

Docket No. UM 1953
Witness: Micha Ramsey

**BEFORE THE PUBLIC UTILITY COMMISSION
OF OREGON**

UM 1953

**In the Matter of
PORTLAND GENERAL ELECTRIC
COMPANY,
Investigation into Proposed Green Tariff.**

RENEWABLE NORTHWEST'S EXHIBIT 400

Phase II Cross-Answering Testimony of Micha Ramsey

July 16, 2020

INTRODUCTION

Q. Please state your name, occupation and business address.

A. My name is Micha Ramsey, and I am a principal at Dr. Micha Ramsey Consulting, LLC.
My business address is 14114 SW Compass Drive, Beaverton OR 97005.

Q. On whose behalf are you testifying?

A. This testimony is on behalf of Renewable Northwest.

Q. Would you please briefly describe your educational and professional background?

A. I have a bachelor's degree and master's degree in mechanical engineering from Case Western Reserve University and a PhD in mechanical engineering from MIT.
Throughout my 17 years of professional experience I have leveraged my ability to do research and development as an integral part of my success. I have experience in the design, build, and testing of advanced sensor hardware; worked for 9 years in the photovoltaics manufacturing industry; and possess unique knowledge about how to develop innovative programs that spur the transition to a new energy economy based on clean, renewable energy designed to directly benefit communities through job growth, education, and resilience. A copy of my CV is attached as Exhibit A.

Q. What is the purpose of your Phase II Cross-Answering testimony?

A. I appreciate the opportunity to testify to the Oregon Public Utility Commission ("the Commission") regarding Phase II of Commission Docket No. UM 1953, an investigation into the green tariff proposed by Portland General Electric Company ("PGE"). The purpose of this testimony is to respond to the issues that have been raised in this docket subsequent to Renewable Northwest's July 26, 2019 submission of the Phase II Opening

Testimony of Michael O'Brien ("O'Brien"),¹ including PGE's Reply Testimony and Exhibits of Brett Sims and Jay Tinker ("Sims-Tinker")² and PGE's Reply Testimony and Exhibits of Karla Wenzel and Josh Halley ("Wenzel-Halley").³ Overall, I support the expansion of PGE's green tariff program and offer suggestions to ensure that green tariff offerings in Oregon spur access to new, additional renewable-energy resources that can contribute to the decarbonization of Oregon's energy sector.⁴

Q. Would you please summarize your testimony?

A. Yes. My testimony is framed in response to Wenzel-Halley, which in turn is organized under the following three headings: Updated Guidelines, Program Design, and Resource Procurement and Long-Term Planning. Beneath each heading, I offer responses to each of PGE's main points or proposals. Additionally, I include a fourth heading of Energy Storage, beneath which I suggest that renewable energy generation combined with energy storage should be considered an appropriate green tariff resource. Throughout my testimony, I refer back to prior testimony as necessary.

1. UPDATED GUIDELINES

Q. Would you please discuss PGE's proposed approach to the "updated guidelines to replace the nine conditions" that currently apply to voluntary renewable energy tariffs in Oregon?⁵

¹ Oregon Public Utility Commission, Docket No. UM 1953, RNW/300 (Jul. 26, 2019).

² Oregon Public Utility Commission, Docket No. UM 1953, PGE/600-606 (Oct. 17, 2019).

³ Oregon Public Utility Commission, Docket No. UM 1953, PGE/700-703 (Apr. 15, 2020).

⁴ PGE refers to its green tariff program as the Green Energy Affinity Rider, or "GEAR," so quotes from PGE's testimony may reflect that terminology.

⁵ Wenzel-Halley / 11.

A. At this stage of Phase II, PGE continues to propose that the nine conditions from Order No. 15-405 be replaced by guidelines. The primary changes PGE is seeking have to do with (1) the program cap (Condition 4) and (2) the relationship between green tariffs and Oregon's long-term Direct Access program (Conditions 5 and 6). Specifically, PGE proposes to modify the program cap from 300 aMW to 500 MW and to remove the conditions governing the relationship between green tariffs and Direct Access.

Q. What are your responses to these two elements of PGE's proposal?

A. Regarding the first element, modifying the program cap, I support PGE's proposal. While the overall program cap is expressed in aMW, or average megawatts, the program has been limited to 300 MW by other terms of Commission Order 19-075; the change to 500 MW is therefore effectively an increase in the program cap.⁶ PGE's experience with Phase I demonstrates that there is significant customer interest in the green tariff program due to customers' demand for renewable energy to help them meet their commitments to mitigating climate change. Regarding the second element, removing Conditions 5 and 6 which govern the relationship between green tariffs and Direct Access, I neither support nor oppose removal but instead recommend that the Commission require regular, perhaps on an annual basis, reporting on the relative subscription levels and overall success of both the green tariff and Direct Access options. If reporting shows that one option is significantly outstripping another, then further investigation into the reasons for any such discrepancy and, possibly, changes to the relationship between the two programs may be warranted. I stop at recommending a reporting requirement rather than any requirements

⁶ Oregon Public Utility Commission, Docket No. UM 1953, Order No. 19-075 at 4 (Mar. 5, 2019) ("PGE may procure up to 300 MW of new nameplate resources through PP As under this program.").

prescribing additional investigations or program changes, however, because it is possible that one program may outstrip the other simply as a result of a functional market where customers are exercising demand based on their preferences -- not based on market distortions attributable to program design.

