



End-User Needs in Puerto Rico for Microreactors

Presented by Eddie M. Guerra, PE
Senior Engineer, Arup
Idaho National Laboratory
June 18, 2019





Background on Puerto Rico Energy Sector



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Ongoing efforts in
Puerto Rico for
Advanced Nuclear



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End-user needs in Puerto Rico



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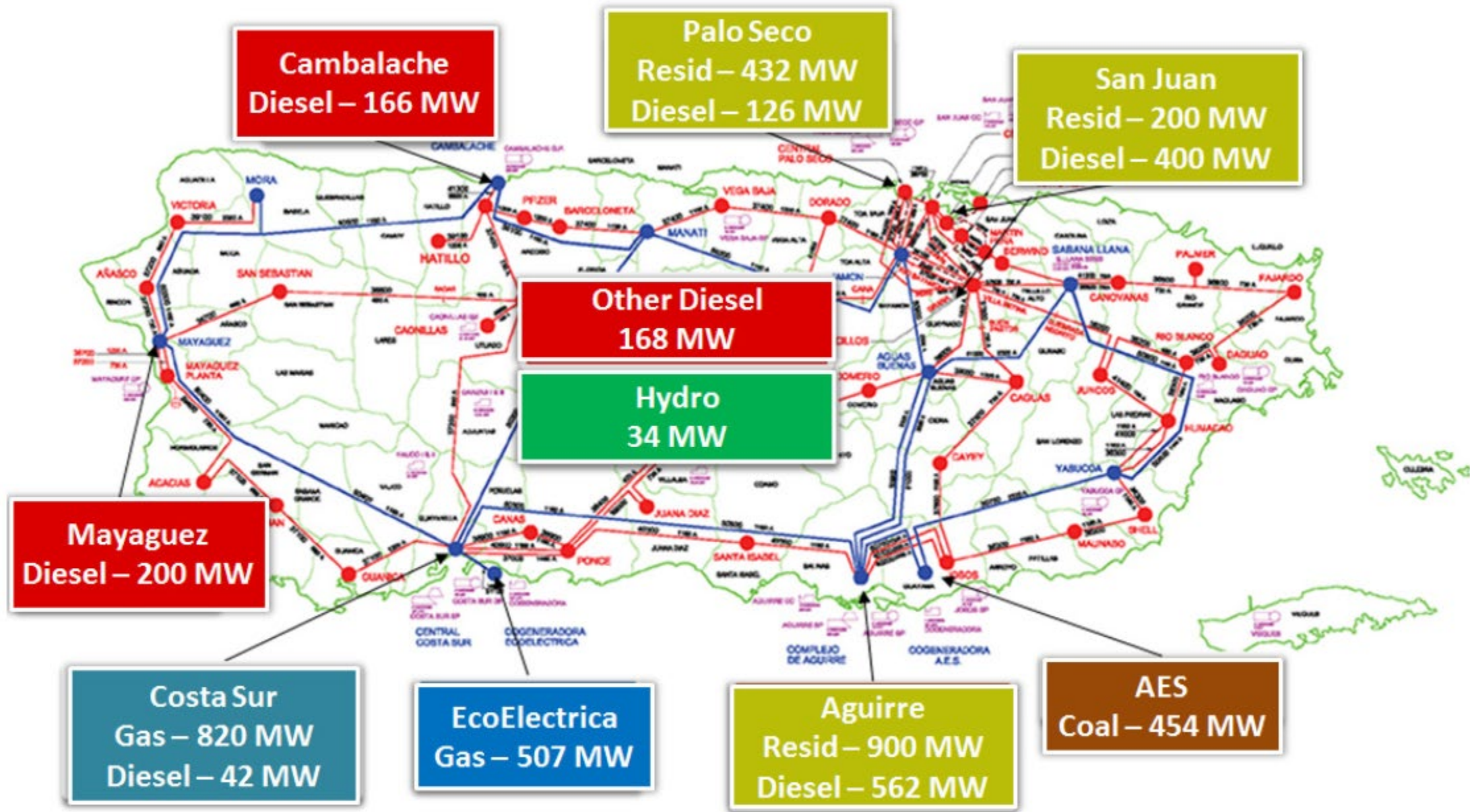


