EC-21-431

CITY OF ALBUQUERQUE

Albuquerque, New Mexico
Office of the Mayor

Mayor Timothy M. Keller

INTER-OFFICE MEMORANDUM July 22, 2021

TO: Cynthia Borrego, President, City Council

FROM: Timothy M. Keller, Mayor

SUBJECT: Approval of an Application for State Grid Modernization Grant

Transmitted herewith for City Council consideration and approval is a Grid Modernization Grant Application prepared by the City of Albuquerque, Department of Municipal Development (DMD). Council approval of grant applications is required pursuant to § 2-11-17, ROA 1994.

DMD seeks funding from the State of New Mexico to establish a data center and computer platform to track energy system data and performance and improve interaction with the electric grid. The State has conditionally approved DMD's application, subject to Council approval.

Request for immediate action.

APPROVAL OF AN APPLICATION FOR STATE GRID MODERNIZATION GRANT

Approved:

8/23/21

Sarita Nair Date
Chief Administrative Officer

Approved as to Legal Form:

DocuSigned by:
Kevin Morrow 7/22/2021 | 4:33 PM MDT
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Esteban A. Aguilar, Jr. Date
City Attorney

Recommended:

DS

DocuSigned by:
7/22/2021 | 2:44 PM PDT
1ED93102F75A41F...

Patrick Montoya Date
Director

Cover Analysis

1. What is it?

Application for State of New Mexico grant for a City of Albuquerque grid modernization project.

2. What will this piece of legislation do?

This legislation will approve and authorize the City's application to the State for a $301,000 grant to support the City's proposed grid modernization project. Council approval of grant applications is required pursuant to § 2-11-17, ROA 1994. The City, Department of Municipal Development (DMD) proposes to establish a data center and computer platform to track energy system data and performance and improve interaction with the electric grid. Because the grant application was due when Council was not in session, DMD submitted the application to the State subject to Council approval pursuant to § 2-11-17(A)(1). The State has conditionally approved DMD's application, subject to Council approval

3. Why is this project needed?

This project is needed to improve the City's day to day energy system operation and electrical system efficiency, and to better interface with the electrical grid. The City will be working with Mountain Vector Energy to implement the project.

4. How much will it cost and what is the funding source?

A total project cost of $580,000 is estimated to build the technology platform. $301,000 will be provided by the State, if the Council approves the application. Mountain Vector will provide $58,000 by providing work hours at no cost, and the Energy and Sustainability Management Division will provide the remaining funds ($221,000) from its budget.

5. Is there a revenue source associated with this contract? If so, what level of income is projected?

No income is expected from this project, however, it will be partially funded by the State through a grant.

6. What will happen if the project is not approved?

DMD will be unable to develop the data center and computer platform.

7. Is this service already provided by another entity?

No.

CITY OF ALBUQUERQUE
Department of Municipal Development
Energy and Sustainability Management Division

Timothy M. Keller, Mayor **Patrick Montoya, Director DMD**

Date: June 24, 2021

To: Jacqueline Waite, EMNRD, 1220 South St. Francis Dr., Santa Fe, NM 87505

From: Saif Ismail, Energy and Sustainability Manager, ESMD/DMD

Subject: APPLICATION FOR GRID MODERNIZATION PROJECTS

1. Applicant Contact Information:

SAIF ISMAIL, CEM
Energy and Sustainability Manager
Department of Municipal Development,
Energy & Sustainability Management Division
sismail@cabq.gov 505-768-5391

Pursuant to City Ordinance, § 2-11-17(A), this application is subject to City Council approval at the next Council meeting scheduled for _____.

2. Project Summary:

History -

The State, City of Albuquerque, and Public Service Company of New Mexico (PNM) have established timetables for the transition to zero-carbon electricity resources, which will require improvements to the modern electric grid. The City of Albuquerque's on-site solar (7.2MW), future on-site solar (6-7MW), PNM Solar Direct (25MW) and 9 battery installations (.7MW) account for a 100% (96M kWh/yr.) reduction in 'non-renewable' energy usage by 2022.

In March 2019, the State of New Mexico passed into law the Energy Transition Act (ETA) that sets a statewide renewable energy standard of 50 percent by 2030 for New Mexico investor-owned utilities and rural electric cooperatives and a goal of 80 percent by 2040. The ETA also sets zero-carbon resources standards for investor-owned utilities by 2045 and rural electric cooperatives by 2050.

In February 2021, PNM introduced their Integrated Resource Plan (IRP) detailing how it will transform its electric generation to 100 percent emissions-free by 2040.[1] In April 2021, PNM joined the Western Energy Imbalance Market (EIM) which is a real time energy market using advanced technology to locate the lowest cost energy to balance energy supply with demand over its entire footprint, maximizing participant resources.[2]

1. Project Approach

To meet its non-renewable energy usage goals and effectively interact with the modern grid, the City of Albuquerque's Energy and Sustainability Management Division (ESMD) Energy Command Center (ECC) seeks to establish a data center and computer platform that enables real time interaction with our current and historical utility related data streams. This data center will be named the Balanced Resource Acquisition and Information Network (BRAIN). BRAIN will enable real time visibility, flexibility and responsiveness with our existing and future storage, generation and building controls resources to benefit the public, the City's critical systems and infrastructure, the State of New Mexico and PNM.

By speeding up our energy decision making capability and enhancing our storage, generation and building controls resources, we envision achieving City of Albuquerque's 'interoperability' with the electric grid combined with the City's behind the meter flexibility to enhance 'resiliency'.

Our flexible energy resources will participate with PNM during periods of critical peak demand as we opt into current and future demand side market instruments like demand response and future firm dispatchable market instruments.

Our vision with BRAIN is to build an integrated data lake, machine learning 'neural network based' predictive models and both internal and public facing dashboards that are easy to use, outcome oriented, scalable, and easily adopted by other New Mexico public entities, ultimately residing behind each entities' secure firewalls.

We are applying to EMNRD for grid modernization grant bunding for a TYPE 2 technology implementation Project to begin building the BRAIN for City of Albuquerque. The city will use its Energy and Information Technology (IT) resources

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1 https://www.pnm.com/documents/396023/22818938/NEWS+RELEASE_PNM+first+in+the+nation+to+detail+emissions+free+plan_02082020.pdf/e56c5611-514f-0f54-1478-f44479a035d9?t=1615244741468

2 https://www.pnm.com/documents/396023/22818938/NEWS+RELEASE+-+PNM+joins+Western+EIM+04012021.pdf/efef9ea2-75ea-2c40-7833-5cbbcddcddf9?t=1621293860407

in conjunction with a contracted energy management partner, Mountain Vector Energy. The City has a contract with Mountain Vector to provide comprehensive energy data management and energy system performance for the City of Albuquerque.

2. Alignment with Grid Modernization and Energy Goals

The City's ESMD manages over 4,500 utility accounts, approaching 39 MW of solar, 9 battery installations, 43 building management systems across over 600 facilities.

Through continuous improvement, new building technologies, data streams, telemetry, metering, and controls present increased flexibility and efficiency with modern building system deployments. The challenge with these new technologies is the ability to rapidly access actionable data that resides in various disparate software systems. With all the new resources and associated software platforms, we are limited regarding city energy data integration and the enhanced decision making that an integrated data resource enables.

The ESMD BRAIN proposal improves day to day energy system operation and electrical system efficiency in the city. Through machine learning neural networks and predictive algorithms using integrated energy and weather-related data streams, constraints can be anticipated to enable pre-cooling and/or demand limiting measures to enhance grid reliability, resiliency, and security. The BRAIN also enables comfort monitoring and fault detection that anticipates potential HVAC system failures, greatly reducing 100% reactive operations and maintenance related response and expense.

Consistent with New Mexico's energy goals, the BRAIN will enable the ESMD ECC to prepare in advance of grid constraints with storage, generation and building controls resources to provide grid flexibility during peak periods. We will have to build the software and system interoperability with City of Albuquerque and partner resources to enable the flexibility to dispatch resources when called upon. The BRAIN will facilitate that interoperability through modern software connections via API or Cloud to Cloud interfaces.

The City of Albuquerque's energy management partner, Mountain Vector Energy, has built similar systems and has the expertise in conjunction with City Energy and IT resources to design, build and implement the BRAIN, ensuring the project's success.

The ECC BRAIN will be a technology platform that is transportable to other City and State entities in New Mexico independent of utility providers.

3. Education and Public Awareness

The ESMD ECC and BRAIN will be a 'learning lab' for the community with a focus on real time energy performance transparency for City of Albuquerque residents, and the State more broadly. The ECC BRAIN will serve as a showcase for the Science, Technology, Engineering and Math (STEM) development of students and community

members as we will put in place a process to share the ECC BRAIN with students in our community. With deep experience in complex database design and creating software tools such as 'bots' and machine learning 'neural networks, we will present great learning opportunities for New Mexico software developers in the energy sector.

4. **Economic Development**

The BRAIN initiative can serve as a catalyst for modern mechanical (HVAC) systems and controls technicians that will be needed to enable ours and other Energy Command Centers (ECC's). Engineers, Software Developers, Mathematicians, Data Scientists, Physicists, and other technical fields are employed in grid modernization and energy management initiatives. As it relates to the BRAIN serving as a scalable tool for public entities within New Mexico and beyond, we know there is a broad commercial market for it, but very few entities have the organic capability and experience to envision, build and deploy it.

3. Project Deliverable Descriptions:

TYPE 2 PROJECTS SCOPE OF WORK

The design and implementation of the City's BRAIN technology installation serves many operational and functional goals of a modern grid, including:

A: accommodating the full integration of DERs;
City of Albuquerque has 37 solar locations and 9 batteries and growing. The operation and availability of these systems during the time of day and in accordance with weather becomes important to grid operation.

B. enabling customers with data and real-time usage information;
The BRAIN enables data to inform actions and decisions for the optimal deployment of City of Albuquerque's grid edge or behind the meter resources. Automated and predictive intelligence in real time will facilitate faster and more precise City of Albuquerque interaction with the PNM grid and economic energy related indicators.

C. maintaining or enhancing electric distribution or transmission grid reliability, resiliency, and grid security;
Through real time decision making on asset deployment and asset reliability, less stress is presented to the grid during critical peak periods.

D. improving system efficiency;
Enhancing City of Albuquerque's energy data monitoring enables renewable resources to operate optimally. Suboptimal performance can be addressed quickly to ensure maximum efficiency and readiness of all energy systems.