Q. Would you please explain why you neither support nor oppose removal of Conditions 5 and 6?

A. At a high level, PGE's testimony appears to be based on the notion that green tariffs and Direct Access are fundamentally different programs for fundamentally different customers.⁷ I agree with the former -- while both programs serve energy consumers with renewable resources, at least at present a green tariff is structured as a cost-of-service rider while Direct Access is essentially an opt-out of the full-service utility model. Whether the two programs serve fundamentally different customers, however, is less clear in this moment of rapid change in the electricity sector. This lack of clarity points to a need for additional reporting and information regarding the relative success of each program. In light of both a broad body of science demonstrating the need for transitions to non-emitting energy sources in order to limit global warming to 1.5C⁸ as well as the Governor's Executive Order No. 20-04 centering decarbonization as a core policy consideration for the Commission,⁹ a reporting requirement would help the Commission to ensure that all options for transitioning large customers to 100% renewable energy as soon as possible will remain robust.

⁷ See generally Wenzel-Halley / 11.

⁸ Intergovernmental Panel on Climate Change, Special Report on Global Warming of 1.5°C at 46 (Oct. 8, 2018), available at www.ipcc.ch/report/sr15/ ("1.5°C pathways with no or limited overshoot include a rapid decline in the carbon intensity of electricity and an increase in electrification of energy end use (high confidence)").

⁹ Executive Order No. 20-04, section 5(A).

Q. PGE also expresses concerns about innovation and competition. Do you have a response to those concerns?

A. Yes. Commission Staff proposed a modification to Condition 6 that would require PGE to “fairly account for differences from Direct Access programs,” by “provid[ing] evidentiary support for those differences” and also that PGE “must consider changes to their direct access programs to match VRET terms and conditions, as appropriate.”¹⁰ I noted that “PGE is concerned that [Staff’s proposed] revised guideline [6] has the appearance of giving the utility opportunity for innovation, but the practical reality is it will create lengthy regulatory hurdles that will stifle opportunity for ‘innovation that could help transform our electricity sector, drive down greenhouse gas emissions, and meet customer demands.’”¹¹ The divide between Staff’s proposal and PGE’s concerns helps to explain why I support an annual reporting requirement and not a more prescriptive process addressing the relationship between green tariff programs and Direct Access. Reporting may show whether there is reason to undertake the additional analysis Staff recommends; absent the underlying information that reporting would provide, however, I am sympathetic to PGE’s concerns that prescribing process barriers up front may restrict innovation and slow system transformation and greenhouse gas-emission reduction.

Q. Do you have more detailed recommendations for reporting regarding green tariffs and Direct Access?

¹⁰ Oregon Public Utility Commission, Docket No. UM 1953, Staff/300 Gibbens/20.

¹¹ Sims-Tinker / 21 (quoting RNW/300 O'Brien/12).

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- A. Yes. First, I recommend that a utility offering a green tariff product be required to submit an annual report showing customer interest and actual subscriptions to the green tariff and Direct Access programs. Second, I recommend that the report include a narrative section demonstrating that both programs are truly available to interested customers and explaining how the green tariff product is affecting or otherwise interacting with the competitive marketplace.

2. GREEN TARIFF PROGRAM DESIGN

Q. What are your overall impressions of PGE's Green Tariff Program Design?

- A. Wenzel-Halley breaks down Program Design into three categories: Phase II Cap Increase, Risk Adjustment Fee, and Utility Ownership of a GEAR Resource.¹² Regarding the Phase II Cap Increase, I support PGE's proposal to increase the cap to 500 MW and express no concern regarding PGE's proposal to eliminate the distinction between the PGE Supply Option ("PSO") and Customer Supply Option ("CSO"). Regarding the Risk Adjustment Fee, I support the concept of a fee to ensure risks are adequately captured to prevent cost-shifting, provided that the fee is designed to account adequately for the possibility that some identified uncertainties may also provide net benefits to PGE or its customers. Regarding utility ownership, I acknowledge that allowing utility ownership of green tariff resources may be appropriate provided that procurement of any such resources is subject to additional scrutiny to ensure any resource added to PGE's system is least-cost and least-risk.

