ADAPTING CREDIT UNION RISK MANAGEMENT FOR CLIMATE CHANGE

BY

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We, the faculty supervising this research project, affirm that we have read and approve of the project as written in scope and quality for the Doctor of Business Administration at City University of Seattle.

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DEDICATION

This work is dedicated to my wife, Beth, and my daughters, Jen and Laura, whose love, support, patience, and tolerance of the many hours spent locked away in my office researching, writing, and sometimes screaming, have never gone unnoticed. It is also dedicated to the talented financial professionals who keep our nation's credit unions safe and sound, ensuring that individuals of modest means will continue to be treated fairly and with dignity by our financial system.

"Writing is like driving at night in a fog. You can only see as far as your headlights. But you can make the whole trip that way." – E.L. Doctorow

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"We drink from wells we did not dig; we are warmed by fires we did not build."

Deuteronomy 6:11

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ABSTRACT

The business problem explored in this study relates to how credit union financial and risk managers adapt their organizations to address climate-related financial risk. The information in this study can guide finance and risk management professionals at community-sized credit unions as they determine how best to incorporate climate-related financial risk into their risk management programs. The research questions (RQs) in the study addressed how credit union financial and risk management professionals define climate-related financial risk, what actions they are currently taking or planning to take to measure this risk, and what progress they are making on developing organizational responses to this risk. The study was delimited to finance and risk management professionals working at credit unions with less than $10 billion in assets and headquartered in Idaho, Oregon, and Washington. The study used a qualitative methodology with a basic design, and the data were gathered using semi structured interviews. Eighteen participants were selected, representing 17 unique credit unions that were chosen using convenience and snowball sampling. Open and axial coding were used to generate categories and themes. The study findings could benefit credit union and bank leaders who are beginning to estimate their exposure to climate change risk. It also informs regulatory agencies that supervise these institutions by providing information about what is being done and not done by institutions in the region. The study participants believed that credit risk would be most highly impacted by climate-related natural disasters in the region and suggested current expected credit losses (CECL) qualitative factor adjustments, mapping member locations against areas known to have a high risk for climate-related events, and tightening of underwriting standards as potential

strategies for mitigation. Recommendations for practitioners include estimating member exposure, participating in the Partnership for Carbon Accounting Financials (PCAF), collaboration and information sharing with other credit unions, and adopting green banking practices. Recommendations for future study include analyzing the effect of climate-related risk on credit union performance metrics, estimating the financed greenhouse gas (GHG) emissions of credit unions to ascertain climate-related transition risk, and developing an approach to estimating a qualitative factor adjustment for climate-related risk in the CECL calculation.

CHAPTER 1: INTRODUCTION TO THE STUDY

The topic of this study was the experiences of finance and risk professionals at community-sized credit unions and the adaptation, or lack of adaptation, in their organizations to account for climate-related financial risks. Both academics and professionals have emphasized the need for financial institutions to identify and quantify these risks. However, few researchers have explored what credit unions are doing to measure these risks.

Given the limited evidence on what credit unions are doing to measure these risks, the primary purpose of this study was to address this knowledge gap and qualitatively explore how community-sized credit unions in the Pacific Northwest are adapting their risk management programs to address climate-related financial risk. The RQs in this study were used to address how credit union risk management professionals define climate-related financial risk in the context of other financial risks, explore what actions these professionals are taking or are planning to take at their credit unions to measure these risks, and report on the progress they are making toward adaptation of policy, governance, and other organizational changes in response to climate-related financial risk. The study sought to inform credit union risk management professionals on the current state of their field concerning climate-related financial risk management. Another goal of the study was to help industry regulators better understand what is currently being done by the credit unions they oversee. Boards of directors and other management personnel at these credit unions were also an audience of the study as well as other types of financial institutions and academic researchers.

Study Background

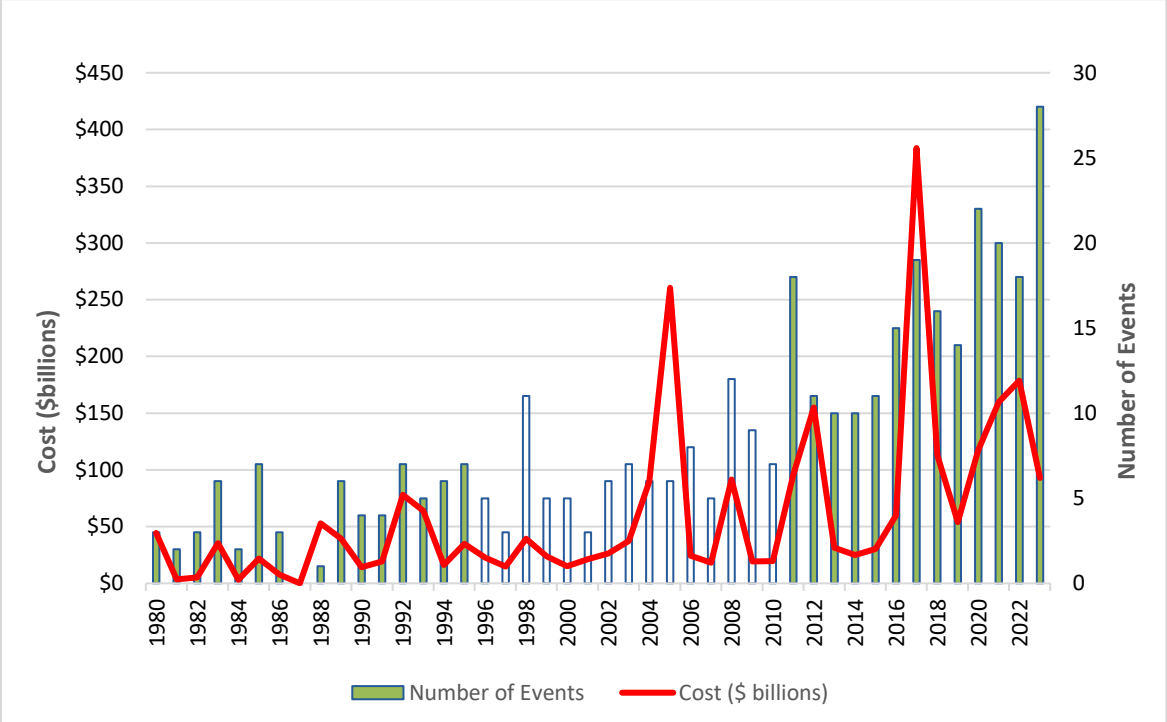
The increasing severity of adverse climate-related losses is a problem facing all organizations, including credit unions. There are various types of climate-related financial risks facing credit unions, and financial regulators have expressed concerns regarding climate change's impact on credit unions. This section summarizes the current state of the field in which the problems exist, the financial risks to credit unions, the unique characteristics of credit unions, and how these unique characteristics have influenced risk management. A description of the deficiencies in academic literature is provided, along with descriptions of the key theoretical frameworks that guided this study. A more detailed discussion can be found in Chapter 2, Literature Review.

Current State of the Field in which the Problem Exists

Climate change is emerging as a financial risk in the United States and the world, with disasters such as hurricanes, wildfires, droughts, and floods increasing in frequency and cost. In 2021, there were 20 separate climate-related disasters in the United States, each causing greater than $1 billion in damage, with the total cost of these disasters estimated at $145 billion (A. Smith, 2022). In 2023, the number of climate-related disasters costing $1 billion or more increased to 28, the highest number on record (NOAA National Centers for Environmental Information [NOAA NCEI], 2024a). Figure 1.1 shows the Consumer Price Index (CPI)-adjusted trend in the number and total cost of these events since 1980.

Figure 1.1

United States Billion Dollar Disaster Events (CPI-Adjusted)



Note. The data in Figure 1.1 was extracted and adapted for clarity from the National Oceanic and Atmospheric Administration's National Center for Environmental Information (NOAA NCEI, 2024a).

First Street Technology (2023), a nonprofit organization whose purpose is to research and analyze climate-related economic risk, estimated that across the United States there are 4.4 million properties that face the potential for increased insurance rates or nonrenewal of insurance due to increasing risk of wildfires, 12 million from increased risk of flooding, and 23.9 million from wind. According to Sherriff (2024), insurance providers are beginning to raise their premiums and even cease covering areas of states that are experiencing increasing risk from extreme weather events due to climate change.

In 2022, insurer Allstate ceased offering new policies on condominiums and new homes in California (Sherriff, 2024). In 2023, insurer State Farm followed suit, while Farmers Insurance discontinued its own-brand home insurance policies in Florida (Sherriff, 2024). Between 2000 and 2020, approximately 3.2 million Americans relocated from neighborhoods experiencing more frequent flood risk in areas such as the Gulf Coast of Texas, coastal Florida, and the Mid-Atlantic region between Washington, D.C. and New Jersey (Porter, 2023). In a study analyzing the correlation between historic flood data and population change in the United States, Shu et al. (2023) found that climate abandonment areas, which are neighborhoods that have lost population due to increasing climate-related flood risk, can even occur in geographic regions that otherwise are experiencing population increases. Over a 5-year return period, Shu et al. found increasing flood risk caused a 7.19% decline in population change versus baseline growth rates in blocks with a high flood exposure, and over a 20-year return period, that reduction from baseline growth was -1.4%. A flood recurrence interval, or return period, is the average number of years between floods of a given size (New Jersey Water Science Center, n.d.). The Consumer Financial Protection Bureau is now advising that homebuyers, sellers, and renters consider risks related to climate change when making housing decisions (McArdle et al., 2022), recommending buyers and sellers look beyond flood insurance and into risks of wildfires and temperature rise, evaluating how these risks could affect utility costs, future insurance costs, and resale value.

Kotz et al. (2024) found that regardless of any action on climate change taken now, the world is already committed to a global per capita income reduction of 19% by 2050. The distribution of this income reduction across the world is not equal, according

to Kotz et al., with some regions facing much greater reductions than others. Parts of South America and Africa will experience per capita income reductions of 30%, according to Kotz et al. Of the three states upon which this study focused, Kotz et al. estimated that Washington and Oregon will experience per capita income reductions between 5% and 10%, and Idaho will experience a per capita income reduction of 5%.

Hofheimer et al. (2022) estimated that $1.2 trillion in credit union assets are at risk due to exposure to potential acute and chronic climate-related events. The Financial Stability Oversight Council (FSOC; 2021), an organization that monitors threats to U.S. financial stability and makes recommendations to banking regulators, stated that the increase in climate-related natural disasters threatens the stability of the financial system and called for greater regulatory scrutiny and analysis of financial system exposure to climate-related risks. This action led state regulators, such as Washington State Department of Financial Institutions Director, Charlie Clark (2021), to ask financial institutions under their supervision to begin analyzing their exposure to climate-related risk and incorporating these risks into their strategic plans.

The Task Force on Climate-Related Financial Disclosures (TCFD; 2017), an organization created to produce climate-risk reporting standards that could be used by businesses and other organizations, categorized the risks posed to financial institutions by climate change into two forms: physical and transition. Under the TCFD classification approach, physical risks pertain to losses stemming from the increasing frequency and severity of climate-related events such as hurricanes, wildfires, and rising sea levels. Transition risks represent the risk of loss stemming from a financial

institution's exposure to firms that are negatively affected by the conversion to using lower greenhouse gas (GHG) emissions (TCFD, 2017).

To measure both physical and transition risk more effectively and consistently, organizations representing partnerships of financial institutions, international organizations, central banks, and others have collaborated to create common reporting standards. The Greenhouse Gas Protocol, developed by the World Resources Institute and World Business Council on Sustainable Development (2004), sets the international standards for how firms of all types can report the GHG emissions that they generate. Using this protocol, the PCAF developed a set of methodologies specifically for use by financial institutions, including commercial banks, credit unions, development banks, investment banks, insurance companies, and asset management firms (PCAF, 2022). These methodologies have provided a standard for how financial institutions can measure the contribution they make to GHG emissions through activities such as lending and investing in GHG-emitting organizations and consumers (PCAF, 2022). The use of these standards is becoming more commonplace throughout the world, with 506 institutions representing $85.6 trillion in financial assets either committing to or already reporting GHG emissions using the PCAF methodology (PCAF, n.d.). A breakdown of the number of each institution type along with the total financial assets represented appears in Table 1.1.

Table 1.1

Types of Financial Institutions Committing to PCAF for GHG Reporting

Institution type	Number of type	Assets ($ millions)
Asset owners/managers	92	12,260,575
Commercial bank	272	47,967,071
Development bank	22	275,035
Export credit agency	4	195,695
Financial services group	36	17,845,386
Insurance	20	3,650,365
Integrated bank-insurance group	2	81,153
Investment bank	11	3,590,189
Promotional bank and other	2	95,905
Total	461	85,961,374

Note. The data in this table were adapted from PCAF (n.d.) and summarized by financial institution type. Data for credit unions is included in the commercial bank category.

To adapt their risk management programs to address the risks of climate change, credit unions must determine how climate-related events could adversely impact their financial performance. Both physical risk and transition risk manifest themselves in the financial performance of credit unions through the traditional banking risk transmission channels, including credit, valuation, and market risk (Basel Committee on Banking Supervision [BCBS], 2021). Credit unions must adapt their risk management policies and procedures concerning these types of traditional risk channels to understand how they may be impacted by the adverse effects of climate change. The next section explores how the practice of financial risk management, including the management of risk transmission channels such as credit, liquidity, and market risk, has developed at credit unions.

Credit unions provide many of the same products and services to consumers as banks. However, banks and credit unions differ in terms of their core mission and their

ownership structure (Federal Credit Union Act [FCUA], 1934/2022; D. J. Smith, 1984). The unique mission and ownership characteristics of U.S. credit unions have influenced the development of their risk management practices, sometimes resulting in better financial performance during periods of economic stress relative to noncredit union banking peers, though these improvements are reduced with increases in asset size and diversity of membership (Ely, 2014; Emmons & Schmid, 1999; Esho et al., 2005). An examination of the unique characteristics of credit unions in the United States helps evaluate the historical reasons for this reduced risk exposure and sheds light on why these advantages may decrease as credit unions grow.

Credit Unions in the United States

Credit unions in the United States are member-owned financial cooperatives whose purpose is to provide a source of credit to individuals of modest means (FCUA, 1934/2022). The FCUA allows members to form and operate their credit unions under the principle of one person, one vote. Credit unions can be organized under a common bond, multiple common bonds, or community charter types. Like banks, the FCUA allows credit unions to offer products such as certificates of deposit, checking accounts, consumer loans, credit cards, money market and savings accounts, and mortgages to their members.

This study was focused specifically on community-sized credit unions. A community-sized credit union is defined in this study as a credit union of any charter type with fewer than $10 billion in total assets. This definition matches how the Federal Reserve defines a community bank and should allow for future comparison of credit unions to banks (Board of Governors of the Federal Reserve System, 2021).

The legal and operational characteristics of credit unions, as outlined in the FCUA, differentiate them from banks in terms of their objective function and optimal pricing behavior (D. J. Smith, 1984). Advancing a decision-making framework unique to credit unions, D. J. Smith, stated that the objective function of a credit union is the maximization of value for its members rather than profit maximization or cost minimization, as is typically the case with banks. The pursuit of value for members instead of profit maximization, according to Smith, results in taking fewer risks that could harm the credit unions if economic scenarios turn adverse. In addition to a difference in their objective function, the cooperative structure of credit unions has also influenced their growth and development as well as their financial stability in times of economic crisis (Ewerhart & Zubrickas, 2019; Kane & Hendershott, 1994; McKillop & Wilson, 2015). The greater degree of social ties between the members of credit unions leads to those members not wanting to receive more at the expense of other members (Ewerhart & Zubrickas, 2019). Credit unions whose members display more of this high degree of social identification with one another tend to be less exposed to adverse changes in economic conditions (Ewerhart & Zubrickas, 2019). These unique traits of credit unions have influenced the practice of risk management at credit unions.

Risk Management in Credit Unions

Development of the theoretical frameworks for credit union operations was begun by Taylor (1971), expanded by D. J. Smith et al. (1981) and D. J. Smith (1984), and then updated by Rubin et al. (2013) and Ewerhart and Zubrickas (2019). Kane and Hendershott (1994) and McKillop and Wilson (2015) explored why credit unions fared better under conditions of economic crisis or risk than other types of financial

institutions. Ely (2014), Emmons and Schmid (1999), and Esho et al. (2005) studied the effect that changes in membership requirements and diversification exerted on credit union financial performance and risk. These researchers have explored decision making and financial risk management in credit unions from the perspective of how these items are affected by credit unions' cooperative structure, membership requirements, and tax-exempt status.

Literature on the structure and risk management of credit unions suggests that credit unions' cooperative, member-owned form can mitigate financial risks relative to banks and shareholder-owned financial institutions (Ely, 2014; Emmons & Schmid, 1999; Esho et al., 2005). Some explanations for this mitigation effect include tighter social ties among members with a common bond, such as a shared profession, workplace, or place of worship, and an incentive structure that favors product offerings maximizing the net benefits of members rather than profit maximization (Ewerhart & Zubrickas, 2019; D. J. Smith, 1984). The reason for this mitigation may be that members who share some type of vocational or social common bond have a desire to see that members of the group do not end up with fewer benefits than other members of the group (Ewerhart & Zubrickas, 2019). A closer link between members could also provide inside information about credit histories that would potentially protect against overly risky lending strategies (Kane & Hendershott, 1994). However, this risk mitigation benefit reduces as the size of credit unions increases, with membership and product offerings becoming more diverse (Ely, 2014; Esho et al., 2005).

Kane and Hendershott (1994) presented an illustration of the cooperative nature concept of credit unions acting as a mitigant to financial risk. Kane and Hendershott

found that the National Credit Union Share Insurance Fund (NCUSIF) remained solvent during the savings and loan crisis of the 1980s while the Federal Savings and Loan Insurance Corporation (FSLIC) and Federal Deposit Insurance Corporation (FDIC) had to be returned to solvency using taxpayer funds. They attributed the ability of the NCUSIF to remain economically solvent to several factors unique to credit unions such as the closer link between members provided by the common bond requirements. In addition, membership requirements, according to Kane and Hendershott, prevented expansion into risky product lines and set limits on how quickly credit unions could grow. All these factors, asserted Kane and Hendershott, contributed to credit unions being less exposed to the risks that were the cause of the savings and loan crisis.

A factor that appears to limit the risk mitigation capabilities of credit unions is the type of charter. The FCUA, as amended through 2022, allows for three types of membership charters (FCUA, 1934/2022). The single common-bond credit unions under the FCUA are comprised of are members who work in the same occupation or have a single common association. Under the multiple common-bond charter, the FCUA allows members from more than one common group or association but with numerical limitations on the number of members from each common group. A community credit union charter under the FCUA permits all people living in a well-defined community to become members. Ely (2014) found that the risk of bankruptcies and regulatory capital problems increased in credit unions with broader fields of membership. However, these risks declined as the size of the credit unions increased. Ely also found that switching from single common bond membership types to broader membership types added risk. Credit unions appear to have an innate tendency to operate in a less risky fashion due to

the tight social ties among their members and their objective function of value maximization to their members. However, as charter types have allowed for broader potential membership, potentially weakening these social ties, these risk-mitigating characteristics appear to be reduced.

Deficiencies in the Evidence

While researchers such as Oh and Kim (2023) and Tsanacas (2024) are beginning to study how community and regional bank leaders are responding to climate-related risks, it appears based on the current literature that little research has been conducted on what specifically credit unions are doing to evaluate and mitigate climate-related risk. The paucity of research could indicate that credit unions are in the very early stages of adaptation. Hofheimer et al. (2022) conducted a series of interviews with 20 credit union representatives, trade association representatives, industry experts, and other related stakeholders to ascertain the level of preparedness of credit unions for climate change in the United States. The findings of the Hofheimer et al. research study revealed that generally credit unions were in the very beginning stages of adapting to climate change. Interviewees reported to Hofheimer et al. that most efforts had focused on increasing the efficiency of internal operations to reduce energy usage and waste. The credit union representatives that Hofheimer et al. interviewed indicated a general reactive stance toward climate-related financial risk and tended to focus analytical efforts on specific weather events. Hofheimer et al. reported a general sense that regulatory action or some agreement about the approach was needed before significant action could be taken. While recommendations that individual banks and credit unions measure climate-related

financial risk exist in the literature, no researchers aside from Hofheimer et al. have attempted to show what individual credit unions are doing in practice.

Key Frameworks

Two sustainability frameworks were incorporated to guide the progress of the study. These frameworks are summarized here and discussed in further detail in Chapter 2. Both frameworks concern the process of achieving sustainability in business development. The framework for strategic sustainable development (FSSD) was developed by Robert (2002), a Swedish cancer doctor and scientist, in the late 1980s. Robert collaborated with B. Wallgren of the Swedish Environmental Protection Agency, B. Ohlson from the Swedish Society for Nature Conservation, and E. Arrhenius, a professor at the Stockholm University Department of Natural Resources. By December 1988, 50 of Sweden's top scientists were part of an advisory council for what would later become an international nonprofit organization called the Natural Step (Robert, 2002). The sustainability principles agreed upon by the members of the Natural Step formed the core of the FSSD. The FSSD provides a precise definition of sustainable development for use by businesses and policymakers (Broman & Robèrt, 2017). The Sustainable Development Framework (SDF) was developed by Willard (2012) and defines a five-stage process by which organizations can move from a state of being unsustainable to one of being sustainable and achieving increased profitability due to the incorporation of sustainable practices (Willard, 2012). Willard's SDF translated the definition of sustainability from the FSSD into terms familiar to business leaders, defining sustainable value creation as a three-legged stool composed of natural capital, human/social capital, and economic capital. The FSSD defines sustainability as an objective state while the

SDF clarifies that definition in business terms and shows how organizations can progress to this objective. The credit union professionals interviewed in this study were analyzed in the context of these two frameworks.

Problem Statement

The business problem explored in this research is how credit union financial and risk managers are adapting their organizations to address climate-related financial risk. The literature review shows that both academic researchers and financial regulators view climate change as an emerging financial risk for the financial system, but studies of credit unions have also shown that credit unions appear to remain in the early stages of analyzing this emerging risk.

General Problem

The general problem is that the financial assets of banks and credit unions are exposed to risks from accelerating climate-related natural disasters and climate-related environmental changes. In this environment of increasing frequency and intensity of adverse climate-related events, credit unions are both exposed to greater financial risks and under increased regulatory reporting obligations to federal and state agencies (Hofheimer et al., 2022). Both industry experts and regulators are urging credit union leaders to review their risk management programs to account for climate-related financial risk and ensure that they have appropriate climate-risk mitigation measures in place (Clark, 2021; Hofheimer et al., 2022; National Credit Union Administration [NCUA], 2023).

The literature that does exist suggests that most credit unions are either not addressing climate-related risk at all, or if they are addressing this risk, they are in the

very early stages of doing so. The Hofheimer et al. (2022) study was the only study focused on the impact that climate change is having on U. S. credit unions. It appears that the response of community-sized credit unions to the risk of climate change is not yet well documented.

Specific Problem

The specific problem is that finance and risk management professionals at community-sized credit unions in the Pacific Northwest lack information on how to incorporate climate-related financial risk into their risk management programs. Academic literature seems to indicate that little is known about how community-sized credit unions in the Pacific Northwest are adapting their risk management programs for climate change and what the experiences of the organization leaders involved have been. Thus, finance and risk management professionals at community-size credit unions who are seeking to adapt their risk management programs to address climate-related financial risk lack information on what is currently being done by other community-sized credit unions; what emerging best practices may exist; what, if any, obstacles may need to be overcome; and where their organizations stand relative to their peers.

Audience

This study applies to several groups. The study has the most direct applicability to financial and risk professionals at community-sized credit unions as it provides insight into how their peers are addressing the problem of climate-related financial risk. Similarly, community-sized banks may also apply the findings of this study to their risk management processes. Boards of directors and other management of financial institutions are another audience of the study as the increased knowledge of what

community-sized credit unions are doing to address climate-related financial risk could help to shape strategic planning at the organizational level. State and national regulators of financial institutions will gain knowledge of how the organizations they supervise are adapting their risk management processes to climate change. This knowledge could assist these regulatory agencies in shaping future regulations and examination procedures. In addition, other types of financial institutions, such as investment managers, insurance companies, and financial technology (fintech) firms, could similarly gain perspective on how they could be affected by and respond to climate-related financial risks.

Purpose of the Study

The purpose of this basic qualitative study was to explore how finance and risk management professionals at community-sized credit unions in the states of Washington, Oregon, and Idaho incorporate climate-related risk into their risk management programs. This aim was addressed in the study by exploring what, if any, actions finance and risk management professionals at community-sized credit unions in the Pacific Northwest are taking to measure, assess, and mitigate climate-related financial risk to their institutions.

Both the academic literature about climate-related financial risk to financial institutions and the regulatory bodies that supervise those organizations have emphasized the importance of gathering firm-level data to assess, measure, and estimate the financial impact of climate change (Clark, 2021; Fabris, 2020; Hofheimer et al., 2022; Sarraf, 2021). While there is much demand for this information, there is little academic literature concerning what community-sized credit unions are doing to address this challenge. Understanding the position on the path to sustainability of credit union financial and risk managers relating to climate-related financial risk is important for industry professionals,

academic researchers, and regulators because it will inform the development of regulations, incentives, and instructions for further preparedness.

Research Questions

The RQs were designed to explore how finance and risk management professionals working at community-sized credit unions in the Pacific Northwest are adapting their risk management policies, procedures, and analytical processes to address the emerging financial risks of climate change.

The RQs were:

RQ1: How do finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations?

RQ2: What actions are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest taking or planning to take to measure the financial risks from climate change?

RQ3: What progress are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest making on policy, governance, or other organizational changes in response to climate-related financial risk?

Significance of the Study

By identifying how community-sized credit unions in the Pacific Northwest are beginning to adapt their risk management programs for climate change and exploring the experiences of the financial and risk management professionals who are implementing these organizational and analytical changes, this study benefits the

leadership of other community-sized credit unions and banks that are beginning to estimate their exposure to climate-related financial risk. The study provides credit union leaders with knowledge about what progress other credit unions are making in adapting to climate-related financial risk, what challenges they are facing, emerging best practices regarding data collection and analysis, and what organizational changes are taking place. It is also an information source for regulatory agencies that supervise these institutions by providing information about what is being done by some institutions, what is not being done, and what challenges are being faced by credit unions that are attempting to address these risks. Possessing this knowledge could assist regulatory agencies in creating appropriate requirements and guidelines regarding climate-related financial risk management. Other researchers and industry consultants also benefit from the study as it has expanded the current body of academic research in this area, pointing to areas of potential additional research.

Methodology and Research Design Overview

The qualitative methodology with a basic design was used for this study. The qualitative methodology was selected based on the fit between the types of RQs being addressed and the characteristics of the qualitative methodology. Punch (2016) advised allowing the RQs to drive the selection of the study's methodology. Creswell and Creswell (2022) explained that RQs designed to explore processes and procedures in a natural setting using information from multiple data sources are best suited to a qualitative methodology. Creswell and Creswell further stated that qualitative research proceeds inductively from specific ideas to the general and is focused on exploring how individuals and groups make meaning in specific situations. The RQs in this study

involved exploring how the credit unions' finance and risk professionals are adapting their organizations to address the risks of climate change, how they define those risks, and what progress has been made toward adaptation. The analysis of data proceeded inductively from the responses of specific participants to the creation of more general conclusions upon analyzing the full set of interview data. Since the analysis proceeded inductively, and the RQs were focused on the perceptions of credit union finance and risk professionals, the qualitative methodology was most appropriate.

The data for the study was gathered using semistructured interviews of finance and risk management professionals working at community-sized credit unions headquartered in the states of Washington, Oregon, and Idaho. Data for the study were obtained via individual semistructured interviews with the study participants. The study participants represented both management and nonmanagement employees who were involved in functions such as corporate financial risk and performance analysis, liquidity analysis, interest rate risk management, credit risk management, pricing, and investment management. As of March 31, 2025, there were 149 credit unions headquartered in these states that met the asset size criteria. Table 1.2 shows the breakout of the number of credit unions and the sum of their assets by state.

Table 1.2

Number and Total Assets ($s) of Community-Sized Credit Unions by State

State	Number of credit	Percentage of total	Total assets ($millions)
Idaho	25	17%	10,243
Oregon	49	33%	38,415
Washington	75	50%	60,962
Total	149	100%	109,619

Note. Data in this table were gathered from Callahan & Associates (n.d.), a service that provides peer analysis for banks and credit unions using data from quarterly regulatory call reports.

Analysis of the collected data first involved either transcribing or cleaning up a recorded transcription of the interviews. A transcript accuracy check was conducted to ensure that the views and responses of the study participants were accurate. Next, open coding of the interviews was used to establish patterns in the data. Open coding is a common practice in studies using a basic qualitative design because it can help the researcher intuitively establish key ideas as they emerge (C. Marshall et al., 2022). As this open coding process unfolded, codes were organized and defined in a code book.

Study Limitations and Biases

Limitations of a study pertain to the chosen research methodology and design and are constant over time, meaning that future researchers using the same methodology and design will experience the same limitations (Miles, 2019). Biases can emerge in a research study due to the background and experience of the researcher about the subject being studied (Creswell & Creswell, 2022). The effect of researcher bias can be mitigated, according to Creswell and Creswell, through a reflexive process of

acknowledging the values, background, and experiences of the researcher that might influence interpretations of the information.

While steps were taken to ensure the confidentiality and anonymity of respondents, some respondents may still have been reluctant to fully disclose. A related limitation was the amount of knowledge that the participants had about the posture of their credit union toward climate-related financial risk. For example, a credit union's response to climate-related financial risk might be addressed by organizational teams not comprised of finance and risk management staff. Efforts were made to involve the actual teams that are involved in addressing climate-related financial risk at these credit unions, but the potential remained for key individuals to be missed, especially in organizations operating in a circumspect manner or using external consultants.

Another limitation was the level of understanding that participants had concerning climate-related financial risk. While academic research on the financial risk from climate change has produced some consistent definitions, finance professionals may not have always been aware of these definitions and may have had their own interpretations. To address this, the study contained interview questions that asked participants to discuss how they viewed climate-related financial risk. In this way, these varying levels of understanding could be made to further inform the study findings.

The focus of the research was finance and risk managers at community-sized credit unions located in the states of Washington, Oregon, and Idaho. I am employed as the director of finance at a community-sized credit union in Washington State, precisely the type of position and organization under study. This created the potential for bias in designing interview questions, interpreting written information, and drawing conclusions.

I mitigated this bias risk by neutrally questioning interviewees with open-ended questions designed to bring out their points of view and did not include his organization in the sample selected. I was cognizant of the risk of asking leading questions and made efforts to avoid doing so.

Study Delimitations

Delimitations are boundaries set for the study over which the researcher has direct control and that involve the scope of the study (Miles, 2019). The first major boundary of this study is that it included only credit unions with assets of less than $10 billion. The second boundary in this study was the geographical boundary of the three specified states. A third boundary was the focus of the study on the finance and risk management professionals working in these institutions.

All three of these boundaries could have the effect of limiting the generalizability of the study to other financial institutions. The restriction to credit unions of a relatively small asset size could result in the discovery of best practices or challenges unique to credit unions of this size, which would not necessarily be pertinent to larger credit unions and banks. The geographic restriction could result in the emergence of physical and transition risks that are specific to the weather and climate conditions of the Pacific Northwest region but may be different from other regions of the United States and the world. The restriction to risk management personnel excludes the perspectives of other types of managers such as information technology professionals, facilities managers, and others whose perspectives, while not steeped in risk expertise, could nonetheless be useful.

Definitions of Key Terms

The following are definitions of key terms used in the study.

Call report: A regulatory report containing financial information about a credit union including assets, liabilities, and capital, revenues and expenses, classifications of loans and shares, investments, and loan delinquencies and charge-offs is known as a call report (NCUA, n.d.).

Carbon tax: A tax levied on GHG emissions is referred to as a carbon tax (Metcalf, 2019). The objective of a carbon tax is to reduce GHG emissions by increasing the cost of producing pollution (Metcalf, 2019). The carbon tax thereby corrects a market failure, whereby the costs of pollution from GHG emissions are borne by members of society who are not party to transactions between GHG emitters and their customers (Metcalf, 2019).

Community-sized credit union: A credit union of any charter type with less than $10 billion in assets on its balance sheet is, for the purposes of this study, considered a community-sized credit union. This definition is consistent with how banks of that size are classified (Board of Governors of the Federal Reserve System, 2021).

Climate change: The shifts in long-term weather patterns and temperatures are known as climate change (United Nations, n.d.). These changes can either be the result of natural processes, such as sun activity or volcanic eruptions, or they can result from human activity such as the burning of fossil fuels. The United Nations (n.d.) stated that since 1800, human activities have been the primary driver of climate change.

Climate-related financial risk: The economic and financial risks from climate change that stem from climate-related disasters or from efforts to reduce or slow climate

change and its effects are called climate-related financial risk (Bank for International Settlements, 2021).

Current expected credit loss (CECL): The accounting guidance that defines how a financial institution's credit losses are estimated is known as the current expected credit loss (CECL) standard. The estimation of future credit losses under CECL accounts for future anticipated macroeconomic factors, future loan cash flows over the life of the instrument, and the correlation between historical loan loss rates and historical macroeconomic factors. To account for additional considerations outside of the quantitative calculations of CECL, qualitative factor adjustments (Q factors) can be applied in the calculation as well (Financial Accounting Standards Board, 2016).

Financed emissions: Emissions that are financed by the lending and investing activities of banks and other financial institutions are called financed emissions (PCAF, 2022). Amounts of financed emissions are expressed in metric tons of CO2e (PCAF, (2022).

Green banking: The philosophy of conducting banking operations that emphasizes environmental stewardship and the protection of the environment is referred to as green banking (Rahman & Mohamad, 2022). The following are characteristics of green banking:

- Green banking activities focused on a bank's internal operations can include environmentally friendly building, installation of solar panels at bank facilities, waste management, use of web conferencing in place of in-person meetings, and the purchase of fuel-efficient fleet vehicles (Lalon, 2015).

- Green banking activities focused externally consider the environmental impact of projects financed by the bank via lending, direct equity investment, or other means (Bukhari et al., 2019).

Banks engaging in the philosophy of green banking can also offer green products, such as certificates of deposit in which funds are invested only in environmentally friendly projects or loans for electric vehicles made at a reduced interest rate (Catherin & Melvin, 2022).

Nonperforming loans: Loans in which there is reason to believe that the borrower may not be able to continue making loan payments, or in which the borrower is already over 90 days past due on a payment are called nonperforming loans (European Central Bank, 2021). Nonperforming loans generate losses for banks in terms of lost interest revenues and higher loan loss provision expenses (European Central Bank, 2021).

Paris Agreement: Signed on December 12, 2015, the Paris Agreement is an international treaty that calls for limiting the increase in global average temperatures to less than 2 degrees Celsius, with efforts to keep the increase to less than 1.5 degrees (National Resources Defense Council [NDRC], 2021). The 186 nations that are party to the agreement agreed to set nationally determined contributions to carbon emissions reduction (NDRC, 2021). The United States committed to reducing carbon emissions to 26%–28% below 2005 levels by 2025 (NDRC, 2021).

Physical risk: The BCBS (2021) defined physical risks as financial losses related to the increasing frequency and severity of acute climate-related disasters such as floods, wildfires, and storms. Physical risk also includes financial losses from climate-related events caused by the longer-term shifts in the climate. These events could include sea

level rise, changes in precipitation levels, and increased volatility of average temperatures. Finally, the BCBS included financial losses from indirect effects of climate change, such as deforestation, soil degradation, and water shortage, under the category of physical risk. From the perspective of credit unions, physical risks could result in disruptions to service to members or the inability of borrowers to continue making payments on their loans (Hofheimer et al., 2022).

Risk management: The process of identifying and analyzing risks, combined with the prioritization and development of procedures to monitor them, reduce their probability, and mitigate their negative impact is called risk management (Hubbard, 2020). For this study, the definition was narrowed to focus on the management of financial risks specific to banking. Financial risks to banks include credit risk, liquidity risk, interest rate risk, currency risk, and market risk, including counterparty risk (Greuning & Bratanovic, 2020). Financial institutions usually create formal financial risk programs that include an established risk management strategy, formalization of decision making, quantitative and qualitative analysis, use of modeling tools, and systematic gathering of relevant data (Greuning & Bratanovic, 2020).

Transition risk: The BCBS (2021) defined transition risks as financial losses related to transitioning to a low-carbon economy. For credit unions, transition risks can bring about changes to regulations, business conditions, or the communities in which credit unions operate (Hofheimer et al., 2022).

Summary

Climate change is emerging as a risk to credit unions and other types of financial institutions, and regulatory agencies at both the state and federal levels in the United

States are responding by asking financial institutions to adapt their risk management programs accordingly. Despite increasing financial losses due to adverse climate-related events and despite calls from regulatory agencies for adaptation of risk management programs to address climate change, credit unions appear to be at the very early stages of adapting these programs.

While there is evidence supporting the increasing financial risk from climate change and guidance from regulatory agencies for financial and risk managers at financial institutions to begin adapting risk management programs for climate change, little research appears to have been published concerning how finance and risk professionals at community-sized credit unions are adapting the risk management programs or practices. The specific business problem resulting from this situation is that financial and risk management professionals at these credit unions lack knowledge of what their credit union peers may be doing to adapt to climate change, what problems they have faced, and what emerging best practices may exist.

The purpose of this study was to provide guidance to finance and risk management professionals at community-sized credit unions in the incorporation of climate-related financial risk into their risk management programs. To accomplish this aim, the study qualitatively explored how community-sized credit unions are adapting their risk management programs to climate change. The data for the study were obtained through semistructured interviews with a minimum of 18 finance and risk management professionals working at credit unions in the Pacific Northwest. The findings of this study can benefit finance and risk professionals at credit unions and community banks, boards of directors at financial institutions, national and state regulators of financial

institutions, and other financial institutions such as investment managers, insurance companies, and fintech firms.