E. helping to optimize existing assets;
This is the purpose of the data lake, associated predictive analytics and visualizations enable time of day based pro-active preparation such as

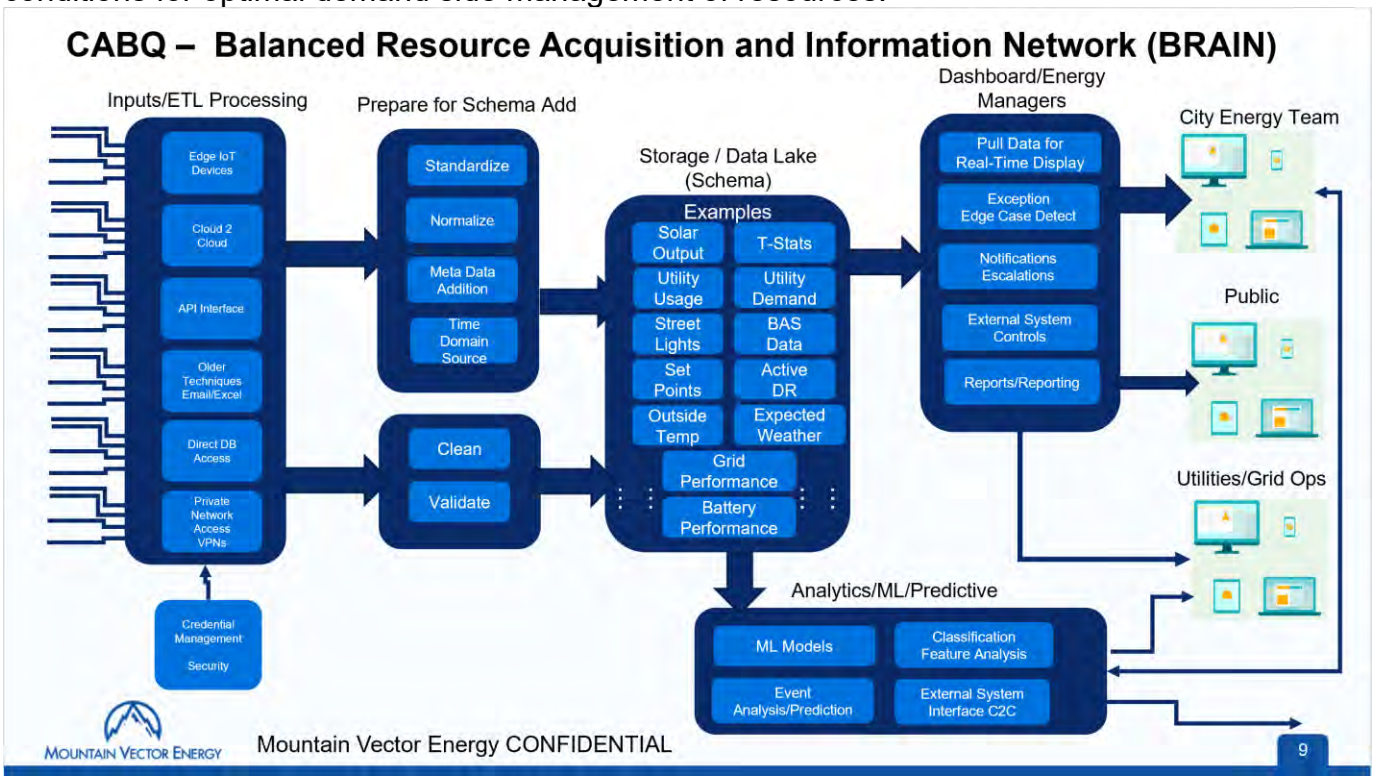
charging/discharge of storage and/or transportation resources for grid and market related events with behind the meter resources.

F. allowing for adaption to changing load, including changes to peak load and demand due to the electrification of buildings and transportation.

The BRAIN will enable recommendations on 'when' to adapt to optimal charging times or run times for building, storage, or generation resources. Building Automation Systems (BAS) can be pre-scripted and called upon for time of day based operational changes such as pre-cooling or demand limiting.

A. Type 2 Project Elements Summary

Technology – The proposed 'behind the meter' technology diagram for the ESMD and IT Divisions directly enables the efficient use of building controls, renewable and storage resources to best relieve stress on the grid during constrained or variable periods based on time of day and/or weather. The system below enables flexibility with City of Albuquerque resources to quickly adjust to variable grid or weather conditions for optimal demand side management of resources.



Benefit to Utility Partner – Per NSMA 1978, Section 71-11-2, the City of Albuquerque is coordinating with the PNM grid modernization personnel to approve this project. As this project is 'behind the meter' for City of Albuquerque, and does not require new or additional interconnect agreements, there can be no adverse impact to electrical system efficiency, reliability, resilience, and security.

Technology Monitoring and Verification Component – The City of Albuquerque will submit a final written report after one year following project implementation. This report will describe monitoring activities and verify the effectiveness and impact of the

technology on the grid, market potential and scalability, and any questions for future research.

Research Question and Methodology –

Research Question: What is the increased capability that is enabled through integrated data access from multiple disparate sources to enhance participation with the modern grid's flexibility and interoperability requirements?

Methodology: Key Performance Indicators (KPI's) will be established in conjunction with key stakeholders to include the ESMD, City IT, and PNM. The KPI's may differ across each entity but will be measured by establishing a baseline pre-BRAIN implementation post-BRAIN implementation. Cost savings, energy optimization, flexibility, reliability, speed and effectiveness of energy resource response, resource performance and enhanced decision making within the ECC are all proposed measurables enabled by the BRAIN initiative.

We will implement automated monitoring, evaluation, verification of this technology against KPI's defined by each stakeholder.

B. Type 2 Project Deliverables

Plan for Execution:

In quarter 1 (Aug-Oct 21), City of Albuquerque ESMD and IT resources and Mountain Vector Energy will jointly define the BRAIN Inputs, Schema, Machine Learning Analysis Models database architecture for configuration.

In quarter 2 (Nov 21-Jan 22) City of Albuquerque ESMD and IT resources and Mountain Vector Energy will code the extract, transform and load (ETL) mechanisms and build the foundation for the data lake or data river.

In quarter 3 (Feb 22-Apr 22) City of Albuquerque ESMD and IT resources and Mountain Vector Energy deploy automated predictive models selected by priority and visualization dashboards to benefit Energy Command Center (ECC) personnel.

In quarter 4 (May 22-Jul 22) City of Albuquerque ESMD and IT resources and Mountain Vector Energy will deploy additional prioritized features and learning models while preparing for year end review with State of NM EMNRD.

Project Timetable:

Track 2 Type 2 Project Deliverables Timeline	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22
1. Determination of Inputs.												
2. Determination of Schema												
3. Determination of potential analysis models (ML)												
4. Determine inputs to be prototyped												
5. ETL of selected inputs into schema												
6. Implementation of initial predicted models												
7. Initial development of prototype dashboard and reporting												
8. Integration of predictive models into dashboard and reporting												
9. Analysis, anomaly resolution, white paper, efficacy												
10. Finalization and preso to ENMRD-government entities												
a. an initial written report summarizing the project that includes:												
i. background and summary of existing research;												
ii. any refinements to the proposed research question and proposed methodology;												
iii. (optional) preliminary or expected results;												
iv. timeline for completing the project;												
v. nature of the relationship with the utility partner;												
vi. the proposed economic impacts of the project; and												
vii. the expected educational value of the project												
b. quarterly written report to include a financial summary and review/evaluation of performance goals.												
c. a final written report summarizing the results of the research; and												
d. a presentation to EMNRD staff or the Grid Modernization Implementation Working Group.												

Process to Document Project Progress and Success:

At the end of quarter 1 (Oct-21), City of Albuquerque ESMD will provide a written report summarizing the project that includes background, refinements to proposed research question and propose methodology, preliminary or expected results, timetable for completing the project, nature of relationship with PNM, the proposed economic impacts of the project and the expected educational value of the project.

At the end of quarter 2 (Jan-22) City of Albuquerque ESMD will submit a written report to include a financial summary and review/evaluation of performance goals.

At the end of quarter 3 (Apr-22) City of Albuquerque ESMD will submit a written report to include a financial summary and review/evaluation of performance goals.

At the end of quarter 4 (Jul-22) City of Albuquerque ESMD will submit a final written report summarizing the results of the research/technology implementation and present to EMNRD staff or the Grid Modernization Implementation Working Group.

Throughout this process, City of Albuquerque Energy, IT Resource and Mountain Vector Energy will collaborate and shape inputs to meet the above documentation and reporting requirements.

Subcontractor:

Mountain Vector Energy is a turnkey Energy Management Service and Technology provider based in Albuquerque, NM and contracted to the City of Albuquerque ESMD. With deep energy, database design and software development experience, Mountain Vector will plan, develop, configure, and produce the BRAIN in collaboration with ESMD and City IT resources.

4. Project Budget:

Budget Allocation by Task						
Tasks:	#People	# Months	#Hours	Time Period	EMNRD Grant Budget	Other Budget
1. Determination of Inputs.	1	2	320	Aug 2021-Oct 2021	$20,758.62	$19,241.38
2. Determination of Schema	1	2	320	Aug 2021-Oct 2021	$20,758.62	$19,241.38
3. Determination of potential analysis models (ML)	1	2	320	Aug 2021-Oct 2021	$20,758.62	$19,241.38
4. Determine inputs to be prototyped	4	0.25	160	Nov 2021-Jan 2022	$10,379.31	$9,620.69
5. ETL of selected inputs into schema	3	2	960	Nov 2021-Jan 2022	$62,275.86	$57,724.14
6. Implementation of initial predicted models	1	2	320	Nov 2021-Jan 2022	$20,758.62	$19,241.38
7. Initial development of prototype dashboard and reporting	3	2	960	Feb 2022-Apr 2022	$62,275.86	$57,724.14
8. Integration of predictive models into dashboard and reporting	1	2	320	Feb 2022-Apr 2022	$20,758.62	$19,241.38
9. Analysis, anomaly resolution, white paper, efficacy	3	2	960	Feb 2022-Apr 2022	$62,275.86	$57,724.14
10. Presentation to ENMRD-government entities (Milestone)				May 2022-July 2022		
Total:	**4**	**12**	**4640**	**Aug 2021 - July 2022**	**$301,000.00**	**$279,000.00**

Detailed budget narrative:

City of Albuquerque ESMD estimates 4640 person hours to perform the scope of work described above as we create the data lake/river, predictive analytics, and visualizations to increase our energy flexibility and interoperability with the modern grid.

Each of our 9 technology build steps are defined above with the quantity of qualified personnel, quantity of months and associated work hours and cost to perform the work.

The total project cost of $580,000 is estimated to build the technology platform. $301,000 is estimated to be available via the Grid Modernization Grant, with $279,000 to be required to bridge to project completion. Mountain Vector Energy will contribute $58,000 (10%) by providing 464 work hours at no cost, leaving a delta of $221,000 to be funded through ESMD's budget.

5. Personnel Qualifications:

City of Albuquerque:

Saif Ismail, CEM
Energy and Sustainability Manager
Department of Municipal Development,
Energy & Sustainability Management Division

- Master of Science, Architectural Engineering
- PHD student UNM School of Engineering
- 10 Years Energy Engineer, Certified energy manager

Mountain Vector Energy:

Steve Kiziuk – B.S. Environmental Engineering USMA 1992, CEM
Bruce Pitt – Software coding Caltech, Stanford, UC Irvine
Paige Mankey – B.S. Pure Mathematics 2011, M.S. Pure Mathematics UNM 2015
Madeline Lamb – B.S. Engineering Physics Colorado School of Mines 2015
Aislin Cooper – B.S. Mechanical Engineering Texas Tech University 2017
David Stern – B.S. Physics Tufts University 2020
Sabri Sansoy – B.S. Astrophysics UNM 1985, M.S. Aeronautics MIT 1987
Vakar Ahmed – B.S. Electrical Engineering 2016, M.S. Intelligent Systems Engineering Indiana University 2020

Resumes:

Mountain Vector Energy has developed 9 scalable energy technology platforms shown in section **7. Additional Documentation** as 'confidential marked' software work product detailing our database, software, and machine learning output for our customers that correlate directly to our capability to design and implement the proposed BRAIN for ESMD.

Mountain Vector Energy has extensive experience completing projects of similar size and scope and the level of understanding to have helped to develop this research question, grant proposal, deliverables, schedule, and budget to ensure on time delivery within budget. We have extensive experience evaluating and communicating project progress and ultimately delivering customer success.