¹² Wenzel-Halley / 10.

a. Cap Increase

Q. Would you please briefly outline your understanding of PGE’s proposed change to the program cap?

A. Yes. PGE proposes to modify its program cap to 500 MW as a response to strong customer demand for the green tariff product. PGE also proposes two changes to the structure of the program cap relative to Phase I: first, eliminating the distinction between the PGE Supply Option (“PSO”) and Customer Supply Option (“CSO”)¹³; and second, limiting each customer to no more than half of the 200 MW incremental cap increase.¹⁴

Q. Do you have any concerns about PGE’s proposed increase to the program cap?

A. No. As I already stated in my answer on the Guidelines, I agree with PGE that demand for the green tariff warrants an effective cap increase. I also agree with PGE that the CSO/PSO distinction in Phase I created confusion that threatened the success of the green tariff program.¹⁵ Eliminating the distinction would be an appropriate response to allow greater flexibility in program implementation and avoid confusion in the future.

b. Risk adjustment

Q. Would you please briefly outline your understanding of PGE’s proposed additions to its risk adjustment to be charged to green tariff subscribers?

A. Yes. In Phase I of this docket, the Commission allowed PGE to apply a risk premium that accounts for the risk that the output of a procured resource may exceed the demand

¹³ Wenzel-Halley / 13-15.

¹⁴ Wenzel-Halley / 13. Wenzel-Halley states that “no more than half of the cap [will be] allocated to one customer to allow for more customer participation.” This is clarified on the subsequent page to mean that no large customer may consume more than 100 MW of the program..

¹⁵ See, e.g., Oregon Public Utility Commission, Docket No. UM 1953, Renewable Northwest’s Response to Staff Report (Oct. 18, 2019), available at <https://edocs.puc.state.or.us/efdocs/HAC/um1953hac155114.pdf>.

associated with subscriptions to that resource under the Green Tariff. Under this model, if a resource were perfectly aligned with subscription levels -- e.g. if PGE procured a 150 MW resource with a 20-year power purchase agreement (“PPA”) to serve subscribers with an expected load of 150 MW and a 20-year commitment -- the risk adjustment would be zero. In Phase II, PGE has proposed to add three new elements to its risk adjustment to better address *uncertainties* as opposed to known risks. “Subscriber load uncertainty” is designed to protect non-subscribing customers in the event that a subscribing customer’s load drops, resulting in a mismatch between a resource’s output and the level of subscription to that resource. “Resource variability” is designed to protect non-subscribing customers in the event that a green tariff resource is less productive than expected, again creating a mismatch between a green tariff resource and its subscription level, and thus requiring PGE to buy replacement RECs to meet customers’ subscribed level for green attributes. “PPA-related risk” is more of a catchall category designed to protect non-subscribing customers from other difficult-to-predict risks resulting from mismatches between a PPA’s terms and subscribers’ needs.

Q. What is your response to PGE’s proposed risk adjustment categories?

A. PGE’s risk adjustment categories are perhaps better characterized as uncertainties. This is to say that PGE has identified circumstances that may or may not occur, and has proposed taking steps to protect against cost-shifting in the event that the circumstances *do* occur. What is not clear from PGE’s proposal, however, is whether the proposal accounts for the possibility that PGE’s identified uncertainties could yield benefits for PGE or its non-subscribing customers in some scenarios and how that impacts the risk

adjustment fee. As an example, mismatches between resource output and subscriber needs may benefit non-subscribing customers; in the event a subscribing customer's load drops unexpectedly, it is possible that a green tariff resource's output could bring energy, capacity, and other benefits to PGE's system -- including to the non-subscribing customers -- that exceed the costs associated with that resource. Therefore, it is important to bear in mind when reviewing proposed risk adjustments that, while the uncertainty-related risks PGE points to are real, so are the uncertainty-related potential benefits. I appreciated PGE's clarification that at this time, "PGE does not propose prescriptive analytical methodologies for each risk because each resource and contract will be different, making a comprehensive formulaic approach that applies broadly challenging."¹⁶ I recommend that any such methodology or formula should account for both potential costs *and* potential benefits.

c. Utility ownership

Q. Would you please briefly outline your understanding of PGE's proposal regarding utility ownership of green tariff resources?

A. Yes. PGE proposes that the company be permitted to own green tariff resources and to include those resources in its rate base.¹⁷

Q. Do you have a position on PGE's proposal regarding utility ownership?

A. Yes. Utility ownership of green tariff resources may be appropriate provided that the process resulting in procurement of a utility-owned resource clearly demonstrates that the resource is the least-cost, least-risk option. While I appreciate PGE's focus on how a

¹⁶ Wenzel-Halley / 15.

