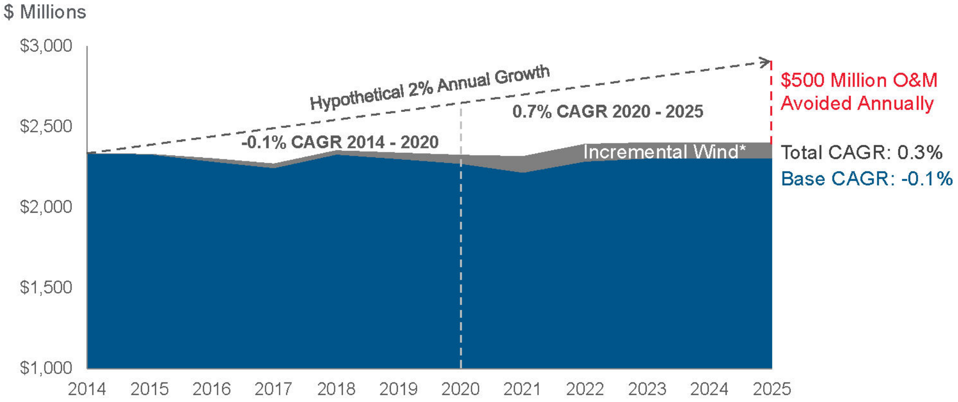
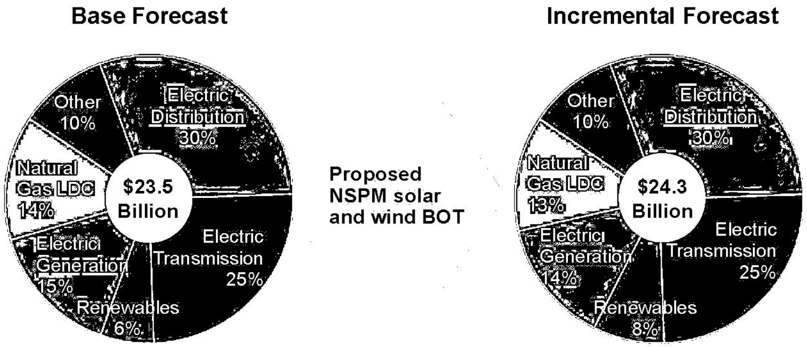
Disciplined O&M Cost Control

CONSISTENT DELIVERY



* Incremental wind O&M is recovered through riders in most jurisdictions



Incremental forecast <u>excludes</u> a significant portion of proposed CO Pathway transmission expansion

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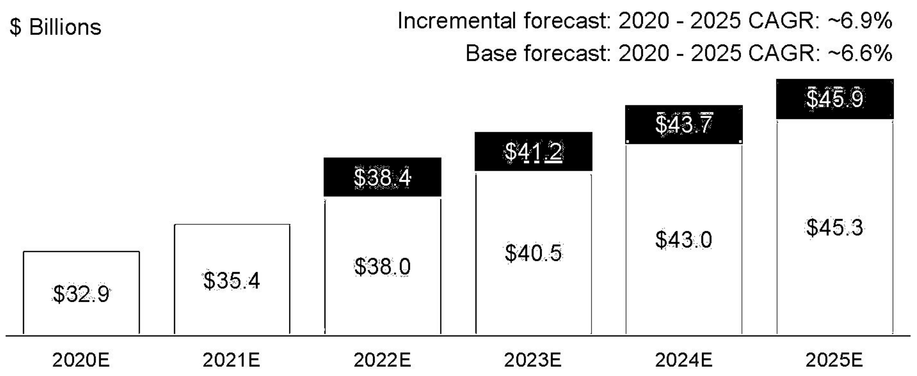
~$785 Million in Additional Wind and Solar

Allete Wind Repowering
- ~$210 million
- ~120 MW
- Approved June 2021

Sherco Solar
- ~$575 million
- ~460 MW universal scale
- Decision 2021 Q4 or 2022 Q1

($ Millions)	2021	2022	2023	2024	2025	Total
Sherco Solar	$10	$170	$215	$180	$0	$575
Allete Wind PPA Buyout	$25	$185	$0	$0	$0	$210
Total	**$35**	**$355**	**$215**	**$180**	**$0**	**$785**

Incremental capital expected to be financed with ~50% equity and ~50% debt



Incremental forecast includes proposed NSPM Sherco solar and Allete wind PPA repowering/buy-out; it excludes a significant portion of proposed CO Pathway transmission expansion

Pragmatic Approach to Reduce Carbon

TRANSPARENT GROWTH

80% Reduction by 2030

Current technology
Renewables, nuclear and natural gas

Responsible transition
For employees and communities

Customer savings
Through low-cost renewables

100% Carbon Free by 2050

New technology
Carbon-free, dispatchable

Technology agnostic
In mindset and approach

Reliability and affordability
Remain paramount

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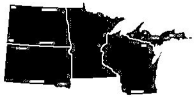
Future Coal Retirements

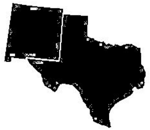
TRANSPARENT GROWTH

80% Carbon Reduction by 2030, Full Coal Exit by 2040



NSPM/NSPW
Alternative resource plan achieves:
- 85% carbon reduction
- Full coal exit by 2030
- **~5,800 MW new renewables**

PSCo
Proposed resource plan achieves:
- 85% carbon reduction by 2030
- Full coal exit by 2040
- **~3,900 MW new renewables**
- ~1,200 MW solar DG



SPS
Full coal exit by 2032:
- Harrington (1,018 MW) – proposed conversion to natural gas by 2024
- Tolk (1,067 MW) – seasonal dispatch, accelerate retirement to 2032

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Alternative Minnesota Resource Plan Proposal

TRANSPARENT GROWTH

Full coal exit by 2030
- King (511 MW) retire 2028
- Sherco 3 (517 MW) retire 2030

Firm peaking capacity (reliability driven)
- Hydrogen ready CTs (800 MW)
- Repowered black start CTs (300 MW)
- Dispatchable capacity (1,900 MW)

Significant renewable additions
- Universal scale solar (3,150 MW)
- Wind (2,650 MW)

Nuclear extension (Monticello to 2040)

June 2021
Updated filing

October 2021
Intervenor comments

2021 Q4 or 2022 Q1
Commission decision

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Colorado Resource Plan Proposal

TRANSPARENT GROWTH

Full coal exit by 2040
- Hayden 1 & 2 (233 MW) retire 2028/2027
- Pawnee (505 MW) convert to nat gas 2028
- Comanche 3 (500 MW) retire 2040; reduced operations begin 2030

Significant renewable additions
- Wind (~2,300 MW)
- Universal scale solar (~1,600 MW)
- Distributed solar (~1,200 MW)

Firm peaking capacity
- Flexible resources (~1,300 MW)
- Storage (~400 MW)

Transmission expansion
CPCN to enable additional renewables while improving reliability

March 2021 Filed > 2022 Q1 Anticipated decision > Post-2025 Investment begins

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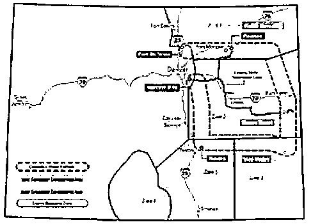
Colorado Pathway – Transmission Expansion

TRANSPARENT GROWTH



Transmission Backbone

- Enables ~5,500 MW of renewable generation
- ~560 miles of 345 kV lines; three new, four expanded substations
- Potential ~$1.7 billion investment
- CPCN filing March 2021; decision anticipated 2022 Q1

Estimated Investment ($ millions)

	2021 - 2025	2026 - 2027	Total
Included in base forecast	$600		**$600**
Incremental opportunity	$700	$400	**$1,100**
Total	$1,300	$400	**$1,700**

Incremental Capital Investment

Potential for $0.5 - $1 billion investment in optional transmission expansion in the CPCN ($300 million), network upgrades, voltage support and interconnection work depending on resource mix/location

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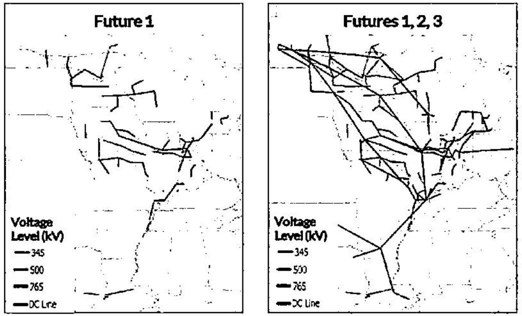
MISO Transmission Outlook

MISO's long-range potential transmission planning roadmap highlighted:

- Three potential futures with up to 50% renewables by 2039
- Urgency for significant expansion over next ~15 years
- Initial set of projects with preliminary estimate of ~$30 billion; potential full rollout up to $100 billion
- ~87 GW in MISO queue, primarily solar and wind

Indicative Transmission Development in MISO



Source: MISO

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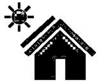
Solar Capacity & Outlook

TRANSPARENT GROWTH

~2,300 MW Today – Limited Ownership

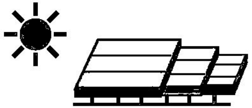
UNIVERSAL ~760 MW
3 voluntary programs,
12,000 participants

GARDENS ~890 MW
~400 sites, 22,000 subscribers



PRIVATE ~660 MW
~70,000 customer and
third-party systems

Significant Opportunities by 2030



- Proposed ~3,150 MW in Minnesota IRP
- Proposed ~1,600 MW in Colorado IRP
- Proposed ~1,200 MW solar DG in Colorado IRP
- Proposed ~460 MW at retiring Sherco plant
- Approved 74 MW owned facility in Wisconsin

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Hydrogen Evaluation & Outlook

Production Using Nuclear | First in U.S. to Use High-Temp Steam Electrolysis

Market studies	Tech assessment	Pilot project	Potential to scale
NREL, EPRI and other utilities	DOE grant with two other utilities	~$10 million DOE grant	Storage, industrial decarbonization
2018 - 2019	2020 - 2021	2021 - 2023	Late 2020s - 2030+

POTENTIAL FUTURE OPPORTUNITIES

Cleaner Power Generation
Use of hydrogen in natural gas CTs/CCs

Greener Natural Gas System
Blending hydrogen into the system

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Electric Vehicle Vision 2030

TRANSPARENT GROWTH

1.5 Million
EVs Enabled

Nation-leading models for home, fleet and public charging

5 million CO_2 tons avoided annually
80% lower vehicle emissions when charging with Xcel Energy

$1 billion annual customer savings
~$1/gallon and lower using off-peak energy; rebates drive adoption

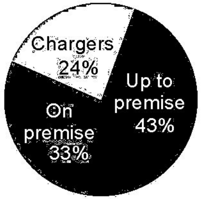
+$2 billion investment
Service connections, charging infrastructure and programs

0.6% to 0.7% incremental annual retail sales growth
~6-7 million MWh new load keeps customer bills low

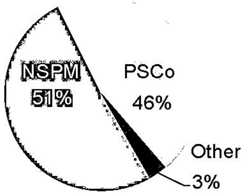
Electric Vehicle Outlook 2021 – 2025

TRANSPARENT GROWTH

$500 million investment



Infrastructure Type



Operating Company

HOME
- Single family and multiunit
- Time-based and flat rates
- Rebates

FLEET
- Cities and transit agencies
- School buses
- Business customers

PUBLIC
- Major corridors
- Underserved areas
- Ride-share programs

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Sustainability Goals & Progress

LEADING ESG PROFILE

Carbon emissions down 80% by 2030*
51% from 2005-2020; tied to LTI since 2005

Methane emissions rate <0.22%**
0.15% in 2020

Water consumption down 70% by 2030
34% reduction from 2005 to 2020

1.5 million EVs powered by 2030
Programs approved in MN, CO & WI
Plans filed in NM

Mitigate impacts of coal retirements
7 plant closures with 0 layoffs

Support local economies
In 2020 >70% of supply chain spend was local; 20 economic development projects added ~$900 million investment and 3,000 jobs

Workforce reflects our communities
Board: 21% female; 14% diverse
Workforce: 23% female; 16% diverse (YE 2020)

~10% spend with diverse suppliers in 2021
Exceeded $600 million goal in 2020, with $640 million, or ~13% (normal goods and services)

* Includes owned and purchased electricity serving customers
** ONE Future consortium target for distribution systems

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Attractive Investment Thesis

Pure-Play Regulated Utility that Consistently Delivers

CONSISTENT **DELIVERY**

TRANSPARENT **GROWTH**

LEADING **ESG PROFILE**

~8-10%
Total Shareholder Return

5-7%
EPS Growth

~2.7%
Dividend Yield

5-7%
Dividend CAGR

60-70%
Payout Ratio

Delivering **100%** **carbon-free electricity** by 2050

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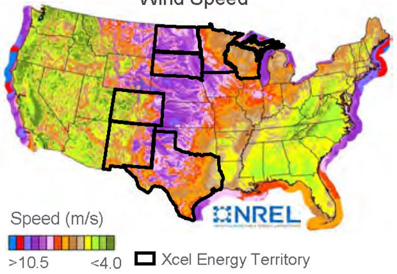
APPENDIX

STEEL FOR FUEL ADVANTAGE

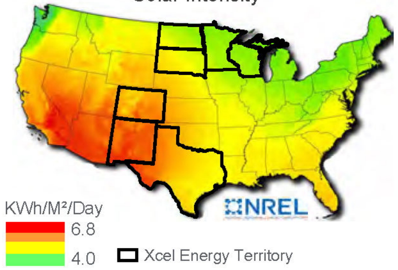
Geographic Advantage for Renewables

High Capacity Factors Enable Greater Efficiency and Lower Costs

Wind Speed



Solar Intensity



National Renewable Energy Laboratory with modification

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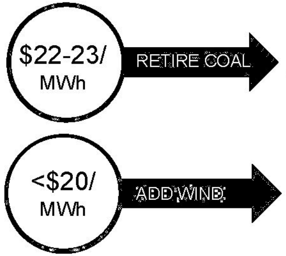
Attractive Economics for Renewables

STEEL FOR FUEL

Replacing Coal with Lower-Cost Wind

Variable cost of
coal generation

Levelized cost of
wind generation



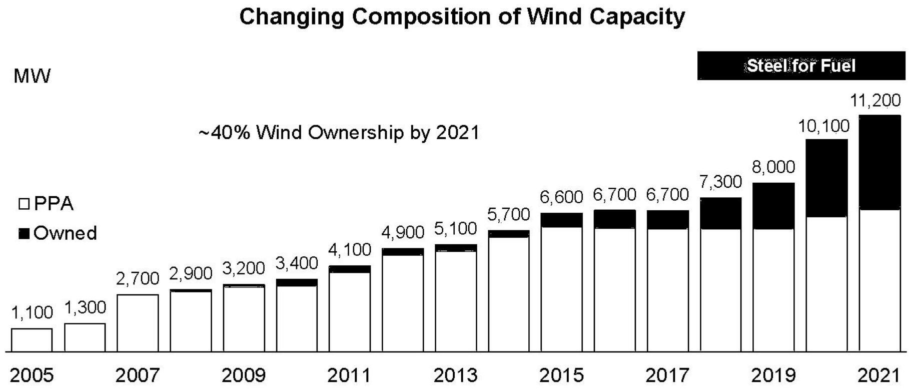
Less carbon, fewer coal assets, lower labor costs

