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GOVERNING FOR GROWTH (G4G) IN GEORGIA

MARKET-CENTERED ENERGY PLANNING (M-CEP)

5 AUGUST 2016

THE REVOLUTION IN THE ENERGY SECTOR IS UPON US

The extent to which energy planners take the revolution into consideration will dictate the potential risk of overbuilding large or incorrect infrastructure projects.

An estimated $40 trillion (IEA World Investment Outlook) is planned for new transmission and large generation plants in the next 20 years worldwide. Emerging markets cannot afford to make the mistake of building the wrong infrastructure.

INTRODUCTION TO M-CEP

Market-Centered Energy Planning (M-CEP) is an innovative approach to energy planning that focuses on the rapidly changing energy markets and the increasing involvement of energy consumers in dictating the type and level of energy they will consume.

M-CEP KEY CONCEPTS

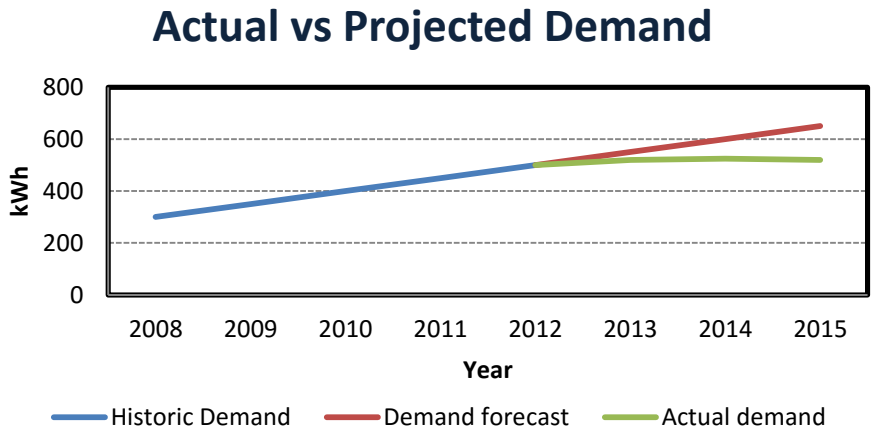
- The number of electricity customers with their own energy generation sources is increasing rapidly
- Advances in technology are changing the way energy consumers interact with energy companies
  - Solar PVs
  - Other renewable energy sources
  - Electric Vehicles
  - Batteries
  - Smart Meters
  - Advanced Metering Infrastructure
  - Data acquisition and communications

M-CEP KEY CONCEPTS

- Competitive energy markets have created options that place more control over energy consumption, energy production and system services in the hands of consumers
  - High competitive prices during high price periods provide consumers economic justification for **energy efficiency programs**
  - Lower prices, sometimes negative prices, encourage **shifting of demand** to low price periods
  - Large consumers with controllable load, own-generation and/or battery banks are **providing operating reserves** at lower costs than grid-connected generating plants.

