

# SERGIO CASTELLANOS

California Institute for Energy and Environment  
Renewable and Appropriate Energy Laboratory, Energy and Resources Group  
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## EDUCATION

- 2009–2015 **Massachusetts Institute of Technology**, Cambridge, MA, USA  
*Ph.D. and M.Sc. in Mechanical Engineering at the Photovoltaic Research Laboratory.*  
Coursework in Energy Economics and Policy, Data analysis (STATA), and Spatial analysis (ArcGIS).  
Ph.D. Thesis: “Electrical impact assessment of dislocations in silicon materials for solar cells”  
M.Sc. Thesis: “Application of infrared birefringence imaging for measuring residual stress in multicrystalline, quasi mono, dendritic web, and string ribbon silicon for solar cells”.  
Thesis Advisor: Prof. Tonio Buonassisi
- 2006–2008 **The University of Arizona**, Tucson, AZ, USA  
*B.Sc. in Mechanical Engineering. Magna Cum Laude*

## ACADEMIC EXPERIENCE

- 2016– **California Institute for Energy and Environment at University of California, Berkeley**, Berkeley, CA, USA  
*Research Professor; Director of the Berkeley-Mexico Energy & Climate Change Initiative (Nov ‘17–present)*
- Lead institute efforts between Berkeley and Mexico on sustainable energy, low-carbon transportation, and climate action.
  - Manage bi-national R&D grant between Mexico-USA universities involving 5 projects, for a total approved budget of \$3.7 M (USD) to study renewable energy technologies, grid-integration policies, and carbon capture studies.
- BECI–ITESM Energy Research Fellow in BECI and the Renewable & Appropriate Energy Laboratory*  
Advisors: Prof. Daniel M. Kammen, Prof. Paul K. Wright, Dr. Carl Blumstein (Jan ‘16–Oct ‘17)
- Lead 2 research projects between academic institutions (MIT, UC Berkeley, Tec de Monterrey) in:
    - (1) Developing an open-source capacity expansion model to optimize for low cost the investment in power generation and transmission assets in the electric grid.
    - (2) Analyzing the opportunities along the value chain in solar photovoltaic manufacturing in Mexico via techno-economic and supply chain models.
- 2009–2015 **Massachusetts Institute of Technology**, Cambridge, MA, USA  
*Graduate Research Assistant and Postdoctoral Research Associate*
- Co-authored 13 peer-reviewed articles, filed for a patent, selected as journal reviewer, and presented at 11 technical conferences and workshops.
  - Lead bi-national R&D grant proposal between Mexico-USA universities, involving 5 professors, government officers, and a consulting agency, for a total approved budget of \$600 K (USD) to study thin-film solar cells.
  - Co-led the organization of the 1<sup>st</sup> workshop “Solar Energy Tech & Innovation in Mexico ‘15” in Mexico.

## SELECTED JOURNAL PUBLICATIONS

- S. Castellanos**, J.E. Santibáñez-Aguilar, B.B. Shapiro, D.M. Powell, I.M. Peters, T. Buonassisi, D.M. Kammen, A. Flores-Tlacuahuac, “Sustainable silicon photovoltaics manufacturing in a global market: a techno-economic, tariff, and transportation framework”, *Applied Energy*, **212**, 704-719 (2018).
- S. Castellanos**, D.A. Sunter, D.M. Kammen, “Rooftop solar photovoltaic potential in cities: how scalable are assessment approaches?”, *Environmental Research Letters*, **12**, 125005 (2017).

M. Kivambe, D.M. Powell, **S. Castellanos**, M.A. Jensen, A.E. Morishige, B. Lai, R. Hao, T.S. Ravi, T. Buonassisi, “*Characterization of high-quality kerfless epitaxial silicon for solar cells: defect sources and impact on minority-carrier lifetime*”, *Journal of Crystal Growth*, <https://doi.org/10.1016/j.jcrysgro.2017.11.016> (2017).

**S. Castellanos**, M. Kivambe, M.A. Jensen, D.M. Powell, K. Nakajima, K. Morishita, R. Murai, T. Buonassisi, “*Exceeding 3 ms minority-carrier lifetime in n-type non-contact crucible silicon*”, *Energy Procedia*, 779-784 (2016).

