Microgrid Solutions

Policy and standards to support success

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Schneider Electric at a Glance

Key figures for 2017

5%
of revenues devoted to R&D

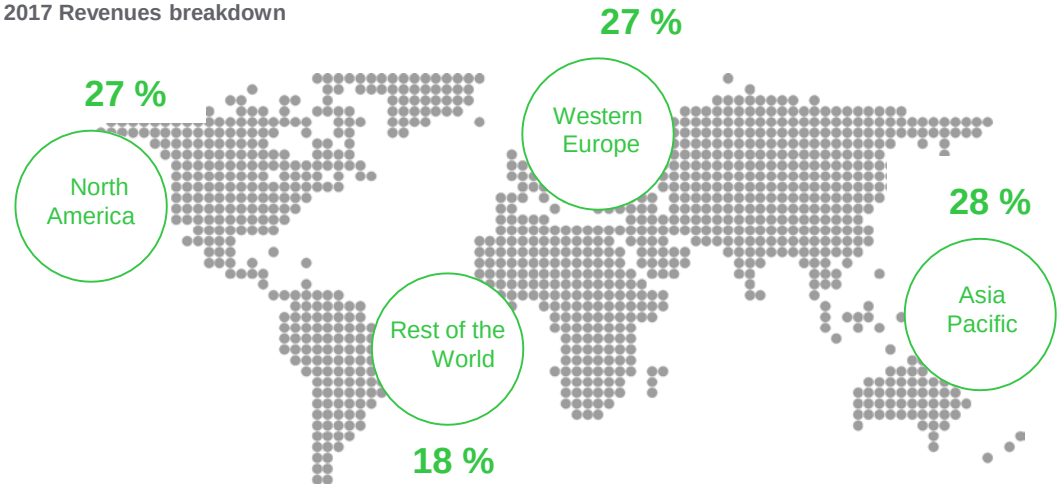
€24.7 billion
2017 revenues

41%
of revenues in new economies

142,000
Employees in over 100 countries

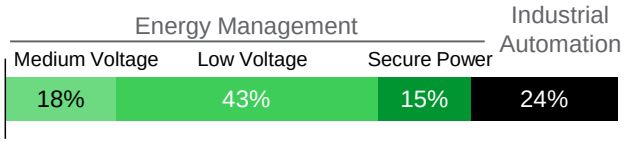
A well-balanced global presence

2017 Revenues breakdown



Four integrated and synergetic businesses

– FY 2017 revenues



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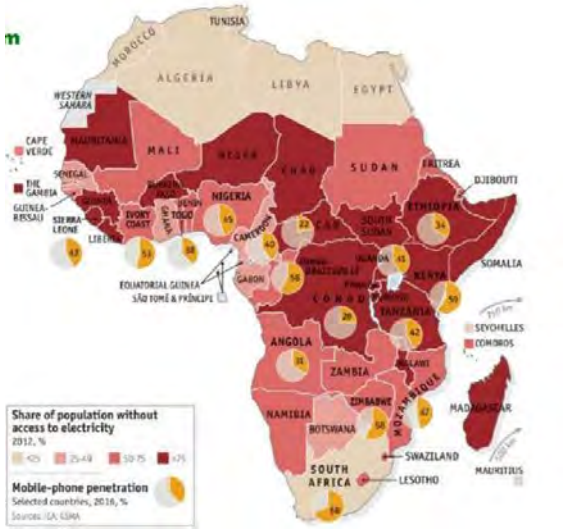
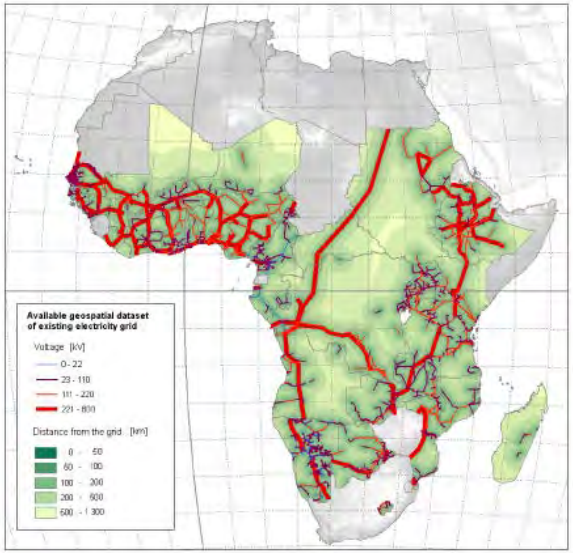
The need is more about Distribution than Generation

The Need & Complexity



The Grid & Quality!