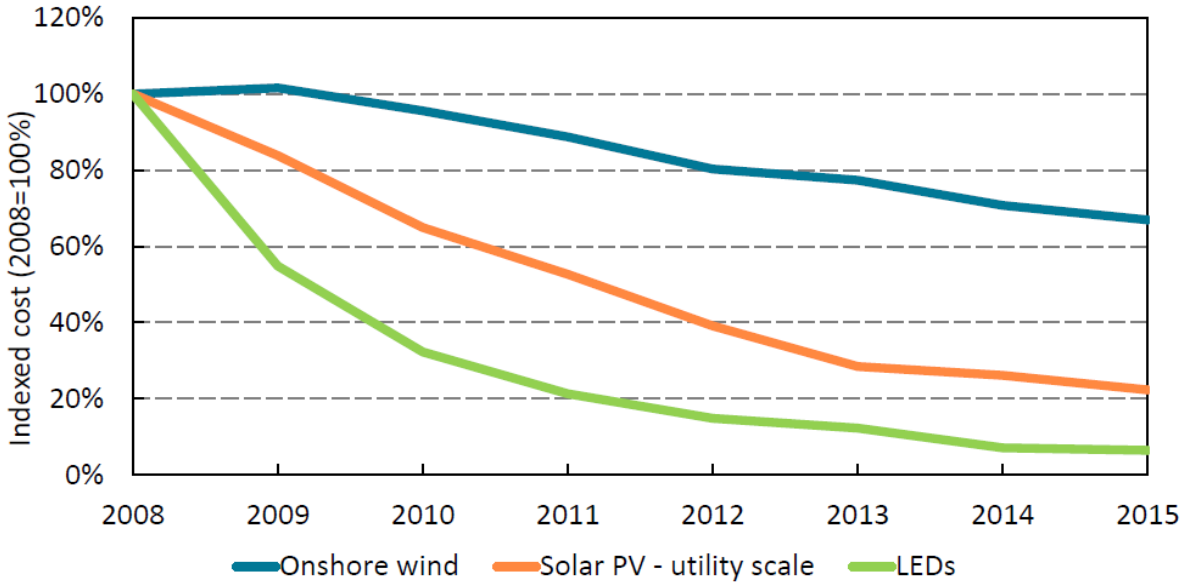
M-CEP KEY CONCEPTS

- Large consumers are more than ever selling their products into global markets and are now dependent on the international economy
  - Ruler-based system demand forecasting is too risky



  - Planners must understand the underlying economic drivers that create energy growth
  - Local data on GDP growth is not indicator of international market growth or sustainability

INDEXED COST OF ONSHORE WIND, UTILITY SCALE PV AND LED LIGHTING



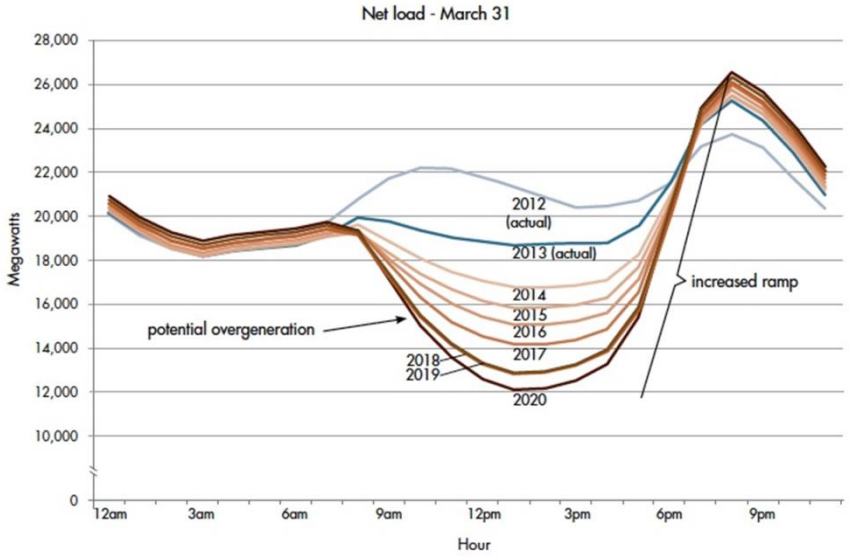
Source: International Energy Agency, 2016