¹⁷ See, e.g., Wenzel-Halley / 16.

well-designed program will ensure that resource costs are borne by subscribing customers and that risks to non-subscribing customers are limited or eliminated, regulatory safeguards may still be advisable. They would help instill confidence in both subscribing customers and renewable-energy developers that the resources PGE procures to serve green-tariff subscribers are the best ones available as well as avoid any optics that there was a preference for selecting PGE to own the green tariff resource.

3. RESOURCE PROCUREMENT AND LONG-TERM PLANNING

Q. Would you please discuss PGE’s proposed approach to resource procurement and long-term planning?

A. PGE breaks its discussion of resource procurement and long-term planning down into three categories: competitive bidding rules, integrated resource plan interactions, and post-Phase II process. I respond to PGE’s position on each of these categories below.

a. Competitive bidding rules

Q. What is your understanding of PGE’s position regarding the application of the Commission’s competitive bidding rules to green tariff procurements?

A. In its most recent testimony, “PGE requests a waiver of the CBRs [competitive bidding rules] required for the acquisition of a major GEAR resource for Phase II if an increase in the cap is approved by the Commission.”¹⁸ PGE says that procurement without a full competitive bidding process would be quicker, less expensive, and even “necessary to meet customer interest.”¹⁹

¹⁸ Wenzel-Halley / 18.

¹⁹ *Id.*

Q. Do you have any response to PGE's position?

A. I recommend that the Commission generally require PGE to follow the competitive bidding rules where utility ownership of a green tariff resource is a possible procurement outcome. That said, I also acknowledge PGE's concerns about aligning the timelines of potential subscribers and the procurement process; given these concerns, a streamlined competitive bidding process may be appropriate for green tariff procurements where utility ownership is not a possible outcome. Even if the customer-choice element of a green tariff program offers a layer of scrutiny that may serve some of the same goals as the competitive bidding rules, the rules provide further protection that will help ensure customer and developer confidence in a fair process that results in procurement of the best available resources. Where utility ownership is not on the table, the need for that further protection is attenuated; accordingly, I recommend requiring adherence to the competitive bidding rules where utility ownership is possible but allowing a streamlined competitive bidding process where it is not. I have not been able to identify any details regarding a proposed streamlined procurement process in PGE's testimony thus far, and I would welcome the opportunity to review such a proposal.

b. Integrated Resource Plan Interaction

Q. What is your understanding of PGE's position regarding the interaction between the green tariff program and its integrated resource plan ("IRP") process?

A. PGE proposes both that its IRP inform its green tariff product and that its green tariff product inform its IRP. On the former, PGE plans to align the energy and capacity credits it provides to green tariff subscribers with the values of the energy and capacity that a green tariff resource brings to PGE's system based on its IRP methodology. On the latter, PGE plans to incorporate known green tariff resources into its IRP analysis and to run sensitivities related to unknown potential green tariff resources as it works to identify overall resource needs.

Q. Do you have any response to PGE's position regarding interaction between the green tariff program and its IRP?

A. I have some concern with one element of how PGE's IRP will inform its green tariff product. Specifically, PGE proposes that "[w]hen there is no need for energy from the market, or capacity to meet customer load, achieving neutral portfolio expected cost impacts in the IRP requires that the energy and capacity credits be set to zero, consistent with the GEAR."²⁰ This suggestion appears to discount the possibility that a green tariff resource could provide energy and capacity benefits to PGE and its customers absent a defined energy or capacity need. A green tariff resource may, however, allow PGE to avoid making market energy purchases or to defer capacity needs even during periods of capacity sufficiency. In each such case, the resource could add value that is not reflected in credits determined on the basis of PGE's energy or capacity needs. With that said, I also recognize that the concept of energy need is evolving in the IRP context²¹ and the Commission is similarly investigating the evolving concept of capacity and how to value

²⁰ Wenzel-Halley / 19.

²¹ See Oregon Public Utility Commission, Docket No. LC 73, Order No. 20-152 at 12-13 (May 6, 2020).

it.²² Thus I would expect that tying energy and capacity credits to IRP methodology may result in better and more accurate credits as the IRP process continues to develop. On the matter of how PGE is incorporating green tariff resources into its IRP process, I have no concerns.

c. Post-Phase II Process

Q. What is your understanding of PGE’s proposal for further process after the conclusion of Phase II?

A. As I understand it, PGE’s primary proposal is to establish up front a process for determining future increases to the green tariff program cap, if any. Specifically, PGE proposes, only for cap increases, to “file a tariff update for the cap increase including an explanation of the circumstances for which we are filing” subject to a 60-day review period.²³ PGE suggests that this approach will help it “to meet customer demand and provide clarity for decision making.”²⁴

Q. Do you have any response to PGE’s proposal regarding a process for cap increases?

A. I agree with PGE that a streamlined process for cap increases is appropriate. As I noted above, there appears significant customer interest in the green tariff program due to customers’ demand for renewable energy to help them meet their commitments to mitigating climate change. Allowing PGE to raise the program cap subject to a 60-day opportunity for stakeholder and Commission review, without having to reopen the broad suite of policy considerations stakeholders are currently engaging with in this docket, will help to meet that customer demand and accelerate achievement of needed greenhouse gas

²² See generally Oregon Public Utility Commission, Docket No. UM 2011.

