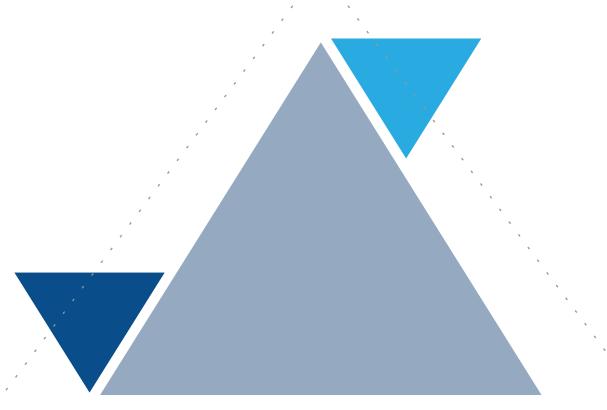


NUCLEAR DECOMMISSIONING

▶ ▶ U.S. OPERATING COMMERCIAL NUCLEAR POWER REACTORS

Arkansas Nuclear 1, 2	Davis-Besse	Monticello	Seabrook 1
Beaver Valley 1, 2	Diablo Canyon 1, 2	Nine Mile Point 1, 2	Sequoyah 1, 2
Braidwood 1, 2	Dresden 2, 3	North Anna 1, 2	Shearon Harris 1
Browns Ferry 1, 2, 3	Farley 1, 2	Oconee 1, 2, 3	South Texas 1, 2
Brunswick 1, 2	Fermi 2	Palo Verde 1, 2, 3	Summer
Byron 1, 2	FitzPatrick	Peach Bottom 2, 3	Surry 1, 2
Callaway	Ginna	Perry 1	Susquehanna 1, 2
Calvert Cliffs 1, 2	Grand Gulf 1	Point Beach 1, 2	Turkey Point 3, 4
Catawba 1, 2	Hatch 1, 2	Prairie Island 1, 2	Vogtle 1, 2, 3
Clinton	Hope Creek 1	Quad Cities 1, 2	Waterford 3
Columbia Generating Station	La Salle 1, 2	River Bend 1	Watts Bar 1, 2
Comanche Peak 1, 2	Limerick 1, 2	Robinson 2	Wolf Creek 1
Cooper	McGuire 1, 2	Saint Lucie 1, 2	
D.C. Cook 1, 2	Millstone 2. 3	Salem 1. 2	



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► ► INTRODUCTION

NISA Investment Advisors, LLC (NISA) is pleased to present the 18th edition of the biennial Survey of Nuclear Decommissioning Trust (NDT) Sponsors. This report, published as a resource for and service to the NDT community, is intended to provide insight into investment activities and trends within the NDT industry. Information contained herein has many potential uses for a variety of audiences, including trust sponsors, federal and state regulatory bodies, trust custodians and investment managers. All individual survey responses remain confidential.

Industry Highlights

- As of the printing of this survey, there are currently 53 plants with 93 operating nuclear power reactors located in 28 states with a combined net capacity of almost 96 GWe. Of the 93 reactors, 31 are boiling water reactors (BWRs) and 62 are pressurized water reactors (PWRs) which generate about 20% of our nation's electrical use. While there are 79 individual plant owners and 19 plant operators, Investor-owned Utilities (IOUs) represent approximately 80% of operating megawatt capacity.
- For the first time since the mid-1990s, a new domestic reactor unit came into service despite significant delays and cost overruns. Vogtle Unit 3, located in Georgia, connected to the grid on April 1, 2023, with plans for an additional unit, Unit 4, to be up and running in 2024.
- ▶ The NRC has approved virtually all operating units for their initial license renewal, extending plant life from 40 to 60 years, with two units currently under review. Five units have had a subsequent license renewal (SLR) completed to extend their license another 20 years to 80 operating years, with 10 units currently under review and nine more expected to submit an SLR within the next few years.
- ▶ Since the prior survey and through June 2023, two units have closed. However, it appears the premature closure of reactors due to "severe economic challenges" has stalled for now thanks to both federal and state-level support. Since February 2013, 13 reactors have ceased operation prematurely, mostly due to operating losses, following a 14-year period without any shutdowns.
- ▶ In November 2021, the Infrastructure Investment and Jobs Act (a.k.a. the Bipartisan Infrastructure Law or BIL) was signed, hence creating the Civil Nuclear Credit Program a \$6 billion strategic investment established to help preserve the existing U.S. reactor fleet and jobs across the country. The program allows owners or operators of commercial U.S. reactors to apply for certification to bid on credits to support their continued operations. To qualify, applicants must demonstrate that the reactor is projected to close for economic reasons and that closure will lead to a rise in air pollutants. Credits will be allocated to selected certified reactors over a four-year period to begin on the date of the selection with credits that can be awarded through September 30, 2031, if funds remain available.
- ▶ In 2021, U.S. power plants generated over four billion megawatts of electricity and 778 million megawatts of nuclear power.
- Since the prior report, an additional seven operating reactor uprates were approved, adding 325 MWh to electrical capacity.