Fuel savings offset new investment; bills stay low

3,600 MW New owned wind (2018-2021) × 8,760 Hours/year × 50% Capacity factor = ~16 million MWh annually

26

Expanding Wind Profile



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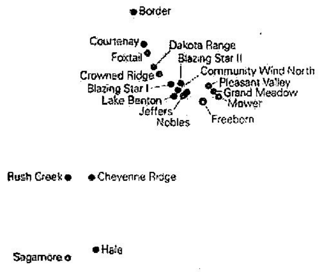
Proven Strength in Wind Development

STEEL FOR FUEL



In Serviced Pre-2020	Capacity
Border	150 MW
Courtenay	200 MW
Grand Meadow	100 MW
Nobles	200 MW
Pleasant Valley	200 MW
Rush Creek	600 MW
Hale	478 MW
Lake Benton	100 MW
Foxtail	150 MW
Total	**2,178 MW**

In Serviced In 2020	Capacity
Blazing Star 1	200 MW
Cheyenne Ridge	500 MW
Crowned Ridge	200 MW
Sagamore	522 MW
Jeffers	44 MW
Community North	26 MW
Total	**1,492 MW**

To Be In Service 2021	Capacity
Mower	99 MW ✓
Blazing Star 2	200 MW ✓
Freeborn	200 MW ✓
Dakota Range	300 MW
Total	**799 MW**

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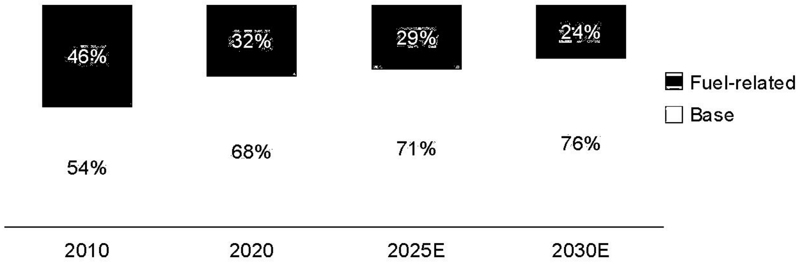
Maintaining Customer Affordability

Fuel Component of Bill Declines Over Time = Customer Savings



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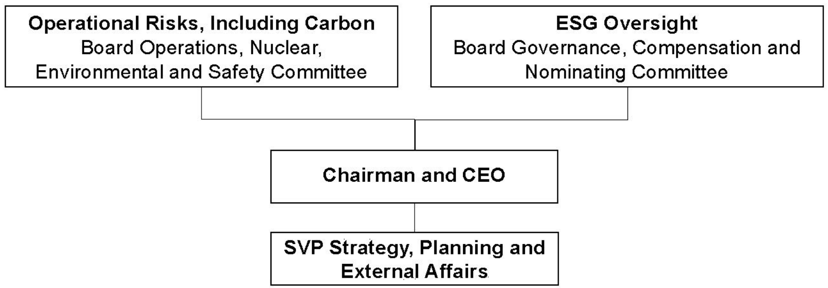
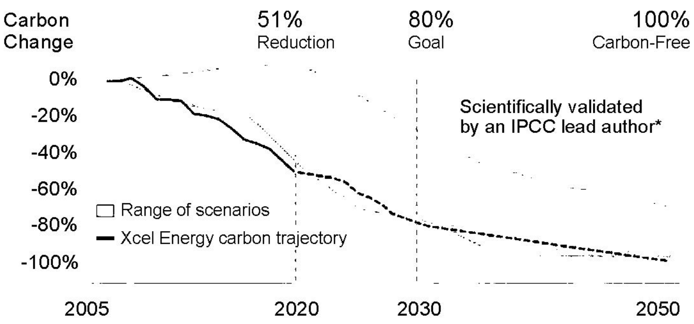
LEADING ESG PROFILE

ESG Governance Structure

LEADING ESG PROFILE



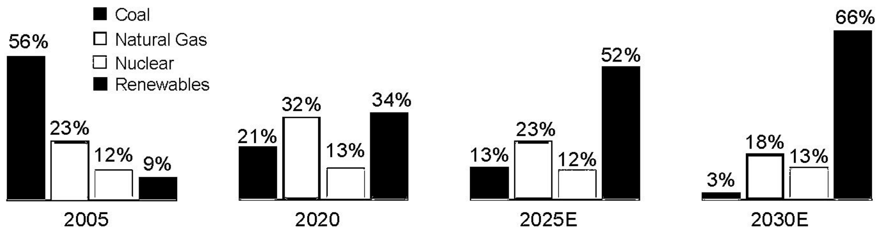
Carbon Trajectory Aligned With Paris Accord



Goal includes owned and purchased power
* Intergovernmental Panel on Climate Change

Tangible Carbon Reduction Plans

Energy Mix – 80% Carbon Reduction by 2030



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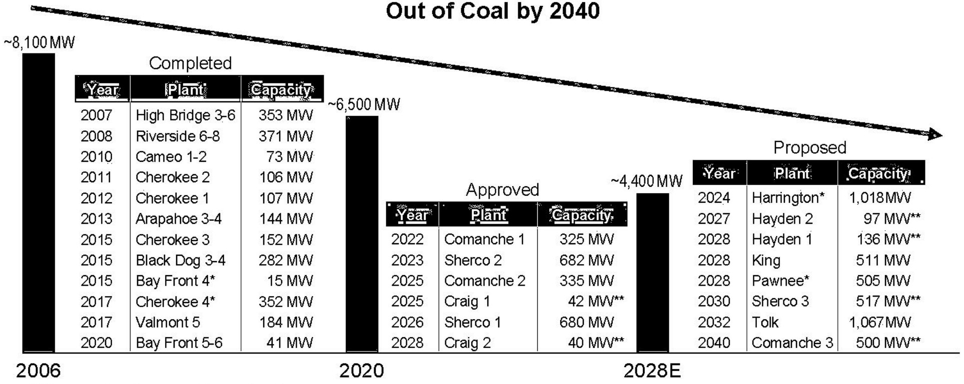
Planned Coal Phaseout

Out of Coal by 2040



Completed

Year	Plant	Capacity
2007	High Bridge 3-6	353 MW
2008	Riverside 6-8	371 MW
2010	Cameo 1-2	73 MW
2011	Cherokee 2	106 MW
2012	Cherokee 1	107 MW
2013	Arapahoe 3-4	144 MW
2015	Cherokee 3	152 MW
2015	Black Dog 3-4	282 MW
2015	Bay Front 4*	15 MW
2017	Cherokee 4*	352 MW
2017	Valmont 5	184 MW
2020	Bay Front 5-6	41 MW

Approved

Year	Plant	Capacity
2022	Comanche 1	325 MW
2023	Sherco 2	682 MW
2025	Comanche 2	335 MW
2025	Craig 1	42 MW**
2026	Sherco 1	680 MW
2028	Craig 2	40 MW**

Proposed

Year	Plant	Capacity
2024	Harrington*	1,018 MW
2027	Hayden 2	97 MW**
2028	Hayden 1	136 MW**
2028	King	511 MW
2028	Pawnee*	505 MW
2030	Sherco 3	517 MW**
2032	Tolk	1,067 MW
2040	Comanche 3	500 MW**

* Conversion from coal to natural gas
** Based on Xcel Energy's ownership interest

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Reductions Beyond Carbon

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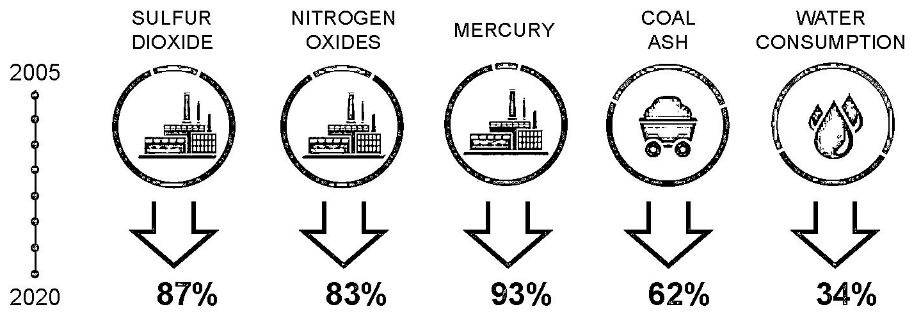
Environmental Improvement Since 2005



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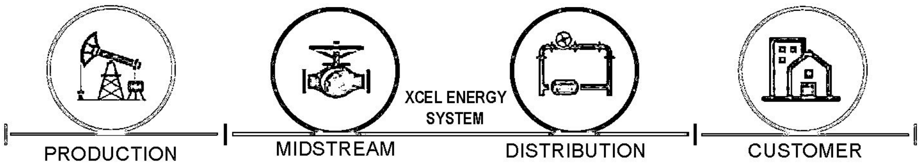
Natural Gas – Controlling Emissions

LEADING ESG PROFILE

Goal to Keep Methane Emissions Rate Below 0.2%



1 **Reduce emissions** from suppliers and our own operations

2 **Require transparency** among suppliers

3 Explore **new sources of energy supply,** such as hydrogen

4 Promote **conservation** and **beneficial electrification**

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Green Financing Impacts

$3.9 Billion Issued to Fund Eight Wind Farms

Climate

+2 Gigawatts
Renewable Energy

+100 Million Tons
Carbon Emissions Avoided

Affordability
Low-cost wind, record-low coupons

Economic Sustainability
+2,100 jobs, $300 million property taxes

Supplier Diversity
9 diverse suppliers, ~$180 million spend

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Responsible Transition Out of Coal

LEADING ESG PROFILE

Proven Commitment to Mitigate Impacts

Demonstrated commitment to our people

- Advanced notice, integrated workforce planning
- Job shadowing, training, tuition reimbursement, relocations
- Helping employees change union locals and job classifications

Meaningful support for our communities

- Close collaboration with community, business, and government leaders
- Helping preserve property tax base through new business

7
PLANTS RETIRED

0
LAYOFFS

Diversity, Equity & Inclusion (DEI)

Strong Focus and Commitment

Drive DEI from the Top
Results tied to 2021 **executive compensation**

Strengthen Community Connections
~$20 million committed, including COVID-19 relief, **racial equity** and **social justice**

Remove Barriers to Entry
Broader outreach and diverse **interview panels**

Establish Academies/Training Programs
Expanding **diversity-focused intern programs** and **micro-inequities training**

Diversity – Representation

LEADING ESG PROFILE

21% female | 14% diverse

CEO DIRECT REPORTS
38% female | 13% diverse

MANAGEMENT
22% female | 10% diverse

WORKFORCE
23% female | 16% diverse

NEW HIRES
33% female | 22% diverse

INTERNS
33% female | 28% diverse

Board figures as of May 2021, workforce figures as of YE 2020

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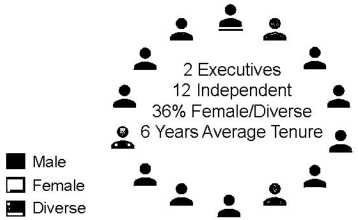
Diverse and Engaged Board

LEADING ESG PROFILE



- Mandatory retirement age and tenure limit
- Lead independent director elected annually
- Independent committee chairs
- Board and committee performance evaluations
- No supermajority approval provisions
- Proxy access adopted
- Annual advisory vote on compensation
- Overboarding policies

Governance, Compensation & Nominating (ESG oversight) | Audit | Finance | Operations, Nuclear, Environmental & Safety

Eight new directors within past five years

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Risk Management – Strong Governance

Clear Board Committee and Management Accountability

Governance, Compensation & Nominating
Board effectiveness, executive compensation, political contributions, ESG oversight

Chief Human Resources Officer

Operations, Nuclear, Environmental & Safety
Safety and operational risk, climate change, reliability, physical and cyber security, environmental performance

President & Chief Operating Officer

Finance
Capital structure and financing, dividend policy, insurance coverage, investor relations

Chief Financial Officer

Audit
Effectiveness of controls, financial statements/disclosures, legal and regulatory compliance, business conduct/ethics

Controller

Risk Management – Effective Mitigation

CLIMATE
- Early coal retirements
- Proactive wildfire mitigation
- Clean tech advancement

OPERATIONS
- Safety and business continuity focus
- Integrated security – physical and cyber
- Reliability core to successful transition

FINANCIAL
- Strong governance
- Conservative planning approach
- Focus on affordability, economic health

REPUTATION
- Robust compliance and conduct program
- Multiple reporting pathways

Risk Management – Wildfires

GOVERNANCE

Direct oversight by designated **Board committee**

Embedded in **enterprise risk management** processes

PREVENTION

Robust inspections using drones, LIDAR and infrared technologies

Disciplined vegetation management

Comprehensive mitigation plans

MANAGEMENT

Strong emergency response and **business continuity** capabilities

Adequate insurance

Colorado standard is **simple negligence**

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Risk Management – Security

Enterprise Risk Management Governance Framework

BOARD OVERSIGHT	**Full Board**	
	Operations, Nuclear, Environmental & Safety Committee	Operational risks, including physical and cyber security; meets 4 times/year
MANAGEMENT OVERSIGHT	**C-Level Security & Emergency Management Committee**	Policy development and adherence; meets quarterly
	VP-Level Steering Committee	Planning and program oversight; meets monthly
EXECUTION	**Business Security Liaisons, Front-line Leaders and Employees**	Threat monitoring, testing, drills, and continuous improvement

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Risk Management – Security

LEADING ESG PROFILE

Comprehensive, Integrated Physical and Cyber Program

Common Operating Picture
Integrated Enterprise Command Center and organization structure: cyber, physical and emergency management

Leading Threat Intelligence Practices
Active engagement with intelligence community and peers; third-party cyber assessments shared with board

Strong Controls
Strong preventative and detective controls, mapping assets to critical processes

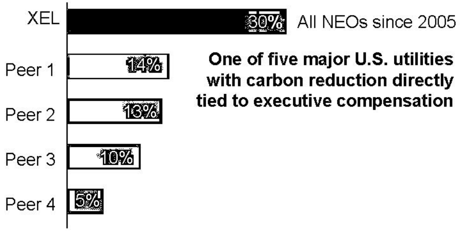
Effective Response Management
Strong business continuity, emergency preparedness and response capabilities

Governance – Paying for Performance

LEADING ESG PROFILE

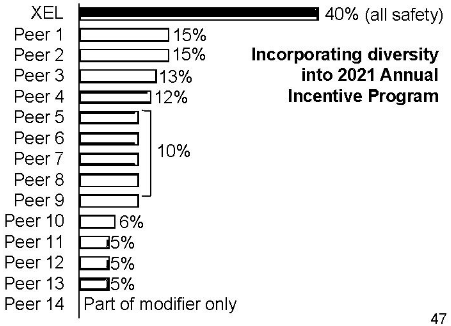
Environmental Goals Tied to Long-Term Incentive Pay Since 2005