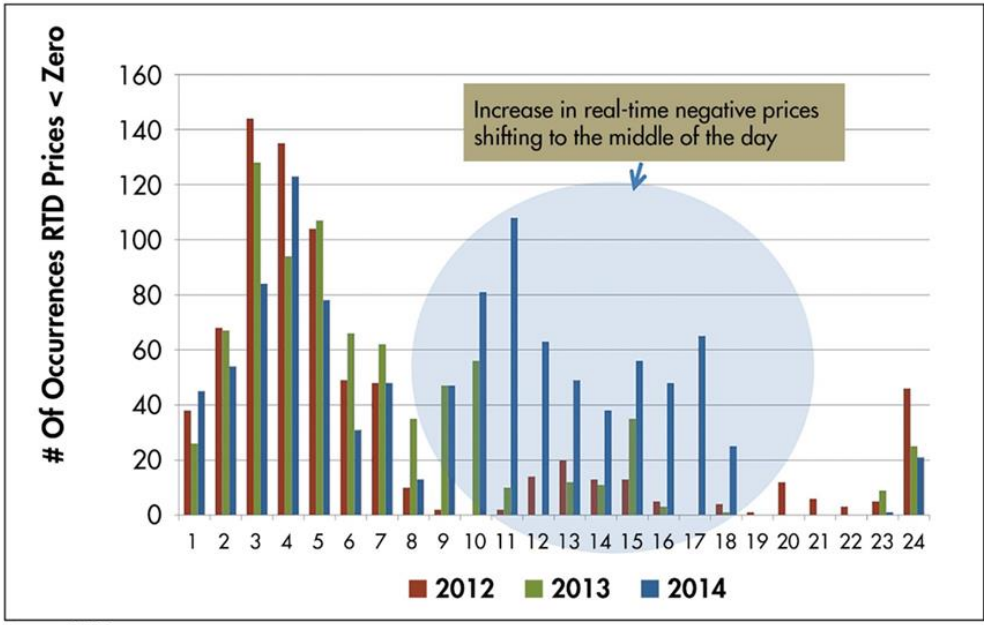
BATTERY TECHNOLOGY

Tesla's Gigafactory – by 2020 will produce ~~35~~ ***105*** *GW of batteries annually*

USA CALIFORNIA

Effect on Net Load and Spot Prices





Source: CAISO

- When scheduled generation exceeds scheduled demand in the hour-ahead market, the price of energy falls below zero in an attempt to balance supply and demand

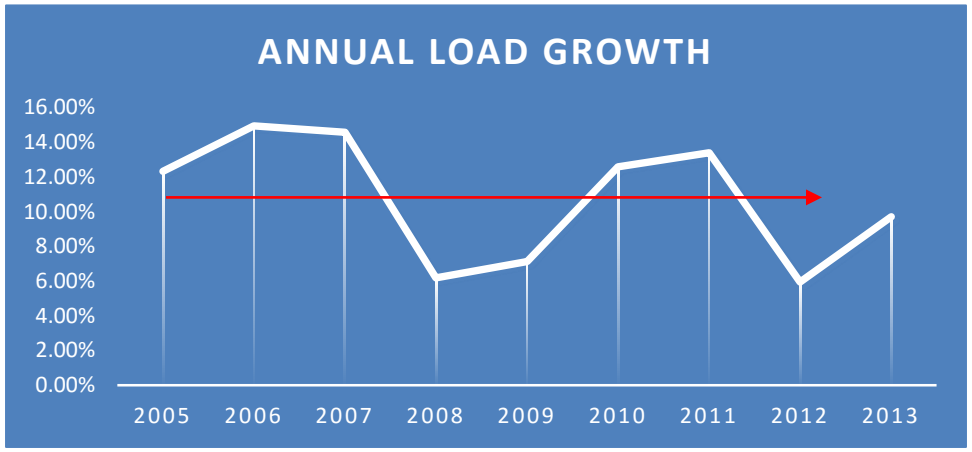
VERMONT - RAPIDLY EXPANDING SOLAR ENERGY

