

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

* * * * *

RE: IN THE MATTER OF ADVICE NO.)
1797-ELECTRIC OF PUBLIC SERVICE)
COMPANY OF COLORADO TO REVISE)
ITS COLORADO P.U.C. NO. 8-) PROCEEDING NO. 19AL-_____E
ELECTRIC TARIFF TO IMPLEMENT)
RATE CHANGES EFFECTIVE ON)
THIRTY-DAYS' NOTICE.)

DIRECT TESTIMONY AND ATTACHMENTS OF DAVID C. HARKNESS

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

May 20, 2019

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

<u>Acronym/Defined Term</u>	<u>Meaning</u>
2014 Electric Rate Case	Proceeding No. 14AL-0660E
ADMS	Advanced Distribution Management System
AGIS	Advanced Grid Intelligence & Security
AMI	Advanced Meter Infrastructure
CIO	Chief Information Officer
CIP	Critical Infrastructure Protection
Commission	Colorado Public Utilities Commission
CPE	Customer Premise Equipment
CRS	Customer Resource System
DEMS	Decentralized Energy Management System
DER	Distributed Energy Resources
DMZ	Demilitarized Zone
DP	Damage Prevention
DRMS	Demand Response Management System
ENGO	Edge of Network Grid Optimization
EPRI	Electric Power Research Institute
ESB	Enterprise Service Bus
ESOMS	Electric Shift Operations Management System
FAN	Field Area Network

<u>Acronym/Defined Term</u>	<u>Meaning</u>
FERC	Federal Energy Regulatory Commission
FLISR	Fault Location Isolation and Service Restoration
FLP	Fault Location Protection
GB CMD	Green Button Connect My Data
GE	General Electric
GIS	Geospatial Information System
GL	General Ledger
HAN	Home Area Network
HTY	Historical Test Year
IEEE	Institute of Electrical and Electronics Engineers
IT	Information Technology
IVVO	Integrated Volt-VAR Optimization
MDM	Meter Data Management
NMS	Network Management System
NOC	Network Operations Center
O&M	Operations and Maintenance
OMS	Outage Management System
OpCos	Xcel Energy Operating Companies
OT	Operational Technology
PC	Personal Computer

<u>Acronym/Defined Term</u>	<u>Meaning</u>
PTT	Productivity Through Technology
Public Service or the Company	Public Service Company of Colorado
RF	Radio Frequency
RFP	Request for Proposal
SAMS	Substation Asset Management
SCADA	Supervisory Control and Data Acquisition
SMS	Sensor Management System
SVC	Static VAr Compensator
SVP	Senior Vice President
WAM	Work and Asset Management
WAN	Wide Area Network
WiMAX	Worldwide Interoperability for Microwave Access
WiSUN	Wireless Smart Utility Network
Xcel Energy	Xcel Energy Inc.
XES	Xcel Energy Services Inc.

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1 I. **INTRODUCTION, QUALIFICATIONS, PURPOSE OF TESTIMONY, AND**
2 **RECOMMENDATIONS**

3 Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

4 A. My name is David C. Harkness. My business address is 414 Nicollet Mall, Suite
5 400, Minneapolis, Minnesota 55401.

6 Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT POSITION?

7 A. I am employed by Xcel Energy Services Inc. ("XES") as the Chief Information
8 Officer and Senior Vice President ("CIO & SVP"). XES is a wholly-owned
9 subsidiary of Xcel Energy Inc. ("Xcel Energy"), and provides an array of support
10 services to Public Service Company of Colorado ("Public Service" or the
11 "Company") and the other utility operating company subsidiaries of Xcel Energy
12 on a coordinated basis.

13 Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THE PROCEEDING?

14 A. I am testifying on behalf of Public Service.

1 **Q. PLEASE SUMMARIZE YOUR RESPONSIBILITIES AND QUALIFICATIONS.**

2 A. As the CIO & SVP of Business Systems, I am responsible for the XES Business
3 Systems organization. Business Systems provides Information Technology (“IT”)
4 services to XES and the Xcel Energy operating companies (“OpCos”), including
5 Public Service, primarily on a common platform, with costs allocated to specific
6 utilities and jurisdictions consistent with the testimony of Company witnesses Ms.
7 Melissa L. Schmidt, Ms. Laurie J. Wold, and Ms. Deborah A. Blair. I am also
8 responsible for the corporate business continuity function and IT disaster
9 recovery. A description of my qualifications, duties, and responsibilities is set
10 forth in my Statement of Qualifications at the conclusion of my Direct Testimony.

11 **Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY AND**
12 **ATTACHMENTS?**

13 A. The purpose of my Direct Testimony is to support Public Service’s plant additions
14 associated Business Systems since the last rate case, for 2014 through 2019,
15 which are appropriately allocated to Public Service retail electric and included in
16 the 2018 Historical Test Year (“HTY”) cost of service that is presented by Ms.
17 Blair. The Company’s last electric rate case was Proceeding No. 14AL-0660E
18 (the “2014 Electric Phase I”), in which a 2013 HTY was approved. This includes
19 the Company’s \$324.1 million in Business Systems plant additions since the last
20 electric rate case¹, for 2014 through 2018, and the \$68.9 million in Business

¹ The Company’s last rate case was Proceeding No. 14AL-0660E (the “2014 Rate Case”), in which a 2013 HTY was approved.

1 Systems plant additions for 2019. These additions are discussed in Sections IV
2 and V, respectively.

3 Ms. Wold has calculated the monthly plant balances to develop the plant-
4 related roll forward, which is in turn used by Ms. Blair to incorporate the year-end
5 plant in service balances into the 2018 HTY cost of service.

6 I also support the \$46.2 million in Business Systems 2018 Operations and
7 Maintenance expenses (“O&M”) (including AGIS) and O&M drivers from 2013 to
8 2018 in Section VI.

9 Additionally, in Section VII, I support the Company’s request for capital
10 and O&M cost recovery with respect to the Advanced Grid Intelligence & Security
11 (“AGIS”) initiative. To support this request, I explain and support the Company’s
12 proposed implementation of, and capital and O&M forecasts for, the Business
13 Systems components of the AGIS initiative. Company witness Ms. Brooke A.
14 Trammell discusses the policy aspects of the AGIS initiative for this rate review,
15 and Company witness Mr. Chad S. Nickell provides an overview of the AGIS
16 initiative and supports the Distribution Business Area’s implementation of the
17 AGIS projects.

18 Through my discussion of the AGIS programs, I support the Business
19 Systems AGIS-related plant-in-service additions through 2019, which Ms. Wold
20 utilizes to develop the plant-related roll forward, which is in turn used by
21 Company witness Ms. Blair to calculate the 2019 year-end plant in service
22 balances for the Company’s 2018 HTY cost of service. I also support Business

1 Systems AGIS-related O&M expenses for 2018, plus an adjustment to account
2 for the known and measurable O&M that the Company anticipates for its AGIS-
3 related Business Systems O&M for 2019, which is also included in the
4 Company's 2018 HTY cost of service presented by Ms. Blair.

5 **Q. ARE YOU SPONSORING ANY ATTACHMENTS WITH YOUR DIRECT**
6 **TESTIMONY?**

7 A. Yes, I am sponsoring the following attachments:

- 8 • Attachment DCH-1: Business Systems Capital Additions 2014–2018;
- 9 • Attachment DCH-2: Business Systems Forecasted Capital Additions 2019;
- 10 • Attachment DCH-3: O&M Expenses by Cost Element; and
- 11 • Attachment DCH-4: O&M Expenses by FERC Account.

12 **Q. WHAT RECOMMENDATIONS ARE YOU MAKING IN YOUR DIRECT**
13 **TESTIMONY?**

14 A. As part of approving the cost of service developed by Ms. Blair, I recommend
15 that the Colorado Public Utilities Commission “Commission”) approve the 2014-
16 2019 Business Systems capital additions and 2018 Business Systems O&M
17 expenses, including for the AGIS initiative, which are included in the Company's
18 2018 HTY cost of service presented in this rate review, and described below.

1 **II. BUSINESS SYSTEMS – BACKGROUND AND OVERVIEW**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?**

3 A. The purpose of this section of my Direct Testimony is to provide an overview of
4 Xcel's Business Systems Business Area, including its key functions and
5 responsibilities.

6 **Q. PLEASE PROVIDE AN OVERVIEW OF THE BUSINESS SYSTEMS BUSINESS
7 AREA.**

8 A. Business Systems is Xcel Energy's centralized IT organization, providing
9 technology services to support all aspects of the operations of the Xcel Energy
10 operating companies, including Public Service. While some IT projects are
11 specific to an individual operating company and/or to electric or gas jurisdictions,
12 the majority of Business Systems work is completed on an Xcel Energy-wide
13 basis. In this era, it is hard to identify an aspect of Xcel's operations that
14 Business Systems does not support in some manner.

15 **Q. HAVE THERE BEEN ANY CHANGES TO BUSINESS SYSTEMS' KEY
16 FUNCTIONS AND RESPONSIBILITIES SINCE THE 2014 ELECTRIC RATE
17 CASE?**

18 A. Yes. The Enterprise Security Services group was formed outside of Business
19 Systems to increase focus on security threats. Business Systems still supports
20 cybersecurity IT project delivery in partnership with this new organization. I
21 therefore discuss Business Systems' cybersecurity efforts, but the Enterprise

1 Security Services costs are part of the other Shared Corporate Business Areas,
2 as discussed by Company witness Mr. Adam R. Dietenberger.

3 **Q. PLEASE DESCRIBE BUSINESS SYSTEMS' KEY FUNCTIONS AND**
4 **RESPONSIBILITIES.**

5 A. The key services Business Systems provides include the following:

- 6 • *Foundational Technology Infrastructure:* Support for each employee's
7 hardware and software needs, including the provision and maintenance of
8 hardware such as computers, phones, and servers; maintaining and updating
9 operating systems; and providing sufficient data storage capabilities.
10 Business Systems also provides protection from cybersecurity attacks,
11 including but not limited to computer viruses.
- 12 • *Systems Control:* Technology support to our Generation, Transmission, and
13 Distribution business areas to enable management and operation of the
14 electric and gas system. One of the systems that we maintain is the Outage
15 Management System ("OMS"), which tracks customer outages and
16 dispatches repair crews to restore service. Business Systems also supports
17 the Supervisory Control and Data Acquisition ("SCADA") system, which is
18 used to monitor the health of the electric and gas transmission and
19 distribution systems.
- 20 • *Customer IT Support:* Hardware and software needed to facilitate
21 interactions with Public Service customers. These activities include
22 maintaining the Xcel Energy website that provides important information to

1 customers about outages, the status of their account, safety, and Public
2 Service operations. Business Systems also maintains the Customer
3 Resource System (“CRS”), which is our customer information system, and
4 which generates billing statements to Public Service retail customers on a
5 monthly basis. Business Systems also supports the Interactive Voice
6 Response software that enables interaction with customers via telephone
7 keypad or speech recognition.

- 8 • *Corporate IT Support:* Business Systems provides IT support for necessary
9 corporate functions such as Human Resources and Financial Management.
10 This includes maintaining software, like our SAP General Ledger (“GL”) and
11 Work and Asset Management (“WAM”) system that improves enterprise
12 processes and enables creation, tracking, reporting, and analysis of budget,
13 forecasts, and actual financials, as well as all employee-related information.
14 Mr. Brown discusses the Company’s WAM and GL replacement projects in
15 detail.

16 **Q. HOW DOES BUSINESS SYSTEMS SUPPORT THE FUNCTIONS DESCRIBED**
17 **ABOVE?**

18 A. Along with our day-to-day work with the technology we have deployed, Business
19 Systems makes capital investments and incurs O&M expenses to support other
20 business areas and functions across Xcel Energy. I discuss these capital
21 investments and O&M expenses throughout the remainder of my Direct
22 Testimony.

1 **III. BUSINESS SYSTEMS BUDGETING AND PLANNING**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT**
3 **TESTIMONY?**

4 A. The purpose of this section of my Direct Testimony is to discuss Business
5 Systems' project development and management processes, along with its capital
6 spending, budgeting, and funding.

7 **A. Overview of Capital Project Needs**

8 **Q. WHAT ARE THE PRIMARY DRIVERS OF BUSINESS SYSTEMS CAPITAL**
9 **ADDITIONS?**

10 A. The five key areas that drive Business Systems budget forecasts are:

- 11 • Addressing evolving cybersecurity threats and requirements;
12 • Replacing aging technology;
13 • Enhancing capabilities of our business and our ability to service customers;
14 • Responding to emergent demands for IT services and solutions; and
15 • Providing and supporting the IT components of the AGIS initiative.

16 **Q. GIVEN THESE BUSINESS DRIVERS, WHAT TYPES OF CAPITAL PROJECTS**
17 **DOES BUSINESS SYSTEMS UNDERTAKE?**

18 A. Business Systems capital additions include hardware (desktop and laptop
19 computers, servers, routers, phone systems, radio systems, microwave
20 communication systems, and network equipment), software (computer
21 programs), related technology infrastructure investments, and cybersecurity
22 solutions that support the Xcel Energy operating companies' business

1 operations. A key example is the Company's investment in software and
2 hardware technology to facilitate advancement of the Company's distribution
3 system through the AGIS initiative.

4 Generally speaking, our investments fall into the categories identified
5 above. To further underscore the importance of Business Systems investments
6 on behalf of Public Service customers, I describe these categories in more detail
7 below, and also describe the key capital projects within each category.

8 The need for Business Systems investments within a utility company is
9 just as essential as the need for investments in poles and wires, meters, and
10 fleet. In today's world, very few large businesses can function in a safe and
11 reliable manner, or provide appropriate customer service levels, without IT
12 investments.

13 **Q. ARE BUSINESS SYSTEMS' CAPITAL NEEDS READILY PREDICTABLE?**

14 A. In some cases they are, as with long-term projects such as the WAM and GL, but
15 in other cases Business Systems must react quickly to changing information
16 technology risks and needs. For example, replacing the GL system required
17 several years of planning and budgeting due to the size and complexity of the
18 project. Business Systems also knew about the pending need several years in
19 advance, due to the age of the prior system. However, many other needs are not
20 so readily estimated – in part because IT is continuously evolving. New
21 cybersecurity risks and new technologies are emerging all the time, requiring
22 flexibility within Business Systems to respond to those risks and needs. Given

1 the nature of the issues Business Systems responds to and our capital additions,
2 our capital additions tend to vary from year to year.

3 **Q. PLEASE DESCRIBE CYBERSECURITY PROJECTS.**

4 A. Investments in cybersecurity ensure the availability, integrity, and confidentiality
5 of our IT systems, as well as compliance with legal and regulatory obligations.
6 These investments provide prevention, detection, containment, and repair
7 services to protect the Company from cyberattacks and to assist in recovery if
8 such an attack occurs. An example of a cybersecurity project is the Advanced
9 Endpoint Protection project, which is a deployment tool to perform Indicator of
10 Compromise sweeps across Xcel Energy's networks.

11 Cybersecurity does not include physical security investments, such as
12 property security. Physical security is part of Shared Corporate Services, and is
13 discussed by Mr. Dietenberger.

14 **Q. PLEASE DESCRIBE AGING TECHNOLOGY PROJECTS.**

15 A. IT assets are no different from other physical assets, in that they are subject to
16 aging and (in this case, technical) obsolescence. A reasonably up-to-date
17 infrastructure is necessary for the Company to continue to meet current legal and
18 regulatory requirements, as well as the service expectations of Public Service's
19 customers. Business Systems seeks to maximize investments by harvesting the
20 value of existing systems prior to replacing them. However, there comes a time
21 when we must upgrade our aging systems due to business, reliability, or

1 compliance needs. Aging technology projects include routine refresh projects, as
2 well as more specific projects.

3 **Q. WHAT ARE ROUTINE REFRESH PROJECTS?**

4 A. Given the breadth and depth of the different equipment Xcel Energy utilizes and
5 manages, Business Systems refreshes smaller components of technology
6 infrastructure on regular cycles. We annually budget for these replacements as
7 routine refresh projects. An example of an aging technology routine refresh
8 project is the Annual Personal Computer (“PC”) Refresh, which upgrades
9 approximately 20 percent of desktop computers annually.

10 **Q. WHAT ARE SPECIFIC REFRESH PROJECTS?**

11 A. Unlike routine refresh projects, which generally address smaller capital
12 replacements on a regular cycle or which are routinely needed, we also must
13 manage larger technology replacements for equipment that is nearing the end of
14 its useful life. Specific refresh projects are often managed over a longer term,
15 reoccur less frequently, and are significantly more complex than routine refresh
16 projects. An example of a specific refresh project is the Voice over Internet
17 Protocol initiative, which will upgrade company technologies for the delivery of
18 voice communications and multimedia sessions over the Internet.

19 **Q. PLEASE DESCRIBE PROJECTS THAT ENHANCE CAPABILITIES.**

20 A. Technology can offer the opportunity to improve productivity, enhance
21 communications between systems and between people, and use data more
22 efficiently. Business Systems is constantly evaluating new technologies and

1 helping business areas examine ways to increase efficiencies and enhance
2 communications between systems that benefit the Company and our
3 customers. Enhancing capability investments can offer efficiency benefits that
4 outweigh their implementation costs. An example of an enhancing capabilities
5 project is the Interval and Complex Billing Project, which will improve the billing
6 accuracy and efficiency of our most complex rates. The project will help inform
7 the customer about usage and varying rates based on time of use to drive
8 increased customer satisfaction, decrease energy consumption, and facilitate the
9 use of rate structures that promote decreased customer usage around peak
10 demand. This project went in-service in late 2018.

