

2nd Symposium on Open Energy Systems

New Microgrid architectures and Business Models

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Strategy & Innovation



ALSTOM

Shaping the future

Our AlstomGrid leadership in SmartGrids

30 years of experience in energy management

30 years ago



5 years ago



3 years ago



Today

**Grid
Stability**

**Renewable
integration**

**Demand
Response / DER**

**Smart
City**



**Smart Digital
Substations**

SmartGrid Technological footprint

New Generation Control Room



New Generation Digital Substation for HV/MV/LV



OT-IT integration

Grid control room solution with Alstom e-terra 3.0 software suite

SCADA	DERM management
Energy & Market management	Cyber security
Demand response, settlement...	Smart metering integration
Integrated Coms	

Grid Automation with Alstom DS Agile

Digital substation	Distribution automation
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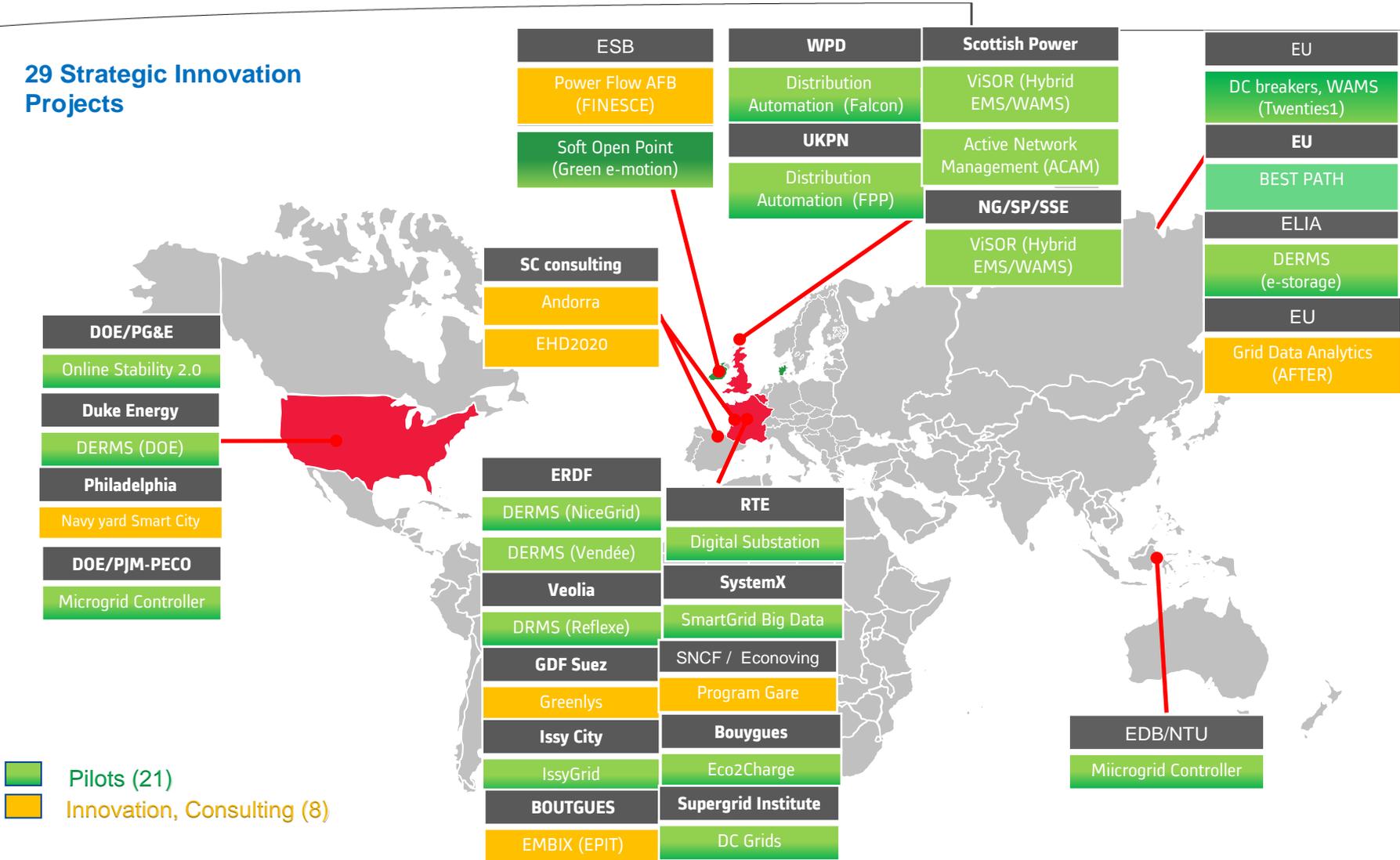
Power electronics with Alstom Maxsine™ eStorage and Alstom FACTS solutions

FACTS	Storage converters
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Smart meters (with partners)