It was demonstrated in this chapter that, at present, finance and risk management professionals at community-sized credit unions in the states of Washington, Oregon, and Idaho lack information on what types of emerging best practices exist for adapting to climate-related financial risk. This chapter further defines the purpose of the study as addressing this problem through the exploration of how finance and risk management professionals at these types of credit unions are incorporating climate-related financial risk into their finance and risk management programs. Chapter 2 delves more deeply into the literature to fully examine credit unions, risk management in credit unions, and key frameworks used in this study. Chapter 3 then details the methodology and design of the study while providing information on how participants were selected and interviewed. The findings of these interviews are discussed in Chapter 4, and Chapter 5 provides an analysis of the findings, recommendations, and applications to business.

CHAPTER 2: LITERATURE REVIEW

The literature reviewed for this study consisted of material from academic researchers, financial institution regulators, and scientific organizations. The body of surveyed literature included peer-reviewed journal articles and publications from financial services industry specialists. Publications from regulators such as the BCBS, the FSOC, the NCUA, and the Federal Reserve Bank (FRB) were included in the review. Information from the Code of Federal Regulations was incorporated to provide further context to the current regulatory environment and to distinguish credit unions from banks. Information from scientific databases such as the National Oceanic and Atmospheric Administration's NCEI was also included to illustrate the effects and costs of climate change. Academic researchers, including Hofheimer et al. (2022), Oh and Kim (2023), and Keenan and Bradt (2020), used climate data from these and other scientific organizations in their research.

While academic literature comprised most of the literature reviewed, guidance from domestic and international governments and banking regulators was also included due to these organizations conducting research outside of academia and the influence that these organizations exerted over the categorization and reporting requirements on climate-related risk. The Bank of England (BOE, 2015) was the first to categorize climate-related financial risks into physical, transition, and liability risks. A subsequent BOE report in 2016 further formalized these definitions and transmission channels through which they affected financial institutions (Monasterolo, 2020). The TCFD, the organization that developed what have come to be the primary reporting standards for climate-related risks, was brought into existence by the Financial Stability Board (FSB),

an organization formed under the auspices of the Group of Twenty (G-20) largest economies in the world (FSB, 2015; G-20, 2015; TCFD, 2017). In the academic literature reviewed, it was evident that these and other governmental and regulatory agencies influence the actions of leaders in the financial services industry regarding climate-related risk. Lack of action and direction from U.S. regulators was cited by academic researchers as an impediment to implementing green banking initiatives, such as developing environmentally friendly bank products, considering the environmental impact of bank investments, developing environmentally friendly internal operations, and taking action on climate-related financial risks (Hofheimer et al., 2022; Oh & Kim, 2023; Park & Kim, 2020). These studies suggest that the views of financial system regulators are relevant to the response of banks and credit unions to the risk from climate change and could play a role in the actions taken so far by their leadership.

This chapter begins with a discussion of the two theoretical frameworks that guided the analysis of credit union preparedness for climate-related risk. The FSSD established the criteria by which development may be considered sustainable along with a four-step process by which organizations can progress toward sustainable operations (Broman & Robèrt, 2017). The SDF similarly established a five-stage journey to sustainability, beginning with a stage in which an organization is disobeying environmental regulations and causing harm to one in which sustainability is a core value of the organization and part of its strategic plan (Willard, 2012). Both frameworks aided in ascertaining where the credit union industry and individual credit unions reside along this sustainability process.

Next, the emergence of climate change as a risk to financial institutions is covered. The sources and drivers of these climate-related risks are then described and categorized, along with how they are propagated through their transmission channels to affect financial institution performance. Estimates of credit union and bank exposure to climate-related financial risk is then discussed, along with recent reactions and recommendations from financial system regulators. An overview of reporting and other standards for measuring and disclosing climate-related risks is also provided.

The focus of the chapter then shifts to a description of the characteristics of credit unions in the United States and how they differ from banks. The development of risk management at credit unions is also covered, along with a discussion of the historical risk management performance of credit unions. The chapter concludes with a discussion of the research into what banks and credit unions are currently doing to assess and mitigate climate-related risks. This discussion examines the objectives, methodologies, and findings of these studies.

Key Frameworks

Two theoretical frameworks guided the research in this study. Both frameworks pertain to the achievement of business development that is sustainable. The FSSD, originally developed in Sweden in the 1990s by a collaboration of scientists and practitioners across many disciplines, has been revised periodically over the past 25 years (Broman & Robèrt, 2017). The FSSD defines the conditions required for development to be considered sustainable (Broman & Robèrt, 2017). The SDF defines five progressive stages at which an organization arrives on the path to sustainability (Willard, 2012). The FSSD defines the proper destination for the organization while the SDF identifies the

organization's current position on the path to sustainability. Both the FSSD and the SDF define a process by which an organization can achieve sustainability in its business conduct.

It is important to define the concept of sustainability so that its relation to climate change can be understood. One of the first definitions of sustainable development was put forth by the United Nations (1987) in its report, *Our Common Future: Report of the World Commission on Environment and Development*, which also became known as *The Brundtland Report*, after its chairperson, Harlem Brundtland. In this report, the United Nations (1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 37). The Brundtland definition was the starting point for the refinement of the sustainable development definition under the FSSD (Broman & Robèrt, 2017).

Framework for Strategic Sustainable Development

The FSSD was the inspiration of Karl-Henrik Robert, a Swedish doctor and scientist, in the late 1980s (Robert, 2002). Robert, who had expertise in the operation of biological systems, viewed the problem of environmental pollution from this perspective. Robert explained the operation of biological systems using an analogy to a tree, where the trunk and the branches equated to the core operations of the system and the leaves represented the various detailed functions of the system (Robert, 2002). Robert believed that too much effort was being expended by society and argued about specific pollution problems (i.e. the leaves) instead of focusing on core principles (i.e. the trunk and branches) that could be agreed upon as a framework by which specific issues could be addressed. Robert drafted an initial version of the FSSD in 1988 and began collaborating

with Bjorn Wallgren of the Swedish Environmental Protection Agency, Bo Ohlson from the Swedish Society for Nature Conservation, and Erik Arrhenius, a professor at the Stockholm University Department of Natural Resources (Robert, 2002). By December 1988, 50 of Sweden's top scientists became involved with the project (Robert, 2002). The collaboration soon received the support of the Swedish government, members of the business community, and the Swedish monarchy (Robert, 2002). The Natural Step (2017b), as the collaboration became known, is an international nonprofit organization that partners with individuals and organizations to progress toward sustainable business practices. The FSSD contained the core sustainability principles of the organization. The Natural Step (2017a) has continued to revise the FSSD over the past 25 years in cooperation with scientists, private individuals, and public sector organizations. The FSSD refines the Brundtland definition of sustainable development, identifies the necessary conditions for a system to be sustainable, and establishes an approach by which organizations can work toward sustainable operations (Broman & Robèrt, 2017).

The FSSD lists four requirements for a sustainable business community and wider society (Broman & Robèrt, 2017):

- Nature must not be subjected to increasing concentrations of extracted substances from the earth's crust, such as coal, oil, and other fossil fuels.
- The planet must not be subjected to physical degradation, such as deforestation and habitat removal, at a pace faster than these things can be replenished.
- The planet must not be subjected to continually increasing amounts of substances produced by society.

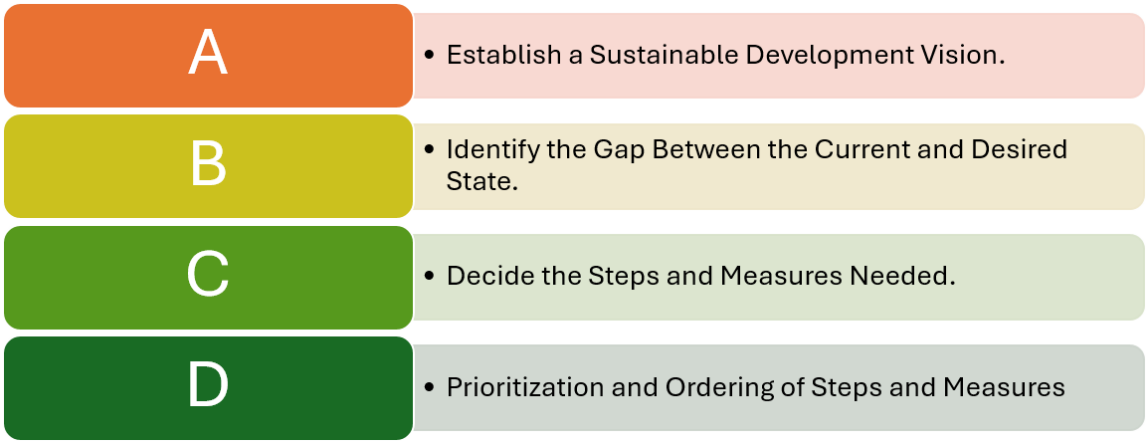
- All members of society must be able to meet their basic human needs.

For an organization to achieve a state of sustainable development, each of these criteria must be met.

Organizations need a model for progressing toward the conditions of sustainable development. Broman and Robèrt (2017) described organizational progress toward sustainable development as an action-learning process occurring over four steps known as the ABCD approach. Step A of this approach is determining a sustainable development vision for the organization. This vision should include the achievement of the four sustainable development conditions described earlier. In Step B of the process, an organization should determine the gap between its present condition and the sustainable vision established in Step A. Once gaps between the current and aspirational conditions are identified, potential challenges to achieving the sustainable development vision should be listed as well. In Step C, the organization lists possible measures to take to progress toward the sustainable development vision. Step D involves the prioritization of the measures listed in Step C. Step D is important in determining what can be done at present and what can wait or needs to wait until a later time. Figure 2.1 illustrates these steps.

Figure 2.1

The ABCD Approach to Sustainable Development



Note. This is a summary of the approach as published by Broman and Robèrt (2017).

Broman and Robèrt (2017) emphasized that a balance must be struck between speed of advancement and return on investment. Progressing too quickly may not be optimal if the market is not ready for certain innovations. Broman and Robèrt stated that the ABCD process could help to prioritize actions that provide important short-term successes.

Sustainable Development Framework

The SDF, created by Willard (2012), also describes a process by which businesses can move from conducting unsustainable business practices to fully embracing sustainability practices as a core component of organizational strategy. Willard's SDF translated the definition of sustainability from the FSSD into terms familiar to business leaders, defining sustainable value creation as a three-legged stool composed of natural capital, human/social capital, and economic capital. The FSSD defined sustainability as an objective state while the SDF clarifies that definition in business terms and shows how

organizations can progress to this objective. Willard's five-stage SDF can be useful in identifying where a specific organization is on the pathway to sustainable operations. Once the organization's current position is estimated, recommendations can be made for advancing toward higher stages.

Five-stages to Sustainable Development

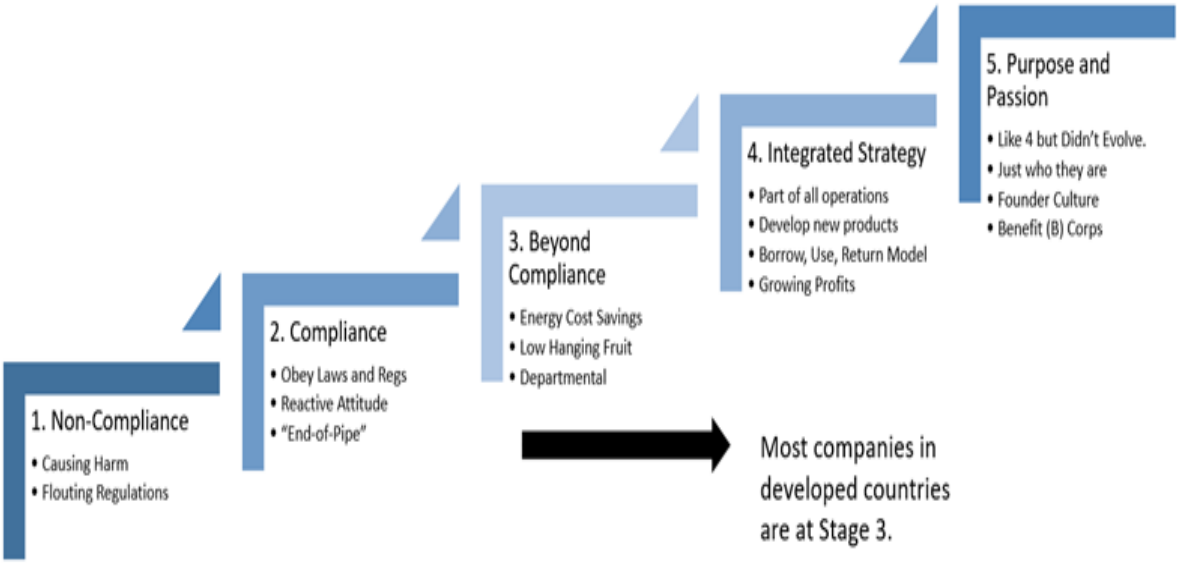
Willard (2012) argued that the path to becoming a sustainable organization occurs along five steps, with progress being made at each step. The first stage is one of noncompliance, when a company skirts environmental regulations and causes harm. The second is the compliance stage, when the company is focused on obeying regulations but is primarily reactive in its focus as opposed to thinking of sustainability in a strategic or beneficial sense.

Willard (2012) defined the third stage as the stage at which most companies in the developed world reside. At this stage, an organization has progressed beyond compliance and has begun to see some business benefits of sustainability such as energy cost savings. However, progress toward sustainability is likely to be confined to individual departments rather than embraced globally throughout the organization. The fourth stage occurs when corporate social responsibility and sustainability strategies become part of the fabric of the organization, and sustainability influences all organizational decisions. The fifth stage is like the fourth stage but is comprised of companies that never had to evolve their processes. Instead, these companies began their existence as sustainable organizations, often due to the aspirations of their founders. An outline of the five-stage sustainable development journey appears in Figure 2.2. Willard stated that organizations should have a goal of reaching Stage 4 so that they can take

advantage of enhanced brand image, additional revenue sources from new product innovations, and new financing and lease opportunities.

Figure 2.2

The Five-Stage Journey to Sustainability



Note. Adapted from *The New Sustainability Advantage Seven Business Case Benefits of a triple bottom line* (10th ed.) by B. Willard, 2012.

Comparison of FSSD and SDF

Both the FSSD and the SDF five-stage model tend to reinforce one another. The sustainability vision described in Step A of the FSSD can correspond to Stage 4 in the five-stage model. Stage 4, as stated earlier, involves incorporating sustainability practices into an organization's strategic and operational planning, developing new products, and generating new innovative products. The sustainable development conditions of the FSSD could guide what types of new products or strategic decisions lead to true

sustainability. New products developed should not subject the environment to increased concentrations of substances from the earth's crust or lead to increased physical degradation of natural habitats.

Steps B through D of the FSSD could also inform an organization as to where it currently resides on the SDF five-stage model. Completion of Step B, determining gaps between the current state and the aspirational state of Step A, could show an organization whether it is in Stage 2 compliance or Stage 3 beyond compliance. Steps C and D of the FSSD could then help to identify steps and prioritization for the organization while moving from Stage 2 to Stage 3. Broman and Robèrt (2017) stated that the FSSD could accommodate and provide insight into many other models. This type of mutual reinforcement appears to be an example of this assertion.

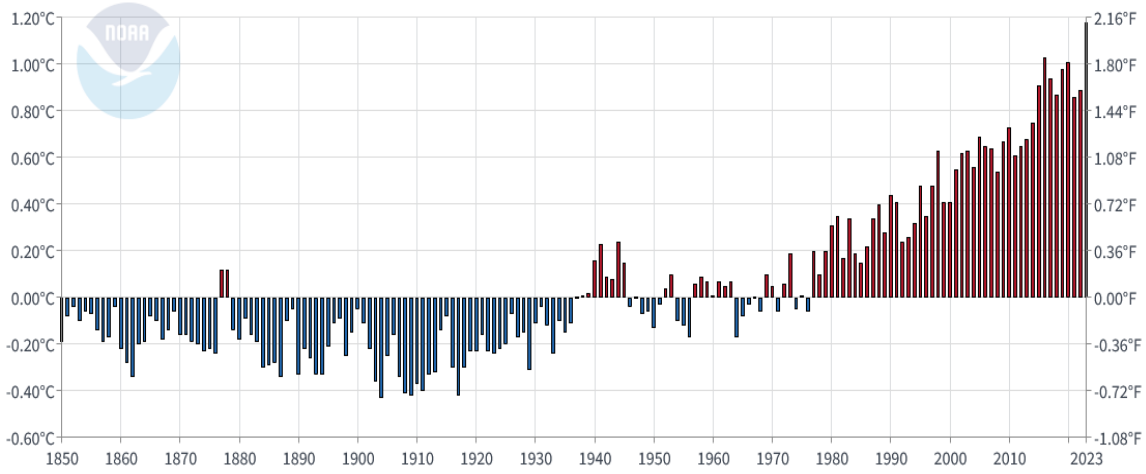
As stated earlier in the chapter, the FSSD listed four conditions necessary for a sustainable society and then identified a four-step action learning process, known as the ABCD approach, by which organizations can achieve the three conditions necessary for sustainability. This ABCD process includes establishing a vision, identifying the gap between the current state and the envisioned state, listing action steps, and setting priorities. Willard's SDF translated the FSSD's conditions into terms more relatable to business professionals and identified points along a five-step journey to sustainability that could be used to evaluate where specific organizations are on that journey. After the data-gathering phase of this study, when interview transcripts were analyzed and coded, this study estimated the stage of the sustainability journey at which each credit union resides. Knowing this information about the credit unions proved helpful in creating recommendations on further actions.

Climate Change as an Emerging Risk to Financial Stability

Academic researchers in scientific and financial publications have agreed that global average temperatures are rising and that climate change is already causing significant monetary losses to financial institutions and the public. The NOAA NCEI (2024b) reported that 2023 was the warmest year on record since the organization began tracking global land and sea temperatures in 1850. The NOAA NCEI also reported that the 10 warmest years since 1850 have all occurred since 2014. The long-term average temperature trend since 1850 is illustrated in Figure 2.3.

Figure 2.3

Global Land and Ocean Average Temperature Anomalies, 1850–2023



Note. The temperature anomaly is the difference between the average land and sea temperature each year and the average global land and sea temperature in the 20th century, a temperature of 13.9 degrees Celsius and 57.0 degrees Fahrenheit. This chart is taken from the NOAA NCEI (2024c) Climate at a Glance Global Time Series.

The cost of climate-related natural disasters is also rising. In 2021, there were 20 climate-related disasters in the United States that each caused more than $1 billion in damage and in total caused estimated losses of $145 billion (A. Smith, 2022). In 2023, the number of climate-related disasters costing $1 billion or more was the highest on record at 28 (NOAA NCEI, 2024a). Worldwide, Rahman and Mohamad (2022) reported climate-related natural disasters such as floods in China and Europe, monsoons in India, and wildfires in Greece, and noted that the underlying causes of these intensifying disasters were deforestation, increased usage of fossil fuels, and industrialization. According to Rahmad and Mohamad, the increasing frequency and intensity of climate-related natural disasters puts financial institutions at greater risk of monetary losses from physical damage, risks from the conversion to a low-carbon economy, regulatory penalties, and governmental policy changes. Artha (2024) concluded that climate-related financial risk is one of the three emerging risks for financial institutions and that these new risks must be incorporated into their risk management frameworks. In response to the need for climate-related risks to be considered in the risk management practices of financial institutions, governmental and regulatory authorities began in 2015 to classify climate-related risks according to their sources and transmission channels. The evolution of this process is described in the next section.

Classification of Climate-related Financial Risk Drivers

What has become the customary approach to classifying climate-related financial risk drivers and transmission channels began as an effort by international government and finance leaders to standardize how climate-related financial risks were reported by organizations across the globe. In April 2015, finance ministers and central bank

governors from the G-20 issued a communique that called for the FSB, an international organization mandated by the G-20, to promote and maintain financial system stability and to bring together representatives from the public and private sectors to study how the financial sector could better account for climate-related risks (FSB, 2015; G-20, 2015). The FSB met later that year and published a proposal calling for the creation of a task force dedicated to producing a set of climate-risk reporting standards that could be used by businesses and other organizations globally to report their climate-related risks consistently (FSB, 2015). The FSB's proposal resulted in the creation of the TCFD (2017).

Physical and Transition Risk Classification

The TCFD (2017) issued its first set of recommendations for climate-related risk disclosure and categorized climate-related financial risks into two broad types: physical risks and transition risks. Physical risks, according to the TCFD, entail the risk of damages from either acute climate-related natural disasters, such as floods, severe storms, and wildfires; or chronic climate-related phenomena such as sea level rise and rising average temperatures. For credit unions, physical risks could bring about disruptions in their ability to provide service to their members, or the inability of borrowers to continue making payments on their loans (Hofheimer et al., 2022).

The TCFD (2017) defined transition risks as pertaining to the financial risks from the global shift to a low-carbon economic system. The TCFD further stated that these transition risks could be related to legal and policy matters, technological change, reputational risks from changing customer preferences, and market risk. For credit unions, transition risks can manifest as changes to regulations, business conditions, or the

communities in which credit unions operate (Hofheimer et al., 2022). Credit unions whose membership is predominantly employed in industries that could be negatively affected by the transition to a low-carbon economy, such as fossil fuel producers or heavy manufacturers, could see transition risk in the form of members who suffer financial losses as a result of downturns at those companies (Hofheimer et al., 2022).

Adoption of the TCFD's (2023) reporting recommendations became widespread, and by October 2023, 4,850 public companies had expressed support for the approach. As the use of the TCFD's recommended reporting standards grew, the classification of climate-change risk drivers into physical and transition risks became commonplace.

An important adoptee of this classification from the perspective of banks and credit unions was the BCBS (2021). The BCBS comprises 45 members from central banks and bank supervisors from 28 jurisdictions and is the main setter of standards for the international regulation of the financial system (BCBS, n.d.). The BCBS was formed in December 1974 in response to the failure of Bankhaus, a large West German bank, when it was decided that international cooperation between central banks and regulators was necessary to prevent the spread of financial risk from a single country to the wider global financial system (Sato, 2024). While the BCBS does not have legal regulatory power, its recommendations are achieved through transparent discussion between the ministers of finance, banking supervisors, and other financial system experts that comprise its membership (Peihani, 2016). Because its members agree to be accountable for implementing BCBS recommendations in their home jurisdictions, the BCBS exercises authority in the banking industry through a "soft law" mechanism (Muñoz,

2019). Through this soft law mechanism, the BCBS framework has become the de facto standard for setting monetary and regulatory policy by its members (Sato, 2024).

The influence of the TCFD and the BCBS in the classification of climate-related financial risk drivers can be seen in the report of the U.S. FSOC, an organization that monitors threats to U.S. financial stability and makes recommendations to member agencies, including banking regulators, concerning regulatory and supervisor proposals (FSOC, 2021). In its report titled, *Report on Climate-Related Financial Risk*, the FSOC classifies climate-related risk drivers into physical and transition risks, citing the BCBS in its definition (FSOC, 2021). As will be discussed in upcoming sections, most academic researchers since the TCFD issued its initial recommendations have analyzed climate-related risk drivers in the context of physical and transition risks (Lee et al., 2023).

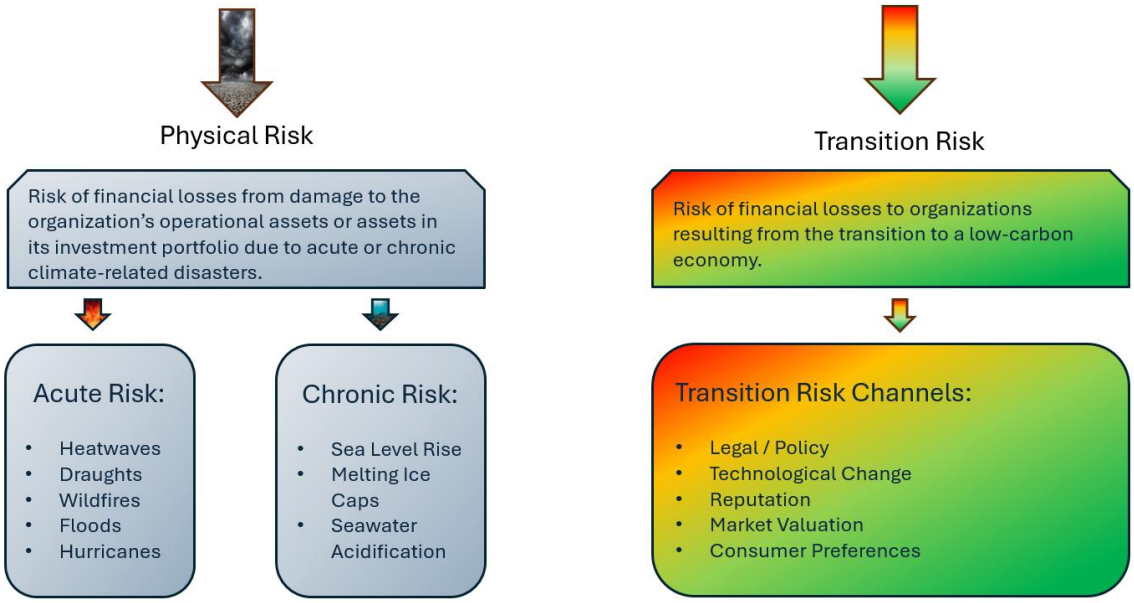
Subdivisions of Physical Risks

Physical and transition risks were further subdivided by some researchers and regulators. The BCBS (2021) divided physical risk from climate change into acute and chronic components. The BCBS listed heatwaves, wildfires, hurricanes, floods, and droughts as examples of acute physical risk drivers. BCBS noted that these climate-related disasters are short in duration but can produce significant damage to property, food production, and other infrastructure. BCBS considered chronic physical risk drivers to be those that unfold more slowly over longer timeframes but have an equal potential for financial losses and damage. Chronic physical risks identified by BCBS included rising sea levels due to melting polar ice caps, which can affect living and working conditions in coastal regions and increase seawater acidification, which can affect coral reefs and other ocean life. Both acute and chronic physical risk drivers can cause

financial losses that can impact the stability of financial institutions. Figure 2.4 summarizes the primary classifications of climate-related financial risk channels.

Figure 2.4

Climate-Related Financial Risk Classifications



Note. Information for this figure is adapted from the BCBS (2021) and TCFD (2017).

Other Climate-Related Financial Risks

While most of the researchers and regulators reviewed for this study divided climate-related financial risks into physical and transition risks, some researchers argued that certain risks warranted additional classification. The BOE (2015) defined liability risk as a third type of climate-related financial risk source. Liability risks are the financial risks stemming from the possibility that parties who experience financial losses from climate-related events could seek damages from people and organizations they believe to be responsible in some way (Carney, 2015). For instance, a group of individuals could

sue a fossil fuel company for damages resulting from the fossil fuel company's failure to follow regulations (Carney, 2015).

Fabris (2020) also defined an additional classification of climate-related financial risk. In an article that proposed a nine-step framework for institutions to use in assessing climate-related financial risk, Fabris identified indirect risks as being separate from physical and transition risks. Indirect risks concern companies that may not be directly affected by the transition to a low-carbon economy but may have customers, suppliers, or other stakeholders who are affected (Fabris, 2020). Fabris encouraged banks to look for any assets in their portfolios, such as businesses serving fossil fuel or manufacturing companies, that could be exposed to these indirect risks.

Another classification of climate-related financial risk was proposed by Rahman and Mohamad (2022). Arguing for the need to incorporate green banking practices in financial institutions, Rahman and Mohamad defined reputational risk as a separate climate-related risk category. Rahman and Mohamad stated that banks and other financial institutions contribute to climate change by lending to carbon-intensive industries such as fossil fuel extractors and certain manufacturers. As consumer preferences change to prefer products with a lower carbon footprint, Rahman and Mohamad argued that banks that continue to lend to carbon-intensive industries could suffer from reputational damage.

Propagation of Climate-related financial risk Through Transmission Channels

The BCBS (2021) defined climate risk transmission channels as the causal connections through which physical and transition risk drivers can manifest as financial risks to banks and other financial institutions. The BCBS defined these transmission

channels as credit risk, market risk, liquidity risk, operational risk, and reputational risk, emphasizing that these transmission channels all represented existing sources of financial risk to banks. For this reason, according to the BCBS, climate risk drivers do not constitute a new type of risk but rather arise in an institution's financial performance through these existing risk transmission channels. The BCBS further subdivided these channels into microeconomic and macroeconomic channels. Microeconomic channels, BCBS explained, are those through which a bank and its counterparties are affected through negative impacts on operations and financial performance. The BCBS defined macroeconomic channels as those through which broader economic measures such as labor productivity, interest rates, inflation, and foreign exchange are affected, and which can indirectly affect an individual financial institution's performance. The BCBS cautioned that risks transmitted through microeconomic channels can potentially spread to and impact the broader economy.

An important mechanism by which physical risk and transition risk drivers affect a financial institution's risk transmission channels is through the creation of stranded assets. In a report that detailed environmental risks to the agricultural sector in the United Kingdom, Caldecott et al. (2013) defined stranded assets as those that experience unexpected and premature reductions in value, complete write-offs, or conversion from assets to liabilities. Assets can become stranded, according to Caldecott et al., from risk factors such as environmental changes, resource availability, regulations, reduced clean technology costs, and changing social preferences. Van der Ploeg and Rezai (2020) studied stranded assets in the context of climate change transition risks and added to Caldecott et al.'s definition, stating that for an asset to become stranded, there must also

be a degree of irreversibility, or the inability of these assets to be put to alternative economic uses. Van der Ploeg and Rezai identified four types of asset stranding that can occur.

- Stranded carbon consists of fossil fuel reserves that can no longer be burned to produce energy in a low-carbon economy.
- Some physical infrastructure of the fossil fuel industry can become obsolete once the conversion to a low-carbon economy is underway.
- Adverse changes in asset prices can occur in anticipation of future changes in policy, regulation, or consumer preferences.
- Delayed asset stranding can occur when small initial changes in asset prices become more significant once future conditions concerning policy decisions, regulations, and customer preferences are known with more certainty.

Climate-related asset stranding can also occur due to physical, litigation, or other risks. In a review of research on stranded assets relating to environmental changes, Caldecott et al. (2021) discussed the asset stranding that can occur due to physical damage from climate-related natural disasters, litigation, and biodiversity loss. Caldecott et al. stated that stranded assets resulting from physical risk can occur due to weather or disaster-related damage to a company's infrastructure, damage to the infrastructure of their counterparties or supply chains, or reductions in property values due to proximity to sea level rise. An example of the latter could involve a situation in which insurance companies refuse to insure properties susceptible to flood risk from sea level rise, which could then cause deterioration of household balance sheets and losses by banks or investors (Caldecott et al., 2021). This situation has already come to pass in California

and Florida, where insurers Allstate, State Farm, and Farmers discontinued new home and condominium policies in those states in 2022 and 2023 (Sherriff, 2024).

Whether the stranding of assets occurs due to physical damage, the potential for physical damage, or causes related to the transition to a low-carbon economy, the reduction or elimination of the economic value of the stranded asset can exert a negative financial impact on credit unions and other financial institutions that invest in these assets (Caldecott et al., 2021). This impact could be due to a reduction in the ability of a fossil fuel company to repay their loans, a deterioration in the value of an equity investment by a financial institution into such a company, or a loss of customer deposits resulting from changing consumer preferences away from institutions that invest in high-carbon assets. In the next section, models of the propagation of physical and transition risks through a financial institution and into the broader economy are examined.

Transmission of Physical Risk

The impact of physical risk through a microeconomic transmission channel can be observed in a study by Apergis (2023). Apergis studied the effect that weather disasters exert on single and multicounty banks' loan-to-deposit and nonperforming loan ratios. These ratios are viewed as a means by which climate change can increase risk or negatively affect performance, with higher nonperforming loan ratios signaling problems with credit quality and lower loan-to-deposit ratios, indicating lower profitability as fewer loans are made (Apergis, 2023). The study consisted of a regression analysis of regulatory call report data for single and multicounty banks from 1995 to 2018 against a national data set formed by Blickle et al. (2021) that combined data from across the U.S. on disasters large enough to require Federal Emergency Management Agency (FEMA)

assistance with damage cost data from a database called SHELDUS. The SHELDUS database was created by the University of South Carolina and since 2018 has been maintained by the Department of Homeland Security and Arizona State University (Blickle et al., 2021). Apergis found that over a 5-year time horizon, a one standard deviation increase in disaster exposure increased nonperforming loans by about 11% for one-county banks and 15% for multicounty banks and led to decreases in the loan-to-deposit ratio of one-county banks by 10% and 11.5% for multicounty banks. Apergis found the effect was more pronounced when only the largest disasters were considered. In these cases, Apergis found that nonperforming loans increased by 16.5% for one-county banks and 17.5% for multicounty banks while loan-to-deposit ratios fell by 12.2% for one-county banks and 14.1% for multicounty banks. Apergis concluded that weather disasters can negatively impact U.S. banks' financial performance through the channels of the nonperforming loan ratio and the loan-to-deposit ratio.

Nie et al. (2023) analyzed the effect that the increasing severity of natural disasters exerted on the amount of nonperforming loans on a population of banks in the Philippines. Nie et al. found that in the years 2011 to 2018, a 1% increase in the severity of a typhoon, calculated as the ratio of the cost of damages to the country's gross domestic product or GDP, caused a 0.72% increase in nonperforming loans in the year of the typhoon. In the 2 years after the typhoon, the amount of originated loans fell by 1.74% in the first year and 2.26% in the second year(Nie et al., 2023). The combination of the increase in nonperforming loans and the reduction in loan origination activity resulted in an increase in the nonperforming loan ratio of 2.3% 1 year after the typhoon and 2.7% 2 years after the typhoon (Nie et al., 2023).

Another study that analyzed the ways in which increased flood risks could propagate through the financial system was conducted by Mandel et al. (2021). Using a quantitative propagation analysis, Mandel et al. examined how the initial increases in flood risks and losses from floods stemming from climate change amplify themselves through the interdependent systems of complex economies, creating systemic shocks in various countries. Mandel et al. studied two scenarios, each with two variants. The first scenario was one of rapid and emission-intense growth, and the second scenario experienced low-carbon, sustainable growth. Both scenarios were examined by Mandel et al. with a variant in which no flooding adaptations existed and a variant in which flooding adaptations had been made. Mandel et al. found that a significant climate flooding event, in a scenario without climate adaptation, could lead to systemic risks, and that these risks would propagate to higher-income countries, whose degree of financial leverage would magnify the event's systemic impact.

Transmission of Transition Risk

Transition risk is related to losses experienced by firms whose operations and markets are negatively affected by the conversion to a less carbon-based economy (BCBS, 2021; Hofheimer et al., 2022). Semieniuk et al. (2021) analyzed academic research on low-carbon transition risk, developing a new framework to analyze the propagation of transition risk through the financial system. The drivers of low carbon transition risk under the Semieniuk et al. model include governmental mitigation policies, new technologies to enable the transition from high carbon dependency, and changing consumer preferences to products with a low carbon footprint. In the Semieniuk et al. model, these drivers can create higher economic costs for high-carbon industries and their

supply chains, which can then lead to reduced revenues, higher unemployment, loss of income in households employed in these industries, and stranded assets. Semieniuk et al. further stated that these economic costs, along with changes in regulations, impact the financial sector through increases in credit risks, such as higher loan defaults from affected borrowers, equity portfolio losses, and insurance payouts. Losses in the financial sector, according to the Semieniuk et al. model, lead to less available credit and investment in the economy, combined with lower purchasing power by consumers. Ultimately, Semieniuk et al. predicted, using the model, that macroeconomic effects such as increasing inflation, greater wealth inequality, and volatility of foreign exchange rates could result, with feedback loops existing at each model stage.

The Semieniuk et al. (2021) model provides a general framework for how transition risk drivers can materialize in the financial performance of a financial institution through the pressure they exert on the costs and revenues of businesses and households in which financial institutions invest and to whom they loan money. Dunz et al. (2019) also studied the process by which transition risk drivers cause adverse financial risk in banks and other financial institutions but differentiated their analysis depending on the specific source. Dunz et al. analyzed three scenarios by which climate actions can transmit transition risk through the banking sector to the real economy and back to the banking sector. The three scenarios analyzed by Dunz et al. were the introduction of a green supporting factor (GSF); a carbon tax; and a change in expectations of banks about the prospects of their low-carbon and high-carbon clients due to shifting policy and regulation.

Under the Dunz et al. (2019) model, a GSF such as a lower regulatory risk weighting for loans that banks make to customers who are low-carbon emitters could result in lower interest rates for those borrowers relative to higher carbon-producing borrowers since lending to low-carbon companies would boost the banks' risk-weighted capital adequacy ratios. Lower interest rates for these low-carbon companies, according to Dunz et al., could result in lower prices for the products of low-carbon companies, increasing consumer demand for their products. Conversely, Dunz et al. predicted higher interest rates for the high carbon companies could lead to higher relative prices and less demand for their products. Lower demand could result in reduced revenues and cash flow for those companies and higher loan default rates for the banks that lend to them.

Under the Dunz et al. (2019) model, introducing a carbon tax on GHG emissions would work the opposite way. According to Dunz et al., a carbon tax would increase the production costs of the high-carbon companies, thus increasing the prices of their products, thereby reducing consumer demand for their products. Low-carbon companies, experiencing a smaller tax burden would be able to price their products more affordably and increase customer demand for them (Dunz et al., 2019). This process would lead to reduced profitability and cash flow for high-carbon companies, negatively affecting their ability to service their debt.