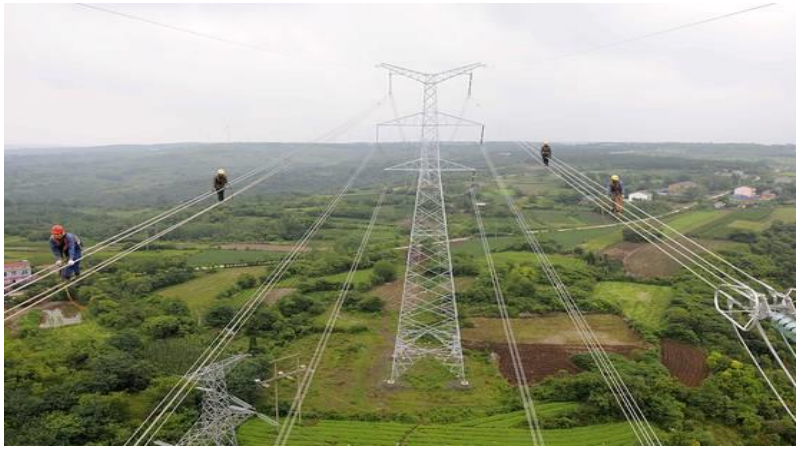
Grid-Connected Farms

Customer Installations

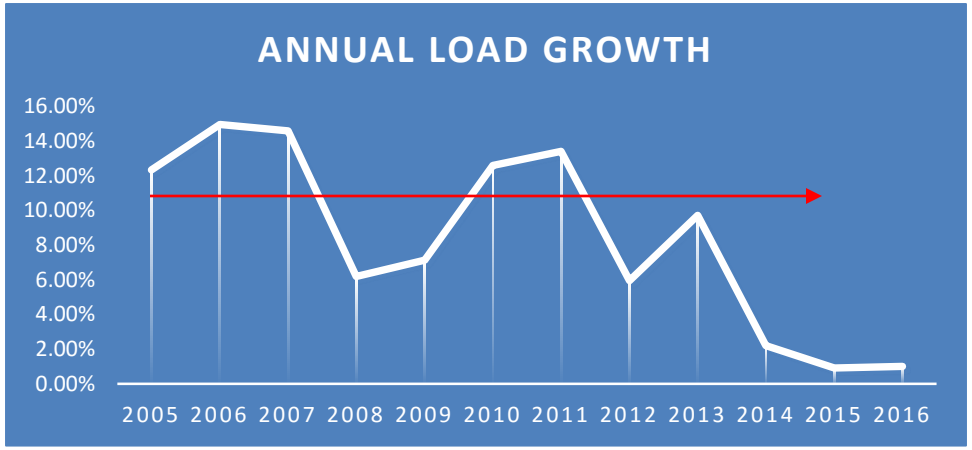
CHINA

China's Seemingly, Fast Expanding Power Sector





China's Economic Slowdown



Source: Index Mundi

Source: Business Day

BULGARIA

The current FIT values:

Solar energy	**24.83 - 30.91 € c per kWh**
Wind energy	7.0 - 9.76 € c per kWh
Biogas	6.08 – 13.44 € c per kWh
Hydroelectricity	5.72 – 11.6 € c per kWh
Biomass	11.6 – 22.07 € c per kWh

The guaranteed period is:

20 years	For geothermal, biomass and solar energy
15 years	For biogas and hydro power
12 years	For wind power plants

Lessons from Bulgaria

- Huge price increases resulting from open season for RES
- Increased retail prices resulted in even lower electricity consumption of electricity (elasticity)
- Customer (or market) feedback (affordability) was missing in energy planning and RES implementation process