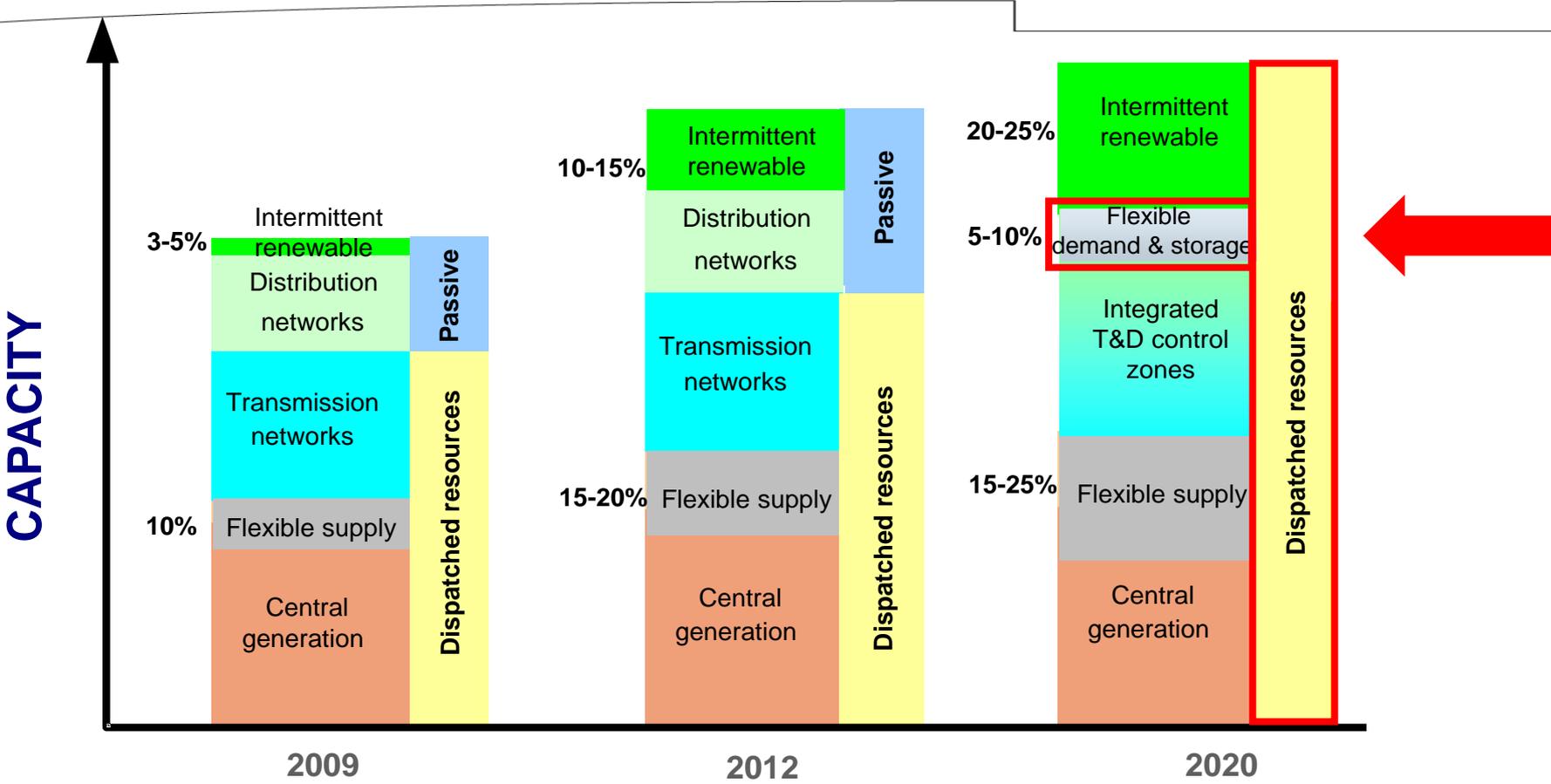
Active Strategic Innovation Projects

29 Strategic Innovation Projects



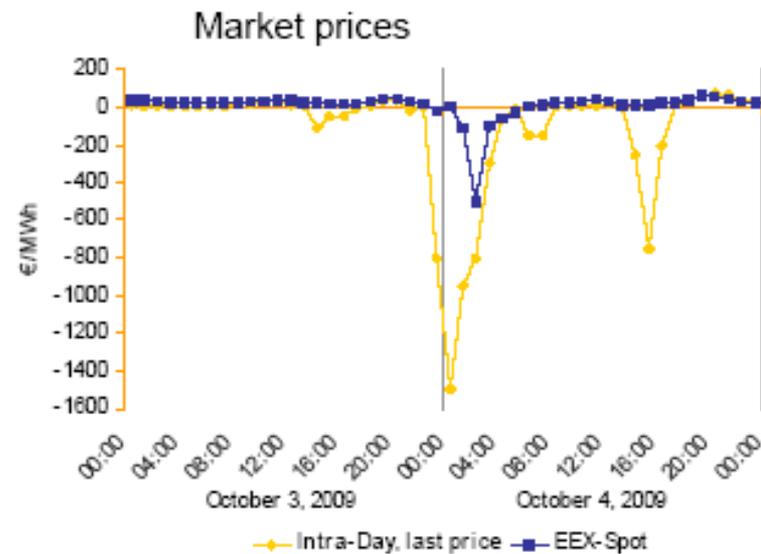
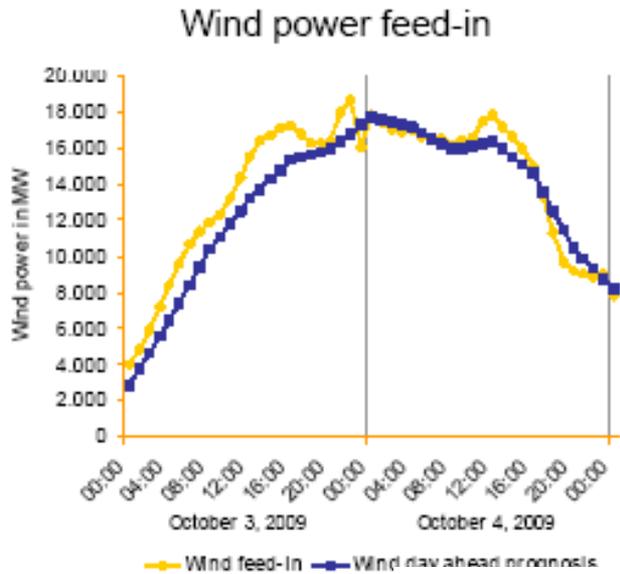
■ Pilots (21)
■ Innovation, Consulting (8)

The energy system flexibility challenge



Leading to rapidly changing price profiles

Flattening base price with higher volatility



New end user expectations for Smart Cities

▶ 1. Quality of Life

- Reduced Traffic Congestions
- Improved Air Quality
- Benchmark on Building Energy efficiency
- Clusters for Electrical Vehicule deployments

▶ 2. Job Creation

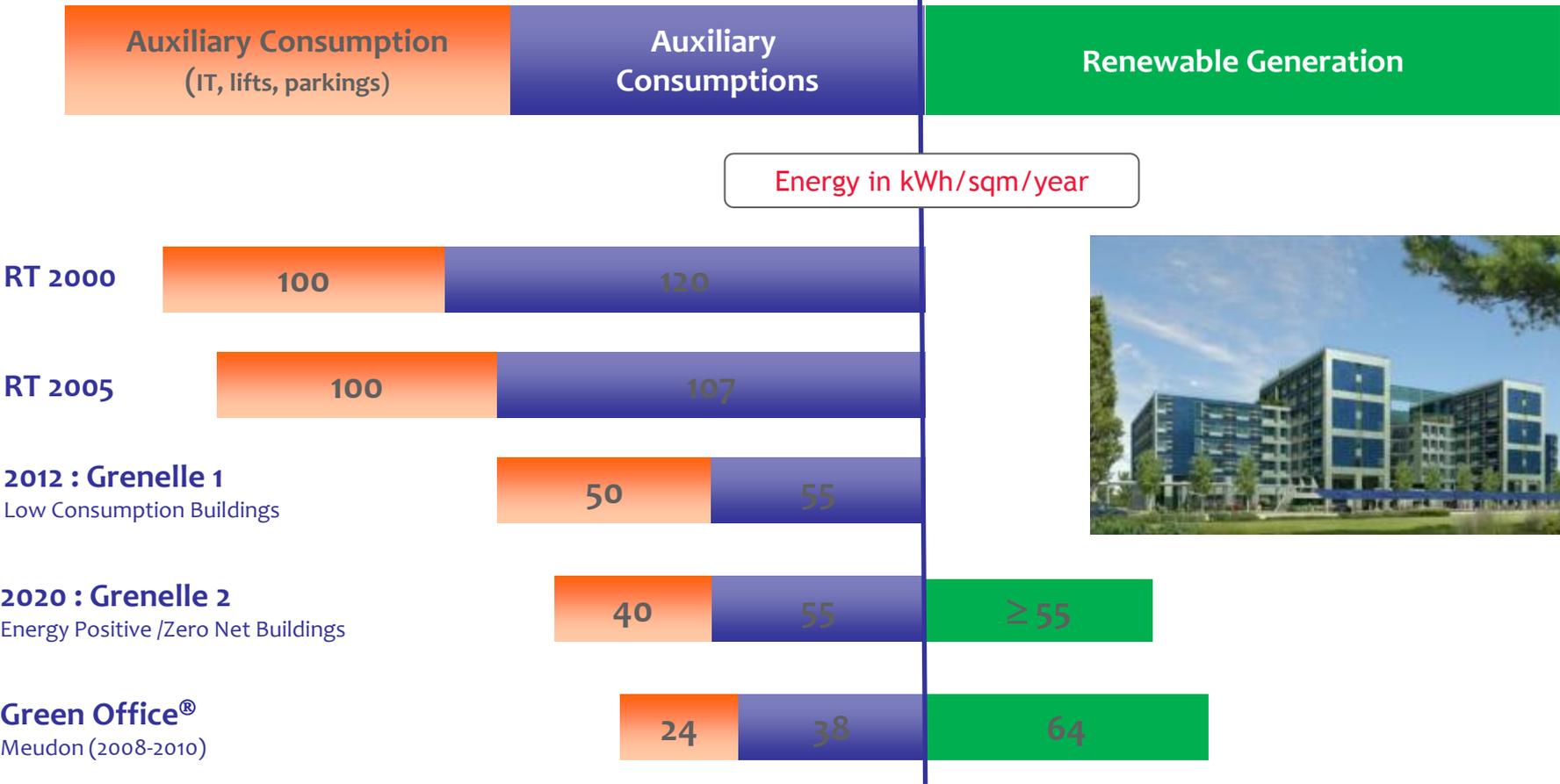
- Greentech investment Clusters (Silicon Valley Model)
- Implication of young early adopter citizens (students)
- Incentives to localise foreign IP and develop employment Market