Shown next are the **resumes** of those available to work on this project:

Saif Ismail
(505) 923-0948
sismail@cabq.gov

Professional Experience:

17 Years

Education/Highest Degree:

Master of Science, Architecture Engineering

PhD current student school of engineering

Highlights:

- *Architectural Design*
- *Construction Management*
- *Facility Management*
- *Mechanical, Plumbing, Electrical, and Air (HVAC) expertise*
- *Bid development/management*
- *Cost tracking*
- *Quality Management*
- *Preventative and corrective maintenance*
- *Budget forecasting and timely reaction*
- *Team building and retention*

Certifications and Training:

- *Certified Energy Manager*
- *Project Management*
- *Safety, Quality, Hazardous Materials*
- *Construction Management and Administration*
- *AutoCAD*
- *REVIT CAD*
- *Primavera*
- *Bilingual*
- *Building Operating Certified*

Saif Ismail

Offers more than 15 years of architectural and MPEA knowledge, subcontract management, team building, and accurate project and budget management with a career-long record of exceptional customer service.

Energy & sustainability Manager (Energy and sustainability Division Management) 2014 - Present

City of Albuquerque

- Manage, coordinate and oversee maintenance functions of all City buildings assigned to Facility Management and assist departments with facility maintenance needs.
- Lead multiple, concurrent energy City of Albuquerque energy efficiency projects throughout City of Albuquerque: 125 total projects valued at $20,000,000
- Manage budget, schedules, audits, usage, analysis/interpretation, usage metrics, and conservation initiatives
- Conduct regular, scheduled, and ad-hoc site visits to track status, audit energy consumption practices, and determine improvement strategy
- Plan, direct, coordinate, assign, review, and evaluate all work activities, products, methods, staff, and consultants
- Develop and maintain project status reports, schedules, and tracked estimated completion costs against actual costs, and forecast needs/predict expenditures
- Manage city contractors performing construction or energy efficiency upgrades
- Develop target metrics, energy data, and building profiles to inform "energy efficiency" resource needs and funding priorities for government operations
- Develop and recommend long-range energy efficiency plans and programs to reduce energy consumption costs
- Present status, results, and findings to Sr. City staff on energy related managers
- Results include $2,000,000 in natural gas cost savings in City facilities

Construction Examiner (Building Code Official) 2012 - 2014

City of Albuquerque

- Examined construction plans, proposals, agreements, and specifications for compliance with established codes, regulations, and ordinances
- Approved plans as needed for Mechanical, Plumbing, and Electrical.
- Performed on-site inspections for compliance with approved plans, specifications, and standards
- Responded to public requests for information regarding construction projects
- Established and maintained a system of log sheets and files to track current status of projects; file approved plans, agreements, and specifications.

Project Manager 2010-2012

AFRA Construction Management and Design

- Managed 10 project staff, multiple subcontractors, project budget, materials, and manpower; obtained all necessary permits and licenses
- Met all quality control, environmental, and health and safety requirements; developed policies, managed daily operations, and planned the use of materials and human resources.
- Analyzed project profitability, revenue, margins, bill rates, and utilization.
- Planned site activities, setting targets and accurately forecasting completion dates.
- Estimated material, construction, and labor costs as well as project timescales.
- Project successes include:
  Sedona Pointe Office / Retail Space - 8110 Louisiana NE, Albuquerque, NM
  Uptown Hilton Garden Inn - Albuquerque Uptown, Albuquerque, NM
  Hilton Garden Inn - 100 North Poplar Rd., Casper, WY
  Hampton Inn & Suites - 100 North Poplar Rd., Casper, WY
  Hilton Garden Inn - 502 East Wake Avenue, El Centro, CA

Saif Ismail – continued

Project Manager **2008-2009**
Dekker/Perich/Sabatini; Albuquerque, NM

- Planned, coordinated, developed, and provided technical and construction management
- Performed field surveys and investigations to determine existing conditions construction requirements
- Developed construction cost estimates; prepared bid and contract documents for competitive bids
- Determining construction operations, methods, and durations; performed engineering design and drafting
- Prepared drawings and schedules, coordinating, inspecting, overseeing, and verifying construction
- Developed AutoCAD drawings and online drawing database
- Project successes include:
  Las Cruces High School
  National CAD Standard (Arizona School District)
  Window Rock High School
  Miyamura High School (Gallup, NM)

Architect / Project Engineer **2005-2008**
Abdullah Aljuburi LLC

- Led field operations on eight different project, monitoring project at all stages, administering budget and approving all expenditures and payroll, maintaining quality and cost control, developing new-hire training, supervising multiple engineers (mechanical, electrical, civil, and architect)

Project Engineer **2003-2005**
Sigma Construction Company, Virginia

- Prepared construction documents, architectural and interior plans, rendered exterior and interior perspectives, and coordinated engineering on four U.S. Air Force projects in Iraq, including the Independent Electoral Commission Building (where first democratic election ballots counted), Helicopter Landing Zone and space for 80 vehicles; Seven two-story barracks buildings; and 3,000 square meter office complex

Site Engineer **2002-2003**
Kellogg, Brown & Root (KBR, Texas) in Baghdad, Iraq

- Site engineering responsibilities on multiple coalition construction projects in Baghdad, Iraq

EDUCATION

- B.S. Architecture Engineering, University of Technology; Baghdad, Iraq 2003
- M.Sc. of Architecture Engineering, University of Technology Urban Planning and Const. Mgt. 2006
- PhD Student at UNM school of engineering. Garduate 2023

- Building Operator Certified
- Certified Energy Manager AEE(Association of energy engineers)

Technical

- Leader Ship in energy and Environment Design (LEED)
- AIA Board Member
- PNM Energy Academy Seminars
- Annual Safety Training
- Direct Digital Control (Building Automation System) Specialist
- Association of energy engineers.
- Pipeline emergency response and damage prevention training program
- Lutron Lighting control specialist.
- Electric, Gas, Water Account Specialist

R. Bruce Pitt
200 Broadway NE
Albuquerque, NM 87102
E-Mail: Bruce@MountainVector.com Phone: 949-981-0001

Education:

California Institute of Technology (Caltech), Fortran IV and Cybernetics (1972)
Golden West College: Math and Accounting Course Work Only (1981-1984)
Stanford University: AEA Executive Institute (1997)
University of California – Irvine: Win32 Realtime Classes (1997-1998)
Medusa Labs: Fibre Channel Studies/Debugging Techniques [ML212/ML325] (2001)

Publications:

Waters Magazine, "The Greed for Speed", 01OCT2005

Patents:

US20110218899 & US20110218900, Systems and Methods for Compression of Trade-Related Records

PROFESSIONAL EXPERIENCE

Chief Technology Officer (CTO), Mountain Vector Energy – Feb 2017 to present

- Mountain Vector Energy is a New Mexico based business that provides comprehensive energy management services and instrumentation and cloud-based analytics products to Commercial, Industrial and Government clients.
- Designed and built the Cufflink™ Sensor device which is ATMEL ATmega2560 chipset with integrated GSM (Cell) interface. Development was in C++ and included all sensor ADC interfaces, onboard configuration software, test and production software.
- Managed and provided all supporting material for a successful UL certification of the Cufflink™ Device for standard 60950. Continue to be their primary contact.
- Developed and wrote all Cufflink™ user and installation documentation.
- Managed and built a Cufflink™ assembly and production area and provided training to assembly personnel. This included case selection and assembly instructions and drill templates.
- Designed, Built, and deployed a cloud-based employee client management site for Cufflink™ devices and other IDR based information systems such as BMS and EMS systems. Full Stack (Front End, Back End, and Database) development was MySQL, PHP, JavaScript, HTML, Bootstrap, C#, and CSS. Cloud architectures were Media Temple and Azure using Plesk and Azure toolsets. Linux based.
- Designed, Built, and deployed the phase one cloud-based client Portal for visualization and downloading of IDR data from Cufflink™ devices and other IDR based instrumentation. Continue to expand and develop this site. Full Stack (Front End, Back End, and Database) development was MySQL, PHP, JavaScript, HTML, Bootstrap, C#, and CSS. Cloud architectures were Media Temple and Azure using Plesk and Azure toolsets. Linux Based.
- Assisted in the production and filing of a Patent for unique processes invented at Mountain Vector Energy. Patent was filed September 2017. Patent is still pending.
- Assisted in the determination and testing of equipment for a Demand Response program with a 3rd party vendor.

Owner and Principal Consultant, RBP Consulting Group, LLC – Mar 2009 to Feb 2017

- RBP Consulting Group was formed to provide software design and programming services, software architecture review and design, project and engineering management, technology development, M&A company evaluation, and business development services to firms in a variety of markets. The following outlines a few of the many different client contracts and requests.
- C# development of IDR data reduction and analytics for large commercial cooling systems with many millions of data points which required data normalization, time correlation, graphical visualization, recommended operational actions, and overall information presentation into Excel based toolsets.
- C# based Windows application replacement of a Windows 95/ME Visual Basic/Fortran application from the 2000s that needed to install and operate in both 32-bit and 64-bit environments (Windows 7,8,8.1, and 10) simulating the original windows 95/ME look and feel. Also developed modern interfaces into the older JET database architecture for upgrading older files into a more modern JSON based file set in both 32-bit and 64-bit environments.
- Several API/Backend web-services contracts in PHP/MySQL with HTML/JavaScript test and verification sites (front ends) where all design and coding were provided by me.
- Delivered an evaluation and proof-of-concept using C++/openCV for a computer vision processing application.
- Performed analysis, evaluation, 5-year planning of a bankrupt technology company for potential acquisition include personnel evaluation and product roadmap.
- RFP and RFI generation and management including vendor analysis and scoring, selection, review against goals. Included vendor company evaluation for longevity.
- Developed a Python based C# to C/C++ library for an automated testing environment including all connectivity to existing systems and MS-SQL and MySQL databases. Provided 30 tests in Python as examples. Eventually the tool was used in over 300 regression tests.
- Built a C# based converter from EBCDIC to ASCII for financial processing between legacy IBM based systems and newer MySQL/Oracle/MS-SQL based systems.
- Contracted to work as CEO/CTO for 2 years with an equity kicker which included work on FIX based trading interfaces, market data acquisition and display, and interface to Clearing Systems. All development was in C# and Java using portlets (185/285 specs). Also performed all Business Development, Marketing, and sales.

Chief Software Architect, Price Doc, Inc. (now Healthinreach) – Aug 2008 to Sep 2009

- PriceDoc was a startup engaged in bringing a new paradigm to the Medical Services industry through a patented and innovative direct pricing model which was designed to serve individuals without medical insurance, those with insufficient coverage, and those individual desiring elective procedures not covered by insurance.
- As a founding member in the development team, I developed and deployed the database and backend technology portions of our offering including all operations support at Rackspace. Technologies utilized were LAMP, WAMP, MAMP. Software was Java, JavaScript, C/C++, and MySQL. Integrated Google Maps and a Zip-Code/distance search algorithm that was 10x faster than WebMD or 1800Dentist.

SVP Engineering, Nexa Technologies, Inc. (Penson Worldwide) – Aug 2003 to Aug 2008

- Nexa Technologies provided OEM trading software, Market Data feeds, Blackbox and High-Volume trading gateways, trading websites and applications serving small brokerages to very large bank clients. Product lines included web-based trading (2.5 Million accounts), thick-client active trading platforms (50 thousand accounts), ASP Interfaces and API, market data and feed products, routing and gateway products, backbox trading products. Annual sales were in the $25MM range with data centers in New York, Chicago, Dallas, Toronto, London, Milan, and Montreal.
- Held various positions as one of the founding members of the development team from the original Feb 2000 formation of the company. Positions included Senior Vice President of Engineering, Acting Senior Vice President of Business development, Global Architect, Vice President of Systems Engineering, Senior Principal Software Engineer, and Chief Architect.
- As SVP of Engineering, in this executive position I was responsible for the operation, budgeting and overall guidance for an engineering department of 70 software, database, and test engineers producing Web and Application based financial trading products. I was also responsible for the Professional Services development including all contract development and negotiations with customers. The engineering department, under my tenure went from a disorganized, unmotivated group who missed the internal and external commitments to an organization that made theirs dates, moral was high, attrition was near zero, system stability and security has been addressed and customer satisfaction was back on track while staying within the agreed to Engineering Budgets.
- As Global Architect, I worked at the Penson Worldwide level across all owned companies as was responsible for intercompany development projects, collaboration opportunities, identification of major issues affecting all companies. Worked on a global Security Master and AML compliance and integration.
- As VP of System Engineering, I built and managed a group of 10 engineers responsible for all backend servers including the Order Management System (OMS), Market Data Feeds, Execution Engine connectivity to the markets, common interface APIs (web and thick client), and trading gateways (FIX, Itch/Ouch, etc.).
- As a Senior Principal Engineer and Chief Architect, developed Nexa's algorithmic trading platform in C++. Built trading and OMS engines in C++, messaging protocols, failover and recovery systems, monitoring systems, and business continuity. Developed all Market Data feeds inbound processing and outbound processing along with all Database and Internal data structures. Supported nine (9) billion market messages per day.