GERMANY

Decision Made

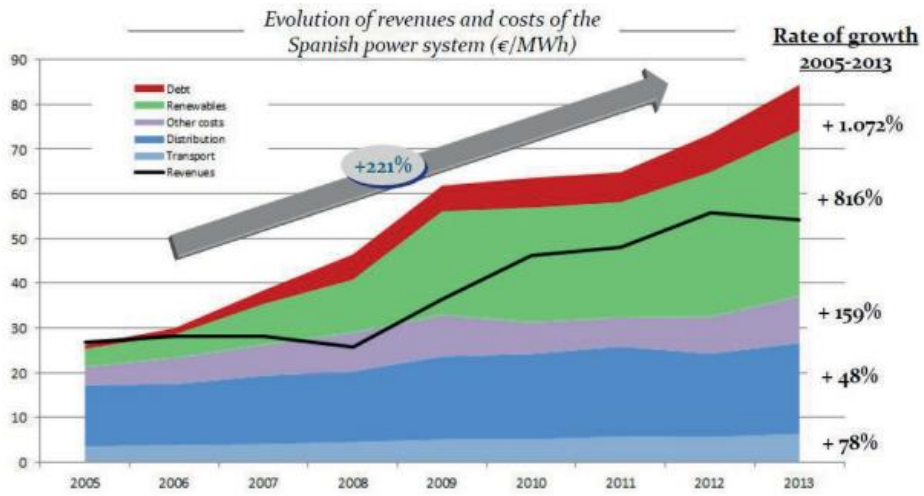
- Feed-in tariffs at higher-than-market price under 2010 Renewable Energy Act (EEG) (Energiewende) plus market premium and low-interest loans
- 2014 subsidies to renewable energy sector: 19.4 billion EUR/year (240 EUR per resident per year)
- Shut down 8 nuclear reactors
- Lignite plants on standby for reserve capacity
- Gas-fired merchant plants sitting idle

	Onshore wind	Offshore wind	Solar	Geothermal	Biomass (CHP)
Feed-in tariffs (c€/kWh)	4.9-8.9	3.9-19.4	8.7-12.8	25.2	5.8-13.6
Contract duration (years)	20	20	20	20	20

SPAIN

Spain's System Costs

Figure 10. Evolution of revenues and costs of the Spanish power system (€/MWh)



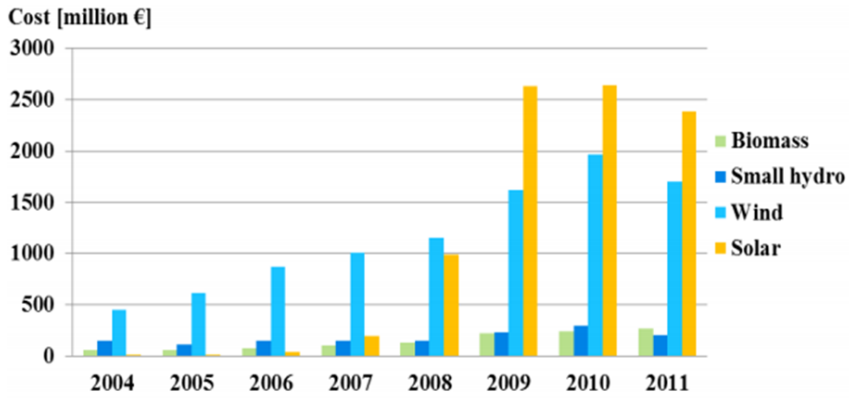


Figure 21. Annual cost of subsidies to biomass, small hydro, wind and solar power in Spain between the years 2004 to 2011 (CNE, 2012).

- In 2013 - Spain used only half of installed capacity during peak demand (101,828 MW vs 43,010 MW)
- Increased costs (i.e. grid costs) outpaced revenues from TPA tariffs + increased RE generation not met by demand → led to tariff deficit of over 20 million EUR by 2012 (2% of GDP)