Background on Puerto Rico Energy Sector



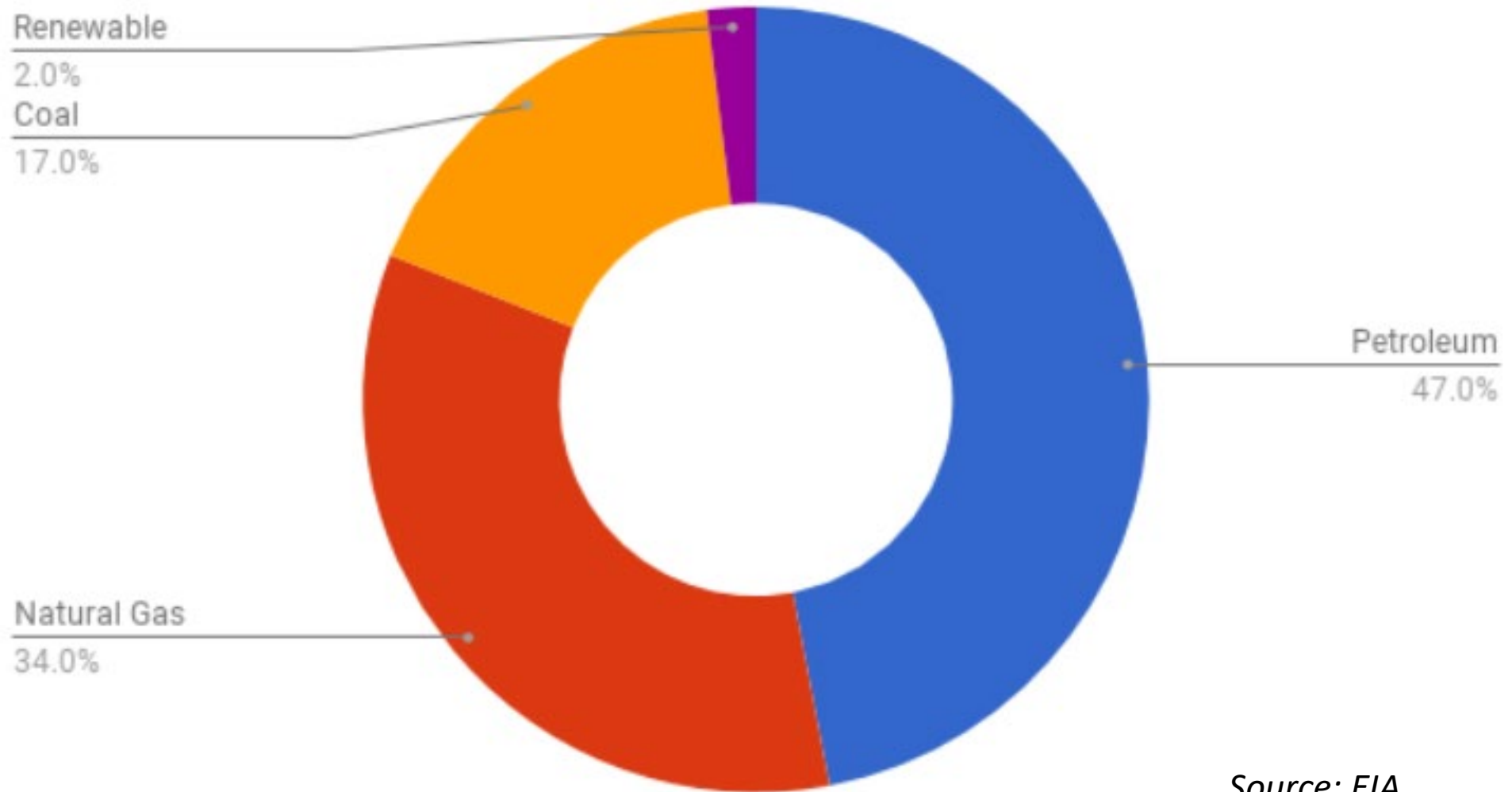
U.S. ARMY





Source: PREPA, Siemens

Puerto Rico's Sources of Energy Generation



Source: EIA



✓ Retirement/Replacement of more than 4,000 MW of installed fossil fuel generation [source: PREPA]

Financial and Oversight Board

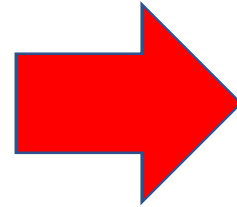
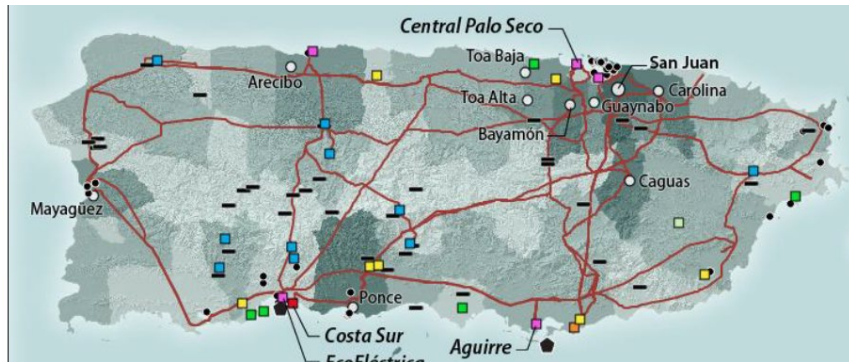
- ✓ Financial Oversight and Management Board (H.R.5278-14th U.S. Congress) calls for energy projects with strong economic potential.