11 **Q. PLEASE DESCRIBE EMERGENT DEMAND PROJECTS.**

12 A. This category relates to projects that are typically in the early stages of planning.
13 The Emergent Demand Account is an account created to ensure Business
14 Systems is able to meet the cybersecurity, aging technology, and efficiency
15 needs that inevitably emerge in a given year. Because of the ever-changing
16 nature of technology and emerging risks, it is not possible to identify in advance
17 all necessary projects that may arise or become critical in a given year. For
18 example, it is not always possible to predict what kind of security risk might be
19 created by hackers as technology continues to develop. In other situations, it
20 may become clear during detailed project development that additional benefits or
21 long-term cost savings could be captured by expanding the scope of the project.

1 The Emergent Demand Account is used to fund important and unexpected
2 projects or changes in scope of previously-planned projects. Each year, funds
3 are allocated to the Emergent Demand Account for these purposes. As the
4 dollars are spent, they are re-classified to the specific project for which the
5 expense was incurred. In this way, Business Systems' year-end cost summaries
6 do not show expenses allocated to Emergent Demand. Similarly, there would
7 not be any actual capital additions classified as Emergent Demand.

8 **Q. PLEASE DESCRIBE THE AGIS INITIATIVE AND BUSINESS SYSTEMS'**
9 **ROLE IN PROVIDING SUPPORT FOR AGIS IN THIS PROCEEDING.**

10 A. The Company's AGIS initiative involves the following foundational programs:
11 Advanced Distribution Management System ("ADMS"); Advanced Meter
12 Infrastructure ("AMI"); the Field Area Network ("FAN"); Intelligent Field Devices
13 that include Fault Location Isolation and Service Restoration ("FLISR"),
14 Integrated Volt-VAR Optimization ("IVVO"), Fault Location Protection ("FLP");
15 and Geospatial Information System ("GIS"). Each of these programs involves a
16 coordinated approach – i.e., planning, design, build, deployment and ongoing
17 support from Business Systems and Distribution. IT integration and
18 cybersecurity protections are needed to support these new technologies. Mr.
19 Nickell provides an overview of the AGIS initiative and supports the Company's
20 overall technical strategy for AGIS and the Distribution Business Area's AGIS
21 implementation. I provide support for the IT integration necessary to carry out
22 the AGIS initiative in Section VII of my Direct Testimony.

1 Because AGIS is largely a Distribution initiative that is supported by
2 Business Systems, I treat this project separately in my Direct Testimony; both
3 capital and O&M needs and costs are described and set forth in Section VII.
4 However, many of the same principles around budget development and
5 management that I discuss below also apply to the overall AGIS initiative.

6 **B. Business Systems Budget Development and Management**

7 **Q. HOW DOES BUSINESS SYSTEMS IMPLEMENT CAPITAL PROJECTS FOR**
8 **PUBLIC SERVICE?**

9 A. Although Business Systems implements some projects specific to individual
10 operating companies, including Public Service, we achieve efficiencies of scale
11 by performing most activities on a system-wide basis. Accordingly, many of the
12 Business Systems projects are planned and budgeted at the Xcel Energy level,
13 allocated or assigned to the appropriate operating companies, and implemented
14 throughout the different operating companies. When certain projects (such as
15 Public Service's Microwave Mountain Range Refresh Project described later in
16 my Direct Testimony) are developed and implemented solely for Public Service
17 or other individual operating companies, the costs are directly assigned to that
18 utility. In other cases, common projects are allocated across Xcel Energy
19 Operating Companies. Ms. Schmidt supports the Company's allocation of
20 common capital costs to the Public Service Electric utility.

21 **Q. PLEASE DESCRIBE THE PROCESS BUSINESS SYSTEMS USES TO**
22 **PREPARE ITS CAPITAL BUDGETS.**

1 A. Business Systems uses an IT Governance process to evaluate any proposed
2 Business Systems investment. IT Governance is Business Systems' budget
3 development, project prioritization, and project oversight process, which helps to
4 establish budgets that are reasonable and to manage our capital expenditures
5 accordingly. These budget processes help ensure Company budgets are
6 reasonably reflective of the projects that will be placed in service during the
7 relevant year or years. As part of the IT Governance process, key Business
8 Systems leaders oversee IT projects as they move from project inception
9 towards in-service, thereby ensuring that projects comply with relevant IT
10 portfolio and project management requirements. Projects are reviewed so that
11 scope and costs are managed from inception through implementation. The IT
12 Governance process oversees IT projects during each phase of the project.

13 **Q. WHAT STEPS DOES BUSINESS SYSTEMS TAKE TO MANAGE PROJECT**
14 **COSTS?**

15 A. Business Systems monitors project expenditures on a monthly basis. Deviations
16 are evaluated and variance explanations prepared. In addition, action plans are
17 developed to mitigate variations in actual to budgeted expenditures. These plans
18 may increase, reduce, or delay other expenditures to support the overall
19 authorized budget. If authorized budget adjustments are required, they are
20 identified and approved at an appropriate level of management.

1 **IV. BUSINESS SYSTEMS 2014-2018 CAPITAL ADDITIONS**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT**
3 **TESTIMONY?**

4 A. The purpose of this section of my Direct Testimony is to provide an overview of
5 the primary drivers of Business Systems capital additions since the Company's
6 2014 Electric Rate Case, which was based on a 2013 HTY. I then present the
7 capital additions for which the Company is seeking approval to include in the
8 2018 HTY, along with illustrative examples broken down by budget grouping.
9 Below I primarily discuss the Company's 2014-2018 capital additions. I address
10 the Company's capital additions planned to be placed into service in 2019 in
11 Section V, below. AGIS-related capital additions are discussed in Section VII.

12 **Q. WHAT IS THE TOTAL DOLLAR AMOUNT OF NON-AGIS BUSINESS**
13 **SYSTEMS CAPITAL ADDITIONS YOU ARE SUPPORTING IN THIS CASE?**

14 A. As reflected in Attachment DCH-1, I am supporting \$324.1 million (Total
15 Company) for non-AGIS Business Systems capital additions for 2014-2018, and,
16 as shown in Attachment DCH-2, I am supporting \$68.9 million (Total Company)
17 for capital additions that will be placed into service in 2019.

18 **Q. WHAT HAVE BEEN THE PRIMARY DRIVERS OF THE COMPANY'S**
19 **INVESTMENT IN BUSINESS SYSTEMS OVER TIME?**

20 A. Business Systems had a relatively steady level of IT investment prior to 2014.
21 However, due to the age of Xcel Energy's IT systems and the ever-changing
22 business and regulatory requirements that affect the Company's and our

1 customers' IT needs, we entered a phase of replacement and upgrade of these
2 systems beginning in 2014. Future investment levels will depend on the evolving
3 needs of the Company and the emergence of technologies over time.

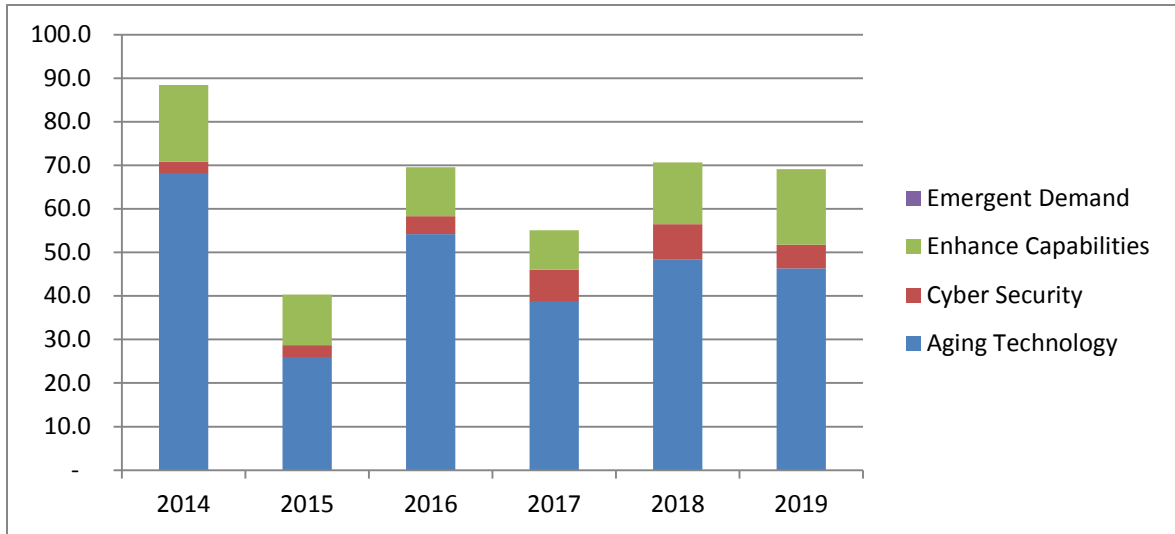
4 **Q. CAN YOU DEPICT THE TREND OF BUSINESS SYSTEMS CAPITAL**
5 **ADDITIONS AFFECTING PUBLIC SERVICE'S RATE BASE FROM 2014-**
6 **2019?**

7 A. Yes. Figure DCH-D-1 below depicts our capital additions trend from 2014 to
8 2019. This Figure illustrates when projects are placed into service, but it is
9 important to note that many technology projects are planned, developed, and
10 implemented (placed into service) over multiple years. As such, capital additions
11 trend information will show larger increases when more or larger projects are
12 placed in service, rather than when the expenditures are made.

13 Some of the projects in these categories, such as Network Strategy –
14 Transmission and Distribution Substation Connectivity in the Aging Technology
15 category, continue over multiple years, with portions of the project placed in
16 service as they are put to use each year. Some of the major capital projects
17 Business Systems completed since the 2014 Rate Electric Case are discussed in
18 more detail below.

1
2
3
4

**Figure DCH-D-1:
Business Systems Capital Additions 2014-2019 – Non-AGIS
Public Service (Total Company)
(Dollars in Millions)**



5 **Q. PLEASE PROVIDE ADDITIONAL DETAIL REGARDING THE DOLLAR**
6 **AMOUNTS DEPICTED IN FIGURE DCH-D-1.**

7 A. Table DCH-D-1 below provides a more granular breakdown of this data, showing
8 annual capital additions placed into service by budget group for the years 2014-
9 2019, excluding Business Systems AGIS-related capital additions, which I
10 discuss below in Section VII. As noted above, an overview of overall AGIS-
11 related costs (Business Systems and Distribution Business Area) is presented by
12 Mr. Nickell.

Table DCH-D-1:

**Business Systems 2014-2019 Capital Additions – Non- AGIS
 Public Service (Total Company)
 (Dollars In Millions)**

	2014	2015	2016	2017	2018	2019
Cybersecurity	2.8	2.7	4.2	7.4	8.2	5.5
Aging Technology	68.0	26.0	54.2	38.6	48.3	46.2
Enhance Capabilities	17.7	11.7	11.2	9.0	14.2	17.1
Emergent Demand*	-	-	-	-	-	**0.0
Total	88.4	40.3	69.6	70.3	70.7	68.9

There may be differences between the sum of the individual category amounts and Total amounts due to rounding.

* Because dollars that are allocated for the Emergent Demand Account are re-allocated to the specific projects for which they are spent, there are no actual capital additions classified as Emergent Demand.

** There is currently a little less than \$50,000 in 2019 Emergent Demand, which rounds down to \$0.

The figures in Table DCH-D-1 are stated on a Total Company (Public Service) basis, meaning that they include both electric utility-specific projects and common electric/gas projects stated at the total Public Service level. As noted above, Business Systems AGIS-related capital additions are discussed separately in Section VII of my Direct Testimony and broken down by AGIS program in Table DCH-D-11, below. AGIS capital additions amounts are Total Company Electric. Attachments DCH-1 and DCH-2 also contain Business Systems capital additions including the AGIS-related Business Systems capital additions, which are discussed below in Section VII of my Direct Testimony.²

² The dollar figures presented in Attachments DCH-1 and DCH-2, and the Tables included in this Testimony will match in total, but the presentation of projects and line items may not correspond exactly. The Attachments show a higher level of granularity with the work orders presented. For example, multiple work orders that each have their own line in an Attachment may comprise a single project that is explained in testimony.

1 Additionally, the data in Table DCH-D-1 reflects capital additions, not
2 expenditures – meaning it relates to projects being placed into service, rather
3 than year-over-year spend. In-servicing of projects can vary widely based on
4 Company needs and the completion date of larger projects, such as the \$7.9
5 million Next-Generation Desktop project, discussed below, which had capital
6 expenditures over several years and partially went into service in 2018 as
7 explained below.

8 **Q. WHAT IS THE OVERALL IMPACT OF RECENT BUSINESS SYSTEMS**
9 **INVESTMENTS ON PUBLIC SERVICE’S COST OF PROVIDING UTILITY**
10 **SERVICE?**

11 A. Business Systems investments affecting Public Service’s electric business have
12 increased in recent years due to the need for greater focus on and attention to IT
13 needs within the Company. Our investment evolution tracks that of the broader
14 industry – which continues to see an upward trend in the technology investments
15 needed to keep pace with the emergence of cybersecurity issues as well as
16 changing customer expectations. These investments are keeping the Company
17 operating, protecting important data, supporting customer service, and helping
18 other areas effectively manage O&M to reasonable levels.

1 **A. Cybersecurity**

2 **Q. WHAT TYPES OF CAPITAL PROJECTS TO ADDRESS EVOLVING**
3 **CYBERSECURITY THREATS AND REQUIREMENTS HAS THE COMPANY**
4 **PLACED INTO SERVICE SINCE ITS 2014 ELECTRIC RATE CASE?**

5 A. Since its 2014 Electric Rate Case, Public Service has placed \$25.3 million in
6 cybersecurity-related capital additions into service. As an illustrative example,
7 Public Service's investments in cybersecurity for 2018 totaled \$8.2 million Total
8 Company as depicted below in Table DCH-D-2.

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Table DCH-D-2
Public Service (Total Company)
(Dollars In Millions)

2018 Cybersecurity Capital Additions	2018 Total (Dollars in Millions)
Transient Cyber Asset Compliance CIP-010	1.6
IT Service Request Automation	1.0
Certificate & Key Management	1.0
Cyber Security - Small project (12 projects)	4.5
Total Company	8.2
There may be differences between the sum of the individual category amounts and the Total due to rounding.	

4 **Q. PLEASE BRIEFLY DESCRIBE CAPITAL ADDITIONS PLACED IN SERVICE**
5 **DURING 2018 TO ADDRESS EVOLVING CYBERSECURITY THREATS AND**
6 **REQUIREMENTS.**

7 A. Below are descriptions of projects with capital additions over \$1 million that were
8 placed in-service during 2018 to address evolving cybersecurity threats and
9 requirements:

- 10 • *Transient Cyber Asset Compliance CIP* (“Critical Infrastructure Protection”) -
11 *010*: This project provides a more secure identification and tracking of
12 security threats. The North American Electric Reliability Corporation CIP-010
13 standard requires Xcel Energy to document and track processes for high-
14 medium impact bulk electric cyber systems including timelines, vulnerability
15 assessments, controls, change management, computer logs, retention, and
16 other related substation equipment. This project represents \$1.6 million in
17 capital additions placed in service in 2018.

- 1 • *IT Service Request Automation:* The project updated an existing application
2 that had grown obsolete and implemented a service broker to provide a
3 unified hub for all applications and services, and maintain common enterprise
4 processes. The software created the ability to automate processes to be
5 proactive on high visibility events. This project represents \$1.0 million in
6 capital additions placed into service in 2018.
- 7 • *Certificate & Key Management:* This project implemented an
8 administration/management system covering digital certificates and
9 encryption keys. This project represents \$1.0 million in capital additions
10 placed in service into 2018.

11 **B. Aging Technology**

12 **Q. PLEASE DESCRIBE SOME OF BUSINESS SYSTEMS CAPITAL ADDITIONS**
13 **RELATED TO REPLACING AGING TECHNOLOGY SINCE ITS 2014**
14 **ELECTRIC RATE CASE.**

15 A. Since its 2014 Electric Rate Case, Public Service has placed \$235.0 million in
16 aging technology capital additions into service. As an illustrative example,
17 investments in aging technology for 2018 totaled \$48.3 million Total Company as
18 depicted below in Table DCH-D-3. Within Aging Technology, we further divide
19 projects into routine refreshes and specific individual refresh projects.

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**Table DCH-D-3:
 Public Service 2018 Aging Technology Capital Additions (Total Company)
 (Dollars In Millions)**

2018 Aging Technology Capital Additions	2018 Total (Dollars in Millions)
<i>Routine Refresh Projects</i>	
Annual Data Storage Project	2.7
Annual Network Refresh	1.8
Annual PC Refresh	3.8
Annual Server Refresh	0.1
Voice over Internet Protocol	1.1
<i>Specific Refresh Projects</i>	
Next Generation Desktop	7.9
DRMS Replacement Project	5.0
DMZ Redesign Project	4.0
PSCo Dispatch Console Upgrade	3.6
NMS 1.x Upgrade	3.0
2018 Oracle License	1.6
IrthNet Damage Prevention Project	1.5
PSCo Microwave Mountain Range Refresh	1.4
Verint Workforce Management upgrade or replacement Project	1.2
Aging Technology - Small project (20 projects)	9.6
Total Company	48.3
There may be differences between the sum of the individual category amounts and the Total due to rounding.	