The Size

Renewable Generation Yes …but more decentralized & Off Grid….

Energy transition means :

More many small Distributed Energy Projects than On Grid large PV Farms

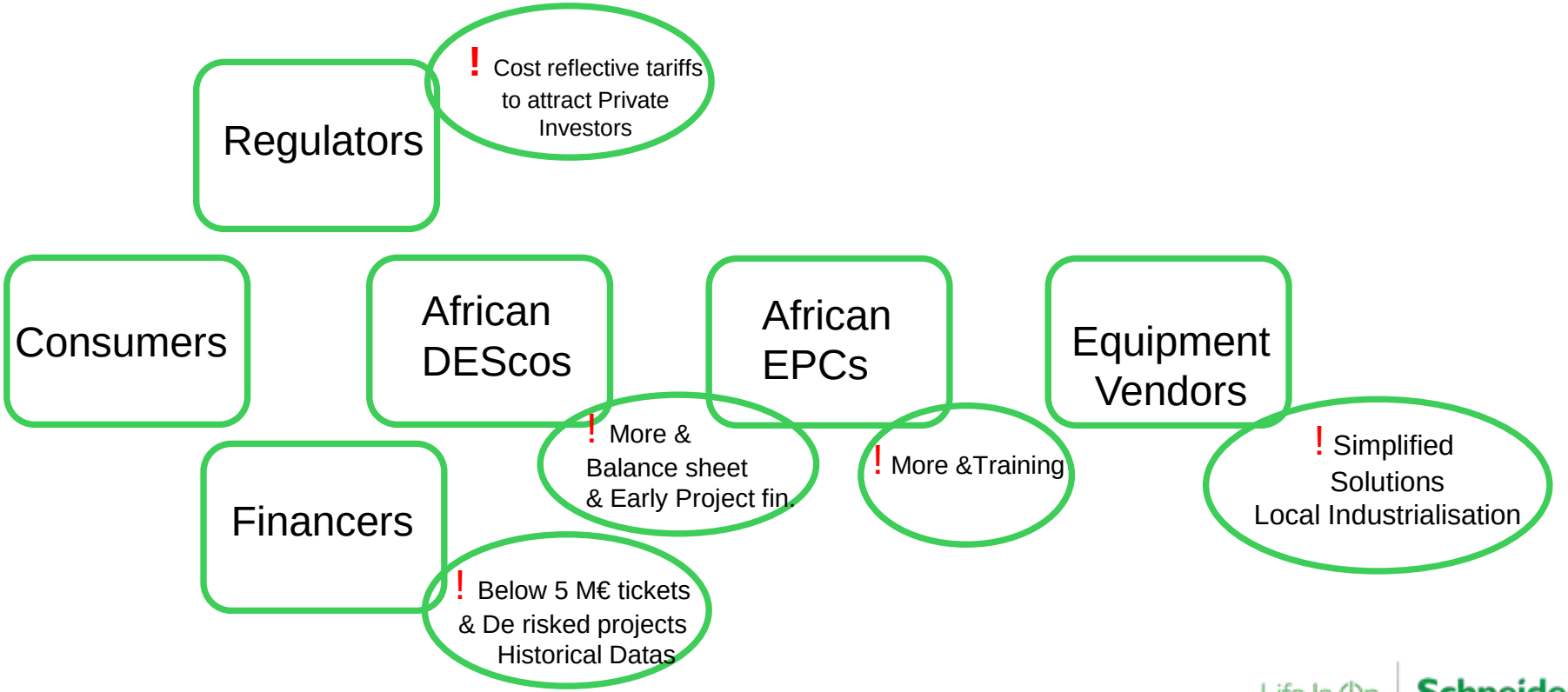
It is about Scalability, Volume deployment capacity