Long-Term Incentive Tied to Environment



One of five major U.S. utilities with carbon reduction directly tied to executive compensation

Annual Incentive Tied to Safety or Environment



Incorporating diversity into 2021 Annual Incentive Program

Source: Meridian based on 2020 proxy statements

Voluntary Disclosures

LEADING ESG PROFILE

FRAMEWORKS & STANDARDS	GRI Index	SASB Index	Supporter	Goal Alignment	Founding Member	Member		
REPORTS & DISCLOSURES	Sustainability Report	Carbon Scenarios	TCFD Response	EEI/AGA Template	Carbon Intensities		Green Bond Impacts	Political Contributions
POLICIES & POSITION STATEMENTS	Environmental Policy	Anti-Discrimination	Anti-Retaliation	Lobbying & Contributions	Human Rights	Responsible Transition	Compliance Program	Code of Conduct

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FINANCIAL SUPPLEMENT

Strong Credit Metrics

Plan	2021	2022	2023	2024	2025
FFO/Debt	~16%	~16%	~17%	~17%	~17%
Debt/EBITDA	5.1x	5.1x	5.0x	4.9x	4.9x
Equity Ratio	41%	40%	40%	40%	40%
Hold Co Debt/Total Debt	24%	25%	23%	24%	24%

Credit Ratings	Moody's	S&P	Fitch
Xcel Energy Unsecured	Baa1	BBB+	BBB+
NSPM Secured	Aa3	A	A+
NSPW Secured	Aa3	A	A+
PSCo Secured	A1	A	A+
SPS Secured	A3	A	A-

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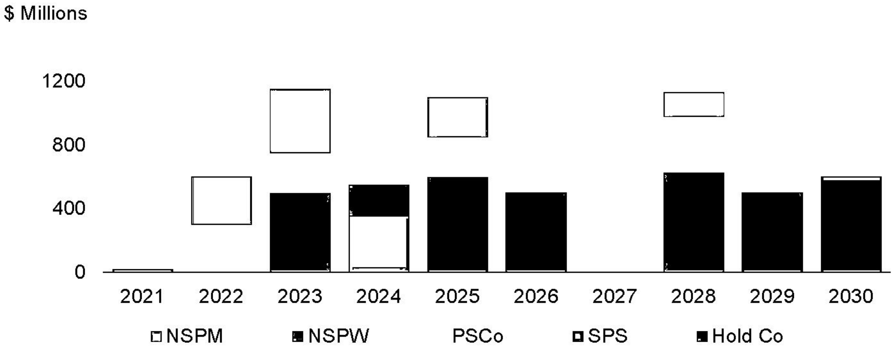
Manageable Debt Maturities

FINANCIAL SUPPLEMENT



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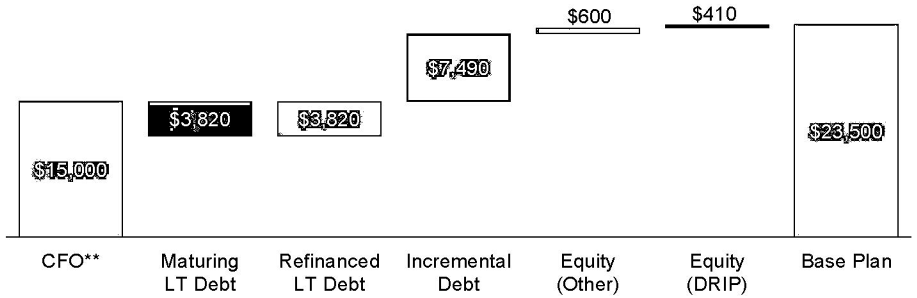
Base Financing Plan 2021 – 2025*



* Financing plans are subject to change
** Cash from operations is net of dividends and pension funding

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2021 Debt Financing Base Plan

Issuer	Security	Amount	Status	Tenor	Coupon
Hold Co	Unsecured Term Loan	$1,200	Completed	1 Yr	N/A
PSCo	First Mortgage Bonds	$750	Completed	10 Yr	1.875%
SPS	Green First Mortgage Bonds	$250	Completed	29 Yr	3.15%
NSPM	Green First Mortgage Bonds	$850	Completed	10 Yr ($425) 31 Yr ($425)	2.25% 3.20%
NSPW	First Mortgage Bonds	$100	Completed	30 Yr	2.82%

Xcel Energy may issue a holding company bond in the fourth quarter to pay down the outstanding term loan

Financing plans are subject to change, depending on capital expenditures, regulatory outcomes, internal cash generation, market conditions, changes in tax policies and other factors

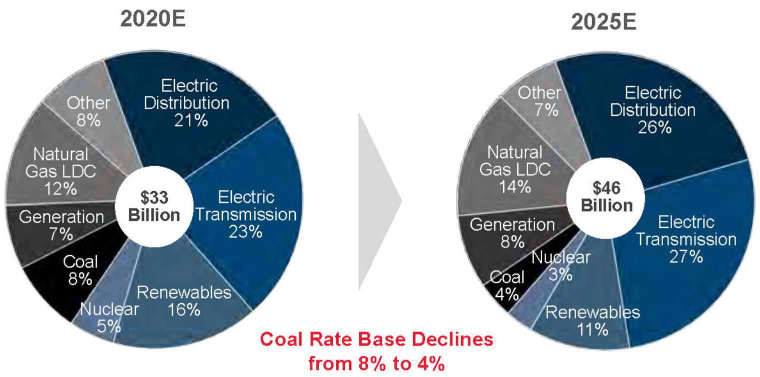
Reconciliation – Ongoing EPS to GAAP EPS

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Ongoing EPS	**$1.15**	**$1.30**	**$1.43**	**$1.45**	**$1.50**	**$1.62**	**$1.72**	**$1.82**	**$1.95**	**$2.03**	**$2.09**	**$2.21**	**$2.30**	**$2.47**	**$2.64**	**$2.79**
PSRI-COLI	0.05	0.05	(0.08)	0.01	(0.01)	0.03	-	-	-	-	-	-	-	-	-	-
Prescription Drug Tax Benefit	-	-	-	-	-	(0.04)	-	0.03	-	-	-	-	-	-	-	-
SPS FERC Order	-	-	-	-	-	-	-	-	(0.04)	-	-	-	-	-	-	-
Loss on Monticello LCM/EPU Project	-	-	-	-	-	-	-	-	-	-	(0.16)	-	-	-	-	-
Impact of Tax Cuts & Jobs Act	-	-	-	-	-	-	-	-	-	-	-	-	(0.05)	-	-	-
Cont. Ops.	**1.20**	**1.35**	**1.35**	**1.46**	**1.49**	**1.61**	**1.72**	**1.85**	**1.91**	**2.03**	**1.94**	**2.21**	**2.25**	**2.47**	**2.64**	**2.79**
Discont. Ops.	0.03	0.01	-	-	(0.01)	0.01	-	-	-	-	-	-	-	-	-	-
GAAP EPS	**$1.23**	**$1.36**	**$1.35**	**$1.46**	**$1.48**	**$1.62**	**$1.72**	**$1.85**	**$1.91**	**$2.03**	**$1.94**	**$2.21**	**$2.25**	**$2.47**	**$2.64**	**$2.79**

Amounts may not sum due to rounding

Xcel Energy's management believes that ongoing earnings reflects management's performance in operating the company and provides a meaningful representation of the performance of Xcel Energy's core business. In addition, Xcel Energy's management uses ongoing earnings internally for financial planning and analysis, for reporting of results to the Board of Directors and when communicating its earnings outlook to analysts and investors.

Diverse Asset Base



2025E includes proposed universal solar projects

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Base Capital Expenditures by Function

	2021	2022	2023	2024	2025	Total
Electric Distribution	$1,205	$1,440	$1,550	$1,505	$1,475	$7,175
Electric Transmission	$870	$1,285	$1,285	$1,270	$1,290	$6,000
Electric Generation	$630	$575	$560	$750	$975	$3,490
Natural Gas	$615	$615	$665	$670	$625	$3,190
Other	$545	$575	$485	$405	$335	$2,345
Renewables	$610	$255	$165	$270	$0	$1,300
Total	**$4,475**	**$4,745**	**$4,710**	**$4,870**	**$4,700**	**$23,500**

The base forecast excludes $785 million for proposed NSPM Sherco solar & Allete wind PPA repowering/buy-out projects.
The base capital forecast also excludes a significant portion of proposed CO Pathway transmission expansion.

Base Capital Expenditures by Company

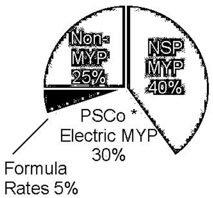
	2021	2022	2023	2024	2025	Total
NSPM	$1,930	$1,785	$1,785	$1,915	$1,890	$9,305
NSPW	$360	$430	$395	$515	$470	$2,170
PSCo	$1,700	$1,835	$1,750	$1,695	$1,655	$8,635
SPS	$505	$710	$770	$735	$675	$3,395
Other*	($20)	($15)	$10	$10	$10	($5)
Total	**$4,475**	**$4,745**	**$4,710**	**$4,870**	**$4,700**	**$23,500**

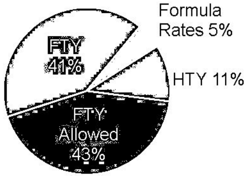
* Includes intercompany transfers for safe harbor wind turbines

The base forecast excludes $785 million for proposed NSPM Sherco solar & Allete wind PPA repowering/buy-out projects.
The base capital forecast also excludes a significant portion of proposed CO Pathway transmission expansion.

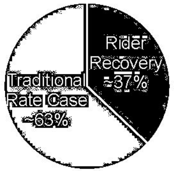
Regulatory Framework

Rate Base Covered by Multi-year Plans

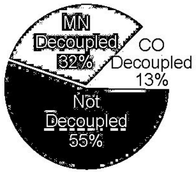




Cap Ex Eligible for Recovery by Rider



Retail Electric Sales Covered by Decoupling



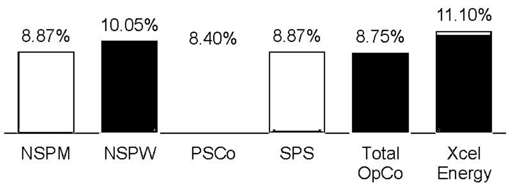
* Colorado Commission approved two three-year electric MYPs in the past

ROE Results – GAAP and Ongoing Earnings

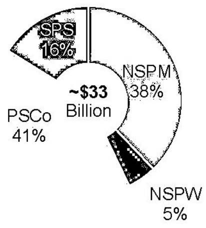
FINANCIAL SUPPLEMENT

GAAP and Ongoing ROE

Twelve Months Ended 6/30/2021



2020E Rate Base



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Regulatory Framework by Company

	NSPM	NSPW	PSCo	SPS
Multi-year Rate Plans	✓	✓	Allowed	
Forward Test Year	✓ MN & ND	✓	Allowed	✓ NM Allowed
Interim Rates	✓		Allowed	*
Fuel Recovery Mechanism	✓	✓	✓	✓
Capacity Recovery Mechanism			✓	
Renewable Rider	✓ MN & ND		✓	✓ NM
Transmission Rider	✓ MN & ND		✓	✓ TX
Distribution or Advanced Grid Rider	✓ MN			✓ TX & NM
Infrastructure Rider	✓ SD			
Generation Rider				✓ TX
Pension Deferral Mechanism	✓ MN		✓	✓
Property Tax Deferral/True-up	✓ MN		✓	
Decoupling	✓ MN		✓	

* Wind settlement in Texas reduces regulatory lag for wind projects

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2020 Rate Base and ROEs

OpCo	Jurisdiction	YE 2020 Rate Base ($ millions)	YE 2020 Authorized ROE (%)	YE 2020 W/N Earned ROE (%)	Regulatory Status
NSPM	MN Electric	10,339	9.20	9.26	Stay-out approved December 2020
	MN Natural Gas	816	10.09	7.19	
	ND Electric	632	9.85	9.54	Filed 2021 rate case; decision expected 2021 H2
	ND Natural Gas	81	9.75	6.63	TCJA Settlement 2019-2020
	SD Electric	727	Blackbox	8.48	TCJA Settlement 2019-2020
NSPW	WI Electric	1,584	10.00	10.46	2020-2021 MYP
	WI Natural Gas	172	10.00	5.59	2020-2021 MYP
	MI Elec. & Nat. Gas	44	9.80(e)/10.00(g)	8.18	2018 Rate Case (e)
PSCo	CO Electric	9,202	9.30	8.73	New rates implemented 2020 (9.3% ROE); 2021-2025 wildfire mitigation rider request pending CPUC approval
	CO Natural Gas	3,030	9.20	8.78	Rates effective April 2021, retroactive to November 2020 (9.2% ROE)
	Wholesale/Steam	763	*	*	
SPS	TX Electric	3,269	Blackbox	7.02**	Rate case filed February 2021; decision expected 2022 Q2
	NM Electric	1,795	9.45	6.20**	Rate case filed January 2021; decision expected 2021 Q4
	SPS Wholesale	1,051	***	***	

* Authorized ROE for PSCo transmission and production formula = 9.72%
** Actual regulatory ROEs are low relative to GAAP ROE due to the use of year-end rate base for regulatory purposes, which includes the Sagamore wind farm, but not the corresponding revenue
*** Transmission ROE = 10.50% and production formula ROE = 10.00%

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Storm Uri Impacts

Maintained Reliability, Managing Customer Bill Impacts

Company	Estimated Storm Impact ($ Millions)			Total Average Resi Bill Impact	Average Monthly Resi Bill Impact
	Electric	Natural Gas	Total		
NSPM	($20)	$250	**$230**	$250 - $300	$10 - $13
PSCo	$305	$305	**$610**	$210 - $220	$8 - $9
SPS	$100	N/A	**$100**	$60 - $70	$2 - $3
NSPW	---	$45	**$45**	$180	$20
Total	**$385**	**$600**	**$985**		

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COMPANY PROFILES

Fully Regulated and Vertically Integrated

COMPANY PROFILES

Four
Operating Companies

Eight
States

3.7 Million
Electric Customers

2.1 Million
Natural Gas Customers

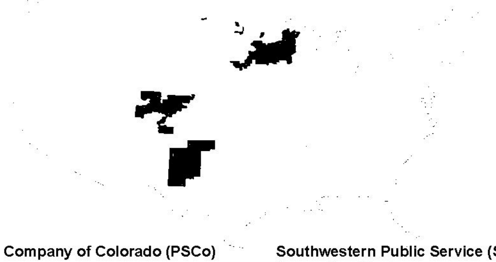
$33 Billion
2020 Est. Rate Base

20 GW
Owned Gen. Capacity

11,000+
Employees

Northern States Power Minnesota (NSPM)
Minnesota, South Dakota, North Dakota
- 2020E Rate Base: $12.6 billion
- 2020 Ongoing EPS: $1.12
- 2021-2025 Base Cap Ex: $9.3 billion