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- Q. WHAT ARE ROUTINE REFRESH PROJECTS?**
- A. Within the Aging Technology grouping, routine refresh projects refer to those projects that relate to updating or refreshing day-to-day technology on a routine basis. Such projects include the annual data storage project, the annual network refresh, the annual PC refresh, and the annual server refresh. Budgets to upgrade technology components on an aggregate level are based on the

1 lifecycles outlined by various original equipment manufacturers. Equipment
2 lifecycles can differ based on each category, but generally speaking most of our
3 network, server and end user computing equipment are on an approximately five-
4 year refresh lifecycle. The funding allocated within each specific group/year
5 represents the aggregate of calculations to address two needs: (a) equipment
6 replacement as outlined above; and (b) net new incremental, or “business-as-
7 usual,” growth.

8 **Q. CAN YOU PROVIDE SOME EXAMPLES OF ROUTINE REFRESH**
9 **PROJECTS?**

10 A. Yes. Examples of routine refresh projects include: the Annual Data Storage
11 Project and the Annual Server Refresh Project.

12 **Q. WHAT IS THE ANNUAL DATA STORAGE PROJECT?**

13 A. The Annual Data Storage project replaces data storage hardware that is no
14 longer cost-effective to support, or that presents significant risk to operations due
15 to aging components or lack of vendor support. The project included \$2.7 million
16 in capital additions placed into service during 2018.

17 **Q. WHAT IS THE ANNUAL SERVER REFRESH PROJECT?**

18 A. The Annual Server Refresh project replaces aging servers prior to failure to
19 support business growth and maintain reliability. This routine refresh project
20 included \$0.1 million in capital additions placed into service during 2018.

1 **Q. PLEASE BRIEFLY DESCRIBE THE ANNUAL NETWORK REFRESH AND**
2 **ANNUAL PC REFRESH PROJECTS.**

3 A. Below are descriptions of the Annual Network Refresh and Annual PC Refresh
4 projects:

5 • *Annual Network Refresh:* The Annual Network Refresh project replaces
6 network devices (switches, routers, radios, channel banks, and voice
7 systems) due to aging technology, out-of-support equipment, security
8 vulnerabilities, and to enable new required capabilities. This routine refresh
9 project included \$1.8 million in capital additions placed into service during
10 2018.

11 • *Annual PC Refresh:* The Annual PC Refresh project replaces aging desktop
12 and laptop computers, as well as those that are lost or inoperable. This
13 project also provides devices to new employees. The project included \$3.8
14 million in capital additions that were placed into service during 2018.

15 **Q. CAN YOU PROVIDE SOME EXAMPLES OF SPECIFIC REFRESH**
16 **PROJECTS?**

17 A. Yes, the Next-Generation Desktop Project, the Demand Response Management
18 System Replacement Project, the DMZ Replacement Project, the Dispatch
19 Console Upgrade Project, and the NM 1 Upgrade Project. I will describe each in
20 turn.

1 **Q. WHAT IS THE NEXT-GENERATION DESKTOP PROJECT?**

2 A. This purpose of this project is to move the enterprise desktop computing devices
3 to the most current standard operating system, and standardize vendor support
4 for maintenance and defect resolution by ensuring overall stability and
5 continuation of patching practices, thereby minimizing security vulnerabilities.
6 The software upgrades enable greater business capabilities and efficiencies,
7 such as mobile and tablet technologies across our business. The project
8 included \$7.9 million in capital additions that were placed into service during
9 2018.

10 **Q. WHAT IS THE DEMAND RESPONSE MANAGEMENT SYSTEM**
11 **REPLACEMENT PROJECT?**

12 A. The Demand Response Management System (“DRMS”) Replacement project
13 involved deploying a new DRMS to address existing compliance and financial
14 risks, and position Xcel Energy’s gas and electric areas to grow demand
15 response in the future and to increase customer choice. This project is well into
16 its development cycle and included \$5.0 million in capital additions that were
17 placed into service during 2018.

18 **Q. WHAT IS THE DMZ REPLACEMENT PROJECT?**

19 A. In computer security, a demilitarized zone (“DMZ”) (sometimes referred to as a
20 perimeter network) contains and exposes an organization's external-facing
21 services to a larger and untrusted network, such as the Internet. The purpose of
22 a DMZ is to add an additional layer of security to an organization’s local area

1 network – i.e., an external network node can access only what is exposed in the
2 DMZ – while the rest of the organization’s network is firewalled. This project will
3 complete the design, build-out, and validation of the new cyber secure internet-
4 facing infrastructure. The new infrastructure is designed to be scalable, flexible,
5 and secure for internet facing applications. The project included \$4.0 million in
6 capital additions that were placed into service during 2018.

7 **Q. WHAT IS PUBLIC SERVICE’S DISPATCH CONSOLE UPGRADE PROJECT?**

8 A. The dispatch console project replaced Public Service’s radio dispatch console
9 system that was developed over 20 years ago. The project expands capability to
10 support mobile and fixed data applications leading to more efficient and safer
11 operations. The project included \$3.6 million in capital additions that were placed
12 into service during 2018.

13 **Q. WHAT IS THE NMS 1 UPGRADE PROJECT?**

14 A. The upgrade of the Outage Management System (Oracle Network Management
15 System (“NMS”)) ensures the application remains under long-term vendor
16 support, ensuring operational reliability. It also provides alignment to the Xcel
17 Energy enterprise standard for key technology components (e.g., JAVA,
18 WebLogic) and eliminates the need for one-off, interim fix-it solutions to maintain
19 critical business functionality e.g., switch plan deletion). Finally, the upgrade
20 supports the short- and long-term outage management system strategy at Xcel
21 Energy. The project included \$3.0 million in capital additions that were placed
22 into service during 2018.

1 **Q. PLEASE BRIEFLY DESCRIBE OTHER SPECIFIC REFRESH CAPITAL**
2 **ADDITIONS THAT WERE PLACED INTO SERVICE TO REPLACE AGING**
3 **TECHNOLOGY.**

4 A. Examples of other projects with capital additions over \$1 million that were placed
5 into service during 2018 to replace aging technology include:

- 6 • *2018 Oracle License Project:* This project is designed to manage the number
7 of licenses needed to support the enterprise. This project represents \$1.6
8 million in capital additions placed in service in 2018.
- 9 • *IrthNet Damage Prevention Project:* This project is designed to combine the
10 current aging IrthNet & Damage Prevention (“DP”) into a single package.
11 IrthNet is end-of-life in 2017, and is coupled with DP to provide underground
12 locating, safety, work assignment, communications, and reporting for
13 regulatory locating and damage prevention programs. This project represents
14 \$1.5 million in capital additions placed into service in 2018.
- 15 • *Public Service Microwave Mountain Range Refresh:* This project will replace
16 Company microwave components that are no longer supported by the vendor
17 per end-of-life guidelines. Replacement will help ensure continued reliability,
18 meet communication requirements, reduce safety concerns, and minimize
19 replacement costs. If not replaced on a cycle, there is an increasing risk of
20 failed systems impacting the availability, stability, and supportability of our
21 environment, which could cause loss of data and related business functions.

1 This project represents \$1.4 million in capital additions placed into service in
2 2018.

- 3 • *Verint Workforce Management Upgrade or Replacement:* This project will
4 replace the current Call Center tool used to support workforce management
5 and Quality Assurance practices aimed at optimizing resource utilization and
6 provide performance monitoring capabilities creating increased modeling
7 capabilities matching resource skills and staffing with call load. Without this
8 project, the Quality Assurance team will remain unable to effectively identify
9 opportunities to increase customer engagement and satisfaction
10 improvements. There is also risk of hardware and software failures as the
11 system was no longer supported by the vendor in mid-2015. This project
12 represents \$1.2 million in capital additions placed into service in 2018.

13 **C. Enhancing Capabilities**

14 **Q. PLEASE DESCRIBE THE COMPANY’S CAPITAL ADDITIONS TO “ENHANCE**
15 **CAPABILITIES” INCLUDED IN THE HTY.**

16 A. Since its 2014 Electric Rate Case, Public Service has placed \$63.8 million in
17 capital additions into service to enhance capabilities. As an illustrative example,
18 the Company’s investments in enhancing technology for 2018 totaled \$14.2
19 million in Total Company additions as reflected below in Table DCH-D-4.

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**Table DCH-D-4:
Public Service 2018 Enhancing Capabilities Capital Additions (Total Company)
(Dollars In Millions)**

2018 Enhancing Capabilities Capital Additions	2018 Total (Dollars in Millions)
Geospatial Integrations Project	4.9
Interval and Complex Billing Project	3.2
New Network for Rush Creek CO Wind Farm	1.3
Real Property Asset Management (RPAM) Project	1.3
SharePoint Upgrade	1.4
Enhance Capabilities - Small projects (4 projects)	2.0
Total Company	14.2
There may be differences between the sum of the individual category amounts and the Total due to rounding.	

4 A. I discuss the projects that account for the majority of the 2018 costs in this capital
5 budget grouping below.

6 **Q. WHAT IS THE GEOSPATIAL INTEGRATIONS PROJECT?**

7 A. The Geospatial Integration Project allows the new SAP WAM system functions to
8 synchronize asset locations with the GIS. It facilitates and supports the asset life
9 cycle including services performed on the various device types in the field. This
10 project represents \$4.9 million in capital additions placed into service in 2018.

11 **Q. WHAT IS THE INTERVAL AND COMPLEX BILLING PROJECT?**

12 A. The Interval and Complex Billing Project is designed to create a new set of
13 capabilities to improve the billing accuracy and efficiency of our most complex
14 rates and support the billing. The project will help inform the customer of their
15 usage to drive increased customer satisfaction, and may decrease energy
16 consumption. This project represents \$3.2 million in capital additions placed into
17 service in 2018.

1 **Q. WHAT IS THE SHAREPOINT UPGRADE PROJECT?**

2 A. The SharePoint upgrade project implemented our SharePoint software from
3 version 2007 to version 2016. SharePoint is a web application that enables
4 employees to collaborate from across all business units and to work more
5 efficiently by letting users share documents and data while maintaining security
6 and version control. Public Service also uses the SharePoint system as a
7 discovery and data sharing tool in regulatory proceedings. The new version is a
8 more powerful platform with improved information governance and security. This
9 project represents \$1.4 million in capital additions placed into service in 2018.

10 **Q. PLEASE BRIEFLY DESCRIBE OTHER PROJECTS PLACED IN SERVICE**
11 **DURING 2018 TO ENHANCE CAPABILITIES.**

12 A. Below are descriptions of other projects with capital additions over \$1 million that
13 were placed into service during 2018 to enhance the capabilities of the Company
14 and its ability to serve customers:

- 15 • *Network Rush Creek Wind Farm:* The purpose of this project is to connect the
16 Rush Creek Wind Farm into the Company's IT network. These connections
17 did not originally exist, and required the Company to acquire and order new
18 fiber and copper connections in order to connect the wind farms. This project
19 represents \$1.3 million in capital additions placed into service in 2018.
- 20 • *Real Property Asset Management Upgrade:* The Real Property Asset
21 Management Upgrade will upgrade software the Company utilizes to operate
22 and maintain facilities. The project will improve decision-making and property

1 management processes, improve facility budget management, and provide
2 improved analytics related to property management. This project represents
3 \$1.3 million in capital additions placed into service in 2018.

1 **V. BUSINESS SYSTEMS 2019 CAPITAL ADDITIONS**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT**
3 **TESTIMONY?**

4 A. The purpose of this section of my Direct Testimony is to provide an overview
5 of the non-AGIS-related Business Systems capital additions that will be
6 placed into service in 2019.

7 **Q. PLEASE DESCRIBE THE NON-AGIS CAPITAL ADDITIONS BUSINESS**
8 **SYSTEMS WILL PLACE INTO SERVICE IN 2019.**

9 A. As reflected in Table DCH-D-1, during 2019, the Company will place into
10 service \$68.9 million (Total Company) in non-AGIS Business Systems capital
11 additions. Below I discuss the capital additions by budget grouping, including
12 examples of capital additions placed into service during 2019.

13 **A. Cybersecurity**

14 **Q. WHAT CAPITAL PROJECTS TO ADDRESS CYBERSECURITY THREATS**
15 **ARE INCLUDED IN THE 2019 BUSINESS SYSTEMS FORECAST?**

16 A. Business Systems' projected cybersecurity-related capital additions for 2019
17 total \$5.5 million Total Company as depicted below in Table DCH-D-5.

1 **Table DCH-D-5**
2 **Public Service 2019 Cybersecurity Capital Additions (Total Company)**
3 **(Dollars In Millions)**

2019 Cybersecurity Capital Additions	2019 Total (Dollars in Millions)
Security Technology Refresh	3.3
Host Intrusion Prevention for Servers	1.2
Cybersecurity - Small project (9 projects)	1.0
Total Company	5.5
There may be differences between the sum of the individual category amounts and the Total due to rounding.	

4 **Q. WHAT IS THE SECURITY TECHNOLOGY REFRESH PROJECT?**

5 A. The Security Technology Refresh is the primary cybersecurity project that will
6 be placed into service over the period 2017-2020. While we call this a
7 “refresh,” it is an update of security technology rather than a routine annual
8 refresh like the projects associated with aging technology. The scope of this
9 project is to update critical cybersecurity technology including perimeter
10 security, internal infrastructure security, application security, and to implement
11 vulnerability management to protect sensitive customer and business
12 information. It is imperative to refresh our technology to ensure continued
13 compliance with regulatory requirements (as for customer data) and overall
14 corporate security objectives while reducing our business’ and our customers’
15 exposure to evolving cybersecurity risks and vulnerabilities. Refresh work is
16 placed into service as the individual pieces of technology become ready for
17 use. This project represents \$3.3 million in capital additions that will be
18 placed into service in 2019.

1 **Q. PLEASE BRIEFLY DESCRIBE OTHER CAPITAL ADDITIONS TO**
2 **ADDRESS CYBERSECURITY THREATS.**

3 A. The Host Intrusion Prevention for Servers project will increase the Company's
4 security efforts against cyber attacks within the Business Systems
5 infrastructure server environment by minimizing the risk of cyber attacks to
6 servers from exterior sources and will provide anti-virus controls for virtual
7 servers. This project represents \$1.2 million in capital additions that will be
8 placed into service in 2019.

9 **B. Aging Technology**

10 **Q. PLEASE PROVIDE AN OVERVIEW OF THE BUSINESS SYSTEMS**
11 **FORECAST FOR 2019 CAPITAL ADDITIONS FOR PROJECTS**
12 **ADDRESSING AGING TECHNOLOGY.**

13 A. Business Systems anticipates that capital additions related to projects
14 addressing aging technology for 2019 will total \$46.2 million Total Company
15 Electric as depicted below in Table DCH-D-6.

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**Table DCH-D-6:
 Public Service 2019 Aging Technology Capital Additions (TOTAL COMPANY)
 (Dollars In Millions)**

2019 Aging Technology Capital Additions	2019 Total (Dollars in Millions)
<i>Routine Refresh Projects</i>	
Annual Data Storage Project	3.0
Annual Network Refresh	4.0
Annual PC Refresh	1.4
Annual Server Refresh	1.8
<i>Specific Refresh Projects</i>	
ESB Environment Refresh	6.3
Next-Generation Desktop	5.2
Tapeless Data Center	2.5
WAN Public Service	2.3
1800 Larimer Juniper Switches Refresh	1.8
Network Inventory and Planning Solution	1.6
2019 Oracle Licenses	1.6
IIB licenses - ESB testing	1.3
PSCo Microwave Mountain Range Refresh	1.2
OSI PI Infrastructure	1.1
Aging Technology - Small project (19 projects)	11.1
Total Company	46.2
There may be differences between the sum of the individual category amounts and the Total due to rounding.	

4 **Q. WHAT ARE THE MAJOR ROUTINE REFRESH PROJECTS PLANNED**
 5 **FOR 2019?**

6 A. There are four major routine refresh projects with capital additions projected
 7 for 2019:

- 8 • \$3.0 million in Annual Data Storage,

- 1 • \$4.0 million in Annual Network Refresh,
- 2 • \$1.4 million in Annual PC Refresh, and
- 3 • \$1.8 million in Annual Server Refresh capital additions.

4 I discuss each of these projects in my Direct Testimony related to 2014-2018
5 capital additions in Section IV.B, above.

6 **Q: WHAT ARE THE MAJOR SPECIFIC REFRESH PROJECTS PLANNED**
7 **FOR 2019?**

8 A. The two major specific refresh projects include the ESB Environment Refresh
9 Project and the Next-Generation Desktop Project.

10 **Q. WHAT IS THE ESB ENVIRONMENT REFRESH PROJECT?**

11 A. This enterprise service bus (ESB) project will integrate a platform that
12 provides fundamental interaction and communication services between
13 complex software applications. The project will upgrade the existing asset to
14 ensure reliable data integrations. This project represents \$6.3 million in
15 capital additions that will be placed into service in 2019.

16 **Q. WHAT IS THE NEXT-GENERATION DESKTOP PROJECT?**

17 A. As I discussed in Section IV.B above, the Next-Generation Project is a multi-
18 year project, with various components placed in service as assets are
19 deployed. This project represents \$5.2 million in capital additions that will be
20 placed into service in 2019.