▶ 3. Energy & Transportation efficiency

- Local distributed renewables / Micro CHPs
- Local energy balancing / storage
- Power supply resiliency
- Consumer demand response /community energy management.
- Intermodal transportation management



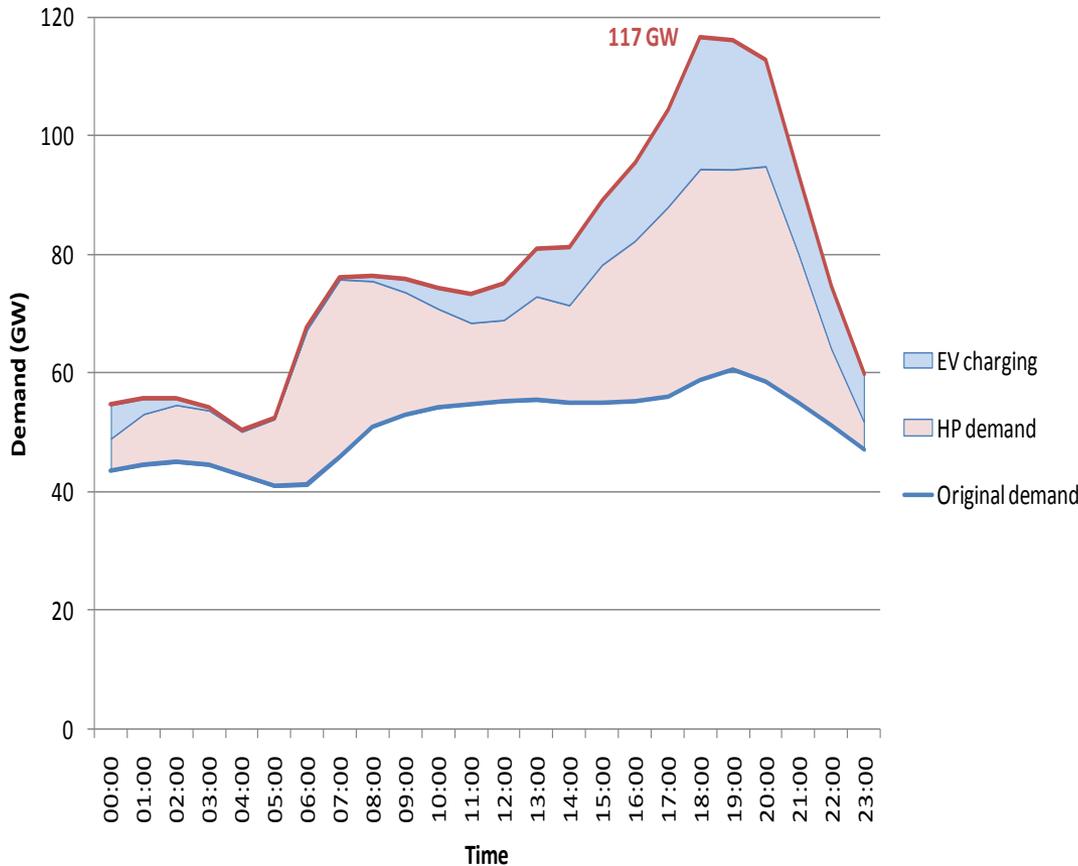
New Energy Positive Infrastructures



New steps in the electrification of urban transportation



Non-optimised EV and HP operation



Significant impact on Distribution Grid Sizing

Strong expectations to connect charging points with EV drivers

Acceleration of multi modal transportation

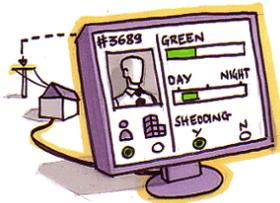


Emerging needs for electrical & transportation infrastructure coordination

Consumer turning into active « Prosumers » leveraging IoT

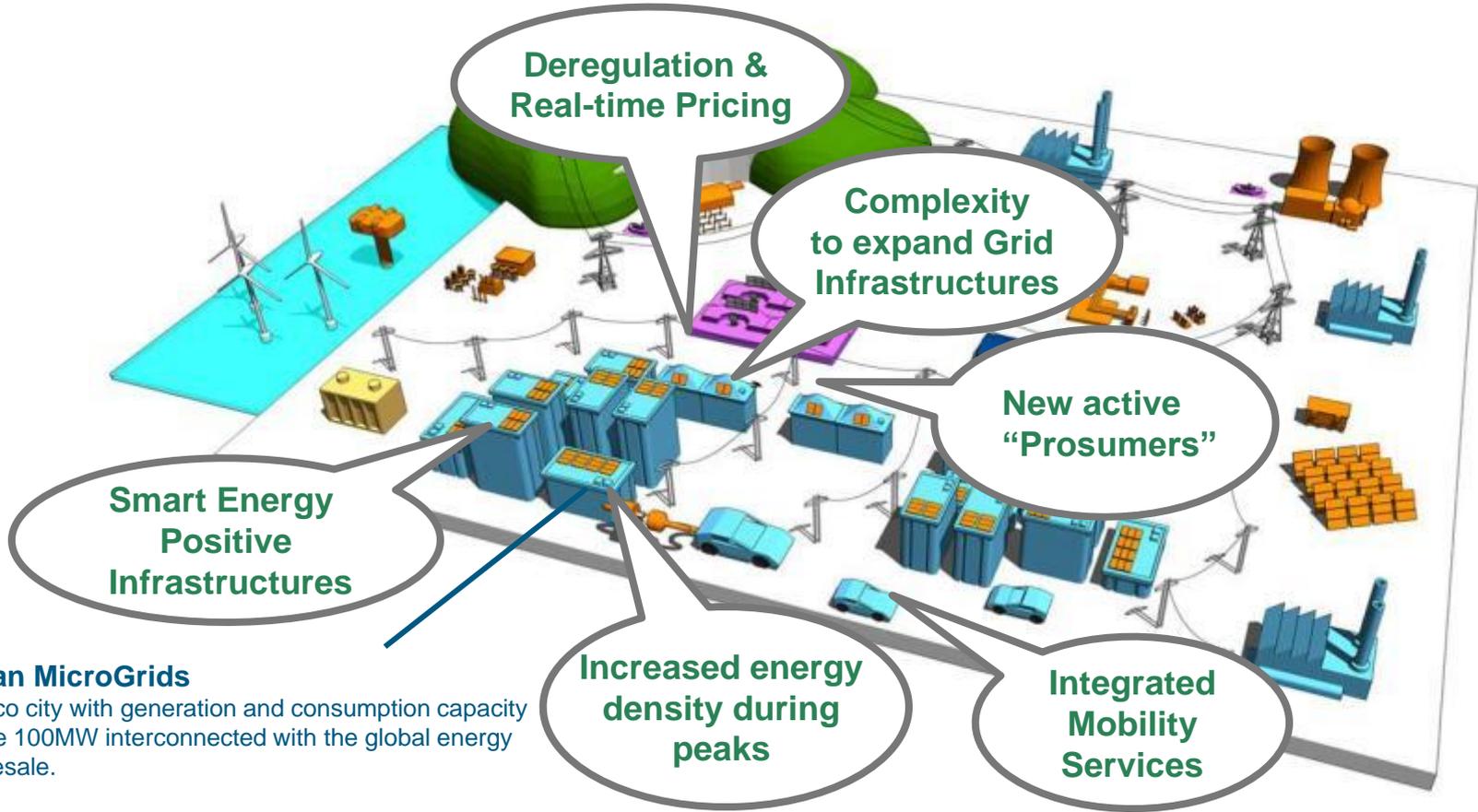
Putting consumers at the center its energy & transportation decisions