²³ Wenzel-Halley / 23.

²⁴ *Id.*

emission reductions in accordance with Oregon’s policy goals.²⁵ I appreciate PGE’s additional clarification that “[a]ny future change to the GEAR, except for a cap increase, would not be subject to the same 60-day review period.”²⁶

4. ENERGY STORAGE

Q. Are there any additional issues you would like to discuss?

A. Yes. In earlier testimony, Renewable Northwest encouraged the Commission to consider allowing hybrid renewable-plus-storage projects to serve green tariff customers.²⁷ PGE viewed this suggestion through the lens of Condition 1 and responded that “PGE does not think it is appropriate to alter this guideline away from the fundamental objective of having green tariffs be programs that allow customers to purchase bundled RECs and thereby drive the development of additional renewable power generation.”²⁸ In my view, opening the green tariff program to hybrid projects would support the fundamental objective of the green tariff program as PGE describes it.

Q. Would you please further explain your position regarding storage resources?

A. Allowing hybrid projects would support the goals of allowing customers to purchase energy bundled with RECs and driving the development of additional renewable power generation. As I understand the first issue, an appropriately configured hybrid resource could provide bundled RECs just as a standalone renewable resource can. More fundamentally, though, as the northwest power system transitions from its current reliance on more-dispatchable, greenhouse gas-emitting thermal generation to

²⁵ See Executive Order 20-04, section 2.

²⁶ Wenzel-Halley / 23.

²⁷ O’Brien / 19.

²⁸ Sims-Tinker / 5.

non-emitting renewable resources with variable but predictable generation profiles, storage becomes an increasingly important aspect of the new electricity grid. Not only can storage resources effectively shift generation in time to align with load, but they also provide increasingly important grid services. Thus both PacifiCorp and PGE in their 2019 IRPs identified preferred portfolios with significant additions of cost-effective renewables paired with more modest but still significant energy-storage additions.²⁹ To put it another way, the development of additional storage resources supports the development of additional renewable resources.

Q. Are there any other benefits to including hybrid resources in the green tariff program?

A. Yes, PGE's treatment of green tariff resources in its IRP may offer further benefits.

Consider this question and answer from Wenzel-Halley:

Q. How does the Company's long-term planning consider the GEAR?

A. The GEAR results in incremental resources that provide energy and capacity to serve PGE's COS energy supply customers. As such, PGE's IRP includes the energy and capacity impacts of the GEAR resources within the Needs Assessment.³⁰

The Needs Assessment in PGE's most recent IRP shows a significant capacity need that may be addressed in part by green tariff resources.³¹ A hybrid resource will generally have a higher capacity value than a standalone renewable resources, so to the extent green tariff subscribers are willing to take on the costs associated with a hybrid resource,

²⁹ See PGE 2019 IRP at 196, Table 7-9 (showing 37 MW of 6-hour batteries as a resource in PGE's preferred portfolio); PacifiCorp 2019 IRP at 245 ("PacifiCorp's preferred portfolio continues to include new renewables, facilitated by incremental transmission investments, demand-side management (DSM) resources, and for the first time, significant battery storage resources.").

³⁰ Wenzel-Halley / 19.

³¹ PGE 2019 IRP at 123, Table 4-14.

they will be displacing more of PGE's capacity need with a clean, non-emitting resource with no cost-shifting to non-subscribing customers. This extra clean capacity benefit may also be attractive to potential green tariff subscribers.

CONCLUSION

Q. Is there anything else you wish to say before concluding your testimony?

A. Yes. I appreciate PGE's work to establish and expand its green tariff program, which has already brought significant incremental renewable energy to Oregon's electric grid and has the potential to bring still more. I view this program as an important element of Oregon's transition to a cleaner electricity system that will help the state to meet its climate goals.

Q. Does this conclude your testimony?

A. Yes.

EXHIBIT A

MICHAELA RAMSEY, PHD

(617) 877-3431 • dr.micha.ramsey@gmail.com • [linkedin.com/in/mekramsey](https://www.linkedin.com/in/mekramsey)

I am a passionate leader dedicated to developing innovations and spurring transformations that will halt climate change and lead to a sustainable existence for humanity. My greatest strength is integrating strategic thinking with tactical execution through implementable actions. I excel at developing fact-based, data-driven solutions to diverse business challenges, and my skillset includes project portfolio management, research & development, custom analysis tools, strategic planning, and budget forecasting. My ability to hire, mentor, and motivate high-performing talent results in my teams achieving key goals within aggressive timelines. I communicate effectively with C-suite executives, technical experts, and operations, enabling me to work well across all levels of an organization.