1 **Q. PLEASE BRIEFLY DESCRIBE OTHER SPECIFIC REFRESH CAPITAL**
2 **ADDITIONS TO REPLACE AGING TECHNOLOGY.**

3 A. The specific refresh capital additions projects to replace aging technology
4 include the following:

5 • *Tapeless Data Center Project:* This project will protect data by encompassing
6 data recovery efforts. The project will upgrade and replacing our current
7 solution. This project represents \$2.5 million in capital additions that will be
8 placed into service in 2019.

9 • *WAN Public Service:* The project will implement wide area network (WAN)
10 reliability and capacity improvements for Distribution and Transmission
11 substations, Energy Supply sites, Service Centers, and third parties. This
12 project represents \$2.3 million in capital additions that will be placed into
13 service in 2019.

14 • *1800 Larimer Juniper Switches Refresh Project:* The project will replace
15 identified End of Life (EoL) Juniper switches at Xcel Energy's 1800 Larimer
16 Street location with Cisco equipment utilizing current technologies to provide
17 for improved network reliability. This project represents \$1.8 million in capital
18 additions that will be placed into service in 2019.

19 • *Network Inventory and Planning Solution Project:* The project will develop a
20 central repository for all network information that can house the inventory of
21 all network assets. This inventory will include Wireless, Fiber, Site Inventory,
22 WAN circuits, and Hardware components and enable management of these

1 assets. This project represents \$1.6 million in capital additions that will be
2 placed into service in 2019.

3 • *2019 Oracle Licences Project:* The project will update the database version
4 across the Xcel Energy Enterprise. Several older versions currently deployed
5 within the enterprise are at end of life and/or no longer supported. This
6 project represents \$1.6 million in capital additions that will be placed into
7 service in 2019.

8 • *The IIB Licences – ESB Testing:* The project will implement a hosting
9 environment for Operational Technology-related ESB Integration
10 components. This project represents \$1.3 million in capital additions that will
11 be placed into service in 2019.

12 • *The Public Service Microwave Mountain Range Refresh Project:* The project
13 will replace microwave components that are no longer supported by the
14 vendor per end-of-life guidelines to ensure continued reliability, meet
15 communication requirements, reduce safety concerns, and minimize
16 replacement costs. This project represents \$1.2 million in capital additions
17 that will be placed into service in 2019.

18 • *The OSI PI Infrastructure Project:* The project will upgrade hardware and
19 software refresh existing OSI PI servers with additional resources, adding
20 new servers to support high availability and creating new development and
21 testing environments. This project represents \$1.1 million in capital additions
22 that will be placed into service in 2019.

1 facilities in Public Service. This project represents \$4.7 million in capital
2 additions that will be placed into service in 2019.

- 3 • *eSOMS (“Electronic Shift Operations Management System”) Project:* This
4 project will implement software and associated business processes to
5 prevent accidental startup of hazardous equipment while a worker is in
6 direct contact with the isolated equipment. This project is required for
7 personal safety and eSOMS is the industry standard in ensuring that
8 dangerous systems are properly shut off and not able to re-start until the
9 work on the isolated equipment is complete. This project represents \$2.2
10 million in capital additions that will be placed into service in 2019.

- 11 • *Enterprise Operational Monitoring:* The project supports corporate
12 initiatives and enables additional monitoring of existing and new critical
13 systems for Xcel Energy employees and customers. This asset will assist
14 the Company by monitoring the enterprise and preventing critical
15 application, hardware failures before they occur. This project represents
16 \$1.6 million in capital additions that will be placed into service in 2019.

- 17 • *Public Service Renewable*Connect:* The Colorado Renewable*Connect
18 project is software that will create the ability for customers to subscribe to
19 renewable energy offerings. This project represents \$1.5 million in capital
20 additions that will be placed into service in 2019.

- 21 • *Substation Asset Management System (“SAMS”) (Enterprise Reliability):*
22 The project will implement a solution to access, store, and analyze all of

1 the data needed to calculate an algorithm for setting priorities for program-
2 driven inspections, preventive maintenance, and corrective maintenance
3 at our substations. The SAMS application will provide the ability to
4 systematically evaluate equipment health, failure history analysis
5 event/condition notification, and lifecycle cost analysis so that we can
6 better manage our substations on behalf of our customers. This project
7 represents \$1.3 million in capital additions that will be placed into service
8 in 2019.

9 **D. Emergent Demand**

10 **Q. ARE THERE ANY CAPITAL PROJECTS TO ADDRESS EMERGENT**
11 **DEMAND OR OTHER BUSINESS SYSTEMS NEEDS REMAINING IN THE**
12 **2019 BUSINESS SYSTEMS FORECAST?**

13 A. As reflected in Table DCH-D-1, there is currently a little less than \$50,000
14 remaining in the forecast to address emergent demand in 2019. The
15 Emergent Demand Account for 2019 has been nearly fully utilized at the time
16 of filing of this rate review. All specific capital projects previously budgeted for
17 emergent demand in 2019 have been classified to the appropriate budget
18 grouping as those funds have been spent.

1 Q. HAS THE COMPANY, AND WILL THE COMPANY, MANAGE ITS
2 BUSINESS SYSTEMS-RELATED CAPITAL ADDITION PROJECTS IN 2019
3 TO ENSURE THE FINAL, ACTUAL COSTS ARE REASONABLE AND
4 PRUDENT?

5 A. Yes.

- 1 • *Application Development and Maintenance:* Costs associated with the
2 development, enhancement, maintenance, and consultation on new or
3 existing IT systems.
- 4 • *Labor:* Costs associated with all employees in the Business Systems
5 department.
- 6 • *Distributed Systems Services:* Costs related to maintenance agreements
7 on servers and data storage, PC maintenance, and help desk services for
8 computer users.
- 9 • *Contract Labor/Consulting:* Consists of fees and expenses for consultants
10 or knowledge base experts that are not employees of Xcel Energy.
- 11 • *Productivity Through Technology (“PTT”) and Stabilize & Optimize Project*
12 *Implementation Costs:* Costs of implementing and maintaining the new
13 SAP GL and WAM systems. These systems are described in greater
14 detail by Mr. Brown.
- 15 • *Other:* includes employee expenses, mainframe, outsourcing services not
16 included in the other categories, shared asset allocation, small purchases
17 for administrative materials, fleet expenses, and addressing company anti-
18 virus needs.

19 **Q. WHAT WERE BUSINESS SYSTEMS ACTUAL 2018 O&M COSTS?**

20 A. Our actual O&M expenses for 2018 totaled \$46.2 million (including AGIS).
21 Table DCH-D-8 below breaks down the amount of overall O&M costs by the
22 categories I discussed above. Attachments DCH-3 and DCH-4 provide an

1 accounting of these expenses by Cost Element and FERC account,
 2 respectively.

3 **Table DCH-D-8:**
 4 **Public Service 2018 Business Systems O&M (Total Electric)**
 5 **(Dollars In Millions)**

2018 O&M (Dollars in Millions)	
Cost Category	Total
Application Development & Maintenance	5.8
Contract Labor/Consulting	5.2
Distributed System Services	1.4
Labor	6.1
Network Services	10.4
Shared Assets	-0.7
Software	13.4
Other	4.7
Total Company Electric	46.2
There may be differences between the sum of the individual category amounts and Total due to rounding. The cost categories above include \$2.2 million in AGIS-related O&M expenses. AGIS-related O&M expenses are discussed below in Section VII of my testimony and shown by AGIS program in Table DCH-D-12.	

6 **Q. ARE THE \$46.2 MILLION IN 2018 O&M COSTS FOR BUSINESS**
 7 **SYSTEMS YOU DESCRIBE ABOVE REFLECTED IN THE COST OF**
 8 **SERVICE PRESENTED BY MS. BLAIR?**

9 A. Yes.

10 **Q. WHAT ARE THE MAJOR DRIVERS BETWEEN BUSINESS SYSTEMS'**
 11 **2013 TEST YEAR COSTS USED IN THE 2014 ELECTRIC RATE CASE**
 12 **AND THE 2018 HTY COSTS?**

13 A. The major drivers are shown in Table DCH-D-9 below.

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2
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**Table DCH-D-9:
 Public Service Business Systems O&M Drivers(Total Electric)
 (Dollars In Millions)**

Drivers of O&M Expenses from 2013 HTY to 2018 HTY (Dollars in Millions)			
Driver	2013 HTY	Driver Amount	2018 Actuals
Total O&M (adjusted)	36.9		
Shared Assets		3.2	
PTT Ongoing Costs		3.1	
PTT Project Costs		0.7	
AGIS		2.2	
Other		0.1	
Total Electric	36.9	9.3	46.2

4 Three major drivers explain the \$9.3 million O&M increase from the
 5 2013 HTY to the 2018 HTY. First, network equipment shared asset costs
 6 increased between 2013 and 2018 by \$8.8 million. Shared asset costs occur
 7 when employees in two or more of Xcel Energy’s operating companies use or
 8 share an asset owned by another operating company, which is the case with
 9 certain network assets supported by Business Systems. Since the 2013
 10 HTY, Public Service’s shared asset costs (recorded in Federal Energy
 11 Regulatory Commission (“FERC”) Account 931) have increased due to an
 12 increase in total Xcel Energy network equipment capital additions. However,
 13 a large Public Service credit (recorded in FERC Account 922) partially offsets
 14 the shared costs resulting in an overall net increase of \$3.2 million for Public

1 Service Electric. Ms. Schmidt and Ms. Wold address shared asset allocations
2 in more detail in their Direct Testimonies.

3 Second, Business Systems has experienced a \$3.8 million increase,
4 which has been driven by the Company's PTT initiative. PTT project
5 implementation costs were \$0.7 million in 2018 as explained by Company
6 witness Mr. Brown. PTT project costs are needed to fund other existing
7 projects that remain in development. Ongoing PTT O&M support costs in
8 2018 were \$3.1 million, and fall within the other categories of the Business
9 Systems budget, including the usual costs of maintaining new IT systems,
10 including software licensing, labor, contract labor/consulting, and other
11 employee expenses. The PTT implementation and ongoing support O&M
12 expenses are representative of future implementation costs for other projects
13 and the continuing ongoing PTT support O&M expenses.

14 Third, Business Systems has experienced an increase of \$2.2 million
15 in O&M expenses in supporting AGIS implementation. As with other O&M
16 expenses, AGIS O&M is included in Attachments DCH-3 and DCH-4. AGIS-
17 related O&M expenses are discussed below in Section VII of my testimony
18 and shown in Table DCH-D-12, broken out by AGIS program. Recovery of
19 AGIS-related costs, including O&M expenses, is discussed by Ms. Blair.

- 1 **Q. IS THE COMPANY'S 2018 BUSINESS SYSTEMS O&M A REASONABLE**
2 **BASIS ON WHICH TO ESTABLISH BUSINESS SYSTEMS O&M COSTS**
3 **FOR THE 2018 HTY?**
- 4 **A. Yes.**

1 **VII. AGIS**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT**
3 **TESTIMONY?**

4 A. In this section of my Direct Testimony, I provide detailed support for the
5 recovery of costs incurred by the Business Systems organization related to
6 the AGIS initiative, including actual capital additions placed into service
7 through 2018 as well as capital additions planned for 2019.

8 Ms. Trammell addresses the policy reasons that support the AGIS
9 investment and Ms. Blair supports the Company's cost of service and
10 revenue requirement associated with AGIS. It is Mr. Nickell, however, who
11 provides an overview of Public Service's AGIS initiative, including the
12 Company's technical strategy. As explained by Mr. Nickell, AGIS is a large-
13 scale undertaking that will transform the grid in Colorado. In the remainder of
14 my Direct Testimony, I describe the types of IT work Business Systems is
15 performing and explain why it is appropriate to carry out each of the IT
16 components of the AGIS initiative in the manner planned by the Company.
17 Immediately below, I provide an introduction to each of the AGIS foundational
18 programs. In Section VII.A, I describe the IT integration that is necessary for
19 the AGIS programs and describe the type of work that Business Systems is
20 doing. I also discuss Business Systems' IT capital and O&M forecasts for the
21 AGIS projects, identifying the drivers of various IT costs. Then, in Sections
22 VII.B-E, I discuss the implementation plan for each component of AGIS, from

1 a Business Systems/Information Technology perspective, including the
2 development of each IT project's forecast and the Business Systems work
3 that needs to be done to successfully complete the associated projects. I
4 discuss both the costs that have already been incurred (through 2018) as well
5 as the forecasts of 2019 costs. Where Business Systems has primary
6 responsibility for a program, I describe the development of that program's
7 forecast, and discuss the capital and O&M forecasts. I support Business
8 Systems O&M expenses for 2018 as well as an adjustment to account for the
9 known and measurable O&M that the Company anticipates for 2019. Where
10 the Distribution Business Area has primary responsibility for the program's
11 implementation, I defer to Mr. Nickell. Finally, I support the overall
12 reasonableness of AGIS project forecasts and implementation plans.

13 **Q. PLEASE DESCRIBE EACH OF THE FOUNDATIONAL PROGRAMS OF**
14 **AGIS.**

15 A. Below I briefly describe each program. These are described in more detail by
16 Mr. Nickell. The AGIS programs include:

- 17 • *Advanced Distribution Management System (ADMS)*: ADMS will provide
18 an integrated operating and decision software and hardware support
19 system to assist control room, field personnel, and engineers with the
20 monitoring, control, and optimization of the electric distribution system. It
21 will manage the complex interaction of distributed energy resources
22 ("DER"), outage events, feeder switching operations and advanced

1 applications such as IVVO and FLISR. ADMS gives access to real-time
2 and near real-time data to provide all information on an operator
3 console(s) at the control center in an integrated manner, which means the
4 different operating systems and technologies will communicate with and
5 update each other in the ADMS platform. ADMS is the fundamental
6 platform that utilizes the updated data the Distribution area is gathering as
7 part of the AGIS GIS project, and manages advanced applications (IVVO,
8 FLISR).

- 9 • *Geospatial Information System (GIS)*: The GIS provides location
10 information about all physical assets that make up the Company's electric
11 distribution system. While the Company already has a GIS, the Company
12 needs to engage in a data gathering effort to validate and update the
13 information in GIS because the ADMS model needs accurate information
14 to operate effectively.
- 15 • *Advanced Meter Infrastructure (AMI)*: AMI meters are able to measure
16 and transmit voltage, current, and power quality data and can act as a
17 "meter as a sensor," enabling ADMS to engage in near real-time
18 monitoring of the distribution system. These meters provide information
19 about customer usage and will enhance the Company's ability to send
20 price signals to customers, allow for new rate structures that will enable
21 customers to manage their energy usage with near real-time energy
22 usage data, identify outages without customer reporting, respond

1 efficiently to metering and usage issues, and allow remote service
2 disconnects and reconnects.

- 3 • *Field Area Network (FAN)*: The FAN is the communications network that
4 will enable communications between the communications infrastructure
5 that already exists at the Company's substations, the ADMS, the new AMI
6 meters, and the new intelligent field devices associated with advanced
7 applications as described immediately below. The FAN may provide
8 benefits to all AGIS projects, but is designed and built according to the
9 needs of various specific components, and each has different
10 communication network requirements.

- 11 • *Advanced Applications that Utilize Intelligent Field Devices*: The following
12 advanced applications and associated field devices will support a more
13 advanced grid:

- 14 • *Integrated Volt-VAr Optimization (IVVO)* is an application that
15 automates and optimizes the operation of the distribution voltage
16 regulating and VAr control devices to reduce electrical losses, electric
17 demand, and energy consumption and provides increased capacity to
18 host DERs.

- 19 • *Fault Location Isolation and Service Restoration (FLISR)* is an
20 application that uses automated switching devices to decrease the
21 duration of, and number of customers affected by, any individual
22 outage. These automated switching devices detect feeder mainline

1 faults, isolate the fault by opening section switches, and restore power
2 to unfaulted sections by closing tie switches to adjacent feeders as
3 necessary.

4 • *Fault Location Prediction (FLP)* is a subset application of FLISR that
5 leverages sensor data from field devices to locate a faulted section of a
6 feeder line and reduce patrol times needed to physically locate the
7 fault.

8 **Q. HOW IS THE COMPANY SUPPORTING ITS AGIS COSTS IN THIS RATE**
9 **REVIEW FILING?**

10 A. AGIS costs are incurred by both the Distribution Business Area and the
11 Business Systems (IT) organization for each of the AGIS programs. Although
12 there are IT components for each of the AGIS foundational components,
13 Business Systems has primary responsibility for the IT portion of ADMS, for
14 the head end and integration components of AMI, the IT integration and
15 deployment of the FAN, and the forecast development for the FAN.
16 Accordingly, I provide the primary support for the costs and processes for
17 these components of these AGIS programs.

18 Mr. Nickell provides the primary support for the costs and
19 implementation for programs and components where Distribution has primary
20 responsibility, including the GIS data collection effort for ADMS, the AMI
21 meters, the procurement and installation of pole-mounted FAN devices, the

1 advanced applications utilizing intelligent field devices (i.e., IVVO, FLISR and
 2 FLP), and additional elements of the AGIS implementation process.