- My CO2 footprint
- My energy demand response strategy (elec/gas/heat)
- My transportation strategy (EV/Public/Car Sharing)
- My Telecom/IT set of services



New IT Connection & real-time interactions

Urban energy infrastructures are facing new end user integration challenges



Urban MicroGrids

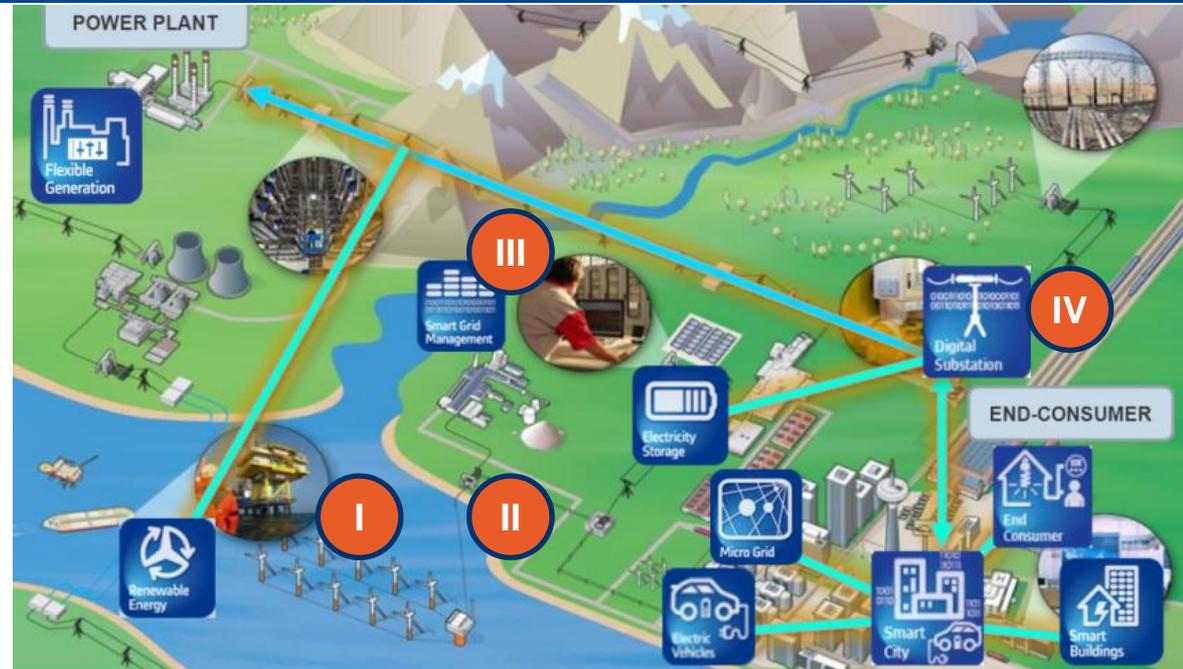
An Eco city with generation and consumption capacity above 100MW interconnected with the global energy wholesale.

The next Grid 2.0

From CENTRALISED energy management towards PEER TO PEER energy management



BEFORE
a simple, one way model for energy



TOMORROW

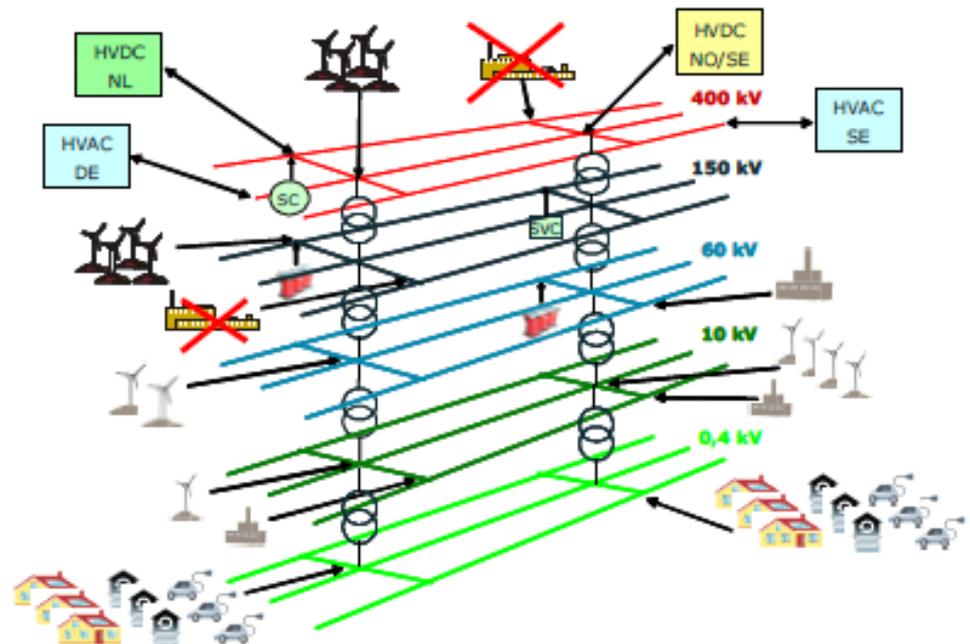
an open, flexible, interconnected and interactive model for energy:

- I** Flow based markets, DER integration
- II** Integrated Grid controls for AC-DC Grid
- III** New distribution grid management / Microgrids
- IV** Further expansion of Grid Digitalisation

Customer Vision of the right system “Paradigm”