CORE COMPETENCIES

Cross-Functional Leadership • Forecasting and Strategic Planning • Integrated Financial and Process Modeling • Research & Development • Executive Communication • Project and Project Portfolio Management • Multi-Million Dollar Budgets • Safety Culture Development

PROFESSIONAL EXPERIENCE

Micha Ramsey Consulting

May 2020 – Present

OWNER & PRINCIPAL

Leveraging technical expertise, business acumen, and passion for creating a clean and sustainable future to help clients solve their unique challenges and move them towards achieving their clean energy and sustainability goals.

Community Energy Labs

Feb 2020 – Present

CONSULTANT

Founded in 2019, Community Energy Labs spun off the foundational work and investment of PECl in grid-edge products, community engagement, and business model development for a rapidly evolving energy landscape to provide innovative solutions for a clean and modern grid with humans at the center.

PECl, Portland, OR

May 2018 – Oct 2019

PECl is a nonprofit corporation dedicated to advancement in energy use, generation and policy. From 2014-2019, PECl focused on developing projects, programs and products that advanced its mission and vision for affordable, equitable, and low-carbon electricity with communities at the center.

SENIOR PROGRAM MANAGER

Core member of nimble, cross-functional team that designs strategies and custom solutions to accelerate the deployment of community energy projects and transform relevant energy markets.

- Provided day-to-day leadership and management for projects, products and programs. Worked closely with communities to enable them to reach their specific environmental and economic goals by providing tailored technical consulting services.
- Led development of the Education and Vocational Training project (Tenino WA) and its funding strategy. Engaged with key stakeholders to build integrated bottoms up project plan, developed relationships within educational and government institutions to promote project and secure support.
- Coordinated the Strategic Energy Management for Tenino School District and City of Tenino (WA). Worked with maintenance staff to analyze potential energy efficiency savings and recommend cost saving projects.
- Collaborated on development of funding applications on behalf of customers through bottoms-up scope, schedule, and budget development, background research, and content generation. Key contributor to several successful grant applications.
- Researched new technologies, market developments, and regulatory changes.
- Improved the effectiveness of internal and external processes. Developed custom project planning tool that became the standard tool for grant applications and customer engagement. The tool was a crucial component in multiple project development cycles. Improved effectiveness of data visualization by implementing new software that allowed for interactive data exploration.
- Led transition of community-based projects as PECl shifts to new strategic direction and work focus. Managed challenging situations, creating solutions that supported the goals of the community as well as enabled continuation of project with new partners.

GCL Solar Materials (formerly SUNEDISON), Portland, OR

Sept 2014 – Jun 2018

ENGINEERING MANAGER, CONTINUOUS CZOCHRALSKI (CCz) CRYSTAL GROWING

Responsible for all process engineering activities and coordination of R&D testing. Primary financial analyst for Portland plant starting in 2016 and owner of process and cost modeling of crystal growing for global organization.

- Owned Portland plant forecasting activities including developing annual budgets, updating actuals, and analyzing spend. Generated scenario sets to inform budgeting decisions.
- Leveraged flexible program management approach to maximize effectiveness of project leaders through project specific methodologies (e.g. agile vs. waterfall). Oversaw all aspects of the CCz project portfolio including project value assessment, prioritization, planning, resource allocation, execution, and closing. Streamlined portfolio management and improved communications between steering committee and project owners resulting in greater visibility of decisions and clear accountability for needed actions.

- Executed bottoms up analysis to inform top down scenarios that facilitate executive level decisions. Built a comprehensive process modeling tool based on manufacturing inputs and integrated model outputs with financial forecasting to tie annual operating plan to specific process improvements. Delivered more accurate and flexible financial forecasting through improved functionality.
- Created multi-year process and cost roadmap as well as benchmarking against competing technologies. Integrated multiple models into coherent analysis with versatile outputs to facilitate communication with key stakeholders.
- Drove continuous process development for CCz technology for improved performance and reduced manufacturing cost including process, equipment, non-durable parts and consumables. Variable conversion cost was decreased by over 40% year over year from 2015 through 2017 as a result of the integrated engineering activities.
- Developed cohesive engineering team through collective goals with clear link to company strategic initiatives, synergistic test planning, and collaborative decision making. Promoted professional development through targeted growth opportunities, coaching, and mentoring resulting in improved project management and leadership skills for the team.

