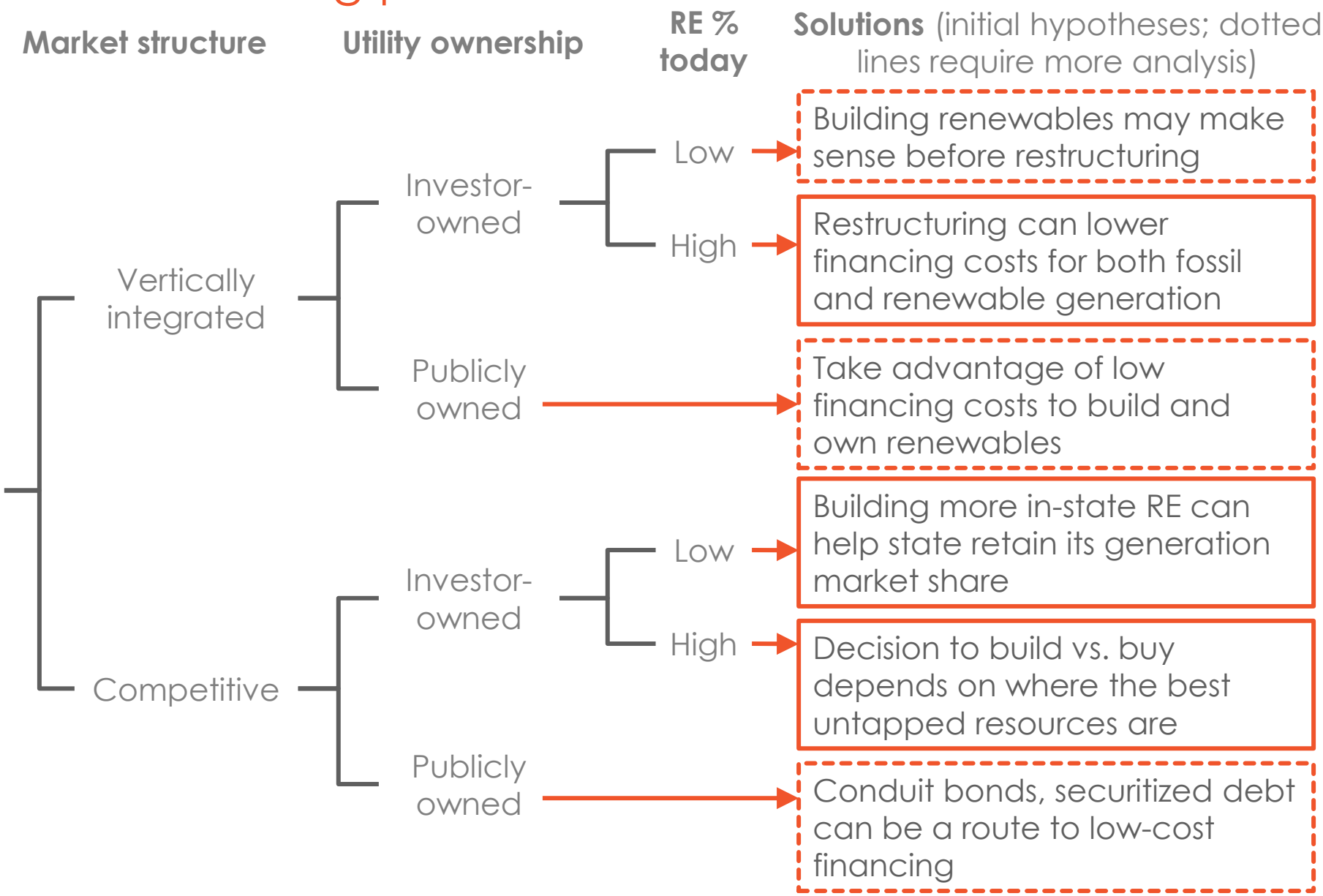
Utility-ownership more expensive as revenue requirements high early & decline with depreciation



NOTE: With operating expenses well under half of projected market prices at the end of 20 years, EDC ownership has the potential up-side of providing terminal value at relatively low costs.