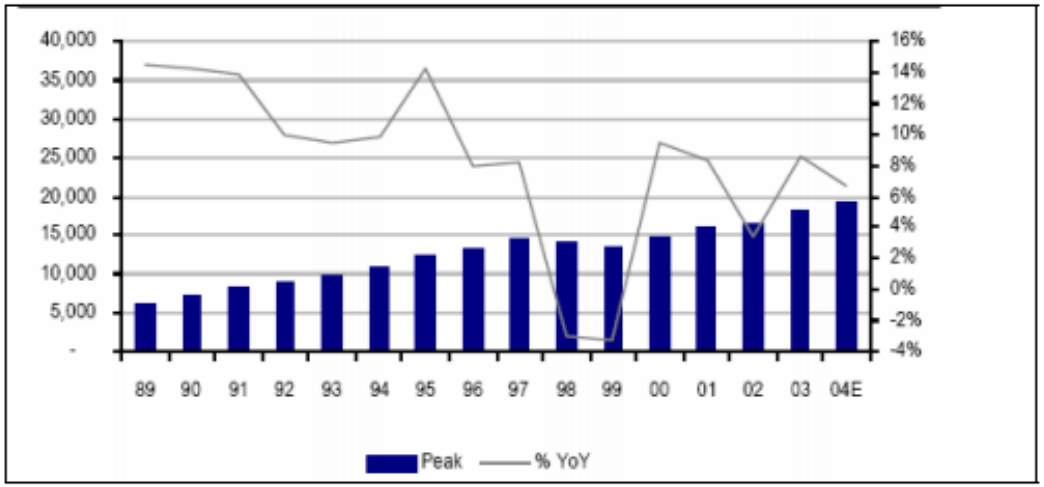
THAILAND

"Chartist" Demand Projection

- EGAT overestimated demand, signed contracts assuming strong growth, not accounting for a host of other factors
  - Industrial demand growth evaporated w/ 1997 Asian Financial Crisis, made worse by Baht-denoted PPAs

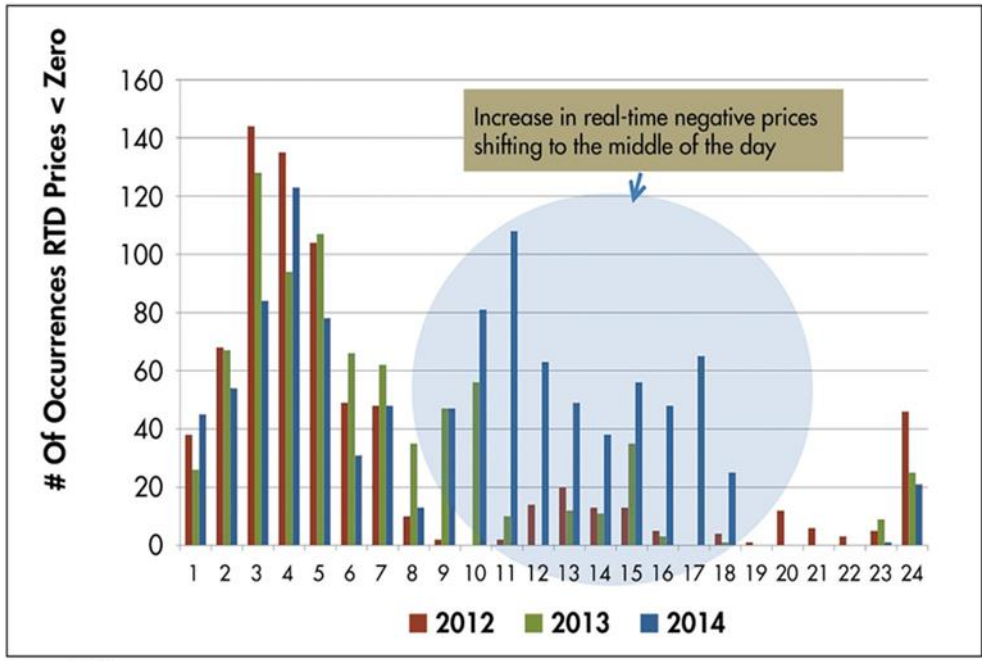
TABLE 3: CHANGES IN EGAT'S FORECASTED PEAK DEMAND (MW)

Power Dev't Plan	Announcement Date	Change
PDP 97-01	Oct-96	+28,518
PDP 97-02	Sep-97	-3,171
PDP 99-01	Dec-98	-7,700
PDP 99-03	Apr-99	-8,223



Source: UBS research (2004)