Northern States Power Wisconsin (NSPW)
Wisconsin, Michigan
- 2020E Rate Base: $1.8 billion
- 2020 Ongoing EPS: $0.20
- 2021-2025 Base Cap Ex: $2.2 billion



Public Service Company of Colorado (PSCo)
Colorado
- 2020E Rate Base: $13.3 billion
- 2020 Ongoing EPS: $1.11
- 2021-2025 Base Cap Ex: $8.6 billion

Southwestern Public Service (SPS)
Texas, New Mexico
- 2020E Rate Base: $5.4 billion
- 2020 Ongoing EPS: $0.56
- 2021-2025 Base Cap Ex: $3.4 billion

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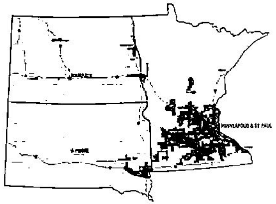
NSPM Overview

Electric - Retail
1.5 million customers
32 million MWh

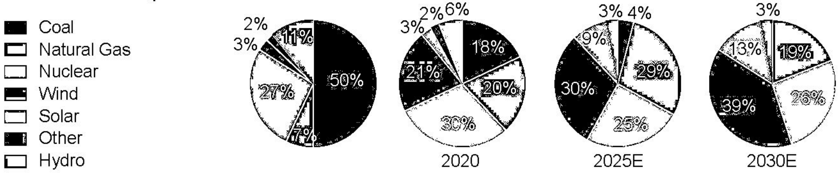
Natural Gas - Retail
531,000 customers
85 million MMBtu



2020 Financials	GAAP & Ongoing
Net Income	$591 million
Assets	$21.1 billion
ROE	9.20%
Equity Ratio	52.7%

Credit Ratings (Secured/Unsecured)	
Moody's	Aa3 / A2
S&P	A / A-
Fitch	A+ / A

NSP System Energy Mix



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NSPM Capital Expenditures by Function

$ Millions

	2021	2022	2023	2024	2025	Total
Electric Distribution	$375	$545	$595	$545	$520	$2,580
Electric Transmission	$235	$305	$320	$305	$305	$1,470
Electric Generation	$335	$340	$350	$450	$760	$2,235
Natural Gas	$175	$150	$175	$185	$175	$860
Other	$215	$265	$195	$160	$130	$965
Renewables	$595	$180	$150	$270	$0	$1,195
Total	**$1,930**	**$1,785**	**$1,785**	**$1,915**	**$1,890**	**$9,305**

The base capital forecast excludes $785 million for proposed NSPM Sherco solar & Allete wind PPA repowering/buy-out.

NSPM Recovery Mechanisms

Minnesota

- Forward test year with interim rates
- Transmission rider
- Renewable energy rider
- Natural gas infrastructure rider
- Environmental improvement rider
- Recovery of grid modernization through transmission rider
- DSM incentive mechanism
- Fuel clause adjustment
- Electric decoupling/sales true-up for all classes (2016 - 2020)
- Multi-year rate plans up to 5 years

North Dakota and South Dakota

- Forward test year with interim rates (ND)
- Historic test year (SD)
- Transmission rider (ND & SD)
- Renewable energy rider (ND)
- Infrastructure rider for capital projects (SD)
- Fuel clause adjustment (ND & SD)

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NSPM North Dakota Rate Cases

Case Nos. PU-20-441 and PU-21-381

Electric Case

- In November 2020, NSPM filed an electric case:
  - Requesting rate increase of $19 million
  - ROE of 10.2% and equity ratio of 52.5%
  - Rate base of ~$677 million; 2021 FTY
  - Interim rates of $13 million implemented
- In August 2021, the NDPSC approved a settlement:
  - Base rate increase of $7 million
  - ROE of 9.5% and equity ratio of 52.5%
  - Deferral of $1.6 million advanced grid costs
  - Rates effective October 2021

Natural Gas Case

- In September 2021, NSPM filed a gas case:
  - Requesting rate increase of ~$7 million
  - ROE of 10.5% and equity ratio of 52.54%
  - Rate base of ~$140 million
  - 2022 forecast test year
  - Interim rates of ~$8 million to be implemented November 1, 2021 (subject to refund)

NSPW Overview

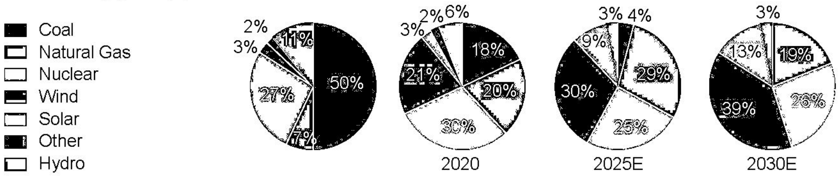
Electric - Retail
264,000 customers
7 million MWh

Natural Gas - Retail
118,000 customers
17 million MMBtu

2020 Financials	**GAAP & Ongoing**
Net Income	$107 million
Assets	$2.9 billion
ROE	10.52%
Equity Ratio	53.6%

Credit Ratings (Secured/Unsecured)	
Moody's	Aa3 / A2
S&P	A / A-
Fitch	A+ / A

NSP System Energy Mix



NSPW Capital Expenditures by Function

$ Millions

	2021	2022	2023	2024	2025	Total
Electric Distribution	$100	$100	$130	$135	$135	$600
Electric Transmission	$145	$145	$125	$150	$155	$720
Electric Generation	$20	$20	$50	$140	$90	$320
Natural Gas	$25	$30	$25	$40	$50	$170
Other	$55	$60	$50	$50	$40	$255
Renewables	$15	$75	$15	$0	$0	$105
Total	**$360**	**$430**	**$395**	**$515**	**$470**	**$2,170**

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NSPW Recovery Mechanisms

Wisconsin and Michigan

- Forward test year (WI & MI)
- Biennial rate case (WI)
- Annual electric fuel plan with reconciliation (WI)
- Purchased natural gas adjustment (WI)
- Natural gas cost recovery mechanism (MI)
- Power supply cost recovery (MI)

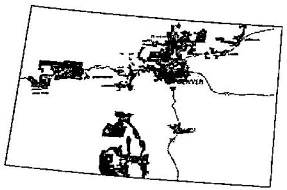
NSPW Electric and Natural Gas Rate Case

Docket No. 4220-UR-125

- In July 2021, NSPW filed an electric and natural gas rate case settlement based on a FTY, reflecting:
  - Electric rate increase: $35 million for 2022 and incremental $18 million for 2023
  - Natural gas rate increase: $10 million for 2022 and incremental $3 million for 2023
  - ROE of 9.8% for 2022 and 10.0% for 2023; equity ratio of 52.5%
  - Electric rate base: ~$1.75 billion for 2022 and ~$1.98 billion for 2023
  - Natural gas rate base: ~$195 million for 2022 and ~$223 million for 2023
  - COVID-19 deferral recovery to be addressed in next rate proceeding
  - Deferral of impacts from potential changes in federal or state tax law
  - Earnings sharing mechanism, which would return to customers 50% of earnings 50 - 75 basis points over authorized ROE and 100% of earnings equal to or in excess of 75 basis points
- Decision expected 2021 Q4

PSCo Overview

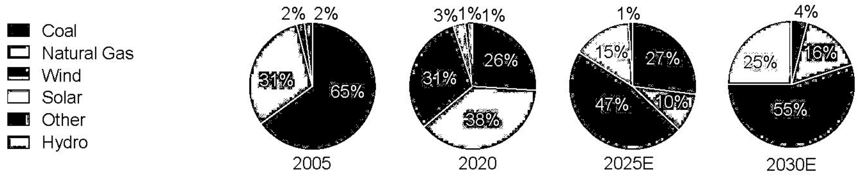
Electric - Retail	**Natural Gas - Retail**
1.5 million customers	1.4 million customers
29 million MWh	145 million MMBtu



2020 Financials	**GAAP & Ongoing**
Net Income	$588 million
Assets	$20.4 billion
ROE	8.06%
Equity Ratio	56.4%

Credit Ratings (Secured/Unsecured)	
Moody's	A1 / A3
S&P	A / A-
Fitch	A+ / A

PSCo System Energy Mix



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PSCo Capital Expenditures by Function

$ Millions

	2021	2022	2023	2024	2025	Total
Electric Distribution	$595	$595	$585	$590	$600	$2,965
Electric Transmission	$250	$470	$470	$465	$470	$2,125
Electric Generation	$220	$165	$80	$80	$85	$630
Natural Gas	$415	$435	$465	$445	$400	$2,160
Other	$220	$170	$150	$115	$100	$755
Total	**$1,700**	**$1,835**	**$1,750**	**$1,695**	**$1,655**	**$8,635**

The base capital forecast <u>excludes</u> a significant portion of proposed CO Pathway transmission expansion.

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PSCo Recovery Mechanisms

Colorado

- Ability to file multi-year requests
- Ability to file either historic or forward test years
- Purchased capacity cost adjustment
- Clean Air Clean Jobs Act rider (forward looking)
- Transmission rider (forward looking)
- Natural gas pipeline integrity rider
- Renewable energy rider
- DSM incentive mechanism
- Energy cost adjustment
- Natural gas cost adjustment
- Decoupling for electric residential and non-demand SC&I classes
- Transportation electrification/EV rider

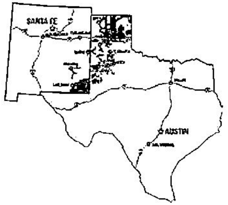
PSCo Electric Rate Case

Docket No. 21AL-0317E

- In July 2021, PSCo filed an electric rate case:
  - Requesting base rate increase of ~$343 million ($470 million total increase, which includes $127 million previously authorized costs currently recovered through riders)
  - ROE of 10.0% and equity ratio of 55.64%
  - Rate base of ~$10.3 billion
  - 2022 forecast test year
  - A historical test year including a 10.5% ROE was also filed as required
  - Rates effective April 2022
- Decision expected 2022 Q2

SPS Overview

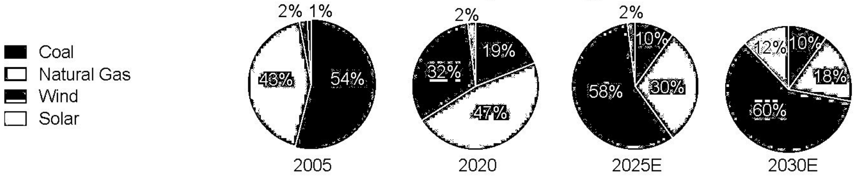
Electric - Retail
398,000 customers
21 million MWh



2020 Financials	**GAAP & Ongoing**
Net Income	$295 million
Assets	$8.9 billion
ROE	9.54%
Equity Ratio	52.2%

Credit Ratings (Secured/Unsecured)	
Moody's	A3 / Baa2
S&P	A / A-
Fitch	A- / BBB+

SPS System Energy Mix



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SPS Capital Expenditures by Function

$ Millions

	2021	2022	2023	2024	2025	Total
Electric Distribution	$135	$200	$240	$235	$220	$1,030
Electric Transmission	$240	$365	$370	$350	$360	$1,685
Electric Generation	$55	$50	$80	$80	$40	$305
Other	$75	$95	$80	$70	$55	$375
Total	$505	$710	$770	$735	$675	$3,395

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SPS Recovery Mechanisms

Texas and New Mexico

- Historic test year (TX) (wind settlement reduced regulatory lag)
- Ability to file forward test year (NM)
- DSM incentive mechanism (TX & NM)
- Fuel clause adjustment (TX & NM)
- Purchased Capacity Cost Recovery Factor (TX)
- Transmission Cost Recovery rider (TX)
- Distribution Cost Recovery rider (TX)
- AMI rider (TX & NM)
- Generation rider (TX)

SPS New Mexico Electric Rate Case

Case No. 20-00238-UT

- In January 2021, SPS filed a required electric rate case:
  - Requesting base rate increase of ~$84 million
  - ROE of 10.35% and equity ratio of 54.72%
  - Retail rate base of ~$1.9 billion
  - HTY ended September 30, 2020, including capital additions through February 2021
  - Changes to depreciation rates to reflect early retirement of Tolk coal plant (2032) and Harrington plant coal handling assets due to conversion to natural gas (2024)
- In June 2021, SPS and various parties filed an uncontested settlement, including:
  - Base revenue increase of $62 million
  - ROE of 9.35% and equity ratio of 54.72%
  - Accelerated depreciation rates for Tolk plant and Harrington coal handling assets
- Decision expected 2021 Q4

SPS Texas Electric Rate Case

Docket No. 51802

COMPANY PROFILES

- In February 2021, SPS filed a required electric case:
  - Requesting base rate increase of ~$143 million
  - Customer increase of $74 million after reflecting fuel savings & PTCs from Sagamore wind farm
  - ROE of 10.35% and equity ratio of 54.60%
  - Rate base of ~$3.3 billion
  - Historic test year ended December 31, 2020
  - Changes to depreciation rates to reflect early retirement of Tolk coal plant (2032) and Harrington plant coal handling assets due to conversion to natural gas (2024)
- Decision expected 2022 Q1

SOAH DOCKET NO. 473-21-2606
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Estimating Shareholder Risk Premia Using Analysts' Growth Forecasts
Harris, Robert S.; Marston, Felicia C.
Financial Management; Summer 1992; 21, 2; ABI/INFORM Global
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Estimating Shareholder Risk Premia Using Analysts' Growth Forecasts

Robert S. Harris and Felicia C. Marston

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■ One of the most widely used concepts in finance is that shareholders require a risk premium over bond yields to bear the additional risks of equity investments. While models such as the two-parameter capital asset pricing model (CAPM) or arbitrage pricing theory offer explicit methods for varying risk premia across securities, the models are invariably linked to some underlying market (or factor-specific) risk premium. Unfortunately, the theoretical models provide limited practical advice on establishing empirical estimates of such a benchmark market risk premium. As a result, the typical advice to practitioners is to estimate the market risk premium based on historical realizations of share and bond returns (see Brealey and Myers [3]).

In this paper, we present estimates of shareholder required rates of return and risk premia which are derived using forward-looking analysts' growth forecasts. We update, through 1991, earlier work which, due to data availability, was restricted to the period 1982-1984 (Harris [12]). Using stronger tests, we also reexamine the efficacy of using such an expectational approach as an alternative to the use of historical averages. Using the S&P 500 as a proxy for the market portfolio, we find an average market risk premium (1982-1991) of 6.47% above yields on long-term U.S. government bonds and 5.13% above yields on corporate bonds. We also find that required returns for individual stocks vary directly with their risk (as proxied by beta) and that the market risk premium varies over time. In particular, the equity market premium over government bond yields is higher in low interest rate environments and when there is a larger spread between corporate and government bond yields. These findings show that, in addition to fitting the theoretical requirement of being forward-looking, the utilization of analysts' forecasts in estimating return requirements provides reasonable empirical results that can be useful in practical applications.