The future power system is diverse and dynamic

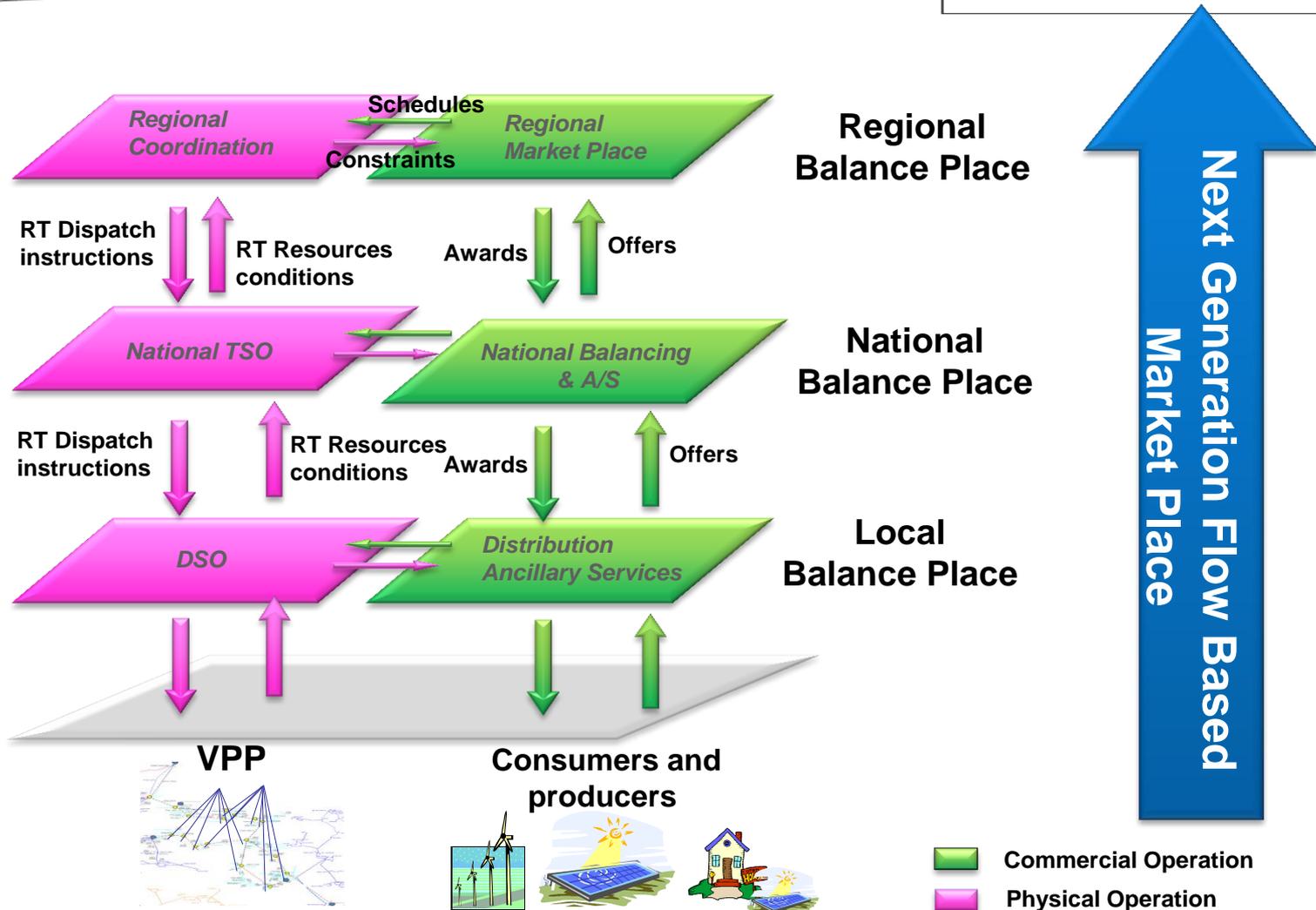
- Cannot be controlled from one centralised location
- Intelligent monitoring and control needed at all voltage levels
- Distributed intelligence with local control
- New measurement technology and situation awareness
- In the long run increasing autonomy e.g. self-healing technology





The brain behind the grid

A new framework required for energy management

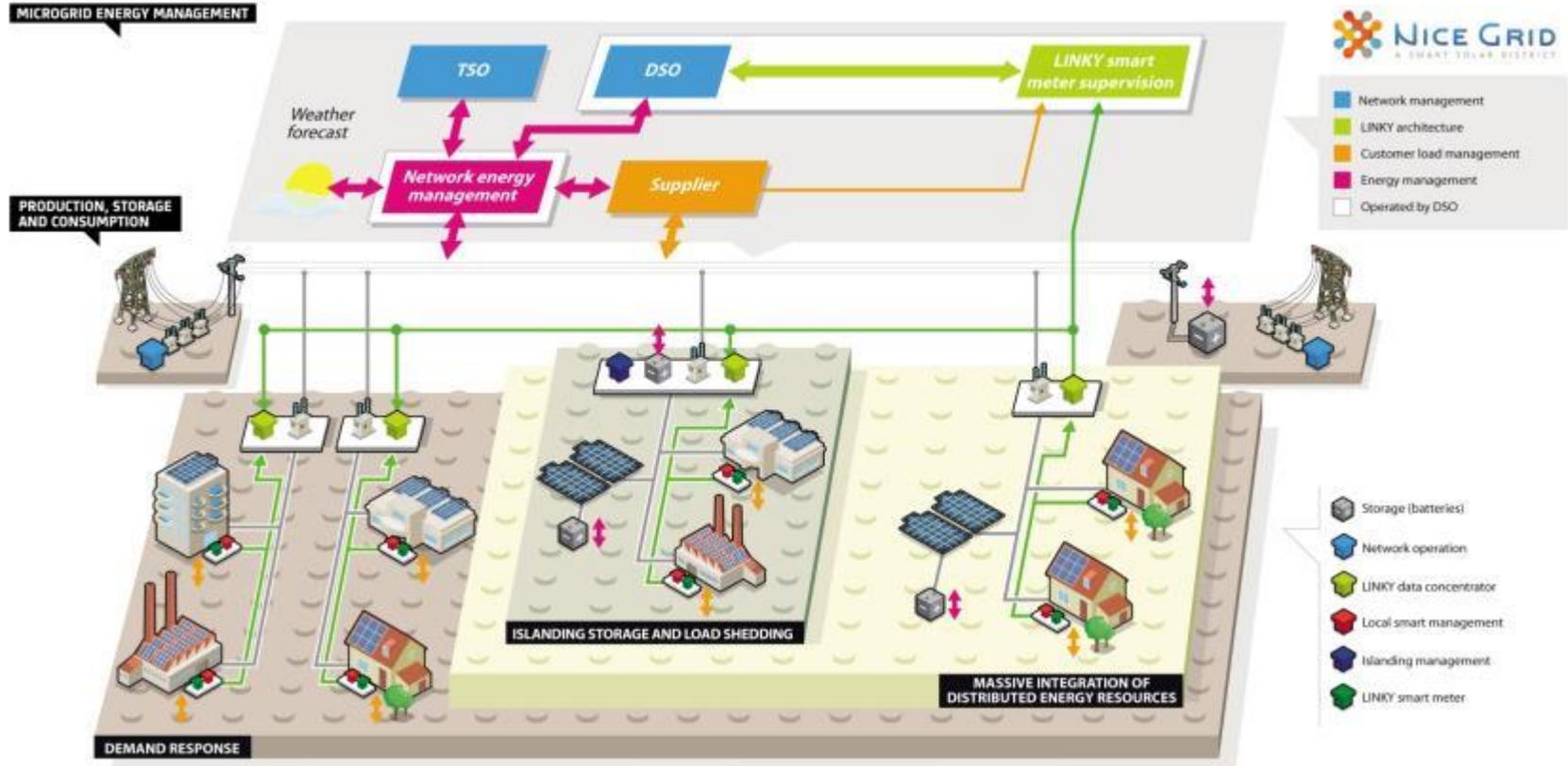


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Emerging Community Energy Management & Retail Market Places