Key risks in the FY2017 forecast and issues to consider in FY2018

- **Little Cash Flow Visibility Outside of the TSA:** Certain component units with independent treasuries may experience deteriorating liquidity; improving this visibility will be a top priority for the Government
- **TRAN's:** Payments starting in April represent a significant cash flow outlay
- **Litigation Expenses:** After the expiration of the stay the Government is exposed to litigation, which costs are not in the projections
- **Pensions:** Liquid assets of the pension system are expected to be exhausted in early FY2018 or sooner, requiring higher contributions to the pension system or a switch to a full "pay-go" system with even higher future payments; the TSA cash flow herein assumes pension system transfers through FY2017
- **ACA Funds:** Significant risk of \$0.8 Bn in FY2018 (partial year impact), increasing to \$1.5 Bn in FY2019 and will continue to increase in future years
- **Special Revenue Funds:** Non budgeted funds with positive accounting balances without corresponding cash reserves could have a significant impact on liquidity

PREPAs Privatization



- ✓ All transmission and generation assets to be sold 2019-2020 timeframe.

Relevant trends in Puerto Rico: Independence from PREPAs Central Grid



Small co-generation LNG units
Hospital Concepcion,
Municipality of San German, Puerto Rico



Signing of Puerto Rico's First
Municipality Energy Consortium, Villalba, Puerto Rico

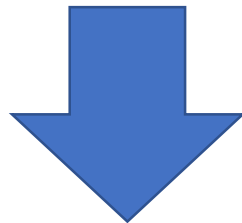
Background on Puerto Rico Energy Sector



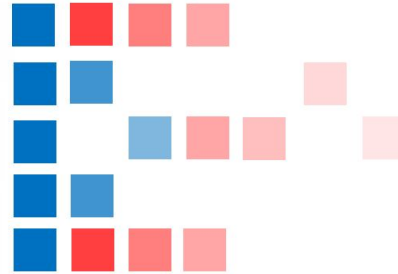
Ongoing efforts in
Puerto Rico for
Advanced Nuclear



Early community and leadership engagement



THE NUCLEAR ALTERNATIVE PROJECT



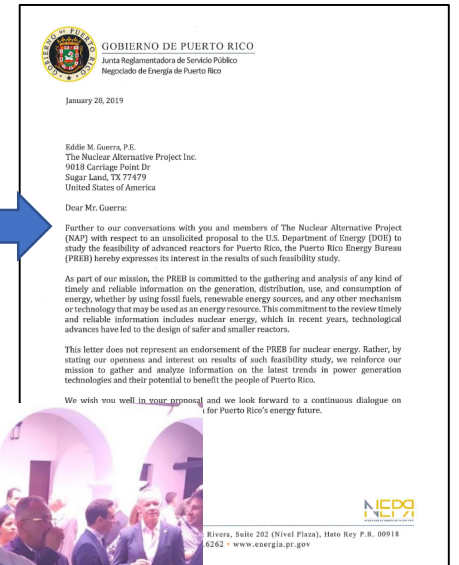
17mo Foro de Constituyentes de INESI

El tema del encuentro es la propuesta recientemente sometida para evaluar la energía nuclear para Puerto Rico.

Invitados: Proyecto Alternativa Nuclear y el Dr. Arjun Makhijani

miércoles, 13 de marzo de 2019
1:00pm - 4:00pm
Plaza Universitaria, UPR-Río Piedras
Torre Central, Salón 3123

UPR
Actividad libre de costo



January 28, 2019

Eddie M. Guerra, P.E.
The Nuclear Alternative Project Inc.
9018 Carriage Point Dr
Sugar Land, TX 77479
United States of America

Dear Mr. Guerra:

Further to our conversations with you and members of The Nuclear Alternative Project (NAP) with respect to an unsolicited proposal to the U.S. Department of Energy (DOE) to study the feasibility of advanced reactors for Puerto Rico, the Puerto Rico Energy Bureau (PREB) hereby expresses its interest in the results of such feasibility study.

As part of our mission, the PREB is committed to the gathering and analysis of any kind of timely and reliable information on the generation, distribution, use, and consumption of energy, whether by using fossil fuels, renewable energy sources, and any other mechanism or technology that may be used as an energy resource. This commitment to review timely and reliable information includes nuclear energy, which in recent years, technological advances have led to the design of safer and smaller reactors.

This letter does not represent an endorsement of the PREB for nuclear energy. Rather, by stating our openness and interest on results of such feasibility study, we reinforce our mission to gather and analyze information on the latest trends in power generation technologies and their potential to benefit the people of Puerto Rico.

We wish you well in your proposal and we look forward to a continuous dialogue on for Puerto Rico's energy future.