Survey Data

Information as of December 31, 2022 was requested from IOUs and several Public Power Authorities (PPAs).

Surveys were sent to owners/operators of nuclear plants. Twenty sponsors completed surveys, many representing multiple plants/ units, which represents over 85% of total IOU megawatt capacity and 79% of total megawatt capacity.

Unless otherwise noted, averages are calculated based on the number of responses.

NDT sponsors for their participation in this survey.

NUCLEAR DECOMMISSIONING TRUSTS ◀ <

Estimated Assets

While the total estimated market value of NDT assets declined for the first time since the great financial crisis in 2008, estimated assets grew at a double digit percentage rate over every two-year period for the prior twelve years before dropping just over 6% from 2020 to 2022. The majority of this decline is attributable to spending decommissioning funds on closed reactors. Assets held by IOUs dropped to approximately \$70 billion, as those held by Public Power Authorities (PPAs), Municipalities (Munis) and Cooperatives (Co-ops) declined to approximately \$7 billion. At the same time, Qualified Trust assets decreased by about 5% as Non-qualified assets shrunk by over 15%. While the majority of the discrepancy is likely due to IOUs spending Non-qualified assets on decommissioning activities first with a limited amount of pour-over activity, the remaining discrepancy is due to variations in asset allocation within each trust type, costs associated with various plant shutdowns, changes in survey participants, as well as contributions.

Expected Contributions

Outside of a single outsized Non-qualified contribution in 2022, total contributions and expected contributions continued their longer-term trend of declining in this survey. Projected 2023 contributions are \$122 million, with \$99 million allocated to Qualified Trusts, \$7 million to Non-qualified Trusts and \$16 million to non-taxable Trusts. While only two Public Power respondents indicated projected contributions in 2023, NRC filing data show a handful of outsized projected contributions over the next several years.

Estimated Decommissioning Costs

Total IOU and PPA 2022 estimated decommissioning costs remained relatively stable for the first time in survey history. The number of premature plant closures for economic reasons seemingly has subsided. Furthermore, Diablo Canyon's early closure over environmental concerns has been pushed back for the time being. A number of plants are accelerating their decommissioning timelines by using either the DECON or delayed DECON method as opposed to SAFSTOR, which results in a significant amount of assets being spent in the early decommissioning years. According to site specific estimates for the remaining operating plants from 2020-2022, the number of cost increases equaled the number of cost decreases, which are typically in the single-digit percentage range. Whereas in prior surveys, virtually all operating reactors saw anticipated costs increase survey-over-survey. The annualized cost escalation rate for the 26-year period from 1996 to 2022 was approximately 2.6%.

The estimated costs shown in the graph represent the greater of NRC-filing or site-specific costs provided by respondents. Based on individual survey responses, NRC costs were, on average, 63% of site-specific costs compared to 82% in the prior survey.

NRC Filing Data

Selected asset and cost data from publicly available decommissioning financial assurance filings as of December 31, 2022 were compared to survey data as a reasonableness check. Survey and NRC differences appear to result primarily from non-radiological decommissioning costs, spent fuel storage and site-specific vs. CFR 50.75 methodologies. The data in the table were estimated based on NRC filings.