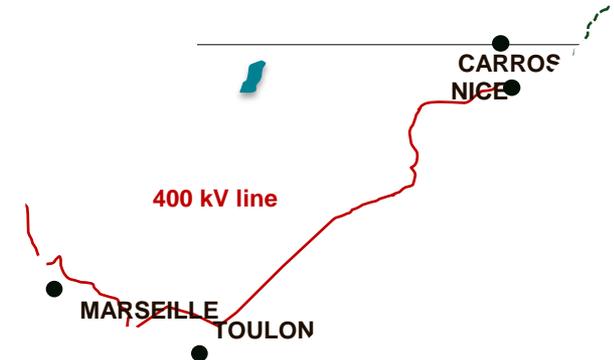




NICE GRID Project : facts and figures

Site description

- **Carros:** 10 500 inhabitants, with residential and industrial areas
 - **1,8 MWp** of existing Solar PV
 - **88** secondary substations
 - **20 MW** peak load at Primary substation



Use cases

- **Optimize massive PV integration in the distribution grid**
 - Test **islanding** within a low voltage area
 - Test **3.5 MW** load shedding
 - Incentivize **Prosumer** behavior

Seven solar districts

- **550** clients with **LINKY** smart meters (2500 Linky in total)
 - **220** clients with **electric water heaters**
 - **50** solar installations: **550 kWp**
- **3** grid **batteries**: 1 x 250 kW/600 kWh and 2 x 33 kW / 106 kWh
 - **20** residential **batteries**: 4.6 kW / 4 kWh



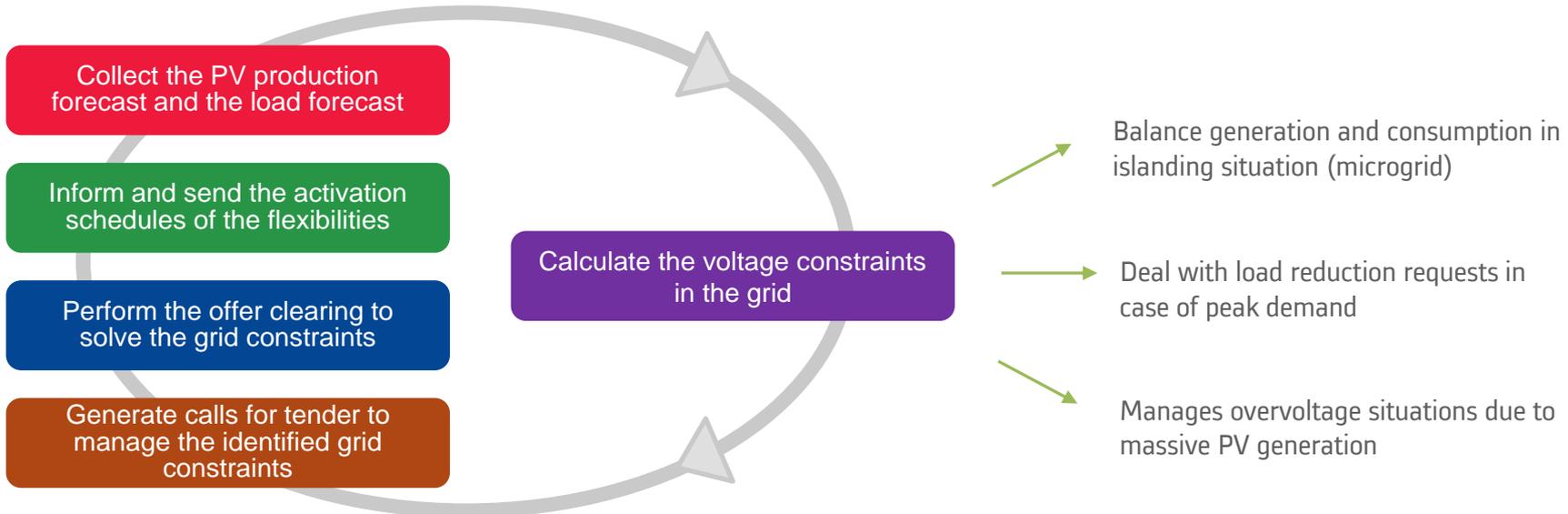
NiceGrid Network Energy Manager

NICE GRID PROJECT FLEXIBILITIES

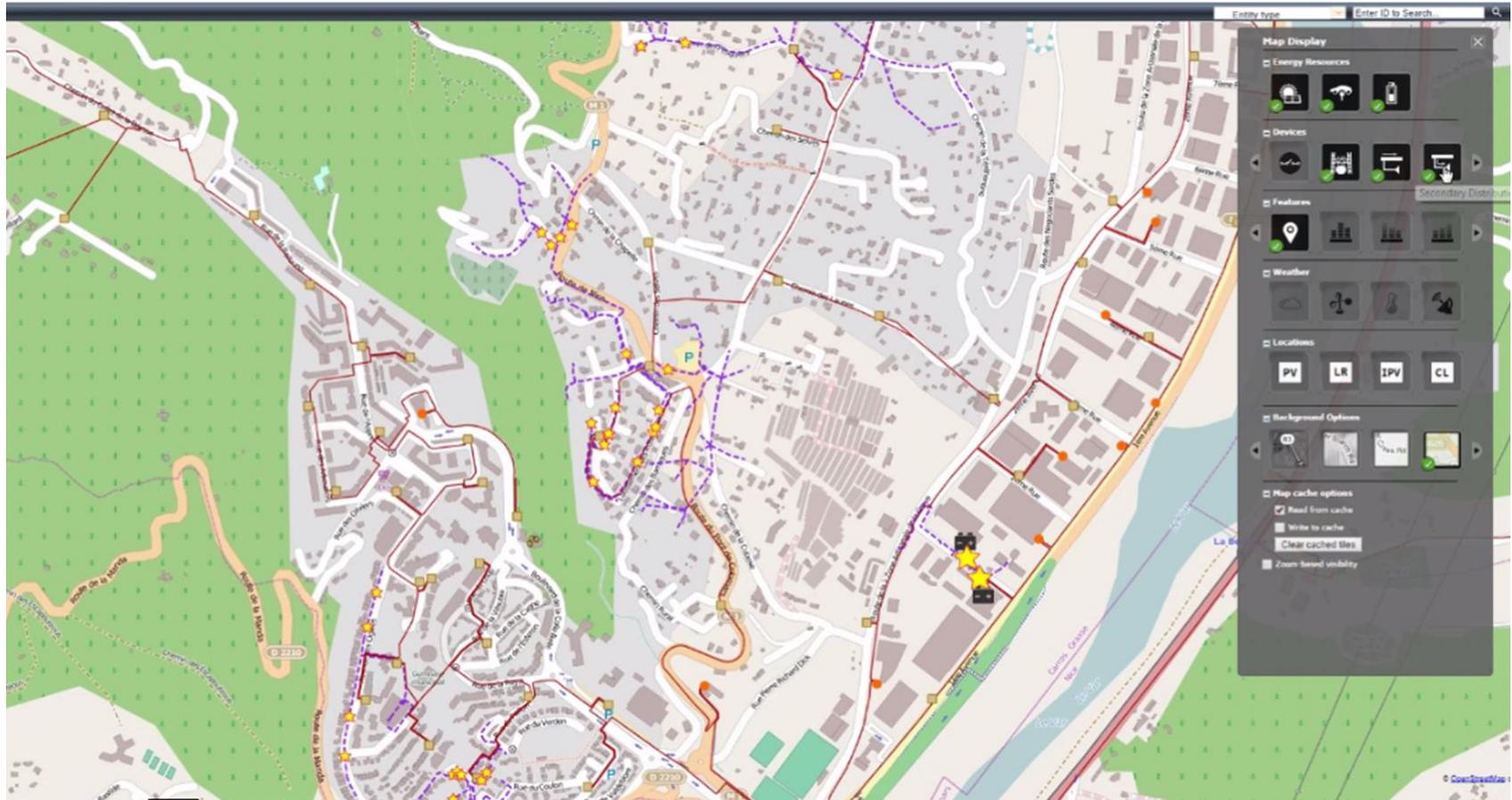
Within NICE GRID, different types of flexibilities are represented in residential, commercial and grid side.