3 **Q. PLEASE SUMMARIZE THE COMPONENTS OF THE AGIS PROGRAMS**
 4 **FOR WHICH THE COMPANY IS SEEKING RECOVERY ALONG WITH THE**
 5 **RESPONSIBLE COMPANY WITNESS.**

6 A. Mr. Nickell and I support the costs of the AGIS components as follows:

7 **Table DCH-D-10: AGIS Program Witness Support**

AGIS Foundational Program	Component	Witness
ADMS / GIS	System Development	Harkness
	GIS Data Collection	Nickell
AMI	IT Integration	Harkness
	Head end application	Harkness
	Meters and deployment	Nickell
FAN	IT Integration and deployment	Harkness
	Procurement and installation of pole-mounted devices	Nickell
IVVO	Application deployment	Harkness
	Advanced application and field Devices	Nickell
FLISR / FLP	Application Deployment	Harkness
	Advanced application and field devices	Nickell

8 **A. AGIS IT Integration Overview**

9 **Q. WHAT IS BUSINESS SYSTEMS' ROLE IN AGIS?**

10 A. Overall, Business Systems is responsible for integrating AGIS's IT systems
 11 and data with other back office applications existing at the Company, as I
 12 describe in more detail below. This is a complex and important part of the

1 overall AGIS planning and implementation process, as information technology
2 plays a key role in the advancement of the Company's distribution system.

3 **Q. WHAT IS "IT INTEGRATION"?**

4 A. IT integration refers to the process of connecting the physical devices and
5 technical components of the AGIS programs (*i.e.*, the ADMS and GIS, AMI,
6 FAN, IVVO, and FLISR/FLP systems) with other Public Service applications,
7 including pre-existing systems, to allow the efficient, timely, and secure
8 transfer of data between and among all of the Public Service systems. The
9 Company's existing software applications include its Enterprise Service Bus
10 ("ESB") — a software architecture on the Company's servers that is used for
11 enabling communication between multiple mutually interacting software
12 applications. The ESB provides reliable inter-system communication of
13 information, and provides a common and consistent integration point for
14 systems to send and receive data. The goal of integration is to ensure new
15 applications and data are able to communicate with our existing applications
16 so we are able to use the data to improve Public Service operations and
17 provide a better customer experience.

18 **Q. CAN YOU PROVIDE AN EXAMPLE?**

19 A. Yes. As one example, AMI meter data must be communicated to the ADMS
20 for operations and management of the grid, as well as to back-office
21 applications such as billing and customer care for the data to be used
22 consistently and as effectively as possible. As the business processes are

1 defined, the necessary data and applications requiring the new data gathered
2 from the AGIS components will be identified. Interfaces will be designed to
3 transfer the data between the applications. The new interfaces to support the
4 new business processes will require significant labor to design and
5 implement. We will need to use existing tools, such as the ESB, to make the
6 implementation and support of the interfaces more efficient.

7 **Q. WHY DOES PUBLIC SERVICE NEED TO INTEGRATE THE**
8 **COMPONENTS OF THE AGIS INITIATIVE WITH OTHER COMPANY**
9 **SYSTEMS?**

10 A. IT integration is necessary for nearly every aspect of AGIS. The devices,
11 equipment, and technologies being deployed to implement the AGIS
12 programs are ultimately supporting services to our customers. To support
13 efficient service to our customers, the devices, equipment and technologies
14 must be integrated with other systems, including existing systems of record
15 for information such as customer and premise identification, outage
16 management, work and asset management, communication channels, and
17 service billing. As a result of systems integration, the processing of
18 information will be automated. Integration will in turn support the Company's
19 ability to maximize the benefits of AGIS by significantly expanding the use of
20 Operational Technology ("OT"), which is identifying or making an operational
21 change based on information received. The information may come directly
22 from, for example, a device or process. As the use of systems and OT

1 matures, the Company will be able to use information from many different,
2 integrated sources to assist in managing the electric grid and maximizing the
3 benefits of AMI for our Colorado electric customers.

4 **Q. TO WHAT EXTENT DOES BUSINESS SYSTEMS ANTICIPATE**
5 **UPGRADES TO BACK-OFFICE APPLICATIONS AS A RESULT OF AGIS?**

6 A. The Company's design work, both completed and in-process, is identifying
7 integrations supporting AGIS requirements that will result in system changes
8 at the points of integration. These changes can be categorized as either
9 functional or non-functional. Functional changes are generally new or altered
10 integrations that support the data processing enabled by AGIS equipment and
11 technologies. Non-functional changes are generally related to the scalability,
12 performance and reliability of the integrations. Work within AGIS includes
13 tasks to address both functional and non-functional requirements that support
14 efficient service delivery to customers, any of which may be considered
15 "upgrades" qualitatively and quantitatively.

16 Some examples of data that we have not received before from meters
17 include voltage and temperature readings. Additionally, the Company will be
18 receiving larger quantities of data than we ever have before as the system will
19 collect data from meters several times a day—and possibly more frequently
20 by customer request—whereas today the Company collects this data on a
21 monthly basis through regular meter readings. To support the new data and
22 processes, the Company will have to upgrade a software application to

1 accommodate new fields and increase the applications data storage capacity
2 and processing. The Company is in the process of determining the designs
3 and uses for information collection, storage, calculation and retrieval of the
4 additional meter data.

5 **Q. WHAT TYPES OF IT CAPITAL COSTS IS BUSINESS SYSTEMS**
6 **INCURRING TO IMPLEMENT THE AGIS PROJECTS?**

7 A. The types of IT capital costs Business Systems is incurring and expects to
8 incur include project implementation costs related to software (purchase and
9 licensing), hardware (servers and firewalls), and labor (implementation and
10 warranty support). Labor costs include documenting requirements, vendor
11 selection, design, implementation of the solution, and the like. After initial
12 implementation, the Company expects to incur costs to upgrade and replace
13 components as needed.

14 **Q. WHAT ARE THE AGIS-RELATED IT CAPITAL COSTS YOU ARE**
15 **SUPPORTING IN THIS CASE?**

16 A. The Business Systems AGIS IT capital additions I am supporting in this rate
17 review are shown below in Table DCH-D-11.

**Table DCH-D-11:
 Public Service AGIS IT Capital Additions (Total Electric)
 (Dollars In Millions)**

1
2

AGIS Business Systems Capital Additions Public Service Company of Colorado – Total Company Electric (Dollars in Millions)			
AGIS Program	2017	2018	2019
ADMS*	0.0	0.0	52.3
AMI	0.0	0.7	33.4
FAN	15.2	6.0	17.5
FLISR	0.0	0.0	1.5
IVVO	0.0	0.0	8.2
Total	15.2	6.7	113.0
There may be differences between the sum of the individual AGIS program amounts and Total amounts due to rounding. * ADMS will be implemented on an enterprise-wide basis by all of the Xcel Energy OpCos. The Business Systems forecasts presented here for ADMS are based on a jurisdictional allocation to PSCo of Xcel Energy-wide costs for this program.			

3 These AGIS IT Capital Additions are also set forth in Attachments DCH-1 and
 4 DCH-2 to my Direct Testimony. I provide additional support for the IT capital
 5 costs, organized by AGIS component, in Sections VII.B-E of my testimony,
 6 below.

7 **Q. ARE THE IT CAPITAL COSTS PRESENTED ABOVE CONSISTENT WITH**
 8 **THE INFORMATION PROVIDED IN PUBLIC SERVICE’S COMPLIANCE**
 9 **FILINGS IN PROCEEDING NO. 16A-0588E?**

10 **A.** The actual costs, which include the costs incurred through 2018, are
 11 consistent with the cost information filed by the Company its Annual Actuals

1 Report for 2017 filed in May 2018 in Proceeding No. 16A-0588E.³ Because
2 AGIS was only in its initial stages in 2017, the Annual Actuals Report for 2017
3 did not breakout costs between IT (Business Systems) and the Distribution
4 Business Area, and did not separate costs associated with the FAN from the
5 costs for AMI and IVVO.

6 The IT capital costs forecasted for 2019 are slightly different from what
7 was reported by Public Service in the Grid CPCN 2019 Forecast Report filed
8 in October 2018 in Proceeding No. 16A-0588E. IVVO IT capital costs are
9 unchanged. However, the forecast for AMI IT capital costs is approximately
10 \$3 million higher than what was reported in the October 2018 filing. This
11 change is largely due to an inadvertent error in which approximately \$3 million
12 of AMI IT capital costs was included in the total for O&M costs. The \$3 million
13 of mis-identified capital expenditures is correctly included in the AMI IT capital
14 costs in this rate review filing and will be corrected in the Company's future
15 compliance report.

16 **Q. WHAT TYPES OF IT O&M COSTS ARE BUSINESS SYSTEMS**
17 **INCURRING TO IMPLEMENT THE AGIS PROJECTS?**

18 A. The types of O&M costs Business Systems is incurring for AGIS include
19 hardware support, data storage, annual software maintenance, application

³ The compliance reports submitted by the Company in Proceeding No. 16A-0588E relate only to the AGIS programs (of portions thereof) that were the subject of the CPCN and the AGIS CPCN Settlement in that proceeding. In addition, the compliance reports show expenditures, not capital additions. Accordingly, the cost information filed by the Company in its compliance reports in Proceeding No. 16A-0588E does not match the Table above.

1 support, and labor for software support. Internal labor is not included in the
 2 adjustment for known and measurable 2019 AGIS-related O&M.

3 **Q. WHAT ARE THE IT O&M COSTS INCURRED BY BUSINESS SYSTEMS**
 4 **FOR AGIS IMPLEMENTATION THAT THE COMPANY SEEKS TO UTILIZE**
 5 **IN ITS COST OF SERVICE IN THIS RATE REVIEW?**

6 A. Business Systems actual (2018) and forecasted (2019) AGIS O&M expenses
 7 are shown below in Table DCH-D-12.

8 **Table DCH-D-12:**
 9 **Public Service Business Systems AGIS O&M (Total Electric)**
 10 **(Dollars In Millions)**

AGIS Business Systems O&M		
Public Service Company of Colorado – Total Company Electric		
(Dollars in Millions)		
AGIS Program	2018	2019
ADMS*	0.7	1.5
AMI	0.4	1.9
FAN	0.9	1.4
FLISR**	0.0	0.0
IVVO	0.1	0.1
Total	2.2	4.9
There may be differences between the sum of the individual AGIS program amounts and Total amounts due to rounding. * ADMS will be implemented on an enterprise-wide basis by all of the Xcel Energy OpCos. The Business Systems forecasts presented here for ADMS are based on a jurisdictional allocation to PSCo of Xcel Energy-wide costs for this program. ** The Business Systems O&M for FLISR includes 2018 O&M actuals of \$28,550 and 2019 O&M forecast of \$3,557. which both round down to \$0 in each year shown in the table.		

11 **Q. WHAT SORT OF GOVERNANCE IS IN PLACE TO ENSURE THE AGIS**
 12 **PROJECTS ARE COST EFFECTIVE?**

13 A. Business Systems employs standard processes and procedures for selecting
 14 technologies to be deployed in the Company's environment as well as the

1 execution of large capital projects. These standard governance processes
2 have been, and will continue to be, utilized within the AGIS program. For
3 product selection, Business Systems uses thorough and methodical
4 approaches when undertaking to select programs and processes that the
5 Company will implement, such as undertaking competitive Request for
6 Proposals (“RFP”) processes. As applicable, the selection processes for the
7 individual AGIS programs are described individually in Sections VII.B-E
8 below.

9 **Q. WHEN DOES THE COMPANY ANTICIPATE THAT CUSTOMERS WILL**
10 **SEE THE BENEFITS OF IT INTEGRATION OF THE AGIS COMPONENTS?**

11 A. Although Mr. Nickell is the primary witness describing the customer benefits
12 driven by AGIS, I would note that as the components of AGIS roll out across
13 the Public Service business area, IT integration will support the overall
14 benefits of the AGIS projects; therefore, the benefits of the IT work will be
15 manifest when the project(s) are operational. Put differently, the benefits of
16 AGIS could not be achieved without IT integration but IT by itself does not
17 provide isolated benefits without the implementation of the Distribution
18 aspects of the AGIS projects.

1 **B. ADMS and GIS**

2 **Q. WHY IS ADMS (ADVANCED DISTRIBUTION MANAGEMENT SYSTEM)**
3 **INTEGRATION NEEDED?**

4 A. ADMS will provide an integrated operating and decision software and
5 hardware support system to assist control room, field personnel, and
6 engineers with the monitoring, control and optimization of the electric
7 distribution system. ADMS is the fundamental platform that manages each of
8 the other AGIS programs. It will be composed of hardware, software,
9 distribution SCADA, and an impedance model, which is an accurate electrical
10 representation of the distribution grid, including substations, core, and
11 advanced applications. ADMS will leverage sensor data for use by the core
12 and advanced applications to make accurate and informed decisions to
13 manage power flow on the distribution grid.

14 From a Business Systems perspective, ADMS will have core
15 applications, which will make up the foundation of ADMS, as well as
16 advanced applications. The core applications include distribution network
17 modeling, network topology processor, impedance calculation, unbalanced
18 load allocation, unbalanced load flow, state estimation, and distribution
19 SCADA. These applications provide the basis for running load flow and state
20 estimation on the distribution system providing near real-time calculations of
21 the state of the network including factors such as voltages, currents, real and
22 reactive power, amps, voltage drops, and losses. The ADMS advanced

1 applications will then utilize the core applications and provide additional
2 capability. As Mr. Nickell describes, Public Service plans to utilize two such
3 advanced applications: IVVO and FLISR, which will rely on accurate power
4 flow calculations to determine the power flow at points on the grid where
5 sensor information does not exist.

6 **Q. WITH WHAT SYSTEMS WILL ADMS BE INTEGRATED?**

7 A. The ADMS will integrate with a number of other systems using real-time and
8 on-demand interfaces. ESB interfaces are preferred and will be used where
9 technically and economically feasible. Additionally, some interfaces may exist
10 as a combination of different interface methods—in particular, interfaces to
11 SCADA systems may utilize a combination of industry-standard interfaces
12 such as ICCP (Inter-Control Center Communications Protocol), file transfers,
13 or web services. Below is a list of systems with which ADMS will integrate,
14 including existing systems as well as AMI.

- 15 • *General Electric (“GE”) SmallWorld GIS*: The ADMS will integrate with
16 Xcel Energy’s GE SmallWorld GIS. SmallWorld GIS contains the “As
17 Engineered” network model of Xcel Energy’s distribution feeders. The
18 ADMS will use the network model as a basis for all of the basic and
19 advanced applications of the ADMS. Additionally, the ADMS will receive
20 land-based vector data to underlay feeder maps within the geospatial view
21 which will provide better operational context and enhanced situational
22 awareness.

- 1 • *CRS*: The ADMS will integrate with Xcel Energy’s Customer Information
2 System, which is referred to as CRS. CRS manages customer service
3 and billing processes. CRS will provide customer information to the
4 ADMS and will be used by Control Center personnel and ADMS
5 applications.
- 6 • *DEMS SCADA*: ADMS will integrate with the Decentralized Energy
7 Management System (“DEMS”) in the following ways: Analogs and status
8 for substation devices from DEMS to ADMS; Control requests from ADMS
9 to DEMS for substation devices; Status & Distributed Energy Resources
10 analogs from ADMS to DEMS; Fault currents and relay targets from
11 DEMS to ADMS; tags from ADMS to DEMS; and SCADA database and
12 ICCP database configuration from DEMS to ADMS.
- 13 • *Oracle Network Management System (NMS)*: Xcel Energy currently uses
14 Oracle NMS to manage electric distribution network outages and planned
15 switching. Currently, the as-operated network model resides in NMS to
16 support the outage management process. Because NMS will continue to
17 perform outage management after ADMS is in production, the network
18 model in the ADMS and the network model in NMS shall remain “in-sync”,
19 with changes in one model being reflected in the other model.
20 Specifically, any state changes made to non-telemetered devices in the
21 NMS model shall be automatically reflected in the ADMS. Additionally,
22 any state changes made to telemetered devices in the ADMS model shall

1 be automatically reflected in NMS. Tags and notes will also be transferred
2 between ADMS and NMS.

- 3 • *Weather Data Service:* Weather data shall be used to support load
4 forecasting and DER output modeling within the ADMS. Weather data
5 from the Weather Data Service will include current and forecasted
6 temperature, wind speed, and solar irradiance.
- 7 • *SailPoint:* SailPoint is Xcel Energy's Identity and Access Management
8 solution. SailPoint supports the Company's technologies to securely
9 govern and manage access into technology resources. SailPoint provides
10 access review services and user provisioning. The ADMS will send user
11 permission information to SailPoint in support of the Quarterly Access
12 Review process.
- 13 • *SAP:* SAP is Xcel Energy's Enterprise Resource Planning system, which
14 Mr. Brown discusses in more detail in his Direct Testimony. ADMS will
15 integrate with SAP to initiate work orders for equipment in electric
16 substations and on distribution feeders. This interface will minimize dual
17 entry of equipment information already available in ADMS when
18 generating SAP work orders.
- 19 • *AMI:* ADMS will integrate with AMI, which will have its own head-end
20 system, to improve load-flow calculation accuracy and IVVO performance.
21 ADMS will receive voltage and power measurements from bellwether AMI
22 meters through the AMI head-end system.