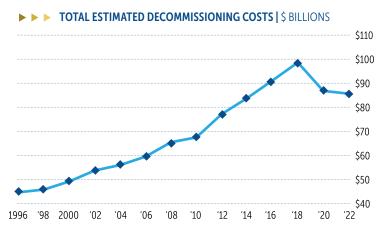
\$30

\$20

\$10







▶ ▶ OPERATIONAL COSTS AND ASSETS | \$ BILLIONS

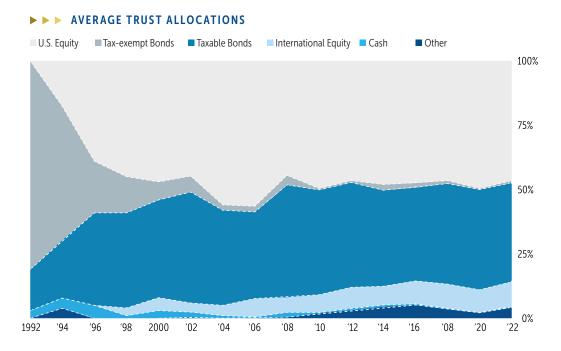
		Costs	Assets	
Investor-owned Utilities	-	\$47.5	\$60.1 ¹	
Non-investor-owned Utilities		\$10.4	\$9.1	
	TOTAL	\$57.9	\$69.2	
¹ After tax.				

► ► Approximately 75% of respondents indicated continued contributions to their Trusts, with only three in excess of \$10 million per year. No units currently in decommissioning indicated additional contributions to the fund.

QUALIFIED TRUSTS

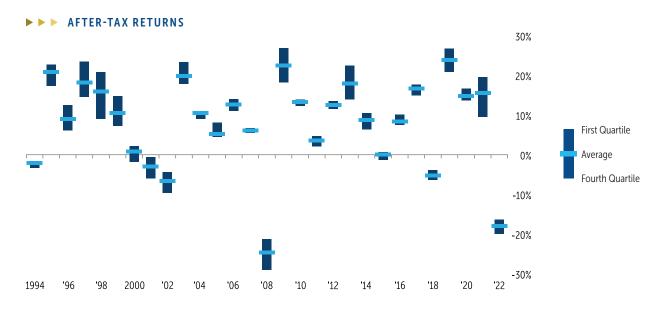
Historical Asset Allocation

Despite several significant equity market movements, a record-long economic expansion, the pandemic, runaway inflation and other periods of high volatility over the past 20+ years, asset allocations have remained fairly constant. Even though the average Qualified Trust equity allocation dipped slightly to 56% in 2022, it remains within 2% of where it has been since 2010. While the "other" category rose marginally survey-over-survey (primarily private equity and real estate) to 4% of Qualified assets, on an asset-weighted basis that number more than doubles to near 9%. Put another way, sponsors with a larger amount of assets are typically those with an actual alternative asset allocation. Nonetheless, about 40% of sponsors indicated a target allocation to alternative asset strategies, with the average target allocation of those sponsors just below 15%. Taxable fixed income allocations remained steady since the prior survey at just under 40% of Qualified Trust assets.



Historical After-tax Returns

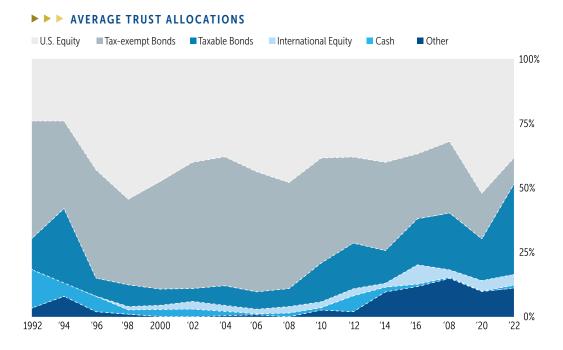
Qualified Trust assets, on average, posted a 13% return in 2021, followed by the second worst year on record in 2022 as interest rates rose and equities plunged. The average trust return has been flat or positive for 23 of the 28 years shown in the graph, while the average annual after-tax return for the 29-year period was 6.5%.