Section I provides background on the estimation of equity required returns and a brief discussion of related

Thanks go to Ed Bachmann, Bill Carleton, Pete Crawford, and Steve Osborn for their assistance on earlier research in this area. We thank Bell Atlantic for supplying data for this project. Financial support from the Darden Sponsors and from the Associates Program at the McIntire School of Commerce is gratefully acknowledged.

literature on financial analysts' forecasts (FAF). In Section II, models and data are discussed. Following a comparison of the results to historical risk premia, the estimates are subjected to economic tests of both their time-series and cross-sectional characteristics in Section III. Finally, conclusions are offered in Section IV.

I. Background and Literature Review

In establishing economic criteria for resource allocation, it is often convenient to use the notion of a shareholder's required rate of return. Such a rate (k) is the minimum level of expected return necessary to compensate the investor for bearing risks and receiving dollars in the future rather than in the present. In general, k will depend on returns available on alternative investments (e.g., bonds or other equities) and the riskiness of the stock. To isolate the effects of risk, it is useful to work in terms of a risk premium (rp), defined as

$$rp = k - i, \quad (1)$$

where i = required return for a zero risk investment.[1]

Lacking a superior alternative, investigators often use averages of historical realizations to estimate a benchmark "market" risk premium which then may be adjusted for the relative risk of individual stocks (e.g., using the CAPM or a variant). The historical studies of Ibbotson Associates [13] have been used frequently to implement this approach.[2] This historical approach requires the assumptions that past realizations are a good surrogate for future expectations and, as typically applied, that risk premia are constant over time. Carleton and Lakonishok [5] demonstrate empirically some of the problems with such historical premia when they are disaggregated for different time periods or groups of firms.

As an alternative to historical estimates, the current paper derives estimates of k, and hence, implied values of rp, using publicly available expectational data. This expectational approach employs the dividend growth model (hereafter referred to as the discounted cash flow or DCF model) in which a consensus measure of financial analysts' forecasts (FAF) of earnings is used as a proxy for investor expectations. Earlier works by Malkiel [17], Brigham, Vinson, and Shome [4], and Harris [12] have used FAF in DCF models, and this approach has been employed in regulatory settings (see Harris [12]) and suggested by consultants as an alternative to use of historical data (e.g., Ibbotson Associates [13, pp. 127, 128]). Unfortunately, the published studies use data extending to 1984 at the latest. Our paper draws on this earlier work but extends it through 1991.[3] Our work is closest to that done by Harris [12], who reviews literature showing a strong link between equity prices and FAF and supporting the use of FAF as a proxy for investor expectations. Using data from 1982 to 1984, Harris' results suggest that this expectational approach to estimating equity risk premia is an encouraging alternative to the use of historical averages. He also demonstrates that such risk premia vary both cross-sectionally with the riskiness of individual stocks and over time with financial market conditions.

II. Models and Data

A. Model for Estimation

The simplest and most commonly used version of the DCF model to estimate shareholders' required rate of return, k, is shown in Equation (2):

$$k = \left(\frac{D_1}{P_0}\right) + g, \quad (2)$$

where D_1 = dividend per share expected to be received at time one, P_0 = current price per share (time 0), and g = expected growth rate in dividends per share. The limitations of this model are well known, and it is straightforward to derive expressions for k based on more general specifications of the DCF model.[4] The primary difficulty in using the DCF model is obtaining an estimate of g, since it should reflect market expectations of future perfor-

[1]Theoretically, i is a risk-free rate, though empirically its proxy (e.g., yield to maturity on a government bond) is only a "least risk" alternative that is itself subject to risk. In this development, the effects of tax codes on required returns are ignored.

[2]Many leading texts in financial management use such historical risk premia to estimate a market return. See, for example, Brealey and Myers [3]. Often a market risk premium is adjusted for the observed relative risk of a stock.

[3]See Harris [12] for a discussion of the earlier work and a detailed discussion of the approach employed here.

[4]As stated, Equation (2) requires expectations of either an infinite horizon of dividend growth at a rate g or a finite horizon of dividend growth at rate g and special assumptions about the price of the stock at the end of that horizon. Essentially, the assumption must ensure that the stock price grows at a compound rate of g over the finite horizon. One could alternatively estimate a nonconstant growth model, although the proxies for multistage growth rates are even more difficult to obtain than single stage growth estimates. Marston, Harris, and Crawford [19] examine publicly available data from 1982-1985 and find that plausible measures of risk are more closely related to expected returns derived from a constant growth model than to those derived from multistage growth models. These findings illustrate empirical difficulties in finding empirical proxies for multistage growth models for large samples.

mance. Without a ready source for measuring such expectations, application of the DCF model is fraught with difficulties. This paper uses published FAF of long-run growth in earnings as a proxy for g.

B. Data

FAF for this research come from IBES (Institutional Broker's Estimate System), which is a product of Lynch, Jones, and Ryan, a major brokerage firm.[5] Representative of industry practice, IBES contains estimates of (*i*) EPS for the upcoming fiscal years (up to five separate years), and (*ii*) a five-year growth rate in EPS. Each item is available at monthly intervals.

The mean value of individual analysts' forecasts of five-year growth rate in EPS will be used as a proxy for g in the DCF model.[6] The five-year horizon is the longest horizon over which such forecasts are available from IBES and often is the longest horizon used by analysts. IBES requests "normalized" five-year growth rates from analysts in order to remove short-term distortions that might stem from using an unusually high or low earnings year as a base.

Dividend and other firm-specific information come from COMPUSTAT. Interest rates (both government and corporate) are gathered from Federal Reserve Bulletins and *Moody's Bond Record*. Exhibit 1 describes key variables used in the study. Data collected cover all dividend paying stocks in the Standard & Poor's 500 stock (S&P 500) index, plus approximately 100 additional stocks of regulated companies. Since five-year growth rates are first available from IBES beginning in 1982, the analysis covers the 113-month period from January 1982 to May 1991.

III. Risk Premia and Required Rates of Return

A. Construction of Risk Premia

For each month, a "market" required rate of return is calculated using each dividend paying stock in the S&P 500 index for which data are available. The DCF model in

Exhibit 1. Variable Definitions

k	=	Equity required rate of return.
P_0	=	Average daily price per share.
D_1	=	Expected dividend per share measured as current indicated annual dividend from COMPUSTAT multiplied by $(1 + g)$.[a]
g	=	Average financial analysts' forecast of five-year growth rate in earnings per share (from IBES).
i_{lt}	=	Yield to maturity on long-term U.S. government obligations (source: Federal Reserve Bulletin, constant maturity series).
i_c	=	Yield to maturity on long-term corporate bonds: Moody's average.[b]
rp	=	Equity risk premium calculated as $rp = k - i$.
β	=	beta, calculated from CRSP monthly data over 60 months.

Notes:
[a]See footnote 7 for a discussion of the $(1 + g)$ adjustment.
[b]The average corporate bond yield across bond rating categories as reported by Moody's. See *Moody's Bond Survey* for a brief description and the latest published list of bonds included in the bond rating categories.

Equation (2) is applied to each stock and the results weighted by market value of equity to produce the market required return.[7] The return is converted to a risk premium

[5]Harris [12] provides a discussion of IBES data and its limitations. In more recent years, IBES has begun collecting forecasts for each of the next five years. Since this work was completed, the FAF used here have become available from IBES Inc., now a subsidiary of CitiBank.

[6]While the model calls for expected growth in dividends, no source of data on such projections is readily available. In addition, in the long run, dividend growth is sustainable only via growth in earnings. As long as payout ratios are not expected to change, the two growth rates will be the same.

[7]The construction of D_1 is controversial since dividends are paid quarterly and may be expected to change during the year; whereas, Equation (2), as is typical, is being applied to annual data. Both the quarterly payment of dividends (due to investors' reinvestment income before year's end, see Linke and Zumwalt [15]) and any growth during the year require an upward adjustment of the current annual rate of dividends to construct D_1. If quarterly dividends grow at a constant rate, both factors could be accommodated straightforwardly by applying Equation (2) to quarterly data with a quarterly growth rate and then annualizing the estimated quarterly required return. Unfortunately, with lumpy changes in dividends, the precise nature of the adjustment depends on both an individual company's pattern of growth during the calendar year and an individual company's required return (and hence reinvestment income in the risk class).
In this work, D_1 is calculated as $D_0 (1 + g)$. The full g adjustment is a crude approximation to adjust for both growth and reinvestment income. For example, if one expected dividends to have been raised, on average, six months ago, a "1/2 g" adjustment would allow for growth, and the remaining "1/2 g" would be justified on the basis of reinvestment income. Any precise accounting for both reinvestment income and growth would require tracking each company's dividend change history and making explicit judgments about the quarter of the next change. Since no organized "market" forecast of such a detailed nature exists, such a procedure is not possible. To get a feel for the magnitudes involved, during the sample period the dividend yield (D_1/P_0) and growth (market value weighted) for the S&P 500 were typically 4% to 6% and 11% to 13%, respectively. As a result, a "full g" adjustment on average increases the required return by 60 to 70 basis points (relative to no g adjustment).

Exhibit 2. Bond Market Yields, Equity Required Return, and Equity Risk Premium,[a] 1982-1991

	Bond Market Yields[b]		Equity Market Required Return[c]	Equity Risk Premium	
Year	(1) U.S. Gov't	(2) Moody's Corporates	(3) S&P 500	U.S. Gov't (3) - (1)	Moody's Corporates (3) - (2)
1982	12.92	14.94	20.08	7.16	5.14
1983	11.34	12.78	17.89	6.55	5.11
1984	12.48	13.49	17.26	4.78	3.77
1985	10.97	12.05	16.32	5.37	4.28
1986	7.85	9.71	15.09	7.24	5.38
1987	8.58	9.84	14.71	6.13	4.86
1988	8.96	10.18	15.37	6.41	5.19
1989	8.46	9.66	15.06	6.60	5.40
1990	8.61	9.77	15.69	7.08	5.92
1991[d]	8.21	9.41	15.61	7.40	6.20
Average[e]	9.84	11.18	16.31	6.47	5.13

Notes:
[a]Values are averages of monthly figures in percent.
[b]Yields to maturity.
[c]Required return on value weighted S&P 500 index using Equation (1).
[d]Figures for 1991 are through May.
[e]Months weighted equally.

over government bonds by subtracting i_{lt}, the yield to maturity on long-term government bonds. A risk premium over corporate bond yields is also constructed by subtracting i_c, the yield on long-term corporate bonds. Exhibit 2 reports the results by year (averages of monthly data).

The results are quite consistent with the patterns reported earlier (i.e., Harris [12]). The estimated risk premia in Exhibit 2 are positive, consistent with equity owners demanding additional rewards over and above returns on debt securities. The average expectational risk premium (1982 to 1991) over government bonds is 6.47%, only slightly higher than the 6.16% average for 1982 to 1984 reported earlier (Harris [12]). Furthermore, Exhibit 2 shows the estimated risk premia change over time, suggesting changes in the market's perception of the incremental risk of investing in equity rather than debt securities.

For comparison purposes, Exhibit 3 contains historical returns and risk premia. The average expectational risk premium reported in Exhibit 2 falls roughly midway between the arithmetic (7.5%) and geometric (5.7%) long-term differentials between returns on stocks and long-term government bonds. Note, however, that the expectational risk premia appear to change over time. In the following sections, we examine the estimated risk premia to see if they vary cross-sectionally with the risk of individual stocks and over time with financial market conditions.

B. Cross-Sectional Tests

Earlier, Harris [12] conducted crude tests of whether expectational equity risk premia varied with risk proxied by bond ratings and the dispersion of analysts' forecasts and found that required returns increased with higher risk. Here we examine the link between these premia and beta, perhaps the most commonly used measure of risk for equities.[8] In keeping with traditional work in this area, we adopt the methodology introduced by Fama and Macbeth [9] but replace realized returns with expected returns from Equation (2) as the variable to be explained. For this portion of our tests, we restrict our sample to 1982-1987

[8]For other efforts using expectational data in the context of the two-parameter CAPM, see Friend, Westerfield, and Granito [10], Cragg and Malkiel [7], Marston, Crawford, and Harris [19], Marston and Harris [20], and Linke, Kannan, Whitford, and Zumwalt [16]. For a more complete treatment of the subject, see Marston and Harris [20] from which we draw some of these results. Marston and Harris also investigate the role of unsystematic risk and the difference in estimates found when using expected versus realized returns.

Exhibit 3. Average Historical Returns on Bonds, Stocks, Bills, and Inflation in the U.S., 1926-1989

Historical Return Realizations	Geometric	Arithmetic
Common stock	10.3%	12.4%
Long-term government bonds	4.6%	4.9%
Long-term corporate bonds	5.2%	5.5%
Treasury bills	3.6%	3.7%
Inflation rate	3.1%	3.2%

Source: Ibbotson Associates, Inc., *1990 Stocks, Bonds, Bills and Inflation*, 1990 Yearbook.

and in any month include firms that have at least three forecasts of earnings growth to reduce measurement error associated with individual forecasts.[9] This restricted sample still consists of, on average, 399 firms for each of the 72 months (or 28,744 company months).

For a given company in a given month, beta is estimated via the market model (using ordinary least squares) on the prior 60 months of return data taken from CRSP. Beta estimates are updated monthly and are calculated against an equally weighted index of all NYSE securities. For each month, we aggregate firms into 20 portfolios (consisting of approximately 20 securities each). The advantage of grouped data is the reduction in potential measurement error inherent in independent variables at the company level. Portfolios are formed based on a ranking of beta estimated from a prior time period (t = -61 to t = -120). Portfolio expected returns and beta are calculated as the simple averages for the individual securities.

Using these data, we estimate the following model for each of the 72 months:

$$R_p = \alpha_0 + \alpha_1 \beta_p + u_p, \quad p = 1...20, \qquad (3)$$

where:

R_p = Expected return for portfolio p in the given month,

β_p = Portfolio beta, estimated over 60 prior months, and

u_p = A random error term with mean zero.

As a result of estimating regression (3) for each month, 72 estimates of each coefficient (α_0 and α_1) are obtained. Using realized returns as the dependent variable, the traditional approach (e.g., Fama and Macbeth [9]) is to assume that realized returns are a fair game. Given this assumption, the mean of the 72 values of each coefficient is an unbiased estimate of the mean over that same time period if one could have actually used expected returns as the dependent variable. Note that if expected returns are used as the dependent variable the fair-game assumption is not required. Making the additional assumption that the true value of the coefficient is constant over the 72 months, a test of whether the mean coefficient is different from zero is performed using a t-statistic where the denominator is the standard error of the 72 values of the coefficient. This is the technique employed by Fama and Macbeth [9]. If one assumes the CAPM is correct, the coefficient α_1 is an empirical estimate of the market risk premium, which should be positive.