1 **Q. PLEASE DESCRIBE FURTHER HOW ADMS AND AMI AND BACK**
2 **OFFICE APPLICATIONS WILL BE INTEGRATED.**

3 A. Public Service will connect AMI meters with the AMI head-end software that
4 sends commands to meters and receives data from the meters using the FAN
5 for communication. From the AMI head-end, data will be distributed to ADMS
6 and other back office applications, likely using an ESB, to enable the
7 capabilities to deliver benefits to the Company and its customers. ADMS data
8 from field devices, including advanced meters, will also be distributed to
9 various back office applications, likely using an ESB, to enable more effective
10 and efficient management of the distribution grid.

11 **Q. WHAT WORK WILL BUSINESS SYSTEMS UNDERTAKE TO INTEGRATE**
12 **THE ADMS PROJECT?**

13 A. The specific functions Business Systems provides for ADMS include:

- 14 • Leading the design of the system including software installation,
15 configuration, interfaces required with the ADMS system and operational
16 procedures impacted by the system;
- 17 • Procurement and installation of all hardware components that will run the
18 software, procurement of the software;
- 19 • Configuration of the software and hardware;
- 20 • Building and installation of any required interfaces;
- 21 • Designing and integration of security into all aspects of the ADMS
22 solution;

- 1 • Thorough unit, system and end-to-end testing of the ADMS solution;
- 2 • User Acceptance Testing (UAT) with the Distribution business resources;
- 3 and
- 4 • Establishment of a full ongoing support structure including process and
- 5 operational requirements.

6 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS HAS ALREADY**
7 **PERFORMED (THROUGH 2018) FOR ADMS IMPLEMENTATION.**

8 A. The Distribution Business Area and Business Systems have conducted their
9 ADMS implementation activities in partnership with each other. In 2017,
10 Business Systems completed the detailed design of ADMS. Business
11 Systems also conducted the installation, configuration, and initial testing of
12 the core components of the software solution, and built the system interfaces.
13 We also engaged in data collection activities and formatted substation and
14 field data for system acceptance and testing. We built the network model for
15 substations and feeders to be used in system acceptance and testing.

16 In 2018, we performed detailed unit, system, and end-to-end testing of
17 the ADMS solution as well as testing of all interfaces. We continued data
18 collection and formatting of all substation and field data required for system
19 acceptance and testing. We completed the building of the network model.
20 And, we performed activities to prepare for ADMS to “go live” and operational
21 in 2019. The ADMS components were not in-service in 2017 or 2018.

1 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS WILL**
2 **UNDERTAKE IN 2019 FOR ADMS IMPLEMENTATION.**

3 A. The Distribution and Business Systems Business Areas will continue working
4 together to implement the ADMS solution. In 2019, we will continue
5 production roll out of the ADMS system, and we anticipate full in-servicing for
6 ADMS components in 2019.

7 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
8 **DEVELOPING THE IT FORECAST FOR ADMS?**

9 Yes, Business Systems is responsible for the hardware, software, and labor
10 associated with the design and build of the ADMS system and interfaces.
11 Therefore, I describe the forecast development process for ADMS in more
12 detail here. Mr. Nickell provides the primary discussion of Distribution's data
13 collection efforts associated with the GIS for use in the ADMS, and I provide
14 some additional discussion of the data collection project.

15 **Q. PLEASE PROVIDE AN OVERVIEW OF THE PROCESS FOR**
16 **DEVELOPING THE IT ADMS FORECAST.**

17 A. The Company issued an RFP in 2015 to determine the most appropriate
18 distribution management system for the Company. Out of that process, a
19 vendor was chosen for the software as well as the systems integration work.
20 A detailed project estimate was created from the pricing and contract
21 information as well as labor and hardware to support the overall ADMS
22 project. This effort was benchmarked and reviewed with other utilities and

1 industry research organizations such as the Electric Power Research Institute
2 (“EPRI”). Upon completion of the detailed design a detailed implementation
3 plan was developed and the project estimates were updated.

4 The ADMS is being developed as one software system that will be
5 used by all of the Xcel Energy OpCos and implemented across a project
6 timeline. The ADMS costs are allocated to each OpCo as described by Ms.
7 Wold.

8 **Q. WHAT ARE THE PRIMARY COMPONENTS OF BUSINESS SYSTEMS’**
9 **ADMS IT CAPITAL FORECAST?**

10 A. There are three key components: (1) labor; (2) software; and (3) hardware.

11 **Q. HOW DID THE COMPANY DERIVE THE LABOR PORTION OF BUSINESS**
12 **SYSTEMS’ ADMS IT CAPITAL FORECAST?**

13 A. The ADMS labor estimate was developed from a bottom-up forecast of all
14 resources required to complete the implementation phase. The estimate
15 includes labor costs already incurred through the detail design phase along
16 with estimates to complete the implementation phase work. Labor
17 components for the implementation phase include external vendors
18 (Schneider, General Electric and Oracle), and contractors. Vendor cost
19 estimates are based on contractual agreements with each vendor. The
20 contractor labor forecast was based on a roll-up of all resources required,
21 including estimated durations and rates for each.

1 **Q. HOW DID THE COMPANY DERIVE THE SOFTWARE PORTION OF**
2 **BUSINESS SYSTEMS' ADMS IT FORECAST?**

3 A. The software portion of the ADMS forecast consists of a license agreement
4 with the ADMS vendor, Schneider, and various third-party (i.e., Microsoft,
5 VMware, InfoBlox and Leidos) infrastructure licenses. The Schneider license
6 agreement is a fixed cost and has been fully executed. The third-party
7 software consists of licenses for the operating systems, databases and
8 security products to operate and secure the ADMS system. The cost
9 estimates were based on the number of hardware environments, servers, and
10 processors based on existing license agreement costs with the third-party
11 companies.

12 **Q. HOW DID THE COMPANY DERIVE THE HARDWARE PORTION OF**
13 **BUSINESS SYSTEMS' ADMS IT FORECAST?**

14 A. Detailed system processing requirements were gathered through the RFP
15 process as well as the contract process with the selected vendor for the
16 ADMS system. These detailed requirements were used by the project team
17 and the Company's infrastructure team, in conjunction with the ADMS
18 vendor's technical experts, to determine size, scale and costs for all aspects
19 of the infrastructure needed to adequately, securely and reliably operate the
20 ADMS system for the Company. The types of hardware required include
21 processors, data storage, security hardware/software, network devices such

1 as firewalls and core switches, as well as critical data center infrastructure
2 including power, cooling and cabling.

3 **Q. WHAT ARE THE PRIMARY COMPONENTS OF BUSINESS SYSTEMS’**
4 **ADMS O&M FORECAST?**

5 A. The primary components of Business Systems’ ADMS O&M forecast include:
6 (1) planning phase activities; and (2) support activities that will occur after
7 ADMS is implemented, including contract labor, ongoing hardware and
8 software maintenance and warranty.

9 **Q. HOW DID BUSINESS SYSTEMS DERIVE THE ADMS O&M FORECAST?**

10 A. The ADMS O&M forecast was developed based on industry benchmarking
11 information as well as the Company’s previous experience with similar system
12 implementations and support models.

13 **Q. WHY IS THE ADMS IT FORECAST REASONABLE FOR CUSTOMERS TO**
14 **SUPPORT?**

15 A. Business Systems employs standard processes and procedures for selecting
16 technologies to be deployed in the Company’s environment as well as the
17 execution of large capital projects. These processes are designed to ensure
18 that the Company is both containing costs appropriately and spending on the
19 items necessary to achieve the desired outcomes and overall reasonable
20 costs. These standard processes have been, and will continue to be, utilized
21 within the AGIS program. They include:

- 1 • *Product Selection:* An RFP process was used to select the Schneider
2 ADMS solution for the ADMS project. This process ensured the most
3 optimal solution for the Company's needs was selected and the price was
4 negotiated to reasonable costs to the Company.
- 5 • *Project and Initiative Governance:* The AGIS initiative's formal project
6 governance processes, which are discussed by Company witness Mr.
7 Nickell, are incorporated into the ADMS project. I note that the
8 governance includes ongoing processes to monitor scopes of work and
9 cost variances as the project progresses.

10 **Q. WHY IS IT INTEGRATION NEEDED WITH RESPECT TO THE GIS?**

11 A. The GIS provides location information about all physical assets that make up
12 the Company's distribution system, as well as specification information of the
13 physical assets, such as a distribution feeder's size. ADMS will use the
14 location and specification information to maintain the as-operated electrical
15 model and advanced applications. While GIS is an existing system, the
16 Company needs to engage in a data gathering effort to validate and update
17 the information in GIS because the ADMS model needs accurate information
18 to operate effectively.

19 **Q. WHAT WORK IS BUSINESS SYSTEMS UNDERTAKING WITH RESPECT**
20 **TO THE GIS PROJECT?**

21 A. Business Systems' role in the GIS aspects of AGIS is to partner with the
22 Distribution Business Area in the data collection effort, validate data accuracy

1 and establish ongoing data collection/update processes. The costs
2 associated with the data collection and validation are included in
3 Distribution's costs. Software integration, storage, and automated processes
4 are included in Business Systems integration costs. This cost allocation
5 ensures that costs are appropriately applied to either the creation of the data
6 asset, with data itself being an asset associated with the management of the
7 distribution system, or to the implementation and management of the
8 supporting technology.

9 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
10 **DEVELOPING THE FORECASTS FOR THE GIS WORK?**

11 A. No. Therefore, Mr. Nickell provides the primary support for the forecasts for
12 the GIS data work. However, Business Systems partnered with Distribution
13 to help develop this forecast in some respects, including through the
14 performance of a gap analysis between what information is required by the
15 ADMS and what is currently stored and available in the GIS data model;
16 assessing the quality of data currently held in the GIS and external sources;
17 and determining if additional data cleanup activities are required. As a result
18 of this effort, a unit cost for each required data element was derived by using
19 the amount of assets in the GIS and applying a data capture cost from each
20 field inspection vendor. This information was documented and managed via
21 a formal RFP process. The activities undertaken by Distribution are
22 discussed by Mr. Nickell.

1 **C. AMI**

2 **Q. WHY DOES AMI REQUIRE IT INTEGRATION?**

3 A. AMI is a system of advanced meters, communications networks, and data
4 management systems that enable two-way communication between utilities'
5 business and operational data systems and meters enabling added benefits
6 for customers and the utilities. AMI meters are able to measure and transmit
7 voltage, current, and power quality data and can act as a “meter as a sensor,”
8 providing near real-time monitoring between the meter and ADMS. Because
9 it consists of both software and hardware and works with other Company
10 systems, information technology integration is key to the success of AMI.

11 **Q. HOW WILL BUSINESS SYSTEMS PARTICIPATE IN THE AMI**
12 **DEPLOYMENT?**

13 A. The advanced meters will be integrated with the Company’s IT system. AMI
14 is data intensive with meter readings, energy usage interval profiles, power
15 outage and restoration events, power quality information and other data
16 transmitted and collected frequently. All data from the advanced meters is
17 transmitted to the AMI head-end application and, depending on what the data
18 is, needs to be integrated and made available to the applicable business
19 system in an accurate and timely manner.

20 Public Service has documented an assumption of four
21 “implementations” of AMI capability release over four years, as discussed in
22 the Grid CPCN 2019 Forecast Report filed on October 31, 2018 in

1 Proceeding No. 16A-0588E. Each implementation will add additional
2 capabilities to the overall AMI solution. There is an assumption that not all
3 business capabilities associated with AMI will be delivered at one time, but
4 sufficient capabilities will be delivered within the four implementations to allow
5 the installation of AMI meters. Business Systems will work with business
6 areas to prioritize the capabilities and will implement based on the cost and
7 benefit of each capability.

8 **Q. WHAT SYSTEMS WILL BE INTEGRATED WITH AMI?**

9 A. The following applications will be integrated so they can use AMI data:

- 10 • *ADMS*: As previously noted, ADMS will provide an integrated operating
11 and decision software support system to assist control room, field
12 personnel, and engineers with the monitoring, control and optimization of
13 the electric distribution system. ADMS will use the AMI data to deliver
14 automated grid capabilities, such as IVVO and FLISR. AMI will provide
15 the ADMS with timely real and reactive power measurement data that will
16 be used in load flow and IVVO calculations. AMI meters will also provide
17 voltage measurements at various points on the distribution system to
18 support IVVO calculations. Additionally, advanced meters will report a
19 power-out or “last gasp” event to the AMI head-end application and report
20 a power-on event when power is restored. “Last gasp” is defined as the
21 final message transmitted by the meter upon detection of an outage. This

1 information will flow from the head-end application into ADMS, improving
2 the calculations for the FLISR and FLP applications.

- 3 • *CRS*: The application provides capabilities for customer service, billing,
4 service orders, and payments. CRS is currently integrated with the Meter
5 Asset Lifecycle Management System and Meter Data Management
6 (“MDM”) System. AMI head-end integration with the CRS will allow Public
7 Service to streamline multiple processes. As an example of a process
8 improvement resulting from integrating the AMI head-end with the CRS,
9 we will be able to obtain a meter reading to begin or end a billing cycle
10 when a customer moves into or out of a premise without a visit to the
11 customer’s premise. As another example, when a customer is delinquent
12 in paying their bills, the Company will be able to issue an order from the
13 CRS to the AMI head-end to request the customer’s service be
14 disconnected. When a disconnected customer pays their bill, an order
15 generated in the CRS will be sent to the AMI head-end to reconnect the
16 service. Disconnect and reconnect processes today are manual
17 processes that require a person to physically visit the customer’s site.

- 18 • *Meter Asset Lifecycle Management System*: This system manages the
19 entire life cycle of serialized metering devices, including purchasing,
20 testing, field installation location, field removal, and retirement of the
21 asset. The Meter Asset Lifecycle Management System is currently
22 integrated with the MDM System and CRS. The integration of the AMI

1 head-end with the Meter Asset Lifecycle Management System will allow it
2 to remain as the Company's primary source of location information and
3 attributes for serialized metering devices. The AMI head-end will receive
4 the meter location and attribute information to enable provisioning of the
5 meter, understand its location, and obtain data from the meter.

- 6 • *MDM*: This system provides capabilities to validate, edit, and estimate
7 meter readings and manages events from the meter, such as power
8 outages and tampering. The MDM will also assist in facilitating
9 communication to, and receiving data from, the AMI head-end. The MDM
10 is currently integrated with the Meter Asset Lifecycle Management System
11 and CRS. The MDM will serve as the central repository for the reading
12 data. The MDM will also validate the meter data and export it for use in
13 billing, customer viewing, and analytics.

14 AMI will significantly increase the number of meters and amount of
15 data loaded to our MDM and Public Service will need to upgrade the
16 currently deployed software solutions for managing the meter inventory
17 and configurations. This MDM system update was anticipated as part of
18 the implementation of AMI, and an initial forecast that is both conservative
19 and preliminary is included in this rate review. However, Xcel Energy
20 recently completed an evaluation of the current MDM system application
21 and infrastructure and determined that an entirely new solution is needed
22 to fulfill the requirements for AMI. The current MDM system application is

1 approaching end of life and does not have the capacity and security
2 elements required to support AMI, including the volume and technical
3 capabilities needed for the Company-wide deployment of advanced
4 meters. A new MDM solution will be utilized enterprise-wide across the
5 Xcel Energy OpCos and we are in the process of developing the full scope
6 of work, total costs, and determining the OpCo allocation. Ultimately, the
7 MDM solution will support the security, functionality, scalability, and
8 performance requirements of AMI meter data management.

- 9 • *Customer portal and new initiatives:* The customer portal (the current
10 version is available on the Xcel Energy website and is known by
11 customers as “My Account”) is used by customers to obtain account
12 information, track energy usage, view billing history, pay bills, and sign up
13 for notifications. AMI data from field devices (i.e., the customer’s meter)
14 will move through the AMI head-end, and be integrated with other
15 customer information, to the customer portal, where customers will have
16 the ability to see more granular meter reading data than they see today.

17 While our final design has not yet been determined, our current
18 customer portal design plan will provide routine meter readings, which will
19 be obtained from the meters several times a day and will provide the
20 majority of the data that is shown when customers request a display of
21 their usage by time interval. In addition, to ensure the customer is able to
22 be provided with the most up to date information, the data from the routine

1 meter readings can be supplemented with the latest information available
2 from the meter. This will be done automatically when the customer uses
3 the portal to send an “on demand” read request to the meter, obtaining the
4 latest readings from the meter; the portal will then combine this new data
5 with the data obtained from the routine reading process for customer
6 viewing. In addition, the customer portal will provide the customer with the
7 option of “refreshing” the information on the screen through a similar
8 process. A smartphone application will also provide customers with
9 similar capabilities.

10 In addition, the advanced meters will be capable of providing data
11 that will be available to a customer’s Home Area Network (“HAN”) and will
12 enhance the customers’ experience through the Company’s utilization of
13 Green Button Connect My Data (“GB CMD”). Mr. Nickell provides an
14 introduction to the Company’s adoption of HAN capabilities, and the costs
15 associated with which are part of the AGIS AMI forecasts.

16 A HAN is a customer’s electronic data network of devices within
17 their premise. Although Customers will select their own HAN hardware
18 and software, the Company is creating a technology infrastructure in order
19 to enable communication between customers’ devices and the advanced
20 meter through the HAN. GB CMD is a standard ratified by the North
21 American Energy Standard Board that allows customers to access their
22 electricity usage data and share that data with third-party service

1 providers. The Company is implementing a GB CMD system that will
2 allow customers to download or view information related to their energy
3 usage and communicate that information to third parties through the GB
4 CMD communication portal.