NON-QUALIFIED TRUSTS ◀ ◀

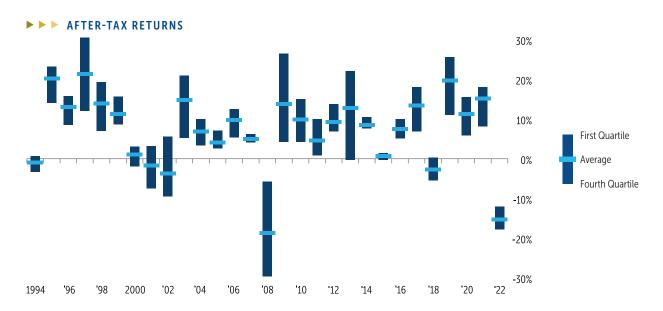
Historical Asset Allocation

Non-qualified Trust assets dropped to 8% of total NDT assets in 2022. Of the taxable respondents, the vast majority reported having some Non-qualified trust assets. Several Non-qualified Trusts have nearly all of their assets invested in a specific asset class. The "other" category remained outsized when compared to Qualified Trusts or PPA asset allocations due to one sponsor holding a large portion of its Non-qualified assets in private equity and private credit. Moreover, the main story survey-over-survey is the shift into taxable bonds. With the taxable bond allocation nearly doubling, sponsors were finally able to move out of Munis and (some) equities with relatively benign tax consequences.



Historical After-tax Returns

The average Non-qualified Trust after-tax total return for the two-year period since the last survey was -2%, slightly better than Qualified Trust returns. The outsized allocation to alternatives may have helped Non-qualified Trusts weather the 2022 public asset storm. The average annualized after-tax return for the 29 years displayed was 6.0%, which is quite impressive considering the 35% corporate tax rate that prevailed for the majority of the period shown in the chart below.

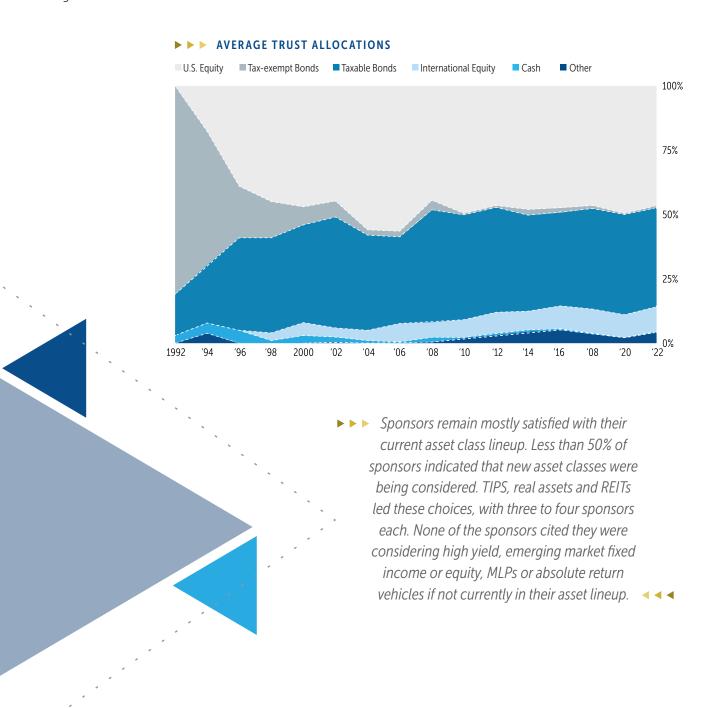


Historical Asset Allocation

The graph below shows average actual allocations to major asset classes since 1992. Once again, overall asset allocations remained steady from the prior survey with the largest mover being domestic equity with a 2% decrease. All other asset allocations moved less than 1% in the two years ending December 31, 2022.

The overall target equity allocation rose slightly to 2014 levels at 54% while the fixed income target allocation dropped 3% to 41% in 2021, which is not terribly far off from actual allocations. Target equity allocations ranged from 39% to 70% while target fixed income allocations were between 20% and 61%. Most of the lower target range fixed income respondents also had a target allocation to the "other" category.