In the third scenario proposed by Dunz et al. (2019), banks’ sentiments about their clients’ financial prospects considering climate-related policy announcements produce a kind of self-fulfilling prophecy. After a climate policy announcement, banks would assess that the less carbon-intensive companies with which they conduct business would have better future cash flow prospects than those of carbon-intensive companies (Dunz et

al., 2019). According to Dunz et al., banks would offer lower interest rates for the low-carbon companies, which would reduce those companies' debt servicing costs and by extension the prices they can charge their customers. The effect under the Dunz et al. model would be the opposite for carbon-intensive companies that would face higher interest rates and that need to increase prices for their products to maintain profit margins. The transition risk in these scenarios, according to Dunz et al., could arise in the banks' financial risk as either a credit risk from the potential increase in loan defaults or as a market risk if those banks had an equity investment in those carbon-intensive companies.

Some empirical evidence in support of the Dunz et al. (2019) model can be seen in a study by Carbone et al. (2021). Carbone et al. studied the relationship between exposure to transition risk and estimated credit risk of 560 European and American firms using panel regressions of estimated transition risk exposure against credit risk estimates. Carbone et al. used the reported GHG emissions of the 560 firms, emissions disclosure activity, and targeted emissions reductions as indicators of exposure to transition risk. The firms' credit ratings from Moody's and S&P were used as credit risk indicators. Carbone et al. also used the distance to default metric as a second credit risk estimate. They found that firms with higher reported GHG emissions tended to have higher estimates of credit risk as reflected in credit ratings. However, Carbone et al. also found that firms that had more aggressive GHG emissions reduction targets and that voluntarily disclosed data on emissions tended to have lower credit risk estimates. The findings of Carbone et al. appeared to indicate that a firm's exposure to climate-related transition risk results in lower credit ratings for that company, but the reduction in credit rating appears

assisted if the company is making efforts to report GHG emissions and taking action toward reducing carbon dependence.

There is also evidence that climate-related transition risk is beginning to be factored into firms' equity prices by security analysts. Cepni et al. (2024) studied the impact that climate change exposure had on the cost of equity financing to firms. Using daily stock price data from 2010 to 2021, Compustat data for company fundamental statistics, and a climate change exposure index developed by Sautner et al. (2023), Cepni et al. estimated the cost of equity financing for 1,238 firms using the capital asset pricing model. They found that higher exposure to climate-related financial risks, particularly transition risks driven by concerns over future business opportunities, was associated with a higher cost of equity financing. Other related factors that exerted influence on the cost of equity financing were the relative level of public knowledge concerning climate change, the intensity of local climate-related events near the firm, and the financial health of the firm (Cepni et al., 2024). The Carbone et al. (2021) and Cepni et al. studies were focused on the climate-related transition risk of firms across the market. They were not specifically focused on the transition risk of banks and financial institutions stemming from exposure to these firms.

Battiston et al. (2017) analyzed the effect that changing climate policies would have on the financial sector specifically. Focusing on Euro-area banks, Battiston et al. used a network-based methodology to stress test the climate policy risk of Euro-area banks. The Battiston et al. test compared the effect of climate policy on a bank's equity portfolio when its utility investments were completely made up of renewable energy utility companies versus an equity portfolio whose utility investments were completely

based on fossil fuels. Categorizing firms into climate policy-relevant sectors including fossil fuels, utilities, energy-intensive, housing, and transport, Battiston et al. then grouped financial investors by types, including investment funds, industrial companies, banks, insurance and pension funds, individuals, governments, and other financial institutions. Battiston et al. then estimated the direct exposure of these financial actors to climate policy-relevant sectors because of their equity investments, bond holdings, or loans with these sectors.

Battiston et al. found that for banks, the exposure to climate-related transition risk through their equity investments in climate policy-relevant sectors was approximately equal to their capital. Battiston et al. also noted that banks often invest in other banks and financial institutions, exposing them indirectly to the climate-related risks of other financial institutions. A weakness of the Battiston et al. study was the dearth of individual loan data available from these banks. Battiston et al. observed that Euro-area banks had relatively little equity exposure and that their exposure to climate-related transition risk through their loan portfolios was likely much greater.

Estimating Credit Union Exposure

The studies examined so far have not had credit unions as their primary focus. Only one identified study by Hofheimer et al. (2022) focused specifically on the exposure of U.S. credit unions to risk from climate change. Hofheimer et al. estimated the exposure of U.S. credit unions to climate-related physical risk by first using the FEMA National Risk Index (NRI) to identify counties across the U.S. that were at risk of climate-related natural disasters or events. These counties were then cross-referenced against credit union locations and branch locations to determine which credit unions might have operations in

at-risk areas (Hofheimer et al., 2022). To estimate a dollar amount of risk exposure, Hofheimer et al. used the June 2021 call report data with mortgage data collected in compliance with the Home Mortgage Disclosure Act (HMDA). Using this methodology, Hofheimer et al. found that there are over 11,000 credit union branches located across 668 counties representing $1.2 trillion in credit union assets at risk due to acute and chronic climate-related events.

Hofheimer et al. (2022) also estimated the climate-related transition risk faced by U.S. credit unions. Hofheimer et al. identified credit unions whose field of membership consisted of employees of petroleum refining, manufacturing, and utility companies. Hofheimer et al. found that credit unions with these membership profiles represented about 6% to 7% of federally chartered credit unions. Dividing the assets of those credit unions by the total assets of all federally chartered credit unions, Hofheimer et al. estimated that $141 billion in credit union assets are exposed to transition risks.

Hofheimer et al. (2022) noted several limitations of their study which they believed could have led to them underestimating the physical and transition risk exposure of U.S. credit unions. The data available from the regulatory call reports did not report assets at the branch level and, therefore, the Hofheimer et al. study proportionally allocated assets among branches, potentially resulting in an over or underestimation of assets exposed to physical risk in specific counties. Hofheimer et al. also noted that data in the HMDA database is not all-inclusive, as not all credit unions are required to report data to it. A limitation of the transition risk exposure estimation in the Hofheimer et al. study was that only about half of all credit unions are required to report their fields of

membership. Hofheimer et al. reported that these limitations could have resulted in inaccuracies and underreporting of exposure.

Climate change has become an emerging risk to global financial stability (FSOC, 2021). The past 10 years have experienced the hottest global average temperatures since tracking of that statistic was begun in 1850 (NOAA NCEI, 2024b). Along with rises in global average temperatures, the cost of climate-related natural disasters has also risen, with the number of natural disasters in the United States causing $1 billion or more in damage rising to 28 in 2023 (NOAA NCEI, 2024a). The TCFD (2017) classified climate-related financial risks into physical and transition risks. Physical risks represent the risk of financial loss stemming from direct damage to facilities and operations from climate-related natural disasters and indirectly from losses in asset valuations due to actual or anticipated climate damage (TCFD, 2017). Transition risk represents the risk of financial losses due to the transition to a low-carbon economy (TCFD, 2017). Both physical and transition risks can result in losses due to the creation of stranded assets, which are assets that experience unexpected and premature reductions in value, complete write-offs, or conversion from assets to liabilities (Caldecott et al., 2013). The propagation of physical risk due to events such as flooding can appear as an increase in the nonperforming loan ratio, a decrease in the loan-to-deposit ratio, and a decrease in the number of loan originations (Apergis, 2023; Nie et al., 2023). An estimate of U.S. credit union exposure to physical risk is about 11,000 branches representing $1.2 trillion in assets (Hofheimer et al., 2022). Transition risk can come from governmental policies, new technologies, and changing consumer preferences, in addition to GFSs such as lower risk weightings for loans to companies with green operations (Dunz et al., 2019; Semieniuk et al., 2021).

There is evidence that credit and equity markets are factoring transition risk into their assessments of companies with higher GHG emission firms receiving lower credit ratings and higher costs of equity financing (Carbone et al., 2021; Cepni et al., 2024). Hofheimer et al. (2022) estimated that $141 billion in credit union assets are exposed to transition risks. The responses of U.S. and international regulators to emerging climate-related financial risk are detailed in the upcoming section.

Regulatory Actions and Recommendations

As stated earlier in this literature review, the decisions of leaders of banks and credit unions are strongly influenced by their governmental regulators. Governmental regulators are, in turn, influenced by the prudential frameworks developed by the BCBS (Sato, 2024). Writing about the history of the BCBS, Sato (2024) explained that there are two prudential pillars of financial regulation: regulation and monetary policy. Regulations are administered by the regulatory authorities of a country while monetary policy is administered by central banks. Sato further explained that while monetary policy is the primary purview of central banks, prudential regulatory policy is also beginning to come under their influence as more attention is focused on the stability of financial systems. Thus, the actions of both regulators and central banks can influence the behavior of financial institutions regarding climate-related financial risk.

Actions of U.S. and International Regulators

Climate-related financial risk began to be addressed by banking and financial industry regulators when the BOE (2015) published its report, *The Impact of Climate Change on the UK Insurance Sector.* According to Caldecott et al. (2021), who studied the evolution of climate change regulation, many other supervisory and regulatory bodies

called for climate stress tests and other reporting in the following years to help protect the solvency of individual institutions. These included European regulators such as Banque de France and the Dutch Central Bank, the European Central Bank, the Monetary Authority of Singapore, and the Australian Prudential Regulation Authority (Caldecott et al., 2021). The development of the TCFD, according to Caldecott et al., helped to complement this increased regulatory focus, and eventually, the BOE and New Zealand required their use in disclosing climate-related risks. Caldecott et al. reported that regulators focused on four key areas: governance (risk actively managed by senior management and boards), risk management, scenario analysis, and disclosure.

In the United States, the FSOC (2021) acknowledged in *Report on Climate-Related Financial Risk* that the increase in climate-related natural disasters has a direct impact on the stability of the financial system, necessitating greater regulatory scrutiny and internal risk analysis. In December 2021, the Office of the Comptroller of the Currency (OCC, 2021), the regulator of U.S. national banks and federal savings associations, requested public commentary on a general framework for managing interest rate risk at banks with assets exceeding $100 billion. The framework put forth by the OCC called for bank boards to understand climate-related financial risks and to define their risk appetite related to these risks. The OCC framework also advised banks to incorporate climate-related risks into policies, procedures, and risk limits. The incorporation of climate-related risks into strategic planning, risk monitoring and measurement, and data collection was also emphasized by the OCC. Finally, the OCC encouraged banks to begin climate-related scenario analysis, evaluating the effect of different paths taken by the economy toward a low-carbon transition. Acting Comptroller

of the Currency, Michael Hsu (2021), provided insight into how the OCC planned to roll out climate-related guidance to U.S. banks under its supervision. Regarding the timing of the rollout of new climate-related guidance, Hsu stated that larger banks would be evaluated first since they have larger and more complex issues and that medium and small banks would be evaluated subsequently. Hsu further stated that smaller institutions should use the time to begin getting prepared.

In April 2022, the FDIC (2022) published for public comment a set of draft principles to establish a high-level framework for climate-risk management for banks with assets greater than $100 billion. The proposed framework called for climate-related risks and information to be factored into an institution's governance, policies, procedures, strategic planning, risk management, reporting, and scenario analysis (FDIC, 2022). The FDIC recommended that institutions utilize climate-related physical and transition risk data in their credit underwriting and liquidity management. The FDIC further stated that the framework should examine climate-related impacts on legal and compliance matters and other nonfinancial issues.

On October 24, 2023, the Board of Governors of the Federal Reserve System, the FDIC, and the OCC issued joint guidance for large banks regarding a framework for safe and sound management of climate-related risk (OCC, 2023). This guidance was largely in keeping with earlier, independently issued guidance from the three bodies with some changes related to commenter feedback (OCC, 2023). These changes included clarifications regarding U.S. operations of foreign banks and confirmation of the lack of any specific guidance on compensation policies (OCC, 2023).

Despite the joint guidance being aimed at banks with assets above $100 billion, Weinberger (2023) found that many leaders of community-sized banks were concerned that regulators would expect them to comply as well. Concerns were expressed to Weinberger that regulators would attempt to use the guidance to dissuade banks from lending to certain industries due to climate risk exposure. In a comment that is indicative of the large influence exerted by regulators on banks, one interviewee of Weinberger stated that the mere fact that regulators are telling banks to evaluate the climate-related risks of their clients will impact their credit decisions.

In March 2024, the U.S. Securities and Exchange Commission ([SEC], 2024) announced that it would begin to require companies under its supervision to disclose in their annual reports and other SEC filings any material climate-related risks and related information. These disclosures are to include any climate-related material risks impacting strategy and financial condition along with the actual or estimated impact. The SEC also required disclosure of risk mitigation activities. The SEC required reporting of costs and capital expenditures from carbon offsets or energy credits, along with a discussion of how reporting assumptions were impacted by uncertainties stemming from climate-related risks.

Regarding U.S. credit unions, the NCUA (2023) requested public commentary on many topics related to how credit unions were evaluating their exposure to climate-related financial risk. The NCUA's request for information sought commentary on how credit unions incorporated climate-related financial risk into organizational areas such as operations, risk management frameworks, interest rate risk, credit risk, and transactional risk. The NCUA's request for information also asked for commentary on how prepared

credit union managers and board members were to address these questions. State-level regulators such as Washington State Department of Financial Institutions director Charlie Clark (2021) also began to ask that financial institutions under their supervision begin incorporating climate-related financial risk into their risk management procedures and strategic plans. A summary of the focus of regulatory authorities concerning climate-related financial risk appears in Table 2.1. Most regulators have a similar focus on governance, scenario analysis, and disclosure of risks, but have provided only limited requirements.

Table 2.1

Focus of U.S. and International Regulators Concerning Climate-Related Financial Risk

Region	Regulator(s)	Focus of recommendations
Europe	Bank of England Banque de France Dutch Central Bank	Governance Risk management Scenario analysis Disclosure (TCFD for reporting)
Asia and Pacific	Australian PRA Monetary Authority of Singapore New Zealand	Governance Risk management Scenario analysis Disclosure (TCFD for reporting)
United States	Office of the Comptroller of the Currency Federal Deposit Insurance Corporation	Joint guidance (October 2023) Banks with assets > $100 billion Governance Risk management Scenario analysis Credit underwriting Liquidity management
United States	Securities and Exchange Commission	Disclosure of material climate-related risks Impact estimates Risk mitigation activities Spending on carbon offsets
United States	National Credit Union Administration	Request for public commentary Operations Risk management frameworks Interest rate risk Credit risk Transactional risk

Note. Adapted from the BOE (2015), Caldecott et al. (2021), NCUA (2023), OCC (2023), and SEC (2024).

The Role of Central Banks and Monetary Policy

Arguments have also been made for central banks to help mitigate climate-related risks in the banking industry. Advocating for central banks and regulators to maintain an active role in mitigating climate-related financial risk and promoting green banking, Schellhorn (2020) asserted that part of the U. S. Federal Reserve's mandate is to preserve

the financial system stability. Schellhorn stated that since climate change represents a significant risk to financial system stability, it falls within the legal mandate of the Federal Reserve to promote more sustainable banking practices to mitigate climate-related financial risk. Schellhorn's argument was also based on the precedent that the Federal Reserve has used its statutory power in the past to purchase assets to stabilize the financial system.

Brainard (2019), Federal Reserve governor, made a similar argument stating that for the Federal Reserve to promote financial system stability, it will need to factor climate-related financial risk into its monetary policy, better understand the propagation of climate-related systemic shocks, and study the disproportionate effect that climate-related financial risk exerts on low- to middle-income populations. Brainard understood climate-related financial risks by regulators as being no different from understanding the risks of cyberattacks or the factors that caused the Great Recession.

Skinner (2021) cautioned against the Federal Reserve moving too aggressively to influence bank behavior concerning climate-related financial risk. Incorporating legal analysis of Federal Reserve history and its statutory mandate, Skinner advised that the Federal Reserve did not possess the legal mandate to take actions to deter banks from lending to high-polluting business sectors or to favor greener sectors. Skinner argued that this type of action would damage the Federal Reserve's credibility and perception of independence. In addition, Skinner stated that this type of activity by the Federal Reserve could have unintended consequences, such as high-polluting companies seeking financing outside of the banking system. Skinner advised that a better course for the Federal Reserve would be to remain defensive in posture relative to climate change,

leveraging its role as lender of last resort, engaging in dialogue with banks on asset quality and climate stress testing, and engaging in research.

Ozdemir (2023) expressed concern that many of the recommendations put forth by regulators would take too long to become effective, pointing out that simpler risk measures for which data were already available had taken decades to perfect. Ozdemir also argued that by taking action on an institution-by-institution basis, some banks would be disadvantaged by competitive pressures for short-term returns while climate-related risks propagate over a longer time horizon. Ozdemir argued that the solution to this problem was to front-load climate and other ESG-related (environmental, social, and governance) risks into the capital charge of a loan. To accomplish this, Ozdemir recommended introducing industry and purpose modifiers into the return on equity calculations for a bank's loans, which would increase the required return, or interest rate, on loans to companies that are high users of GHG emissions relative to those that are not. The purpose modifier would have the effect of reducing the capital charge to loans made for climate mitigation purposes (Ozdemir, 2023). In this way, high-polluting companies could benefit from investing in carbon-reducing measures. Ozdemir stated that the effective way to set these modifiers would be centrally by a governmental regulator. The conflicting views of Skinner (2021) and Ozdemir (2023) reflect the tension between the need to maintain a democratic rule of law and the need for fast results in reducing GHG emissions.

In a study on how banking regulatory authorities can encourage banks to finance the transition to a low-carbon economy, Hubert and Hilke (2024) distinguished what they called managing prudential climate risks from the process of mobilizing transition

finance. Hubert and Hilke acknowledged that regulatory authorities cannot by themselves incentivize banks to take steps toward financing a low-carbon economy transition, taking a position similar to that of Skinner (2021). However, some actions regulatory authorities could take now include encouraging dialogue with counterparties on the impacts of climate change on strategies and operations, promoting public-private partnerships to reduce transition finance risk, and having banks explain how risk assessments impact transition financing decisions (Hubert & Hilke, 2024).

Park and Kim (2020) studied the progress of the transition to green banking in the financial services industry in developed and undeveloped countries, identifying barriers to progress both at the institutional level and the sector level. At the institutional level, they identified several barriers to progress including a lack of monitoring capabilities, high costs of short-term funding, high perceived risks of undergoing the transition, and a lack of understanding of the opportunities involved in green banking transition such as climate adaptation finance. At the sector level, they cited a lack of regulatory frameworks as a key impediment, along with inadequate economic incentives and limited access to affordable financing. Differentiating between developed and undeveloped economies, Park and Kim noted that central banks in countries with developing economies have been mandating green banking changes while central banks in developed countries have enacted a voluntary and market-driven approach. This insight concurs with current statements from U.S. regulators, who have encouraged financial institutions under their supervision to begin adapting their strategic and operational processes for climate change but have not implemented actual regulatory requirements to date. It is thus up to financial

institutions to determine how best to assess their climate-related financial risk exposure, report to their stakeholders, and adapt strategically.

Both financial regulatory agencies and central banks have expressed positions on how financial institutions should address climate-related financial risk. Recommendations by U.S. regulators have been consistent. Most regulators have expressed a need for financial institutions to begin data collection on their exposure to climate-related financial risk and that this process should already be underway (Clark, 2021; FSOC, 2021; NCUA, 2023). Regulators also emphasized that financial institutions should begin to incorporate climate-related financial risk into their strategic and operational decisions (Clark, 2021; FSOC, 2021; NCUA, 2023). While regulators have not so far provided any specific regulatory requirements regarding climate-related financial risk, they have sought commentary from practitioners on the status of existing preparedness (NCUA, 2023). Leaders of the FRB and other researchers have also expressed the need for the central bank to begin considering climate-related financial risk when making monetary policy decisions (Brainard, 2019; Schellhorn, 2020). However, this position is not universally held, with Skinner (2021) expressing concerns about unintended consequences and the perception of a lack of impartiality at the FRB. Hubert and Hilke (2024) similarly argued that rather than actively mobilizing transition finance, regulatory authorities could encourage dialogue with counterparties, promote public and private partnerships to ease the burden of economic transition, and help banks to explain the effects of risk assessments on transition finance. U.S. regulatory agencies have thus agreed on the importance of gathering data on exposure to climate-related financial risk and incorporating climate-related financial risk into organizational decision making but

have not provided specific regulatory guidance on how to accomplish these tasks. With much of the consensus having been on the need for the gathering of data and reporting, standards and best practices for these activities will be reviewed in the next section.

Reporting and Other Standards

To more effectively and consistently measure both physical and transition risk, organizations representing partnerships of financial institutions, international organizations, central banks, and others have collaborated to create common reporting standards. The World Economic Forum listed risk identification, risk measurement, and risk integration as three components of an effective climate risk management strategy for financial institutions (Vikas, 2024). One means of estimating the level of transition risk faced by a financial institution was to use metrics such as the green ratio, which is a ratio of loans made for environmentally friendly economic activities versus total loans (Vikas, 2024). Another recommendation by the World Economic Forum was for financial institutions to estimate the amount of GHG emissions they generate and finance through lending and investing activities (Vikas, 2024). Understanding the level of GHG emissions that a financial institution creates through its financing and investing activity is important for measuring exposure to transition risk (PCAF, 2022).

The Greenhouse Gas Protocol, developed by the World Resources Institute and World Business Council on Sustainable Development (2004), sets the international standards for how firms of all types can report the GHG emissions they generate. Using this protocol, the PCAF developed a set of methodologies specifically for use by financial institutions including commercial banks, credit unions, development banks, investment banks, insurance companies, and assets management firms (PCAF, 2022). These

methodologies have provided a standard for how financial institutions can measure the contribution they make to GHG emissions through activities such as making loans to and investing in GHG-emitting organizations and consumers (PCAF, 2022). The use of these standards is becoming more commonplace throughout the world, with 506 institutions as of July 2024 representing $85.6 trillion in financial assets either committing to or already reporting GHG emissions using the PCAF methodology (PCAF, n.d.).

Measuring GHG emissions, according to the University of Oxford (n.d.), is important because the Paris Agreement has set a worldwide goal of net zero GHG emissions by 2050. In the context of climate change science, net zero refers to a situation in which all GHG emissions by humans into the atmosphere are offset by an equal amount of GHGs that are removed (Levin et al., 2023). Removal of GHGs can occur through something naturally occurring, such as the expansion of forests, or through technology such as direct carbon capture and storage (Levin et al., 2023). To avoid the worst effects of climate change and to comply with the Paris Agreement, GHG emissions must be reduced by half by 2030 and be fully net zero by 2050–2060 (Levin et al., 2023).

Dennis and İşcan (2024), researchers on staff at the Federal Reserve, proposed a five-tier transition risk metric based on pairing a country and a specific industry or business sector. The new metric introduced by Dennis and İşcan would be ascertained by determining an emissions factor for the country/business sector pair by dividing their level of GHG emissions by their level of output and then comparing that figure to a 25th percentile emissions factor for that business sector globally. Dennis and İşcan's metric would also measure the degree to which an individual country/sector is either converging

or diverging from that global factor. There are five levels to the Dennis and İşcan (2024) metric:

- Level T1: indicates no gap between the country/sector emissions factor and the global emissions factor
- Level T2: indicates a low emissions factor that is converging toward the frontier
- Level T3: indicates that there is a low emissions factor that is nonconverging
- Level T4: indicates a low emissions factor gap that is diverging from the frontier
- Level T5: indicates a high emissions factor

While this metric is new, it seems the simplicity of the ranking system and the fact that it accounts for movement either toward or away from levels of risk seen globally could help researchers who are comparing the level of transition risk companies in a portfolio.

The European Union has also established standards and requirements for sustainability reporting. The Corporate Sustainability Reporting Directive (CSRD) was announced in April 2021 and will go into effect in 2024 for reporting in 2025 (KPMG), 2024). According to KPMG, the directive covers approximately 49,000 companies and requires disclosure in annual management reports of several ESG topics. These topics include business models and strategies, key performance indicators, and risk and opportunity management (KPMG, 2024). The CSRD is in alignment with TCFD standards, and it will require forward- and backward-looking data across a company's value chain (KPMG, 2024).

The Committee of Sponsoring Organizations (COSO) of the Treadway Commission established in the early 2000s is an integrated reporting standard used to help organizations comply with the requirements of the Sarbanes-Oxley Act (Johnson & Wong, 2023). In March 2023, COSO published guidance for how organizations could use these internal reporting control principles to report on ESG issues (Johnson & Wong, 2023). Like the original reporting control standards, the principles were based on five components: control environment, risk assessment, control activities, information and communication, and monitoring activities (Johnson & Wong, 2023). Examples of the application of these five components to ESG reporting included the creation of incentives related to ESG goals, analysis of ESG risks and opportunities for the organization, and integration of ESG risks into the organization's enterprise risk management (ERM) program (Johnson & Wong, 2023).

Many reporting standards and protocols on climate-related financial risk have been developed. The PCAF (2022) was arguably the most relevant to banks and credit unions due to its methodologies for estimating the GHG emissions embedded in a financial institution’s portfolios of loans. However, others, such as the transition risk metric developed by Dennis and İşcan (2024), could become useful in the future. The European Union’s CSRD, which became operational in 2024, will require approximately 49,000 companies to disclose information related to ESG matters (KPMG, 2024). Within the United States, the guidance from COSO on the use of its reporting standards to report on ESG risk provides another set of standards by which companies can report climate-related financial risk (Johnson & Wong, 2023). To properly report on GHG emissions and, more broadly, adapt risk management programs to address the risks of climate

change, credit unions must determine how climate-related events could adversely impact their financial performance. Both physical risk and transition risk affect the financial performance of credit unions through the traditional banking risk transmission channels, including credit, valuation, and market risk (Hofheimer et al., 2022). Credit unions must adapt their risk management policies and procedures concerning these types of traditional risk channels to understand how they may be impacted by the adverse effects of climate change. The next section explores how the practice of financial risk management, including the management of risk transmission channels such as credit, liquidity, and market risk, has developed at credit unions.

Credit Unions in the United States

Within the United States, credit unions are member-owned, democratically controlled financial cooperatives whose purpose is to provide a source of credit to individuals of modest means (FCUA, 1934/2022). The FCUA allows members to form and operate their credit unions under the one-person, one-vote principle. Under the FCUA, credit unions can be organized under three charter types: common bond, multiple common bonds, or community. This study focused specifically on community-sized credit unions, defined in this study as a credit union of any charter type with fewer than $10 billion in total assets. This definition matches how the Federal Reserve defines a community bank and should allow for future comparison of credit unions to banks (Board of Governors of the Federal Reserve System, 2021).

The Federal Credit Union Act

The FCUA (1934/2022) defines the legal and operational framework of federally chartered credit unions in the United States. Credit unions are member-owned and

operate under the principle of one member, one vote. Members elect a board of directors annually to oversee the activities of the credit union. Under the Act, credit unions are permitted to make loans to members subject to certain restrictions on maximum interest rates and terms to maturity, and they can issue shares, share drafts, and certificates of deposit. Members may have both loan and savings accounts, same as they would with banks.

The FCUA as amended through 2022 allows for three types of membership structures. The single common-bond credit unions under the FCUA are comprised of members who work in the same occupation or have a single common association. Under the multiple common-bond charter, the FCUA allows members from more than one common group or association but with numerical limitations on the number of members from each common group. A community credit union charter under the FCUA permits all people living in a well-defined community to become members.

Due to their cooperative, not-for-profit structure, credit unions are exempt from federal, state, and local taxation (FCUA, 1934/2022). L. Marshall and Pellerin (2017) reported that this tax-exempt status has been criticized as credit unions have grown within the financial system with critics complaining that the exemption provides an unfair competitive advantage versus commercial banks. According to L. Marshall and Pellerin, proponents of the tax exemption,have argued that the credit union's mission is to provide financial services to people of modest means and that these tax savings can be passed to these members in the form of higher deposit rates, lower loan rates, or additional services. In a study of how the savings from the credit union tax exemption are allocated among key stakeholders, Deyoung et al. (2022) found that most of these tax savings to

credit unions were passed on to credit union members in the form of more favorable interest rates on loans and deposits. However, Deyoung et al. also pointed out that doubt has emerged as to whether credit unions are truly serving members of modest means since credit union members have higher average incomes than bank customers. While the debate over the justification for the credit union tax exemption is likely to continue, the exemption remains a distinction between banks and credit unions as of the time of this study.

The legal and operational characteristics of credit unions as outlined in the FCUA differentiate them from banks in terms of their primary mission and optimal pricing behavior (D. J. Smith, 1984). The cooperative structure of credit unions has also influenced their growth and development along with their financial stability in times of economic crisis (Ewerhart & Zubrickas, 2019; Kane & Hendershott, 1994; McKillop & Wilson, 2015).

Management Decision-Making in Credit Unions

Taylor (1971) proposed a theoretical framework for credit union operations that was built on the economic theory of cooperative organizations as put forth by Robotka (1947) and Kaarleiito (1956). The economic theory of cooperatives, according to Taylor, is that a cooperative is a subsidiary of its members, existing to help them meet their own unique economic and social objectives rather than possessing an economic objective of its own. Thus, Taylor stated, the cooperative acts in a manner that is most beneficial to its membership. Taylor concluded that since credit unions are member-owned financial cooperatives, their incentive structure differs from that of banks, which are focused on profit maximization for their shareholders.

D. J. Smith (1984) agreed, finding in a study of decision making in credit unions that it was the cooperative nature of credit unions, where their owners were also their consumers, that negated the profit maximization model in favor of one in which the goal is maximization of the net gain of membership. Under D. J. Smith's framework, the credit union's decisions on setting interest rates are based upon the inherited balance sheet from the prior period, operating costs, the regulatory environment, and the borrower/saver preference of the credit union. Rubin et al. (2013) updated the D. J. Smith model, adding a dynamic, intertemporal element whereby the optimal loan interest rates, deposit interest rates, and level of retained earnings are allowed to fluctuate from one period to another.

Effect of Credit Union Size on Financial Performance

Taylor (1971) proposed that credit unions could operate differently based on their number of members. When credit unions are small, Taylor stated, there is much social interaction among members, and they are likely to be more inclined to help one another. As the credit union grows, according to Taylor, this familiarity would be reduced. Taylor explained that at this stage, the credit union would more closely resemble a typical business, with greater potential for conflict among members with competing priorities.

Since the initial proposal of this idea by Taylor (1971), several researchers have studied how credit union membership requirements and charter types affect their financial performance. Ely (2014), Emmons and Schmid (1999), and Esho et al. (2005) studied the effect that changes in membership requirements and diversification exerted on credit union financial performance and risk. These researchers explored decision making and financial risk management in credit unions from the perspective of how these items

are affected by credit unions' cooperative structure, membership requirements, and fee structure. Emmons and Schmidt studied the effect that changes in credit union charter requirements had on the formation and consolidation of credit unions. Using the Herfindahl Heisenberg Index (HHI) to determine market share based on the number of deposits, Emmons and Schmidt found that, all things being equal, the enrollment rate of members in credit unions decreased as potential fields of membership increased in size. However, these rates of enrollment, or participation, in credit unions were found by Emmons and Schmidt to rise in specific areas with higher concentrations of deposit accounts among fewer financial institutions. Emmons and Schmidt concluded that credit unions did experience economies of scale in their operations as their membership size increased.

In a study that explored the effect that higher concentrations of noninterest revenues exerted on the risk of financial institutions in Australia, Esho et al. (2005) used risk measures such as degree of total leverage, probability of bankruptcy, and the coefficient of variance on earnings to examine credit union performance. Esho et al. found that credit unions could benefit from economies of scale as membership size increased and that these benefits could extend beyond cost containment and into risk reduction. However, Esho et al. also noted that credit unions that had higher proportions of revenue coming from noninterest sources—such as fees had lower returns as measured by return on assets, and greater volatility in those returns as measured by the standard deviation of return on assets—than those credit unions with lower proportions of noninterest revenue to total revenue. Esho et al. also found that credit unions with a higher portion of their interest income coming from residential loans and a lower

proportion of their interest income coming from personal loans tended to have more favorable risk metrics.

Ely (2014) explored the impact of regulatory changes and changes in types of fields of membership (multiple common bond and community charters) on credit union risk. Two risk measures were used by Ely in the study. The first measure was the probability of bankruptcy, also known as a Z-score, which represented the number of standard deviations of return on assets below the mean return on assets at which a credit union's net worth is depleted. The second measure was the probability of exhausting regulatory capital, expressed as the number of standard deviations of return on assets below the mean return on assets at which the credit union would breach regulatory capital requirements. Ely found that the risk of bankruptcies and regulatory capital problems increased in credit unions with broader fields of membership. However, these risks declined as the size of the credit unions increased. Ely also found that switching from single common bond membership types to more broad membership types added risk. The increase in risk tended to stem from higher volatility in earnings coupled with lower levels of return on assets and net worth ratios. Switching from single common bond membership types to more broad membership types increased both risk measures used in the Ely study. Ewerhart and Zubrickas (2019) also studied why cooperative financial institutions tend to be more resilient in times of financial crisis. Ewerhart and Zubrickas found that financial cooperatives with members who prefer fair social treatment of fellow members were less exposed to unanticipated shocks relative to institutions dedicated to serving members with more selfish motives. Ewerhart and Zubrickas found that this

effect was lessened as common bond requirements were relaxed, or the institution increased in size.

Gomez-Biscarri et al. (2021) studied the effect that increasing business loan originations exerted on the level of risk and depositor behavior in credit unions in the United States. Using quarterly call report data from 1994 to 2014 for credit unions with greater than $50 million in assets, Gomez-Biscarri et al. found that an increase in business lending could be related to lower credit union net worth in following years. Gomez-Biscarri et al. also found a correlation between higher levels of business loans and lower levels of deposit and loan growth in later periods.

The studies by Ely (2014), Emmons and Schmidt (1999), Esho et al. (2005), and Ewerhart and Zubrickas (2019) suggested that credit unions' cooperative, member-owned form can act as a mitigant to financial risks. However, as credit unions increased their number of members, broadened their fields of membership, or increased the diversity of their product offerings, these risk mitigations appeared to lessen. Kane and Hendershott (1994) illustrated this idea. They found that the NCUSIF remained solvent during the savings and loan crisis of the 1980s while the FSLIC and FDIC had to be returned to solvency using taxpayer money. Kane and Hendershott estimated the market value solvency of the NCUSIF by using call report data from 1987 to 1990 and using opportunity cost (discounting by the implied market values of various loan and investment types) analysis on each credit union's balance sheet. They then estimated the cost to the insurance fund of the economically insolvent credit unions, along with the probability of future costs of currently solvent credit unions. Kane and Hendershott attributed the ability of the NCUSIF to remain economically solvent to several factors

unique to credit unions including the closer link between members provided by the common bond requirements. In addition, membership requirements, according to Kane and Hendershott, prevented expansion into risky product lines and set limits on how quickly credit unions could grow. Kane and Hendershott asserted that all these factors contributed to credit unions being less exposed to the risks that were the cause of the savings and loan crisis.

Climate Risk Mitigation at Credit Unions

Though academic researchers and regulators are signaling that climate change is an emerging financial risk, little research has been conducted on what credit unions are doing to mitigate this risk. Existing research seems to indicate that credit unions are in the very early stages of adaptation. Hofheimer et al. (2022) conducted a series of interviews with 20 U.S. organizations including credit unions, trade associations, industry experts, and other related stakeholders to ascertain the level of preparedness of credit unions for climate change. The interviews revealed that, generally, credit unions were in the very beginning stages of adapting to climate change. Respondents reported that most efforts had focused on increasing the efficiency of internal operations to reduce energy usage and waste. The credit unions that Hofheimer et al. interviewed were generally reactive in their stance toward climate-related financial risk and tended to focus analytical efforts on specific weather events. Hofheimer et al. reported a general sense that regulatory action or some agreement about the approach was needed before significant action could be taken. While recommendations that individual banks and credit unions measure their risk from climate change, no researchers aside from Hofheimer et al. have attempted to show what individual banks and credit unions are doing in practice. Hofheimer et al.

recommended that credit union leaders looking to begin preparing for climate-related risk should acknowledge as an organization that climate change represents a balance sheet risk, begin educating themselves through research, collect climate-related data, adopt the TCFD recommendations, conduct climate scenario analysis, leverage partnerships, and initiate communication with other credit unions leaders and stakeholders.

While few studies have addressed specifically the preparedness of credit unions for adaptation to climate change, several studies have examined banks in the United States and abroad. Tsanacas (2024) provided insight into how 20 banks in the second Federal Reserve District, consisting of the states of New York, Connecticut, and New Jersey, perceived and responded to extreme weather risks due to global warming. The Tsanacas study was conducted via a survey with multiple-choice responses in which more than one answer could be made. All the participants in the Tsanacas survey expressed concern about the impact of increasing extreme weather events on their operations and on their asset and investment valuations, and about 90% of the respondents reported increased monitoring of mortgage concentration in areas at high risk for extreme weather damage. Approximately 30% of the participants reported being involved in risk assessment activities, 20% of the respondents reported disclosing climate-related financial risk in their external bank documents, and just 10% were involved in climate risk stress testing (Tsanacas, 2024). Some participants in the Tsanacas study had established climate-related working groups whose goal was to incorporate climate risk into strategic decision making. Some participants also mentioned sectoral geographic risk reviews, monitoring of loan concentrations in high-risk areas, and modified enterprise-wide risk statements (Tsanacas, 2024). A major challenge

identified by the participants in the Tsanacas study was the lack of available weather and exposure-related data. While the number of banks surveyed is small, Tsanacas did successfully obtain responses from banks on what they are currently doing relating to climate-related financial risk.