S. Woo, M.I. Bertoni, K. Choi, S. Nam, **S. Castellanos**, D.M. Powell, T. Buonassisi, H. Choi, “*An insight into dislocation density reduction in multicrystalline silicon*”, *Solar Energy Materials and Solar Cells*, **155**, 88-100 (2016).

**S. Castellanos**, K.E. Ekstrøm, A. Autruffe, M.A. Jensen, A.E. Morishige, J. Hofstetter, P. Yen, B. Lai, G. Stokkan, C. del Cañizo, T. Buonassisi, “*High-performance and traditional multicrystalline silicon: comparing gettering responses and lifetime-limiting defects*”, *IEEE Journal of Photovoltaics*, **6**, (3), 632-640 (2016).

D.M. Powell, V.P. Markevich, J. Hofstetter, M.A. Jensen, A.E. Morishige, **S. Castellanos**, B. Lai, A.R. Peaker, T. Buonassisi, “*Exceptional gettering response of epitaxially grown kerfless silicon*”, *Journal of Applied Physics* **119**, 065101 (2016).

**S. Castellanos**, T. Buonassisi, “*Dislocation density reduction limited by inclusions in kerfless high-performance multicrystalline silicon*”, *Phys. Status Solidi RRL* **9**, 503-506 (2015).

J. Hofstetter, C. del Cañizo, H. Wagner, **S. Castellanos**, T. Buonassisi, “*Material requirements for the adoption of unconventional silicon crystal and wafer growth techniques for high-efficiency solar cells*”, *Prog. Photovolt: Res. Appl.* (2015) DOI: 10.1002/pip.2699.

K. Choi, **S. Castellanos**, D.M. Powell, T. Buonassisi, H. Choi, “*Dislocation density reduction in multicrystalline silicon via cyclic annealing*”, *Phys. Status Solidi A*, **1-7** (2015).

M. Kivambe, D.M. Powell, **S. Castellanos**, M.A. Jensen, A.E. Morishige, K. Nakajima, K. Morishita, R. Murai, T. Buonassisi, “*Minority-carrier lifetime and defect content of n-type silicon grown by the noncontact crucible method*”, *Journal of Crystal Growth* **407**, 31-36 (2014).

**S. Castellanos**, M. Kivambe, J. Hofstetter, M. Rinio, T. Buonassisi, “*Variation of etch-pit geometry: An indicator of bulk microstructure and recombination activity in multicrystalline silicon*”, *Journal of Applied Physics* **115**, 183511 (2014).

V. Ganapati, S. Schoenfelder, **S. Castellanos**, S. Oener, R. Koepge, A. Sampson, M.A. Marcus, B. Lai, H. Morhenn, G. Hahn, J. Bagdahn, T. Buonassisi, “*Infrared birefringence imaging of residual stress and bulk defects in multicrystalline silicon*”, *J. Appl. Phys.* **108**, 063528 (2010).

## **TEACHING AND RESEARCH SUPERVISION**

### **University of California, Berkeley**

#### **Teaching**

- Energy & Resources Group (ERG) and Goldman School of Public Policy  
*Energy and Society* (Professor Daniel Kammen); Guest Lecturer for “Environmental Justice”, Fall 2017
- Reviewer for 2 online teaching classes (mini massive open online courses) focused on (1) Sustainable energy transition, and (2) Solar PV technologies, at <https://minimooocs.clubesdeciencia.mx>, 2017.

#### **Mentoring**

- M.Sc. Thesis committee member for Energy Engineering student’s defense at Tec de Monterrey, México, 2017.
- M.Sc. Thesis co–advisor for Electrical Engineering and Computer Science student at UC Berkeley, 2017–2018.
- Research Leader for United Nation’s Data for Climate Action Challenge Team (Grand Prize Winner): “Electromobility in Mexico City” in partnership between UC Berkeley and Mexico’s Institute for Ecology and Climate Change (INECC), 2017.
- Research mentor for 3 master students, 21 undergraduate students and 1 high school student on energy, transportation, and environmental justice projects, 2016–2018.
- Raised \$21K (USD) for students’ financial support, 2016–2017.