To test the sensitivity of the results, we also repeat our procedures using individual security returns rather than portfolios. To account, at least in part, for differences in precision of coefficient estimates in different months we also report results in which monthly parameter estimates are weighted inversely by the standard error of the coefficient estimate rather than being weighted equally (following Chan, Hamao, and Lakonishok [6]).

Exhibit 4 shows that there is a significant positive link between expectational required returns and beta. For instance, in Panel A, the mean coefficient of 2.78 on beta is significantly different from zero at better than the 0.001 level (t = 35.31), and each of the 72 monthly coefficients going into this average is positive (as shown by that 100% positive figure). Using individual stock returns, the significant positive link between beta and expected return remains, though it is smaller in magnitude than for portfolios.[10] Comparison of Panels A and B shows that the results are not sensitive to the weighting of monthly coefficients.

While the findings in Exhibit 4 suggest a strong positive link between beta and risk premia (a result often not supported when realized returns are used as a proxy for expectations; e.g., see Tinic and West [22]), the results do not support the predictions of a simple CAPM. In particular, the intercept is higher than a proxy for the risk-free rate over the sample period and the coefficient of beta is well below estimates of a market risk premium obtained from either expectational (Exhibit 2) or historical data (Exhibit

[9]Firms for which the standard deviation of individual FAF exceeded 20 in any month were excluded since we suspect some of these involve errors in data entry. This screen eliminated very few companies in any month. The 1982-1987 period was chosen due to the availability of data on betas.

[10]The smaller coefficients on beta using individual stock portfolio returns are likely due in part to the higher measurement error in measuring individual stock versus portfolio betas.

Exhibit 4. Mean Values of Monthly Parameter Estimates for the Relationship Between Required Returns and Beta for Both Portfolios and Individual Securities (Figures in Parentheses are *t* Values and Percent Positive), 1982-1987

	Intercept	B	Adjusted $R^{2\,c}$	F^c
Panel A. Equal Weighting[a]				
Portfolio returns	14.06 (54.02, 100)	2.78 (35.31, 100)	0.503	25.4
Security returns	14.77 (58.10, 100)	1.91 (16.50, 99)	0.080	39.0
Panel B. Weighted by Standard Errors[b]				
Portfolio returns	13.86 (215.6, 100)	2.67 (35.80, 100)	0.503	25.4
Security returns	14.63 (398.9, 100)	1.92 (47.3, 99)	0.080	39.0

[a]Equally weighted average of monthly parameters estimated using cross-sectional data for each of the 72 months, January 1982 - December 1987.
[b]In obtaining the reported means, estimates of the monthly intercept and slope coefficients are weighted inversely by the standard error of the estimate from the cross-sectional regression for that month.
[c]Values are averages for the 72 monthly regressions.

3).[11] Nonetheless, the results show that the estimated risk premia conform to the general theoretical relationship between risk and required return that is expected when investors are risk-averse.

C. Time Series Tests — Changes in Market Risk Premia

A potential benefit of using ex ante risk premia is the estimation of changes in market risk premia over time. With changes in the economy and financial markets, equity investments may be perceived to change in risk. For instance, investor sentiment about future business conditions likely affects attitudes about the riskiness of equity investments compared to investments in the bond markets. Moreover, since bonds are risky investments themselves, equity risk premia (relative to bonds) could change due to changes in perceived riskiness of bonds, even if equities displayed no shifts in risk. For example, during the high interest rate period of the early 1980s, the high level of interest rate volatility made fixed income investments more risky holdings than they were in a world of relatively stable rates.

Studying changes in risk premia for utility stocks, Brigham, et al [4] conclude that, prior to 1980, utility risk premia increased with the level of interest rates, but that this pattern reversed thereafter, resulting in an inverse correlation between risk premia and interest rates. Studying risk premia for both utilities and the equity market generally, Harris [12] also reports that risk premia appear to change over time. Specifically, he finds that equity risk premia decreased with the level of government interest rates, increased with the increases in the spread between corporate and government bond yields, and increased with increases in the dispersion of analysts' forecasts. Harris' study is, however, restricted to the 36-month period, 1982 to 1984.

Exhibit 5 reports results of analyzing the relationship between equity risk premia, interest rates, and yield spreads between corporate and government bonds. Following Harris [12], these bond yield spreads are used as a time series proxy for equity risk. As the perceived riskiness of corporate activity increases, the difference between yields on corporate bonds and government bonds should increase. One would expect the sources of increased riskiness to corporate bonds to also increase risks to shareholders. All regressions in Exhibit 5 are corrected for serial correlation.[12]

[11]Estimation difficulties confound precise interpretation of the intercept as the risk-free rate and the coefficient on beta as the market risk premium (see Miller and Scholes [21], and Black, Jensen, and Scholes [2]). The higher than expected intercept and lower than expected slope coefficient on beta are consistent with the prior studies of Black, Jensen, and Scholes [2], and Fama and MacBeth [9] using historical returns. Such results are consistent with Black's [1] zero beta model, although alternative explanations for these findings exist as well (as noted by Black, Jensen, and Scholes [2]).

[12]Ordinary least squares regressions showed severe positive autocorrelation in many cases, with Durbin Watson statistics typically below one. Estimation used the Prais-Winsten method. See Johnston [14, pp. 321-325].

Exhibit 5. Changes in Equity Risk Premia Over Time — Entries are Coefficient (t-value); Dependent Variable is Equity Risk Premium

Time period	Intercept	i_{lt}	$i_c - i_{lt}$	R^2
A. May 1991-1992	0.131 (19.82)	-0.651 (-11.16)		0.53
	0.092 (14.26)	-0.363 (-6.74)	0.666 (5.48)	0.54
B. 1982-1984	0.140 (8.15)	-0.637 (-5.00)		0.43
	0.064 (3.25)	-0.203 (-1.63)	1.549 (4.84)	0.60
C. 1985-1987	0.131 (7.73)	-0.739 (-9.67)		0.74
	0.110 (12.53)	-0.561 (-7.30)	0.317 (1.87)	0.77
D. 1988-1991	0.136 (16.23)	-0.793 (-8.29)		0.68
	0.130 (8.71)	-0.738 (-4.96)	0.098 (0.40)	0.68

Note: All variables are defined in Exhibit 1. Regressions were estimated using monthly data and were corrected for serial correlation using the Prais-Winsten method. For purposes of this regression, variables are expressed in decimal form, e.g., 14% = 0.14.

For the entire sample period, Panel A shows that risk premia are negatively related to the level of interest rates — as proxied by yields on government bonds, i_{lt}. This negative relationship is also true for each of the subperiods displayed in Panels B through D. Such a negative relationship may result from increases in the perceived riskiness of investment in government debt at high levels of interest rates. A direct measure of uncertainty about investments in government bonds would be necessary to test this hypothesis directly.

For the entire 1982 to 1991 period, the addition of the yield spread risk proxy to the regressions dramatically lowers the magnitude of the coefficient on government bond yields, as can be seen by comparing Equations 1 and 2 of Panel A. Furthermore, the coefficient of the yield spread (0.666) is itself significantly positive. This pattern suggests that a reduction in the risk differential between investment in government bonds and in corporate activity is translated into a lower equity market risk premium. Further examination of Panels B through D, however, suggests that the yield spread variable is much more important in explaining changes in equity risk premia in the early portion of the 1980s than in the 1988 to 1991 period.

In summary, market equity risk premia change over time and appear inversely related to the level of government interest rates but positively related to the bond yield spread, which proxies for the incremental risk of investing in equities as opposed to government bonds.

IV. Conclusions

Shareholder required rates of return and risk premia are based on theories about investors' expectations for the future. In practice, however, risk premia are often estimated using averages of historical returns. This paper applies an alternate approach to estimating risk premia that employs publicly available expectational data. At least for the decade studied (1982 to 1991), the resultant average market equity risk premium over government bonds is comparable in magnitude to long-term differences (1926 to 1989) in historical returns between stocks and bonds. There is strong evidence, however, that market risk premia change over time and, as a result, use of a constant historical average risk premium is not likely to mirror changes in investor return requirements. The results also show that the expectational risk premia vary cross-sectionally with the relative risk (beta) of individual stocks.

The approach offers a straightforward and powerful aid in establishing required rates of return either for corporate investment decisions or in the regulatory arena. Since data are readily available on a wide range of equities, an investigator can analyze various proxy groups (e.g., portfolios of utility stocks) appropriate for a particular decision as well as analyze changes in equity return requirements over time.

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Investor growth expectations: Analysts vs. history

Analysts' growth forecasts dominate past trends in predicting stock prices.

James H. Vander Weide and Willard T. Carleton

For the purposes of implementing the Discounted Cash Flow (DCF) cost of equity model, the analyst must know which growth estimate is embodied in the firm's stock price. A study by Cragg and Malkiel (1982) suggests that the stock valuation process embodies analysts' forecasts rather than historically based growth figures such as the ten-year historical growth in dividends per share or the five-year growth in book value per share. The Cragg and Malkiel study is based on data for the 1960s, however, a decade that was considerably more stable than the recent past.

As the issue of which growth rate to use in implementing the DCF model is so important to applications of the model, we decided to investigate whether the Cragg and Malkiel conclusions continue to hold in more recent periods. This paper describes the results of our study.

STATISTICAL MODEL

The DCF model suggests that the firm's stock price is equal to the present value of the stream of dividends that investors expect to receive from owning the firm's shares. Under the assumption that investors expect dividends to grow at a constant rate, g, in perpetuity, the stock price is given by the following simple expression:

$$P_S = \frac{D(1+g)}{k-g} \qquad (1)$$

where:

P_S = current price per share of the firm's stock;

D = current annual dividend per share;

g = expected constant dividend growth rate; and

k = required return on the firm's stock.

Dividing both sides of Equation (1) by the firm's current earnings, E, we obtain:

$$\frac{P_S}{E} = \frac{D}{E} \cdot \frac{(1+g)}{k-g} \qquad (2)$$

Thus, the firm's price/earnings (P/E) ratio is a non-linear function of the firm's dividend payout ratio (D/E), the expected growth in dividends (g), and the required rate of return.

To investigate what growth expectation is embodied in the firm's current stock price, it is more convenient to work with a linear approximation to Equation (2). Thus, we will assume that:

$$P/E = a_0(D/E) + a_1 g + a_2 k. \qquad (3)$$

(Cragg and Malkiel found this assumption to be reasonable throughout their investigation.)

Furthermore, we will assume that the required

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rate of return, k, in Equation (3) depends on the values of the risk variables B, Cov, Rsq, and Sa, where B is the firm's Value Line beta; Cov is the firm's pretax interest coverage ratio; Rsq is a measure of the stability of the firm's five-year historical EPS; and Sa is the standard deviation of the consensus analysts' five-year EPS growth forecast for the firm. Finally, as the linear form of the P/E equation is only an approximation to the true P/E equation, and B, Cov, Rsq, and Sa are only proxies for k, we will add an error term, e, that represents the degree of approximation to the true relationship.

With these assumptions, the final form of our P/E equation is as follows:

$$P/E = a_0(D/E) + a_1g + a_2B + a_3Cov + a_4Rsq + a_5Sa + e. \quad (4)$$

The purpose of our study is to use more recent data to determine which of the popular approaches for estimating future growth in the Discounted Cash Flow model is embodied in the market price of the firm's shares.

We estimated Equation (4) to determine which estimate of future growth, g, when combined with the payout ratio, D/E, and risk variables B, Cov, Rsq, and Sa, provides the best predictor of the firm's P/E ratio. To paraphrase Cragg and Malkiel, we would expect that growth estimates found in the best-fitting equation more closely approximate the expectation used by investors than those found in poorer-fitting equations.

DESCRIPTION OF DATA

Our data sets include both historically based measures of future growth and the consensus analysts' forecasts of five-year earnings growth supplied by the Institutional Brokers Estimate System of Lynch, Jones & Ryan (IBES). The data also include the firm's dividend payout ratio and various measures of the firm's risk. We include the latter items in the regression, along with earnings growth, to account for other variables that may affect the firm's stock price.

The data include:

Earnings Per Share. Because our goal is to determine which earnings variable is embodied in the firm's market price, we need to define this variable with care. Financial analysts who study a firm's financial results in detail generally prefer to "normalize" the firm's reported earnings for the effect of extraordinary items, such as write-offs of discontinued operations, or mergers and acquisitions. They also attempt, to the extent possible, to state earnings for different firms using a common set of accounting conventions.

We have defined "earnings" as the consensus analyst estimate (as reported by IBES) of the firm's earnings for the forthcoming year.[1] This definition approximates the normalized earnings that investors most likely have in mind when they make stock purchase and sell decisions. It implicitly incorporates the analysts' adjustments for differences in accounting treatment among firms and the effects of the business cycle on each firm's results of operations. Although we thought at first that this earnings estimate might be highly correlated with the analysts' five-year earnings growth forecasts, that was not the case. Thus, we avoided a potential spurious correlation problem.

Price/Earnings Ratio. Corresponding to our definition of "earnings," the price/earnings ratio (P/E) is calculated as the closing stock price for the year divided by the consensus analyst earnings forecast for the forthcoming fiscal year.

Dividends. Dividends per share represent the common dividends declared per share during the calendar year, after adjustment for all stock splits and stock dividends). The firm's dividend payout ratio is then defined as common dividends per share divided by the consensus analyst estimate of the earnings per share for the forthcoming calendar year (D/E). Although this definition has the deficiency that it is obviously biased downward — it divides this year's dividend by next year's earnings — it has the advantage that it implicitly uses a "normalized" figure for earnings. We believe that this advantage outweighs the deficiency, especially when one considers the flaws of the apparent alternatives. Furthermore, we have verified that the results are insensitive to reasonable alternative definitions (see footnote 1).

Growth. In comparing historically based and consensus analysts' forecasts, we calculated forty-one different historical growth measures. These included the following: 1) the past growth rate in EPS as determined by a log-linear least squares regression for the latest year,[2] two years, three years, . . ., and ten years; 2) the past growth rate in DPS for the latest year, two years, three years, . . ., and ten years; 3) the past growth rate in book value per share (computed as the ratio of common equity to the outstanding common equity shares) for the latest year, two years, three years, . . ., and ten years; 4) the past growth rate in cash flow per share (computed as the ratio of pretax income, depreciation, and deferred taxes to the outstanding common equity shares) for the latest year, two years, three years, . . ., and ten years; and 5) plowback growth (computed as the firm's retention ratio for the current year times the firm's latest annual return on common equity).

We also used the five-year forecast of earnings per share growth compiled by IBES and reported in mid-January of each year. This number represents the consensus (i.e., mean) forecast produced by analysts from the research departments of leading Wall Street and regional brokerage firms over the preceding three months. IBES selects the contributing brokers "because of the superior quality of their research, professional reputation, and client demand" (IBES *Monthly Summary Book*).