Each flexibility type is managed by an aggregator.

Aggregators make available to the NEM the aggregated flexibilities in order to solve identified grid constraints.



NiceGrid Community Energy Manager



Pilotage Actif de la Tension VVC & Low Voltage SCADA 2% Load Reduction

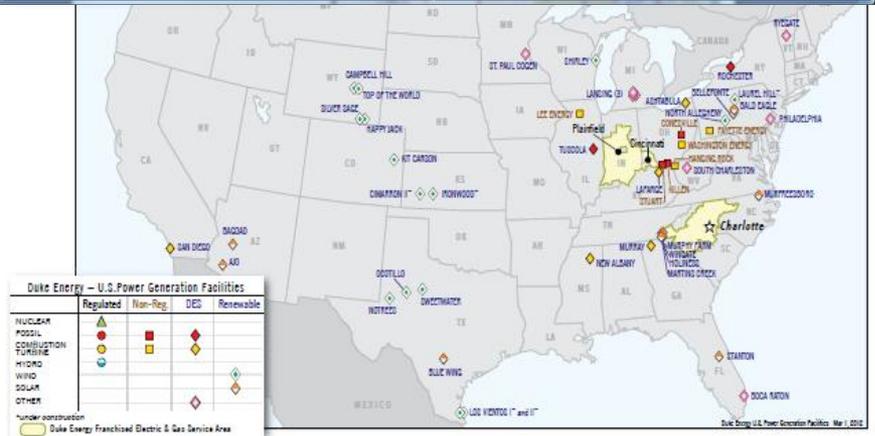


At a Glance

- 150+ years of service
- Operating Revenues – \$14.5 billion
- Total Assets – \$62.5 billion
- Employees – 18,250
- Service territory - 50,000 square miles in the Carolinas and Midwest



Customers	4 million
Primary substations	1400
Feeders/circuits	4500
Distribution lines	153,000 miles
Distribution Transformers	1,200,000
Generation	36,000 MW



2% Load reduction reached through Volt Var Controls



NiceGrid New Volt/VAr management between TSO and DSO

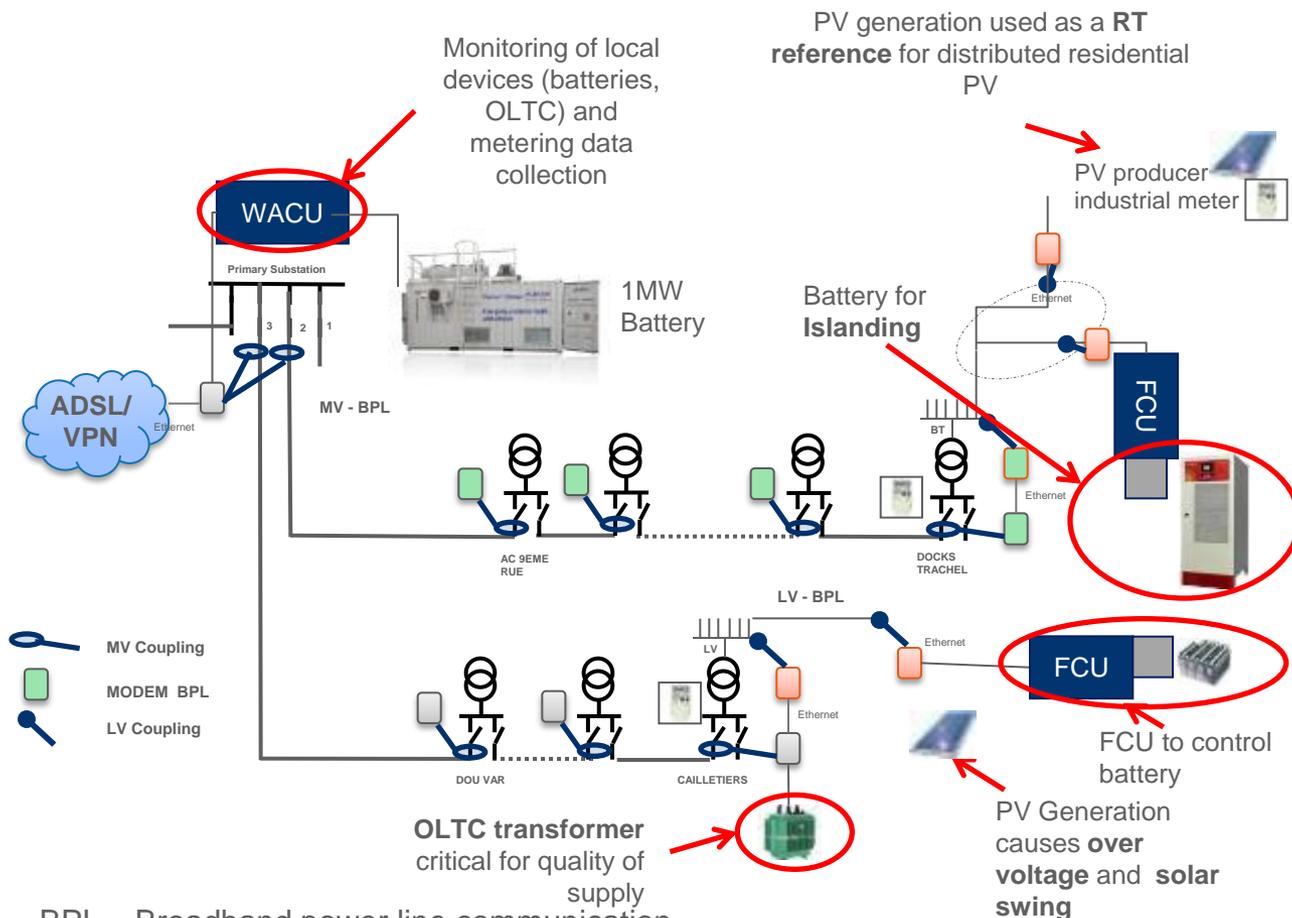
Transmission

- Provide 3 year average VAR schedules
- Provide VAR setpoints



DSO

- Follow 3 year average VAR schedules
- VVC to optimize OLTC, Grid Batteries and losses
- Coordinate VAR injections from DERs



BPL – Broadband power line communication

WACU – Wide Area Control Units

FCU – Field control unit

Project reference – Nice Grid (France) Smart-solar energy demonstration project

Nice Grid project : First application of MaxSine™ eStorage integrated at microgrid level, combined with photovoltaic farm. Located in the municipality of Carros near the French Riviera, France.