INESI
Riverside, Suite 202 (Nivel Plaza), Hato Rey P.R. 00918
6562 - www.esenergia.pr.gov



Proposal for Feasibility Study



Technical Advisory Board



Luis Reyes
Chair of the Board



Xenergy



NUSCALE



Westinghouse



GE HITACHI

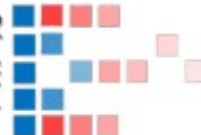


MEIC, LLC



UNIVERSITY OF HOUSTON

THE NUCLEAR
ALTERNATIVE
PROJECT



Overall plan moving forward



Early community and leadership engagement

Policy in Puerto Rico: Resolution 1189

Proposal for Feasibility Study

Overall plan moving forward



Early community and leadership engagement

Policy in Puerto Rico: Resolution 1189

Proposal for Feasibility Study

Early customer engagement

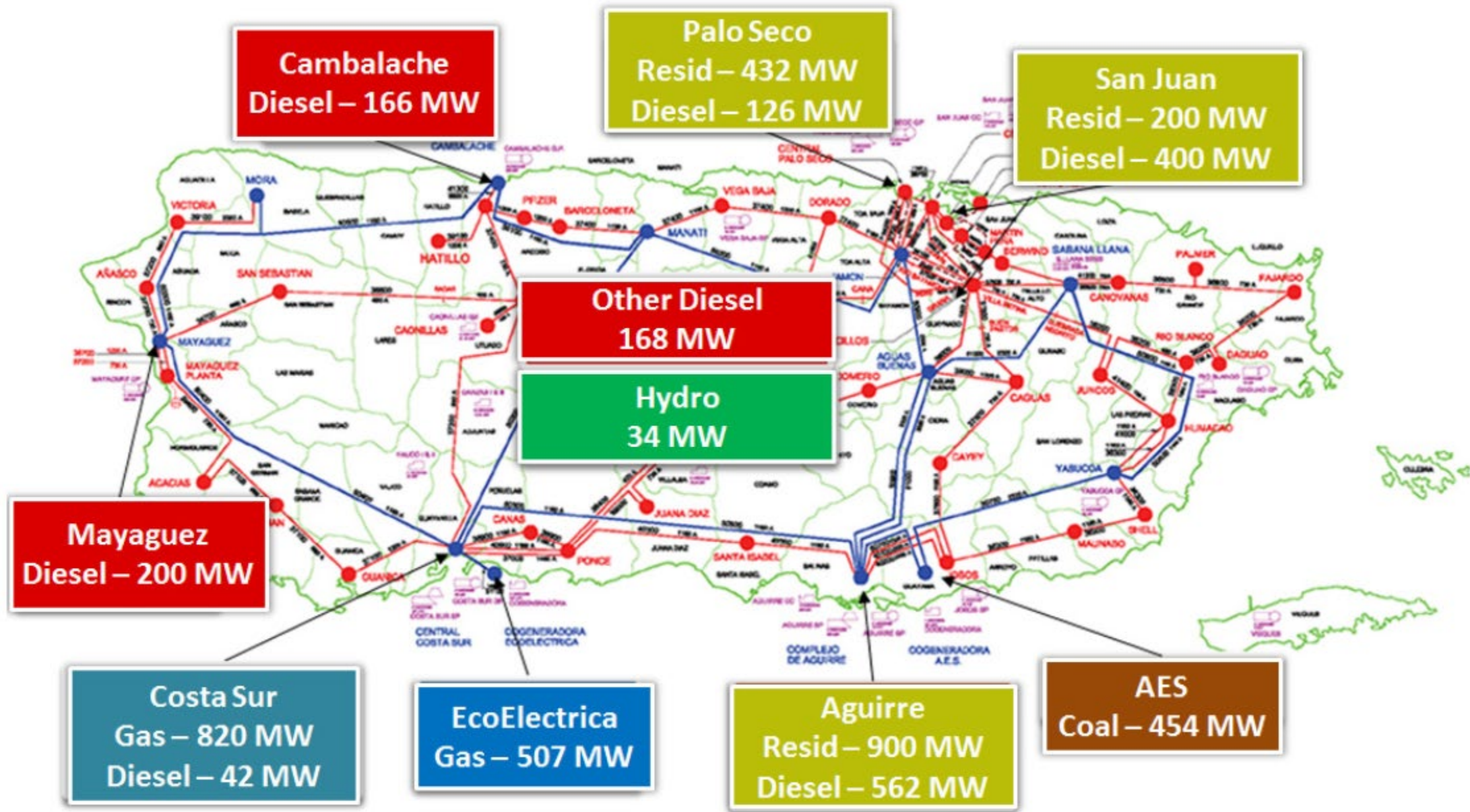
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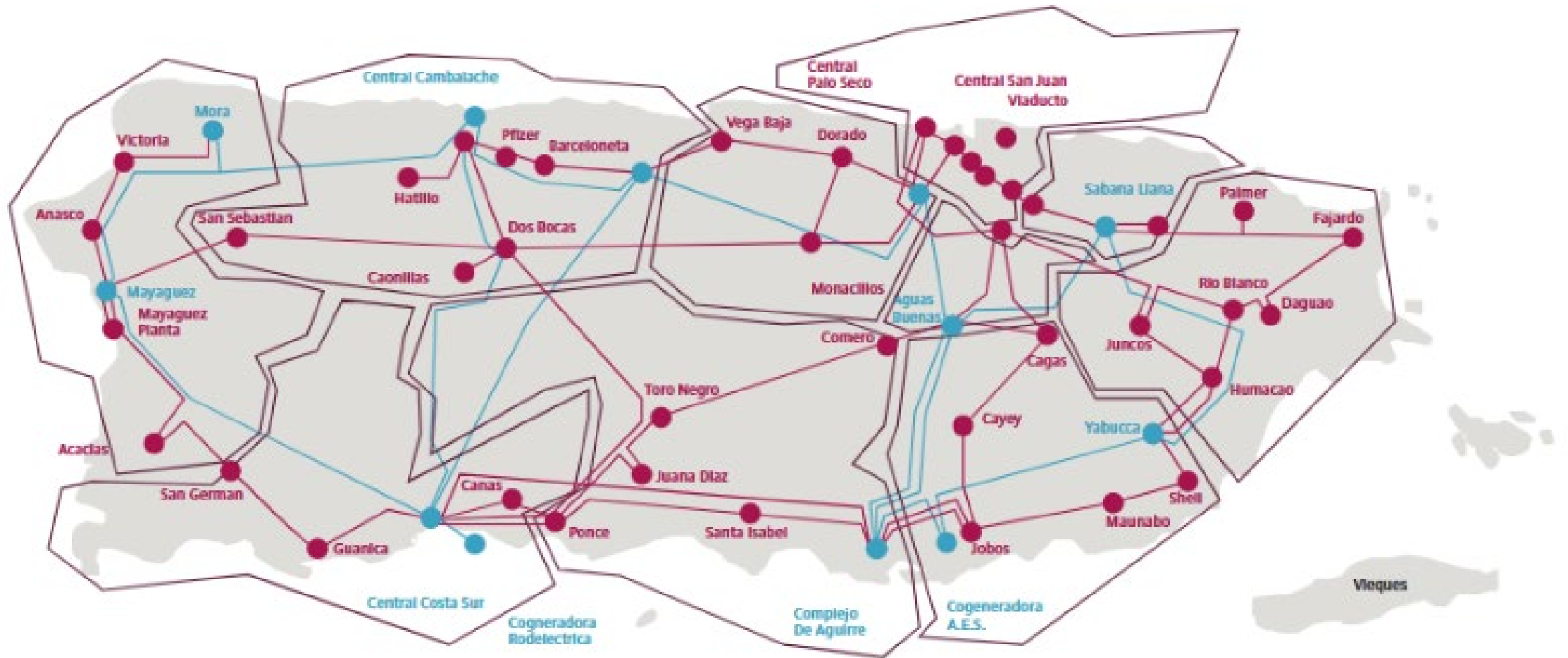
End-user needs in Puerto Rico