A study by Oh and Kim (2023) provides an example of an analysis of responses to climate-related risk using publicly available data. Oh and Kim studied the strategic decisions and choices of community banks with fewer than $1 billion in assets that had recently experienced flooding events. Three possible strategic choices in response to increasing flood risk were evaluated in the study. One option evaluated was whether the affected banks took steps to increase their capital safety net, as measured by their Tier-1 capital levels one to four quarters after the flooding event. A second potential option for the affected banks was an increase in their loan portfolio diversification, which was evaluated by calculating the HHI for each bank's loan portfolio. A third option, greater geographic diversification, was estimated by Oh and Kim using the number of bank branches. The study found that the banks evaluated did employ the strategies of safety net increase (core capital increase) and loan portfolio diversification, but both were to a small degree, according to Oh and Kim. The authors did not find much evidence of branch expansion in the face of flood risk.

Of the literature surveyed, the only study that focused specifically on the actions of credit union leaders to address climate-related financial risk was the Hofheimer et al. (2022) study. Other studies, such as those by Oh and Kim (2023) and Tsanacas (2024), focused on banks. Moreover, the majority of the studies surveyed were based on quantitative analysis, often employing regulatory reporting data. The Hofheimer et al.

study was the only one surveyed that interviewed credit union leaders. The scarce amount of credit union-centric literature concerning the adaptation to climate-related financial risk constituted a gap in the academic literature. This gap was addressed in this study using semistructured interviews to more deeply explore how credit union leaders define climate-related financial risk and to identify how they are analyzing it and making organizational changes to address it.

Summary

The topic of this study was the experiences of finance and risk professionals at community-sized credit unions and the adaptation, or lack of adaptation, in their organizations to account for climate-related financial risks. The literature reviewed for this study included peer-reviewed journal articles, publications from financial services industry specialists, and studies conducted by financial regulators. The review also contained information from the Code of Federal Regulations and information from the databases of scientific organizations such as the NCEI, which were used in some of the surveyed academic studies. Information and guidance from international governments and banking regulators were included in the review due to the research that these organizations have conducted outside of academia and because of the influence that these organizations exert over the activities of banks and credit unions. Two theoretical frameworks that guided the study were also overviewed. Through the creation of the FSSD, Broman and Robèrt (2017) established the criteria by which any development can be considered sustainable and produced a four-step process by which organizations can achieve sustainable development . Willard (2012) then developed the SDF, which was the second theoretical framework used. Using the SDF, Willard established a five-stage

journey by which organizations progress from a state where they are flouting environmental regulations to one in which sustainability is a core value of the organization.

Academic and scientific researchers have shown that global average temperatures are rising and that climate change is causing significant monetary damage. The year 2023 was the warmest year on record, and the 10 warmest years since such records began to be kept in 1850 have occurred since 2014 (NOAA NCEI, 2024b). Also in the year 2023, the United States experienced 28 natural disasters costing $1 billion or more (NOAA NCEI, 2024a). Researchers from both regulatory and academic circles have identified climate change as a new risk to financial institutions and the stability of the financial system as a whole (Artha, 2024; Clark, 2021; FSOC, 2021; Hofheimer et al., 2022).

In 2015, world governments and regulators began to organize and classify climate-related financial risks. The G-20 that year tasked the FSB to study how the financial sector could better account for climate-related risks (FSB, 2015; G-20, 2015). The result was the creation of the TCFD, which, in 2017, issued its first set of recommendations for climate-related risk disclosure and categorized climate-related financial risks into two broad types: physical risks and transition risks (TCFD, 2017). Physical risks entailed the risk of damages from either acute climate-related natural disasters, such as floods, severe storms, and wildfires; or chronic climate-related phenomena such as sea level rise and rising average temperatures. Transition risks pertained to the financial risks from the global shift to a low-carbon economic system (TCFD, 2017).

Physical and transition risks emerge as financial risks to banks and other financial institutions through transmission channels, which the BCBS identified as credit risk, market risk, liquidity risk, operational risk, and reputational risk. These transmission channels all represent existing sources of financial risk to banks (BCBS, 2021). An important mechanism by which physical risk and transition risk drivers affect a financial institution's risk transmission channels is through the creation of stranded assets, which are assets that experience unexpected and premature reductions in value, complete write-offs, or conversion from assets to liabilities (Caldecott et al., 2013). The reduction or elimination of the economic value of the stranded asset can exert a negative financial impact on financial institutions that invest in these assets (Caldecott et al., 2021). A study of single and multicounty banks in the United States found that a one standard deviation increase in exposure to flooding disasters increased nonperforming loans by as much as 17.5% and decreased the loan-to-deposit ratios of the affected banks by as much as 14.1% (Apergis, 2023). Another study by Mandel et al. (2021) found that a significant climate-related flooding event, in a scenario where no climate adaptation had been undertaken, could lead to systemic risks, and that these risks would propagate to higher-income countries, whose degree of financial leverage would magnify the event's systemic impact. Semieniuk et al. (2021) analyzed low-carbon transition risk, developing a new framework to analyze the propagation of transition risk through the financial system. In the Semieniuk et al. model of transition risk, drivers such as governmental mitigation policies, new technologies, and changing consumer preferences can create higher economic costs for high-carbon industries and their supply chains, which can, in turn, lead to reduced revenues, higher unemployment, loss of income in households employed

in these industries, and stranded assets. There is evidence that these transition risks are beginning to be factored into the credit ratings and asset prices of firms exposed to them (Carbone et al., 2021; Cepni et al., 2021).

Credit unions in the United States are similar to banks in the United States in that they can take deposits from their members, pay interest on those deposits, and make loans (FCUA, 1934/2022). However, they differ from banks in that they are owned by their members and their primary objective function is maximizing the utility of those members (D. J. Smith, 1984). Credit unions' cooperative, member-owned format can act as a mitigant to financial risks, but as credit unions increase their membership, broaden their fields of membership, or increase the diversity of their product offerings, these risk mitigations appear to lessen (Ely, 2014; Emmons & Schmid, 1999; Esho et al., 2005; Ewerhart & Zubrickas, 2019). Estimates of the exposure of U.S. credit unions to physical and transition risk from climate change are limited in number, with just a single study by Hofheimer et al. (2022) focusing exclusively on them. Hofheimer et al. estimated that $1.2 trillion in credit union assets were at physical risk from climate change and that $141 billion in credit union assets were exposed to transition risks. Hofheimer et al. conducted a series of interviews with 20 U.S. organizations including credit unions to ascertain the level of preparedness of credit unions for climate change. The findings of the Hofheimer et al. interviews revealed that generally credit unions were in the very beginning stages of adapting to climate change.

Banks in the United States appear to be in the early stages of adapting to climate-related financial risk as well, with one study reporting only 30% of bank participants being involved in risk assessment activities, 20% of the respondents disclosing climate-

related financial risk in their external bank documents, and just 10% being involved in climate risk stress testing (Tsanacas, 2024). Another study found that the banks evaluated increased their core capital safety net and increased their loan portfolio diversification but only to a small degree (Oh & Kim, 2023).

As global average temperatures increase and climate-related natural disasters increase in frequency and intensity, financial institutions are coming under pressure to adapt their risk management policies and procedures in response. Both financial system regulators and academic researchers are recommending that banks and credit unions begin data collection on their exposure to climate-related financial risk and incorporating climate-related financial risk into their strategic and operational decisions (Clark, 2021; FSOC, 2021; NCUA, 2023). Credit unions, being member-owned, and having a primary objective function of maximizing member utility, have some distinction from banks, whose primary objective is profit maximization for their shareholders. Historically, this differentiation appears to make the financial performance of credit unions less volatile in times of financial stress, though as credit unions become larger and more complex, this effect appears to decrease. Despite this historical distinction, there is a dearth of literature detailing how credit union risk management professionals are adapting their institutions to address climate-related physical and transition risk. This study builds upon the work of Hofheimer et al. (2022) by addressing this gap in the literature and providing insight for credit union risk management professionals as they move forward in their efforts to adapt to climate-related risks. In Chapter 3, the choice of methodology, design, method of data collection, and process of analyzing the data in the study are covered.

CHAPTER 3: METHODOLOGY

The topic of this study was the experiences of finance and risk professionals at community-sized credit unions and the adaptation, or lack of adaptation, in their organizations to account for climate-related financial risks. Both academics and professionals emphasize the need for financial institutions to identify and quantify these risks. However, few researchers have explored what credit unions are doing to measure these risks.

The purpose of this qualitative basic study was to explore how finance and risk professionals at community-sized credit unions in the states of Washington, Oregon, and Idaho incorporate climate-related financial risk into risk-management programs. The study addressed how credit union risk management professionals define climate-related financial risk in the context of other financial risks, explored what actions these professionals are taking or are planning to take at their credit unions to measure these risks, and reported on the progress they are making toward adaptation of policy, governance, and other organizational changes in response to climate-related financial risk.

The central question explored by the RQs is how finance and risk management professionals working at community-sized credit unions in the Pacific Northwest region of the United States are adapting their risk management policies, procedures, and analytical processes to address the emerging financial risks of climate change.

The RQs were:

RQ1: How do finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations?

RQ2: What actions are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest taking or planning to take to measure the financial risks from climate change?

RQ3: What progress are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest making on policy, governance, or other organizational changes in response to climate-related financial risk?

In this chapter, the processes for identifying study participants, collecting data, and analyzing that data are explained in detail. The qualitative research methodology is described along with the rationale for its use in this study. Several qualitative designs are then overviewed, along with a rationale given for the selection of the basic design for use in this study. Identification and selection of participants is covered, along with the precautions taken to protect their identity and confidentiality. The process of analysis of the gathered data, including the software used for transcribing interviews and techniques for identifying themes in interview transcripts, are provided. The study limitations, delimitations, and biases were identified, and ways by which the trustworthiness of the analysis can be maintained are discussed.

Research Method

The qualitative methodology with a basic design was used for this study. The qualitative methodology was selected based on the fit between the RQs being addressed

and the characteristics of each methodology. The three research methodologies (qualitative, quantitative, and mixed methods) differ in terms of their process of reasoning and their underlying ontology and epistemology (Creswell & Creswell, 2022; Guba & Lincoln, 1994; Merriam & Tisdell, 2015). These variations in worldviews drive differences in how each research methodology is conducted.

Punch (2016) advised allowing the RQs to drive the selection of the study's methodology. The RQs in this study involved exploring how the credit unions' finance and risk professionals are adapting their organizations to address the risks of climate change, how they define those risks, and what progress has been made toward adaptation. The analysis of data proceeded inductively from the responses of specific participants to the creation of more general conclusions upon analyzing the full set of interview data.

The nature of the RQs pointed to a qualitative methodology as being the most appropriate. Creswell and Creswell (2022) explained that researchers should use a qualitative methodology when their RQs require the exploration of processes and procedures in a natural setting and utilize information coming from multiple data sources. Creswell and Creswell further stated that qualitative research proceeds inductively from specific ideas to the general and is focused on exploring how individuals and groups make meaning in specific situations. C. Marshall et al. (2022) similarly stated that qualitative research is context-focused, centered in the natural world, and interpretive. Another feature of qualitative research is the idea of the researcher as a primary instrument in the study—spending time in the environment of the subject of the research conducting interviews, gathering written data, and interpreting data (Merriam & Tisdell, 2015). Since the analysis proceeds inductively, the RQs were focused on the perceptions

of credit union finance and risk professionals, and interviews were the means of data gathering, the qualitative methodology made the most sense.

A quantitative methodology was less appropriate to the RQs in this study. Quantitative research is a methodology that Creswell and Creswell (2022) described as a process of testing objective theories or the relationships between variables. Quantitative research proceeds deductively, proposing an initial hypothesis that is tested using a research instrument, ultimately concluding that the data either supports or does not support the initial hypothesis (Creswell & Creswell, 2022). Data for a quantitative study is normally numeric and is collected through an instrument such as a questionnaire or survey that asks closed-ended questions (Creswell & Creswell, 2022). In this study, the RQs were not seeking to evaluate a relationship between variables. Moreover, an initial hypothesis requiring testing was not being advanced. Rather, the RQs and the interview questions (Appendix A) were open-ended, allowing conclusions to be reached inductively through an analysis of the responses. For these reasons, a quantitative methodology was not appropriate.

A mixed methods approach, such as an exploratory sequential design, was also not be appropriate for the RQs of this study. Creswell and Creswell (2022) recommended a mixed methods approach when integrating qualitative and quantitative techniques would yield additional insights over choosing one methodology or the other. There are several ways to design mixed-methods research. An exploratory sequential design, for example, uses quantitative research as a means of testing data revealed by a qualitative study (Creswell & Creswell, 2022). Since the goal of this study was not to confirm any of the qualitative findings, this type of design was not appropriate.

Research Design

Within the qualitative methodology, a variety of research designs exists. Research designs vary in terms of how they collect data, the types of data they collect, the time it takes to conduct the study, and the position of the researcher in relation to the participants (Creswell & Creswell, 2022; Guba & Lincoln, 1994; Merriam & Tisdell, 2015). For this study, the basic qualitative design was used. Merriam and Tisdell explained that basic qualitative research has at its core the epistemological position that the meaning of a phenomenon is constructed through human engagement. Because of this epistemological underpinning, they stated, basic qualitative research concerns the interpretation of experiences and how humans construct their world. Worthington (2013) added that the basic design seeks to uncover the experiences of participants and develop an understanding of processes. The RQs in this study were designed to aid in the understanding of how the participants define climate-related financial risk in the context of their current risk management programs and what adaptations are being made. In addition, a second research objective was to understand and uncover any new processes that have been put in place by the participants. Since the goal of the study was to understand the experiences of the participants and the processes involved, the basic qualitative design was a good fit for this study. A basic qualitative design is characterized by the use of purposeful sampling in the selection of participants (Patton, 2002). In the next section, the process of identification and selection of participants is described.

Participants

The target population was finance and risk management professionals working at community-sized credit unions in the states of Washington, Oregon, and Idaho. The

primary reason for the choice of this geographic area was that I live and work in a credit union in one of these states and interact with credit union professionals from all three states. However, the three states also possess a large variety of climates and geographies, exposing them to many climate-related risks and potential impacts, including wildfires, droughts, flooding, and heatwaves (USDA Climate Hubs, n.d.). Financial and risk management professionals were defined by this study as individuals who manage or analyze corporate financial risk and performance, including financial forecasting, cash flow analysis, liquidity analysis, interest rate risk management, credit risk management, pricing, and investment management. Because the target credit unions could differ in the number of employees and resources available, the focus was on functions performed rather than job titles. Participants could have either a management or a nonmanagement role. While the function of the participants' role is more important than their job title, it was expected that typical job titles of participants could include but not be limited to financial analyst, credit analyst, risk analyst, asset liability management analyst, financial manager, lending manager, vice-president of finance, chief financial officer, and chief executive officer.

According to Callahan and Associates (n.d.), 149 community-sized credit unions, those with assets less than $10 billion, were headquartered in the three states targeted by the study. Twenty to 25 participants were targeted, representing at least 15 unique credit unions. While a minimum of 15 credit unions were sought to be included, the actual number of credit unions participating was 17. All but one of the credit unions had one participant, while one credit union had two participants in the study, making the total

number of participants 18. The level of participation was sufficient to achieve code and meaning saturation (Hennink et al., 2017).

Participants for the study were selected using a purposeful sampling approach. Purposeful sampling, according to Patton (2002), is a defining aspect of qualitative methodologies and is characterized by the intentional selection of information-rich cases from which a large amount of in-depth information can be gleaned. For the purposeful selection of participants in the study, convenience and snowball sampling techniques were used. Convenience sampling is a technique in which participants for a study are chosen based on being close to the researcher due to location or ease of access (Whitehead et al., 2020). Convenience sampling for this study involved the recruitment of credit union risk management personnel who were in my professional network. Members of my professional network were also asked for referrals to additional credit union risk management professionals for recruitment. This technique of asking for referrals from current participants is known as snowball sampling (Whitehead et al., 2020).

For credit unions whose finance and risk management professionals exist outside my professional network, targeted attempts were made to recruit participants on professional social media sites such as LinkedIn and from regional groups for bank and credit union professionals such as GoWest Credit Union Association. For these participants, a recruiting e-mail and phone script were utilized to notify and attract participants. These materials are included in Appendices B and C, respectively. All participants were required to complete a consent form, which is in Appendix D.

Data Collection

The data for the study were gathered by using individual, semistructured interviews of participants and by analyzing any public reporting made by the credit unions regarding their adaptations to climate-related financial risk. The interviews were recorded and transcribed. The data from the interviews were coded, analyzed for common categories, and grouped into themes. These categories and themes are discussed in connection with the RQs with which they were associated.

Interviews are one of the primary means of obtaining data for a qualitative study. (Creswell & Creswell, 2022; C. Marshall et al., 2022; Punch, 2016). An advantage of semistructured interviews is that a consistent set of questions can be asked across multiple sites (Creswell & Creswell, 2022; C. Marshall et al., 2022). Also, within the context of the initial set of questions, follow-up questions can be asked of the participants to gain additional context (C. Marshall et al., 2022). By conducting semistructured interviews, I also elicited historical information and perspectives that were not evident in direct observation or reading of documents (Creswell & Creswell, 2022). For these reasons, data for the study were collected using individual semistructured interviews with the study participants.

Since travel to the participants' locations was not practical, the online meeting software, Microsoft Teams, was used for remote interviews and recorded in both audio and video format. Having both video and audio recordings allowed the analysis of facial expressions and other nonverbal cues to aid in contextual understanding (Creswell & Creswell, 2022). However, in the actual implementation of the study, the analysis of facial features and nonverbal cues was not undertaken. The interviews were recorded on

Microsoft Teams . Microsoft Teams has an automated transcription feature that generates a written transcript of the speech in the recording. While these transcriptions required editing, the automated transcription saved time.

The individual interviews were semistructured, with the questions being open-ended to allow for elaboration and follow-up questions. Questions were based on the RQs of the study. The same questions were given to each of the interview participants, though follow-up questions differed depending on the individual participant's responses. Interviews took 30–60 minutes. Steps such as the use of an alphanumeric code in place each participant's name were taken to ensure the confidentiality of the credit unions, the participants, and the member data of the credit unions.

Data Analysis Methods

The raw data collected in the semistructured interviews was organized, analyzed, and interpreted. The analysis of this data was undertaken using a five-step process described by Creswell and Creswell (2022): (1) organizing and preparing the raw data, (2), reading the data thoroughly, (3) coding the data, (4) developing categories and major themes, and (5) interpreting and describing the major themes. The information uncovered by interpreting and describing these major themes was used to provide answers to the RQs.

Data Analysis

Analysis of the collected data first involved either transcribing or cleaning up a recorded transcription of the interviews. The automatic transcription feature of Microsoft Teams or similar virtual meeting software saved time, but it was necessary to clean up the generated interview transcripts, removing speech fillers, extraneous words, unnecessary

headings generated by the software, and other items that could distract from the data analysis. In addition, manual notes taken during the interviews were typed and appended to the transcripts. This organization and clean-up process eased the later steps of the data analysis. Prior to analyzing the interview transcripts, a transcript accuracy check was conducted to ensure that the transcript accurately captured the interviewees' meaning, views, and beliefs about the items discussed in the interviews. An interview transcript was supplied to each participant, along with a cover letter asking the interviewee to review the transcript and indicate any areas requiring corrections, updates, or improvements. A sample of the transcript accuracy check cover letter is included in Appendix E. Only one participant returned a transcript with modifications and corrections. In this case, the corrected transcript was used for analysis.

Upon confirming the accuracy of the transcripts, the interview transcripts were read several times. Interesting or important passages were identified. The goal at this stage was to get a general sense of the data that are in the interview transcripts and what meaning they had (Creswell & Creswell, 2022). Notes and comments were made in the interview transcripts that helped form the basis for the next stage of the analysis.

Open coding of the interviews was then used to establish patterns in the data. Open coding is a process of giving names and labels to significant phenomena found in the data (C. Marshall et al., 2022). This is done by bracketing notable parts of the interview text and assigning a short description (Creswell & Creswell, 2022). In this study, the words of the interview participants were used to form the code descriptions, a type of coding called in vivo coding (Creswell & Creswell, 2022; C. Marshall et al.,

2022). As this open coding process unfolded, codes were organized in a code book and defined.

Related codes, or those with commonalities, were then grouped into specifically identified categories in a process called axial coding (C. Marshall et al., 2022). Finally, categories were grouped into broader themes. Assigning categories helps identify the commonalities between individual codes that have been identified, while themes are meant to help identify an "essence" that runs through the interviews (Morse, 2015). As the major themes emerged, interpretations of the meaning of the data from the interviews were made, which then addressed the RQs. As an example of axial coding, interview responses concerning data collection could be grouped into in vivo codes, such as information from vendors, lack of data for planning, and lack of data mining resources. These in vivo codes were then grouped into a category called "data availability," which then became part of a theme of concern from credit unions about data challenges limiting the potential impact they exert on the climate change problem.

A research study has credibility when it instills confidence in the truth of its findings (Lincoln & Guba, 1985). To establish credibility in this study, a transcript accuracy check was conducted with the interview participants. This process served as a means of member checking. Member checking is a process of gathering feedback from a study's participants about the data collected, along with the interpretation and hypotheses regarding that data (Guba & Lincoln, 1989). The process of member checking, according to Guba and Lincoln, is the most critical technique to ensure credibility.

Transferability is enhanced by presenting data using thick description, a technique that dives deep into the reasoning for the conclusions being made (Lincoln & Guba,

1985). Thick description in this study consisted of a thorough comparison of the interview responses across the participating credit unions, as well as a comparison of how the participants define climate-related financial risk and adapt their risk management processes for it. The discussion of the interview findings and the themes emerging from these responses is detailed in Chapter 4, while the analysis of these findings appears in Chapter 5.

Limitations and Biases

Limitations of a study pertain to the research methodology and design chosen and are constant over time, meaning that future researchers using the same methodology and design will experience the same limitations (Miles, 2019). Biases can emerge in a research study due to the background and experience of the researcher (Creswell & Creswell, 2022). The effect of researcher bias can be mitigated, according to Creswell and Creswell, through a reflexive process of acknowledging the values, background, and experiences of the researcher, which might influence interpretations of the information. While the study interviews and analysis were conducted, notes were kept for the purpose of further identifying potential biases, tracking the rationale for analytical decisions, impressions of the interviewees, and other notes on the progress of the study.

While steps were taken to ensure the confidentiality and anonymity of respondents, some respondents may still have been reluctant to allow full disclosure. A related limitation was the amount of knowledge that the participants had about the posture of their credit union toward climate-related financial risk. For example, a credit union's response to climate-related financial risk might be addressed by organizational teams not comprised of finance and risk management staff. Efforts were made to include

the actual individuals involved in addressing climate-related financial risk at these credit unions, but the potential remained for key individuals to be missed, especially in organizations operating in a close-to-the-vest manner or using external consultants.

Another limitation was the level of understanding that participants had concerning climate-related financial risk. While academic research on the financial risk from climate change has produced some consistent definitions, the finance professionals interviewed were not always aware of these definitions and may have had their own interpretations. To mitigate this, the study contained interview questions that asked participants to discuss how they view climate-related financial risk. In this way, these varying levels of understanding could be made to further inform the study findings.

The focus of the research was finance and risk managers at community-sized credit unions located in the states of Washington, Oregon, and Idaho in the Northwestern United States. I am employed as the director of finance at a community-sized credit union in Washington, precisely the type of position and organization under study. This created the potential for bias in designing interview questions, interpreting written information, and drawing conclusions. I mitigated this bias risk by neutrally questioning interviewees with open-ended questions designed to bring out their points of view and did not include my organization in the sample selected. I was cognizant of the risk of asking leading questions and made efforts to avoid doing so.

Delimitations

Delimitations are boundaries set for the study over which the researcher has direct control and define the scope of the study (Miles, 2019). The first major boundary of this study was that it was restricted to credit unions with assets of less than $10 billion. The

second boundary in this study was the geographical boundary of the three specified states. A third boundary was the restriction to finance and risk management professionals working in these institutions.

All three of these boundaries could limit the generalizability of the study to other financial institutions. The restriction to credit unions of a relatively small asset size could have resulted in the discovery of best practices or challenges unique to credit unions of this size, which would not necessarily be pertinent to larger credit unions and banks. The geographic restriction could have resulted in the emergence of physical and transition risks that are specific to the weather and climate conditions of the Pacific Northwest region but may be different from other regions of the United States and the wider world. The restriction to risk management personnel excludes the perspectives of other types of managers, such as information technology professionals, facilities managers, and others whose perspectives, while not steeped in risk expertise, could nonetheless be useful.

Summary

This study explored how finance and risk management professionals at community-sized credit unions in the states of Idaho, Oregon, and Washington are adapting their risk management programs to address climate change. The study used a basic qualitative design, with the data being collected using semistructured interviews. Seventeen unique credit unions were included for the study, with 18 individuals interviewed. Interviews were recorded and transcribed using Microsoft Teams.

The interview data collected were analyzed using the five-step process of Creswell and Creswell (2022): (1) organizing and preparing the raw data, (2), reading the data thoroughly, (3) coding the data, (4) developing categories and major themes, and (5)

interpreting and describing the major themes. Open coding was used to give names to significant facts uncovered in the interview data and to establish patterns. Axial coding was then used to combine related codes into categories and form the basis for establishing themes.

There were several potential limitations of the study, including the level of knowledge of the participants about climate change and about what their credit union is doing to address climate change. Another limitation was the potential reluctance of individuals to discuss frankly the actions their credit unions are taking regarding climate change, possibly due to concerns about confidentiality. Finally, researcher bias could have presented a limitation as I am also a finance and risk professional at a credit union in the region.

There were three delimitations of the study. The first was that it was delimited to credit unions with total assets of less than $10 billion. The second was a geographical restriction of credit unions being headquartered in the states of Idaho, Oregon, and Washington. The third delimitation was the restriction to finance and risk management professionals. These delimitations had the potential to limit the generalizability of the findings to geographical areas outside of the three states included in the study or to financial institutions of a larger size.

CHAPTER 4: FINDINGS

This basic qualitative study explored how finance and risk management professionals working at community-sized credit unions in the Pacific Northwest region of the United States are adapting their risk management policies, procedures, and analytical processes to address the emerging financial risks of climate change. Both academics and professionals emphasize the need for financial institutions to identify and quantify these risks. However, few researchers have explored what credit unions are doing to measure these risks. The FSSD and the SDF were used as the theoretical frameworks to guide the study. The conditions required for development to be considered sustainable are defined by Broman and Robèrt (2017) in the FSSD. Willard (2012) identifies in the SDF the five progressive stages by which an organization arrives on the path to sustainability (Willard, 2012). The study's RQs were:

RQ1: How do finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations?

RQ2: What actions are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest taking or planning to take to measure the financial risks from climate change?

RQ3: What progress are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest making on policy, governance, or other organizational changes in response to climate-related financial risk?

The qualitative methodology with a basic design was used for this study. The qualitative methodology was selected based on the fit between the RQs being addressed and the characteristics of each methodology. Creswell and Creswell (2022) advised the use of a qualitative methodology when data are obtained from multiple sources, the RQs are designed to explore processes and procedures in a natural setting, and data analysis proceeds inductively from specific ideas to general. Within the qualitative methodology, a basic design was chosen. Merriam and Tisdell (2015) stated that basic qualitative research concerns the interpretation of experiences and how humans construct their world. Worthington (2013) added that the basic design is used to uncover the experiences of participants and develop an understanding of processes. Since the RQs in this study were developed to explore how the participants defined climate-related financial risk and identify new processes that participants have put in place or are considering putting in place, the basic qualitative design was a good fit for the study.

The data for the study were gathered using individual, semistructured interviews. There were 11 interview questions. During the interviews, additional follow-up questions were asked to stimulate further discussion and expand on relevant topics. The interviews were recorded and transcribed using Microsoft Teams, an application commonly used by credit union professionals. After the interviews, copies of the transcripts were sent to the participants, who were given the opportunity to make corrections and clarifications. One participant did make some minor corrections, and that version of the transcript was used for data analysis. To protect the identity of the participants, each was assigned an alpha-numeric code in the form of “Pxx,” where the

"P" stood for "participant" and "xx" represented the participant number. Thus, P01 was participant number one. Participants are numbered P01 through P18.

Presentation of Findings

The findings from the semistructured participant interviews are presented in this section. The process of participant selection is discussed first, along with some characteristics of the participants, including information on their state of residence, educational background, experience in risk management, and number of years residing in the Pacific Northwest. Data analysis procedures used in the study are then reviewed, followed by a detailed discussion of each theme revealed during the interviews. Five major themes were identified.

Participant Selection and Characteristics

Participants for the study were recruited from my professional network, referrals from individuals in my professional network, targeted prospecting on professional social media pages such as LinkedIn, and regional professional groups such as the GoWest Credit Union Association. A total of 18 individuals representing 17 credit unions participated in the study. At the outset of participant recruitment, there were a total of 149 credit unions with assets less than $10 billion headquartered in Idaho, Oregon, and Washington. Attempts were made to contact all 149 credit unions. Of the 153 credit unions on the initial list, a successful connection was made with 74 of them. Of that number, 18 individuals agreed to be interviewed. With 17 unique credit unions represented, 11% of the total number of credit unions in the region are present in the study. Table 4.1 shows the breakdown of participant recruitment.

Table 4.1

Study Recruitment Breakdown

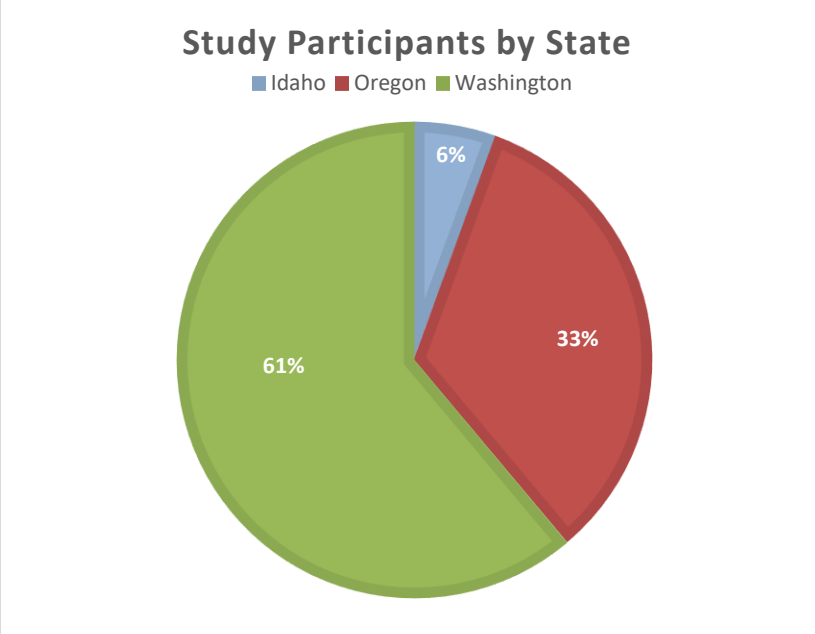
Contact stage	Number
Credit unions in the target region	149
Attempted contact	149
Successfully contacted	74
Agreed to participate	18
Unique credit unions	17
Percentage participating	11%

Note. Attempted contact indicates the identification of an individual at the target credit union and an attempt made to establish contact. Successfully contacted indicates that contact information for the individual was received, and a study recruitment attempt was made to the individual.

The 18 participants represented all three states in the targeted region of the study, with 61% of the participants coming from Washington, 33% from Oregon, and 6% from Idaho. Figure 4.1 illustrates the representation of the participants by state.

Figure 4.1

Study Participants by State



The participants had a wide range of experience in financial services, credit unions, and the discipline of finance and risk management. The participants averaged just over 22 years in financial services, with just under 13 years of average experience occurring specifically at credit unions. The participants had, on average, been with their current credit union for just under 8 years and averaged 20 years of work in the finance and risk management disciplines. Table 4.2 shows the high, low, and average amounts for these participants' experience.

Table 4.2

Participant Experience Distribution

	High	Low	Average
Years in financial services	40.0	3.0	22.1
Years working in credit unions	29.0	2.0	12.9
Years at current credit union	22.0	0.3	7.8
Years in financial or risk management	40.0	4.0	20.0

The participants had all attained at least a bachelor's degree. Eight of the participants had progressed beyond a bachelor's degree, with some earning master's degrees, and some qualifying as certified public accountants (CPA), which requires education beyond a bachelor's degree. Table 4.3 shows the distribution of the participants' highest level of educational and professional certification attainment.

Table 4.3

Participant Education Distribution

Highest level of degree or certification	Number
Bachelor's degree	10
MBA	1
Other master's degree	2
CPA	3
Juris doctorate	1
MBA plus other master's degree	1

All the participants had lived in the Pacific Northwest region of the United States for at least 9 years, with 10 having lived there for their entire lives. One participant

reported being born in Washington and then living in multiple states but did not give a precise breakdown of the years spent in each state. The distribution of the amount of time the participants had resided in the Pacific Northwest is shown in Table 4.4.

Table 4.4

Distribution of Number of Years Lived in the Pacific Northwest

Time in the Pacific Northwest	Participants
All my life	10
Multiple states	1
Greater than 15 years	2
10 to 15 years	4
Less than 10 years	1

Note. Source (Interview data, this study)

Figure 4.2 shows a word cloud visualization of the primary job responsibilities reported by the participants. Eleven respondents reported financial risk management as one of their primary job responsibilities. These responsibilities included managing liquidity, interest rate risk, and investment risk. Four participants primarily managed lending and credit risk. Two participants reported accounting and financial reporting as their primary job responsibility but stated that they also managed the financial and reputational risks stemming from those responsibilities. One participant was responsible for compliance and fraud risk. Six participants, who were higher-ranking managers, described strategic planning and budgeting as part of their responsibilities in addition to balancing the needs of the credit union with the needs of members.

Figure 4.2

Visualization of Participant Job Responsibilities

Data Analysis

The participant interviews were recorded and transcribed, with a copy of the transcriptions being provided to the participants. Once the interviews were completed, the data were analyzed using a five-step process described by Creswell and Creswell (2022): (1) organizing and preparing the raw data, (2), reading the data thoroughly, (3) coding the data, (4) developing categories and major themes, and (5) interpreting and describing the major themes. The information uncovered by interpreting and describing these major themes was used to answer to the RQs. The process of analyzing and coding the interview data was iterative, requiring several passes through the data to arrive at a satisfactory number of codes and categories. First, each interview was read several times, and the responses were summarized using the participants' own words, a process known as in vivo coding (Creswell & Cresswell, 2022). Next, an additional level of

subcategories was created to help organize the large number of in vivo codes that emerged. The subcategories were then grouped into categories. Five themes emerged during the reading of the data and were assigned at the in vivo code level, meaning that some categories were placed under multiple themes. In total, 446 in vivo codes emerged that were grouped into 126 subcategories that, in turn, made up 19 categories.

Categories and Themes

The five themes emerging from the interview data are listed in Table 4.5. The five themes were direct risks, indirect risks, data challenges, no policy or procedural changes, and financial institution and government responses. All the themes were supported by at least two categories.

Table 4.5

Themes and Categories

Theme number	Theme	Category	Number of codes
1	Direct risks	Trend of climate change	18
		Climate-related credit risk	28
		Physical and operational risk	15
		Reputational risk	2
2	Indirect risks	Insurance	42
		Climate-related systemic risk	23
3	Data challenges	Data availability	18
		Data locations	11
		Data integrity	9
		Collaborative data Gathering	15
		Artificial intelligence	4
		Data—personnel	7
		Time and prioritization	9
		Types of data	13
4	No specific policy or procedural changes	Time and prioritization	5
		Strategic planning	36
5	Financial institution and governmental responses	Green lending	92
		Public sector role	22
		Credit risk and operational Adaptations	51
		Organizational adaptations	26
	Grand total		446

Note. Source (Interview data, this study).

The five themes are described in Table 4.6. The themes emerged from the responses to various questions, and there were many instances when individual in vivo codes within a subcategory would apply to different themes. The category of time and prioritization, for example, contains subcategories and in vivo codes that cross themes, with nine appearing under Theme 3 and five appearing under Theme 4.

Table 4.6

Theme Descriptions

Theme number	Theme name	Theme description
1	Direct risks	Losses and other risks stemming directly from climate-related events
2	Indirect risks	Losses and other risks not stemming directly from a climate-related event, but rather from another source that has been affected by climate-related events.
3	Data challenges	Challenges related to the availability, integrity, interpretation, type, use, or prioritization of climate-related data.
4	No specific policy or procedural changes	The absence of any climate-related changes to organizational policies and procedures.
5	Financial institution and governmental responses	Actions being contemplated or taken by credit unions, either alone or with government aid, to address climate-related risk.

Note. Source (Interview data, this study)

Primary Financial Risks Managed

Participants were asked in the interviews to describe the primary financial risks that they managed at their credit unions. These were not risks that were tied specifically to climate change. Rather, these risks represent the most significant risks that the participants believed they had to manage day to day, regardless of the cause. While participants were allowed to list more than one risk, 16 participants reported the combination of liquidity risk, credit risk, and interest rate risk. Two participants reported cybersecurity and fraud risk, while two others mentioned the risk of losing depositors.

Pricing was another risk identified by two participants. Table 4.7 shows the full list of primary risks identified by the participants.

Table 4.7

Primary Financial Risks Managed by Study Participants

Type of risk mentioned	Number reporting
Liquidity risk, credit risk, and interest rate risk	16
Cybersecurity and fraud	2
Loss of depositors	2
Pricing	2
Balancing the needs of membership with the needs of the credit union	1
Expenses	1
Health of the membership segment	1
Nonmember deposits	1
Portfolio concentration	1
Reputation and succession	1
Staying relevant	1

Note. Some participants reported more than one risk.