Risk Variables. Although many risk factors could potentially affect the firm's stock price, most of these factors are highly correlated with one another. As shown above in Equation (4), we decided to restrict our attention to four risk measures that have intuitive appeal and are followed by many financial analysts: 1) B, the firm's beta as published by Value Line; 2) Cov, the firm's pretax interest coverage ratio (obtained from Standard & Poor's Compustat); 3) Rsq, the stability of the firm's five-year historical EPS (measured by the R^2 from a log-linear least squares regression); and 4) Sa, the standard deviation of the consensus analysts' five-year EPS growth forecast (mean forecast) as computed by IBES.

After careful analysis of the data used in our study, we felt that we could obtain more meaningful results by imposing six restrictions on the companies included in our study:

1. Because of the need to calculate ten-year historical growth rates, and because we studied three different time periods, 1981, 1982, and 1983, our study requires data for the thirteen-year period 1971-1983. We included only companies with at least a thirteen-year operating history in our study.
2. As our historical growth rate calculations were based on log-linear regressions, and the logarithm of a negative number is not defined, we excluded all companies that experienced negative EPS during any of the years 1971-1983.
3. For similar reasons, we also eliminated companies that did not pay a dividend during any one of the years 1971-1983.
4. To insure comparability of time periods covered by each consensus earnings figure in the P/E ratios, we eliminated all companies that did not have a December 31 fiscal year-end.
5. To eliminate distortions caused by highly unusual events that distort current earnings but not expected future earnings, and thus the firm's price/earnings ratio, we eliminated any firm with a price/earnings ratio greater than 50.
6. As the evaluation of analysts' forecasts is a major part of this study, we eliminated all firms that IBES did not follow.

Our final sample consisted of approximately sixty-five utility firms.[3]

RESULTS

To keep the number of calculations in our study to a reasonable level, we performed the study in two stages. In Stage 1, all forty-one historically oriented approaches for estimating future growth were correlated with each firm's P/E ratio. In Stage 2, the historical growth rate with the highest correlation to the P/E ratio was compared to the consensus analyst growth rate in the multiple regression model described by Equation (4) above. We performed our regressions for each of three recent time periods, because we felt the results of our study might vary over time.

First-Stage Correlation Study

Table 1 gives the results of our first-stage correlation study for each group of companies in each of the years 1981, 1982, and 1983. The values in this table measure the correlation between the historically oriented growth rates for the various time periods and the firm's end-of-year P/E ratio.

The four variables for which historical growth rates were calculated are shown in the left-hand column: EPS indicates historical earnings per share growth, DPS indicates historical dividend per share growth, BVPS indicates historical book value per share growth, and CFPS indicates historical cash flow per share growth. The term "plowback" refers to the product of the firm's retention ratio in the currennt year and its return on book equity for that year. In all, we calculated forty-one historically oriented growth rates for each group of firms in each study period.

The goal of the first-stage correlation analysis was to determine which historically oriented growth rate is most highly correlated with each group's year-end P/E ratio. Eight-year growth in CFPS has the highest correlation with P/E in 1981 and 1982, and ten-year growth in CFPS has the highest correlation with year-end P/E in 1983. In all cases, the plowback estimate of future growth performed poorly, indicating that — contrary to generally held views — plowback is not a factor in investor expectations of future growth.

Second-Stage Regression Study

In the second stage of our regression study, we ran the regression in Equation (4) using two different measures of future growth, g: 1) the best historically oriented growth rate (g_h) from the first-stage correlation study, and 2) the consensus analysts' forecast (g_a) of five-year EPS growth. The regression results, which are shown in Table 2, support at least

TABLE 1

Correlation Coefficients of All Historically Based Growth Estimates by Group and by Year with P/E

Historical Growth Rate Period in Years

Current Year	1	2	3	4	5	6	7	8	9	10
1981										
EPS	−0.02	0.07	0.03	0.01	0.03	0.12	0.08	0.09	0.09	0.09
DPS	0.05	0.18	0.14	0.15	0.14	0.15	0.19	0.23	0.23	0.23
BVPS	0.01	0.11	0.13	0.13	0.16	0.18	0.15	0.15	0.15	0.15
CFPS	−0.05	0.04	0.13	0.22	0.28	0.31	0.30	0.31	−0.57	−0.54
Plowback	0.19									
1982										
EPS	−0.10	−0.13	−0.06	−0.02	−0.02	−0.01	−0.03	−0.03	0.00	0.00
DPS	−0.19	−0.10	0.03	0.05	0.07	0.08	0.09	0.11	0.13	0.13
BVPS	0.07	0.08	0.11	0.11	0.09	0.10	0.11	0.11	0.09	0.09
CFPS	−0.02	−0.08	0.00	0.10	0.16	0.19	0.23	0.25	0.24	0.07
Plowback	0.04									
1983										
EPS	−0.06	−0.25	−0.25	−0.24	−0.16	−0.11	−0.05	0.00	0.02	0.02
DPS	0.03	−0.10	−0.03	0.08	0.15	0.21	0.21	0.21	0.22	0.24
BVPS	0.03	0.10	0.04	0.09	0.15	0.16	0.19	0.21	0.22	0.21
CFPS	−0.08	0.01	0.02	0.08	0.20	0.29	0.35	0.38	0.40	0.42
Plowback	−0.08									

two general conclusions regarding the pricing of equity securities.

First, we found overwhelming evidence that the consensus analysts' forecast of future growth is superior to historically oriented growth measures in predicting the firm's stock price. In every case, the R^2 in the regression containing the consensus analysts' forecast is higher than the R^2 in the regression containing the historical growth measure. The regression coefficients in the equation containing the consensus analysts' forecast also are considerably more significant than they are in the alternative regression. These results are consistent with those found by Cragg and Malkiel for data covering the period 1961-1968. Our results also are consistent with the hypothesis that investors use analysts' forecasts, rather than historically oriented growth calculations, in making stock buy–and–sell decisions.

TABLE 2

Regression Results
Model I

Part A: *Historical*

$P/E = a_0 + a_1 D/E + a_2 g_h + a_3 B + a_4 Cov + a_5 Rsq + a_6 Sa$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	$\hat{a}_5$	$\hat{a}_6$	R^2	F Ratio
1981	−6.42*	10.31*	7.67*	3.24	0.54*	1.42*	57.43	0.83	46.49
	(5.50)	(14.79)	(2.20)	(2.86)	(2.50)	(2.85)	(4.07)		
1982	−2.90*	9.32*	8.49*	2.85	0.45*	−0.42	3.63	0.86	65.53
	(2.75)	(18.52)	(4.18)	(2.83)	(2.60)	(0.05)	(0.26)		
1983	−5.96*	10.20*	19.78*	4.85	0.44*	0.33	32.49	0.82	45.26
	(3.70)	(12.20)	(4.83)	(2.95)	(1.89)	(0.50)	(1.29)		

Part B: *Analysis*

$P/E = a_0 + a_1 D/E + a_2 g_a + a_3 B + a_4 Cov + a_5 Rsq + a_6 Sa$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	$\hat{a}_5$	$\hat{a}_6$	R^2	F Ratio
1981	−4.97*	10.62*	54.85*	−0.61	0.33*	0.63*	4.34	0.91	103.10
	(6.23)	(21.57)	(8.56)	(0.68)	(2.28)	(1.74)	(0.37)		
1982	−2.16*	9.47*	50.71*	−1.07	0.36*	−0.31	119.05*	0.90	97.62
	(2.59)	(22.46)	(9.31)	(1.14)	(2.53)	(1.09)	(1.60)		
1983	−8.47*	11.96*	79.05*	2.16	0.56*	0.20	−34.43	0.87	69.81
	(7.07)	(16.48)	(7.84)	(1.55)	(3.08)	(0.38)	(1.44)		

Notes:
* Coefficient is significant at the 5% level (using a one-tailed test) and has the correct sign. T-statistic in parentheses.

Second, there is some evidence that investors tend to view risk in traditional terms. The interest coverage variable is statistically significant in all but one of our samples, and the stability of the operating income variable is statistically significant in six of the twelve samples we studied. On the other hand, the beta is never statistically significant, and the standard deviation of the analysts' five-year growth forecasts is statistically significant in only two of our twelve samples. This evidence is far from conclusive, however, because, as we demonstrate later, a significant degree of cross-correlation among our four risk variables makes any general inference about risk extremely hazardous.

Possible Misspecification of Risk

The stock valuation theory says nothing about which risk variables are most important to investors. Therefore, we need to consider the possibility that the risk variables of our study are only proxies for the "true" risk variables used by investors. The inclusion of proxy variables may increase the variance of the parameters of most concern, which in this case are the coefficients of the growth variables.[4]

To allow for the possibility that the use of risk proxies has caused us to draw incorrect conclusions concerning the relative importance of analysts' growth forecasts and historical growth extrapolations, we have also estimated Equation (4) with the risk variables excluded. The results of these regressions are shown in Table 3.

Again, there is overwhelming evidence that the consensus analysts' growth forecast is superior to the historically oriented growth measures in predicting the firm's stock price. The R^2 and t-statistics are higher in every case.

CONCLUSION

The relationship between growth expectations and share prices is important in several major areas of finance. The data base of analysts' growth forecasts collected by Lynch, Jones & Ryan provides a unique opportunity to test the hypothesis that investors rely more heavily on analysts' growth forecasts than on historical growth extrapolations in making security buy-and-sell decisions. With the help of this data base, our studies affirm the superiority of analysts' forecasts over simple historical growth extrapolations in the stock price formation process. Indirectly, this finding lends support to the use of valuation models whose input includes expected growth rates.

TABLE 3

Regression Results
Model II

Part A: *Historical*

$P/E = a_0 + a_1 D/E + a_2 g_h$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F Ratio
1981	−1.05	9.59	21.20	0.73	82.95
	(1.61)	(12.13)	(7.05)		
1982	0.54	8.92	12.18	0.83	167.97
	(1.38)	(17.73)	(6.95)		
1983	−0.75	8.92	12.18	0.77	107.82
	(1.13)	(12.38)	(7.94)		

Part B: *Analysis*

$P/E + a_0 + a_1 D/E + a_2 g_a$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F Ratio
1981	3.96	10.07	60.53	0.90	274.16
	(8.31)	(8.31)	(20.91)	(15.79)	
1982	−1.75	9.19	44.92	0.88	246.36
	(4.00)	(4.00)	(21.35)	(11.06)	
1983	−4.97	10.95	82.02	0.83	168.28
	(6.93)	(6.93)	(15.93)	(11.02)	

Notes:
* Coefficient is significant at the 5% level (using a one-tailed test) and has the correct sign. T-statistic in parentheses.

[1] We also tried several other definitions of "earnings," including the firm's most recent primary earnings per share prior to any extraordinary items or discontinued operations. As our results were insensitive to reasonable alternative definitions of "earnings" we report only the results for the IBES consensus.

[2] For the latest year, we actually employed a point-to-point growth calculation because there were only two available observations.

[3] We use the word "approximately," because the set of available firms varied each year. In any case, the number varied only from zero to three firms on either side of the figures cited here.

[4] See Maddala (1977).

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U.S. Energy Information Administration

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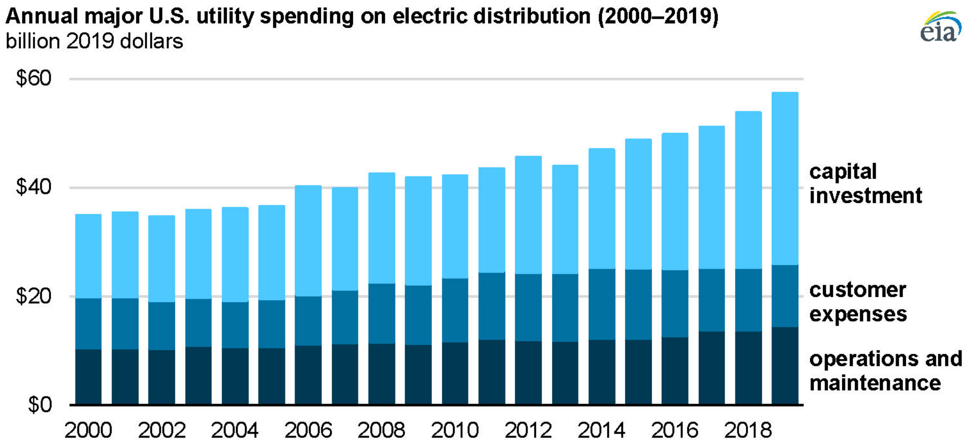
Today in Energy

May 27, 2021

Major utilities' spending on the electric distribution system continues to increase



Source: Graph created by EIA, based on data from Federal Energy Regulatory Commission (FERC) Financial Reports, as accessed by Ventyx Velocity Suite

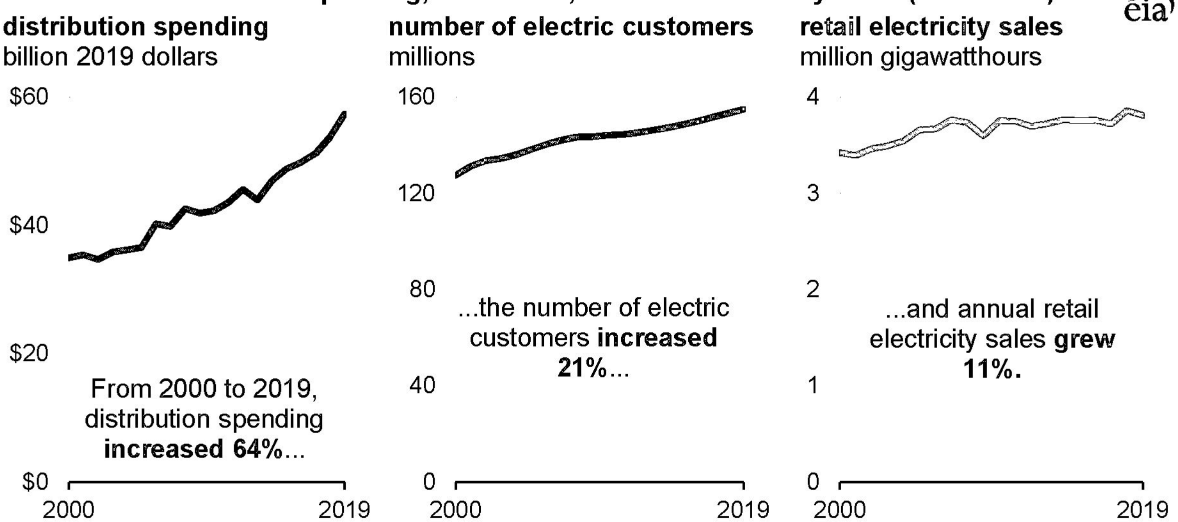
Annual spending on electricity distribution systems by major U.S. utilities continues to increase. Utilities spent $57.4 billion on electric distribution in 2019, 6% more than the previous year and 64% more than they spent in 2000 after adjusting for inflation. More than half of utility distribution spending in 2019 went toward capital investment ($31.4 billion) as utilities worked to replace, modernize, and expand existing infrastructure. Another $14.6 billion paid for operations and maintenance (O&M), and $11.5 billion went to customer expenses, which include advertising, billing, and customer service.