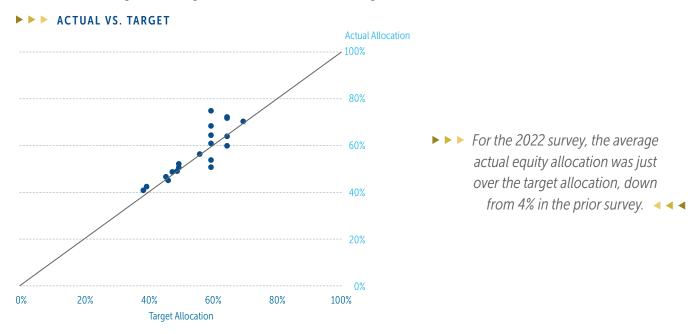
Almost half of respondents indicated some allocation to alternative asset strategies resulting in the 5% allocation to the "other" asset class. For those who targeted an allocation to alternatives, the average was 14%, with the maximum target of 23% and minimum target of 4%.



ASSET ALLOCATIONS ◀ ◀ ◀

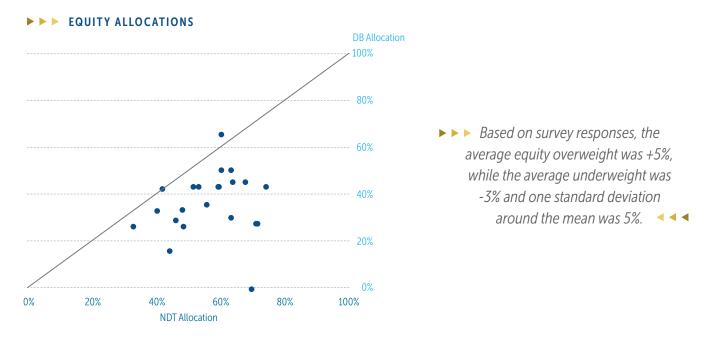
Equity Allocations

The chart below shows each trust's actual equity allocation relative to its target allocation for December 31, 2022. The three points just below the diagonal reflect equity allocations that are below their targets, while those above the diagonal reflect allocations above their targets. Despite the approximately 20% downturn in equity markets during 2022, many equity sleeves of Trusts still have a meaningful amount of unrealized gains. Loss harvesting opportunities did arise in many fixed income sleeves during 2022, allowing some room for rebalancing back to target allocations without a meaningful tax cost.



NDT vs. Defined Benefit

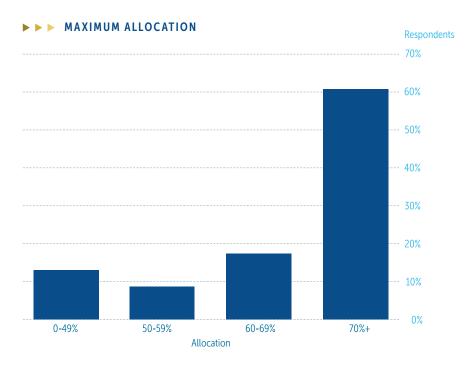
The chart below shows the relationship of each sponsor's NDT equity allocation relative to its Defined Benefit (DB) equity allocation. Observations above the diagonal indicate a larger equity allocation in the DB plan relative to the NDT. Interestingly, a little over a decade ago, it was often difficult to tell a DB plan and an NDT apart. Today, DB pensions have drastically shifted their asset allocation out of equities into long duration fixed income/LDI and alternatives. Even though survey responses indicated that the average NDT had a 22% larger allocation to the U.S. Equity asset class than did the average DB plan, the overwhelming majority of DB fixed income assets were in longer duration strategies while no sponsors indicated an allocation to long duration fixed income strategies in their NDTs. DB plans also indicated a 20% allocation to the "other" category, which is the same level as in 2020.





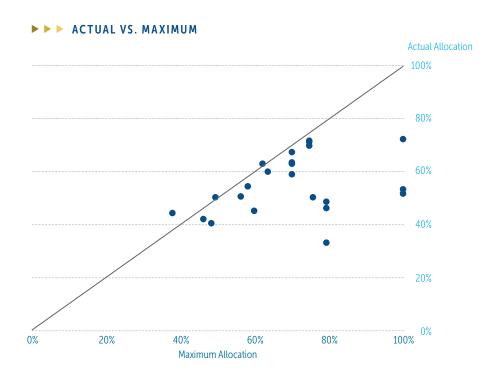
Style Allocations

The estimated total equity allocation was \$35 billion for Qualified Trusts, \$3 billion for Non-Qualified Trusts and \$4 billion for PPAs, Munis and Co-ops. International equity accounted for approximately 17% of the total equity allocation, however, PPAs and Co-ops indicated an allocation much higher than their taxable peers, perhaps due to potential tax headaches for some international equities. Large cap domestic equity styles in Non-qualified Trusts dominated the overall equity allocation, potentially due to the dividend-received-deduction (DRD). The Russell 3000, S&P 500 and MSCI ACWI Ex U.S.A. (USD) had total returns, as reported by the index providers, of 1.5%, 5.4%, and -3.2%, respectively, for the two-year period ending December 31, 2022.