The BCBS (2021) listed credit risk, market risk, liquidity risk, operational risk, and reputational risk as transmission channels through which climate-related financial risk can manifest in financial performance. Three of these transmission channels are named by the study's participants as risks that they already manage. While none of the study participants used the term "transmission channels" or mentioned the BCBS, many of the climate-related risks discussed by participants during the interviews were related to these channels. In the next five sections, each theme is addressed in detail.

Theme 1: Direct Risks

During the semistructured interviews, participants were questioned on how the primary risks that they manage could be affected by climate change and how climate-related risks could affect their members. The responses fell along two major lines. The first consisted of impacts to primary risks that were a direct result of climate-related events such as hurricanes or forest fires. Examples of these direct risks included credit risk from collateral damage, physical impacts on credit union operations, and reputational risks. These risks were grouped under a common theme and are addressed in this section. The second major response line consisted of impacts to primary risks that emerged indirectly from effects on members, insurance costs and availability, and propagation of climate impacts through the larger economy. These indirect impacts on primary risks were grouped under a separate theme and are discussed in the next section.

Seventeen of the 18 participants spoke of at least one direct risk to their credit unions that would be affected by climate-related events. The participant who did not mention a direct risk being affected by climate change did mention climate-related risks from indirect sources, which are discussed in the next section. Four categories were represented within Theme 1. The categories were the trend of climate change, climate-related credit risk, physical and operational risk, and reputational risk. A list of the categories making up Theme 1 and the number of participants mentioning each category is shown in Table 4.8.

Table 4.8

Breakdown of Categories in Theme 1

Category	Number reporting
Trend of climate change	8
Climate-related credit risk	15
Physical and operational risk	8
Reputational risk	1
Participants reporting at least one category	17

Note. Source (Interview data, this study). Some participants spoke to more than one category.

The following sections first address participants' views on the trend of climate change and either their credence or skepticism concerning the threat it poses to credit unions and their members. Climate-related credit risk, reputational risk, and physical and operational risk are then discussed in detail. Within climate-related credit risk, the risk to agricultural lending is specifically broken out since five participants brought it up during their interviews.

Trend of Climate Change

Of the eight participants who commented on the trend of climate change, two participants expressed skepticism that climate change or climate-related events represent an immediate threat to credit unions. One reason for this view was the perception that climate change occurs over a long period of time, allowing credit unions time to adjust. P11 stated:

> In order for [climate change] to really present an immediate risk, it would have to be an immediate change. With climate change, which generally happens very slowly or over decades, we're able to change the risk of our portfolio and modify our underwriting procedures. So … we would naturally adjust if risk was presented. Like, for instance, what if temperatures went way up and people didn't want to live here anymore and they started moving away? And our … average

> mortgage only lasts for 7 years anyway. Even if it's a 30-year mortgage, people refinance. So, it would gradually change based on risk parameters and pricing over time. Well, that's going to take 50 years for that to gradually occur. So, I can't think of any scenario where a change in climate could happen rapidly enough to have any significant risk.

P10 believed that not enough is yet known about climate change to be able to say for sure whether it is not just a short-term phenomenon:

> I think if we're looking at things that are specifically related to climate change, the reliability of the data and the amount of data available, I think, is limited … so what's hard to really say is [whether] what we're experiencing right now [is] anecdotal versus part of a larger trend? And we've only had accurate weather-type reporting for 100 years, 150 years.

Participants who were not skeptical about the risk to credit unions from climate change also recognized the presence and reasons for skepticism among their peers. P16, who recognized the risks from climate change and climate-related events, acknowledged that it is easy to view climate change as "that slow walk that no one's paying attention to because it seems to be so slow." When discussing possible responses to climate change, P04 noted, "There may also be a little bit of denial too, because [of the question of] whether or not climate change is something that we know [is] impacting us. But is it that important, or should we just be adapting?"

Six participants viewed climate change and climate-related risk as presenting a much more immediate threat to credit unions and believed that climate-related events are already having an impact. Some of this belief was due to the locations and intensity of recent events. P04, discussing the January 2025 fires in Los Angeles, stated, "You know when the fires happened down in Los Angeles? We know that those are climate-related, right? We didn't have that kind of fire before." P01 noted, "I grew up here, and you know, I don't remember even hearing about fires. Way back in the day, that wasn't even

a concern." P16 thought that the impact of climate change could be "huge, especially if the events themselves, the frequency of them, continue to increase." P14 stated similarly, "If this continues on the track it's on with global warming, I think it's going to become more and more to the head. … [These types] of fires and large natural events can't keep going as things are now."

Climate-Related Credit Risk

Participants reported that climate-related events and climate change could impact credit risk to their organizations in several ways. A common concern expressed by the participants was the risk that a climate-related event, such as a wildfire or flood, could damage or destroy the collateral that supported their loan portfolios. Concerns about the effects on members' financial well-being and livelihoods and the subsequent impact on their ability to repay loans were also expressed. The agricultural industry was seen by five participants as particularly at-risk, prompting concerns about the exposure of credit unions with loan portfolios to that segment. Three participants expressed concern about the effect that climate-related events would have on the supply chains of their credit unions or their business members.

Eight participants discussed the risk to collateral posed by climate-related events and the importance of being aware of how much of the loan portfolio is exposed to areas of increased climate-related risk. P18, while implying that their loan portfolio was not at present experiencing increased climate-related risk, thought that credit risk from the destruction of collateral would be the only means by which an increase in climate-related events could affect the risks that they manage:

> If there's tornadoes or hurricanes in our region, all of a sudden, like if they just start popping up, then I could foresee there being some huge credit risks for the

> homes that we financed or the auto loans that we financed. And then, I think that's the only ones I could really see. Maybe more forest fires, too. Obviously, burning down some homes that we have liens against.

P05, whose credit union had experienced wildfires in its area of membership in the last several years, stated that the location of the credit union's collateral is impacting its CECL modeling:

> I also took the liberty of talking to our VP of Risk before this just to ask her, like, are we doing anything that I'm not aware of? And from that stance, I would say CECL specific [impacts] are collateral risk. Like, where's our mortgage portfolio sitting? … The wildfires that we've been experiencing have real tangible asset risks like collateral risk.

P08, whose credit union had similarly experienced a wildfire that directly impacted the credit union's membership, agreed, emphasizing that the impact of climate-related events on members can increase credit risk:

> The wildfire risk, of course, puts us in credit risk … from the borrower side. Any sort of emergency situation is a huge interruption in their life. Any sort of interruption in their industry is a challenge to continue to worry about … things like car payments, and any sort of financial loss for them is a financial loss for us.

Participants also reported being more cognizant of the location of their collateral, or at least the need to become more aware of it, to deal with increasing climate-related events. P14 commented on the need for this awareness considering their heavy concentration in real estate loans. P14 stated, "So about half our portfolio's in real estate. It's actually more than half right now. … So as we have more climate events, we're cognizant of, where are our properties located?"

P17, whose credit union is active in lending for heavy equipment, expressed, "I would say that of the equipment we do finance, a fair amount of that equipment is in areas that are more fire-prone," and adding later, "You can argue, honestly, that these days there's really nowhere that's safe from a wildfire."

Commenting on a need to become more aware of flood risk among credit union members, P16 stated, “I haven't mapped it, but an uneasy guess is that most of those [home equity lines of credit] are in a serious floodplain. So, our assets are actually not great in that respect.” Real estate loans and their locations were a significant concern among the participants, but another loan segment that received attention from the participants was the credit risk of agricultural lending.

Risk to Agricultural Lending. The credit exposure of the agricultural sector and agricultural lending to climate-related financial risk was mentioned by five participants. P06 summarized how agricultural lending could be impacted by climate change:

> You know, we have additional wildfires. We had additional heat swings. We have irregular weather patterns, and that impacts our growth pattern in our area. And so [that] impacts the livelihood for anybody who’s in agriculture in our area, and so that impacts livelihoods and income streams.

Agricultural loans can involve mortgages on the farmland itself, loans for seed, and loans for farming equipment. P16 explained how these aspects of risk can be interwoven in a climate-change context:

> A lot of credit unions … do agricultural lending. That kind of thing is a problem, and not so much from the people they employ, since they're so mechanized now. But the farms that are mortgaged, the loans that [fund] the initial planting, the companies that are impacted if the crop doesn't happen. So the manufacturers, and yeah, it's interwoven and everything.

P04, whose credit union offers loans to cannabis growers, stated that even that industry, in which the product is grown indoors, could be impacted by climate change:

> Climate change affects growers because they've got to be able to depend upon one of the most margin-controlled environments, because they grow inside. But they still have to depend upon what's happening in the climate to make sure that their crops are working. Or make adjustments to what they're doing.

Commenting on the portion of their loan portfolio most exposed to climate-related credit risk, P14 said, "When you think about environmentally impacted [industries], the closest one is probably the agricultural processing that we have. That would be impacted by things like droughts." P11 thought that the climate-related credit risk to agricultural lending is less of a risk in the immediate term, "but in the long term, if hot areas become hotter and agriculture goes down, then you have to shift where you produce food. So, there are extra costs associated with that." Participants who mentioned risks to agricultural lending believed that climate change and climate-related events could impact the ability to successfully grow crops and negatively affect the income streams of the farmers and related industries. The effects on these participants could then impact the repayment of agricultural loans.

Other Climate-Related Credit Risks. Five participants saw the potential for increased credit risk if climate change or climate-related events disrupted their members' lives to the point of missing loan payments. P05, P10, and P13 stated that they could see loan losses resulting from climate-related events due to situations such as the loss of a home, loss of livelihoods, or loss of savings. P13 also mentioned that the potential reduction in members' savings could lead to liquidity problems for the broader credit union industry if the climate-related event were significant enough:

> I think it can deteriorate members' … financial well-being to a place where you are experiencing increased delinquency or charge-offs. Your deposit balances are coming down because members now need those savings balances to live. And so now the liquidity in the industry is coming down. And again, I think it would need to be a large event for this to impact the industry as a whole.

P15 noted that higher energy costs, particularly for commercial members, could increase expenses enough to cause problems with making loan payments. P06 saw the

potential for climate change to create supply chain problems, commenting, “If there are climate changes even 10 years down the road that inhibit the supply chain or the water rights or those types of things, that could definitely impair loan losses.” Supply chain problems facing either the credit union or its members were also mentioned in the context of physical and operational risk.

Physical and Operational Risk

Nine participants discussed, during the interviews, the risk to their physical facilities and operations from climate change and climate-related events. These types of risks centered on employee safety, loss of facilities, disruptions in supply chains, and continued service to members. P05 saw an increase in physical risk to their credit union’s branches and their employees. Two employees at their credit union lost their houses in a recent wildfire. Describing how increases in wildfires could impact risk to credit unions, P05 stated:

> I think just … the actual risk for our physical locations. … Our branch could go up in flames. That's kind of what I imagined to be our risk to our employees. We've had a couple employees whose houses have been taken in different fires, and that affects their ability to do their job and show up to work.

P08 reflected that while their credit union is not calling the increase in wildfires in their area a climate-related risk, the credit union did increase focus on employee safety in the event of wildfires after a discussion of the Hofheimer et al. (2022) study:

> It did open up the conversation. It did at least get fire risk in our risk assessment criteria. The risk group, completely on their own, did an entire awareness campaign for our employees and an awareness and safety campaign for our employees.

P13 acknowledged that, while no natural disaster had yet affected their credit union, the fact that the credit union’s members were concentrated in a rural area meant

they were at risk. Since the credit union's membership is located near two large rivers, flooding resulting from a climate-related event could exert a significant risk to operations and to members as well. P04 indicated that the location of a credit union's members and business members can make a difference when evaluating climate-related risk, and emphasized the importance of understanding what parts of the organization and its membership reside in at-risk areas:

> I mean, aren't we seeing some of the climate change and how it's impacting homeowners, right? I think that's probably something really important to consider. Where your members are, and where your businesses [are]. If you're more commercial like we are, where they're at can make a difference. So, considering that as part of what we're needing to start to do as a credit union.

While five participants specifically stated that their credit unions were located in areas that were at risk for climate-related events or had already experienced some, not all participantsperceived their organizations or members to be in at-risk areas. P07 explained:

> I don't know that we have a huge amount of risk here in our area. But certainly it's a big issue for those that sit on the coast in the Southeast where they deal with hurricanes, or in the Midwest, where you have tornadoes.

P14 stated that while there had been some flooding north of their town, it didn't affect a lot of members. They added that most members were not located in rural areas that were subject to wildfire risk and that their county also considered the risk of fires and floods to be relatively low.

P14 acknowledged that they had some potential supply chain risk due to outsourcing some functions to businesses located in other areas of the country. They explained, "We have a lot of outsources. One of those outsources is [that] our mortgage program is underwritten by folks back East, down South. And so, we are exposed

operationally to natural disasters, on the East Coast." P07, who saw the potential for supply chain disruption to home building projects, stated, "One thing I hadn't thought about is if resources became really finite, it might be more difficult to build, and that might put a strain on certain types of lending, home building and then by default … mortgage lending." This type of concern about the risk to operations was also expressed by P03, who saw climate-related risk as potentially inhibiting the credit union from locating branches in areas that were more at risk to climate-related events. This concern was, in part, due to the risk of not being able to service members effectively:

> You know, we've wanted to get branches on the coast. And there's a good amount of risk that comes into having a property on the coast. So, it's something we battle back and forth with. Do we want to have a branch that lets people down? So now our own brand is being tarnished because we did that without fully preparing, knowing what could happen. So that's when we use the climate data in those conversations.

P03's comment reflected a more general concern about reputational risk stemming from climate-related risk. This concern was expressed only by P03, but since reputational risk was cited by the TCFD (2017) as being a component of transitional risk, it is discussed in the next section.

Reputational Risk

P03 expressed the concern that disruptions to operations from climate-related events could lead to a reduced ability to service members effectively:

> Say we have a blizzard or, you know, forest fires, whatever the case may be. Our members may not be able to access their money. Our business members may not be able to open their businesses, or they cannot come into a branch, so we have to make sure that we cover enough ground and try to do everything we can either digitally or in person, that the members are confident not only in their own business but us as well, because as soon as [they] lose confidence in us they're going to leave. So there go loans, there go deposits, overall membership.

P03 thought that if a credit union were unable to allow members access to cash and other services, the news of that inability could soon spread, damaging the credit union's reputation and leading to a reduction in member confidence. This loss in confidence could then lead to other, more material risks. P03 continued:

> It just trickles down from there. Word of mouth. So it does impact those risks. You know if people leave, that's liquidity risk because they could be taking their deposits. As far as interest rate [risk] goes, if they take their loans elsewhere and those were really good loans from a financial perspective, that could hurt as well. It's being so reliant on others to put their loans and their deposits to run our business. … So it can domino effect into our liquidity, our earnings, our interest rate risk, all of that.

P03's comment demonstrates the interrelated nature of risks to operations with financial risks such as liquidity risk and interest rate risk, and how, by affecting a credit union's ability to service members, climate-related events can create reputational risks that can have additional impacts on financial performance.

Direct risks, which represent impacts to credit unions stemming directly from climate change or climate-related events, include the risk of destruction of the collateral that supports loans in portfolios and disruption to the lives of members, which could negatively impact their ability to repay loans. Agricultural lending was cited by five participants as particularly vulnerable to climate-related risks. Other risks noted by participants included physical risks to facilities and operations, supply chain disruptions, and reputational risk. Other risks mentioned by participants were ones that emerged indirectly from other sources that were affected by climate-related events or climate change. These indirect risks are explored in the next section.

Theme 2: Indirect Risks

Indirect risks to credit unions from climate change are considered by this study to be risks that arise not directly from climate-related events but rather through other sources that were impacted by climate change or climate-related events. These risks generally fell into two major categories. The first category was risk from either increases in the costs of insurance or increased difficulty in obtaining insurance. The second category was systemic risk and the effects that they had on members. These two categories are discussed in detail in the following subsections, beginning with indirect risks due to insurance cost and availability. Table 4.9 details the number of participants who spoke about each category.

Table 4.9

Breakdown of Categories in Theme 2

Category	Number reporting
Insurance	12
Climate-related systemic risk	9

Note. Source (Interview data, this study). Some participants spoke about more than one category.

Insurance

The topic of insurance was mentioned by 11 of the study participants (61%) during the interviews. Sherriff (2024) reported that insurance companies such as Farmers Insurance and State Farm are raising premiums and discontinuing coverage in the states of Florida and California. Participants were aware of these activities by insurers, and some participants added commentary from their own observations. Participants' concerns over the negative effects of climate change on insurance availability fell along two lines.

The first general concern expressed was about the increasing difficulty of obtaining insurance in some areas, and the probability that with worsening climate-related events, that difficulty could spread. The second concern expressed was the significant increase in insurance premiums for members on homes and automobiles. Four participants reported that these increases in premiums were raising the cost of their members' mortgage payments and cost of vehicle ownership, increasing the risk of delinquencies and defaults.

Participants observed that climate-related events could be exerting pressure on insurance costs and availability. P14 stated, "The changing ecosystem and the risk for widespread disaster at the magnitude that we've seen in recent years. That has tremendous effects on the ability to get reasonable insurance." P12 also thought that increasing frequencies of climate-related events such as floods were affecting insurance availability, stating:

> Insurance companies are experiencing a lot of losses on these floods and wildfires and all this other stuff. So, a lot of claims are on the vehicles that you see that are burned up or underwater, and in these flooded areas.

P06 believed that one impact of climate change on their credit union's members could be increased difficulty in "the ability to obtain insurance. Because of the ability to obtain insurance, in fire and fire risk or flood risk areas. Some insurers are just pulling out." Discussing financial risks that could be impacted by climate change, P13 referenced the increases in premium costs being experienced currently by residents of Florida and California and the potential for increases in costs to credit unions:

> I think about what's happened with Florida's insurance premiums and what's happening now in California. I think of the cost of doing business continuing to

> go up, the cost that the credit union incurs to maintain insurance in bonds on itself, its people, its properties. Those things [are] going up as those risks [are] going up.

P10 observed that insurance companies in California have "gone through and essentially said [that] these people who are in these areas, we're going to take away the insurance and we're not going to insure them because it's too costly. I don't think that's a great answer."

In addition to concerns about insurance cost and availability in other states, some participants stated that their members were beginning to be affected as well. P03 reported that their credit union's members residing closer to the Oregon Coast and in rural areas are seeing higher insurance premiums and are being required to pay high upfront costs for some types of coverage:

> And something we're seeing a lot of, at least on our end we're getting calls about it, is [that] insurance coverage is getting really difficult in some areas of Oregon, specifically. And this could be because of blizzards, because of forest fire areas, earthquakes. We figured out [that with] a lot of [insurers you will] have to pay $40,000 first. … They're going to make you pay for it upfront.

P03 then added:

> We had one individual who had a home in Bend, and he could not get insurance. He could get insurance, but the price of it was through the roof. So, he actually called us asking what advice can we give to him because he needs insurance on his home or else he can lose his loan.

P08 stated that while their credit union was not seeing widespread lack of coverage, members were, in some cases, needing to resort to alternative carriers:

> We're seeing where people have had long-standing insurance relationships with one company. That company doesn't want to insure them anymore. They are able to find alternative relationships, but it generally is costing more and may not be as good of coverage.

P08 also mentioned that these trends in insurance were beginning to be monitored by the Asset Liability Committee at the credit union as part of a broader discussion of risks.

Participants discussed the importance of the availability and affordability of insurance for the continuation of loan originations at their organizations. Emphasizing the importance of insurance availability in their credit union's operations, P14 stated, "I think that's the primary thing … that we were concerned about. It's just our members' availability of insurance and that our loans are able to be adequately covered." P04, echoing these sentiments in more blunt terms, stated:

> I can't close that home loan, right? If they can't get insurance on their home, you can't really lend to them either. So, you have to look for what? What are we going to be able to do to support folks who need to have houses and can't get them?

Similarly, P17 reported that increases in climate-related events such as wildfires could also affect their credit union's business lending. "If, all of a sudden, we have forest fires that tear through a bunch of areas where logging equipment is, for example. It's going to become a lot harder to insure logging equipment." They added that their credit union now requires borrowers to have insurance that covers wildfires. P03 also pointed out that if a credit union opened its own line of credit with another organization, then they would need to ensure that the credit union's loans that would serve as collateral for that line were sufficiently insured. P03 stated, "If we pledge that collateral for a line of credit, they want to make sure it's insured."

In addition to the effects that decreased insurance availability could have on loan origination, participants expressed concerns about the effect that increasing insurance premiums could have on loan delinquencies and defaults. Sudden and significant increases in home insurance premiums could create unexpected increases in mortgage

payments, putting pressure on the budgets of homeowners. Automobile insurance rates, which were also observed by participants to have been increasing rapidly, could stretch the budgets of members in a similar way, making it difficult to afford vehicle payments. P14 noted that "the most frequent reason we have for repossessing a car today is the insurance has gone up to the point where they can't afford it." They added, "In a lot of cases, the insurance alone doubles. Say they have a $450 payment or $440. [Now] their insurance is that much a month. That's what people were accustomed to for mortgage payments, not auto-related [payments]."

P12 also noted that when insurance costs for vehicles rise, cash-strapped members may choose to no longer make their insurance premium payments, which can lead to forced placements of more expensive insurance. This process can lead inexorably to voluntary vehicle surrenders:

> Because the insurance companies have to cover those [increased claims], and, of course, [they] raise insurance premiums, which we're seeing a lot of people not paying for insurance. And we have to force-place insurance, CPI collateral placed insurance, and, of course, that raises their payment because we have to cover that for them. And that's, again, a payment that [they] cannot afford. Depending on the car, your make and model, it could add several thousand to the balance of their loan. We try to amortize that for the next year and add that to their monthly payment, but their monthly payment may jump up to 3–4, maybe up to 5–6 hundred bucks a month just to cover that CPI payment. And then it gives them more, I want to say, motivation, to walk away from that just because of the new payment or revised payment for the insurance.

P14 observed that the increases to members' monthly expenses from higher insurance premiums is exerting the greatest negative impact on their lower-income borrowers, who are already struggling in the current state of the economy:

> The economy so far has hit worst the lowest 40th percentile wage earners, and so any increases in costs, whether it's indirectly through increased costs of services or goods because it's passed on due to increased insurance, or direct costs of increased insurance. Financially, it's becoming harder and harder for our members

> to afford services. So, I think the financial impact is just huge [from] climate change and climate-related [events].

Decreased availability of insurance, combined with increased costs for insurance when it is available, was seen by participants as a significant indirect financial risk emerging from climate change and increases in climate-related events. Increased difficulty for members to obtain insurance was reported as making the origination of loans more difficult and the servicing of existing loans potentially problematic as well. Increases in insurance costs on home and auto insurance contribute to delinquencies and loan defaults, often resulting in vehicle surrenders in the case of automobile loans. These cost increases impacted lower-income borrowers to a greater degree. Other indirect systemic risks are discussed in the next section.

Climate-Related Systemic Risks

Participants reported several other indirect risks of a systemic nature that could affect the risks that they manage. These indirect systemic risks include risk to the valuation of credit union assets, risk to key industries that made up credit union segments or were important to the communities they served, and risks from disruptions such as shortages and spread of risk contagion due to the interconnected nature of the financial services industry and the larger economy.

P16 discussed the progression of impacts that a major flooding event could have on the valuation of the housing stock in the small community where the credit union resides, highlighting the short- and long-term impacts:

> Say that we have a mega flood in our town. The housing stock is already distressed because of the climate and relative lack of income to keep it up. And it makes the housing values go down or collapse, which means that the revenues for city government go down. And then that has a ripple effect because it can't maintain [public services]. And then people really don't want to live there.

P16 also noted that climate-related events could impact key industries in their community that are reliant on environmental stability. Two industries that remained in the credit union's community that P16 noted as being particularly vulnerable to climate-related events were the timber industry and the local port. Other participants also emphasized the impact climate change and climate-related events could have on key industries in their communities or membership segments. P17 recognized the timber industry as an important one for their credit union and one that is vulnerable to climate-related events. "It [climate change] certainly affects tree growth for us. I mean the health of the forests." P17 continued, "Our industry is 100% reliant on a healthy environmental stasis."

Other participants expressed concern over increased loan losses should key industries and businesses experience problems operating due to climate-related events. P03 stated, "We could have losses on loans if they can't run their business, which would increase our rates, and this is just not us, but other institutions as well." P04 and P18 both thought that if a significant enough climate-related event affected employers of their members, it could lead to unemployment and influence jobs. Commenting on the effects of wildfires on tourism in their area, P08 said:

> The smoke from that affects our tourism. We have [a] festival here, which includes outdoor performances and multiple theaters. They've had to shut down because the air quality is too poor [due to the wildfires], and people don't want to sit for 2 hours outside. … You're probably taking out a month of tourism revenue, depending on how long some of these things go.

P08 also discussed that members can be affected by business adaptations to climate change: "As industries maybe are no longer viable or become viable because of innovation, that affects the members, and that affects the credit union." While stating that

they did not see as much climate-related risk to credit unions stemming from commercial lending, P10 did note that one way climate change could impact risk to credit unions is through "investing in businesses that potentially are going to be impacted by climate." P14 thought that their credit union, which did not offer commercial loans, could nonetheless be at downstream risk to these types of businesses if their members were affected:

> I know there is a heightened level of risk with business lending because it adds a whole new complexity to things like supply chain management. So, we would indirectly be impacted by climate change if there were natural disasters. But it would be through employees working for other organizations, not lending to organizations themselves.

P02 described how a climate-related event in one area could have repercussions for employers elsewhere:

> Let's say, for example, a hurricane can cause shortages somewhere along because it hits the East Coast or down in certain areas where they generate certain things, right? … So then there could be shortages of different types of things, and those shortages could impact the main employers in our area. … Other places like that, maybe parts or certain things don't get produced. So there can be labor shortages, things like that.

P04 also noted how climate-related risk that impacts one aspect of the economy could affect the overall economic system:

> I'm sure that there are economic pieces to that, too, right? Because you break apart one piece of the system, everything is interconnected. So it would affect pricing. It would affect what we would need to reserve. … It just starts to increase the risk, and with increased risk comes increased costs, typically.

Indirect risks to credit unions from climate-related events and climate change were perceived by the study participants to emerge from problems relating to insurance, effects on key industries, and propagation of losses and disruptions in an interconnected economic system. Participants observed that increased costs of insurance were causing

increases in delinquencies and voluntary surrenders of collateral. Some participants also stated that insurance was becoming more difficult to obtain in their areas of membership. Participants also stated that climate-related events could affect key industries in their communities, affecting member income and employment, and potentially causing loan losses.

Theme 3: Data Challenges

A third theme that emerged during the participant interviews was challenges related to the data needed for analyzing climate-related financial risks. Participants discussed potential challenges concerning both the gathering of the data, data types, data uses, and data analysis timing and prioritization. Potential data gathering challenges included issues related to the availability of data, the locations of the data, the integrity of the data, and the costs to obtain the data. Each of these challenges is discussed in detail in the following subsections, beginning with the issue of data availability. Table 4.10 details the number of participants who spoke about each category.

Table 4.10

Breakdown of Categories in Theme 3

Category	Number reporting
Data availability	11
Data locations	5
Data integrity	7
Time and prioritization	5
Collaborative data gathering	5
Artificial intelligence	2
Data personnel	5
Data types	9

Note. Source (Interview data, this study). Some participants spoke to more than one category.

Data Availability

Twelve of the study participants (67%) discussed potential challenges to data availability. Within this group, there were differing opinions about the types of data that might be needed for proper analysis and how much of that data already resided within the credit unions' existing databases versus residing somewhere outside of their organizations. Three participants mentioned that since credit unions have records of their members' financial transactions, they might have an advantage at the start relative to other types of businesses. P04 thought that credit unions might be able to begin with the data they have on their affected members to gain insights:

> We can look at what those members that we know are impacted today from things that we know that are happening as a result of climate change, and then start to extrapolate what that can mean. I think that we would need to be able to mine our core to find out who they are and find out what kinds of things we have. Because we have access to transactions, you can see a lot about what's happening.

P03 thought that the kind of information possessed by credit unions about their members would be the envy of other types of companies:

> We have a good amount of data with our members, and that's something I say all the time … we have some of the best data we could get on people possible. We have spending habits, social security numbers, birth dates, addresses. Companies would kill for that type of information just to have it, and we have all of it.

P11 believed that the data already possessed by credit unions were not only valuable, but they were all that were needed:

> I can't think of any pieces of data we don't already have. … I can't think of any better representation of understanding what your members are doing than having their bank accounts and their loans. That's probably more descriptive of what a person's doing than anything else we could get. It is super secret information.

Five participants thought that to analyze climate-related financial risks to their credit unions, they would need to look beyond the data residing in their internal databases, robust as they may be. P07 thought that it would be important to collect data on whether insurance rates were increasing in wildfire-prone areas, but these data might be fragmented and difficult to collect. “It's fragmented,” they said, “so you're not going to be able to collect it very neatly. You may have to go to a third party to get it. In fact, you probably would. So there'd be some costs there.” P09 anticipated similar challenges in obtaining insurance cost data about flood-prone areas:

> I think it would probably involve some more in-depth analysis of … recent or historical damages that have been done or claims in certain areas, to identify where those areas might be. For example, the flooding. If it's further out than any river was typically before. So, I think that it'd be that type of data that isn't necessarily accessible for insurance claims or other ways for us to determine.

P08 thought that to incorporate climate-related data into forecasts, a longer-term trend of climate-related historical data would be needed and that these data may not yet be available.

> I think it's a lack of historical data. … We're kind of like in the trend. We can't necessarily see the trend yet. … I think it's always a harder or more uncertain space when you're experiencing it versus when you are looking at the past and then drawing a conclusion. So I think that is a real challenge.

P10 was similarly skeptical that enough historical trend data existed, asking, “Do we even have enough data to be able to then map out a statistical trend that's reliable enough to be able to make strategic decisions?” P14 thought that a challenge with climate-related data is the level of detailed information needed and that much of these data were not currently being collected by credit unions, whose priorities are often on more immediate matters:

> I think the problem that I hear when people go down this path of climate risk is it gets really granular really fast. And a lot of that data we're simply not tracking. … But in order to really go down this path … of understanding climate risk, that granular activity seems to be a lot more time-intensive, and at our size, generally we're worried about bigger picture items than [we are] at that granular level.

Of the 12 participants who mentioned challenges with data availability, three participants thought that the data their credit unions already housed internally were sufficient to analyze climate-related risk. Five participants thought that additional climate-related data would need to be obtained. These five participants cited challenges involving the locations of data, both inside and outside the credit union. They also stated that determining where to find external climate-related data and coordinating and analyzing data from multiple systems were also challenges to be addressed.

Data Locations

P16 reported that small credit unions often lacked data mining resources and the time to obtain data from outside the credit union. P16 expressed that having more easily accessible resources could help smaller credit unions:

> I think that it would be helpful if there were resources that were more easily accessible about these kinds of things where you don't have to be so [focused] on it … and be somewhat proficient at gathering data in order for people who either have a small credit union [or] don't have the staff to do the kind of research.

Three participants who thought that data would need to be obtained from outside the credit union had mentioned the possibility of using outside vendors to obtain it. P17 reported using third-party vendors for information on items such as timber projections, which helped them to set their Allowance for Credit Losses (ACL). P17 thought that third-party vendors could also be used to help collect climate-related data that small credit unions were unable to obtain from their members but that care must be taken to make sure the information is worth the cost. P17 stated:

> I think it would be finding a vendor that's doing a good job of that, and also making sure, being a small place too, like a cost-benefit analysis of, "Is it worth paying X amount for some subscription to know that information for us as a small credit union."

P03, also a user of outside vendors for climate-related data as well as other information, described how they qualify vendors:

> We go through the vendors for it. So, it's using the right vendors and not being complacent, using the same vendor over and over; seeing which other ones are out there. Each one's going to be different. And we have to make sure that we're not just checking the box. We want to make sure that we're being thorough with it.

P03 stated that most information outside of information on individual spending behavior, addresses, etc., is obtained from vendors. P12 also believed that outside vendors could be used to obtain the data required to evaluate their credit union's exposure to climate-related financial risks. P12 also thought that finding the right vendor was important and thought that organizations such as Credit Union National Association (CUNA, now America's Credit Unions), could assist in the process:

> It is trying to find the right vendor. We're a member of the CUNA Council. So you can reach out by just typing up a question in the Council, and all the members can chime in and give you a push in the right direction, whether it's a certain vendor, a situation, an issue, or a problem.

Three participants commented on potential difficulties with the compatibility of data coming from multiple data systems. P01, whose credit union is addressing the problem of data coming from multiple systems, described how they mapped their member locations against known fire-prone areas using a data warehouse:

> One of the things we did last year was map out our members' locations, and so … we've been building this program over … 6 years, when we first started accumulating our own data and warehousing that in a way that we can get access to it across systems. … We've got multiple systems. You got your core, but then you have other systems, maybe, that are originating [loans]. Or you've got a mortgage system versus the core system. Or you've got all these different systems. …and through the data analytics department that we have, they've been able to

> use Tableau, for instance, … to map our members to try and overlay that onto known fire areas. In order to understand, do we have members that are at risk?

P06 also thought that a means of estimating exposure to climate-related financial risk could be mapping member locations against known wildfire areas to determine concentrations of mortgages in risky areas. They similarly observed the potential for risks from data incompatibility stemming from multiple data locations:

> The challenge may be that [the data is] in two different systems, but we could bring that together just given time … and correlating the similar data from one to the next. If we were to correlate internal data about our loans, for example, with an external source of variability of an assumption. Making sure that they were 1 to 1 to be able to compare apples to apples would probably be a challenge.

P03 stated that their credit union addresses potential data incompatibility with vendors:

> One of my best practices is, before you sign the contract with them, make sure it's compatible and make them work for it. [That] is kind of what we do is if you want the business, show me you could put it in my format first.

Participants discussed approaches to obtaining data that resided outside of the credit unions' internal systems. Three participants mentioned addressing this issue through the use of outside vendors. Three other participants discussed approaches to ensure that the data obtained from systems outside of the credit union were compatible. Proposed solutions included pulling multiple system data into a data warehouse and challenging potential vendors to make their data fit the data format of the credit union. A closely related challenge to the issue of making data from multiple locations compatible is the question of data integrity.

Data Integrity

Nine participants commented on issues related to the integrity of data. For this study, data integrity refers to the consistency, accuracy, completeness, and relevance of the data obtained. Two participants brought up the issue of accuracy and consistency of

data entry. P01 described how misspelled or inconsistently spelled words lead to there being too many collateral codes in their data warehouse:

> When we first started getting in and looking at this stuff, I think we had 2,500 collateral types. And so as we started to look at this, we had stuff like misspelled windows. So, it was "window" instead of "windows." Somebody would put an "s" on windows, and somebody wouldn't put an "s" on window, and so even though you just had this finite amount of collateral types, we had just so many descriptions in there because it was a free-form field.

P02 expressed similar concerns when asked about challenges to obtaining data for climate-related risk exposure:

> I think that the challenge is always getting the front end to put the data in correctly in the right areas. … The reason is that you have to get staff and other people to understand that in order to truly price reflect these things as to what their real costs are, this information is needed. They can say that they're going to do it, and they may start off for a month or so, and then they kind of let it slide. … I think that that tends to be one of the main barriers overall.

Two participants expressed concern over the reliability of climate-related data that is currently available. P10 expressed, "I think if we're looking at things that are specifically related to climate change. The reliability of the data and the amount of data available, I think, is limited." P09 pointed out that the unpredictable nature of climate change could create difficulties in building predictive models:

> We can predict housing values because we can say, "Oh, this population is moving to this area or, these homes have retained their value over X number of years." But when you're talking climate and environmental changes, it's not as predictable. So I think it would be, "How do you create a model or analysis of something that could potentially be a targeted area that might have some challenges?"

Lack of clarity on what data are required or what question is being asked also emerged as a potential issue. P03 discussed the importance of being clear about the exact nature of the data needed for climate-related risk analysis:

> Somebody may have a request on something, [but] if they're not specific, you're kind of playing a guessing game on what you ultimately want to build for that person, and that's what risk was telling me is that just telling them we want to see all the at-risk members that we have, that's not really going to do a whole lot. We need to say we want to see forest fire areas [or] areas that have blizzards or high snow. … So, we have to be very specific, but we can get the information.

In a similar way to being clear about the data needed, the relevance and importance of that data for the project were also considerations. P01 stated that they were selective about the data being brought into their data warehouse:

> We didn't try and bring every single piece of data in on day one because we also wanted to kind of run it through that filter that says, "Well, one, what is this data? Is it relevant, and does it have meaning?" Because if it's not, we don't want to spend the time to bring it in.

P08 pointed out that the use of surveys geared toward the membership to gauge how they are being affected by climate change could be useful, but cautioned that data coming from these types of instruments would need to be carefully scrutinized. In addition to having to read responses from participants after the fact, bias and wording of the survey could skew results:

> I think it leaves a really strong onus on the data users to be very cautious in how they use that data and what interpretations they draw from it. It is not the same as, "This invoice cost this dollar amount, and we paid this dollar amount." That is a finite item that does not change and anything with values believed. Perspective cannot be used in exactly the same way.

Participants reported several potential issues related to the integrity of the data they might gather to assess climate-related financial risks to their credit unions. Participants stated that data input consistency and accuracy could become an issue and used examples from their own experiences to illustrate the problem. Participants expressed concerns that climate-related data could be unpredictable, causing problems in making any kind of predictive models using it. The need for clarity on what data are

needed was also a key concern, as well as the need to account for bias in data collection instruments such as surveys. Two items mentioned by participants that factored into discussion of any effort to collect data were the time and prioritization allocated to obtaining data and the cost to obtain it.