Source: PREPA, Siemens

Possible Mini-grid Coverage

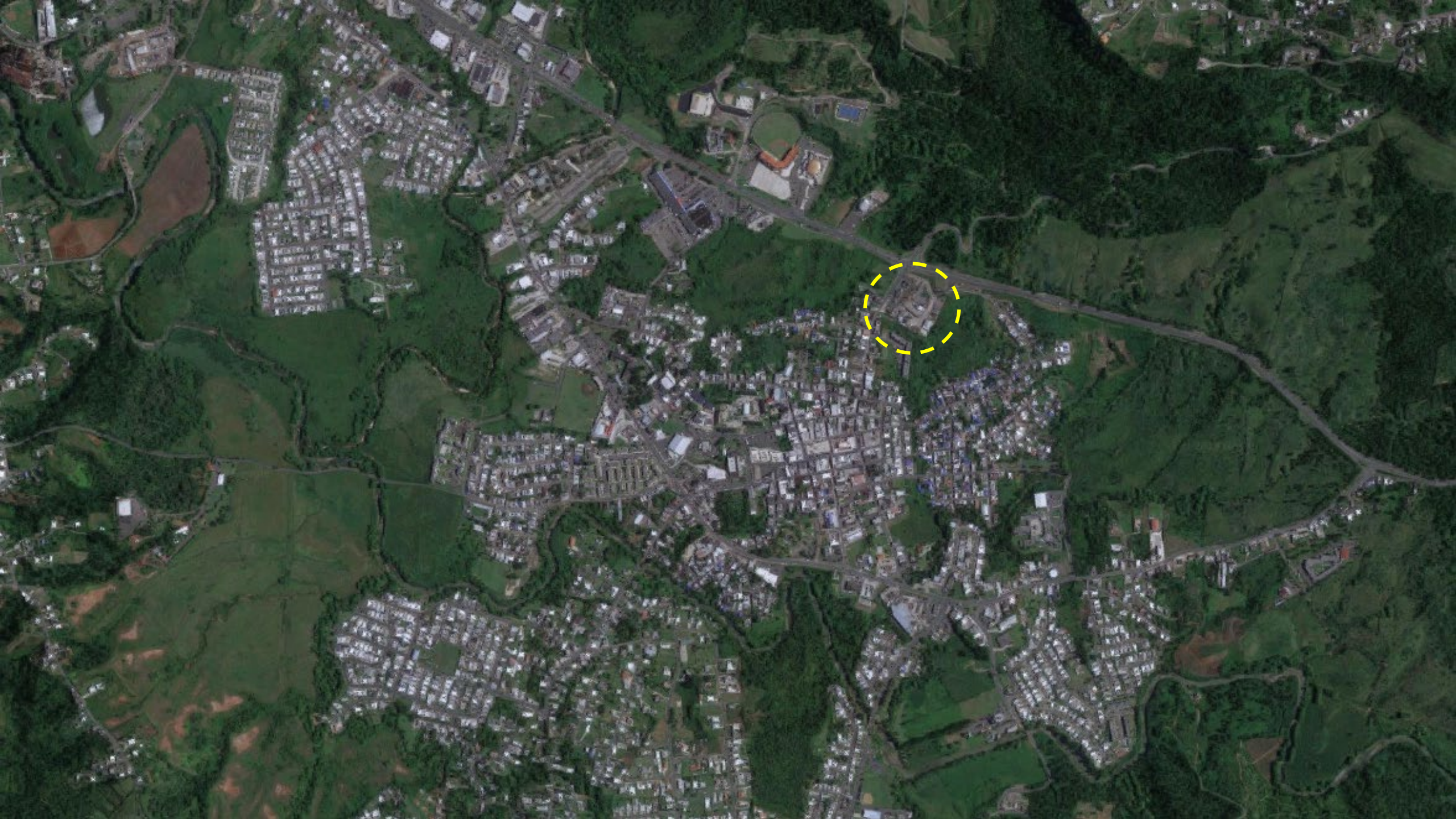


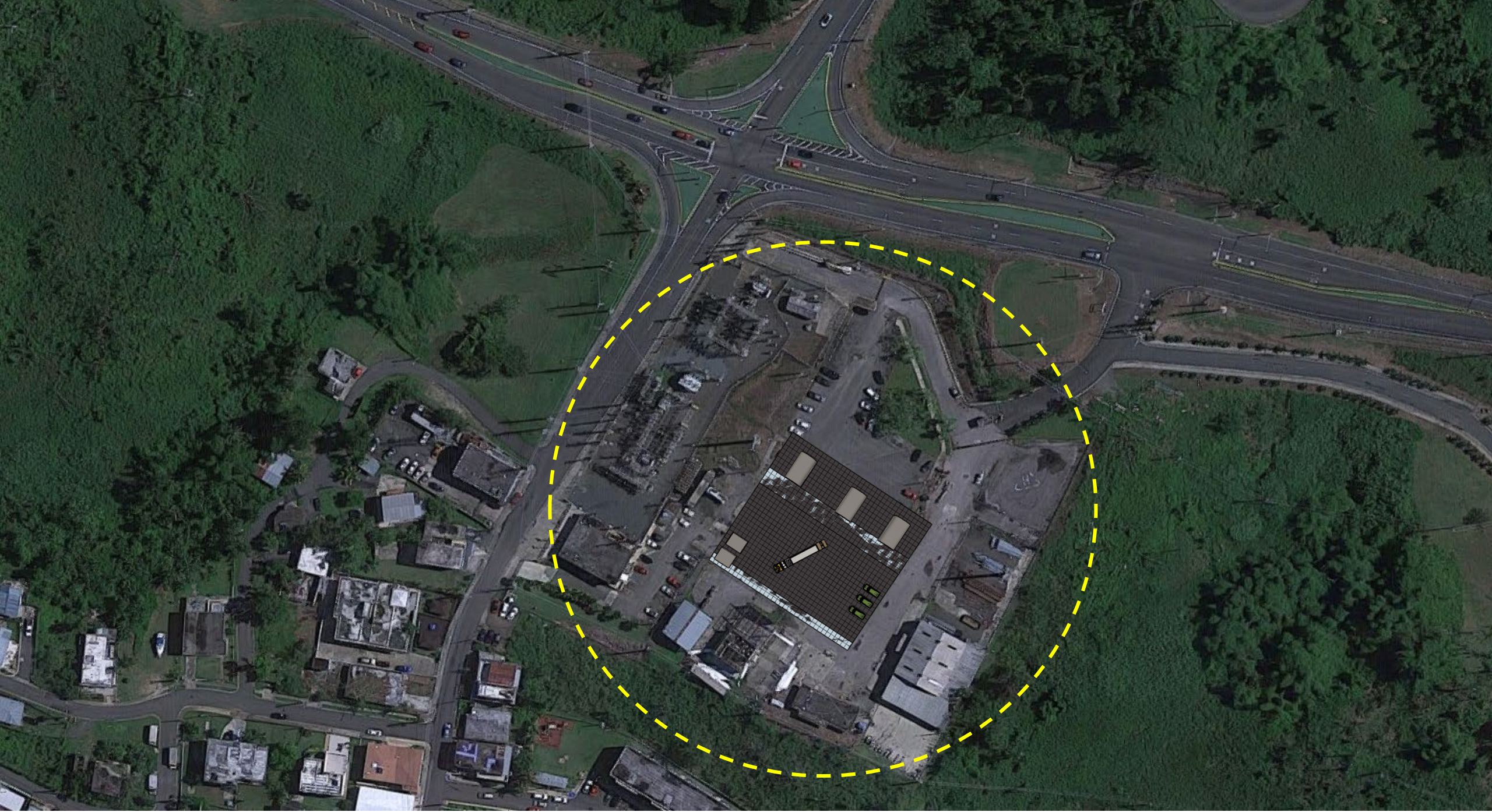
Resilient by Design: Enhanced Reliability and Resiliency for Puerto Rico's Electric Grid