Sr. Principal Firmware Engineer/Systems Analyst, Concept Development – Jan 2002 to Aug 2003

- Concept Development is a boutique hardware/software development shop specializing in small batch and prototype hardware and software development in a variety of industries including avionics, medical imaging, modern replacement of antiquated and end-of-life devices.
- Designed and implemented two variations of a i960RX based 40 page/minute PCI copier interface (52Mbytes/sec). Developed in GNU C and i960 Assembly language. Built BSP and BIST.

- Designed and implemented a Jet-Boat gaming SDLC/HDLC communications system. C++ on a i960 based Cyclone 914 board.
- Assisted in the development and delivery of a 100BaseT/FX communications bridge for a custom network in in the City of London camera monitoring systems.
- Developed Windows NT TCP/IP Winsock simulator for a medical imaging and networking product in HL7 to characterize performance and measure improvements.
- Developed in-flight entertainment (IFE) system (LRU) for managing and playing movies and audio to seatback Video/Audio Units. Coded, tested, and certified all firmware and APISs. Designed FPGA versus software algorithms. Supported 408Mbytes/sec for up to 512 simultaneous streams. Worked in VxWorks, Wind River Tornado, Windows NT, in C++.
- Developed Windows NT device drivers and FPGA algorithm design for a Broadcom based PC104 in-flight entertainment (IFE) system eventually flown in Air Canada 767 and Lufthansa Planes.
- Provided conference software and support for QuickLogic's DEVCON99 booth display and introduced their 5032/5064 products with a Web based demo with ActiveX and Java interfaces to a real-time backend.

Sr. Principal Software Engineer, Gadzoox Networks, Inc. – Feb 2001 to Jan 2002

- Gadzoox Networks was the inventor of Fibre Channel Hubs. They also produced Fibre Channel Switches (in competition with Brocade).
- Stabilized and resolved issues with an existing C code base for a PowerPC/ASIC based 18 Port 2Gb Fibre Channel Switch. Product shipped as the Slingshot 4218/4210 and as an embedded (Raid) option for a major OEM.
- Issues resolved extended through the HTTP, SNMP, Console, FSPF, Proxy Server, and well-known address services – all were resolved.
- Added Multi-Frame Sequence support.
- Participated in the hardware, ASIC, FPGA, and software design of the next generation switches, a design that Brocade eventually also implemented.
- Produced first performance characterization on current hardware switch.
- Utilized Diablo C, pSOS, pROBE+, Vision Ice, and XML.

Sr. Principal Firmware Engineer/Manager FTC, Western Digital, Inc. – Jun 1999 to Feb 2000

- Western Digital is a manufacturer of Hard Drives, Solid State Disk Drive, Network cards, and other retail computer products.
- As manager and principal architect in the Functional Test and Characterization Group (FTC) with eight direct reports, we designed, implemented, and executed tests designed to simulate real-work hard disk usage.
- Performed initial stub, unit and system testing of all firmware features including black-box testing, white-box testing, and regression testing.
- Built new Windows NT, C++, and Java user-level tools along with low level kernel based driver interfaces.
- Was responsible for all Compiler Toolchains and Emulation tools for all of Western Digital's development teams.

Principal Software Engineer/Manager OEM S/W, VitalCom, Inc. – Feb 1991 to Jan 1998

- VitalCom (formerly Pacific Communications) was a manufacturer of wireless ambulatory heart monitoring (non-diagnostic) hardware and software including central monitoring units for ECG, Pulse Ox, IBP, Infusion Pumps, Ventilators. Eventually sold to GE Medical.
- Head a variety of positions at the company including Senior Engineer, OEM Project Leader, Manager OEM Software, and Principal Software Engineer.
- Designed, coded, tested, documented, and deployed Vitalcom's Spectrum Analyzer software which would allow customer support and the installation team to determine best frequencies to set the hardware to. Development was in C and ASM86 on a DOS/VRTX O/S platform but displayed graphically using inhouse graphics rendering engine.
- Designed, coded, tested, documented, and deployed a completely new variation of Vitalcom's central monitoring system capable of communicating with a wide variety of patient physiological monitoring devices. On average, two major releases of this product line per year.
- Was responsible for year FDA, client/customer, and ISO 9001 audits.
- Created and updated life-cycle procedures to be a superset of IEEE, ISO and cGMP (FDA) requirements for software.
- Ported existing software from 16-bit to 32-bit system.
- As manager of OEM Software, was responsible for $12MM/year in annual sales (51% of the company revenue).

Senior Engineer, McDonnel Douglas, Inc. – Mar 1987 to Feb 1991

- McDonnell Douglas (now a division of Boeing) developed a wide variety of products including commercial and military aircraft, spacecraft and satellites, along with other government and commercial products. The division I was in was involved with government contracts in the Tactical C^3I – Communications Group.
- Held a Top-Secret Clearance (18MAR88) with an EBI/SBI (JUL87) rider. Expired.
- Development in ASM86, ASM286, ASM51, PLM86, PLM51, VMS Pascal, VMS C.
- Built BSP and BIST and bootstraps. Developed custom SCSI drivers.
- Worked on iRMX86, iRMX III real-time O/S along with VAX, VMS, IBM AT/XT, Intel 310, Intel Series II develop platforms.
- Test equipment used included I2ICE, ICE5100-254, ICE386, Bit Error Rate Testers, Data Line and Communication Analyzers, O-Scopes, Logic Analyzers.

Additional Work Experience prior to March 1987, available upon request.

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Education:

Masters of Science, Aeronautics & Astronautics, Massachusetts Institute of Technology 1987
Bachelor of Science, Astrophysics University of New Mexico 1985

PROFESSIONAL EXPERIENCE

Principal Software Engineer & Data Scientist, Mountain Vector Energy - Apr 20 to present

-Mountain Vector Energy is a New Mexico based business that provides comprehensive energy management services to Commercial, Industrial and Government clients

- Develop front and backend software for a historical and real-time energy usage web based reporting tool.

- Developing C++ software for next generation Cufflink2.0 showing real-time energy and water usage and costs.

-Mountain Vector Energy generates over $1M/yr. revenue with zero debt and zero outside
investment. We are laser focused on growing our CufflinkTM SaaS revenue with our US Patent #10,460,361 for Utility real time usage and spend.

Part-time Faculty Member, Central New Mexico Community College - Jan 20 to present

-Teach principles of software programming using C language

-Advisor to creating online lectures.

CEO & Founder, Orchanic - Aug 2015 to Apr 2020

-Mission was to help clients integrate one or more of the subcategories of Artificial Intelligence to include Machine/Deep/Reinforcement Learning, Robotics and Computer Vision and iOT.

- Experience with a wide variety of hardware platforms including nVidia
Jetson TK/TX series, RaspberryPi, Particle Photon/Electron, Arduino and Intel Movidius Neural Compute Sticks.

Senior Creative Developer, Deutsch Advertising Agency - Apr 2012 to Aug 2015

- Worked with team to support and develop web and mobile based applications for big name clients like VW, Target, Pizza Hut, KFC, PopSecret, Taco Bell, and many others.

- Developed applications using traditional LAMP stack, javascript, html, css, python.

- Developed in-house machine learning team with first project leveraging audio and deep learning to drive a VW car with one's voice.

CEO & Founder - Green Wavelength - April 2009 to June 2015

-Clean energy company focused on leveraging solutions found in nature, from bumblebees to tumbleweeds, to apply to everyday conundrums.

Chief Technology Officer, Animax Entertainment - Apr 2008 to Apr 2009

-Managed a team of 20 software developers and IT personnel in support of creating animated virtual worlds, online games, websites, social media, and TV shows.

Vice President, Entertainment Technology at Sony Pictures / GSN - Sep 2001 to Apr 2008

-Supervised cross-functional team of local and offshore employees in the research and development of digital media technologies to support various television, online and mobile initiatives.

Chief Technology Officer, Icebox LLC - Apr 2000 to Apr 2008

- Supervised a team of software developers and IT engineers to develop streaming technologies to serve 3 minute webisodes created in-house by an unparalleled lineup of Hollywood writers, producers and animators.

Senior Software Engineer II, Raytheon - Apr 2001 to Sep 2001

- Developed C/C++ applications for communication satellite systems

Simulation Engineer, Schafer Corporation - Apr 1995 to Apr 2000

- Analyzed static and dynamic designs of structural aerospace systems.

-Volunteered engineering time to Team Remax which was an attempt to fly around the world by manned balloon non stop.

Structural Engineer, Triad Suspension / Indian Motorcycles - Apr 1994 to Mar 1995

- Structural and mechanical design and optimization of Indian Motorcycle components to include shock systems.

Structural Engineer, Sparta Corporation Jan1992 - Mar 1994

- Designed subsystems for the US Air Force Strategic Defense Initiatives "Miniature Sensor Technology Integration (MSTI) Satellite.

First Lieutenant, US Air Force, Edwards AFB, CA - May 1987 - Dec 1991

- Chief engineer for the ADVANCED ICBM Technologies in-house effort to design and build advanced ballistic missile technologies at the Rocket Laboratory.

Vakar Ahmed
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Education:

Master of Science, Intelligent Systems Engineering (Computer Engineering track) 2020
Indiana University, Bloomington IN

Master of Science, Control Engineering, 2017 – 2018 (Transferred 08/2018)
Sapienza University of Rome, Rome Italy

Bachelor of Technology, Electrical Engineering 2016
Islamic University of Science and Technology, J&K India

Research and Publications:

"Disturbance Rejection of a Single-Axis of a Quadcopter using Lead Compensation", Advances in Control & Optimization of Dynamical Systems Conference (2018).

The O&P Edge, "Prosthetic Design Team wins Award, partners with O&P Provider", 17APR20

PROFESSIONAL EXPERIENCE

Technical Project Manager, Mountain Vector Energy – September 20 to present

Development:

- Development of tools for employee usage – productivity tools
- Assistance in the support and development of IoT devices.
- Assistance in the support and development of company's Portal Technologies

Analytics:

- Utility data capture and analytics for electric, gas and water.
- Energy and facility audits to identify energy savings opportunities.
- Identify and quantify Energy Efficiency Measures (EEMs), related savings and ROI models and oversee implementation with cross functional teams and vendors.
- Interface with customer Building Management Systems (BMS) and various facility management mechanical, electrical and emergency systems
- Manage customer meetings and regularly present findings/updates.

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Graduate Assistant, UGS Indiana University – May 19 to July 20

- Maintenance and development of UGS core and related websites.
- Maintenance and customization of XML eApps and eDocs based in Kuali Rice.
- Monitoring data anomalies for incoming graduate applications. (Suspense processing).
- User access management to a variety of graduate approval groups.
- Assistance in data migration to WebAdmit.

Research Associate in Product Development, Design Innovation Center, IUST Mar 17 – Aug 17

- Designed, developed, and manufactured a haptic based wearable communication band for students with hearing disabilities.
- Worked on circuit size reduction, cost and power optimization of the embedded system. Final prototype was manufactured for under $3.