Partners : ERDF (leader), EDF, ALSTOM, SAFT
PCS & local control : Alstom's Maxsine eStorage (1MW)
Battery : Saft (Li-ion - 1MW / 560 kWh)
EMS : Alstom's eTerra solution
In operation : Since February 2014
Applications : Load shifting, voltage regulation



MW scale BESS for load shifting – 1MW / 560 kWh

Issy Les Moulineaux, France Integrated EcoDistrict Energy Management



- **Commercial Buildings: 160 000 m²**
- **10 000 employees**
- **Residential: 2 000 houses**
- **5 000 inhabitants**
- **Public buildings : Schools**

- **Renewable : PV, cogeneration,**
- **Load : residential, tertiary buildings, commerces**
- **Storage : LI-Ion Batteries**
- **Smart Street Lighting**
- **EV Charging Spots,**



New community energy management

Prosumer Portals



ALSTOM MY DEVICES MY PROGRAMS MODE: At home

SEPTEMBER 11, 2013

Objective Monitoring: Excellent! Budget 798 kWh, Used: 263 kWh, Available: 535 kWh

Monthly Forecast: € 93

Savings: € 0 since January 1, 2013

POWER USE FROM SEPTEMBER 2 TO SEPTEMBER 8

- Your total power use for the week amounts to 4,758 kWh, eq. to € 582.83
- On average, you have used 2,887 % more power per day than last week.

CHALLENGE: 5 points

EFFICACITE ENERGÉTIQUE: CONNECT, EMPOWER, ENGAGE
GESTION DE LA DEMANDE: ANALYSE, PILOT

Personal Targets

Monthly bill estimates

Saving Calculation

Competition with the rest of the community

Challenger ecocampus Towards multi energy Microgrids



Challenger Eco District Microgrid



Generation & storage management



Real-time monitoring & benchmarking

Demand response management

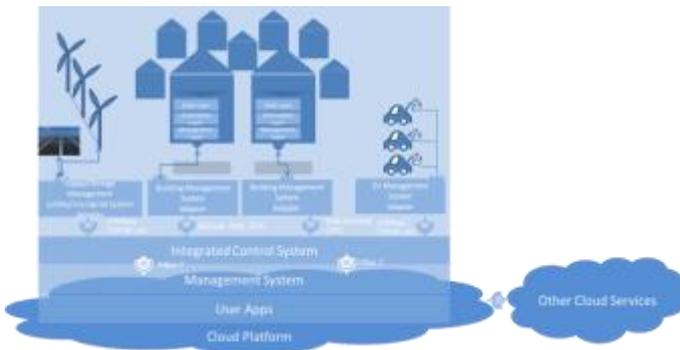


Microgrid Management As a Service

Grid Operator Interfaces



Real-time carbon footprint measurement



EV/PHEV Smart Charging



Large scale deployment in French islands EDF SEI EMS/IDMS enabling Smart Grid step change



Duration: 4 years 2011 – 2015

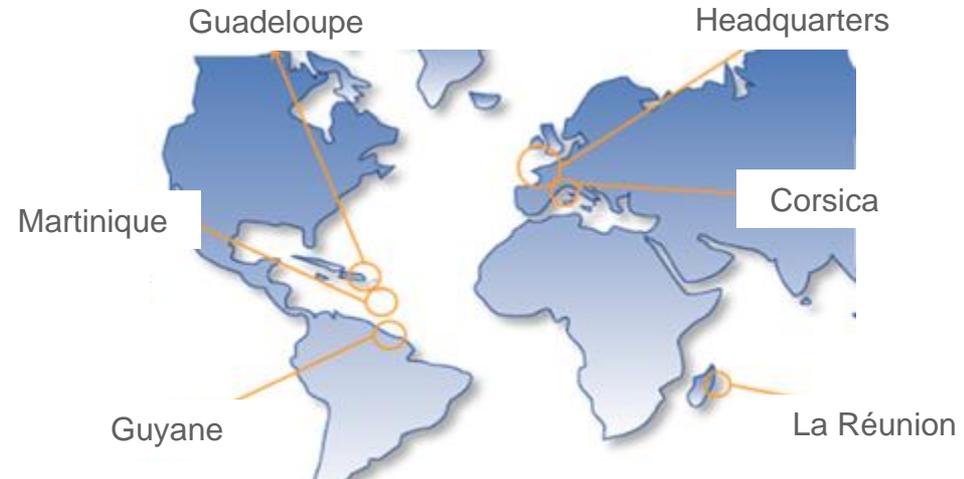
Objectives: enable step change in island grid operation: more renewables, more robustness against storm conditions

Challenges:

- Small isolated grids, very low inertia
- High and growing penetration of renewables
- Very tough weather conditions
- Contrasted topologies/densities

Solution

- Alstom Grid SCADA/EMS/DMS for the 5 islands
- Storm-proven (ack. in press)
- Distributed Energy Resource integration



Business Models require to combined Revenue streams



Typical Energy Transactions		Typical Flexible MW	Time horizon	Reaction time	Duration	
Load Supply	Energy/Renewable Efficiency	10,000	Week	Days	Days	
	Load Management	500	Hours	Minutes	Minutes	
	Power Quality	Islanding	< 10	Seconds	Minutes	Minutes
		Quality			Seconds	Seconds
Markets	Peak/Grid Capacity		Yearly	Days	Days	
	Peak/Off Peak Week Ahead	10,000	Week	Days	Days	
	Peak/Off Peak Day Ahead	100 - 1,000	Day	Hours	Hours	
	Energy Infra Day	< 100	Hours	Minutes	Minutes	
Grid services	Ancillary Services	Reserve	< 200	Hours	Minutes	Hours
		Regulation	< 100	Minutes	Minutes	Seconds
		Emergency	< 10	Minutes	Minutes	Minutes
	Power Quality / Reliability		< 200	Minutes	Seconds	Minutes

Each Microgrid have specific business models

Conclusions

Market evolutions

- ❖ Integration of more distributed energies & renewables
- ❖ Need for an open, flexible, interconnected and interactive model for energy

Answer

Comprehensive intelligent solutions across the grid
integrating **new Microgrid coordination layers** between substations &
control rooms



Welcome in the Smart Grid connected world !