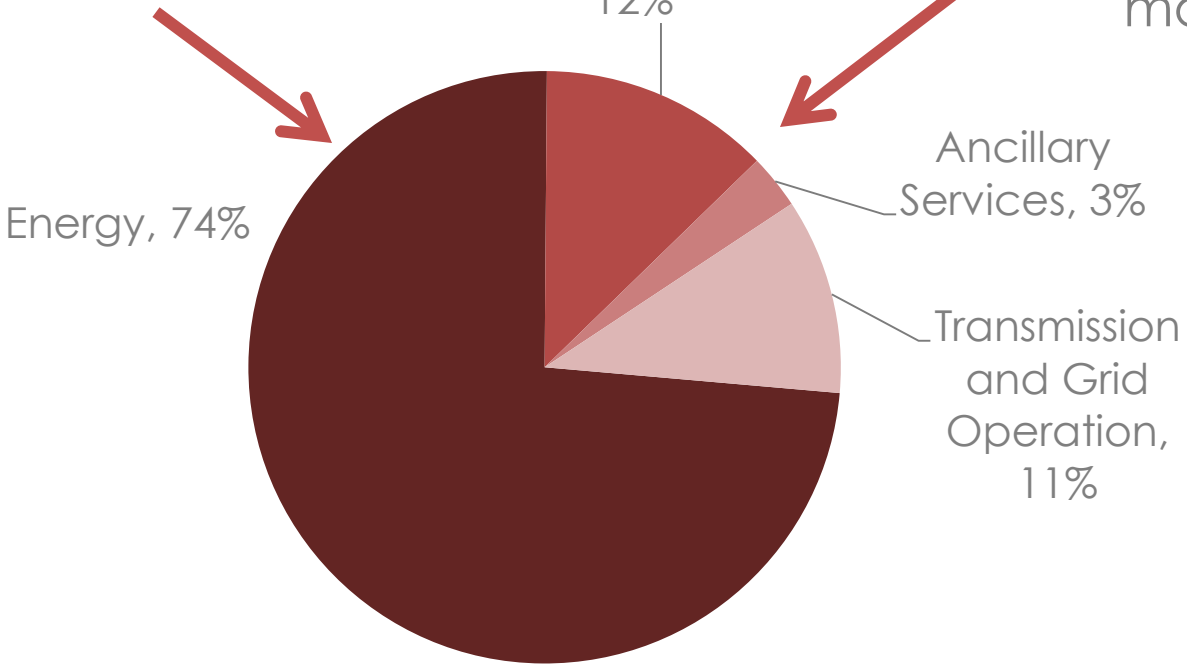
The lowest-cost strategy for each state depends on its starting point



Market structures and priorities will need to change in a system with more clean energy

Current markets are driven by fuel and other operating costs

In a system dominated by clean energy with zero fuel cost, timing and flexibility will be more important



Breakdown of wholesale energy costs in PJM market (2012)

State-level policy options to reduce the risk of stranding fossil fuel power plants

Stranded asset risk is real, but can be minimized with good policy/regulatory choices

In an electricity system with high renewable penetration, resources that can provide flexible power will be more valuable

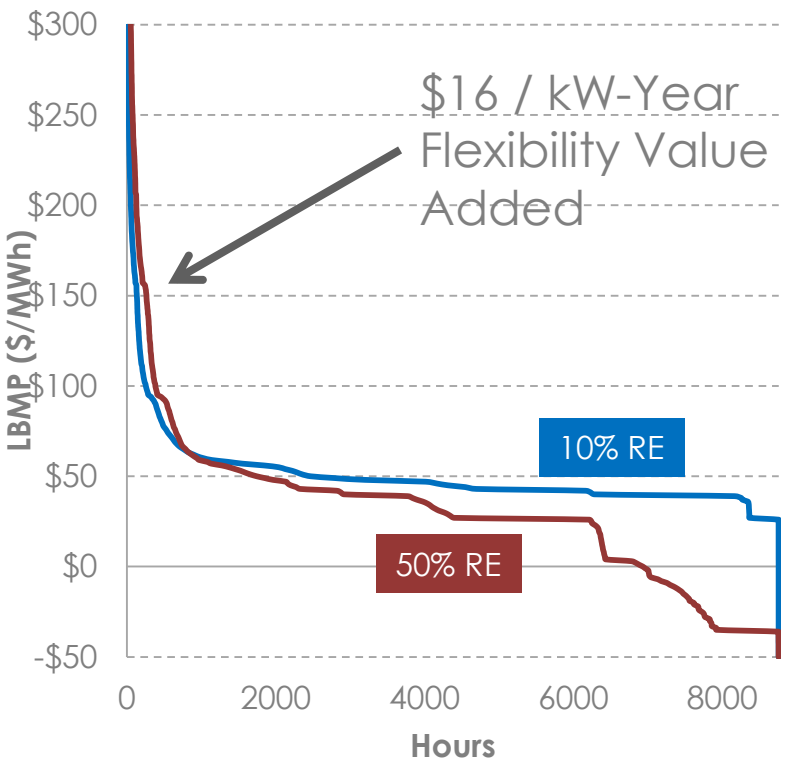
- Today, most markets do not price flexibility
- Pulling inflexible low-carbon generators (renewables, nuclear) out of real-time markets provides a better price signal to flexible generators
- For RTOs, collaboration among states will be needed to change markets