## Massachusetts Institute of Technology

### Mentoring

- MIT 2.626 “Fundamentals of Photovoltaics”. Final class project mentor for 8 students on “Solar PV implementation in Mexico”. Presented results to government officials, 2014.

## LEADERSHIP AND AWARDS

### Post-Graduate

- 1<sup>st</sup> place – Grand Prize winning team, *United Nations Global Pulse: Data for Climate Action Challenge*, International competition (450 participants), Work on Electro-mobility solutions for Mexico City, 2017
- Awarded +\$15 K (USD) in equipment donation by WesternDigital Company to pursue Electro-mobility research.
- 1<sup>st</sup> place – Winning team, *Berkeley Energy and Resources Collaborative’s Cleanweb Hackathon*, Work on solutions to reduce acquisition costs for solar rooftop PV, 2016
- BECI–ITESM Energy Fellowship, 2016–2018

### Graduate

- 2<sup>nd</sup> place – *MIT Mechanical Engineering de Florez Award Competition (Graduate Science Category)*, 2015
- Best Poster Award – *IEEE Photovoltaic Specialist Conference*, 2014
- Co-President – *MIT Mexican Students Association*, 2012–2014
- Co-Chair – Alumni and External Relations, *MIT Energy Club*, 2014–2015
- Chair – Solar Community, *MIT Energy Club*, 2012–2014
- Student Recognition Award – *Crystalline Silicon Solar Cells Workshop*, 2013
- Roberto Rocca Fellowship (1 out of 12 from a total of 7 countries), 2010
- Director – Energy Night Content, *MIT Energy Club*, 2009
- MIT Conflict Manager (Certified)
- Liaison responsible for raising \$5K (USD), “*Clubes de Ciencia*”, a US-Mexico educational organization.

### Undergraduate

- German Academic Exchange Service (DAAD) Scholarship for research on organic/inorganic solar cells in Duisburg-Essen University, 2008.
- Competed at EPA’s National “P3”. Technical Lead: built a solar-powered magnetohydrodynamic generator.
- Competed at DOE’s International “Solar Decathlon”. Engineering Lead: sized energy loads in sustainable house.
- Founder of non-profit organization (PROGRESOL) that distributed solar-based cooking ovens in rural Mexico.

## SERVICE IN SCHOLARLY JOURNALS AND INTERNATIONAL REPORTS

- Journal Reviewer: Energy Policy, Applied Energy, IEEE Journal of Photovoltaics, Advanced Sustainable Systems, American Institute of Physics (AIP) Advances, Crystals, Applied Sciences, Energies, Physica Status Solidi a.
- International Panel on Climate Change – Expert reviewer for the Special Report on Global Warming of 1.5°C.

## CONFERENCE PROCEEDINGS

**S. Castellanos**, A. Pasos-Trejo, P. Sánchez-Pérez, M. Torres, A. Monroy-Tellez, J. Johnston, A. Jain, F. James-Langer, D. Ponce de Leon, D.M. Kammen, “Modeling high penetration of solar PV and renewables in the grid: A case for México”, 45<sup>th</sup> *IEEE Photovoltaic Specialists Conference*, Waikoloa, HI (2018).

**S. Castellanos**, J.E. Santibáñez-Aguilar, B.B. Shapiro, D.M. Powell, I.M. Peters, T. Buonassisi, D.M. Kammen, A. Flores-Tlacuahuac, “Sustainable silicon photovoltaics manufacturing in a global market: a techno-economic, tariff, and transportation framework with an applied case for México”, 45<sup>th</sup> *IEEE Photovoltaic Specialists Conference*, Waikoloa, HI (2018).

**S. Castellanos**, T. Buonassisi, “Quantitative residual stress imaging of multicrystalline, quasi-Mono, and thin kerfless silicon wafers by infrared birefringence and sectioning”, 39<sup>th</sup> *IEEE Photovoltaic Specialists Conference*, Denver, CO (2014).