> **600 Millions** People without electricity on such a large continent Means

- **300.000 Villages** to Power (50KW to 200KW) with DER, = **1000 DERs Mini grids /Month during 30 years**

- **20.000 Large Sites** from 1 MW to 10 MW with DER, = **100 DERs Large Mini Grids /Month during 20 Years**
- **Traditional project scheme, = 6 Months engineering, 12 Months Commisionning and Testing**
- **Industry needs to:**
  - Productize and Standardize the solutions, and make it Modular and Scalable, Factory tested & remotely managed
  - to reduce drastically Engineering time, Site Comissioning, maintenance costs and enable local Contractors to manage the deployment.

African Capacity needs in Deploying and Operating DERs



Scale = Needs to attract Private Investors

POLICY

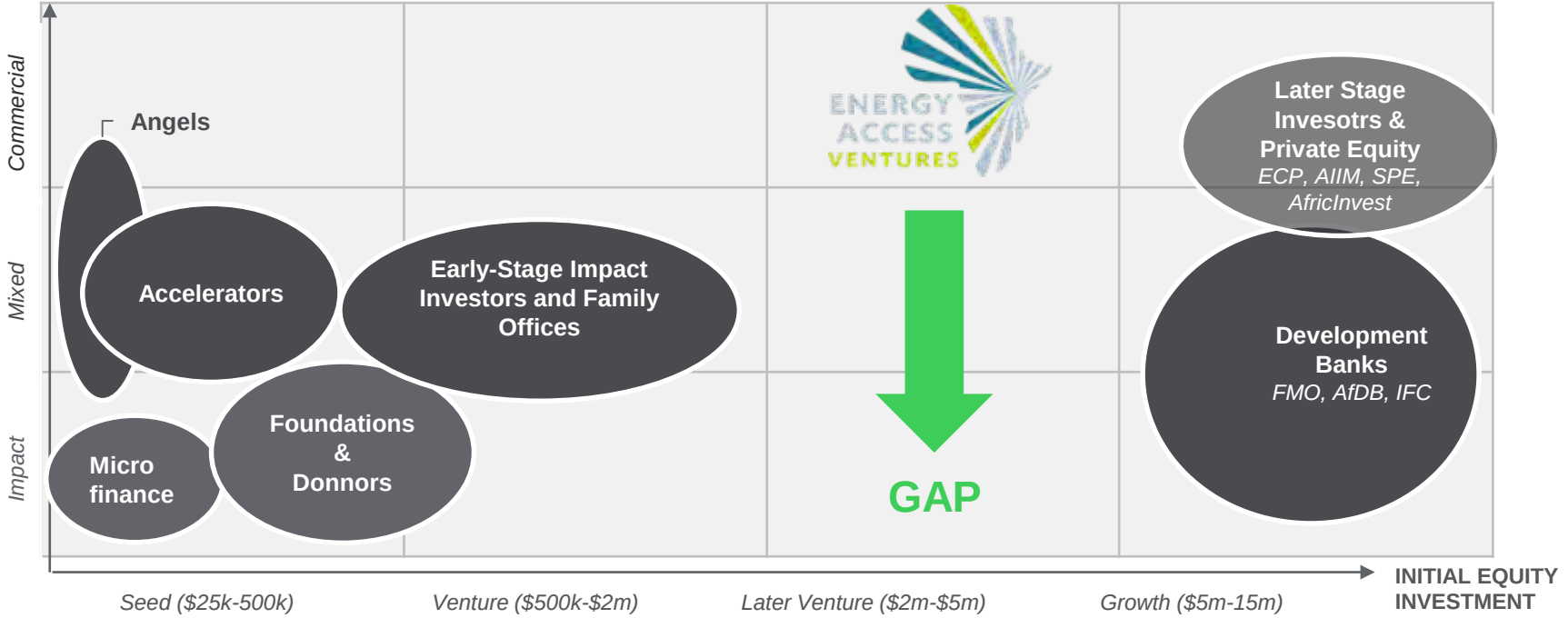
The AfDB's Africa Strategy for Green Minigrids (GMG) was **endorsed by Energy Ministers** in April 2017