Many of the most polluting plants are old — important to avoid new investment in plants that will soon become uneconomical

A separate market for renewables could allow flexible fossil fuel plants to remain viable with high renewable energy penetration

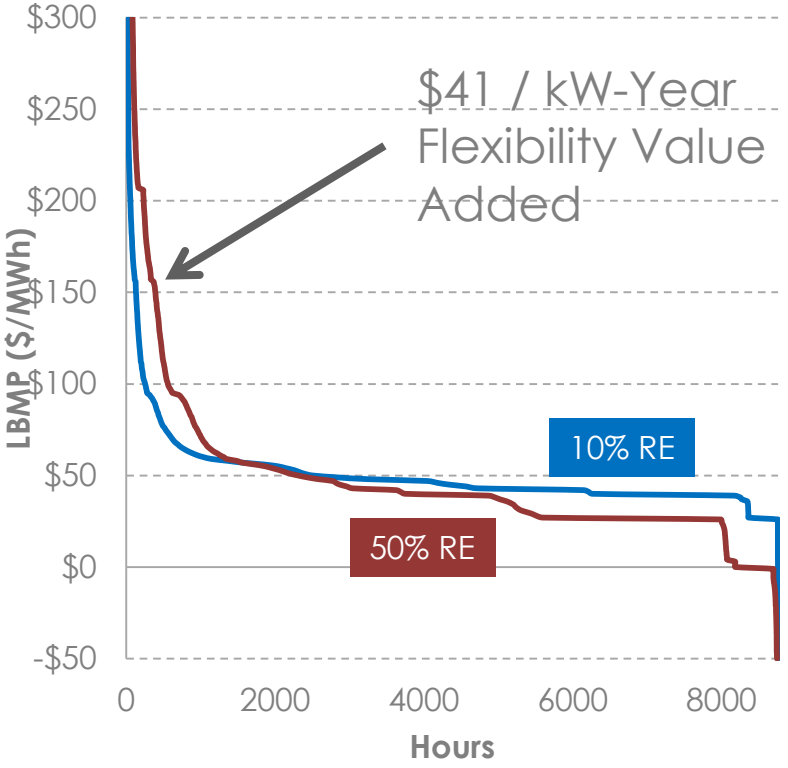
Modeling a sample of power plants in New York:

Single Energy Market



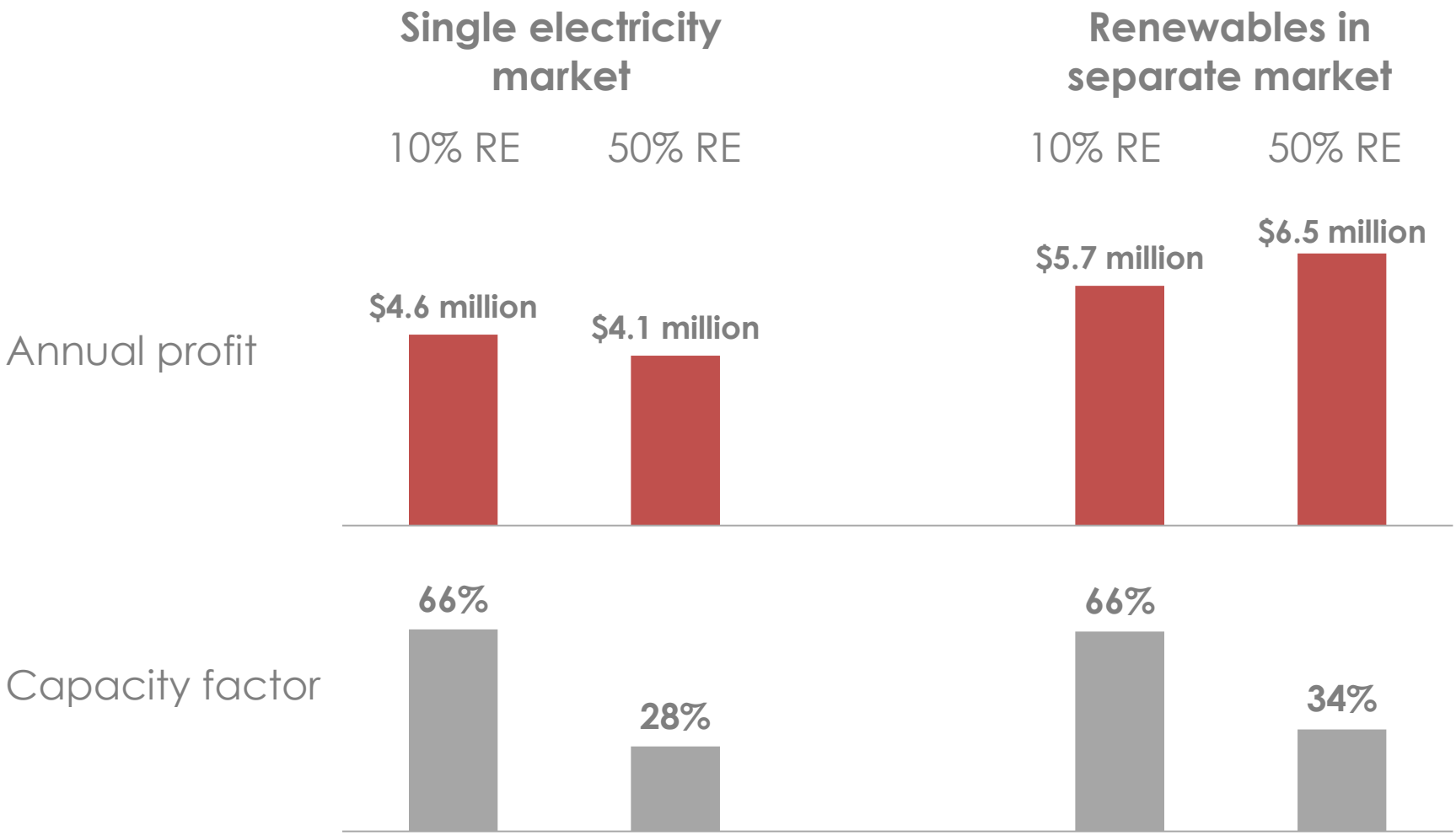
Average electricity price	
10% RE	$51/MWh
50% RE	**$32/MWh**

Renewables in Separate Market



Average electricity price	
10% RE	$52/MWh
50% RE	**$54/MWh**

Profitability of a highly flexible and efficient gas turbine:



Stranding / Flexibility Example: Indiana & 111(d)

PRELIMINARY ANALYSIS: INDIANA

Indiana in 2012

Generation Mix:

Coal	81%
Natural Gas	13%
Oil	1%
Wind	3%
Other - Renewable	1%
Other - Non-renewable	1%

ISOs: MISO and PJM Territories

EPA Proposed 2030 Target: 23% reduction in CO_2 emissions/MWh

Implementation Scenario 1

Inside-the-fence, rate-based standard shuts down the least efficient coal facilities; 4% generation from renewables enters existing market

Implementation Scenario 2

Renewable portfolio standard set at 12%; energy efficiency reduces load; renewables do not participate in hourly electricity market

In each implementation scenario, system reliability is maintained by matching supply and demand on an hourly basis

Lowest net cost option does not close all coal plants – instead, it values them to provide flexible power to a grid with more clean energy