V. Ganapati, S. Schoenfelder, **S. Castellanos**, S. Oener, T. Buonassisi, “Infrared birefringence imaging of residual

stress and bulk defects in multicrystalline silicon”, 35<sup>th</sup> *IEEE Photovoltaic Specialists Conference*, Honolulu, HI (2010)

S. Castellanos, M.I. Bertoni, M. Vogl, A. Fecych, T. Buonassisi, “Stress and temperature coupling effects on dislocation density reduction in multicrystalline silicon”, 35<sup>th</sup> *IEEE Photovoltaic Specialists Conference*, Honolulu, HI (2010)

## **SELECTED CONFERENCE PRESENTATIONS**

### **Invited & Oral**

- “Clean Transportation and Climate Impact: The Case for Electric-mobility in CDMX”. Keynote Speaker. *MIREC WEEK CONFERENCE 2018, Mexico City, Mexico*.
- COP23 International Renewable Energy Agency (IRENA) session on “Transport, Renewables & Climate: The Case for Electric-mobility in Mexico City”. *COP23 Conference of the Parties, 2017, Bonn, Germany*.
- “Electro-mobility: Cleaning Mexico City’s Air with Transformational Climate Policies through Big Data Pattern Analysis in Traffic and Social Mobility”. *Working Group: Identifying National Priorities on R&D, Technical and Human Resource Development to Reduce Fuel Consumption in Cities, 2017, Mexico City, Mexico*.
- “SWITCH–Mexico: Open Access Platform to Plan the National Electric Grid with High Penetration of Renewable Energy”. *Dialogues for the Future of Mexico’s Energy Sector (DEMEX), 2017, Mexico City, Mexico, and National Renewable Energy Laboratory (NREL)*.
- “Latest Events and Future Projections for the Solar Photovoltaics Manufacturing Sector”. Panel Discussion. *MIREC WEEK CONFERENCE 2017, Mexico City, Mexico*.
- “Solar Energy Worldwide and Future Prospective in Mexico amidst the Energy Reform”. *Grupo Fenosa, 2017, Mexico City, Mexico*.
- “Quantitative Residual Stress Imaging of Multicrystalline, Quasi-Mono, and Thin Kerfless Silicon Wafers by Infrared Birefringence and Sectioning”. *IEEE Photovoltaic Specialists 2014 Conference, Denver, CO*.
- “Correlation between Dislocation Microstructure, Recombination Activity, and Etch Pit Topology”. *Crystalline Silicon Solar Cell Conference 7; Fukuoka, Japan and Materials Research Society Fall 2013 Conference; Boston, MA*.
- “On the Observations of Dislocation Density Reduction in Multicrystalline Silicon”. *Materials Research Society Fall 2012 Conference; Boston, MA*.
- “Stress and Temperature Coupling Effects on Dislocation Density Reduction”. *IEEE Photovoltaic Specialist 2010 Conference; Honolulu, HI*.

### **Poster**

- “Modeling high penetration of solar PV and renewables in the grid: A case for México”, *IEEE Photovoltaic Specialists 2018 Conference, Waikoloa, HI*.
- “Sustainable Silicon Photovoltaics Manufacturing in a Global Market: A Techno-economic, tariff & Transportation Framework Applied in Mexico”. *IEEE Photovoltaic Specialists 2018 Conference, Waikoloa, HI; University of California Solar Symposium 2017, San Francisco, CA*.
- “Inferring Dislocation Recombination Strength in Multicrystalline Silicon via Etch Pit Geometry Analysis”. *IEEE Photovoltaic Specialists 2014 Conference, Denver, CO*.
- “Application of infrared Birefringence Imaging to Measure Residual Stress and Defect Distribution in Ingot Multicrystalline Silicon”. *National Renewable Energy Laboratory (NREL) 21<sup>st</sup> Workshop on Crystalline Silicon Solar Cells, Breckenridge, CO*.
- “Stress Analysis of Bulk Microdefects in Multicrystalline Silicon Solar Cell Wafers Using Infrared Birefringence Imaging”. *Materials Research Society Fall 2009 Conference; Boston, MA, and National Renewable Energy Laboratory (NREL) 20<sup>th</sup> Workshop on Crystalline Silicon Solar Cells; Breckenridge, CO*.