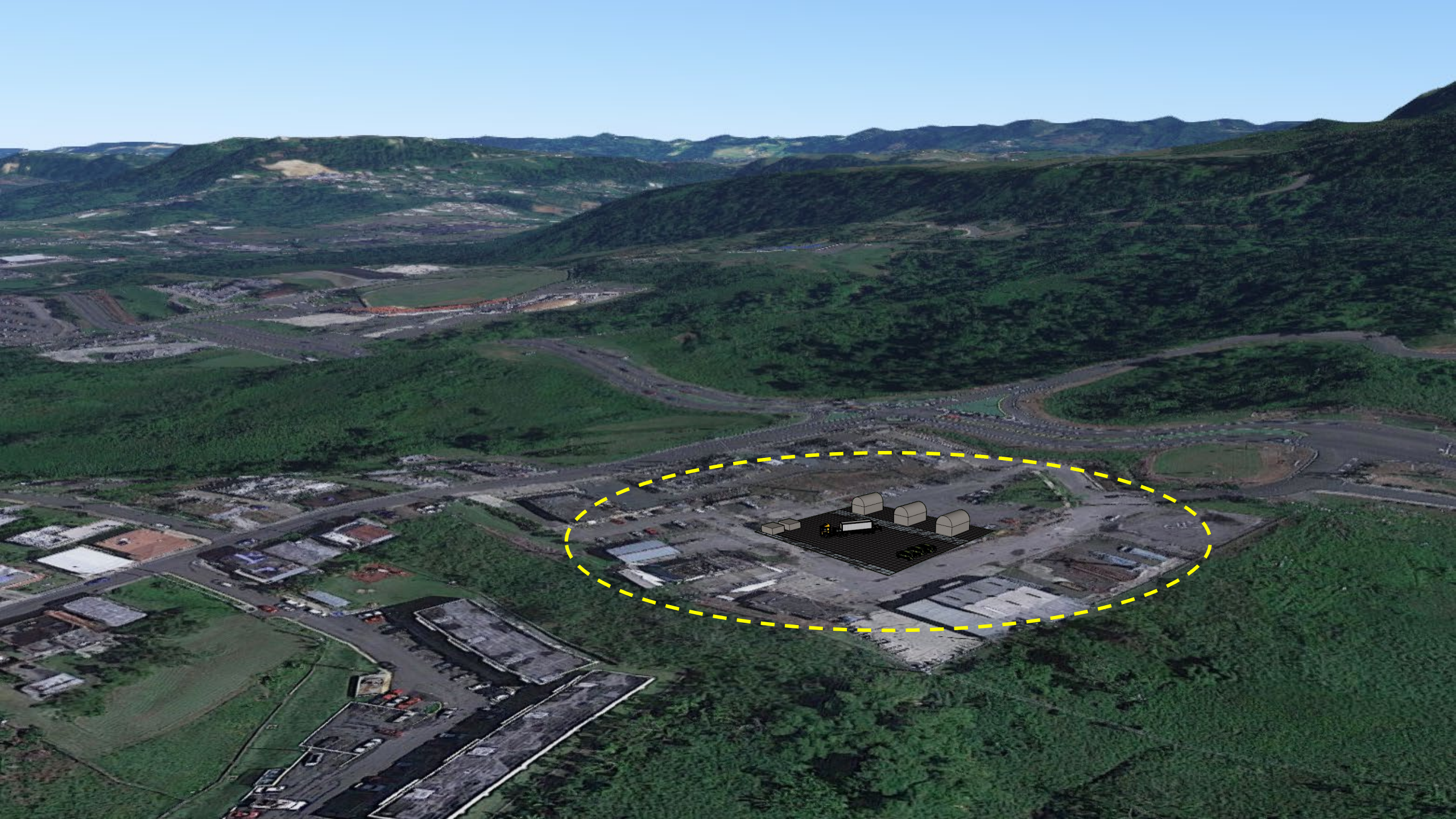
Siemens

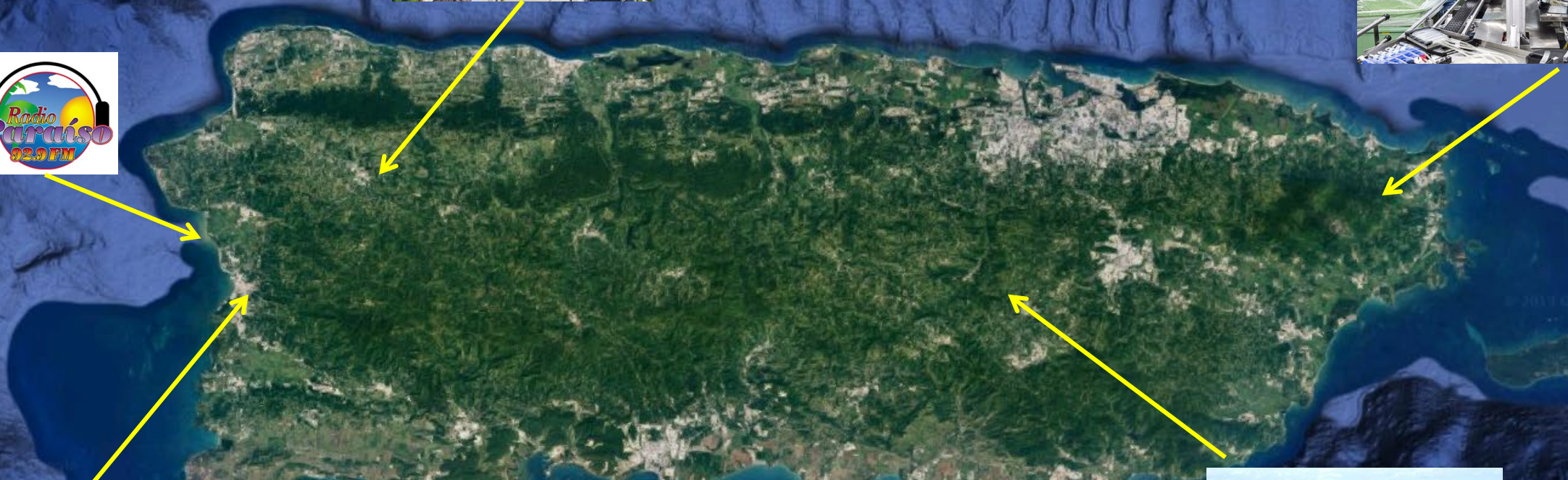
An aerial photograph of a city valley. In the foreground, there are several large industrial or commercial buildings, some with flat roofs and others with more complex structures. A road runs through the center of the valley. The middle ground is filled with residential housing, appearing as a dense cluster of smaller buildings. The background consists of rolling green hills and mountains under a clear blue sky. The overall scene is a mix of urban development and natural landscape.

Microgrid integration + Optimal City Resiliency Index









Pharmaceutical – Facility in Town of Fajardo, Puerto Rico

- 250,000 sqft facility
- It took 4 weeks to restart the Site, and another 4-5 months to reach normal operation levels (full PREPA supply).
- losses due to facilities repairs and production loss in the range of \$1.5-2.0 MM
- Connected to PREPA's grid 7/24 through a 32kV distribution line
- Two (2) diesel fuel generators, 2.5MW each



Pharmaceutical – Facility in Town of Fajardo, Puerto Rico

- Looked at alternative of LPG-fed, modular micro-turbines for Site generation of power, without disconnecting from PREPA. The capital needed for the equipment installation and connection to our internal distribution system (coordination between PREPA, diesel generators, and micro-turbines supply streams) made the investment not feasible.
- Cost of electricity from PREPA $\sim 0.21/\text{kWh}$, with an expectation of a 10-15% increase in 2019.
- Diesel cost is approximately $\$2.6/\text{gallon}$. During a typical year consumption around $\$950\text{k}$ in fuel; an emergency situation can add another $\$200\text{-}250\text{k}$ in costs



Hospitals – Puerto Rico

- \$500,000 a year in electricity and diesel costs
- PREPA costs expected to increase this year and hospitals energy demand expected to increase with enhanced technologies for CTSCANs, Laboratory and emergency room.
- Lack of diesel in the aftermath of Maria – personnel had to use Diesel from ambulances to keep the generators running
- PREPA restored power 4 weeks after Maria
- \$2 million in losses after Maria



In closing...

- The Market...

Shared insights into the market in Puerto Rico

- Nuclear in Puerto Rico

The Nuclear Alternative Project: Community & leadership, follow-up with Resolution 1189 and feasibility study.

- End user needs in Puerto Rico

Needs focused on microgrid integration and energy demands/resiliency needs for pharmaceutical/hospitals applications

Thank You



HITACHI



UNITED NUCLEAR
INDUSTRY ALLIANCE



For a Better Puerto Rico