Stephen R. Kiziuk
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Education:
Bachelor of Science, Environmental-Engineering 1992
United States Military Academy, West Point, NY

PROFESSIONAL EXPERIENCE

President, Mountain Vector Energy – May 12 to present

- Mountain Vector Energy is a New Mexico based business that provides comprehensive energy management services to Commercial, Industrial and Government clients.
- Enabled Albuquerque Public Schools to showcase their comprehensive Energy and Operational performance with the Council of the Great City Schools, Dude Solutions and the APS School Board.
- Saved APS $4.1M and achieved 98% of a 10 year energy savings goal in 4 years.
- The Association of Energy Engineers recognized our customers 4 years in a row for excellence in Energy Management at their annual World Energy Engineering Congress.
- Saved PHS $850,000 on a $7.5M/yr. Utility spend.
- Served the City of Albuquerque with their strategic Net Zero energy initiatives and utility, solar and energy efficiency performance data management. Supported the CABQ Chief of Staff with Net Zero energy and carbon data performance for press release.
- Serve as the 'in-market' Energy Management Team for Enbala in managing PNM Peak Saver, a 25MW 10 minute automated Demand Response program across 80 NM sites.
- Serve as the contracted Energy Management Team for Encycle to ensure their data, product and engineering priorities are synched to customer requirements.
- Developed the Cufflink™ Utility Sensor for real time usage and spend patent pending.

Vice President of Sales, Noribachi – Mar 11 to May 12

- Noribachi was a U.S. based LED engineering and technology corporation originally founded in Albuquerque, NM.
- I established the sales organization that increased revenue 272% in 2011 by delivering $3.1M in sales. During a critical growth period, this enabled Noribachi to successfully exit its 'startup' phase.

Senior Business Development Manager, EnerNOC Oct 07 – Mar 11

- Successfully positioned automated energy efficiency platforms with National customers such as Demand Response, Building Level Metering, Energy Procurement Services, Carbon Management and Automated Continuous Commissioning.
- Recognized as the highest producing Business Development Manager at EnerNOC in 2010. Awarded the 'Momentum Player of the Year Award' for delivering over $7.2M in gross margin from sales across the United States.
- Achieved Certified Energy Manager (CEM) certification.

Global Spares Operations Mgr, Intel Virtual Factory, Applied Materials Jul 05 – Oct 07

- Responsible for a $150M/yr materials and services business unit with 10 managers and a

total of 68 exempt employees serving 12 Intel Factories in 3 countries.
- Key contributor to $168M revenue and 40% margin in materials sales by managing 8 Global Spares Commodity Managers & 2 Cost of Ownership Team members in FY'06.
- Rated Top 5% in a Fortune 500 Company of 12,000 employees from 2003 thru 2007.

Cost of Ownership Manager, Intel Virtual Factory, Applied Materials Nov 04 – Jul 05
- Accountable to meet contractual spare parts spending commits for existing and future technologies for Intel. The CoO Team closed greater than $9M in savings in 2005.
- Owned Applied Materials product Quality Program for Global Intel across 12 factories and 4 separate semiconductor technology generations.

Operations Manager, Intel Fab 11/11X, Applied Materials Nov 00 – Oct 04
- Hired and Trained 86 Equipment Service Technicians to ramp a new Intel 300mm factory with over 75 Applied Materials tools across 7 process technologies.
- Accountable for all activities, policies and procedures including factory and office Safety Standard Operating Procedures, financial performance, employee training and certification, new factory ramp engineering, employee performance management and knowledge transfer from Technology Development. Teamed with HR and Legal in support of employee reviews, coaching, corrective action and disciplinary issues.
- Personally lead multiple technical task force / quality resolution teams as 'staff engineer' across various technologies during failures in various electrical, mechanical and chemical systems. I oversaw complex troubleshooting paths with highly time sensitive requirements to support factory output requirements.

Global Installation Manager, Intel World Wide Account, Applied Materials July 99 – Oct 00
- Hired and trained a team of 35 Installation Service Technicians and one Operations Manager in support of global semi-conductor capital equipment installations at 12 Intel factories.
- Managed over 150 system installations, worldwide, across 8 different platform technologies.

Tactical Marketing Project Manager, Dielectric Deposition, Applied Materials, Inc. Jan 98 – Jun 99
- Marketing Project Manager of a team responsible for successful order fulfillment from quotation and configuration to 'on-time' shipment for Intel.
- Created and managed over 30 types of technology Conversion Packages needed to support Intel's production capacity, emerging business strategies and equipment re-use.

United States Army Officer May '92 – Dec '97
- Served as Second-in-Command of a US Army Special Operations Ranger Company consisting of 20 Officers and 130 enlisted men. Rated top 5% of peer group.
- Airborne Infantry Platoon Leader and XO of Long Range Surveillance Detachment while stationed in Ft. Richardson, AK. Rated top 5% of peer group.

Paige Mankey
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Education:

Master of Science, Pure Mathematics 2015
University of New Mexico, Albuquerque, NM
Thesis: "Closure Operations on Subgroups"

Bachelor of Science, Pure Mathematics 2011
University of New Mexico, Albuquerque, NM
Minor: Astrophysics

PROFESSIONAL EXPERIENCE

Technical Program Manager, Mountain Vector Energy – January 2016 to Present

- Tracks and analyzes electric, water, and natural gas billing data for Albuquerque Public Schools (APS), Presbyterian Healthcare Services (PHS), and the City of Albuquerque (CABQ) and leads the conversion of the various data sources to information, action, and results
- Responsibility covers over 29M square feet and $46.1M in utility spend across 868 locations
- Uses utility data to forecast electric and natural gas consumption and spend, accounting for changes in the utilities' rates and projected impact of energy-saving initiatives and technologies, for the purposes of budgeting, long-term financial feasibility of projects, and achieving energy conservation goals
- Tracks and assesses the energy consumption and capital impact of anticipated HVAC and lighting projects for PHS
- Assembles and submits rebates to PNM on behalf of PHS for both new construction and retro-commissioning projects
- Performs walkthrough audits to identify opportunities to reduce energy waste for various building types, such as schools, community centers, and libraries
- Is a member of and regularly reports to the APS Energy Team, whose weekly meetings discuss a variety of water- and energy-related topics including but not limited to: utility data review, HVAC equipment trend data assessments, regularly engaging with HVAC controls vendors to understand the logic behind HVAC equipment operations, upcoming energy- and water-saving projects, and programs that encourage staff and student engagement in saving energy at each school
- Is a member of and regularly reports to the Presbyterian Performance Team, whose biweekly meetings covering utility data review, HVAC equipment trend data assessments, tracking and prioritizing projects that require capital funding to implement, rebate opportunities, and quarterly energy consumption and savings reports
- Presents in monthly APS Water and Energy Conservation Committee (WECC) meetings, which challenges APS' innovation and celebrates its achievements by bringing together multiple communities from around the state; representatives from the APS Leadership Team, APS Board of Education, neighboring school districts, energy and water utility providers,

the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD), and the APS Energy Team are regularly in attendance
- Recognized by the APS Board of Education for energy management contributing to student success during the 2015-2016 school year

Assistant Coordinator for the STEM Tutoring Program, Center for Academic Program Support (CAPS) at the University of New Mexico – January 2015 to December 2015

- Worked closely with the head of the STEM Tutoring Program to develop weekly trainings for STEM tutors that meet professional, academic, and College Reading and Learning Association (CRLA) standards
- Created work schedules for student employees that are conducive to the academic success of both the STEM tutors and prospective student users
- Worked with Assistant Coordinators from other tutoring programs within CAPS to plan and facilitate weekly trainings for the Student Managers
- Used Microsoft Excel on a daily basis: modified an existing workbook to create employee schedules, tracked and approved tutors' requests to add or remove shifts, and created numerous spreadsheets to log various logistical data
- Regularly maintained and updated employee work schedules
- Assisted the Associate Director of CAPS with the interviewing, assessing, and hiring of potential Math, Physics, Statistics, Chemistry, and Biology tutors for the Fall 2015 term

Student Manager for the Math, Physics, and Engineering Tutoring Program, CAPS at the University of New Mexico – August 2012 to December 2014

Assisted in running weekly trainings for Mathematics and Physics tutors, focusing on content knowledge and acquiring skills for assisting a large and diverse student population
- Coordinated schedules for both the Math and Physics content trainings, consulting the tutors and other Student Managers on the team in order to make the best use out of these trainings for each tutor
- Supervised the evening tutoring sessions held at CAPS' satellite location in the UNM Student Union Building, and effectively handled any unexpected situations, ranging from potential employee shortages to on-the-spot disturbances
- Served as a mentor and guide for tutors, particularly with content knowledge and tutoring practices

Tutor for Mathematics and Physics, CAPS at the University of New Mexico – August 2011 to December 2014

- Certified Level III Tutor with the CRLA (December 2012)
- Assisted students in various undergraduate Physics, Astronomy, and Math courses
- Ran content- and study strategies-oriented workshops for Algebra and Calculus students
- Gave individualized, appointment-based help in introductory-level Math and Physics courses

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Education:
Bachelor of Science, Engineering Physics, May 2015
Colorado School of Mines, Golden, CO

PROFFESSIONAL EXPERIENCE

Business Intelligence Manager, Mountain Vector Energy – August 2015 to present

As a highly educated and technically capable member of the Mountain Vector Energy team, I cover a broad range of responsibilities. My skills fit the breadth of electrical, mechanical and computer based systems that we interact with, as well as the data intensive trending and analysis side of our business. I have built several advanced programmed architectures for our customers that regularly blend utility, interval, and Building Management System data, analyzes, and reports findings in a meaningful, professional, presentation quality manner.

PAST AND ONGIONG PROJECTS

Programming the Company Website

-Contributed to the development of the MVE website using PHP and Javascript.

Designing our Patented Real Time Usage and Spend Visualizations

-Using my experience with all kinds of data MVE that works with to come up with useful and informative graphs and visualizations that layer all data sources together as applicable, especially Spend data layered with Usage data live in real time, a feat which has never been done in the industry before.

Inventing the Cufflink™

-Pioneered the engineering of our Cufflink™ device. Skills required included electrical engineering, electrical schematics, advanced electricity/physics knowledge, computer programming, *Eagle* software, *Microsoft Visual Studio*.

Time of Use Modelling

-City of Albuquerque (CABQ) required a model to be built to predict potential impact to cost of a future electricity price rate schedule change. I built an Excel file that works off of real data plus adjustable parameters to model the would-be costs of the new rate schedule as compared to current.

Work Orders Analysis

-Work Order data, while not energy related, is still within our wheelhouse of capabilities. I have built and maintained extensive work order data analyses that help inform future budgeting decisions.

Energy Conservation Measures (ECMs) Team

-A cooperative effort between MVE and Albuquerque Public Schools' (APS) Building

Management System (BMS) programmers to monitor and analyze Heating Ventilation and Air Conditioning (HVAC) data and energy usage data, and make energy saving adjustments to the Building Management System (BMS) controls parameters, programming logic, scheduling, timing, and temperature set points, while maintaining school comfort levels.

ASHRAE Level 2 Audits

-Leading student groups in energy projects through the APS Building Buddies student outreach program. Conducting ASHRAE level 2 energy audits checking boilers, chillers, air handling units, etc.

GENERAL ROLES AND CAPABILITES

-Visualizing, layering, and analyzing data of all types, especially utility, BMS, and work order data.

-Using advanced *Excel* tools such as *Visual Basic* programming, macros, pivot tables, templates, and more to make quickly built, beautiful, repeatable, and easily updatable graphs.