Public policy factors critical to attracting private investment into GMGs	Immediate action required by governments
Simplified licensing requirements and procedures	**Design streamlined GMG licensing** requirements and procedures for legitimate GMG service providers, including the **preparation of mini-grid standards** that ensure the required quality, safety and consumer protections.
Dependable outcomes if the main grid expands to a microgrid location	**Publish expansion plans for the main gri**d and update them regularly. Determine and put into law dependable outcomes in the event of grid connection to a mini-grid, including **fair compensation to GMG business owners for the loss of productive assets**.
Appropriate tariff structures and public funding	Allow for and put into law provisions permitting the application of **cost-reflective and reasonable consumer tariffs**, or provide regular **compensatory subsidies for GMG operations**.
Integrated national energy planning	Implement **national energy planning** processes that assess least cost options for all centralized grid and decentralized solutions.
Increased capability to support GMG implementation	Support the **establishment of centres of excellence** to build the GMG capabilities of government officials and private sector service providers

"This Africa Strategy for Green Mini-Grids, once adopted by Energy Ministers, will provide a solid foundation for investment into and growth of the GMG sector in Africa, and represent a crucial step forward in fostering sustainable development and achieving universal access to electricity."

Source: AfDB, African Strategy for Green Minigrids, Dec. 2016

Private Investment and Financing Gap filling



- Needs for Lower Tickets below 5 M€
- Needs financial Historical Datas
-

Needs regulatory env. Private Investor

Needs for De risked Projects

Nigeria

20+ village electrifications (3 years experience)

Partnership with **Green Village Electricity** (GVE)

Schneider Electric as **Technology Partner,**

- Provides support to design the overall Mini-grid system.
- 24 - 38 kWp solar Microgrids installed combining:
  - Conext XW+ power conversion package with remote monitoring
  - A pay-as-you-go prepaid metering solution

Uninterrupted renewable power supply to:

- 200 to 300 households per villages
- 25 small to medium scale enterprises per villages
- Schools, mosques and churches, and public buildings

GVE benefited from a **unique concessional funding scheme** (debt + equity) provided by a commercial bank (Bank of Industry) backed by the UNDP

Cost Reflective tariff to ensure Investor Return

Schneider Electric Microgrid Offer- From 7KW to 10 MW

Conext Smartgen Power

Ecostruxure Microgrid Advisor
Ecostruxure Microgrid Operator

Energy Control Center

Battery Energy Storage

Villaya Community

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Schneider Electric EcoStruxure Microgrid Solutions

Open | Scalable | Secure | Global | On-Premise & Cloud

EcoStruxure™

End-to-End Cybersecurity

Life Cycle Management

- Apps, Analytics & Services
- Edge Control
- Connected Products

Microgrid

EcoStruxure™ Microgrid Advisor		Forecast and Optimize when to consume, produce, Store, or Sell Energy
EcoStruxure™ Microgrid Operation		Ensure system stability & safety whatever the system configuration

Villaya Emergency

Battery Energy Storage

Energy Control Center

Smart switchgear, power meters, solar inverters, EV charging stations …

Energy Consulting

- Demand expertise : analysis of present and future energy needs, energy efficiency
- Supply expertise : analysis of present and alternative energy supply
- Financial, environmental, TCO analysis
- Regulation, standards and country codes

Power System Engineering

- Technical & economical sizing
- Technical studies : Load flow, voltage plan, protection studies
- Dynamic stabilities

Conclusion

- Energy transition to Renewable in Africa is **more about Distribution logic** than Generation, adopt a DER strategy would help a lot
- **Scalability is a roadblock,** Modular & Scalable solutions, Development of Local DEScos and EPCs would help a lot
- **Financing** at minimum ticket of 25 M€ is not adapted to the solution which **is more large Qtys of small projects** below this minimum.
- **Governments Regulations** should be very **open to private investors**, and their need for profit, they should adopt as a minimum a cost reflective approach or full deregulation to develop African DEScos, Jobs and Profits.
- Finally, **starting with Commercial & Industrial Building**, Bankable projects, would bring solutions costs down and Financial costs down, that will help in a second Phase Rural electrification.