Maximum Allocations

Even though the average maximum equity allocation rose to 70% in 2022 when compared to 66% in the last survey, it is down from 74% several surveys ago. While the average actual equity allocation was approximately 14% below the average maximum allowed, only one respondent exceeded the stated maximum and a handful were more than 20% below the max.



FIXED INCOME ◀ ◀ ◀

Sector Allocations

The estimated total fixed income allocation was \$23 billion for Qualified Trusts, \$3 billion for Non-qualified Trusts and \$3 billion for PPAs, Munis and Co-ops.

Despite having nearly equal tax rates as Qualified Trusts since 2018, tax-exempt bonds remained a significant portion of Non-qualified Trust assets, until recently. As such, allocations to taxable bonds more than doubled survey-over-survey to almost 40% of Non-qualified assets. The substantial increase in yields allowed sponsors to sell tax-exempt bonds without material realized gains (or with realized losses) and shift into instruments such as taxable nominal bonds. The "other" category, which is primarily private credit/debt and real assets, rose to 12% of Non-qualified fixed income assets making it larger than the tax-exempt allocation. PPA Trusts remained a mix of credit and government securities, as well as public real assets, with a larger portion of assets in broad indices, such as the Bloomberg Aggregate, relative to taxable Non-qualified Trusts.

►►► SELECT BENCHMARKS

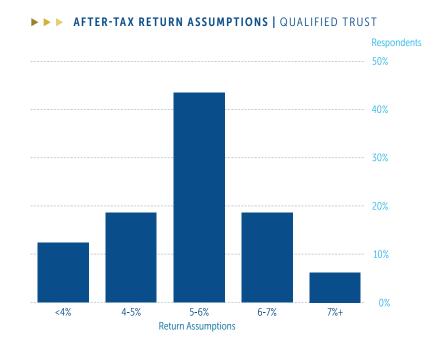
QUALIFIED TRUST	NON-QUALIFIED TRUST	PPAs
Bloomberg Aggregate	Bloomberg Aggregate	Bloomberg Aggregate
Full Credit or Corporate	U.S. Treasury	U.S. Treasury/Agency
U.S. Treasury	Municipal	TIPS
TIPS	Custom Blends	
Barclays Securitized	TIPS	
Bloomberg Universal Bond Index	3m SOFR + 300 bps	
BofA High Yield		
JPM Emerging Market		
BofA Merrill Lynch Preferred Stock Hybrid		
Custom Blends		

The search for yield displayed in the prior survey has ended as protection against inflation dominates the new asset classes being considered by sponsors. These inflation protection categories include REITs, TIPS and real assets.

► ASSET RETURN ASSUMPTIONS

Qualified Trust

The Qualified Trust average after-tax return assumption rose from the lowest level in survey history by the largest amount on record. This is likely due to the ~500 bps increase in the Federal Reserve overnight rate from the prior survey. As return assumptions remain well below peak levels of the late 1990's, based on each respondent's target asset allocations and expected returns for each asset class, the average after-tax return assumption was 5.6%.



Non-qualified Trust

The Non-qualified Trust average after-tax return assumption increased by more than their Qualified counterparts, also rising by record survey levels. Non-qualified and Qualified Trust average aftertax return expectations are now much more in-line than in older surveys, likely due to the current similar federal tax rates on both Qualified and Non-qualified Trusts and Non-qualified asset allocations moving out of municipal bonds into taxable fixed income.