-Providing expert data interpretations fueled by my experience over the years at MVE and my physics education background.

-Applying my advanced knowledge of physics to all applicable areas of our company and customers' needs. Thermodynamics, electricity, and electronics are the most prevalent topics.

-Doing 'deep-dive' analyses of data when problems are spotted, or questions arise.

-Reporting of analyses in polished and concise reports that are simple and clean yet rich and meaningful to the intended audience.

-Coordinating with Controls Vendors, IT personnel, and other key technology contacts.

SKILLS

Computer – Computer Types: Microsoft, Apple, Linux

Basic: Adobe Suite, Cloud. Types 65 wpm.

Microsoft Programs: Word, PowerPoint, Excel, Teams, Outlook, Visual Studio, OneDrive

Excel: Advanced features such as pivot tables, macros, *Visual Basic* programming, etc.

Programming Environments: Visual Studio, Code::Blocks, NetBeans, Git, TortoiseGit, GitHub

Languages: Mathematica, Visual Basic, Python, Matlab, C/C++/C#, HTML, PHP, Javascript

Electronics Programs: LabView, Eagle, MAESTRO

Computer Aided Design: SolidWorks, BricsCAD

Other: Comfortable with photo editors like Photoshop, Paint.net, Snagit (advanced screenshots)

Electrical – Skills: Ladder logic programming, wiring, soldering, troubleshooting, electronic schematics

Instruments: Multimeter, oscilloscope, power supply, function generator, driver, Arduino

RECOGNITIONS

-Certificate of Recognition from Albuquerque Public Schools for Energy Management Services
-Nominated for Albuquerque's Women in Technology Award

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Education:
Bachelor of Science, Mechanical Engineering, 2017
Minor, Mathematics
Texas Tech University, Lubbock, TX

PROFESSIONAL EXPERIENCE

Technical Project Manager, Mountain Vector Energy – Jan 2018 to present

- Deployed C&I demand response program; delivered an average of 25.13 MW of capacity across 12 event calls in 2018; generated $2MM in program revenue
- Directed technical installations to build out IoT infrastructure for cloud-based IDR monitoring and demand response control at 100+ unique sites; designed and implemented site-specific curtailment strategies
- Managed vendors on site; adhered to site-specific safety policies and controlled budget through effective installation procedures
- Engaged a diverse portfolio of demand response participants by regularly communicating and responding to various requests through all stages of recruitment, installation, and program participation
- Analyzed budget impact of multiple demand response program contingencies; presented data and collaborated with participants to optimize program performance
- Assisted in development of proprietary cellular IDR monitor by building prototype, troubleshooting and deploying multiple iterations of software, directing installations, and assembling hardware

Intern, Yamasoto, Fujiwara, Higa, & Associates, Inc., dba Aquila – Summers 2015 to 2018

- Calibrated 1000+ radiation dosimetry devices; streamlined personal workflow and collaborated with assembly and logistics personnel to help meet production milestones and fulfill a $25MM contract
- Tested product reliability: followed a rigorous test regime to ensure accuracy and precision at temperature extremes after accelerated aging processes
- Utilized industrial tools for testing and fabrication: temperature chambers, electrodynamic shaker, laser cutter, fused deposition modeling 3D printer
- Analyzed ample test data and compiled detailed report on product reliability at customer's request; assured buyer of production quality
- Assembled various products to specification, including radiation dosimetry devices and high performance servers; troubleshot and replaced defective components

Skills:

- Mechanical: Designed and machined precision aluminum and steel parts, designed and built complex drivetrain assemblies
- Computer Aided Design: Autodesk Inventor
- Programming: MATLAB, Python, Visual Basic, Java
- Electrical: Multimeter, wiring, soldering, troubleshooting, drawing schematics

David Milton Stern
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Albuquerque, NM 87102
Email: David@mountainvector.com Phone: 240-286-0559

Education:
Bachelor of Science, Physics, 2020
Tufts University, Somerville, Massachusetts

Professional Experience

Technical Project Manager, Mountain Vector Energy-Sept. '20- Present

-Led collaboration with the Albuquerque International Sunport, getting a full picture of the airports utility usage and spend, as well as finding a 200 kW power spike due to a chiller-startup by studying the airports IDR data, costing the airport an extra $3,200 a month in demand charges

-Assisted in the planning of future solar sites for the City of Albuquerque to fill the remaining 5.5 MW gap required to take the City fully renewable, including assessing the available square footage at various sites and analyzing the sites kWh usage in order to fit the sites potential solar installation size to its energy profile

-Evaluated the performance of the City of Albuquerque's already existing solar arrays, focusing analysis on any underperforming sites that required further attention

-Studied City of Albuquerque sites energy usage with and without advanced Building Management Systems (BMS) schedules and controls in order to evaluate the energy savings from having a BMS system compared to the cost of keeping the BMS system

Research Assistant, MIT Department of Nuclear Science & Engineering- May '19-Aug '19

-Built a directional Neutron Detector using time-of-flight chamber methods with the goal of detecting fissionable material through the direct detection of high-speed neutron emissions

-Used SOLIDWORKS to design the parts of the neutron detector, then 3-D printed the parts and assembled

-Applied Grasshopper and Root to the analysis of potential neutron paths and interactions inside the detector as well as the possibility of ionization and electron avalanches

-Assessed and selected the design for the outer shell of the detector chamber in order to ensure structural integrity of the device to up to 10 atmospheres

Science Intern, Passport Systems Inc.- May '18- Aug '18

-Used Gamma Ray Spectroscopy and Nuclear Resonance Fluorescence (NRF) to detect contraband including explosives such as C4 and narcotics such as Cocaine

-Assisted in the design of a new scanner with thinner walls, specifically focusing on radiation safety using attenuation data of gamma rays through certain materials

-Evaluated the viability of Gamma Ray Spectroscopy at detecting contraband in air cargo, specifically focusing on the resolution of the scans and their ability to notice small amounts of contraband hidden within other materials

-Updated the companies Nuclear Resonance Fluorescence library, focusing on the algorithm's correct detection of single and double escape peaks

6. Statement of Cooperation:

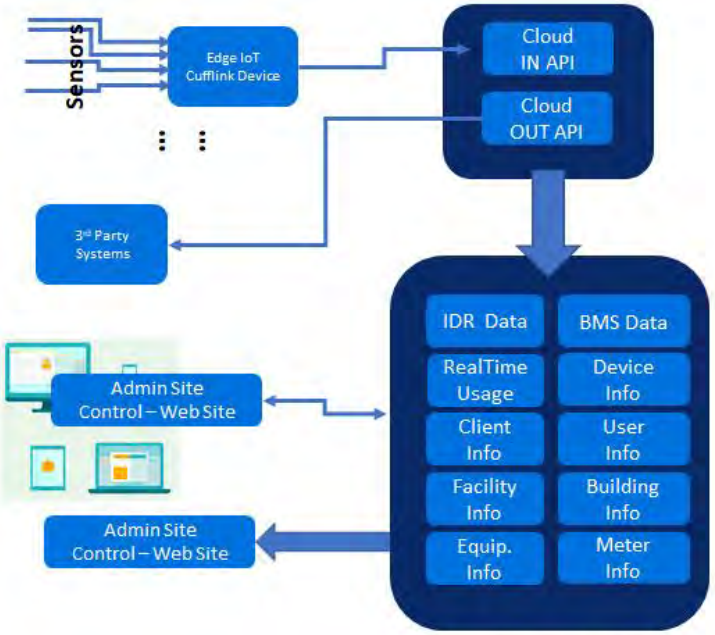
7. Additional Documentation:

Confidential marked Mountain Vector Energy work product for energy data management and software solutions with machine learning customer applications.

STATEMENT OF COMPLIANCE:
The City of Albuquerque Energy and Sustainability Management Division acknowledges our full compliance with all applicable federal, state, and local environmental laws, including but not limited to the Cultural Properties Act, NMSA 1978 §§ 18-6-1 through 18-6-17, and the Endangered and Protected Species Act NMSA 1978 §§ 17-1-14 through 17-5-21.

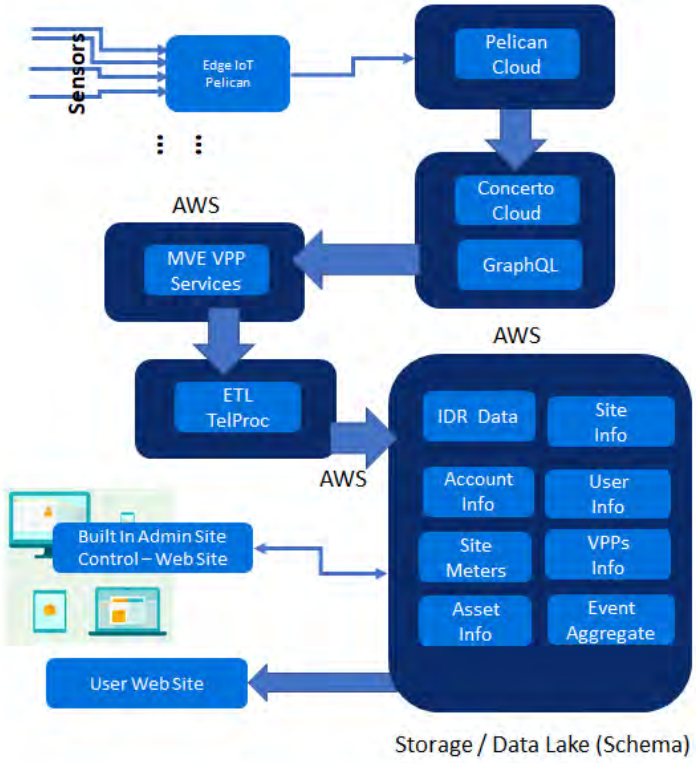
MOUNTAIN VECTOR ENERGY WORK PRODUCT FOLLOWS:

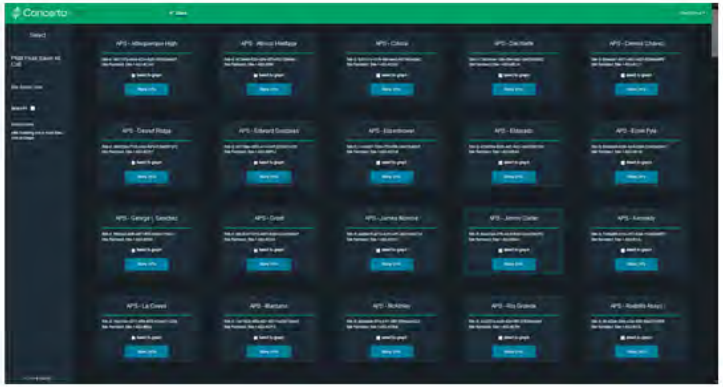
Cufflink – Client Portal



Storage / Data Lake (Schema)

Enbala UI/UX – Cufflink Front End for PNM Peak Saver





Cufflink – Building Automation System

Dissimilar client data sources

BAS - 1

BAS - 2

BAS - 3

.
.
.

BAS - n

BAS Data Extraction

Custom Scrapers

APIs

Archived Datasets(CSVs, xlsx..)