SHIFTING LOAD TO LOW PRICE PERIODS



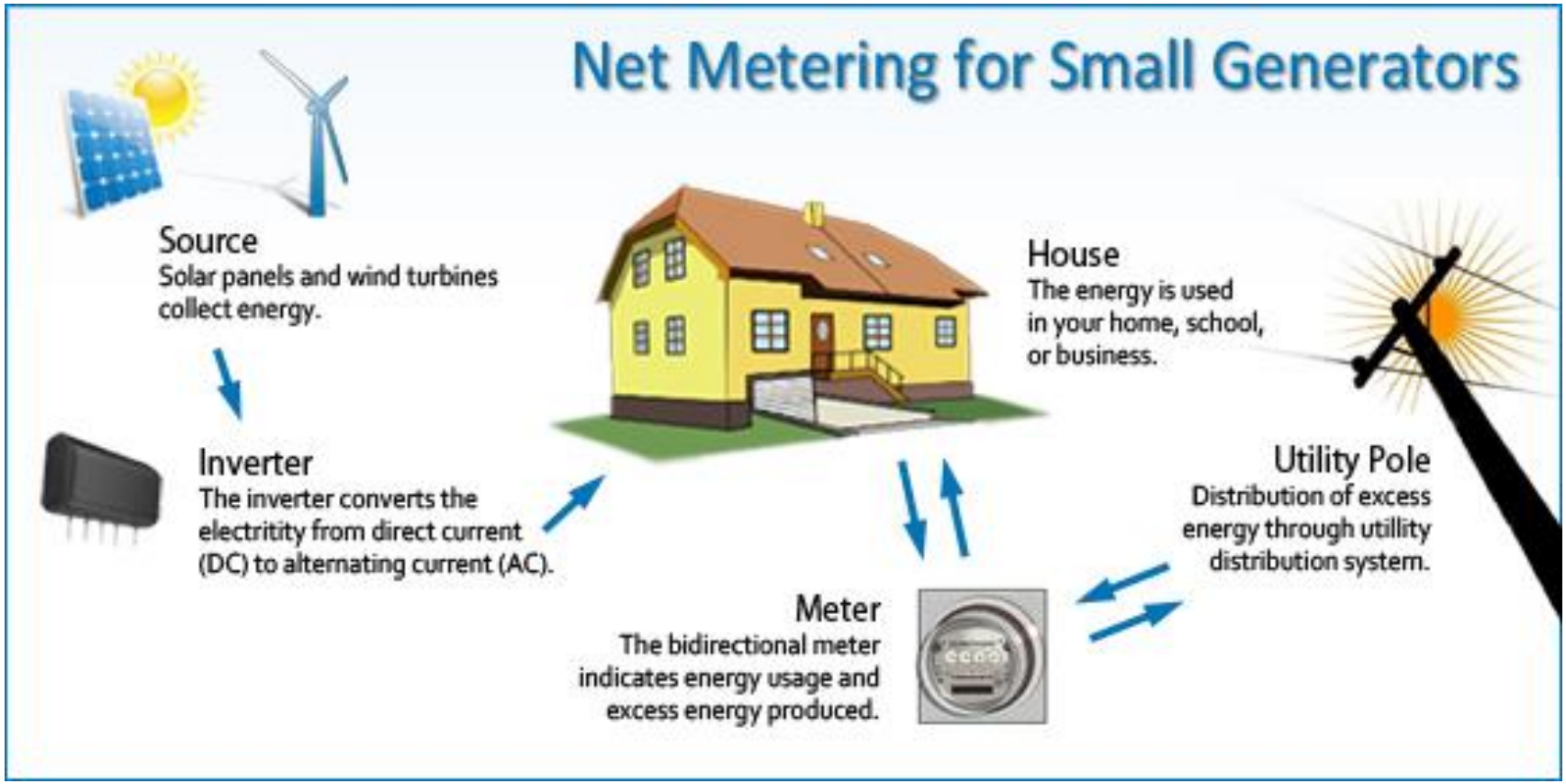
Source: CAISO

TARGETING ENERGY EFFICIENCY

- Utility, EE fund administrators, and customers agree on EE programs that benefit system and customers