Project References

Project references (non exhaustive) across the different market segments

A2E / Off grid sites

1. REIDS Project
2. Microsol (8 sites UEMOA)
3. Niomoume Electrification
4. DER Sizing Philippines
5. Microgrid Lab in Technopole

Smart districts

1. Issygrid
2. IMT Campus Microgrid

Grid connected / Islandable sites

1. Boston One Campus (islandable)
2. SDEM (islandable)
3. Mini Kergrid
4. Alectra
5. Solbruket
6. Costa Mesa
7. Refinery Load Preservation Microgrid
8. Montgomery County Microgrid (islandable)
9. EQI Prosumer Smart Building
10. Ameren Microgrid (islandable)
11. Oncor Microgrid (islandable)
12. Shedd Aquarium
13. Fairfield (islandable)

Utility microgrid

1. Feroe Islands
2. SIGDE
3. Gibraltar

MICROSOL

Electricity and heat Integration in 8 countries ECOWAS

Type: Island, off grid microgrid
Location: 8 ECOWAS Countries
Completed: Under execution

Customer pain point

Installed a mixed solution to provides Electricity and heat to ensures community food and beverage development. The solutions allows populations to transform raw products into added values transformed product with conservation

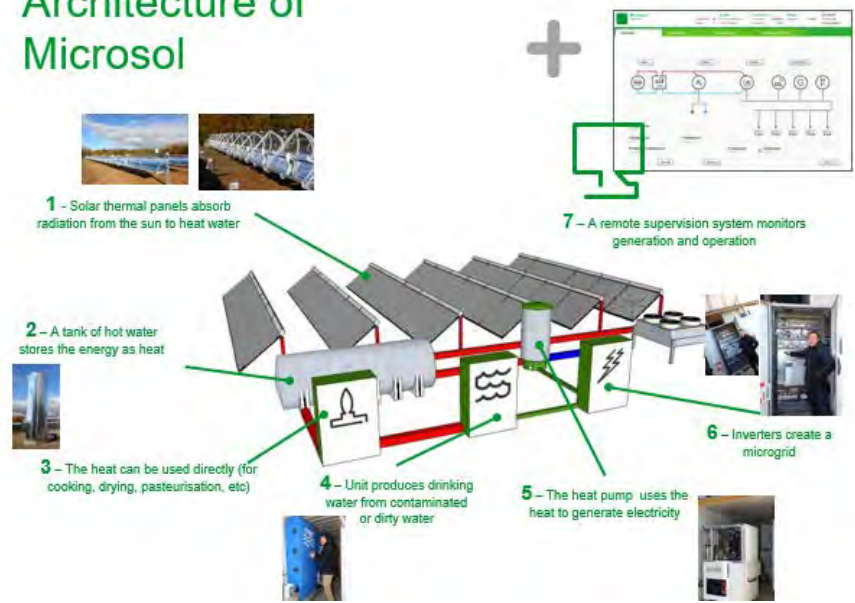
Solution

Microsol full containerized solution with remote control via Ecostruxure microgrid operation

Scope

- Ecostruxure Microgrid Operation
- Smart PV inverter with VSM capabilities
- DER: Solar PV, sodium batteries

Architecture of Microsol



A multifluid system that combines electricity and hydrogen

Innovative technology to increase renewables integration up to 100%

Efficient and powerful microgrid management solutions

Access To Energy Project

NIOMOUNE Rural Electrification

Renewable Energy Integration Senegal

Type: Island, off grid microgrid
Location: Niomoune Island
Completed: Under execution

Customer pain point

Provides electricity to population in remote access through an local ESCO.