Distribution is the final stage in delivering electricity to consumers. The distribution system connects to the high-voltage transmission system, lowers the transmission voltage, and carries the electricity to homes and businesses on distribution lines. The electricity distribution system includes neighborhood power lines, poles and towers, line transformers, meters that measure customer electricity use, and station equipment that lowers the voltage from the long-distance transmission system.

In 2019, most of the $31.4 billion distribution system capital investment (40%) was spent on power lines, both underground (23% of investment) and overhead (17% of investment). Distribution lines are added or expanded to accommodate new neighborhood development or higher electricity flows as sales increase.

Operations and maintenance of overhead lines cost $7.3 billion and made up the bulk of O&M expenses in 2019. Vegetation management and tree trimming; animal protection; line testing for strength, temperature, voltage and frequency; and repairs due to storms or faults accounted for much of this expense.

U.S. electric distribution spending, customers, and retail electricity sales (2000–2019)



Source: Graph created by EIA, based on data from *Annual Electric Power Industry Report*; Federal Energy Regulatory Commission (FERC) Financial Reports, as accessed by Ventyx Velocity Suite

Distribution spending has outpaced growth in both the number of electric customers and in retail electricity sales because much of the increased distribution spending in the last 20 years has been on projects that are not directly related to customer growth or increased sales. These projects include replacing aging equipment, modernizing and upgrading maintenance and billing technology, and fortifying distribution structures against weather-related damage.

Principal contributor: Lori Aniti

Ethical and Professional Standards and Quantitative Methods

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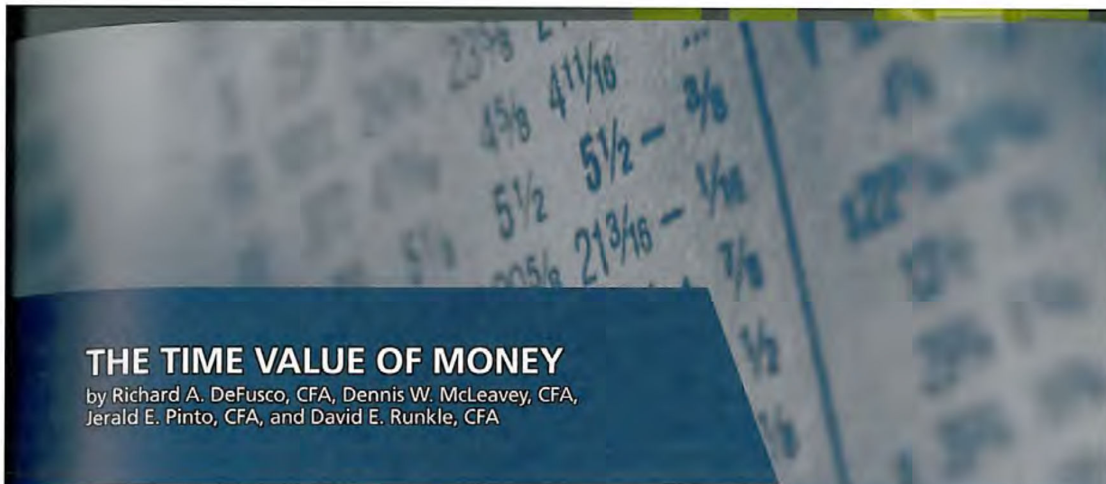

THE TIME VALUE OF MONEY

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READING 5

LEARNING OUTCOMES

The candidate should be able to:	Mastery
a. interpret interest rates as required rate of return, discount rate, or opportunity cost;	☐
b. explain an interest rate as the sum of a real risk-free rate, expected inflation, and premiums that compensate investors for distinct types of risk;	☐
c. calculate and interpret the effective annual rate, given the stated annual interest rate and the frequency of compounding;	☐
d. solve time value of money problems when compounding periods are other than annual;	☐
e. calculate and interpret the future value (FV) and present value (PV) of a single sum of money, an ordinary annuity, an annuity due, a perpetuity (PV only), and a series of unequal cash flows;	☐
f. draw a time line and solve time value of money applications (for example, mortgages and savings for college tuition or retirement).	☐

INTRODUCTION 1

As individuals, we often face decisions that involve saving money for a future use, or borrowing money for current consumption. We then need to determine the amount we need to invest, if we are saving, or the cost of borrowing, if we are shopping for a loan. As investment analysts, much of our work also involves evaluating transactions with present and future cash flows. When we place a value on any security, for example, we are attempting to determine the worth of a stream of future cash flows. To carry out all the above tasks accurately, we must understand the mathematics of time value of money problems. Money has time value in that individuals value a given amount of money more highly the earlier it is received. Therefore, a smaller amount of money now may be equivalent in value to a larger amount received at a future date. The **time value of money** as a topic in investment mathematics deals with equivalence relationships between cash flows with different dates. Mastery of time value of money concepts and techniques is essential for investment analysts.

The reading is organized as follows: Section 2 introduces some terminology used throughout the reading and supplies some economic intuition for the variables we will discuss. Section 3 tackles the problem of determining the worth at a future point in time of an amount invested today. Section 4 addresses the future worth of a series of cash flows. These two sections provide the tools for calculating the equivalent value at a future date of a single cash flow or series of cash flows. Sections 5 and 6 discuss the equivalent value today of a single future cash flow and a series of future cash flows, respectively. In Section 7, we explore how to determine other quantities of interest in time value of money problems.

2 INTEREST RATES: INTERPRETATION

In this reading, we will continually refer to interest rates. In some cases, we assume a particular value for the interest rate; in other cases, the interest rate will be the unknown quantity we seek to determine. Before turning to the mechanics of time value of money problems, we must illustrate the underlying economic concepts. In this section, we briefly explain the meaning and interpretation of interest rates.

Time value of money concerns equivalence relationships between cash flows occurring on different dates. The idea of equivalence relationships is relatively simple. Consider the following exchange: You pay $10,000 today and in return receive $9,500 today. Would you accept this arrangement? Not likely. But what if you received the $9,500 today and paid the $10,000 one year from now? Can these amounts be considered equivalent? Possibly, because a payment of $10,000 a year from now would probably be worth less to you than a payment of $10,000 today. It would be fair, therefore, to **discount** the $10,000 received in one year; that is, to cut its value based on how much time passes before the money is paid. An **interest rate**, denoted r, is a rate of return that reflects the relationship between differently dated cash flows. If $9,500 today and $10,000 in one year are equivalent in value, then $10,000 − $9,500 = $500 is the required compensation for receiving $10,000 in one year rather than now. The interest rate—the required compensation stated as a rate of return—is $500/$9,500 = 0.0526 or 5.26 percent.

Interest rates can be thought of in three ways. First, they can be considered required rates of return—that is, the minimum rate of return an investor must receive in order to accept the investment. Second, interest rates can be considered discount rates. In the example above, 5.26 percent is that rate at which we discounted the $10,000 future amount to find its value today. Thus, we use the terms "interest rate" and "discount rate" almost interchangeably. Third, interest rates can be considered opportunity costs. An **opportunity cost** is the value that investors forgo by choosing a particular course of action. In the example, if the party who supplied $9,500 had instead decided to spend it today, he would have forgone earning 5.26 percent on the money. So we can view 5.26 percent as the opportunity cost of current consumption.

Economics tells us that interest rates are set in the marketplace by the forces of supply and demand, where investors are suppliers of funds and borrowers are

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following the valuation date. This amount represents the long-term normalized base level of net cash flows or a base from which the level of cash flows is expected to increase or decline at a more or less *constant* rate. This single-year net cash flow is then divided by the capitalization rate.

A challenge with capitalizing is that for most investments, expected net cash flows are rarely projected to increase at a constant rate into perpetuity from either the year preceding or the year following the valuation date. We do note that such a simplifying assumption is commonly used to estimate the residual year value (sometimes called terminal year value or continuing value) in a multi-period analysis; however, that residual year net cash flow is intended to represent the sustainable or normalized level of cash flows into perpetuity.

Alternatively, discount rates are applied in the context of a *multi*-period analysis. There, annual expected net cash flows from the subject investment are projected over the life of that investment. Again, this is appropriate when the expected cash flows are *not* constant, or are *not* changing at a constant growth rate. In these cases, the expected cash flows are divided by a present value factor (the terms "$(1 + k)^1$" through "$(1 + k)^n$" in Formula 1.1), which includes a discount rate (k) estimate. Common practice in business valuation is to assume that the net cash flows are received on average continuously throughout the year (approximately equivalent to receiving the net cash flows in the middle of the year), in which case the present value factor is generally based on a mid-year convention (e.g., $(1+k)^{0.5}$).

A challenge associated with discounting (for most investments) is the accuracy of the projection of expected net cash flows for each specific projection period several years into the future. Nevertheless, since the future cash flows of businesses (and capital projects) are typically not constant, and in some cases vary significantly from period to period, these types of investments lend themselves to discounting, more so than to capitalizing.

Relationship Between Capitalization Rates and Discount Rates

If the expected increase or decrease (i.e., growth) in net cash flows for the investment is stable and sustainable over a long period of time, then a discount rate (cost of capital) can reasonably be converted into a capitalization rate. We could even say that the capitalization rate is a function of the discount rate and growth rate under these conditions. The relationship between the discount rate and the capitalization rate can be put into equation form as shown in Formula 1.2:[1.5]

Formula 1.2

Capitalization Rate = Discount Rate − Expected Growth Rate

Can the discount rate and capitalization rate ever be the same value? Yes – the discount rate and capitalization rate are equivalent when the expected growth rate is equal to zero.[1.6]

Lastly, notable to Formula 1.1 is its use of g, a constant expected rate of growth in net cash flows.

1.5 A critical assumption in Formula 1.2 is that the expected rate of increase (growth) in the net cash flow from the investment is reasonably constant over the long term (technically into perpetuity).

1.6 A simple example of when the growth rate could be equal to zero is a preferred stock that is issued in perpetuity, is not callable, for which there is not prospect of liquidation, and which pays a set dividend at the end of each year.

observed market price. Clearly, given that dividends are paid quarterly and that the observed stock price reflects the quarterly nature of dividend payments, the market-required return must recognize quarterly compounding, for the investor receives dividend checks and reinvests the proceeds on a quarterly schedule. Perforce, a stock that pays four quarterly dividends of $1.00 commands a higher price than a stock that pays a $4.00 dividend a year hence. Since investors are aware of the quarterly timing of dividend payments and since the stock price already fully reflects the quarterly payment of dividends, the DCF model used to estimate equity costs should also reflect the actual timing of quarterly dividends.

The annual DCF model inherently understates the investors' true return because it assumes that all cash flows received by investors are paid annually. By analogy, a bank rate on deposits that does not take into consideration the timing of the interest payments understates the true yield if the customer receives the interest payments more than once a year. The actual yield will exceed the stated nominal rate. Bond yield calculations are also routinely adjusted for the receipts of semi-annual interest payments. What is true for bank deposits and for bonds is equally germane to common stocks.

Most, if not all, finance textbooks discuss frequency of compounding in computing the yield on a financial security. The handbooks that accompany popular financial calculators as well as the financial functions available in popular spreadsheet programs such as Excel, used almost universally by the financial community, contain abundant directions with respect to frequency of compounding.

The quarterly DCF model assumes that the company pays dividends quarterly and that each dividend payment is constant for four consecutive quarters. There are four different possible quarterly dividend patterns, depending on the timing of the next dividend increase.[1] Figure 11-2 displays the four dividend increase scenarios.

Appendix 11-A formally derives the quarterly DCF model, which has the following form:

$$K = \frac{[d_1(1+K)^{3/4} + d_2(1+K)^{1/2} + d_3(1+K)^{1/4} + d_4]}{P_0} + g \qquad (11\text{-}1)$$

where: d_1, d_2, d_3, d_4 = quarterly dividends expected over the coming year
g = expected growth in dividends
P_0 = current stock price
K = required return on equity

[1] This section is adapted from Vander Weide (2003).

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Chapter 5

The Equity Risk Premium

The expected equity risk premium can be defined as the additional return an investor expects to receive to compensate for the additional risk associated with investing in equities as opposed to investing in riskless assets. It is an essential component in several cost of equity estimation models, including the buildup method, the capital asset pricing model (CAPM), and the Fama-French three factor model. It is important to note that the expected equity risk premium, as it is used in discount rates and cost of capital analysis, is a forward-looking concept. That is, the equity risk premium that is used in the discount rate should be reflective of what investors think the risk premium will be going forward.

Unfortunately, the expected equity risk premium is unobservable in the market and therefore must be estimated. Typically, this estimation is arrived at through the use of historical data. The historical equity risk premium can be calculated by subtracting the long-term average of the income return on the riskless asset (Treasuries) from the long-term average stock market return (measured over the same period as that of the riskless asset). In using a historical measure of the equity risk premium, one assumes that what has happened in the past is representative of what might be expected in the future. In other words, the assumption one makes when using historical data to measure the expected equity risk premium is that the relationship between the returns of the risky asset (equities) and the riskless asset (Treasuries) is stable. The stability of this relationship will be examined later in this chapter.

Since the expected equity risk premium must be estimated, there is much controversy regarding how the estimation should be conducted. A variety of different approaches to calculating the equity risk premium have been utilized over the years. Such studies can be categorized into four groups based on the approaches they have taken. The first group of studies tries to derive the equity risk premium from historical returns between stocks and bonds as was mentioned above. The second group, embracing a supply side model, uses fundamental information such as earnings, dividends, or overall economic productivity to measure the expected equity risk premium. A third group adopts demand side models that derive the expected returns of equities through the payoff demanded by investors for bearing the risk of equity investments.[1] The opinions of financial professionals through broad surveys are relied upon by the fourth and final group.

The range of equity risk premium estimates used in practice is surprisingly large. Using a low equity risk premium estimate as opposed to a high estimate can have a significant impact on the estimated value of a stream of cash flows. This chapter addresses many of the controversies surrounding estimation of the equity risk premium and focuses primarily on the historical calculation but also discusses the supply side model.

Calculating the Historical Equity Risk Premium

In measuring the historical equity risk premium one must make a number of decisions that can impact the resulting figure; some decisions have a greater impact than others. These decisions include selecting the stock market benchmark, the risk-free asset, either an arithmetic or a geometric average, and the time period for measurement. Each of these factors has an impact on the resulting equity risk premium estimate.

The Stock Market Benchmark

The stock market benchmark chosen should be a broad index that reflects the behavior of the market as a whole. Two examples of commonly used indexes are the S&P 500® and the New York Stock Exchange Composite Index. Although the Dow Jones Industrial Average is a popular index, it would be inappropriate for calculating the equity risk premium because it is too narrow.

We use the total return of our large company stock index (currently represented by the S&P 500) as our market benchmark when calculating the equity risk premium. The S&P 500 was selected as the appropriate market benchmark because it is representative of a large sample of companies across a large number of industries. The S&P 500 is also one of the most widely accepted market benchmarks. In short, the S&P 500 is a good measure of the equity market as a