## PROFESSIONAL EXPERIENCE

- 2017– **Office of Science and Technology Information for Mexico’s Congress of the Union**  
**Oficina de Información Científica y Tecnológica para el Congreso de la Unión (INCyTU)**  
*Technical, Scientific, and Policy Analyst*
- Develop scientific-based reports on renewable energy, climate change mitigation, and sustainability topics to Mexico’s Legislative Chamber to support the establishment of data-driven public policies.
- 2017  
Fall **Working Group: “National Priorities on R&D, Technical and Human Resource Development to Reduce Fuel Consumption in Cities” lead by Centro Mario Molina, Mexican Institute of Petroleum, and Renewable Energies Institute**  
*Member and Panelist*
- Contribute in strategy discussions for establishing national R&D priorities to transition to sustainable cities development in Mexico.
- 2015  
Summer **Mexico’s National Energy Museum – Museo Nacional de Energía y Tecnología (MUNET)**  
*Consultant to the Planning Committee*
- Recommended solar energy-related content to be implemented in Mexico’s National Energy Museum (to be opened in 2018), given current, and future techno-economic projections.
- 2014  
Summer **Mexico’s Department of Energy – Secretaría de Energía de México (SENER), Ciudad de México, México**  
*Advisor to the Energy Planning and Transition section of the Mexican Energy Secretariat*
- Supported drafting the vision, objectives and research thrusts of two national research centers focused on Bioenergy and Ocean energy, with approved budgets of above \$60 M (USD).
- 2008  
Fall **GLHN Architects & Engineers, Inc., Tucson, AZ, USA**  
*HVAC Engineering Intern*
- Estimated building load consumptions and, through data-driven analysis, proposed a variety of energy-efficient equipment to be installed. Interacted in a multidisciplinary and fast-paced team.
- 2008  
Summer **Technicians for Sustainability, LLC., Tucson, AZ, USA**  
*Solar PV Systems Installer*
- Installed rooftop PV systems in residential and commercial buildings.

## CONTINUING EDUCATION

- 2018 **UDacity: “Machine Learning” Nanodegree**, Online
- *Data science course*: Developed python-based scripts for data wrangling and database use to generate insights from large datasets by using Machine Learning algorithms.
- 2017 **FORM+FUND Certificate Workshop on Startups and Innovation by Startup@BerkeleyLaw**
- *Startup and Innovation Principles workshop series*: Studied best practices to form startups and raise capital to bring academic ideas to the real world.
- 2017 **S&P Global Market Intelligence: “Analyst in the Power and Gas Sectors”**, NYC, New York, USA
- *Immersive power and energy markets analysis training course*: Studied industry performance metrics, energy market drivers, and factors impacting diverse value chains segments.
- 2015 **Harvard School of Arts and Science’s with Harvard Business School: Mini-MBA**, Cambridge, MA, USA
- *Immersive mini-MBA program*: Case-based set of 11 sessions on Finance, Operations, Economics, Strategy, Accounting, Ethics, Marketing, and Organizational Behavior.

## **OTHER SKILLS**

- Languages: Fluent in English and Spanish; Elementary French and German.
- Emergency Medical Technician (Volunteer) at Mexican Red Cross:
  - PHTLS certified, Aquatic Rescue Squad member, and automobile-trapped 'Jaws of Life' tool operator.
  - Constantly lead crew of firefighters, cops, and EMTs under high pressure and risky environments.

## **MEDIA**

- Coverage of Postdoctoral work on Big Data & Electro-mobility recognized by UN and featured in news media online, including "Businesswire", "Wired Insider", "Datamakespossible", "El Financiero", "UN GlobalPulse", and "Udacity Blog".
- Coverage of Ph.D. research work featured in 40+ news media globally, including "Phys.org", "La Jornada", and "Solar Novus".
- Quoted by Royal Society of Chemistry in <https://www.chemistryworld.com/news/pollutant-particles-prevent-solar-cells-from-reaching-full-potential/3009460.article>