BAS Data Processing

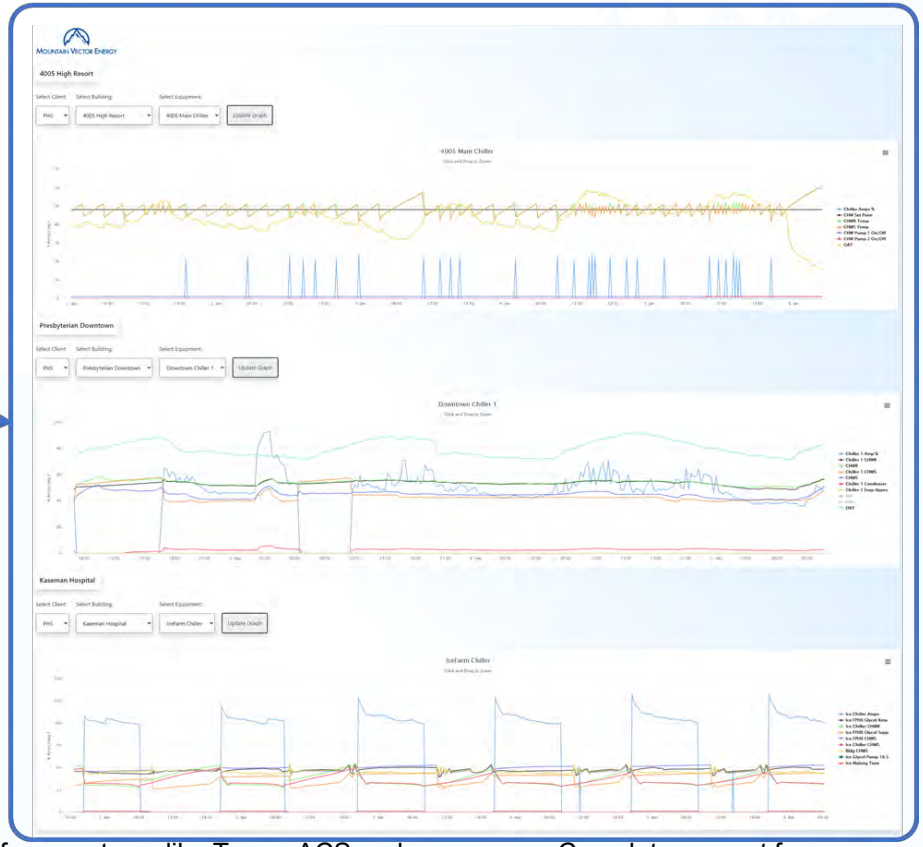
Clean-up

Standardize

Transform into Cufflink IDR Data Model

Cufflink IDR Data Model

Visualized in a Unified UI



A unified interface to monitor BMS/BAS data from systems like Trane, ACS and many more. Complete support for all predictive and analytics capabilities of the Cufflink Model.

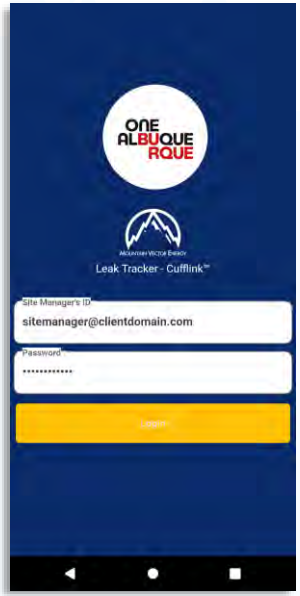
MOUNTAIN VECTOR ENERGY

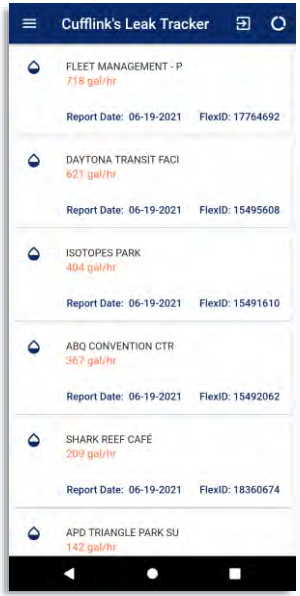
Cufflink – Water Management

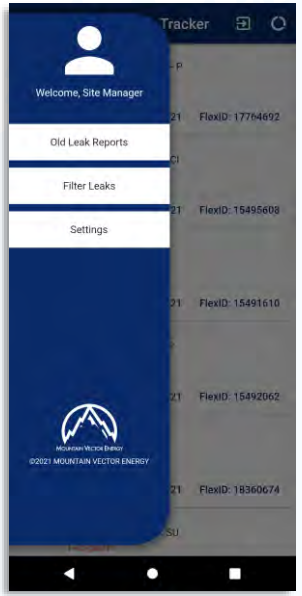
Leak Tracker

An app to automate the process of water leak identification for clients.

- Parallelize water leak notifications to the respective site managers/maintenance directly.
- Secure storage of historic leaks and resolution details.
- Compatible with Android/iOS/Web.



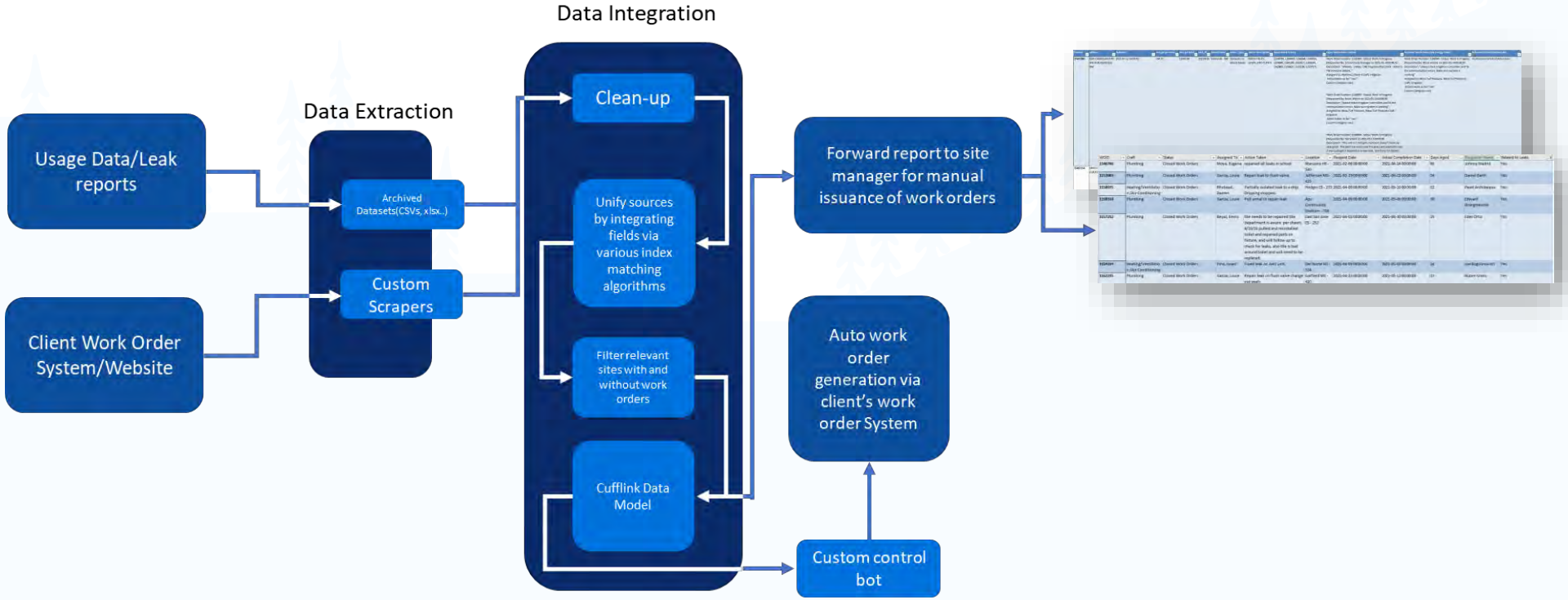




Leak Tracker allows site mangers to be notified of leaks at their respective sites. This is based on the water usage data obtained from the water authority on a daily basis. It allows for immediate visibility of new leaks and allows the managers to keep track of persistent leaks for their sites.

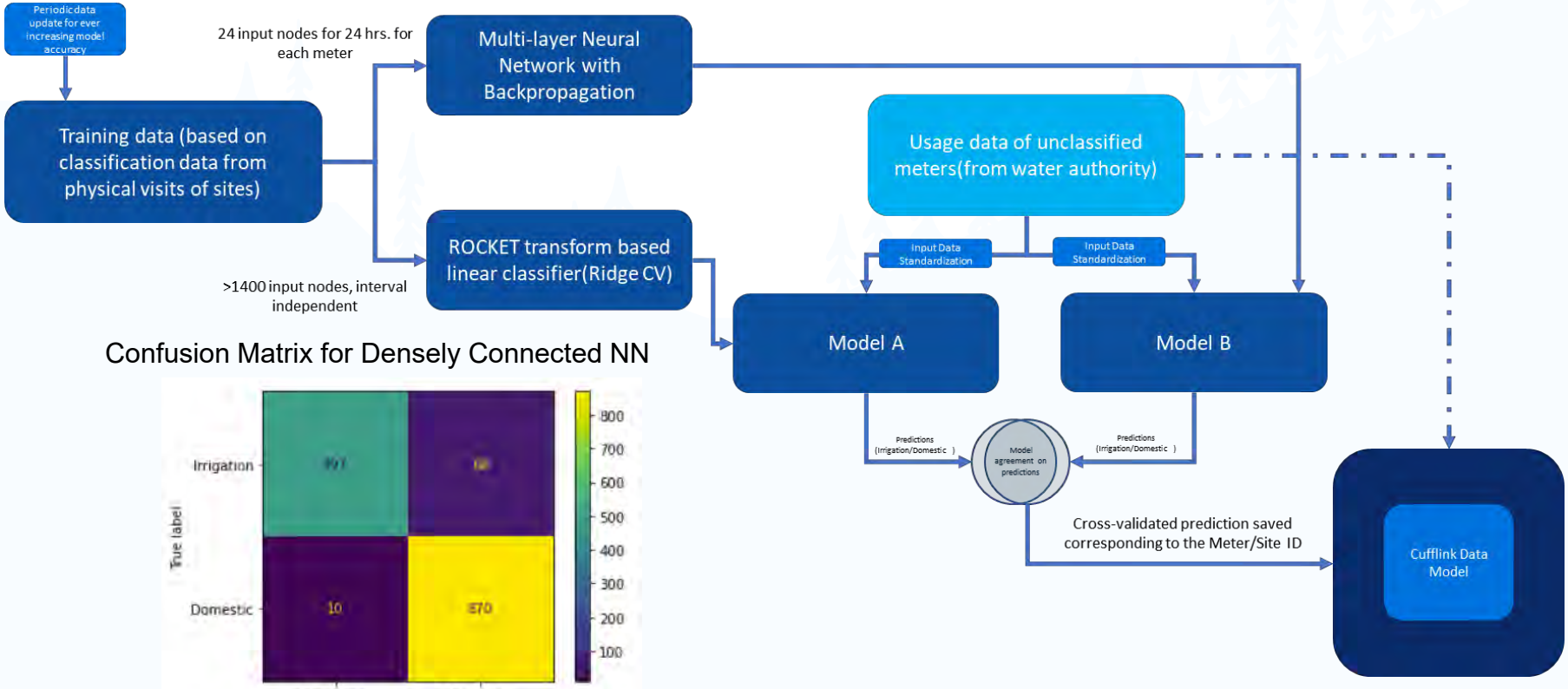
Cufflink – Water Management

Automated work order management – Multiple software platorms integrated for actionable reporting



Cufflink – Water Management

Classifying water meter types(Domestic/Irrigation) by usage via Machine Learning neural network



Confusion Matrix for Densely Connected NN

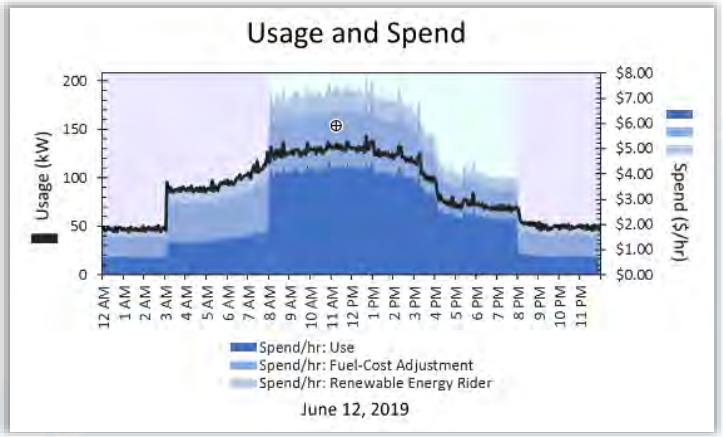
Cufflink – Real Time Usage and Spend

Know how much you're using and spending right now with our patented method for visualizing Real Time Usage and Spend.