▶ ▶ AFTER-TAX RETURN ASSUMPTIONS | NON-QUALIFIED TRUST Respondents 50% 30% 10% 0% <4% 4-5% 5-6% 6-7% 7%+

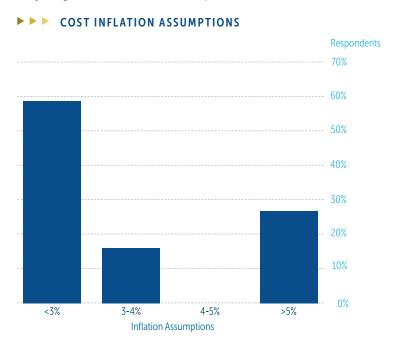
Return Assumptions

►► AFTER-TAX RETURN ASSUMPTIONS

	2022	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002	2000	1998	1996	1994	1992	
Qualified Average	5.6%	5.0%	5.0%	5.4%	5.8%	6.0%	6.0%	6.3%	6.3%	6.6%	6.5%	6.3%	6.7%	6.5%	6.4%	6.1%	
Non-qualified Average	5.5%	4.7%	4.8%	5.1%	4.8%	5.5%	5.5%	5.3%	5.4%	5.5%	5.9%	5.8%	6.2%	6.2%	6.0%	6.6%	

Cost Inflation Assumptions

Inflation assumptions have a prevailing influence on estimating decommissioning liabilities and determining implied after-tax real rates of return. The average composite cost inflation assumption increased by 80 bps from the 2020 survey to levels not seen in over a decade despite broader long-term CPI forecasts remaining relatively stable. Compared to 2020, when about 3/4 of respondents had a cost inflation estimate less than 3% and the highest estimate of 4.2%, just over half have an estimate less than 3% and over 1/4 have estimates over 5%. Cost inflation estimates have averaged ~130 bps over CPI forecasts since 1992, estimates for this survey ranged from as low as 2.0% up to 7.0%.

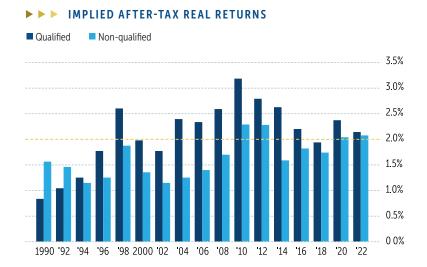


	AVERAGE COST INFLATION RESPONSE	CPI 10-YEAR FORECAST*
2022	3.5%	2.4%
2020	2.7%	2.3%
2018	3.1%	2.2%
2016	3.3%	2.3%
2014	3.2%	2.2%
2012	3.3%	2.4%
2010	3.2%	2.5%
2008	3.6%	2.4%
2006	4.0%	2.4%
2004	4.2%	2.4%
2002	4.7%	2.4%
2000	4.4%	2.6%
1998	4.3%	2.5%
1996	4.7%	3.0%
1994	5.0%	3.4%
1992	5.2%	3.9%

^{*}Federal Reserve Bank of Philadelphia.

Implied After-tax Real Return Assumptions

Implied after-tax real return assumptions were calculated based on each respondent's after-tax return and cost inflation assumptions. With after-tax return assumptions and cost inflation expectations increasing, implied real returns actually remained relatively stable. Qualified Trust implied after-tax return assumptions decreased by 20 bps to 2.1% and Non-qualified Trust implied after-tax return assumptions remained at 2.0% in 2022. The horizontal line at 2% represents the allowable real return assumption permitted in 10 CFR \$50.75 (e) (1) (ii). Weighting the 2022 Qualified, Non-qualified and PPA Trusts' implied after-tax returns by their market values as shown on page 5 yields a total 2.0% NDT average implied after-tax real return, which is exactly in line with the allowable real return assumption outlined in \$50.75.



PPAs had an implied real return of 1.9% in 2022, an increase of 20 bps from the prior survey.

► ► NDT MANAGEMENT

Overview

A new question was posed to survey participants starting in 2014 that focused on risks to decommissioning funding adequacy going forward. Once again, most options received numerous votes with some consistency developing over the prior surveys for each response. Many respondents marked multiple risks; the overall percentage for each option can be seen below. While almost all respondents see cost increases outpacing investment returns as a major issue, 2/3 view spent fuel disposal as a risk in the future.