Solution

Villaya community full containerized with sodium batteries solutions.

Scope

- Ecostruxure Microgrid Operation
- Smart PV inverter with VSM capabilities
- DER: Solar PV, sodium batteries

Ecostuxure Microgrid Advisor/ Ecostruxure Microgrid Operation. Smart Operation management

Innovative technology to increase renewables integration up to 100%

Efficient and powerful microgrid management solutions

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REIDS Project

Renewable Energy Integration Development Singapore

Type: Island, off grid microgrid
Location: Semakau Island, Singapore
Completed: Under execution

Customer pain point

Break the 30% renewable penetration limit, with a plug & play, scalable approach compatible with use of generators and inverters forming together a Microgrid

Solution

EcoStruxure Microgrid Operation that ensures the stability will be provided by Schneider Electric as well as smart inverters for PV.

Scope

- EcoStruxure Microgrid Operation
- Smart PV inverter with VSM capabilities
- DER: Solar PV, Wind, Marine, Bioenergy, Genset, Battery, Hydrogen, Desalination, fish hatchery, H2

The largest Wind-Turbine in Singapore: 42 meters and 100 kW

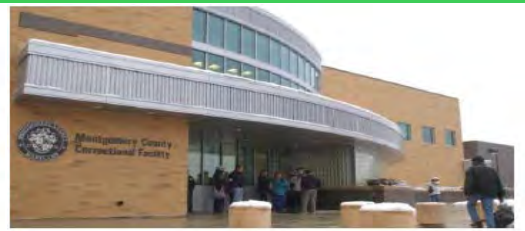
A multifluid system that combines electricity and hydrogen

Innovative technology to increase renewables integration up to 100%

Different storage technologies (li-Ion, supercapacitor)

Efficient and powerful microgrid management solutions

Montgomery County Microgrid



Customer needs

- Aging infrastructure with **power outages**
- **Budget challenges** with no capability to perform upfront investment
- Aggressive **sustainability goals**

Public Safety Headquarters

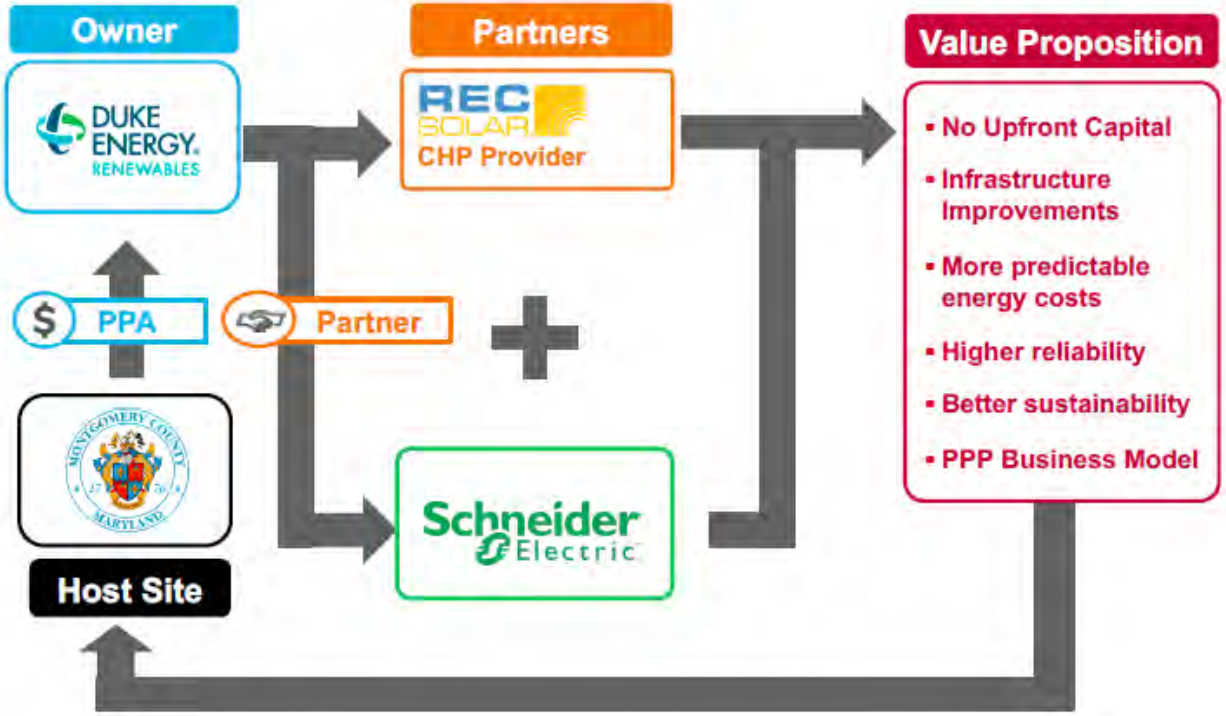
- Large electrical upgrades
- New 2 MW Solar
- Load management with BAS
- New Cogen
- Integrate Existing gas generator