Cost, Time, and Prioritization

Seven participants expressed that cost, time, or prioritization of gathering data for climate-related risk analysis could be a challenge. P17 thought that, along with finding a good vendor from whom to obtain climate-related information, an analysis of the costs and benefits would be needed:

> I think it would be finding a vendor that's doing a good job of that and also making sure, being a small place too, like a cost-benefit analysis of is it worth paying X amount for some subscription to know that information for us as a small credit union?

The specialized nature of climate-related data also came up as a potential source of high costs. In addition, it was mentioned that additional personnel might be needed to interpret and analyze such data once they were obtained. P05 reflected:

> The consulting dollars, I think, would be high compared to some of the other consulting we do at this level. And I think that they would need to consider having at least a full-time analyst to take that data and implement it and do things with it. Or else it would be a humongous waste of consulting dollars.

P13 thought differently, stating:

> I think most of the data is out there and free. I'm sure you could pay for it in some capacity if you really wanted to, but I don't think the data that I'm thinking of I would need to pay for.

P13 believed that time, rather than monetary cost, would be the more significant hurdle in obtaining climate-related data. P06 also thought that time was a challenge related to data collection. Commenting on the process of merging data from two systems,

P06 said, “The challenge may be that it's in two different systems, but we could bring that together just given time, and you know the time is a constraint, right?” P16 thought that a critical resource needed to obtain climate-related data would “simply be staff time.” As the leader of a small credit union, P16 did not think that they had the time personally to gather data either:

> Assuming we all have the time to do this, and that's why I haven't done it, I would really like to map out where our HELOCs are, for example. It would be nice to know how many of our members are tied really closely to the timber industry, the ports, the fishing. Those kinds of things. It would be nice to spend some time on the dollar amount of those. … You know, we need to get busy on this.
> I mean, clearly, I feel like that already, but I don't have the bandwidth.

P13, thinking that prioritization among many other competing management priorities would be a significant challenge, stated, “I feel like a lot of this data is out there. So I think the biggest challenge would be time, right? Prioritizing this with all the other priorities we have as leaders of our credit unions.” P05 viewed management’s lack of willingness to prioritize the gathering of climate-related data as being due to a perceived lack of tangible economic benefits in a capitalistic system:

> The biggest and the most incredibly obvious [barrier] to me is interest. A willingness to put the time and resources in for what, I believe, our management does not see to be tangible gains. We live in a capitalistic country. You put money in to get money out. If you're putting money into a system that's not getting you money, it's broken, right? So I would say that right now, there is not enough real physical economic risk for leadership to find it to be worth it to put monetary and time resources into.

Seven of the study participants believed that there are challenges to effectively gathering and using data for the analysis of climate-related financial risk related to cost, time, and prioritization. A potential means of addressing these challenges that emerged was data gathering through collaboration with other credit unions.

Collaborative Data Gathering

Another idea that emerged from the interview responses was using collaborative action to share and collect data. Participants discussed the value of collaboration through cooperative action and information sharing. Five respondents indicated that collaboration with other credit unions through information sharing could be a good means of gathering data for climate-related risk analysis. P18 stated that collecting data from other financial institutions that have experienced climate-related events could help to predict the effect on charge-offs, deposits, overdrafts, and other metrics. When asked what types of data would be important to collect to understand their credit union's exposure to climate-related risk, they stated:

> I think data around institutions that have experienced climate-related incidents in their area and what that's done to their charge-offs. What it's done for their deposits, what it's done for, any kind of overdrafts, things of that nature.

P18 further commented that this type of data could be obtained by reaching out to other credit unions within their peer network:

> I would reach out through my network of peers and say, "hey, who do you know over here?" And try and make connections that way. Our association is really good about making and building connections and things like that. So, I'm sure I could reach out … and then get connected with the leaders of the association in that area and try and get some connections with some credit unions that they think would be willing to share that information.

P18 added that the information gathered from fellow credit unions could provide understanding beyond financial numbers, stating, "I mean, we could look at the 5,300 reports or the FPRS and kind of do our own little bit of analysis, but we would have the numbers and not the actual … the 'why' behind those numbers." P12 stated that they habitually reached out to credit union peers to get information or solutions to questions, and that this could be a good means of obtaining information about climate-related risks as well:

> What I like to do is reach out to ones that are similar in size of assets, first of all, and then of course go to some of the bigger ones where you know they would have to because they do have different departments versus in credit unions that are smaller people wear different hats and they can tell you the answer right away.

P16 thought that speaking with organizations that have already been adapting to climate-related risk and dealing with climate-related events could lead to insights into how to use information gathered through other processes:

> You know, maybe other things that would be helpful [would be] workgroups led by folks who have done it, who have suggestions. Ways to implement the information that you've gathered. What to do with it. What to prioritize. That sort of thing.

P04 noted that these kinds of collaborative efforts could be difficult to bring together but would be worth the effort, especially given the inclination of credit unions to work together. The important factor in such an effort would be coming to an agreement on what sort of data each credit union should be gathering. P04 stated:

> I mean, trying to coordinate that effort, to bring it together, is probably hard. But I feel like, at least in credit unions, we like to share. I think the challenge would just be like organizing and putting together the effort and making sure that we've … all agreed upon what data we should be looking at, because there'll always be people who want to bring in their own their own take on it.

In addition to using collaboration to simplify the gathering and analysis of climate-related data, participants also discussed the need for dedicated data analysts within their credit unions. The use of artificial intelligence (AI) applications was also discussed.

Artificial Intelligence and Data Personnel

Seven participants, as stated earlier, reported that time and prioritization of gathering and analyzing climate-related data were challenges at their credit union. Two participants saw a potential in AI to help small credit unions that lacked sophisticated

information technology platforms and personnel make headway in climate-related data analytics. P14 believed that AI applications could open up opportunities for their credit union to begin delving into climate change analytics:

> A lot of times, we don't have specialists in statistics or data. Interestingly enough, AI is opening up a lot of this analytics side. And I don't know how much of the data out there exists for AI. But we're starting to use AI more and more in this type of broad analytical accumulation of data. In AI, I think, is the way that small institutions will be able to even dabble in some of this.

P14 went on to provide an example of a scenario in which the AI application ChatGPT could be used to help identify and plan for climate-related risks:

> So, I asked ChatGPT … I gave it some parameters and said, "You're the CEO of a $[xx] million shop and looking at climate risks in the area for headquarters in … Can you identify the risks and develop a plan?" And boom, you know, just a few minutes later spits this out. And it says, "Would you like communication to your Board of Directors regarding this?" And so, I do think that AI, even just talking about, analyzing the data that's out there. … Any of these AI [applications] and we can give it specifics about us, or even load in data about our disasters. We can load in data about our membership. We can load all that in and let AI analyze it, which is huge when you're wearing multiple hats, you know?

Five participants stated that a dedicated employee or team of employees would be necessary to gather and analyze climate-related data. P05 stated, "I think that they would need to consider having at least a full-time analyst to take that data and implement it and do things with it." P06 agreed, stating, "The list is long for all of our time and resources to achieve things that are more immediate, and so I would love to have a data scientist."

P01, whose credit union uses AI functionality in its Tableau software application, stated that even with the use of an AI platform, dedicated personnel were still very important:

> In my estimation, you've got to have an A-Team, department, group, whatever you want to call it, that's focused on this. I'm focused on collecting the data, structuring the data, and then getting that data into a centralized warehouse

> somehow. Because it takes that focus in order to create that consistency and set up the structure.

Another challenge in the gathering and analysis of climate-related data is figuring out what types of data need to be collected. This question is explored in the next section.

Types of Data to Collect

While there were consistent responses from participants with respect to the need for data and some approaches to the use of data, the types of data to be collected, and the metrics to be used were the subject of some uncertainty. P16 thought that talking with credit unions that have already been dealing with climate-related risk could help determine what data would be appropriate to gather:

> It would also help in a longer-term effort in terms of what data we should collect. You know, what new pieces of information as far as, I don't think there's any…I know there's no requirement, but should you? We've got flood maps. But do you need to know the elevation of a given building? Is there additional information that would be helpful if we're building a real estate portfolio, that it should only be, you know, 40% of your property should only be in a flood zone or that sort of thing.

P01 thought that identifying key metrics that could serve as climate-risk red flags would be important, but that they were still developing what that list of metrics could be:

> It's also one we're still developing. I would say in a lot of this could be around credit metrics, you know, "How do we identify those metrics?" Maybe they're called red flags, whatever you want to call them, for our members, so we can get to them ahead of time. You know, I'd much rather get to a member before they're at that point where it's like, "OK, I haven't been able to make payments for 3 months. I'm done."

Four participants thought that gathering various types of data on the characteristics of their members and their experiences during climate change could be important. P08 thought that gathering data on members' experiences and beliefs regarding climate change could help the credit union adapt its responses:

> I think there are some data points that are important about people's experience and belief of the climate situation, especially for our members to know how much we should be dedicating of their money towards these efforts, finding out where they care, how much they care about that thing, how much they are worried about it, things where they would like to see protections or improvement.

P10 believed that "pulling in data … trying to identify our members' employers. See if we have any over-concentrations there," could help identify concentrations of loans within vulnerable employer segments. P06 suggested that understanding members' energy use compared to the energy supply of some areas could be useful:

> The other part that I would key in on, and I don't know what evaluation would be done, but the energy uses and energy availability and supply, because I know in some of our territories, there in some of our geographic regions, there's a shortage of electricity.
>
> And being a hydroelectric generating area, hydroelectrical generation takes years to put into place, and so understanding the electrical supply, I think, would be interesting to cross-reference to some of our exposures as well.

P09 also thought that energy usage data on members could be helpful but from the perspective of helping them determine how much money they could save on utility bills after installing solar panels on their houses or buildings:

> And then even in the solar world, even a firmer grasp of how much can someone expect to have compensated on their utility costs? Is it 100%? Could they generate enough to sell some back to a utility company? Make money? … So I think a lot of that would be super helpful.

Themes 1 and 2 detailed the direct and indirect risks that the study participants believed were posed to their institutions by climate change. Theme 3 was related to challenges regarding gathering and analyzing climate-related data. In the next two themes, the responses of the participants to climate-related risk are explored in detail.

Theme 4: No Policy or Procedure Changes

Thirteen of the 18 participants stated that no organizational policies and procedures have yet been changed in response to climate-related financial risks.

However, 11 participants stated that climate-related risk is a topic that is either beginning to be talked about by management or is embedded in financial decisions while not being stated explicitly in policies and procedures. In this section, the participants' ideas along these lines are explored. Table 4.11 details the number of participants who spoke about each category.

Table 4.11

Breakdown of Categories in Theme 4

Category	Number reporting
Strategy, policy, and procedure impact	15
Time and prioritization	4

Note. Source (Interview data, this study). Some participants spoke to more than one category.

Strategy, Policy, and Procedure Impact

Thirteen of the 18 participants, 72%, reported that their credit unions had made no climate-specific change to their organizational policies and procedures. However, though climate-related risk may not be mentioned specifically in policies and procedures, 11 participants acknowledged that these risks may still be addressed in existing risk management procedures, such as underwriting, or that climate-related risk and other ESG concerns were beginning to be discussed in strategic planning meetings.

P04's credit union was an example of this type of situation. "I can't think of anything direct that we've done where we've said, 'because of climate change, we should be implementing this policy.' There's not really anything that we've ever said around that," P04 explained. However, P04 also stated that, though there was not a specific

climate-related part of strategic planning, the credit union was active in helping members alleviate some of the effects of climate change. “It's not part of our strategic planning session where we're talking about the credit union, but it is definitely part of when we say … what do we want to do, and how do we want to make an impact.”

P14 stated, “I don’t think we mention climate in any of our policies,” and explained further that to this point, climate-related risk had been occasionally mentioned at board meetings and at conferences:

> There have been some discussions, but they're not regular and systematic at the credit union. So there's just been conversations at times, some more forward thinking, that says, “What happens at the point where we don't own our own cars, and we just call a rideshare?” And so again, I think at the Board level, it's just been mainly in passing comments and just from a strategic perspective, just say, “You know, what would we do?”

P06 also stated that they have no policies or procedures in place specifically for climate-related risks but that those risks could be embedded in risk measurement items such as cash flow estimations:

> I don't know that they are specifically. You know, we talk about having the underwriting risks, and the credit decisioning. … There's not a line item that says “OK, climate risk change or climate risk factor to it.” It's just embedded in with the forecast of a business or the forecasted cash flows of a business.

P17 also stated that at this point, no specific policies had been altered. They explained that part of the reason for not adjusting policies, in general, was to prevent them from becoming too specific:

> You don't want to write policy that is too exclusive or too specific, so you have to go to the board for, you know, approval to do, you know, every little loan or every loan. But at the same time, yeah, I think, yeah, I think that'd be a consideration.

Five participants spoke about how climate-related risks, while not being specifically addressed in polices and procedures, are beginning to surface in strategic risk

analyses and board meetings. P06 explained that their credit union has a strategic analysis report on emerging risks, and that ESG, which includes environmental risks, has become a topic of discussion within that report:

> So we went through a full ESG emerging risk environmental scan this year and presented it within our strategic committee. And what happens is that our leadership team uses that information to inform our strategic plan, and that gets talked about in conversation with our board in June. … But this year was new. We carved it out to have its own separate conversation. So, climate change was part of that as well as another one that's a physical type of focus for physical branches. So, between the two, we covered climate change risk.

P08 similarly explained that while climate-related risk is not something that is explicitly mentioned in management meetings or in policy, wildfire risk has become a frequent topic of concern:

> It is, I'm going to say, unusual that a lot of words like climate change are discussed in our strategic planning session, but wildfire risk is discussed specifically in our annual planning session. So, we had felt this very finite risk and experience. And so that never came back off the table. That is now part of our risk environment that we consider. … And so, I think we are building that conversation and getting more comfortable with maybe the broader implications of climate change in general versus just this one direct threat.

P03 explained that the addressing of climate-related risk could be included in a list of social responsibility initiatives that are brought to the board each year:

> I don't have a policy I was able to get my hands on. But we have written up social responsibilities that we have that we bring to the board every single year, and we try to have a couple initiatives each year to do so. The [electric vehicle] loan one is part of it for 2025.

Time and Prioritization of Climate Response

Four participants discussed reasons that the prioritization of a response to climate-related risk could be challenging. P05 reported being told that their management "did not have the time and resources and energy" to make climate-related financial risk a priority. P05 further stated, "I just don't think it's a focus outside of the immediate danger to our

members and employees during fire season so far." The participants stated that the unpredictability of climate-related events also made any kind of policy or procedural means of addressing the issue difficult. P01 said that, due to this unpredictability, the credit union tended to address climate-related risk as they happened:

> With the forest fires, it's hard to predict where they're going to be, and [they occur in] different places every year. It's not like they show up in the same place every year, and we can, you know, do something about it, type of thing. It's just kind of an unknown risk that we have to deal with when it happens, and then, at the time, if we've got a situation where, especially [if] multiple members are affected … then we can put things into place.

P10 agreed, stating, "You can't necessarily adapt and be prepared for things that are maybe acts of God that are just out there, unknown."

While 13 of the study participants stated that their credit unions had not made any specific policy or procedure changes concerning climate-related risks, 11 also stated that these risks were, in some capacity, beginning to be discussed in management meetings and covered in analyses or initiatives. The next theme explores ideas that emerged as the study participants discussed climate-related risks they were observing. The participants also discussed their ideas for response or mitigation of these risks. Some of the participants were already undertaking some of the suggested approaches, while others were suggesting them as possibilities.

Theme 5: Financial Institution and Government Responses

During the interviews, participants discussed a variety of ideas for mitigating climate-related financial risks. Some of the potential responses suggested were already being implemented, while others were just ideas. The ideas for responses fell along three broad lines. The first broad approach was to assist members in preparing for climate change by offering green banking solutions. The second broad approach was taking

advantage of various types of governmental assistance. The third broad approach involved adaptations in credit risk management and other operational processes. Each type of approach is discussed in detail in this section. Table 4.12 details the number of participants who spoke about each category.

Table 4.12

Breakdown of Categories in Theme 5

Category	Number reporting
Green lending	13
Government assistance and regulation	8
Credit risk and analysis	14
Organizational adaptations	11

Note. Source (Interview data, this study). Some participants spoke to more than one category.

Helping Members Adapt Through Green Lending

A common idea that surfaced during the interviews was mitigating climate-related risk by helping members to proactively adapt to it. Ten participants discussed that a part of managing climate-related risk to their own credit unions resided in helping their members adapt to and deal with climate-related risk and events. P01 reported that their credit union is addressing climate-related risks through the lending function, offering products such as solar and electric vehicle loans that help members adapt to and address climate risks:

> I would say probably it's the lending side where we're trying to support more than the climate perspective, in you know, providing those various ways for our members to help mitigate the climate on their side. That might be through solar

> lending through … helping to improve their houses so that they're more efficient that they can take advantage of, you know, energy programs.

In this way, P01 also thought that it was important to locate and help members who are in at-risk areas ahead of time to advise them on how the credit union could assist them. The challenge, they thought, was in determining, from their data, the best way to accomplish this:

> How do we put things into place where we can help our members ahead of time if they do happen to fall within one of these areas that are affected more by climate … whether it's flooding or landslides or … fires or whatever those things are. How can we get to them ahead of time and reach out to them? … That's part of that program that we're trying to build out with the data we have and trying to bring other data in to supplement that and those types of things.

P15 similarly discussed how they are addressing climate-related risks by helping their members to adapt:

> We've looked at this and identified what we think is an obvious trajectory of climate change as something that we need to prepare for, both with regard to our own operations, but especially to help our communities prepare for climate change through our solar lending program. If you look at our balance sheet, you would find that about 90 plus percent of our loans are what we call “green” loans. They fund solar panels, energy storage, EV charging stations, and other home improvements and products that help members reduce carbon emissions. So, we see we have focused more on using our financial institution’s ability to lend to fight climate change.

Commenting on the impact of reduced energy costs on their lower-income members resulting from this type of lending assistance, P15 stated:

> The monthly energy cost for somebody who earns a modest income, in many cases, is similar to that of somebody who lives in a house a mile away but who has a lot of income. So, to save on energy costs has a much more significant benefit for those with lower incomes. So, the impact, the financial impact, of reducing that expense for someone who has very little means is much more impactful societally as well as reducing their carbon emissions.

P15 further commented on how this approach could also benefit the credit union "if they don't have to worry as much about their ability to make their electric bill payment, they're more easily able to make the payments to us."

P09 discussed how their credit union is using their Community Development Financial Institution (CDFI) grants to help with lending to members for climate retrofitting. This type of climate adaptation assistance is being requested by members who, in years past, had not required items such as air conditioning or solar panels to improve livability and reduce electricity costs:

> Now, the more people I talk to, you know, they talk about having solar to compensate for some of their utilities. They talk about installing A/C into their homes and where they never would have done that before, and so I do think that that conversation has created a new avenue for us in that space of trying to meet the needs, even some of our CDFI lending that we're looking at doing in the future is how do we retrofit apartment buildings or new buildings or like old apartment buildings to be more ecologically sound and offset some of the utility costs and provide better windows, more efficiency.

P05 spoke of offering disaster relief loans at low interest rates to members affected by recent wildfires in their area:

> We have, in the last few years, promoted more disaster loans, so emergency loans, especially for wildfires, a lot of promotion in the areas like Medical Lake, for instance, a lot of promotion on low-interest emergency-type funds when your house has been burned down or something of that nature.

Four participants reported they were looking into either doing more lending of this type or increasing the amount that they already do. P02 stated, "We're trying to find ways to do that, along with ways to do electrical vehicles and loans, working with the government to get grants and things like that." P18 talked about investigating green lending and the potential for differentiating themselves from their competition by offering these types of products:

> I don't know how much yet, but we are looking at doing green lending. That's an endeavor that we're putting forth right now. So, I don't know if it's the risk so much as the opportunity that we're looking at. People are more invested in more green solutions, electric vehicles. Smart water heaters, HVACs, you know, those green updates for their homes. And so we're trying to lean into that and get out in front of it and try and differentiate ourselves that way.

P12 also reported that their new CEO was proposing a strategic plan that includes solar and other types of lending for climate-related improvements. These new offerings could include:

> More of service or product gaps, such as solar lending, home improvement lending … maybe for upgrading windows or installation, and some improvements to the house, where we can provide financing for members who want to improve the efficiency … going forward. We didn't offer that before, but … I want to say he has the ball rolling.

P15 also believed that their emphasis on green lending and green banking products presented an opportunity to differentiate themselves from competitors. They further thought that not being answerable to shareholders added to the advantage:

> I think that there's just a fantastic opportunity for us, especially credit unions, because we don't have stockholders we need to answer to and have returns and dividends to them. I think there's an incredible opportunity for us to differentiate ourselves. And I think that the climate-centric elements that we're talking about are great ways we can do it. And we can make money at it. I mean we don't gouge, but we can add this element to what we're doing and really differentiate ourselves, and I think we'll be very attractive to the Gen. Zs and Gen. Xers.

Nine of the participants who discussed expansion into green and climate-adaptative lending to help their members address climate change also reported on some of the risks and opportunities inherent in that type of lending. Three participants discussed the opportunities for business combinations related to green lending. Risks in green lending reported by six of the participants included the need to understand solar loan default rates, insurance costs for solar panels, issues with Uniform Commercial

Code (UCC) filings, and problems with solar dealers. In one case, bad information from solar dealers prompted a credit union to begin developing its own green lending competencies. Whether to offer incentives for loans on items such as electric vehicles was also discussed by six participants.

Three participants indicated that nonfinancial company providers of financing for climate-adaptation items, such as solar panels, have provided inaccurate or incomplete information to drive sales, causing the credit unions to get more directly involved in green lending. P02, whose credit union is merging with another credit union that already practices solar lending, stated, “We feel like, for example, right now in green lending, the nonbanking institutions are really kind of taking advantage of people.” They continued:

> Right now, nonfinancial institutions charge people, give them a low interest rate, but charge them up in fees so much that people don't realize that they're actually being harmed more than if you'd went through a higher interest rate. But people will then not understand the amount of fees and don't care about the amount of fees on the back end that they're having to pay. So, I think that we need to be able to think about this as financial institutions and how can we step in and help our members and other people in our communities get better products at a more reasonable rate.

In addition to fees, solar dealers also employed what one participant thought were questionable assumptions when calculating the payback of an investment in solar panels. Explaining that investing in solar panels is not always a purely positive financial payoff for a purchaser in the Pacific Northwest, P01 stated:

> It doesn't pay the individual to necessarily go to solar. Although I will say the dealers try to convince you it will pay. They have to throw some assumptions in there that are very long-term assumptions that may or may not come true in order for it to pay. They have this equation. They plug in … part of that equation is an elevated increase in your energy costs in order to offset the cost of the installation and the panels, and the equipment that goes into providing that. Whereas in other parts of the country, they can show you without any kind of increase, this is gonna save you money.

P09 also reported discovering that bad information had often been provided by solar providers to the credit union's indirect lending members. These items included unexpected property liens, UCC filings, and loan structures that the members did not fully understand. While the loans were originated by the credit union, the applications were being taken by the vendor, a process that resulted in misunderstandings by members about loan terms and collateralization. This disconnect ultimately led the credit union to opt to work directly with members to finance such projects:

> What we started to see is that, unfortunately, just the information that was relayed or lack of information relayed did create some challenges on the affordability in the long run for those members, where they didn't realize a lien may have been tied to their home. You know, a UCC Filing. Or they didn't understand the structure of the loan, which created some hardships. … The need, I think, was still there. The need for an ability to have affordability of lowering utility costs. I think everybody, you know, continues to see that as a need or an advantage for that, but it was more, I think, of the knowledge that, or lack thereof, that was between that type of relationship, and when we have it on the direct side, it's much easier. Because we're working with them directly and we can disclose or answer any questions and be much more transparent.

P15's credit union has built its core strategy around green lending and green banking products. This approach has made it attractive as a potential merger partner for other credit unions eager to get into the green lending business. It has also enabled the duplication of the lending model across the country. As a result, the credit union is creating a Credit Union Service Organization (CUSO) to allow credit unions in other states to use their loan origination system (LOS). P15 explained:

> We've totally doubled down on green lending and distinguished ourselves, and have attracted the attention of multiple credit unions. … We were also creating a CUSO to share our green lending LOS with other credit unions. It's got AI-driven decisioning and a very quick, very nice user experience for those who want to buy solar. And so, what we've learned in originating in all these states is that it's very hard for us to have a really good understanding of all the different programs that the local utilities have in these different states.

Participants whose credit unions were embracing green lending also discussed several elements of risk that were inherent in the process. P15 discussed the fact that solar panels can be destroyed in natural disasters, such as hurricanes, and because of this it is important to be able to place insurance on them:

> We have, you know, different risks in making energy loans than we do with others. We're talking about solar panels. There's always the risk that the panel can be destroyed, so certain areas of the country are definitely more risky than others. Financing solar panels in Miami is a bit riskier, and it's hard to get insurance on them. There's just different risks that we mitigate by maybe avoiding some areas.

P02 discussed the need to understand the default rates on solar and electric vehicle loans and make adjustments to the credit union's loan pricing model if the default rates are higher:

> We want to know as a percentage, how much the percentage of those types of things do we have. What's the default on those? You know, the type where they can't pay, make payments, or stuff like that. Loan losses associated with electrical vehicles. Those would be important for not just vehicles, but say they're solar panels and how that compares to loans and other things like that today because what happens is that if you have something, let's say you do solar panel loans and their default rate is the same as car loans, which tends to be our higher amount of default. Then you're going to need to price that into your rates, your pricing model.

P03's credit union was considering approaching solar lending as a personal loan with rates about 3% less than the normal personal loan rate. This proposed approach has caused some discomfort among management. P03 explained:

> That's one thing I know we've been looking into solar loans. This has been going on for years. I'll tell you honestly, a lot of people are uncomfortable with it because it's basically an unsecured loan for a large dollar amount to do solar panels. So, some people are iffy on that one.
>
> The idea is you offer it a loan. Say your personal loan is 10%. You would offer this one at 7. You would have to prove, give us an invoice that this is for the solar panels, and then we'd give you the loan. So, it's really no lien, no collateral.

P09's credit union, whose solar lending program has experienced enough demand to require adjustments to loan concentration limits, has a different approach, collateralizing solar panel loans by filing UCC liens against the homes to which the financed solar panels are installed. This situation has necessitated the updating of servicing procedures. P09 explained:

> I think there was a huge need for [solar lending]. We hit our concentration limit. So, I think that it's kind of snuck up on us. So I think concentration limits was really important going forward and how we manage the refiling of our UCCs. So we had to update our process and our guidelines, and procedures to create systems that would allow us to refile every 5 years on those UCC filings. So we kind of had to adjust the way that we did our typical lending as a kind of set it and forget it type thing, where this was like, no, we have to start refiling some of these UCCs and creating new processes to do that on the servicing side.

Another reported challenge related to the underwriting of green loans was described by P08 as a bias toward traditional underwriting. They explained that some people are now using building materials that are more fire resistant. However, standard underwriting models, whose terms and conditions allow banks and credit unions to sell those mortgage loans on the secondary market, do not yet allow for the use of those materials. P08 believes that this bias can also hamper innovation in the design of more fire-resistant building materials:

> I think in, you know some, of the standard underwriting practices, we've seen a real bias towards traditional energy production. Traditional building structure types … follow building code, but it's a lot easier to get financing for standard companies or standard businesses or buildings that are built the same way every single other building is built. There's no … new technology that might be scary there. … You're on the grid.
>
> They're not producing your own power. I think that there's been a real bias towards that type of building, which of course makes it much easier to build that type and kind of hampers any innovation. You have to be able to self-fund and be innovative at the same time, that really slows progress.

Another risk mentioned by five of the participants was the potential for reputational risk should their climate-risk mitigation tactics be perceived as violations of fair lending standards. This concern often arose when participants were discussing what they could do to mitigate risks in areas that are more prone to climate-related events than others. P01 explained that instead of refusing to lend to members residing in such areas, a better approach could be to use data analytics to identify at risk members in advance of a climate-related event:

> You probably know this from a financial institution, you can't redline. You can't identify areas where you're not going to lend, but you know, again it almost gets back to but then how do we … put things into place where we can help our members ahead of time if they do happen to fall within one of these areas that are affected more by climate … And again, that's part of that program that we're trying to build out with the data we have and trying to bring other data in to supplement that and those types of things.

P02, when discussing what types of data would be needed to evaluate climate-related risk, also expressed concern about fair lending should a credit union get too granular in its acquisition of certain data:

> I think the real danger comes in, though, if you try to get, you know, too much into certain things. I worry that it's gonna be, you know, "All right, well, I need to track him by their career or by whatever type of thing." … You don't wanna do stuff that is against fair lending policies. You have to lend to whoever can.

P16, whose credit union has a small field of membership, also expressed that it would be difficult to reduce lending in response to climate-related risk without it seeming like discrimination:

> I just thought about, given our small footprint, our field of membership.
> It would be hard for us to say that we are going to somehow limit, especially residential lending. Because … it could begin to look like redlining.
> Of course, it's not, and it wouldn't be on an impermissible purpose or reason.

Redlining is an illegal and discriminatory practice of labeling neighborhoods with predominantly African American populations as having greater risk, making it more difficult for residents of those neighborhoods to obtain mortgage financing (Jackson, 2021).

Among the study participants whose credit unions were active in green banking and green lending, there was some difference of opinion on whether credit unions should actively try to encourage members to move into products such as solar panels or electric vehicles, or whether the credit unions should simply find ways to meet member needs as they traditionally have. P01, P04, P09, and P15 worked for credit unions for which green lending and the protection of the environment were central to the organization's core values. P04 explained that their credit union had a program in which a percentage of their net income is donated to one of three pillars—organizations that help with climate change. "We try to support organizations that will lessen greenhouse gas, right. That is something that we consciously plan for," P04 explained. P09, whose credit union had an ESG mission, explained how this mission impacted their lending:

> We've always, or at least with our previous CEO, he was very in tune with the environment and environmental mission. And so we had developed a suite of products that included the early solar loan program.
>
> But you know, bicycle lending, we would also give discounts for hybrid or electric vehicles. And I think just that movement into reducing pollution has kind of shifted the type of loans and trying to give incentives for folks to purchase those types of loans or get that loan with us because we want to use our loan dollars towards those types of loans that are part of our, you know, people, planet, and profit. … And so that aligns with our strategy for sure.

Three participants reported that their credit unions, while not having it as a core part of their mission, were either considering or beginning to try to incentivize loans for solar panels, electric vehicles, and other climate adaptation loans. These incentives were

typically in the form of rate reductions. P03's credit union had a goal of $50 million in electric vehicle loan originations in 2025 and was providing a 150 basis point interest rate reduction. P12 likewise discussed a new program to incentivize green loans for their members:

> With the new [CEO] so forth, he's looking at … more of service or product gaps such as solar lending, home improvement lending, maybe for upgrading windows or installation, and some improvements to the house, where we can provide financing for members who want to improve the efficiency [of their] houses going forward. … So, we're looking probably at a launch maybe around May or so, [on] some of these products.

Three participants did not think that it was appropriate for credit unions to try to influence the behavior of their members. This group of participants believed that it was the responsibility of credit unions and financial institutions to let their members drive the types of products they offered through their consumer preferences. P02, whose credit union participated in green lending, stated that they are not trying to incentivize their members to go green. P02 did not believe that trying to steer members toward certain products was the right strategy:

> I'm not trying to incent them to go green, but if we have naturally people who are, there are also naturally people who aren't. … I wouldn't want to try to tell somebody… one thing that I think we've learned: don't try to tell the end user what it is that they want. Instead, ask them what they want, and then be there willing to provide service A for certain people and [service] B for others.

P10 similarly thought that the role of credit unions and financial institutions was to facilitate innovation by responding to market demands as climate change evolves:

> Are we really driving member behavior, or are members telling us what they want, and we're trying to meet their needs? You know, you go back 3–4 years, and we thought CDs were all dead. That changed really quickly, and our portfolio exploded with CD growth. I don't think we drove that. I think that was us reacting and responding, and I think that's how we'll see the industry go and especially with things like climate. We'll react with the membership goes and the needs of

the membership and try to be earlier adopters to things that are needed.

P08 explained that their credit union was balancing the offering of incentives with the avoidance of dictating behavior, trying to remove barriers to obtaining green financing while keeping a neutral stance:

> I would say [in] the current year [the credit union] is trying to take a neutral stance on it, but they're trying to take a more neutral stance, not a … maybe legacy stance that's making it challenging for those members who do want to get those solar panels on their house or buy that expensive electric vehicle. If they're not making it through underwriting because of it being an electric vehicle, we also want to address that.
>
> So, I wouldn't say we're necessarily doing incentives, but we are trying to have a neutral stance that gives our members the option to do what they want.

The question of whether credit unions should promote products that align with their organizational mission or whether credit unions should simply follow the market had a corollary. Similar ideas arose with respect to the role of the public sector and regulators in helping credit unions to mitigate climate-related financial risk. This question is discussed in the next section.

Government Assistance and Regulation

Eight participants (44%) discussed the role of government during the interview process. Participants recognized that government grants and other types of financial assistance could be used to help get green lending and climate adaptation programs going more quickly. Climate-related data supplied by government agencies was also seen as valuable to the process of risk assessment. While financial assistance and data were seen by participants as being helpful, opinions differed on the scope of any climate-related regulations that could potentially be imposed.

Three participants reported receiving or applying for government grants and assistance in financing solar panels, electric vehicles, and other climate adaptations. P02

reported that their credit union is applying for government grants to help their members purchase electric vehicles:

> We're working at trying to get grants and things like that for our members so that we can help them have a lower interest rate, let's say, or help pay for part of the down payment, or whatever it is that we end up deciding that we're going to do.

P15's credit union had recently applied for a federal grant to help fund solar projects for people who live in low-income or economically disadvantaged areas. P15 also described a program created for use by credit unions through the Inflation Reduction Act to help with GHG reduction:

> The Inflation Reduction Act peeled off about $27 billion, I think, for a greenhouse gas reduction fund, and an organization called "Inclusiv" received a portion of that. … They've embraced clean energy or green lending operations for low-income and disadvantaged communities, and obtained a $1.87 billion grant from the Greenhouse Gas Reduction Fund to be used exclusively by credit unions to bring the benefits of clean energy to those communities.

At the time of the interview, P15 had not yet received the funds, and they anticipated that, under the current presidential administration, some of the funds might be reduced, but they did anticipate that the funds would ultimately be released. P09 also commented that political trends can affect the receipt of grant money for these types of programs, and hence the stability of those types of programs:

> Not to get too political, but grant money, federal grant money, can be restricted. We've seen it in the previous experience, whether it's Biden or Trump, ebbs and flows of who they're choosing to get federal money to. So, our state may be lacking some federal grant money that would help us with some of our efforts, or even the CDFI grants. Who's eligible to get those, and who [is] selected. So, most of those are environmental or economic type grants. So that could certainly be a risk to us going forward as well.

Participants also commented on the value of data that are supplied by government agencies and expressed concern that, under the current political climate, some of these data sources might be going away. P04 worried about the changes taking place at NOAA

during the early spring of 2025 and what effect those changes might have on the ability to plan for a future climate-related event:

> Maybe getting more of that agricultural and farm data may be harder as we lose some of our resources in the government that aggregate data. We've got the government changes with NOAA, which tells us that's our weather. Like what could happen? What we might need to know to plan for a future storm for things like that. We might not get information as quickly. So, I think getting that data is really dependent upon these organizations.

Data loss was not just a concern at the federal level. P16 discussed a potential flood risk created by a loss of data from studies on levy construction paid for by their county:

> Hoquiam and Aberdeen have partnered over the years with the county and the Corps of Engineers and all these people to work on additional levies. … It was probably last year, 2 years ago, that I was asking, "So, you know, I keep hearing about this levy and, I think it was that the studies were done years and years ago for this." And I said, "So, have they been updated, given the new thoughts about how much sea level change and things like that?" "Well, no, not that I know of."

P16 then explained that officials from the county were not overly concerned about flooding from sea level rise because they believed that the flooding risk in the area stemmed primarily from the local river overflowing at high tide. P16 was concerned about both the lack of new information and the attitudes of the county officials.

Participants also discussed the possibility of the implementation of new regulations to address climate-related risk. P02 reported that the Washington State Department of Financial Institutions had begun asking about policies and procedures around climate change. P02 stated that they have not modified any policies and procedures yet in response, but that "it's something that we will look at as we go into the future." P03 also acknowledged that climate-related risk is leading to new regulations, but those have not made it to institutions in this asset size range yet. P03 said, "There are

regulatory changes that have occurred that we've seen over the years. And kind of what we were talking about before. It's mainly starting at the bigger fish, and it's going to work its way down to us."

P02 was concerned about the unintended consequences of climate-related regulations. In particular, they worried that the government trying to dictate the use of electric vehicles was the wrong approach to addressing climate-related risk. P02 suggested that having more data on electric vehicle sales could help credit unions to push back against such mandates:

> It's very concerning … I get concerned a little bit on the 12 states that are trying to make it mandatory. By 2035 that it's all electrical vehicles, and it's like what [if the] technology still isn't there? 'Cause it's not there now. And what if the electrical grid still isn't capable? 'Cause it's still, it's definitely not capable now. And all kinds of things like that that still need to be worked out. And if you have a drop-dead, absolutely hard thing, I get worried.
>
> So, for me, I think having the real data will be beneficial because then, when Olympia or somebody wants to try to do something [where] it's absolutely mandatory, we could say listen. It's still early 5% of the cars are still on the electrical vehicles, and 10% are hybrid. That's still only 15% of the cars. If you force this to happen, this will cause a massive problem.