	2014	2016	2018	2020	2022
Regulatory Issues	35%	50%	35%	33%	50%
Spent Fuel Disposal	54%	46%	58%	52%	67%
Low-level Radioactive Waste Disposal	23%	19%	19%	24%	23%
Cost Increases Outpacing Investment Returns	69%	88%	74%	86%	90%
A "Black Swan" Event	38%	38%	19%	14%	43%
Other	8%	12%	6%	0%	0%

In compiling this survey, we attempted to extract a breakdown of asset allocations relative to remaining plant life. Even though the majority of multi-unit and multi-site survey responses were returned aggregated as one survey, we were able to make the following observations:

- After the recent wave of premature shutdowns, there are not significant allocation differences for currently operating plants. Sponsors with fewer than 15 years on average remaining on their current licenses have just as much equity exposure as those with 15-20 years or even 25+ years remaining on their operating license. Perhaps those with less than 15 years remaining are planning an SLR to extend the plant life for another 20 years.
- ▶ Once a plant enters the decommissioning phase, some equity risk is typically removed. Hence, the average trust shifts to an approximate 30/70 equity to fixed income allocation.
- Despite the long duration of the decommissioning liability for the majority of operating plants, long duration fixed income remains virtually non-existent in plan sponsors asset allocations

Given some meaningful recent market events, we asked sponsors to identify any actions or considerations taken with regards to regional bank exposure, AT1/contingent convertible exposure, inflation hedging assets or allocations to broad fixed income. While 1/3 of sponsor respondents indicated they either were considering or already have implemented increasing inflation hedging asset allocations, three indicated higher fixed income allocations given higher interest rates. Only one sponsor gave pause with respect to AT1's or regional banks.

The majority of respondents are planning to undergo an asset/liability study either this year or in 2024. A Monte Carlo or similar simulation is often used to forecast the probability of a funding shortfall.

Rebalancing activity remains robust across trust sponsors for numerous reasons. 90% of sponsor respondents indicated they rebalanced the asset allocation in the past two years, with the majority of those citing an internally-driven decision as opposed to investment committee or regulatory driven. While the majority of sponsors have not materially revised their asset allocation policy in the past several years, a handful have, due to diversification, which was the most widely cited reason, closely followed by revised risk parameters and/or revised return objectives for the trust. Several sponsors mentioned a glidepath once a certain funded level is reached or a more definitive decommissioning timeline (DECON/SAFSTOR) is finalized. Lastly, if funds remain post decommissioning, the vast majority of sponsors plan to return excess funds to ratepayers, while a handful do not currently have a plan.

NDT/DB

The divergence between NDTs and DB plans continued through 2022, as DB plans continued to de-risk by shifting assets to fixed income/LDI. The average DB plan invests across a broader spectrum of investments focusing on longer duration fixed income (despite, in many cases, having a materially shorter liability duration than an NDT) while the average NDT remains in a more traditional asset mix. For instance, sponsors reported a 34% allocation to long duration fixed income or LDI and a 20% allocation to the "other" asset class in their DB plans and 0% and 5% respectively in NDTs. There are many potential explanations for this including taxes, uncertainty regarding the size and timing of cash flows, regulatory restrictions, method of viewing the liability and separate investment committees, among others.

NISA'S NDT Team

NISA is a 100% employee-owned investment management firm based in St. Louis, Missouri with \$270 billion* in physical assets under management for 215 clients including NDTs, defined benefit plans, defined contribution plans and other institutional investors. Having managed assets for NDT clients since its inception in 1994, NISA is currently one of the largest NDT asset managers in the U.S. with \$17.5 billion* in NDT assets under management for 14 utilities representing at least a portion of assets for over 70% of active reactor units and units currently undergoing decommissioning. NDT assets represent over 75% of NISA's taxable assets under management.

NISA manages all portfolios with a team approach. As such, a team of senior investment professionals services the NDT portfolios, which is supported by a staff of investment professionals. The Investment Committee, comprised of David Eichhorn, Ken Lester, Anthony Pope, Biswajit Bhattacharya, Stephen Douglass and Daniel Scholz, has the primary responsibility for the overall NDT investment strategy.

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Please contact Rusty Groth if you would like additional copies of this report or more information regarding NDT management services. This survey and prior year surveys are available at www.nisa.com.

*As of June 30, 2023.

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