Correctional Facility

- Minor Electrical Upgrades
- New 250 kW Cogen
- Integrate existing Diesel

Montgomery County Microgrid

Solution



- **Adding DER** (CHP, PV)
- **Adding control system** (Ecostruxure Microgrid Operation, Ecostruxure Microgrid Advisor) + MV/LV equipment
- All financed via **Microgrid as a Service Business Model**

Montgomery County Microgrid

Customer benefits

- Improve **resiliency** of county operations
  - Upgrade existing **aging electrical distribution** infrastructure
  - Ability to **island operations for >7** days without grid support
- **Mitigate risk of escalating energy price** over 15 years
- **Upgrade infrastructure without CAPEX** - Small increase in term of energy price ($/kWh)
- **Reduce greenhouse gas** and other emissions

Grid connected / Islandable sites

Oncor

Type: Campus, industrial facility, islandable
Location: Texas, USA
Size: 1 MW
Completed: 2016

Customer pain point

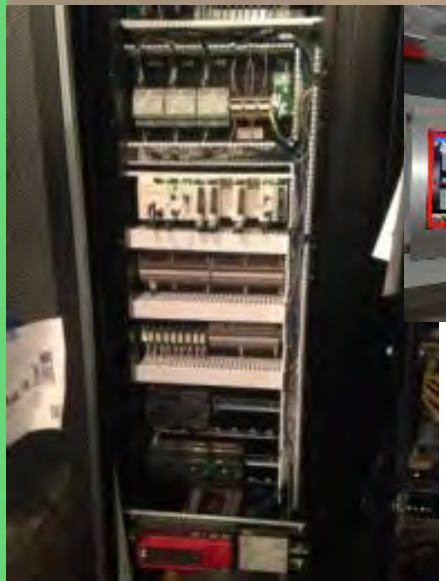
Willingness to demonstrate Microgrid technology at their campus for raising awareness about microgrids

Solution

Advanced microgrid in term of control, with full islanding capabilities + customer showroom
ROI in 3,5 years on EMA performing demand charge reduction and tariff management

Scope

- 4 separate Microgrids, autonomous and dynamic
- EcoStruxure Microgrid Advisor and Operation
- Design and delivery of the customer showroom
- DER: PV, BMS (HVAC), EV, Energy storage, micro turbine



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IMT Campus Microgrid

Type: Smart District
Location: Grenoble, France
Size: 7 buildings
Completed: Under execution

Customer pain point

Better integrating local energy generation, managing all energy flow (thermal and electrical), training students about energy

Solution

EcoStruxure Microgrid Advisor leveraging DEMIS features for forecasting and optimizing when to produce consume store energy, regarding all energy flows in the whole campus

Scope

- EcoStruxure Microgrid Advisor with DEMIS
- DER: PV, BMS (HVAC), EV, Energy storage, CHP
- Delivering of a learning platform dedicated to students

IMT GRENOBLE
INSTITUT DES METIERS ET DES TECHNIQUES

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