P16, while seeing value in regulations and the danger of climate change, appeared to think that, at times, mandated regulations could be impractical given the resources of their small credit union:

> I'm a fan of regulation. I think the government provides a very necessary role. But now, having been in a credit union. … I do now better appreciate the feelings that arise when you're told that you need an official, detailed succession plan. Don't have time. Yeah. And this [climate-risk regulation] could easily be one of those, that I could probably get behind. Readily see that we need a plan for. Because it's not if. It's when.

P16 appreciated recommendations from regulators and auditors as well as work groups, but added, "Of course, you don't want to mandate. You want a recommendation." There were common recommendations and ideas that the interview participants had for

how to potentially address climate-related financial risk. Some of these ideas were discussed in the last two sections. The next section explores these common ideas in more detail.

Credit Risk and Analysis

During the semistructured interviews, the participants discussed a variety of ideas for responses to climate-related credit risk, including methods of data gathering, uses of newly acquired data, and underwriting changes. Broadly, these ideas could be categorized as credit analysis, mapping member locations against high-risk areas, and correlation to existing financial metrics. Some of these ideas were already being implemented at the participants' credit unions, and some were just being considered, if only by the participants themselves.

Credit Analysis. Eleven of 18 (61%) participants discussed the impact that climate-related risk could have on credit analysis and underwriting. Of the 11 participants who discussed credit analysis, six thought that one means of factoring climate-related risk into credit risk analysis would be to include climate-related risk as a qualitative factor adjustment to the CECL calculation. Other ideas included tightening loan underwriting standards, incorporating climate-related risks into loan portfolio reviews, and working to better understand which parts of the loan portfolio may be most exposed to climate-related risk.

P05's credit union uses a CECL model that incorporates NGFS assumptions and scenarios for climate-risk modeling. P05 discussed how a Q factor could be incorporated to account for the increased fire risk in their credit union's geographic area:

> So, in our models, the data that they use to create our loss rate, our national numbers, we have some scalers to help get us closer to institutions that are our

> asset size, similar to our geographical area maybe, but they're not that similar to our area when I look at them. Some of them are Portland, for instance. And so I think that there is a possibility of us implementing more of a Q factor to say, "Yeah you can create an agricultural loan in that area if you want, but here's the added risk associated with the fact that it's lit on fire four times in the last 5 years."

P13 similarly discussed the possibility of identifying which members were in areas that were exposed to climate-related financial risks and then setting aside additional reserves for them in the CECL calculation:

> I think you could certainly risk-rate your members based on their home address. So, we've mapped out the area, the counties we serve, and we've said these sectors have the highest climate risk based on flooding, fire, maybe hurricanes, right? Whatever factors we're deciding and we heat map it and OK. Now I'm gonna plug them into this heat map based on their home address and identify that these numbers are the highest risk for a climate event occurring. What types of accounts do they have with us? You know, are they heavy in deposits? And they could be a liquidity risk in the event of, you know, XY or Z happening. Or are they heavy in loans, and we should think about a qualitative and, you know, economic factor, a Q factor to put on to our allowance for credit loss.

Commenting on the increasing difficulty for members to obtain insurance, P08 talked about how their credit union was considering making an adjustment to their ACL, as well as taking other actions:

> We don't necessarily have like a game plan or anything yet, but we're [asking ourselves], "Do we change our CECL allowance? Do we change our credit quality components to try and protect the credit union for an additional risk that's kind of outside of the borrowers' ability and outside of the credit union's ability?" Talk to the credit union groups and try and do some political persuasion, as far as, "Hey, credit unions need people to be able to be insured also." We're really kind of just exploring whatever avenues we have at the point. Not going super hard into anything, but just wanting to know what our options are.

Other participants mentioned the idea of incorporating climate-related risk into the normal loan underwriting and monitoring process. P09 discussed factoring climate-related risk data into their established watch list and annual portfolio review process:

> Annually we do a portfolio review that includes right now values. So even on our auto loan portfolio, our mortgage loan portfolio and we get a risk assessment like I mentioned like the value of a home is a lot easier to predict. Hey, you have X amount of your portfolio that is close to say, over 80% CLTV you've got, you know, this amount of auto loans that are over 120% LTV.
>
> So you can kind of assess that risk and say OK, then break it down further. What credit tiers are they? Are they in the more risky creditors? Are they not in the risky creditors? So, then the likelihood of loss later on top of that would kind of give us an idea of how much risk we're truly taking and then it goes back to that profitability of the product.

P12 discussed that tightening underwriting standards was one response to climate-related risk that they had already been using:

> It's getting to the point where we just had a meeting last week where we have to tighten up the underwriting guidelines for some of these indirect loans. … You may have to not do older types of vehicles, will have to do only top-tier tier, top-shelf type of loans, A and B. Maybe not do D or E or that type of tier pricing, even though it's risk-based pricing. What we're seeing now, even the higher interest rates won't cover the losses that we're seeing.

Reflecting on the possibility of pricing differently for members in areas more prone to climate-related events, P04 said, "We might have to think about, 'Well, your rate's going to be higher because that's where you're at,' which is weird to think about, right?" P03 also expressed the increasing importance of knowing how the business landscape of an area and its risk profile evolve over time:

> I think it's important to know how the landscape changes. So what was low risk before could be a high risk now. And we have tons of people moving in and out of here. I'm just trying to think just back to 2020, how many businesses have closed? … This information could be pretty relevant because as more places come in, they could be very climate-friendly or not. They could be a business that, you know, a blizzard could ruin them and make them go belly up. So I think it's relevant to keep monitoring it and how the landscape changes. I would say especially on the business side of it. Where our business portfolio is growing more and more.

Participants suggested a variety of adaptations to credit risk analysis procedures to account for climate-related financial risk. These suggestions included making qualitative factor adjustments to the CECL calculation and tightening underwriting standards.

Adjustments to the Allowance for Credit Losses (ACL) were also being made. Concerns were expressed about the risk of tightening underwriting standards in areas with higher climate-related risk being perceived as discriminatory. Mapping member locations against areas known to have higher climate-related risk is discussed in the next section.

Mapping Member Locations Against High Risk Areas. Understanding which members were most exposed to climate-related risks was important for participants who thought that adjustments to the ACL should be made or that underwriting standards needed to be tightened. Ten participants suggested that part of their climate-related data analysis should consist of mapping member locations against geographic areas with a high risk for climate-related events. They thought that this could be a way of anticipating which members could experience the most difficulty should a climate-related event occur. P05 stated, "It would be interesting to see a map of all of our collateral thrown on it and our high-risk environmental areas." P01 described how their credit union accomplished this using their data analytics department:

> Through the data analytics department that we have, they've been able to use Tableau, for instance, and there's mapping there. In order to map our members to try and overlay that onto known fire areas. In order to understand, "Do we have members that are at risk? Do we have members that, maybe we haven't heard about it, but that have had homes devastated," those types of things.

P08 spoke about how their credit union had been able to use this type of overlaying of member locations, by zip code and address, against fire risk maps to help members when a forest fire occurred:

> We have a fire risk map that Oregon already produces, and the cross-section of those people may be more affected in the event of wildfire evacuation notices.
>
> When that event did occur … when there was a fire, we proactively pulled the ZIP code, you know, pulled the addresses by ZIP code, and we reached out to our members and said, hey, if you've been affected by this, come talk to us. We're going to work things out with you.

P06, commenting on the importance of understanding concentrations of risk in the commercial loan portfolio, suggested that once the locations of members could be compared to areas of climate-related risk, in this case, fires, that information could be correlated and compared to underwriting assumptions that had been made. P06 said:

> I think it would be important to understand, going back to concentration risk, the concentration of loans. By maturity, but also by industry and by product type, for some of our business loans or commercial loans. Understanding a concentration of location.
>
> For some of our commercial properties or business property loans that, for example, when we had the couple of wildfires a year and a half to 2 years ago, they were both hit a lot at the same time.
>
> So we quickly looked to see what collateral risk we had in the way of the fires on that day. So, I think collecting some of that information and comparing that to the underwriting assumptions that were put as part of those loan structures to understand the 10-year impact for the growth stream or the income stream that's embedded within that underwriting.

Understanding which credit union members were located in areas that are at high risk for climate-related events was seen as important by 10 participants. Participants reported some progress being made toward being able to accomplish this, with one participant using a fire risk map and, when fires occurred, contacting members in the affected zip codes. Another participant described using their organization's data warehouse to begin mapping their members in this manner. Another participant's credit union had begun looking at which commercial members resided in areas where recent wildfires had occurred, with the idea of comparing those businesses and locations with the underwriting assumptions used in the loan origination.

Correlation to Performance Metrics. Another use of climate-related data that three participants talked about was using gathered climate-related data and correlating it to known performance metrics or forecasts that ultimately could result in actionable

business decisions. P05 commented on the importance of taking data obtained from what happened because of climate-related events and tying that knowledge to something on the credit union's income statement:

> I think that it would be one thing to even find out what happens to our membership and their employment status as we have natural disasters. But then, how do we link employment status to a change in loss rate?

P08 thought that climate-related data could be factored into income and expense forecasts for affected line items:

> I think it would and should be part of our projections as far as increases in expenses and future challenges that may be growing faster than your normal 3% a year. … Adding data like this, where we can really zero in on specific line-items or risk areas to add a little more informed projection information, I think, can be really valuable.

P06 saw a potential use of climate-related data in a capital at risk chart that could show, among other risks to capital, the effect of climate-related risk from specific concentrations of loans:

> It'd really [be] fun to have a chart to show here's our capital and here are the parts that have risk or opportunity, of which one could be climate risk and the detail behind that could be the swing of the loss ratio for a concentration of loans that are in a particular industry or something like that.

Operational Adaptations

Finally, 11 participants discussed operational changes they are making or potentially could make in response to climate-related financial risk. Many of these changes focused on energy efficiency in buildings. P14 described how their credit union had designed a new branch to better manage heating and cooling:

> We designed a new branch, and it was at the peak of lumber costs. But we were designing the way we located it. We were doing eco-block so it would retain heat, and basically it would take out the ebb and flow of the natural heat cycle. It basically cuts off the top and bottom.

P03's credit union was also focused on energy efficiency in their new buildings. P03 discussed their new headquarters building:

> The headquarters building that we bought is LEED [Leadership in Energy and Environmental Design] certified. Everything down to we've changed the lighting in our branches and all the rest of our buildings. So they're motion sensors. So we're not wasting as much energy there, just things like that.

LEED certification is awarded by the U.S. Green Building Council (2022) when a building meets specific minimum environmental prerequisites, depending on the type of building. While criteria for the green building can vary, LEED certified buildings typically meet standards for energy and water use, quality of the indoor environment, and selection of materials.

Other participants discussed the possibility of having to identify where their members were relocating to in response to climate-related risk and then make determinations on future locations based on that information. P10 talked about this in terms of decisions on where to locate branches:

> Then it's looking to see where member behavior is shifting. Are we seeing people shift to different parts of the community? Do we then need to strategically put branches in those different areas as people start adapting to the changes in the environment?

P03 took this idea a step further, suggesting that there is risk in locating branches in new areas that could potentially face climate-related events, which would then make it difficult to service members and put the credit union's reputation at risk. P03 suggested that a mobile branch could be a potential solution:

> You know, we have had worries about it that if we get branches further out towards the coast or Bend, or you know what? It's hard to enter that. It's hard to enter any marketplace, but then you have increased premiums that we would have to pay. And then if we can't reach those members, we don't let them down. So I mean, something we started discussing is maybe doing a mobile branch.

P16, whose membership resides in an area that is exposed to climate-related risk, suggested that expanding the potential membership base could help to diversify the credit union's member profile, spreading climate-related risk among a larger base:

> We would probably, in terms of marketing, start looking at marketing in areas that don't have the same risks. We probably would look at increasing our field of membership. Our field of membership is restricted right now to [a single town], and the whole harbor has problems from a climate risk perspective.

Finally, two participants discussed incorporating climate-related risk into their existing ERM programs. P13 stated, "So we are now working on an ERM framework to … manage to. So, I would certainly think, you know, this is one of those types of risks as we think about ERM." P14 stated that, at present, most reporting of a climate-related nature was being incorporated into enterprise risk disaster recovery reporting:

> I think it's just on the broad level when we look at … enterprise risk, and we do provide, you know, reports to our board overall. It's more so at this point on the disaster [side], and it'll come up in strategic planning sessions where we talk about potential risks and concentrations.

Eleven participants discussed organizational adaptations that could be implemented to mitigate climate-related financial risk. One adaptation put forth was adapting the credit unions' buildings and facilities to be more energy efficient. Another suggestion was using a mobile branch to service areas deemed to risky to locate a credit union branch. Expanding the field of membership of the credit union to achieve greater diversification was another idea suggested. Climate-related risk was also being introduced into ERM safety and business continuity programs.

Operational adaptations comprised the last major category that emerged under Theme 5. This concludes the detailed discussion of the five themes revealed during the participant interviews. The following is a summary of the key points in Chapter 4.

Summary

In this chapter, the responses of the interview participants were explored and analyzed. The interview transcripts were analyzed using the axial coding process. Five themes emerged from the data analysis. The themes identified were direct risks, indirect risks, data challenges, no specific policy or procedural changes, and financial institution and governmental responses. Direct risks (Theme 1), which were defined in this chapter as losses and other risks stemming directly from climate-related events, included risks such as climate-related credit risks, physical and operational risks, and reputational risk. Indirect risks (Theme 2), which were defined in this chapter as losses and other risks not stemming directly from a climate-related event, but rather from another source that has been affected by climate-related events, included decreased availability of insurance on loan collateral, increases in insurance premiums, and climate-related systemic risks. Climate-related systemic risks included risk to the valuation of credit union assets, risk to key industries that made up credit union segments or were important to the communities they served, and risks from disruptions such as shortages and spread of risk contagion due to the interconnected nature of the financial services industry and the overall economy.

Data challenges (Theme 3) consisted of challenges related to the availability, integrity, interpretation, or prioritization of climate-related data. Commonly reported data challenges involved the lack of availability of needed data, multiple locations and varying formats of data, data consistency and integrity, and lack of time and prioritization for the gathering and analysis of data. Participants also discussed the need for dedicated personnel to analyze gathered data, and some also thought that AI applications could help

credit unions that lacked the money or resources for dedicated analytics staff. No specific policy or procedural changes (Theme 4) emerged as it became evident that 72% of the participants had not modified or created any policies or procedures specifically for climate-related risk. Finally, protection of members from unscrupulous vendors and unfair lending practices was discussed.

Financial institution and government responses (Theme 5) involved the actions that participants' credit unions were taking or thinking of taking to mitigate climate-related risk to their organizations. The offering of green lending products was viewed by participants as a means of climate-risk mitigation. In addition, opportunities for differentiation were also seen in efforts to promote green lending. Participants recognized that government grants and other types of financial assistance could be used to help get green lending and climate adaptation programs going more quickly. Climate-related data supplied by government agencies was also seen as valuable to the process of risk assessment. While financial assistance and data were seen by participants as being helpful, opinions differed on the scope of any climate-related regulations that could potentially be imposed.

Other response ideas in Theme 5 were also put forth by participants. Broadly, these ideas could be categorized as pertaining to credit analysis and organizational adaptations. Ideas for credit analysis included making adjustments to the ACL and mapping member locations against areas known for exposure to climate-related risks. Other ideas included using climate-related data to enhance budgeting and other forecasts and tying data on climate-related events to metrics already being used by the credit unions to gauge their impact.

In the next chapter, these themes are discussed in the context of how they answer the RQs of the study.

CHAPTER 5: CONCLUSIONS AND DISCUSSION

Both academics and professionals continue to emphasize the need for financial institutions to identify and quantify the emerging financial risks of climate change. However, few researchers have studied what credit unions are doing to measure these risks. Using the FSSD and the SDF as the theoretical frameworks, this basic qualitative study explored how finance and risk management professionals working at community-sized credit unions in the Pacific Northwest region of the United States are adapting their risk management policies, procedures, and analytical processes to address these risks. The data for this basic qualitative study were gathered through semistructured interviews of 18 finance and risk management leaders from 17 unique community-sized credit unions in the states of Idaho, Oregon, and Washington.

The findings from the semistructured participant interviews were discussed in detail in Chapter 4. Five themes emerged from the data collected during the interviews. These themes are listed in Table 5.1.

Table 5.1

Themes That Emerged in Interview Data

Theme number	Theme name	Theme description
1	Direct risks	Losses and other risks stemming directly from climate-related events
2	Indirect risks	Losses and other risks not stemming directly from a climate-related event, but rather from another source that has been affected by climate-related events.
3	Data challenges	Challenges related to the availability, integrity, interpretation, type, use, or prioritization of climate-related data.
4	No specific policy or procedural changes	The absence of any climate-related changes to organizational policies and procedures.
5	Financial institution and governmental responses	Actions being contemplated or taken by credit unions, either alone or with government aid, to address climate-related risk.

Note. Source (Interview data, this study).

In the next section, these themes are discussed in relation to how each addresses the RQs posed in the study. In later sections, the applications of these findings to the problem statement and the applicability of the findings to credit unions, regulators, and academics are discussed. The chapter concludes with a discussion of recommended actions and items for future research.

Discussion of Findings and Conclusions

The aim of this study was to answer three RQs related to how finance and risk management professionals at community-sized credit unions in the Pacific Northwest are adapting to address climate-related financial risk. The RQs were:

RQ1: How do finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations?

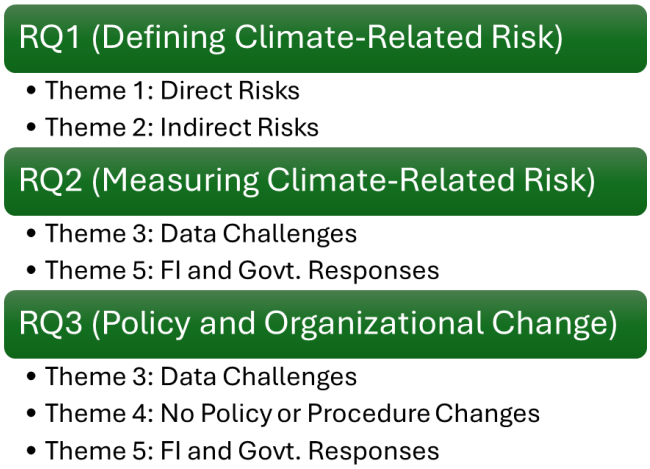
RQ2: What actions are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest taking or planning to take to measure the financial risks from climate change?

RQ3: What progress are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest making on policy, governance, or other organizational changes in response to climate-related financial risk?

The five themes that emerged during the participant interviews each contributed to answering these questions. Themes 3, 4, and 5 contributed to more than one RQ. Figure 5.1 shows the link between each RQ and the themes that address it.

Figure 5.1

Research Questions and Related Themes



In the following sections, each RQ is discussed in detail with explanations for why the specified themes help to answer it. Summaries of how the participants responded in each theme, and the ties, if any, that these responses have to the surveyed literature, are also noted.

RQ1

RQ1 addressed how finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations. During the interviews, participants were asked about their primary job responsibilities and the risks they manage at their organizations. While participants were allowed to list more than one risk, 16 participants reported the combination of liquidity risk, credit risk, and interest rate risk. Two participants reported cybersecurity and fraud risk, while two others mentioned the risk of losing depositors. Pricing was another risk identified by two participants. For the purposes of this study, the risk of losing depositors was a subset of liquidity risk, since a credit union's liquidity is affected by the amount of dollars its members have on deposit. Pricing risk, insofar as it influences the amount of revenue earned on loans and the amount of dividend expense paid on member deposits, is considered for the purpose of the study to be related to both liquidity and interest rate risk. Thus, except for cybersecurity risk and fraud risk, the primary risks managed by the study participants were liquidity risk, credit risk, and interest rate risk.

Credit risk was the most common risk mentioned by participants as being potentially affected by climate change and climate-related events. Participants believed that credit risk could be affected directly through the occurrence of a climate-related

event, such as the destruction of a loan's collateral in a wildfire or flood. In addition, participants also stated that credit risk could be negatively impacted by the disruptions that climate-related events could inflict on their members' lives, inhibiting those members' ability to work, earn income, and repay loans. Participants also observed that credit risk could be negatively impacted indirectly through higher costs of items such as automobile and homeowner insurance in regions where the risk of climate-related natural disasters was greater. It was noted that these increased costs of insurance were already causing increases in delinquencies and voluntary surrenders of collateral. Participants also stated that climate-related events could affect key industries in their communities, affecting member income and employment, and potentially causing loan losses. The common denominator of these various directions from which climate-related risk could affect credit unions was increasing credit risk.

While credit risk was, regardless of the path that climate-related events took to affect it, seen by participants as the primary risk affected, liquidity appeared to be a secondary, though important, concern. The concern over liquidity was expressed as concern over the potential loss of depositors because of climate change. Collapses in the value of housing stock could lead not only to loan losses but to reductions in local government tax revenue, which could lead to reductions in local government services, potentially causing residents to leave the region and, by extension, the credit union. Should credit union members relocate under such a scenario, taking with them their savings and other deposit accounts, the credit union could face reductions in liquidity. This scenario displayed an understanding by participants of the potential for climate-related risk to propagate from an initially affected societal segment to another.

The risk to agricultural lending illustrates another example of how participants understood the progression from credit risk in one population of members to risks in downstream populations. Climate-related events such as droughts, wildfires, or floods could negatively impact the ability to successfully grow crops. Should crops fail, repayments of loans for the seed to plant those crops would be impacted, which could impact the viability of those farms. Workers on those farms could then lose their jobs, and companies supplying those farms could face reduced revenues, affecting their financial stability. Depending on the location of these stakeholders, a credit union could face loan losses from farms, loan losses from workers on those farms, and reductions in liquidity should workers have to relocate to find work elsewhere.

While branch operations and supply chain management were not stated by participants as being under the set of risks that they managed, study participants also spoke of the risks of damage to their credit unions' branches and other facilities that could affect their ability to render service to their members. Supply chain problems stemming from climate-related events occurring in other areas of the country were cited by participants as potentially affecting both operations and some types of loan originations, such as construction lending. In addition to presenting a safety risk to the credit unions' employees, damage to branches and facilities could lead to increased reputational risk should that damage cause a long-term disruption to member service. Should supply chain disruptions affect the origination of certain types of loans, interest rate risk could be impacted due to the restrictions created on where to deploy member deposits for the best rate of return.

Participants reported credit risk as being most potentially affected by climate-related events, whether through direct effects of climate-related events or through indirect means such as increased insurance costs or propagation of risk systemically. Systemic effects could further impact liquidity in the case of members either leaving the credit union entirely or having to reduce their savings in response to disruptions caused by climate-related events. Participants recognized that climate-related events could have both immediate and downstream consequences.

Analysis in Context of Literature

The participants' views on the risks to their credit unions that were affected by climate-related events were consistent with the literature reviewed for this study in Chapter 2. The TCFD (2017) divided climate-related financial risks into physical risks and transitional risks, with physical risks comprising the risk of damage from either acute or chronic climate-related events, and transition risk comprising the financial risks stemming from the transition to a low-carbon economic system. Physical risks could include disruptions due to the inability of credit unions to provide service to their members or from the inability of their members to repay their loans (Hofheimer et al., 2022).

While the study participants did not use the terms "physical risk" and "transitional risk," the risks they described fell into the physical risk category. The scenarios that the participants described as affecting their credit risk and other risks all stemmed from climate-related events occurring either through direct or indirect means. These climate-related events would then affect the members' ability to repay loans. Participants did not speak of any risk resembling what the TCFD would describe as transitional risks. To the

extent transitional risks could manifest as changes to regulations or business conditions (Hofheimer et al., 2022), participants did not view such changes as affecting credit, liquidity, or interest rate risk. Rather, they viewed changes in regulations in the context of responses to climate-related risk, discussed in the RQ2 section.

Participants viewing climate-related risks as primarily affecting risks they already manage (credit, liquidity, and interest rate risk) is also consistent with the literature. While not stating the term climate-related risk specifically, the participants saw credit, liquidity, interest rate, operational, and reputational risks as the transmission channels through which climate-related risk would manifest in their financial performance. The BCBS (2021) defined climate risk transmission channels as the causal connections through which physical and transition risk drivers can manifest as financial risks to banks and other financial institutions. The BCBS defined these transmission channels as credit risk, market risk, liquidity risk, operational risk, and reputational risk, emphasizing that these transmission channels all represent existing sources of financial risk to banks. One difference from the literature that emerged was how reputational risk was defined. The TCFD (2017) and Rahman and Mohammed (2022) defined *reputational risk* as stemming from changes in customer preferences away from organizations that conduct business with high carbon-emitting firms, such as those engaged in manufacturing or in the extraction of fossil fuels, in favor of those with a lower carbon footprint. From the view of literature, reputational risk was more of a transitional risk. However, the study participants, when they mentioned reputational risk, did so in the context of physical risks preventing their credit unions from serving their members effectively. The participants' view that credit risk would be the major transmission channel through which climate-

related events would affect the risks they manage was also consistent with the quantitative studies by Apergis (2023) and Nie et al. (2023), who showed increases in nonperforming loans in the years after major natural disasters.

As an answer to RQ1, the participants of the present study defined climate-related risk in the context of the other financial risks to their organizations as a source of risk that would most affect credit risk in terms of their borrowers' ability to repay loans. There could also be secondary effects on liquidity and interest rate risk should members be forced to relocate to find new work or to areas where they can obtain affordable homeowners' insurance. The participants saw climate-related financial risks as being primarily physical risks, as that term is defined in the academic literature. Their responses also matched the reviewed literature in terms of viewing climate-related risk as being transmitted through existing risk channels. How the participants defined reputational risk was different from the current literature.

RQ2

RQ2 was concerned with what actions the participants in the study were taking or were planning to take to measure the risk from climate change to their organizations. Participants were asked questions during the interviews that related to the types of data they thought they would need to collect to measure climate-related financial risk, what organizational resources would be required to do so, what challenges they expected to face in acquiring the data, and how that data could ultimately be used in financial and other reporting. From the interview responses, information from Theme 3 (data challenges) and Theme 5 (financial institution and governmental responses) helped to address this question.

No participants stated that they were actively engaged in activities meant to measure their exposure to climate-related risk. However, the use of tools that would potentially be needed to measure this risk, such as the construction of a data warehouse, was reported. In addition, participants mentioned several ideas for how to best measure their exposure to climate-related financial risk if they were to go about doing so. One of the most common approaches mentioned was mapping or overlaying their members' locations against areas that were known to have a greater risk for the occurrence of a climate-related event. This could include both areas with exposure to acute climate-related events, such as wildfires, or areas with exposure to chronic climate-related events, such as sea level rise. This approach would quantify the amount of members in higher risk areas, along with the amount of outstanding loan balances, types of collateral at risk, and the dollar amount of deposits at stake. A second commonly mentioned idea was to incorporate climate-related risks as a qualitative factor adjustment to the CECL calculation of the required ACLs reserve. This practice would help to ensure that the reserves set aside for loan losses are sufficient to accommodate the increase in credit risks associated with climate change. A challenge with this approach would be determining how to measure an appropriate qualitative factor. A third idea put forth during the interviews was incorporating climate-related data into the normal loan underwriting and monitoring processes. Insofar as the primary risk affected by climate change was thought by participants to be credit risk, this idea also made sense. Corelating any climate-related data to existing performance metrics was also put forth as an idea for helping to measure climate-related risk. While no participants reported that they were actively measuring exposure to climate-related risk specifically, they proposed several ideas for ways to

begin doing so. These ideas focused on the primary risk they thought would be affected by climate change (i.e., credit risk) and were able to be incorporated into existing means of risk measurement.

Participants also reported what they believed would be challenges related to gathering this type of data. These challenges concerned the availability of the data needed, the locations of some of the data, and the integrity of that data once obtained. Other concerns included the lack of time and prioritization on the part of management in putting these data together. Ideas for addressing these challenges included collaborating with other credit unions to gather and share data, hiring dedicated data personnel, and making use of AI to analyze data.

Analysis in Context of Literature

The ideas put forth by the study participants for measuring climate-related financial risk centered primarily on analyzing its effect on credit risk, which was identified in RQ1 as the risk most likely to be significantly affected by a climate-related event. These analytical approaches were formulated to address a climate-related physical risk that stemmed from either acute or chronic climate-related events. In contrast, most of the literature reviewed that was concerned with reporting and analyzing an organization's exposure to climate-related financial risk dealt with transitional risk. Dennis and İşcan (2024) proposed a quantitative approach to estimating transition risk at the national level. The World Economic Forum recommended an approach to measuring transition risk by calculating what they called a "green ratio," estimated by dividing the number of loans made for environmentally friendly economic activities by the institution's amount of total loans. The methodologies recommended by the PCAF (2022) to estimate a financial

institution's financed emissions are also designed for the purposes of estimating transition risk and measuring overall global financed emissions. These studies and methodologies were concerned with enabling financial institutions to measure the GHG emissions that they financed, for the purpose of estimating both transition risk for the institutions themselves and total global emissions in the context of the Paris Agreement.

Hofheimer et al. (2022), however, were more directly focused on credit unions. Hofheimer et al. had estimated the physical risk exposure of U.S. credit unions as a group using financial data from regulatory call reports, mortgage loan data collected through HMDA compliance, and county-by-county data on the climate-related risk exposure contained in the FEMA NRI. The Hofheimer et al. approach could provide participants with an initial analytical framework for the idea of mapping member locations against areas known for high levels of exposure to climate-related events. For instance, credit union leaders could identify, for each county in which they have members, the risk for specific types of climate-related natural disasters and compare that to the concentration of members, along with the types of credit union products those members have. In this way, the Hofheimer et al. approach could serve as an initial blueprint for mapping member locations against areas at high risk for climate-related events.

While the study participants did not identify any analytical methods that they were currently employing to measure climate-related financial risk specifically, they did provide ideas on some potential approaches. The analytical approaches they discussed centered mostly around the potential increases in credit risk that could stem from exposure to climate-related events. Ideas from the participants included identifying qualitative factors as an adjustment to the CECL calculation, incorporating climate-

related risk data into normal loan underwriting and monitoring practices, correlating climate-related data to existing performance metrics, and mapping member locations against known areas of climate-related risk. While most of the surveyed literature that dealt with estimating climate-related risk exposure involved the measurement of transition risk, Hofheimer et al. (2022) outlined an approach to estimating physical risk that participants could use to begin mapping member locations against areas of known climate-related risk exposure.

RQ3

RQ3 was concerned with what progress finance and risk management professionals working at community-sized credit unions in the Pacific Northwest are making on policy, governance, or other organizational changes in response to climate-related financial risk. Participants were asked interview questions concerning what policies and procedures had been changed to address climate-related risk, how climate-related risk had affected strategic planning at their credit union, and how climate-related risk was considered when making investment, credit, or operational decisions.

While the majority of participants (72%) reported that no policies or procedures had been modified or created to address climate-related risk specifically, it was becoming a subject of discussion at management and board meetings. Climate-related risk was also reported as beginning to surface in strategic risk analyses. It was also commented that while climate-related risk was not being called out by name, events such as wildfires were becoming part of management discussions more often than in the past. Part of the reason for a lack of specific climate-driven policy and procedure changes was an attempt to avoid having policies and procedures become too specific, thus hampering efficiency

and flexibility. Lack of time and prioritization were also cited a reasons for not adapting policies and procedures. The unpredictability of climate-related events and the difficulty that unpredictability would cause in creating plans of action were also listed as contributing factors for the lack of policy and procedural changes.

While progress on modifications to or the creation of policies and procedures related to climate-related risk had been limited, participants reported progress in other areas. Green loan originations for products such as solar panels and electric vehicles were seen as a means of helping members adapt to climate change, and these adaptations were viewed as helping to mitigate climate-related risk to the credit union. The energy savings from the adaptations financed by these loans were seen as a means of helping members to pay their bills, reducing credit risk to the organization. Green loans and green banking products were also seen as a means of differentiation from competitors who did not offer such products. Government assistance was reported as helping to implement green lending programs. Participants had applied for government assistance in the form of grants to fund solar projects for people in economically disadvantaged areas, grants to support the purchase of electric vehicles, or funds available to credit unions through the Inflation Reduction Act to support GHG reduction. Participants were divided between those who saw the origination of green loans for solar panels, electric vehicles, and other climate adaptations for homes as being a part of their organizational mission and those who saw green lending more as a means of fulfilling member needs without making it an organizational mission. Overall, though, participants whose credit unions participated in green lending programs viewed participation in those programs as a means of addressing climate-related risk.

Participants also reported organizational adaptations that had either been implemented or could be implemented to mitigate climate-related financial risk. Many of these changes focused on energy efficiency in buildings. Other participants discussed the possibility of having to identify where their members were relocating to in response to climate-related risk and then make determinations on future locations based on that information. A mobile branch was floated as a potential alternative to a new branch building when a credit union needs to serve members who live in areas at high risk for climate-related events. Another organizational adaptation suggested was expanding the potential membership base to diversify the credit union's member profile, thus spreading climate-related risk among a larger base. Participants also discussed incorporating climate-related risk into their existing ERM programs. Except for the more energy-efficient branch locations, though, these adaptations were still in the idea phase.

Analysis in Context of Literature

The most significant area of progress toward organizational changes that could help adapt the participants' credit unions for climate-related financial risks was made in the area of green lending. Another area of progress was in the construction of newer and more energy-efficient facilities, such as branches. While climate-related financial risk was beginning to be discussed in strategy analyses and in management and board meetings, no specific climate-related policies and procedures had yet been developed or modified. These findings were consistent with those of Hofheimer et al. (2022), who reported that most of the credit unions they studied had focused on increasing the efficiency of internal operations to reduce energy usage and waste. The credit unions that Hofheimer et al. interviewed were generally reactive in their stance toward climate-

related financial risk and tended to focus analytical efforts on specific weather events. As is discussed in detail in the next section, codifying adaptations for climate-related risk into policies and procedures indicates a more permanent level of organizational commitment to mitigating climate-related risk.

Rahman and Mohamad (2022) stated that since banks and other financial institutions contribute to climate change by lending to carbon-intensive industries and fossil fuel extractors, they are at risk for reputational damage as customer preferences shift toward low-carbon producers. Rahman and Mohamad advocated for the adoption of green banking practices by financial institutions to reduce this reputational risk. This view is similar to that of the participants who viewed the offering of green lending products and other green banking services as a means of differentiating themselves from competitors.

Park and Kim (2020) studied the progress of the transition to green banking at the institutional and sector levels. Park and Kim noted several barriers to green banking adoption by financial institutions. These barriers included a lack of monitoring capabilities, high costs of short-term funding, high perceived risks of undergoing the transition, and a lack of understanding of the opportunities involved in green banking transition, such as climate adaptation finance. The experience of the participants in this study with respect to the adoption of green lending products suggests that these credit unions have found ways around some of these barriers. Participants whose credit unions were engaged in green lending understood that a differentiation opportunity existed in the offering of the products, and an opportunity for credit risk mitigation existed in assisting members with preparing for the effects of climate change. Participants did not report any

problems with monitoring these loans. Challenges related to the costs of funding were likely mitigated in some cases by the receipt of government grants.

Framework Analysis

Two theoretical frameworks guided the research in the study. The first framework, called the FSSD, was originally developed by Robert (2002) and contained four conditions necessary for a sustainable society. These conditions were:

- Nature must not be subjected to increasing concentrations of extracted substances from the earth's crust, such as coal, oil, and other fossil fuels.
- The planet must not be subjected to physical degradation, such as deforestation and habitat removal, at a pace faster than these things can be replenished.
- The planet must not be subjected to continually increasing amounts of substances produced by society.
- All members of society must be able to meet their basic human needs.

Without all four of these conditions being met, Robert (2002) stated, societal development could not be sustainable.

Willard (2012) outlined in the SDF a series of stages at which an organization can arrive on its journey from conducting unsustainable business practices to fully embracing sustainability practices as a core component of organizational strategy. These steps progress from the first stage, which is one of non-compliance, where the organization is causing environmental harm, to a second stage where the organization obeys environmental regulations but is still primarily reactive in its stance toward sustainability. In the third stage, organizations have begun to some business benefits and cost savings

from sustainability, but this progress has not progressed beyond the level of individual departments. The fourth stage occurs when corporate social responsibility and sustainability strategies become part of the fabric of the organization, and sustainability influences all organizational decisions. The fifth stage is like the fourth stage but is comprised of companies that never had to evolve their processes. Willard (2012) stated that most companies residing in developed countries are currently at Stage 3. Willard's five-stage SDF can be useful in identifying where a specific organization is on the pathway to sustainable operations. While the FSSD defined sustainability as an objective state, the SDF clarified that definition in business terms and showed how organizations can progress to this objective. Once the organization's current position is estimated, recommendations can be made for advancing toward higher stages.

Information obtained in the participant interviews can be used to estimate the stage of each participant's credit union along the SDF. One participant's credit union, for example, had a stated ESG mission, which made it likely that the credit union was at Stage 5. Another participant reported that green lending was a core component of the credit union's business model and that this model was sufficiently developed to enable it to be used to help other credit unions originate green loans. This credit union was most likely in Stage 4. Since 72% of participants reported that no organizational policy or procedures had been changed in response to climate-related risks, it was likely that the majority of participants' credit unions are not yet at Stage 4. Moreover, it was also unlikely, based on the information gleaned in the participant interviews, that any of the participants' credit unions were at Stage 1, in which organizations are flouting regulations and making sustainability problems worse. Thus, the remainder of the

participant credit unions are likely at either Stage 2 or Stage 3. In Appendix F, the five stages of the SDF are listed along with some likely indicators, based on participant responses, of the stage an individual credit union may currently reside. Appendix F also indicates how many credit unions from the study were estimated to reside at each stage. Indicators of a credit union being at Stage 3 included the exploration or early development of green lending programs, the beginnings of data gathering and analysis (even if in only beginning this process), board and management discussions of climate-related risk, and the presence of energy efficiency changes. Indicators of Stage 2, in which organizations comply with sustainability-related regulations but are generally reactive in their stance, included having skepticism that climate-related risk was a threat to the credit union, a wait-and-see approach, and comfort with data that were currently available.