SOLARWORLD INDUSTRIES AMERICA, Hillsboro, OR
Feb 2009 – Sept 2014
PROGRAM MANAGER, CRYSTAL GROWING R&D
FEB 2013 – SEPT 2014

Directed all crystallization R&D at the Hillsboro site. Led a cross-functional team of 9 engineers, scientists, and technicians to develop innovative crystal growth technologies that produce superior efficiency substrates at lower cost than incumbent methods. Responsible for all aspects of scope, schedule, budget, and resource management.

- Co-authored multiple grant applications resulting in \$4M of DOE funding crucial for program continuation. Secured program support from executive management by effectively communicating the R&D progress, challenges, and technology potential through technical presentations, capacity and cost modeling, and technology transfer schedules.
- Led team to deliver key technology demonstrations required for program continuation. Enabled team to successfully resolve roadblocks by implementing systematic problem solving, improving contingency planning, and developing accountability for schedule based progress.
- Secured R&D funding for additional equipment and Capex through high-level executive engagement. Drove aggressive design and install schedule to bring second tool online enabling increased rate of development and autonomous operations.
- Led organization through difficult transition during shutdown of crystal growing and wafering production. Safely decommissioned idled equipment, planned and executed consumable requirements needed for R&D operations, and implemented safety protocols for R&D team. Balanced recognition of achievements with focusing remaining team on business objectives through empathetic leadership from the heart.

ENGINEERING / PROCESS TECHNOLOGY MANAGER FOR CRYSTAL GROWING
MAR 2011 – JAN 2013

Led the US crystal growing engineering team, managing 9 process and equipment engineers. Drove the development of continuous process and equipment improvements to ensure efficiency and reliability in a 24/7 manufacturing environment.

- Drove data-driven decisions making through improved experimental design and data analysis. Developed comprehensive yield metrics data package and standardized process and equipment changes, leading to more robust data collection within department as well as better integration of information from downstream processes. Delivered a 9% increase in total yield, a 15% productivity improvement, and a 38% reduction in cost per unit of good-for-product material.
- Led implementation of process control systems for department. Deployed SPC charts on the production floor with associated response plans for critical to quality metrics, incoming materials, and equipment deviations. Consequently, operations responded more quickly and effectively to out of control events, engineers improved containment of both incoming materials and grown ingot quality issues, and equipment related process deviations were reduced.
- Fostered crystallization technology exchange collaboration within global company. Welcomed colleagues from Germany for extended stays and sent engineers overseas for special projects, arranged joint seminars by crystallization specialists, and hosted quarterly virtual workshops.

SENIOR PROCESS ENGINEER
FEB 2009 – FEB 2011

Significantly improved the quality of materials and reduced the cost of producing mono-crystalline silicon by executing experiments and analyzing production data. Led thermal modeling activities and cost-benefit analysis for process and equipment improvements.

- Led global cross-functional R&D teams in investigation of light induced degradation (LID) as local project manager. Defined strategies to reduce LID by up to 80% and implemented production monitoring of LID at the Hillsboro site.
- Optimized crystal growth recipe, increasing productivity 20% and total yield by 6% and decreasing oxygen levels by 20%.

MIT LINCOLN LABORATORY, Lexington, MA
Feb 2003 - Feb 2009
TECHNICAL STAFF MEMBER

Worked with interdisciplinary teams to solve complex engineering challenges for DoD, NASA, and other agencies. Responsible for mechanical design, project management, and extensive experimental field testing. Team Excellence and Appreciation awards on multiple projects.

- Managed mechanical design project team for 2nd generation airborne optical sensor. Developed prototype and managed production of operational units to meet aggressive delivery dates.

- Performed aircraft integration and flight testing of experimental sensors on NASA's WB-57 and Scaled Composites' Proteus aircraft. Performed maintenance, repairs, aircraft integration, flight testing, and data analysis. Identified and resolved root causes of issues. Liaised between internal teams and NASA personnel. Evolved to system engineer and field-team lead for the program.
- Designed thermal control for airborne sensor system. Successful redesign for new aircraft with minimal hardware changes.
- Designed chip packaging for state-of-the art CCD optical sensor and optimized mounting process.
- Developed analyses, trade studies, and conceptual designs for airborne sensors from advanced radar technologies to novel optics.
- Tools: MS Office, VBA, Origin, Solid Designer, Matlab

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

Jul 1997 - Dec 2002

RESEARCH ASSISTANT

Performed NASA-funded experimental research on identifying the nature and origin of the critical native point defect in photorefractive bismuth silicate by growing and analyzing crystals.

- Developed and characterized crystal growth system including hardware, software, and process parameters.
- Performed reduced gravity experiments on wetting behavior aboard NASA KC-135 aircraft.

CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH

Jun 1993 - Dec 1996

RESEARCH ASSISTANT

Performed NASA-funded experiments investigating effects of microgravity on germanium and gallium arsenide crystal growth.

- Designed and built crystal growth system with interface demarcation capability. Grew and analyzed single crystals to determine current-induced growth rate changes using optical and atomic force microscopy.
- Principal Investigator's Science Team member, supporting experiment that flew on the space shuttle Columbia (USML-2, STS-73).

EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT), Cambridge, MA

PhD in Mechanical Engineering (Feb 2003)

CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH

MS (Jan 1997) and BS (Summa Cum Laude, May 1995) in Mechanical Engineering

PROFESSIONAL DEVELOPMENT

Corporate Responsibility Foundation Course (2017), Agile Project Management (2016), TWI Job Instruction Training (2016), Situational Leadership II (2013), Senior Leadership Development Program (SolarWorld, 2012), VOICES Leadership Forum for Emerging Women Leaders (2011/2012)

ADDITIONAL INFORMATION

Native German speaker • Board of Directors, German International School (Beaverton, OR) • Board of Directors, Home Owner's Association • Member, Ninety-Nine Girlfriends (Collective Giving organization) • Outdoor enthusiast and athlete

PUBLICATIONS**Peer reviewed**

Wiegel, M.E.K., and Piotr Becla. "Comparative Analysis of Electro-Optic Properties in Bismuth Silicate Grown by the Czochralski, Bridgman-Stockbarger, and Hydrothermal Methods." Optical Materials, 26 (2004) 471-478.

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Presentations

M. Ramsey, M. Dietrich, G. Fischer, B. Freudenberg, M. Hollatz, M. Müller, M. Reinecke, B.Seipel, J. Stenzenberger, "Silicon Crystallization in PV - the Race Continues between Different Techniques." Deutsche Kristallzüchtungstagung in Freiberg, Germany (Mar 2012).

Wiegel, M.E.K., and Piotr Becla. "Comparative Analysis of Electro-Optic Properties in Bismuth Silicate Grown by the Czochralski, Bridgman-Stockbarger, and Hydrothermal Methods." 3rd International Symposium on Laser and Nonlinear Optical Materials in Keystone CO (Jul 2003).

- Wiegel, M.E.K. "Investigation of the Relationship between Growth Conditions and Defect Incorporation in Bismuth Silicate ($\text{Bi}_{12}\text{SiO}_{20}$) Grown in a Vertical Bridgman-Stockbarger Furnace." American Conf. on Crystal Growth, Keystone CO (Jul 2003).
- Wiegel, M.E.K. and August F. Witt, "Vertical Bridgman Stockbarger Growth of BSO ($\text{Bi}_{12}\text{SiO}_{20}$): Melt stability and defect formation in a ground-based environment." American Conf. on Crystal Growth and Epitaxy, Burlington, VT (Aug 2001).
- Wiegel, M.E.K., "Determination of the Peltier Coefficient in Germanium in a Vertical Bridgman-Stockbarger Furnace." American Conference on Crystal Growth and Epitaxy, Vail, CO (Aug, 1996).
- Wiegel, M.E.K., "Determination of the Peltier Coefficient in Germanium and Gallium Arsenide." Region V Student Conference of the American Society of Mechanical Engineers, Toronto, Canada (Apr 1996).
- Wiegel, M., "Growth of Gallium Arsenide in Microgravity to Study the Dopant Segregation Behavior." Region V Student Conference of the American Society of Mechanical Engineers, Kalamazoo, MI (Apr 1995).

Posters

- Wiegel, M.E.K. "Growth and Defect Analysis of Czochralski Grown Bismuth Silicate ($\text{Bi}_{12}\text{SiO}_{20}$)." Presented at the 15th American Conference on Crystal Growth in Keystone CO (Jul 2003).
- Wiegel, M.E.K. and August F. Witt. "Design Issues of Microgravity Oxide Single Crystal Growth Experiments: Bismuth Silicate ($\text{Bi}_{12}\text{SiO}_{20}$)." Presented at the 1st International Conference on Microgravity in Sorrento, Italy (Sep 2000).
- Wiegel, M.E.K. and August F. Witt. "Wetting Behavior and Interaction of Bismuth Silicate ($\text{Bi}_{12}\text{SiO}_{20}$) on Platinum/5% Gold Substrates". Presented at the 12th American Conference on Crystal Growth and Epitaxy in Vail, CO (Aug 2000).
- Wiegel, M.E.K. and Simone Hochgreb. "Chemically Inhibited Laminar Jet Diffusion Flames in Microgravity". Presented at the 27th Bi-annual Conference of the Combustion Institute in Boulder, CO (Aug 1998).

*** *References Available Upon Request* ***