Live Cufflink Usage data

Utility Cost Information

U.S. Patent #10,460,361

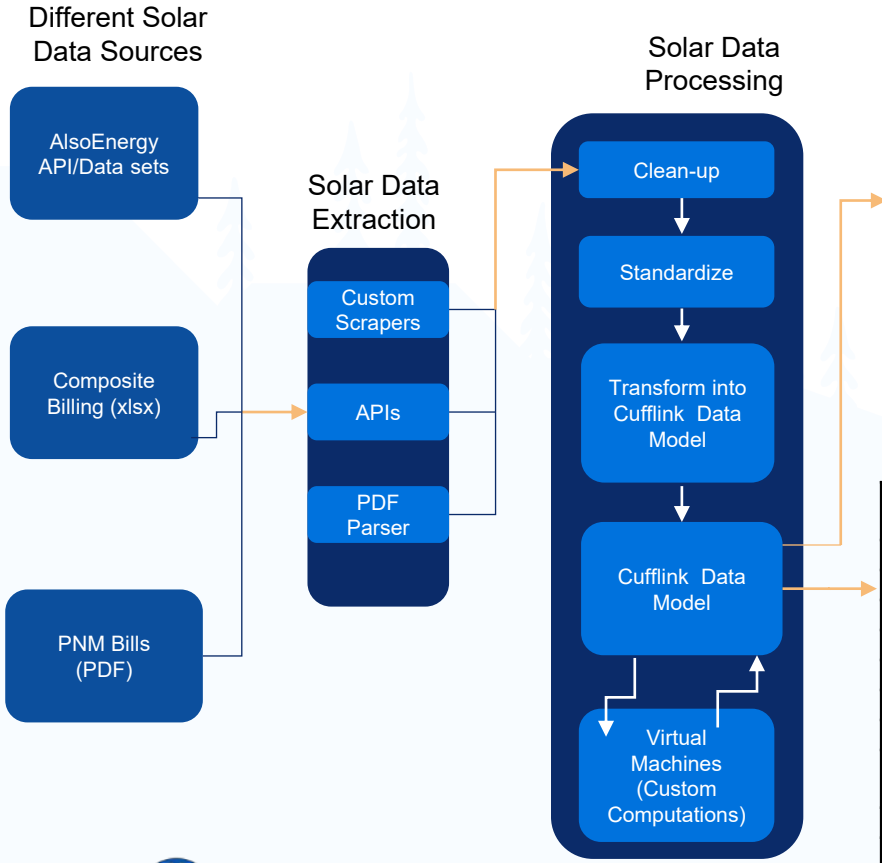


Live spend data generated from and displayed alongside usage for:

Measuring the immediate cost impact of building control changes.

Monitoring of peak demand.

Cufflink – Solar Performance Management



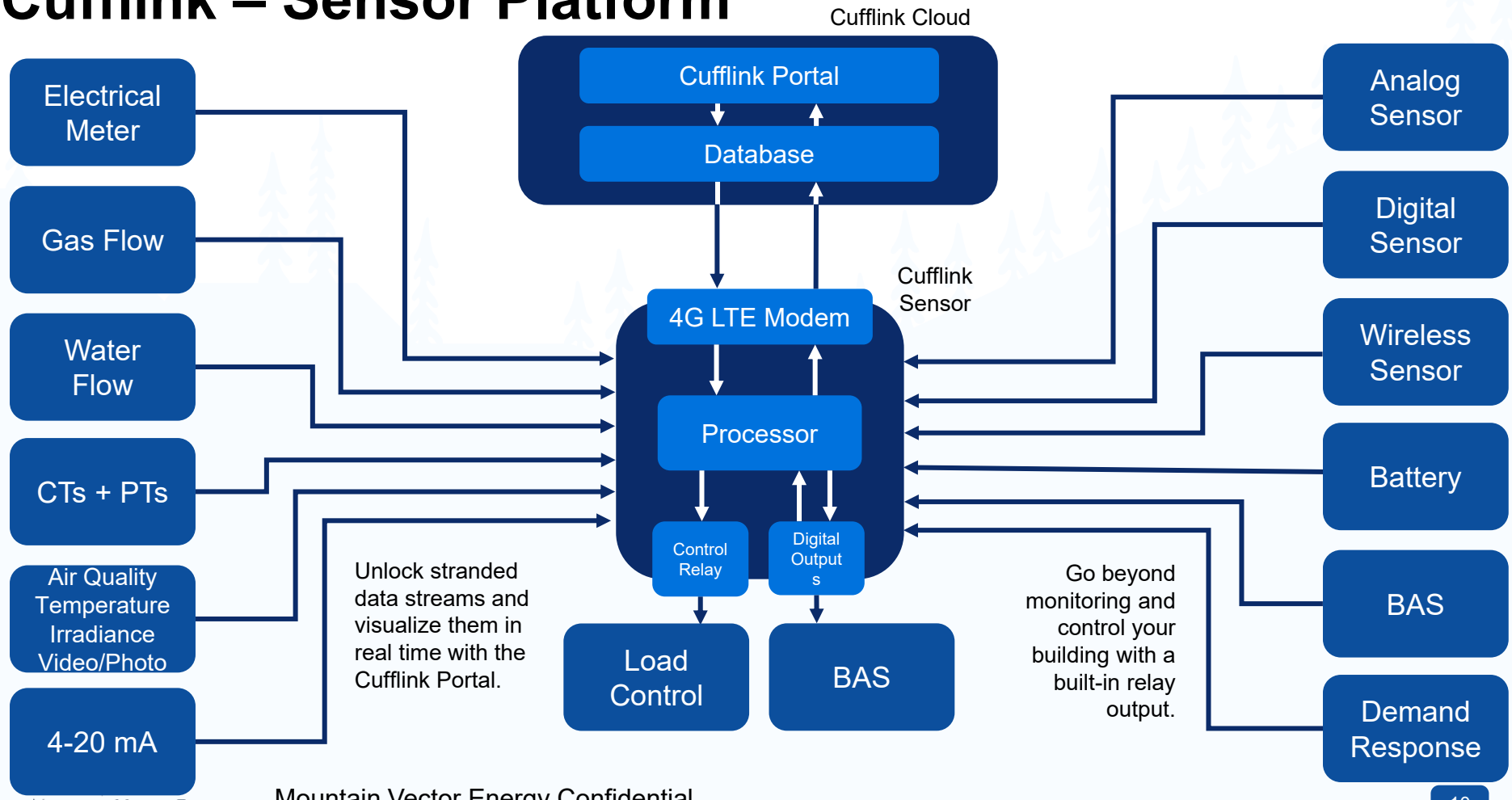
Solar Financial Performance

Project Location	Start Date	Expected Bill Savings	Observed Savings from One Year of Data (Avoided Solar Spend + Recs)	% of Expected	Calculated Sheet Blended Rate $/kWh	Financial Delta
Police Training	Jul-19	$ 16,189.51	$ 33,174.17	205%	$ 0.13	$ 16,984.67
Los Altos Swimming Pool	Nov-19	$ 7,231.67	$ 14,045.95	194%	$ 0.11	$ 6,814.28
5th Area Command	Jun-20	$ 6,683.18	$ 10,656.26	159%	$ 0.11	$ 3,973.08
Fire Station 21	Oct-18	$ 15,036.00	$ 14,853.39	99%	$ 0.13	$ (182.61)
Fire Station 11	Feb-19	$ 7,290.81	$ 6,887.83	94%	$ 0.13	$ (402.99)
Fire Station 18	Jan-19	$ 6,255.49	$ 5,435.32	87%	$ 0.13	$ (820.17)
Forensics	Aug-19	$ 53,213.30	$ 45,243.55	85%	$ 0.09	$ (7,969.75)
Fire Station #7	Apr-19	$ 12,462.97	$ 10,572.62	85%	$ 0.13	$ (1,890.35)
Botanical Garden Aquatic Center	Aug-20	$ 30,258.20	$ 25,340.17	84%	$ 0.08	$ (4,918.03)
Fire Station #2	Mar-19	$ 11,426.44	$ 8,696.88	76%	$ 0.13	$ (2,729.55)

Solar kWh Performance

Project Location	Project System Size KW	PV Generation YEAR ONE (kWh)	Output Last 12 Months (kWh)	Output % of Performance Guarantee	Start Date
Fire Station 21	73	134,582.00	131,961.69	106%	Oct-18
Barelas Senior Center	77	121,925.00	116,246.30	101%	Mar-19
Fire Station #2	47	89,458.00	61,306.00	69%	Mar-19
Fire Station #7	51	98,958.00	88,300.00	94%	Apr-19
Fire Station 5	101	161,566.00	171,109.20	112%	Mar-19
Fire Station 11	36	57,941.00	59,437.40	109%	Feb-19
Fire Station 18	29	49,496.00	52,628.10	114%	Jan-19
North Domingo Baca Multigeneration Center	72	124,381.00	110,814.00	89%	Apr-19
Cherry Hills Library	102	160,776.00	174,848.00	114%	Jun-19
Pino Yards	349	651,561.00	574,440.00	88%	Nov-19
Police Training	140	305,843.00	249,009.73	85%	Jul-19

Cufflink – Sensor Platform



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Fax : 505.241.4343

June 30, 2021

Jacqueline Waite
NM EMNRD
1220 South St. Francis Drive
Santa Fe, NM 87505

Re: Letter of Cooperation for CABQ's Application for Grid Modernization Project

Public Service Company of New Mexico ("PNM") is pleased to offer this letter of cooperation for the proposed BRAIN (Balanced Resource Acquisition and Information Network) Project submitted by the City of Albuquerque (CABQ) in response to the New Mexico Energy, Minerals & Natural Resources Department's (EMNRD) Request for Applications for Grid Modernization Projects.

Headquartered in the City of Albuquerque, PNM is the largest electricity provider operating in New Mexico, serving more than 530,000 customers in dozens of communities across the State. PNM has a strong interest in successfully enabling promising technologies within the PNM service area. As such, PNM supports the overall goals of enabling real time visibility, flexibility and responsiveness with existing and future energy storage, generation and building control resources to benefit the public, the City's critical systems and infrastructure, and thereby furthering the State's energy policy.

PNM's participation in this project is expected to be as a technical advisor, with the scope of activities to be mutually acceptable to PNM and CABQ. PNM will not seek reimbursement for time spent collaborating with CABQ on this project, and thus, PNM expects to be able to provide this type of support without being subject to terms and conditions that may apply to a vendor for the project.

While PNM supports the concept of this project, and believes that it may have positive implications, PNM encourages CABQ to carefully consider the upstream impact of a potential cyber-attack on the grid. Given the heightened cyber-threat landscape, the likelihood of a CABQ installation being targeted by ransomware or other significant cyber-attack is high. While this may not directly impact utility systems, it could result in a grid imbalance and potential instability in the grid. PNM would need to assess the security architecture of this installation and understand any safeguard that would limit the potential impact of a voltage loss behind the meter.

We appreciate the opportunity to provide this letter of cooperation for this project and recommend its selection in your evaluation process.

Sincerely,

Ron Darnell
Senior Vice President, Public Policy