The average stage was 2.88, with 59% of the participant credit unions estimated to be in Stage 3, 29% in Stage 2, and 6% each in Stages 4 and 5. These estimations were in line with Willard (2012), who also found that most companies in developed countries were at Stage 3. It may be helpful to think of each of the stages as a continuum rather than a fixed point. Of the 10 credit unions estimated to be in Stage 3, there were varying levels of progress in that stage. P08, who reported their credit union as having begun to map member locations against state fire maps and discuss wildfire and safety risks at management meetings, could be considered further along than P12's credit union, where new management with a focus on climate-related risk was only recently hired. Both these credit unions were estimated to be in Stage 3, but one had made more progress than the other.

The importance of attaining Stage 4 is important for two reasons. First, from an organizational profitability perspective, being in this stage means that upper management and the board have made a commitment to sustainable practices, which include adapting to climate-related risk, enabling the organization to begin developing new products, and earning greater profits. From the perspective of the wider world, the development of more sustainable products means that the organization is likely to be meeting the four conditions of sustainability as outlined in the FSSD. Later in this chapter, recommendations for these credit unions that could help them make it through Stage 3 and toward Stage 4 are presented.

Summary of Findings and Conclusions

In terms of how participants in the study defined climate-related risk in the context of the risks they already managed, they thought that climate change and climate-related natural disasters impact credit risk most significantly either through direct or indirect means. Regarding what actions were currently being taken to measure climate-related financial risk, no participants stated that they were actively engaged in activities meant to specifically measure their exposure to climate-related risk, but the use of tools that would potentially be needed to measure this risk, such as the construction of a data warehouse, was reported. In addition, participants mentioned several ideas for how to best measure their exposure to climate-related financial risk, such as (a) mapping or overlaying their members' locations against areas that were known to have a greater risk for the occurrence of a climate-related event, (b) inserting a climate-related qualitative factor adjustment to the CECL calculation of the required ACLs reserve, and (c) incorporating climate-related data into the normal loan underwriting and monitoring

processes. Regarding organizational and policy changes to address climate change, participants had not created or modified any policies and procedures expressly for climate-related risk. However, over half of the participants' credit unions were involved or becoming involved in green lending, and climate-related risk was beginning to become a topic at management and board meetings as well as in strategic analyses.

Applying the concepts of the study's theoretical frameworks, based on the participant responses as described earlier, it was estimated that 59% of the credit unions in the study were in Stage 3 of the SDF, with 29% in Stage 2, and 6% each in Stages 4 and 5. Stage 3 indicates that an organization is moving beyond just complying with sustainability regulations and is beginning to make progress at a departmental level. Indicators of being in Stage 3 include beginning to explore green lending, initiating data gathering or developing data competencies, and discussing climate-related risk at board and management meetings.

From a practical perspective, the participants surveyed thought that credit risk would be impacted most significantly by climate-related events. To begin preparing for this, participants suggested that mapping member locations against areas known for high probability of climate-related events, fine-tuning the estimation of loan loss reserves with a climate-related CECL qualitative factor adjustment, and constructing data warehouses for improved data analytics could all help. These ideas could get credit unions moving into and through Stage 3 of the SDF, progressing toward Stage 4.

Application of Findings to the Problem Statement

The specific problem addressed by this study is that finance and risk management professionals at community-sized credit unions in the Pacific Northwest region of the

United States lack information on how to incorporate climate-related financial risk into their risk management programs. Academic literature seems to indicate that little is known about how leaders of community-sized credit unions in the Pacific Northwest are adapting their risk management programs for climate change and what experiences those leaders have accumulated in the process. Thus, finance and risk management professionals at community-sized credit unions who are seeking to adapt their risk management programs to address climate-related financial risk lack information on what is currently being done by other community-sized credit unions, what emerging best practices may exist, what obstacles may need to be overcome, and where their organizations stand relative to their peers. By providing answers to the RQs, the study provided insights into the components of the problem statement. In the next sections, the problem of not being able to determine from the literature what is currently being done at community-sized credit unions in the Pacific Northwest to address climate-related risk, not knowing what types of best practices may be emerging, and the obstacles that may need to be overcome are discussed.

What is Currently Being Done

The analysis of RQ3 provided insights into what is currently being done at community-sized credit unions in the Pacific Northwest to address climate-related risk. The findings of the participant interviews revealed that these credit unions appear to be in the early stages of adapting their risk management policies and procedures for climate-related financial risk. At the time of the interviews, 72% of the participants reported that no policies and procedures at their organizations had been created or modified to address financial risks from climate change specifically. An important additional note to this

statistic is that the remaining participants did not state that they had made changes. They just did not say that they had not changed their policies. So, it is possible that none of the participants had adopted any policies or procedures specifically for climate-related financial risk.

However, this lack of creation or modification of procedures does not mean that nothing is being done at community-sized credit unions to address climate-related financial risk. Five of the study's participants reported that while policies and procedures had not been created or changed for climate-related risk specifically, the issue of climate change was beginning to be discussed at board meetings, management meetings, and in strategic analysis reports. One participant, for example, stated that ESG issues were now being discussed as a section of an annual strategic report on risk. Another participant observed that green lending had become one of the credit union's social responsibility initiatives for 2025. Two participants stated that while no policies and procedures had been changed, risks of wildfires were beginning to be discussed in management meetings where they had not been discussed in the past.

One practice that 10 participants reported their credit unions were doing was originating green loans to help their members purchase solar panels, electric vehicles, and other climate adaptations to help them save money on energy costs and prepare for climate change. Participants viewed this practice as helping to mitigate climate-related risks by enabling members to save money on energy bills, thus freeing up cash to make loan payments. In addition, the increasing use of solar panels and electric vehicles could contribute to a reduction of GHG emissions in the credit unions' areas of operation. The

offering of green lending products was also seen as an opportunity to create differentiation from competitors.

Two participants stated that they had made changes to their buildings to make them more energy efficient. One participant reported that their credit union had designed a new branch building with Eco block technology, while the other reported purchasing a new headquarters building that was LEED certified by the U.S. Green Building Council (2022).

Of what is currently being done to address climate-related risk by community-sized credit unions in the Pacific Northwest, the largest component is participation in green lending activities. These credit unions have not updated or created policies and procedures to address climate-related risk specifically. However, the subject of climate-related risk is beginning to be discussed in strategy reports, particularly in the larger context of ESG. Climate-related risk is also being discussed in management and board meetings more often. Finally, while not specifically calling it climate-related risk, the risk from climate-related events such as wildfires is beginning to be discussed at credit unions where it had not been discussed before. While credit unions were generally in the early stages of climate-related risk adaptation in terms of what they were already doing, participants had a variety of ideas.

Ideas and Emerging Best Practices

The analyses of RQ2 and RQ3 provide insights into some emerging ideas for best practices for addressing and adapting to climate-related financial risk. These ideas centered generally around credit risk and analysis, operational adaptations, and seeking governmental assistance.

Participants expressed several ideas for incorporating climate-related risk into existing credit analysis practices. One common approach was the creation of a qualitative factor adjustment in the CECL calculation. This factor could adjust the result of the CECL calculated loss reserve estimate for areas at higher risk for climate-related natural disasters. The tightening of lending underwriting standards in general for at-risk areas was also put forth as an idea, where climate-related risk data could be incorporated into existing loan portfolio reviews. Another common idea was the mapping of member locations against areas known to be at high risk for climate-related events. This practice could allow for proactively contacting members before an event occurs or for incorporating information on probabilities of disaster events into loan underwriting. Correlating changes in climate-related data to existing performance metrics to see how one influences the other was another idea put forth.

Participants whose credit unions were involved in green lending also reported applying for government assistance to offer those programs. Participants had applied for government assistance in the form of grants to fund solar projects for people in economically disadvantaged areas, grants to support the purchase of electric vehicles, or funds available to credit unions through the Inflation Reduction Act to support GHG reduction.

Other ideas were put forth related to organizational adaptations. One participant suggested expanding the credit union's membership base to diversify the credit union's member profile, spreading climate-related risk among a larger base of membership. Finally, combining climate-related risk into existing ERM reports was discussed.

Participants put forth a variety of ideas for estimating and responding to exposure to climate-related risk. These ideas have not yet been implemented, so it is not quite accurate to really consider them best practices at this stage. The most commonly mentioned ideas were the creation of a CECL qualitative factor adjustment, mapping member locations against areas of high risk for climate-related events, and correlating climate-related risk data against known performance metrics. Credit unions attempting to determine how to begin analyzing climate-related financial risk could investigate these approaches as a start.

Challenges to Overcome

RQ2 and RQ3 helped to illustrate the important challenges facing credit union leaders who are attempting to adapt their organizations to address climate-related risk. One challenge to overcome was that of time and prioritization. Participants reported that climate-related risk would need to be identified by management as an important business priority to which both time and money would need to be allocated. Management of many of the credit unions do not have the time to make climate-related risk a priority outside of times when climate-related events, such as wildfires, were actually occurring. Part of this lack of time and prioritization has to do with the unpredictable nature of the occurrence and severity of climate-related events. However, given the fact that both the number and severity, in terms of both lost lives and dollar cost, of climate-related natural disasters are increasing (NOAA NCEI, 2024a), and given the increasing cost and difficulty of obtaining insurance (First Street Technology, 2023), leaders at community-sized credit unions must find a way to prioritize the estimation of exposure faced by their organizations.

Participants also reported what they believed would be challenges related to gathering this type of data. These challenges concerned the availability of the data needed, the locations of some of the data, both in terms of being outside the credit union and inside the credit union but on different systems, the integrity of the data, and the compatibility of that data with existing credit union data. Ideas for addressing these challenges included collaborating with other credit unions to share and gather data, hiring dedicated data personnel, and making use of AI to analyze data. Collaboration with other credit unions could prove particularly useful in terms of learning what types of experiences other institutions have had with climate-related natural disasters. While it was not a question asked of every participant as a formal interview question, anecdotally across the group of participants, there were some whose organizations had not yet faced a climate-related natural disaster that affected their membership, while others had, with some facing more than one. Other potential solutions to data-related challenges that were suggested by the participants in the study included the use of AI in conjunction with a data warehouse and the hiring of dedicated data analysts or data scientists to study and make sense of the data acquired.

Credit union leaders planning to begin analyzing their exposure to climate-related financial risk should thus be prepared to set aside time to analyze the data and devote organizational resources to data personnel and analytical systems.

Application to Business

As outlined in Chapter 1, global temperatures are rising, and climate-related natural disasters are occurring more frequently and becoming more costly. In 2021, there were 20 separate climate-related disasters in the United States, each causing greater than

$1 billion in damage, with the total cost of these disasters estimated at $145 billion (A. Smith, 2022). In 2023, the number of climate-related disasters costing $1 billion or more increased to 28, the highest number on record, with 2024 falling back only slightly to 27 but costing $182.7 billion (NOAA NCEI, 2024a). The increase in the number and cost of these disasters has been accompanied by adverse trends in the availability and cost of insurance. First Street Technology (2023), a nonprofit organization whose purpose is to research and analyze climate-related economic risk, estimated that across the United States, there are 4.4 million properties that face the potential for significantly increased insurance rates or nonrenewal of insurance due to increasing risk of wildfires, 12 million from increased risk of flooding, and 23.9 million from wind. According to Sherriff (2024), insurance providers are beginning to raise their premiums and even cease covering areas of states that are experiencing increasing extreme weather events due to climate change. Climate-related risk has also caused people to relocate to other areas. Between 2000 and 2020, approximately 3.2 million Americans relocated from neighborhoods experiencing more frequent flooding in areas such as the Gulf Coast of Texas, Coastal Florida, and the Mid-Atlantic region between Washington, D.C., and New Jersey (Porter, 2023).

Climate change is also threatening the future earning potential of people globally and locally. Kotz et al. (2024) found that regardless of any action on climate change taken now, the world is already committed to a global per capita income reduction of 19% by 2050. Of the three states upon which this study focused, Kotz et al. estimate that Washington and Oregon will experience per capita income reductions from 5%–10%, and the State of Idaho will experience a per capita income reduction of 5%

. While less than the global per capita income reduction, the amount will nevertheless negatively affect the ability of credit union members to qualify for and repay loans.

Leaders of community-sized credit unions in the Pacific Northwest will need to conduct business in an environment that could, because of the increase in climate-related disasters and their ripple effects, become increasingly unstable. The findings and conclusions of this study can apply to the business practices of risk management professionals at community-sized credit unions in the Pacific Northwest in several ways. Most of the literature surveyed for this study, such as the studies by Dennis and İşcan (2024), PCAF (2022), and Vikas (2024), concerned regional and larger-sized banks or were written from an international perspective. These studies were also concentrated primarily on transition risk. The current study provided the perspectives of credit union leaders within the region who worked at similarly sized institutions, creating a more relatable and relevant set of recommendations. The credit union leaders who participated in the study generally cited the increase in credit risk due to the physical risk of climate-related events as being of primary concern. The credit union leaders also presented their perspectives on the source of this physical risk. Direct forms of physical risk included the destruction of a loan's collateral in a wildfire or flood and the disruptions that climate-related events could inflict on their members' lives, inhibiting those members' ability to work, earn income, and repay loans. Higher costs of items such as automobile and homeowner insurance in regions where the risk of climate-related natural disasters was greater were also noted, with some participants experiencing increases in delinquencies and voluntary surrenders of collateral due to these higher costs. Participants also stated

that climate-related events could affect key industries in their communities, affecting member income and employment, and potentially causing loan losses. In this way, the study could provide leaders of regional credit unions and their regulators with information on where the increase in climate-related risk could surface. These leaders and regulators could then better prepare for climate-related risk adaptation.

The study also provided ideas on some potential best practices that could apply to credit union leaders. One of the most common practices undertaken by these credit unions was the offering of green lending products for the financing of solar panels, electric vehicles, and other climate adaptations for their members. Other potential best practices included creating qualitative factor adjustments for the CECL calculation, mapping member locations against areas at risk for climate-related events, tightening underwriting standards in at-risk areas, and correlating data on climate-related events to performance metrics. These approaches could be applied to the existing business practices of credit unions in the region to incorporate climate-related risk.

Finally, the study provided credit union leaders with knowledge of some potential organizational and data challenges and some ideas to overcome them. By studying an issue that is global in scale and bringing together 18 participants who are leaders at community-sized credit unions to discuss how their organizations could be affected by and react to it, a more applicable set of ideas to address climate-related risk arose.

Recommendations for Action

The following recommendations for action are based on the information learned in this study through the semistructured interviews with the 18 participants and the literature surveyed. These recommendations are intended for use by leaders of

community-sized credit unions and community banks with the intention of beginning or continuing the process of adapting the organization for climate-related financial risks. The recommendations are presented in ascending order of complexity of implementation, with shorter-term quick wins listed first and longer-term strategic ideas listed later.

Collaborate with Other Credit Unions

Credit union leaders should first begin collaborating with other credit unions to share experiences and ideas regarding climate-related risk. Participants in the study reported that they commonly network with other credit unions, either on an ad hoc basis or through associations, to share ideas and solve problems. The same could be done regarding climate-related financial risk. This approach could be especially helpful for smaller credit unions that lack the resources or time to conduct climate-related risk assessments on their own, an obstacle reported by participants. Sharing experiences, best practices, and means of overcoming obstacles could all be helpful in this early stage. This recommendation is similar to a recommendation put forth by Hofheimer et al. (2022), who advised credit unions to both invest in their own organizations while taking advantage of opportunities to create partnerships and build resources throughout the system. For credit union leaders who have not yet begun to explore their organizations' vulnerability to climate-related risk, this recommendation is a simple first step.

Join a Climate-Related Organization for Assistance

The second recommendation is for credit union leaders to join an organization such as the PCAF. The PCAF (2022) provides methodologies for estimating the financed emissions of a financial institution's loan portfolio. Understanding the level of GHG emissions that a financial institution creates through its financing and investing activity is

important for measuring exposure to transition risk (PCAF, 2022). While community-sized credit unions are not as likely to lend to large manufacturers or fossil fuel companies, understanding the level of GHG emissions financed through something like an automobile portfolio could be informative and would enable the credit union to be prepared in case consumer preferences suddenly turned away from internal combustion automobile engines.

Identify Members at Risk

The third recommendation is for credit union leaders to identify members who at risk of being negatively impacted by climate-related events. This process could include identification of any areas within the credit union's operating area that are at higher risk for climate-related events such as wildfires, floods, or droughts, and then ascertaining how many members live there and what types of loan and collateral exposures they have. The approach taken by Hofheimer et al. (2022), in which they matched counties in the FEMA NRI against branch locations and HMDA mortgage data, could be a model for starting this on a single credit union level. One participant in the study used a state fire risk map and identified how many members resided in zip codes that had the highest level of risk. As discussed by the participants, identifying these members could involve integrating data from different systems within the credit union and incorporating outside data on geographies that are at greater risk of experiencing climate-related events. For this reason, this recommendation is likely to take longer to be enacted and requires more organizational commitment in both resources and time.

Offer Green Banking Products

A fourth recommendation is for credit unions that are not already doing so to begin offering green banking products such as solar, electric vehicle, or climate-adaptation loans. Rahman and Mohamad (2022) and Park and Kim (2020) advocated for the adoption of green banking practices, as did 10 participants whose credit unions are engaging in the practice at some level. Participants noted that it could serve as an opportunity for differentiation from competitors. Rahman and Mohamad similarly saw green banking adoption as a means of mitigating reputational risk. Participants in the study also viewed green lending as a means of helping their members adapt and prepare for climate change, an activity that could save the members money and help them afford loan payments. Initiating a green lending program is the most complex of the recommended actions. As discussed by the participants, developing green lending products involves understanding the unique risk characteristics of these products, such as vulnerability to damage, developing underwriting guidelines for them, and making decisions on whether to offer the products directly to consumers or through collaboration with other organizations.

If followed by community-sized credit unions in the region, these recommendations will enable credit unions to begin to understand their exposure to climate-related risk. They will also become more familiar with how other financial institutions of similar size and complexity are approaching the issue, as well as some of the broader issues related to climate change beyond the credit union space. Adopting green lending, while the most operationally complex of the four recommendations, could enable credit unions to help their members adapt to climate change and put themselves in a better marketing position.

Recommendations for Future Research

The findings of the study revealed several areas for future research. Study participants cited credit risk as the risk that they thought would be most affected by climate-related events and climate change. Mapping member locations against areas of higher risk for climate-related events would enable credit unions to identify potential sources of credit risk. However, this would not help with estimating the degree to which credit risk would change, nor would it show the potential for increases in losses given the occurrence of a climate-related event. Studies similar in structure to the Apergis (2023) study, which examined the effect that major natural disasters exerted on banks' nonperforming loans and loan-to-deposit ratios in the years following the disaster, could be a potential fit if applied to the occurrences of wildfires in the region.

Another potential area for future study relates to transitional risk. Participants in this study did not mention transition risk during their interviews. While that may indicate that they are not as exposed to it, it may also mean that they simply had not thought along those lines. Physical and transition risks were not mentioned specifically in the interview questions because they were designed to ascertain what the participants already knew about climate-related risk. Studies on the potential transition risk faced by credit unions in the region could be helpful. Hofheimer et al. (2022) estimated the total transition risk for U.S. credit unions by identifying credit unions whose field of membership consisted of employees of petroleum refining, manufacturing, and utility companies, which turned out to be about 6%–7% of credit unions, and then multiplying that percentage by total federal credit union assets. An approach similar to this could be used but applied regionally or by ranges of credit union asset size to ascertain how transition risk is

distributed geographically or among credit unions of various sizes. Another idea for transition risk research would be for credit unions to estimate their own financed emissions as recommended in the previous section. Academic researchers could potentially assist credit union leaders in these estimations.

A third area of potential research involves the qualitative factor adjustments to the CECL calculation. A common idea expressed for responding to climate-related credit risk was adding a qualitative factor adjustment to the CECL calculation to account for climate-related risk that might not yet be accounted for by the statistical calculations. However, participants did not specify how this qualitative factor would be designed or on what assumptions it would be based. Research on the development of such a qualitative factor adjustment could be useful in this regard.

A final area of potential research would be to analyze the responses of a similarly constructed qualitative study in the context of a different analytical framework such as institutional theory. Institutional theory is the study of how societally accepted rules, norms, and expectations can influence the behavior of organizations (Galleli & Amaral, 2025). The respondents indicated in the interviews that their organizations are subject to competitive pressure, member demands, and the influences and collaboration from other credit unions. A study that explored the influence of these and other items on the decisions of financial and risk management professionals regarding climate-related risk could provide insights into how to best help credit unions adapt to climate-related risk.

Concluding Statement

This study explored how the participants defined climate-related financial risk in the context of the other risks that they manage, what actions they are taking or planning

to take to measure climate-related financial risk, and what progress they are making on organizational and procedural changes to address climate-related risk. Participants in the study thought that climate change and climate-related natural disasters impact credit risk most significantly either through direct or indirect means. No participants stated that they were actively engaged in activities meant to measure their exposure to climate-related risk specifically, but the use of tools that would potentially be needed to measure this risk, such as the construction of a data warehouse, was reported. In addition, participants mentioned several ideas for how to best measure their exposure to climate-related financial risk, such as mapping or overlaying their members' locations against areas that are known to have a greater risk for a climate-related event, inserting a climate-related qualitative factor adjustment to the CECL calculation of the required ACLs reserve, and incorporating climate-related data into the normal loan underwriting and monitoring processes. Participants had not created or modified any policies and procedures expressly for climate-related risk. However, over half of the participants' credit unions were involved or becoming involved in green lending, and climate-related risk was beginning to become a topic at management and board meetings as well as strategic analyses.

With climate-related natural disasters increasing in frequency and intensity, and with the availability and cost of homeowners and automobile insurance rising as a result, leaders of community-sized credit unions need information on how to measure and mitigate climate-related financial risk to their organizations. This study is applicable to this business problem in that it relates information obtained from finance and risk management leaders at community-sized credit unions in the Pacific Northwest. The credit union leaders who participated in the study were estimated based on their

responses to interview questions to be at credit unions that were in Stage 2 or 3 of the SDF, meaning that they were either not yet adapting their organizations for climate-related risk or were at the early stages. Ideas for addressing this risk, such as the mapping of member locations against areas of high risk for the climate-related events, would thus be applicable for a leader of this size credit union that is beginning to grapple with adapting financial risk management policies and procedures to address climate-related risks.

Recommended actions for leaders of community-sized credit unions are to collaborate to share information and data with other credit unions regarding climate-related risk, join an organization such as the PCAF to learn more about estimating GHG emissions and transition risk, identify which members are at risk or are exposed to a climate-related natural disaster, and adopt green lending practices. Recommendations for further study include attempting to measure the impact of climate-related events on credit union performance metrics such as nonperforming loans or the loan-to-deposit ratio, analyzing transition risk for community-sized credit unions in the region, and establishing a set of appropriate assumptions for the estimation of a qualitative factor adjustment in the CECL calculation for climate-related credit risk.

The findings of this study inform both credit union practitioners and their regulators. From a practitioner's perspective, the study provides practical and actionable recommendations on how one can get started analyzing climate-related financial risk based on the knowledge and experiences of community-sized credit union leaders. From a regulatory perspective, the study provides important information on how finance and risk management professionals and community-sized credit unions in Idaho, Oregon, and

Washington view the risk of climate change in the context of risks they currently manage, what their current level of understanding and perception is of the threat of climate change, and what they are doing or think they should do to mitigate these risks. Regulators should view the information in this study as a starting point for dialogue and collaboration with leaders who want recommendations and not mandates.

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APPENDIX A

Interview Questions

Introductory questions to obtain background data on the participants.

1. How long have you worked in the financial services industry?
2. How long have you worked specifically for credit unions?
3. How long have you been at your current credit union?
4. How long have you worked in finance and/or risk management?
5. How long have you lived in the Pacific Northwest? (or in your current state?)
6. What are your primary job responsibilities?
7. What was your degree(s) or certification(s) earned?

RQ1. How do finance and risk management professionals working at community-sized credit unions in the Pacific Northwest define climate-related financial risk in the context of other financial risks to their organizations?

1. What do you consider to be the primary financial risks that you manage at your credit union?
2. How do climate-related events or climate change impact those risks?
3. How do climate-related events or climate change impact the financial system as a whole?
4. How could climate-related events or climate change affect your credit union's membership?

RQ2. What actions are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest taking or planning to take to measure climate-related financial risk?

5. What types of data would be important to collect to understand the credit union's exposure to climate-related financial risk?
6. What types of challenges would you anticipate when attempting to collect this data?
7. What types of organizational resources do you think would be needed to acquire the types of data you identified?
8. How is this data, or how could this data, be used in financial risk reporting and management?

RQ3. What progress are finance and risk management professionals working at community-sized credit unions in the Pacific Northwest making on policy, and governance?

9. How has climate-related financial risk impacted strategic planning at the credit union?
10. What, if any, risk management policies and procedures have been modified or newly created to incorporate climate-related financial risk?
11. How are climate-related financial risks considered when making credit, investment, or operational decisions?

Referral Question.

12. Do you know of any other financial or risk management professionals working in credit unions in Idaho, Oregon, or Washington with less than $1 billion in assets who may be interested in participating in this study?

APPENDIX B

Recruitment E-mail

Dear (Potential Participant),

My name is Rob Stafford and I would like to invite you to participate in a study that I am conducting on how community-sized credit unions (defined in this study as having $10 billion or less in assets) in the States of Idaho, Oregon, and Washington are adapting their financial risk management processes to address climate-related financial risk.

You have been chosen to be a potential participant based on your experience as a finance and risk management professional at a credit union in this asset size range in one of these three states.

The purpose of this qualitative study is to provide guidance to finance and risk management professionals at community-sized credit unions on how best to incorporate climate-related financial risk into risk management programs. Academic literature seems to indicate that little is known about how community-sized credit unions in the Pacific Northwest are adapting their risk management programs for climate change and what the experiences of the organization leaders involved have been. Thus, finance and risk management professionals at community-size credit unions who are seeking to adapt their risk management programs to address climate-related financial risk lack information on what is currently being done by other community-sized credit unions, what emerging best practices may exist, what if any obstacles may need to be overcome, and where their organizations stand relative to their peers. This study will address this knowledge gap by exploring how finance and risk management professionals working at credit unions of this asset size range and within this region understand, define, and respond to climate-related financial risk.

Participation in the study requires an interview conducted either in person or via video conference on an application such as Microsoft Teams or Zoom. The interview will be audio and video recorded and a transcription made. It is anticipated that the interview will last anywhere from 60 to 90 minutes. Please note that because this is a qualitative study, there will be no quantitative tests conducted. Rather, the intent is to learn about your credit union and how you as a finance professional view climate-related financial risk to your credit union and its stakeholders. The interview consists of semi-structured interview questions. The purpose of these questions is to gain an understanding of how you and/or your organization define climate-related financial risk in the context of other financial risks, learn about what actions you are taking to analyze and measure this risk, and how climate-related financial risk may be impacting your credit union’s policy and governance. It is important to emphasize that there are no right or wrong answers in this type of study. If you and your organization are not incorporating climate-related financial risk into your risk management processes, that is a fact that also contributes to the overall understanding of how climate-related financial risk is understood and perceived.

This section is to summarize the events that will be required of you and your rights as a participant:

1. Face-to-face meeting that will be audio recorded and/or video recorded,
2. 60 – 90 minutes of your time for the interview,
3. An additional interview may be necessary for clarification,
4. You have the option to not answer any questions that might make you uncomfortable,
5. You have the right to withdraw from the study at any time, and
6. You will have the opportunity to review the transcript of the audio recording within a week after it has been transcribed. Doing so will enable you to remove anything you do not wish to share.

The research that I am conducting has been reviewed and approved by the Institutional Review Board (IRB) of the School of Business and City University of Seattle, which ensures your safety and privacy always be maintained.

If you choose to participate in this study, please respond to this email to acknowledge your participation. Once you agree to participate, I will contact you to set up a meeting time and date that is convenient for you.

Because of your experience as a credit union finance professional, your contribution to this study would be greatly appreciated. If you are unable to participate in this research, it would be greatly appreciated if you could share any information you have about anyone who might be willing to participate.

Please feel free to contact me if f you have any questions or need clarification on the study or your responsibility as a participant.

Rob Stafford
stafford.robert@cityu.edu
Mobile: 509.942.4300
Doctoral Candidate
School of Business and Management
City University of Seattle

APPENDIX C

Recruitment call script

Hello [potential participant], my name is Rob Stafford and I'm a doctoral candidate at City University of Seattle. I'm studying how finance and risk management professionals at credit unions in Washington, Oregon, and Idaho are adapting their risk management policies and procedures to address climate-related financial risks. Current academic research in this area indicates that not much is yet known about how credit unions in this region are responding to climate-related financial risk. The purpose of the study is to shed some light on this question by interviewing financial and risk management professionals at credit unions in this region to learn about what actions they are taking to analyze and measure this risk and how climate-related financial risk may be impacting their credit unions' policy and governance. Your name came up as a potential participant in the study because your credit union is located in the region and matches the asset size range that is being addressed in the study. In addition, our mutual colleague, [referral source], felt that you might have some good insights to offer. One thing I want to emphasize is that there are no right or wrong answers in this type of study. If you and your organization are not incorporating climate-related financial risk into your risk management processes, that is a fact that also contributes to the overall understanding of how climate-related financial risk is understood and perceived. Also, you will not be required to complete any quantitative tests in this study.

Participation in the study requires a short time commitment of about 60-90 minutes to conduct the interview. We will conduct the interview on Microsoft Teams or Zoom, and I will record and transcribe the interview. It is important to note that your

name and your credit union's name will not be published anywhere in the study. Rather, your interview responses will be analyzed alongside the responses of other participants for the purpose of uncovering common themes. You will have the opportunity to review the interview transcript and make corrections or clarifications as you see fit. You are not required to answer any questions that make you uncomfortable, and you can withdraw from participation in the study at any time.

If you are interested in participating in the study, I will follow up with a more detailed description of the study and some paperwork that will need to be completed prior to getting started.

APPENDIX D

Participant Consent Form

CityUniversity of Seattle

CITYU RESEARCH PARTICIPANT INFORMED CONSENT

Title of Study:

_____

Name and Title of Researcher(s):
Rob Stafford – Doctoral Candidate

For Student Researcher(s):
Faculty Supervisor: Dr. Chrisina Gehrke
Department: School of Business and Management
Telephone: 425-761-0777
City U E-mail: Gehrkechristina@CityU.edu

Program Coordinator (or Program Director):
Dr. Greg Price

Sponsor, if any:
N/A

You are being invited to participate in a research study.

Key Information about this Research Study

The researcher will explain this research study to you before you will be asked to participate in the study and before you sign this consent form.

- Your participation is voluntary and you can decide not to participate or withdraw your participation at any time without penalty or negative consequences.
- It is your choice whether or not you want to participate in this research.
- The purpose of the research is to explore how community sized credit unions in the Pacific Northwest region of the United States are adapting their financial risk management processes and procedures to address climate-related financial risks.
- If you choose to participate you will be asked to answer questions in a semi-structured interview either in-person or using Microsoft Teams or Zoom.
- The risks or discomforts from this research include risks of participation are not greater than the benefits of the study. Negative memories may arise and cause discomfort to the participant.
- The direct benefits of your participation are learning about climate-related financial risks to banks and credit unions and adding through the interview

responses to the general public understanding of how credit unions are preparing to address climate-related financial risk.

You should talk to the researcher(s) about the study and ask them as many questions you need to help you make your decision.

What should I know about being a participant in this research study?

This form contains important information that will help you decide whether to join the study. Take the time to carefully review this information.

- You are eligible to participate in this study because you are a finance and risk management professional working at a community-sized credit union in the state of Washington, Oregon, or Idaho.
- You will be in this research study for approximately 60-90 minutes
- About 20 individuals will participate in this study.

Why is this research being done? This research is being undertaken because finance and risk management professionals at community-size credit unions who are seeking to adapt their risk management programs to address climate-related financial risk lack information on what is currently being done by other community-sized credit unions, what emerging best practices may exist, what if any obstacles may need to be overcome, and where their organizations stand relative to their peers.

Purpose of Study: This study aims to provide guidance to finance and risk management professionals at community-sized credit unions as they determine how best to incorporate climate-related financial risk into risk management programs.

Research Participation.
You will be asked to participate in the following procedures:

I understand I am being asked to participate in this study in one or more of the following ways (initial options below that apply):

☐ Respond to in-person; and/or, ☐ telephone Interview questions; Approximate time 60-90 minutes.

☒ Participate in a virtual video interview using this video program/app Microsoft Teams or Zoom; Approximate time 60-90 minutes

You may refuse to answer any question or any item in verbal interviews, written questionnaires or surveys, and, you can stop or withdraw from any audio or visual recording at any time without any penalty or negative consequences.

Are there any risks, stress or discomforts that I will experience as a result of being a participant in this study?

Taking part in this research involves certain risks: This could include: risks of participation are not greater than the benefits of the study. Negative memories may arise and cause discomfort to the participant.

Will being a participant in this study benefit me in any way?

We cannot promise any benefits to you or others from your participation in this research. However, possible benefits may include increased knowledge and understanding of climate-related financial risk.

☒ You will not receive any payment for participation in this study.

Confidentiality

I understand that participation is confidential to the limits of applicable privacy laws. No one except the faculty researcher or student researcher, his/her supervisor and Program Coordinator (or Program Director) will be allowed to view any information or data collected whether by questionnaire, interview and/or other means.

If the student researcher's cooperating classroom teacher will also have access to raw data, the following box will be initialed by the researcher. ☐

Steps will be taken to protect your identity, however, information collected about you can never be 100% secure. Your name and any other identifying information that can directly identify you will be stored separately from data collected as part of the research study. The results of this study will be published as a thesis and potentially published in an academic book or journal, or presented at an academic conference. To protect your privacy no information that could directly identify you will be included.
All data (the questionnaires, audio/video tapes, typed records of the interview, interview notes, informed consent forms, computer discs, any backup of computer discs and any other storage devices) are kept locked and computer files will be encrypted and password protected by the researcher. The research data will be stored for 5 years. At the end of that time all data of whatever nature will be permanently destroyed. The published results of the study will contain data from which no individual participant can be identified.

Signatures

I have carefully reviewed and understand this consent form. I understand the description of the research protocol and consent process provided to me by the researcher. My signature on this form indicates that I understand to my satisfaction the information provided to me about my participation in this research project. My signature also indicates that I have been apprised of the potential risks involved in my participation. Lastly, my signature indicates that I agree to participate as a research subject.

My consent to participate does not waive my legal rights nor release the researchers, sponsors, and/or City University of Seattle from their legal and professional responsibilities with respect to this research. I understand I am free to withdraw from this

research study at any time. I further understand that I may ask for clarification or new information throughout my participation at any time during this research.

I have been advised that I may request a copy of the final research study report. Should I request a copy, I understand that I will be asked to pay the costs of photocopy and mailing.

Participant's Name: _____
Please Print

Participant's Signature: _____ Date: _____

Researcher's Name: Robert Stafford
Please Print

Researcher's Signature: _____ Date: _____

If I have any questions about this research, I have been advised to contact the researcher and/or his/her supervisor, as listed on page one of this consent form.

Should I have any concerns about the way I have been treated or think that I have been harmed as a research participant, I may contact the following individual(s):

Dr. Gregory Price, Program Coordinator (and/or Program Director), City University of Seattle, at
521 Wall St., Suite 1000, Seattle, WA 98121, 206.491.0839, priceg@cityu.edu

This study has been reviewed and has been approved by the Institutional Review Board (IRB) of City University of Seattle. If you have questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact the IRB at IRB@Cityu.edu.

APPENDIX E

Transcript Accuracy Check

Dear (Participant),

Thank you for participating in my research. Your participation has helped tremendously and supported quality research in the field of entrepreneurship.

I have attached a transcription of the interview you granted on (date). You are receiving this transcription as a part of the process within this research study. I am asking that you review the transcription for accuracy and let me know if you believe the summary accurately reflects your views and beliefs on the subjects we have discussed. Should you find areas that may need updates or improvements, or where corrections are needed, please make those adjustments and additions and return them to me. Finally, should you wish to contact me for clarification on this request or have any general questions, please let me know how I can help.

Thank you again for your time and help!

Sincerely,

Rob Stafford
Doctoral Candidate
School of Business
City University of Seattle

APPENDIX F

Credit Unions at Each Stage of SDF

Stage	1 Non-Compliance	2 Compliance	3 Beyond Compliance	4 Integrated Strategy	5 Purpose and Passion
Description of Stage	Causing Harm Flouting Regulations	Obey Law and Regs Reactive Attitude End-of-Pipe	Energy Cost Savings Low-Hanging Fruit Departmental	Part of All Operations Developing New Products Borrow, Use, Return Model Growing Profits	Like 4 But Didn't Evolve. Just Who They Are Founder Culture Benefit (B) Corps.
Indicators of Stage for Participants	Actively Spreading Misinformation Intent to Defy Regulations if Enacted	Wait and See Approach Comfortable with Existing Data Possible Skepticism of Threat Continue to Manage Through Existing Procedures	Exploring Green Lending Beginning to Gather Data or Develop Data Gathering Competency Initiating Efficiencies Board Discussion	Active in Green Lending Estimating Exposure Board and Organizational Recognition and Commitment	Sustainability and ESG principles are embedded into the credit union's espoused mission and values.
Number of Participants in Stage	**0**	**5**	**10**	**1**	**1**
Percent of Participants in Stage	**0%**	**29%**	**59%**	**6%**	**6%**
Average Stage	**2.88**				