- 5 • *FAN*: The AMI meter's two-way communication module is a component of
6 the mesh network layer of the FAN, which is the component of the FAN
7 included in the CPCN Projects.⁴ The meter's communication module
8 retrieves meter data that is stored within the meter as prescribed by ANSI
9 C12.19 meter table implementation standards. The radio frequency
10 communications modules in the meters may also act as a repeater for
11 other mesh network devices, enabling two-way communication between
12 the meters and the mesh network. This function has the benefit of
13 increased reliability of communication between the AMI meters and the
14 head-end application. In limited circumstances where deployment of the
15 WiSUN mesh network is not practical (such as remote locations on the
16 edge of Public Service's distribution system), meter data may be
17 transmitted over the FAN via public cellular or other wireless technologies.
18 The FAN is discussed in more detail below in Section VII.D.

⁴ The term "mesh" refers to the network's topology, which resembles the interlaced design of mesh material. All nodes on the network will relay data and cooperate in the distribution of that data in the network. The mesh design provides redundancy benefits, which are described in more detail below.

1 **Q. WHAT WORK IS BUSINESS SYSTEMS UNDERTAKING TO INTEGRATE**
2 **THE AMI PROJECT?**

3 A. The specific functions Business Systems provides for AMI include:

- 4 • Leading the design of the overall system and components mentioned
5 above;
- 6 • Procurement and installation of all hardware components that will run the
7 software;
- 8 • Procurement of the software;
- 9 • Configuration of the software and hardware;
- 10 • Designing, procuring and installation of the necessary hardware and
11 software referred to as the “head-end” application that reads the meters
12 and other field devices in the AMI solution and monitors and manages the
13 network and attached devices. The head-end application will also be used
14 by the other Xcel Energy operating companies when they deploy
15 advanced meters;
- 16 • Building and installation of any required interfaces throughout all
17 applications involved in the AMI solution including MDM (Meter Data
18 Management, CRS (Customer Resource System), Portals/Mobile
19 Applications, Meter Device Management System (MDMS – device
20 inventory and configuration management) and OMS (Outage Management
21 System);
- 22 • Designing and integration of security into all aspects of the AMI solution;

- 1 • Thorough unit, system, and end-to-end testing of the AMI solution;
- 2 • User Acceptance Testing (UAT) with the Distribution, Customer Care and
- 3 Customer Solutions business resources; and
- 4 • Establishment of a full ongoing support structure including process and
- 5 operational requirements.

6 Put differently, Business Systems will implement new AMI head-end software.
7 The AMI head-end software will be installed and configured to run on new
8 server hardware. From the AMI head-end, interfaces will need to be built to
9 transfer the data to other applications, such as ADMS, MDM, CRS, and
10 MDMS.

11 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS HAS ALREADY**
12 **PERFORMED (THROUGH 2018) FOR AMI IMPLEMENTATION.**

13 A. In 2017, Business Systems and the Distribution Business Area jointly
14 undertook a programmed approach for staffing and vendor selection for AMI
15 system integration. Business Systems and Distribution participated in
16 contract awards (from RFPs) for a network vendor to support WiSUN (the
17 mesh network portion of the FAN that will utilize the advanced meters'
18 communications modules). We also commenced design and planning
19 processes for AMI.

20 In 2018, we engaged in detailed design and planning of all interfaces
21 with the AMI solution, and undertook the installation and testing of the head-

1 end system to support reading data from field devices. No AMI components
2 were in service in 2017 or 2018.

3 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS WILL**
4 **UNDERTAKE IN 2019 FOR AMI IMPLEMENTATION.**

5 A. Public Service plans to deploy approximately 1.6 million advanced meters in
6 Colorado between 2019 and 2024. The Business Systems organization will
7 engage in software development, which includes integrating AMI, the other
8 AGIS systems, and related data with the Company's existing applications.
9 Specifically, new AMI head-end software will be installed and configured to
10 run on new server hardware. From the AMI head-end, interfaces will also be
11 built to transfer the data to other applications, such as the billing and
12 customer service systems.

13 In 2019, Business Systems will complete work on building and testing
14 all interfaces of the AMI software solutions required for Implementation 1.
15 This will include the design, build, and testing of the head-end system to
16 support reading and monitoring of the AMI meters to be installed to support
17 IVVO. The AMI functionalities that will be placed in service in 2019 are
18 consistent with the AGIS CPCN Settlement. Business Systems remains on
19 schedule for future AMI functionality consistent with the AGIS CPCN
20 Settlement.

21 Going forward, Business Systems will also continue work on AMI
22 functionalities that will be placed into service in later years, including providing

1 customers with near real-time access to their usage data on the My Account
2 portal, as well as HAN and GB CMD IT implementation. The context for
3 these programs is described by Mr. Nickell. Software expenses related to the
4 HAN are part of the Business Systems AMI forecast.

5 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
6 **DEVELOPING THE FORECAST FOR AMI?**

7 A. Business Systems is responsible for developing the forecasts for the head-
8 end application and integration. Therefore, I describe the forecast
9 development process for these aspects in more detail in my Direct Testimony.
10 Mr. Nickell addresses the forecast for the meters themselves.

11 **Q. PLEASE PROVIDE AN OVERVIEW OF THE PROCESS FOR**
12 **DEVELOPING THE AMI IT FORECAST.**

13 A. A series of RFPs was conducted to determine the most appropriate AMI
14 solution for the Company. The Company received responses from industry
15 leaders in the space as part of its competitive bidding process. From that
16 process, vendors were chosen for the software as well as the system
17 integration work. A detailed project estimate was created from the pricing and
18 contract information, as well as labor and hardware to support the overall AMI
19 project. Itron was selected based on optimal pricing, strategic fit, and industry
20 experience. This effort was benchmarked and reviewed with other utilities
21 and industry research organizations such as EPRI.

1 **Q. WHAT ARE THE PRIMARY COMPONENTS OF THE AMI IT CAPITAL**
2 **EXPENDITURE FORECAST?**

3 A. The AMI IT forecast has three key components: (1) hardware, (2) software,
4 and (3) labor.

5 **Q. HOW DID THE COMPANY DERIVE THE HARDWARE PORTION OF THE**
6 **AMI IT FORECAST?**

7 A. Xcel Energy has standards for all hardware that is deployed in our data
8 centers. These standards define hardware for which the Company has
9 industry benchmarked, negotiated pricing. The estimates were then derived
10 utilizing the hardware requirements of the applications(s) and applying
11 standard pricing.

12 **Q. HOW DID THE COMPANY DERIVE THE SOFTWARE PORTION OF THE**
13 **AMI IT FORECAST?**

14 A. The initial estimates were derived utilizing pricing gained from industry
15 benchmarks and reviewed with other utilities and industry research
16 organizations such as EPRI. These benchmarks drove the negotiations with
17 the selected vendor(s) from which final estimates were created. The software
18 portion of the AMI head-end forecast includes a detailed list of software
19 components provided and offered from the vendor. The RFP process
20 identified these specific software components and included those that are
21 required (mandatory) and those that are optional. As previously mentioned,

1 these estimates will be reviewed and refined throughout the lifecycle of the
2 project.

3 **Q. HOW DID THE COMPANY DERIVE THE LABOR PORTION OF THE AMI IT**
4 **FORECAST?**

5 A. It is expected that the selected vendors will provide the majority of the labor
6 required to deliver the program. The initial estimates were derived utilizing
7 pricing gained from industry benchmarks and reviewed with other utilities and
8 industry research organizations such as EPRI. These benchmarks drove the
9 negotiations with the selected vendor(s) and final estimates were created.

10 **Q. WHY IS THE AMI HEAD-END AND INTEGRATION FORECAST**
11 **REASONABLE FOR CUSTOMERS TO SUPPORT?**

12 A. As previously noted, the Company employs standard processes and
13 procedures for selecting technologies to be deployed in the Company's
14 environment, as well as for the execution of large capital projects. For AMI,
15 these processes include:

- 16 • *Product Selection:*
 - 17 • Head-End. The Company used multiple RFP processes to select the
18 optimal vendor partners for various aspects of the AMI delivery. A
19 competitive bid was completed at the end of 2017 resulting in the
20 selection of Itron for the AMI head-end software solution. An additional
21 competitive bid process was completed in 2018 to select a vendor
22 partner for all program testing.

1 • System Integration. Negotiated individual statements of work were
2 developed with existing vendors that own and support each of the
3 interfacing applications in order to gain the most optimal cost for the
4 integration effort.

5 • *Project and Initiative Governance:* The AGIS initiative's formal project
6 governance processes are incorporated into the AMI project.

7 **Q. WHAT ARE THE PRIMARY COMPONENTS OF BUSINESS SYSTEMS'**
8 **AMI O&M FORECAST?**

9 A. The primary components of Business Systems AMI O&M costs include: (1)
10 planning phase activities, including scope definition and solution selection (for
11 example, the AMI RFP and vendor selection); and (2) support activities that
12 will occur after AMI is implemented, including contractor labor, maintenance
13 and warranty.

14 **Q. HOW DID BUSINESS SYSTEMS DERIVE THE FORECAST FOR AMI**
15 **O&M?**

16 A. The AMI O&M forecast was developed based on industry benchmarking
17 information as well as the Company's previous experience with similar
18 systems implementations and support models.

1 **Q. WHY IS BUSINESS SYSTEM'S AMI FORECAST REASONABLE FOR**
2 **CUSTOMERS TO SUPPORT?**

3 A. AMI is a foundational component of AGIS. As discussed above, AGIS is a
4 long-term strategic initiative to transform our electrical distribution system to
5 enhance security, efficiency, and reliability, to safely integrate more DERs,
6 including those that are customer owned, and to enable improved customer
7 products and services. The IT components described above are necessary to
8 implement AMI and the AMI IT forecast is reasonable in enabling
9 technologies that improve customer products and services.

10 **D. The FAN**

11 **Q. WHAT IS THE FAN?**

12 A. Public Service's FAN will be a resilient wireless communications network that
13 will provide connectivity and enable two-way communications between the
14 existing infrastructure at the Company's substations and new and planned
15 field devices up-to and including the customer meter.

16 **Q. WHY DOES THE FAN REQUIRE IT INTEGRATION?**

17 A. The FAN is the communications network that will enable communications
18 between the communications infrastructure that already exists at the
19 company's substations, the ADMS, and the new intelligent field devices
20 associated with advanced applications, including AMI, IVVO, and FLISR. The
21 FAN may provide benefits to all AGIS programs but is designed and built

1 according to the needs of various specific components, and each has
2 different communication network requirements.

3 **Q. HOW WILL THE FAN CONNECT TO THE COMPANY'S EXISTING**
4 **INFRASTRUCTURE?**

5 A. The FAN will be connected to Public Service's pre-existing Wide Area
6 Network ("WAN"). Public Service's WAN is a communications network
7 primarily composed of private optical ground wire fiber and a collection of
8 routers, switches, and private microwave communications that are
9 supplemented by leased circuits from a variety of carriers as well as satellite
10 backup facilities. The WAN is an intermediate link in the Company's
11 communication system that provides high-speed, two-way communications
12 capabilities and connectivity in a secure and reliable manner between Public
13 Service's core data centers and its service centers, generating stations, and
14 substations. The connections will be primarily at substations on the
15 distribution system. This connection at the substation will be via private fiber
16 or alternate cabling within the substation from the WiMAX base station radios
17 to the routers at the substations which are connected to the WAN. The WAN
18 is monitored at all times by the Network Operations Center ("NOC").

19 The WAN is designed to communicate to and through substations
20 (transmission and distribution) to ensure the security and future-proofing of
21 the network. The WAN also provides primary and backup communication

1 capabilities to the service centers, office locations, and generation facilities in
2 Public Service's areas of operation.

3 While the WAN will be the main linkage for transporting data from the
4 WiMAX network to the Company's data centers upstream, it already carries a
5 lot of other traffic (that is, the actual digits and bytes of data that flow over the
6 wired and wireless networks) to support utility operations. The data centers
7 are the locations that house the Company's computers (servers) and store
8 data. The data centers will also house the advanced applications associated
9 with AGIS (such as ADMS and AMI, and the sub-applications, including
10 IVVO, FLISR, FLP and GIS).

11 **Q. WHAT ARE THE COMPONENTS OF THE FAN?**

12 A. The FAN will consist of two separate wireless technologies: (a) a lower-speed
13 Wireless Smart Utility Network ("WiSUN") mesh network⁵; and (b) a high-
14 speed point-to-multipoint Worldwide Interoperability for Microwave Access
15 ("WiMAX") network.⁶

16 **Q. PLEASE DESCRIBE THE INFRASTRUCTURE AND DEVICES THAT WILL**
17 **BE INTEGRATED WITH THE WISUN MESH PORTION OF THE FAN.**

18 A. The core infrastructure for the WiSUN mesh network will consist of two main
19 device types: (1) access points; and (2) repeaters.

⁵ The mesh network is based on Institute of Electrical and Electronics Engineers ("IEEE") 802.15.4g standard, sometimes known as a Wireless Smart Utility Network ("WiSUN"). The WiSUN naming convention is similar to how "Wi-Fi" is the commercial name for IEEE's 802.11 standard, which is used throughout the general public.

⁶ WiMAX is the commercialized name for the IEEE's 802.16 series of standards.

1 An access point is a device that will link the Company's endpoint
2 devices that are enabled with wireless communication modules with the rest
3 of the Company's communications network. The access points will wirelessly
4 connect directly to backhaul (which is an intermediate link in the
5 communications network—WiMAX, in this case) in order to pass traffic
6 between the mesh network and the WAN. Access points will extend the
7 reach of Public Service's communications network and will define the
8 boundary of the mesh itself.

9 Repeaters are range extenders and are used to fill in coverage gaps
10 where devices would be otherwise unable to communicate. These two device
11 types will be principally located on distribution poles and other similar
12 structures.

13 Other devices that will participate in the mesh include AMI meters and
14 DA devices, such as the intelligent FLISR and IVVO field devices, that have
15 built-in mesh radios. The former will be located on customer premises; the
16 latter will be co-located with either pole-mounted or pad-mounted distribution
17 devices. The radio frequency ("RF") communication modules in these
18 devices will enable two-way communication between the AMI meters and the
19 mesh network.

20 In addition to their metering function, the advanced meters will have
21 embedded communication modules that will allow the devices to
22 communicate as part of the WiSUN network. The Company estimates that

1 the AMI meters themselves (and their communications modules) will make up
2 over 90 percent of devices that will communicate as part of the mesh network.
3 The WiSUN component transfers information between meters and transmit
4 data over the mesh network to an access point device that transitions the
5 data from the mesh network to the WiMAX tier of the FAN. The mesh
6 network allows multiple devices to connect with each other, which provides
7 multiple potential communication routes ensuring a robust communications
8 network. In most cases this communication will be with the WiSUN mesh
9 radios via IEEE's 802.15.4g standard described above. This standard for
10 local and metropolitan area networks is well-accepted in the utility and
11 communications industries. WiSUN can wirelessly connect meters, sensors,
12 distribution devices, street lights, and signal repeaters to create a robust and
13 reliable wireless network. Xcel Energy, on behalf of Public Service and the
14 other operating companies, participates as a full member in the WiSUN
15 Alliance with other utilities and equipment manufacturers. By selecting a
16 technology that conforms to the IEEE standard, Public Service will ensure the
17 interoperability of the FAN with other systems.

18 **Q. PLEASE DESCRIBE THE INFRASTRUCTURE AND DEVICES THAT WILL**
19 **BE INTEGRATED WITH THE WIMAX PORTION OF THE FAN.**

20 A. As noted above, data from the mesh network will be transmitted across the
21 WiMAX network to the WAN for data backhaul. The WiMAX network will
22 wirelessly connect directly to devices on the Company's distribution feeder

1 lines as well as provide the secure, reliable connectivity between Public
2 Service's WAN and WiSUN networks. The WiMAX network will consist of two
3 main components: (1) base stations; and (2) customer premise equipment
4 ("CPE"). To provide context, CPE is a common term in the network industry
5 that refers to specific equipment. In the term "CPE", the "customer" refers to
6 Public Service (or a similarly-situated entity using this equipment), which is a
7 customer of the equipment manufacturer. It does not refer to any specific
8 customers of Public Service, or to Public Service's customers generally.

9 Base stations will serve as the key communication points between the
10 substation WAN and the WiSUN (mesh) network. The WiMAX point-to-multi-
11 point network will be based in Public Service's substations and will enable
12 high-speed connectivity at locations across the distribution system. At
13 substations, there will be a base station with up to three radios that will
14 communicate multi-directionally with CPEs out in the field of operations.
15 Through the substations' connection to the WAN, the base stations will
16 enable end-to-end communication between the intelligent field devices and
17 the Company's advanced applications and other back office applications.⁷

18 In the case of a CPE that is wirelessly connected to a WiSUN access
19 point, this will further enable the back office applications to communicate with
20 any device accessible to that access point's connections to the mesh

⁷ "Back office" applications and systems are those that actually use and manipulate the data and perform specific business functions, including energy management system applications.

1 network. For any particular mesh “cluster” (that is, a logical collection of
2 mesh nodes), there will be multiple access points connected to WiMAX that
3 will provide redundant paths of communication to the WAN. This will result in
4 a more reliable, robust field area network.