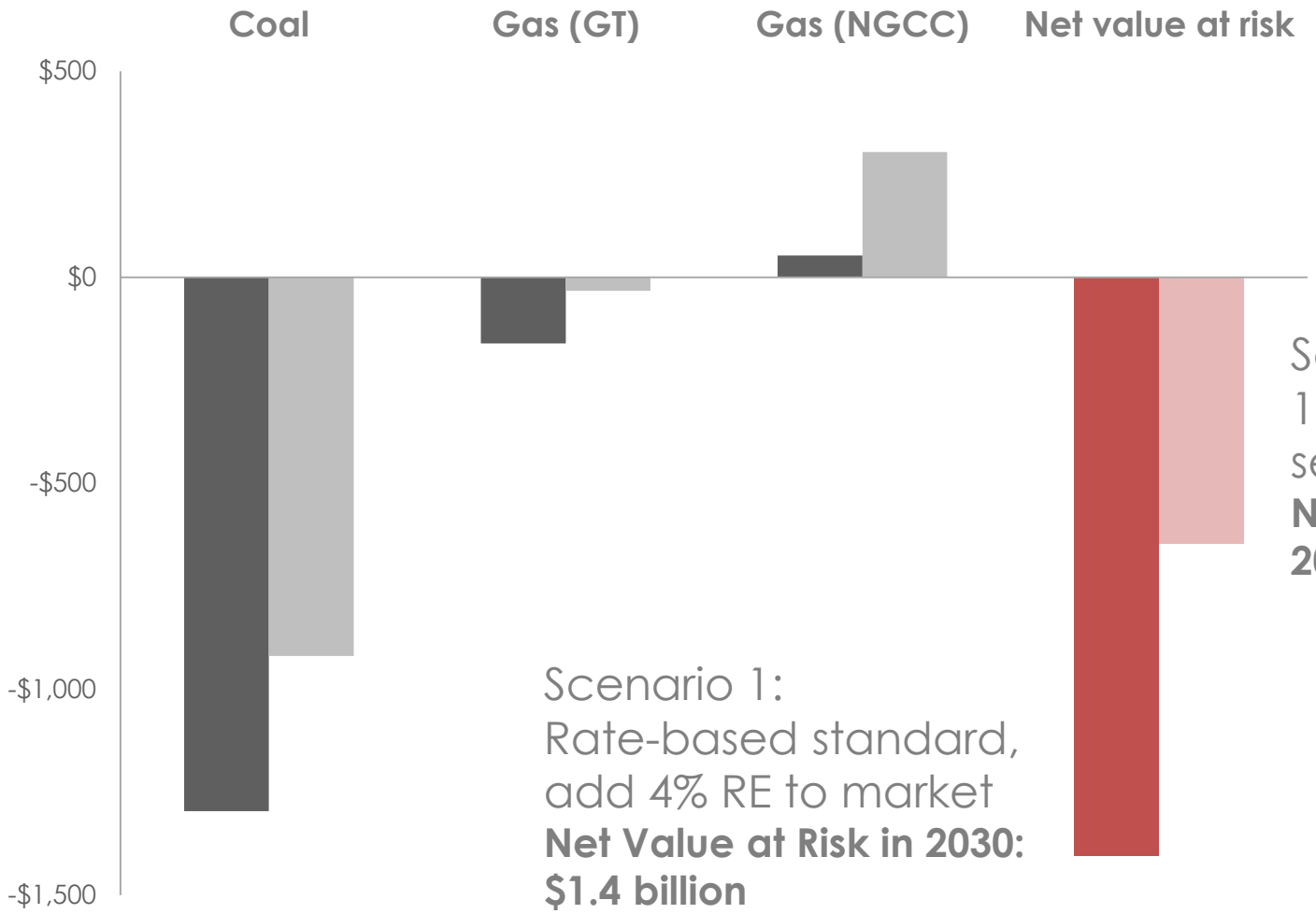
PRELIMINARY ANALYSIS: INDIANA

Change from baseline through 2030 ($millions):

	Scenario 1: Rate-based standard, add 4% RE to market		Scenario 2: 12% RPS, renewables in separate market	
	Fossil	Renewable	Fossil	Renewable
Capital costs	+ $76	+ $64	+ $271	+ $383
Operating costs	– $377	+ $40	– $784	+ $240
Financing costs	+ $1,334	+ $35	+ $375	+ $208
Net impact on costs	**+$1.1 billion**		**+$700 million (41% lower)**	

An RPS and separate market for renewables could reduce value at risk by more than 50%

PRELIMINARY ANALYSIS: INDIANA



Scenario 1:
Rate-based standard, add 4% RE to market
Net Value at Risk in 2030: $1.4 billion

Scenario 2:
12% RPS, RE in separate market
Net Value at Risk in 2030: $650 million

About CPI

Climate Policy Initiative (CPI) works to improve the most important energy and land use policies around the world, with a particular focus on finance.

CPI's Energy Finance program works with governments, utilities, companies, banks, investors, and foundations around the world to **understand the true cost** of the transition to a low-carbon energy system, to **evaluate and improve policy**, and to **design new financial vehicles** that can lower costs and align investment returns from low-carbon energy assets with investors' needs.

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