5 Xcel Energy, on behalf of Public Service and the other operating
6 companies, participates fully as a member of the WiMAX Forum, an industry
7 group tasked with the continued development, maintenance, and certification
8 of products for the 802.16 standards. By selecting a technology that
9 conforms to the IEEE standards, Public Service will ensure the interoperability
10 of the FAN with other systems.

11 **Q. WHAT SYSTEMS WILL BE INTEGRATED WITH THE FAN?**

12 A. The following applications will be integrated with the FAN:

- 13 • *AMI*: The WiSUN mesh network, including the meters’ communication
14 nodes that will communicate as part of the network, will support AMI
15 through the meters’ communication function. The FAN will provide the
16 transport for data transfer between the meters and the AMI head-end
17 application, including interval reads, register reads, voltage information,
18 and power quality data. It will also provide the sending and receiving of
19 commands like power outage notifications and remote connect/disconnect
20 commands.
- 21 • *ADMS*: The FAN infrastructure will provide data from field devices to the
22 WAN, which will then deliver data to ADMS. The FAN enables data and

1 information from field devices to be communicated to ADMS, and also
2 enables commands to be transmitted to the field devices from ADMS. The
3 FAN infrastructure will provide data from endpoint devices, such as meters
4 and field devices, to a common ESB via the WAN, which will then deliver
5 data to ADMS. The ESB will also receive commands from ADMS that will
6 be delivered to the devices connected to the FAN via the WAN. The FAN
7 enables data and information from field devices to be communicated to
8 ADMS, and also enables commands to be transmitted to the field devices
9 from ADMS.

10 **Q. WHAT WORK IS BUSINESS SYSTEMS UNDERTAKING TO IMPLEMENT**
11 **THE FAN PROJECT?**

12 A. The specific functions Business Systems provides for FAN implementation
13 include:

- 14 • Leading the design of the network systems (WiMAX and WiSUN);
- 15 • Procurement and installation of all hardware components that will operate
16 the network. This task is a joint effort between Business Systems and
17 Distribution in the procurement and deployment of the hardware
18 components with Business Systems primary responsible for the
19 installation of WiMAX base stations and Distribution Business Area
20 resources responsible for the installation of devices that will be located on
21 Distribution poles (CPE's, AP's and repeaters primarily). Company
22 witness Mr. Nickell discusses the costs associated with the Distribution

- 1 Business Area's participation in the procurement and installation of pole-
2 mounted FAN devices;
- 3 • Configuration of the software and hardware;
 - 4 • Designing and integrating security into all aspects of the FAN solution;
 - 5 • Thorough unit, system and end-to-end testing of the FAN solution;
 - 6 • User Acceptance Testing (UAT) with the Distribution, Customer Care and
7 Customer Solutions business resources; and
 - 8 • Establishment of a full ongoing support structure including process and
9 operational requirements.

10 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS HAS ALREADY**
11 **COMPLETED (THROUGH 2018) TO SUPPORT THE FAN**
12 **IMPLEMENTATION.**

13 A. In 2017, the Company completed its RFP for a WiSUN design vendor, and
14 selected Itron Networked Solutions, Inc.. The Company received responses
15 from industry leaders in the space as part of its competitive bidding process.
16 Itron was selected based on optimal pricing, strategic fit, and industry
17 experience. Contract negotiations were completed in December 2017, and
18 WiSUN devices were selected. The WiSUN devices will be located on the
19 Company's distribution poles or pad-mounted cabinets to have effective
20 communication coverage with end-devices. The Company also engaged in
21 the continued deployment and testing of WiMAX installations at substations in
22 the Denver metro area, conducted planning activities for 2018 installations,

1 and tested WiMAX installations. A small number of FAN sites in the
2 Stapleton area were placed in-service to support the battery storage projects.

3 In 2018, we continued the deployment of WiMAX installations at
4 substations in the Denver metropolitan area and in areas outside of the
5 Denver area, conducted planning activities for 2019 installations, and tested
6 WiMAX installations. In addition, the installation of CPE devices on
7 Distribution poles was also begun. A number of FAN sites in the Denver
8 metro area were placed in-serve in 2018 to support installation of IVVO
9 intelligent field devices.

10 **Q. PLEASE DESCRIBE THE WORK BUSINESS SYSTEMS WILL**
11 **UNDERTAKE IN 2019 TO SUPPORT IMPLEMENTATION OF THE FAN.**

12 A. In 2019, Business Systems will continue deployment of WiMAX installations
13 at substations in the areas outside of Denver. This task is a joint effort
14 between Business Systems and Distribution in the procurement and
15 deployment of the hardware components with Business Systems primary
16 responsible for the installation of WiMAX base stations and Distribution
17 resources responsible for the installation of devices that will be located on
18 Distribution poles (CPE's, AP's and repeaters primarily). Mr. Nickell
19 discusses the costs associated with Distribution's participation in the
20 procurement and installation of pole-mounted FAN devices. We will also
21 continue planning for any remaining FAN sites installations, and testing of all
22 new WiMAX installations. A significant amount of FAN sites in the Denver

1 area are planned to be in-serviced in 2019 to support installation of IVVO
2 devices, ADMS and initial meter deployments that will support IVVO.
3 Business Systems will provide operational support for FAN network in
4 production use via the NOC.

5 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
6 **DEVELOPING THE FORECASTS FOR THE FAN?**

7 A. Yes. Business Systems was responsible for developing the forecast for both
8 the WiSUN and WiMAX components of the FAN. Therefore, I describe the
9 forecast development process for these aspects in more detail below. As
10 noted above, Mr. Nickell discusses the costs associated with Distribution's
11 participation in the procurement and installation of pole-mounted FAN
12 devices.

13 **Q. PLEASE PROVIDE AN OVERVIEW OF THE PROCESS FOR**
14 **DEVELOPING THE WISUN FORECAST.**

15 A. As previously noted, Business Systems employs standard processes and
16 procedures for selecting technologies to be deployed in the Company's
17 environment, as well as the execution of large capital projects. These
18 standard processes are being utilized for deployment of the FAN, as follows:

- 19 • *Product Selection:* The Company awarded a contract for the WiSUN
20 mesh network in 2017; and
- 21 • *Project and Initiative Governance:* The AGIS initiative's formal project
22 governance processes are incorporated into the FAN project.

1 **Q. PLEASE PROVIDE AN OVERVIEW OF THE PROCESS FOR**
2 **DEVELOPING THE WIMAX FORECAST.**

3 A. The Company's standard forecast development processes were followed, as
4 set forth below:

5 • *Product Selection:* An RFP was issued and awarded for the WiMAX
6 primary vendor in 2015. That portion of the project is in the deployment
7 process. The Company awarded a contract for this part of the AGIS
8 solution in 2017. In conjunction with the RFP for the AMI Software
9 selection noted above, Itron was also selected in 2017 for the Wi-SUN
10 mesh aspects of the FAN. This process ensured the most optimal solution
11 for the Company's needs was selected and the Company negotiated a
12 contract with reasonable costs.

13 • *Project and Initiative Governance:* The AGIS initiative's formal project
14 governance processes are incorporated into the FAN project.

15 **Q. WHAT ARE THE PRIMARY COMPONENTS OF THE FAN IT CAPITAL**
16 **FORECAST?**

17 A. The FAN forecast has two key components: (1) labor; and (2) hardware. As
18 noted above, Mr. Nickell discusses the costs associated with Distribution's
19 participation in the procurement and installation of pole-mounted FAN
20 devices.

1 **Q. HOW DID THE COMPANY DERIVE THE LABOR PORTION OF THE FAN**
2 **FORECAST?**

3 A. The labor costs were derived utilizing pricing gained from industry
4 benchmarks and reviewed with other utilities and industry research
5 organizations such as EPRI. These costs were also analyzed and reviewed
6 as the result of the limited deployment of the FAN that tested out the
7 technology, the deployment process, monitoring and performance. As each
8 stage of the FAN deployment is conducted, the labor costs and estimates are
9 reviewed on a per-site basis and forward-looking estimates are refined.
10 These costs will be reviewed and refined throughout the lifecycle of the
11 project. Labor cost types include installation labor, RF design, configuration
12 and testing, planning engineering, program management, and network
13 services.

14 **Q. HOW DID THE COMPANY DERIVE THE HARDWARE PORTION OF THE**
15 **FAN FORECAST?**

16 A. Xcel Energy has standards for all hardware that is deployed in the field.
17 These standards define hardware for which the Company has industry
18 benchmarked, negotiated pricing. In addition, Xcel Energy issued an RFP for
19 hardware, and awarded the work for the WiMAX primary vendor in 2015.
20 Types of hardware purchased included WiMAX base station antennas, radios,
21 router, batteries, CPE communications boxes, and the like. That portion of
22 the project is in the deployment process.

1 **Q. WHAT ARE THE PRIMARY COMPONENTS OF BUSINESS SYSTEMS’**
2 **FAN O&M FORECAST?**

3 A. The primary components of Business Systems’ FAN O&M forecast include
4 ongoing field support for devices deployed, hardware maintenance (patches
5 and firmware upgrades), technical support for the network, and NOC support
6 for monitoring the network.

7 **Q. HOW DID BUSINESS SYSTEMS DERIVE THE FAN O&M FORECAST?**

8 A. We used existing data from other network installations of a similar nature as
9 well as input from our FAN vendor and information gathered from other
10 utilities and industry organization such as EPRI.

11 **E. Advanced Applications Utilizing Intelligent Field Devices (IVVO,**
12 **FLISR, FLP)**

13 **Q. WHY IS IT INTEGRATION IMPORTANT FOR THE ADVANCED**
14 **APPLICATIONS (IVVO, FLISR, AND FLP)?**

15 A. The advanced applications of IVVO and FLISR will rely on accurate power
16 flow calculations to determine the power flow at points on the grid where
17 sensor information does not exist. As such, they require integration with the
18 core ADMS systems. As I described earlier, the advanced applications must
19 be integrated with the ADMS core applications and other critical systems to
20 provide their intended benefits to Public Service customers.

1 **Q. WHAT WORK IS BUSINESS SYSTEMS UNDERTAKING WITH RESPECT**
2 **TO THE ADVANCED APPLICATIONS?**

3 A. The role of Business Systems with respect to these advanced application
4 projects is:

- 5 • Leading the design of the system components associated with each
6 advanced application;
- 7 • Configuration of the software and hardware required for each advanced
8 application;
- 9 • Building and installation of any required interfaces;
- 10 • Designing and integrating security into all aspects of each advanced
11 application;
- 12 • Thorough unit, system and end-to-end testing of each advanced
13 application; and
- 14 • User Acceptance Testing (UAT) with the Distribution business resources.

15 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
16 **DEVELOPING THE FORECASTS FOR IVVO?**

17 A. Management System (GEMS) software for the secondary static VAR
18 compensator (“SVC”) devices that are part of the IVVO implementation, and
19 for managing the integration of the IVVO advanced sub-application with
20 ADMS. Although Mr. Nickell provides a discussion of the forecast process
21 with respect to the IVVO advanced application and its related field devices in

1 his Direct Testimony, I discuss GEMS below, and discussed ADMS
2 integration above.

3 **Q. PLEASE DESCRIBE THE GEMS SOFTWARE THE COMPANY HAS**
4 **SELECTED TO SUPPORT THE IVVO FIELD DEVICES.**

5 A. The Company completed its RFP process for an SVC vendor in the second
6 quarter of 2018, selecting Varentec's Edge of Network Grid Optimization
7 ("ENGO") unit as the winning bidder for the SVC devices. The Company will
8 deploy the GEMS software for management and control of the ENGO SVC
9 devices. The Company previously piloted the ENGO device and GEMS
10 software. The pilot used a "cloud based" solution, though for the IVVO
11 deployment the Company is planning to host the server in-house. Vendor
12 specific management software will likely be required based on the vendor with
13 which the Company selects to partner.

14 **Q. WHAT ARE THE PRIMARY COMPONENTS OF THE IVVO IT CAPITAL**
15 **FORECAST TO IMPLEMENT THIS SOFTWARE?**

16 A. The IVVO IT capital forecast has two key components: software and labor.

17 **Q. HOW DID THE COMPANY DEVELOP THESE COST ESTIMATES?**

18 A. Varentec provided budgetary quotes for their ENGO device licensing based
19 on a cloud-based approach and an in-house server based approach. The in-
20 house approach was used to develop cost estimates, consistent with the
21 Company's security preferences.

1 **Q. WHAT ARE THE PRIMARY COMPONENTS OF BUSINESS SYSTEMS**
2 **IVVO O&M COSTS?**

3 A. The primary components of Business Systems IVVO O&M costs include
4 hardware support, data storage, annual software maintenance, application
5 support, and labor for software support.

6 **Q. HOW DID BUSINESS SYSTEMS DERIVE THE IVVO O&M FORECAST?**

7 A. We used comparative information from other applications currently supported
8 within Business Systems.

9 **Q. WAS BUSINESS SYSTEMS PRIMARILY RESPONSIBLE FOR**
10 **DEVELOPING THE FORECASTS FOR FLISR/FLP?**

11 A. No. However, Business Systems is responsible for the integration of the
12 Sensor Management System ("SMS") for Aclara sensors into ADMS, and for
13 managing the integration of the FLISR (and FLP) sub-application with ADMS.
14 Although Mr. Nickell provides a discussion of the forecast process with
15 respect to the FLISR/FLP advanced application and its related field devices in
16 his Direct Testimony, I discuss the Aclara SMS below, and discussed ADMS
17 integration above.

18 **Q. WHAT IS THE ACLARA SMS FOR FLISR?**

19 A. The Aclara SMS is software which provides control and reporting on sensors
20 across the Company's distribution system. It also acts as a virtual RTU,
21 providing the ability to integrate the sensor data with the SCADA system. The
22 sensors and SMS will be used in conjunction with each other to support

1 FLISR. FLISR requires that the substation relay provide certain signals in
2 order to communicate to the ADMS to begin automatic locating of the fault
3 and subsequent restoration. Public Service's current substation standard
4 requires a specific make and model of relay which many of the Company's
5 substations do not have, so these sensors provide a low cost alternative that
6 can provide that telemetry.

7 **Q. WHAT ARE THE PRIMARY COMPONENTS OF THE IT CAPITAL**
8 **FORECAST TO IMPLEMENT FLISR/FLP?**

9 A. The FLISR/FLP IT capital forecast is primarily composed of labor costs.
10 There is minimal anticipated O&M for FLISR/FLP within Business Systems.

11 **Q. HOW DID THE COMPANY DEVELOP THESE COST ESTIMATES?**

12 A. The Company developed labor estimates using actual labor costs for the
13 design and implementation of the FLISR / FLP functionality leveraging ADMS,
14 SMS, and sensor data. No new software is required.

1 **VIII. RECOMMENDATIONS AND CONCLUSION**

2 **Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS**

3 A. In summary, as part of approving the cost of service developed by Ms. Blair, I
4 recommend the Commission approve the 2014-2019 Business Systems
5 capital additions and 2018 Business Systems O&M expenses, including for
6 the AGIS initiative, which are included in the Company's 2018 HTY cost of
7 service presented in this rate review, and as described above.

8 **Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?**

9 A. Yes, it does.

Statement of Qualifications

David C. Harkness

David C. Harkness is the Chief Information Officer and Senior Vice President for Xcel Energy Services Inc. David is responsible for the XES Business System organization, which provides Information Technology services to XES and its operating company affiliates, including Public Service Company of Colorado. David is also responsible for the corporate Business Continuity function and IT disaster recovery.

David has 28 years of experience in the field of IT, with 24 of those years in a management role. He joined Xcel Energy in November 2009, following six years at PNM Resources at Albuquerque, New Mexico, where he first served as Senior Director, Business Process Outsourcing, then as Senior Director of Business Transformation and finally, as Vice President and CIO for more than three years. While in New Mexico, David was also appointed by Governor Richardson to New Mexico's Information Technology Commission, where he helped establish and direct the IT Strategy for the State of New Mexico. Prior to that experience, David held several IT Leadership roles for McLeod USA, MCI, and Rockwell International, where he began his career in 1986.

David graduated from the University of Iowa where he earned a Bachelor of Science degree in Computer Science and a Bachelor of Arts degree in Applied Mathematics.

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

* * * *

RE: IN THE MATTER OF ADVICE)
NO. 1797-ELECTRIC OF PUBLIC)
SERVICE COMPANY OF)
COLORADO TO REVISE ITS) PROCEEDING NO. 19AL-____E
COLORADO P.U.C. NO. 8-)
ELECTRIC TARIFF TO IMPLEMENT)
RATE CHANGES EFFECTIVE ON)
THIRTY-DAYS' NOTICE.)

AFFIDAVIT OF DAVID C. HARKNESS
ON BEHALF OF
PUBLIC SERVICE COMPANY OF COLORADO

I, David C. Harkness, being duly sworn, state that the Direct Testimony and attachments were prepared by me or under my supervision, control, and direction; that the Direct Testimony and attachments are true and correct to the best of my information, knowledge and belief; and that I would give the same testimony orally and would present the same attachments if asked under oath.

Dated at Minneapolis, Minnesota, this 7th day of May, 2019.



David C. Harkness
Chief Information Officer and Senior Vice President

Subscribed and sworn to before me this 7th day of May, 2019.



Notary Public

My Commission expires 1-31-2022