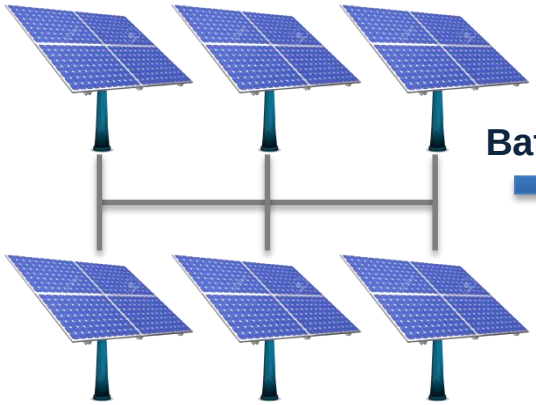
- LED appliances
- Electric vehicles, batteries, smart switches, etc.

DISTRIBUTED GENERATION



THE REVOLUTIONARY DESIGN

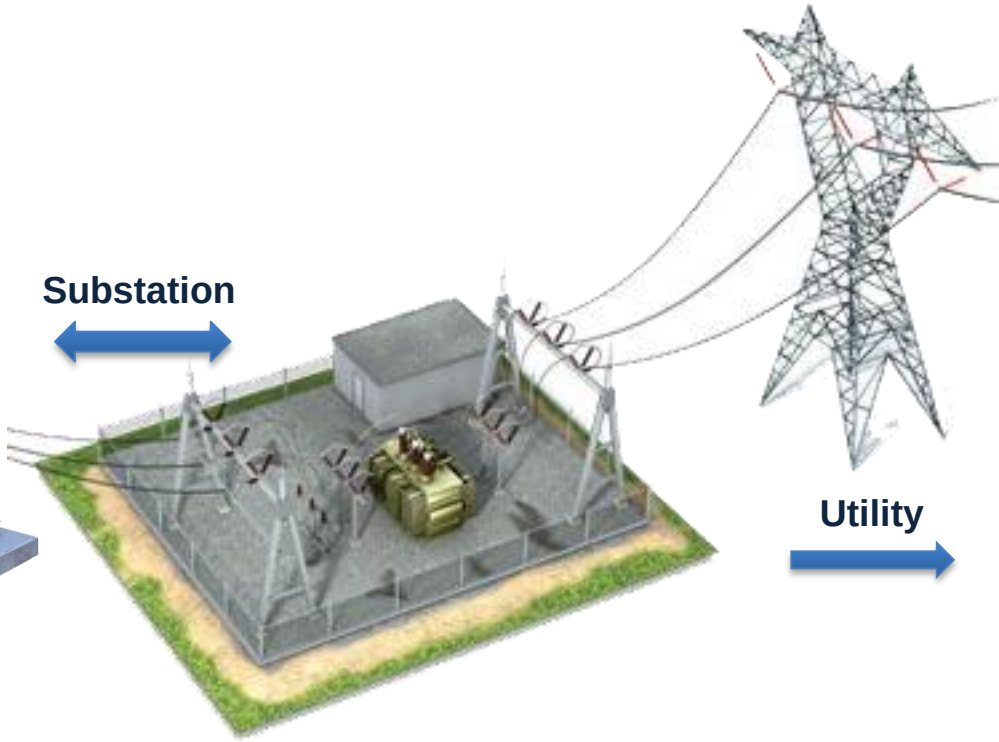
Solar Panels



Battery Pack

Retail Customer

Substation



Utility

FUEL SWITCHING

- Complimented by modern equipment upgrades, fuel switching is a simple approach to reducing energy consumption and costs for end-users

TARGETING ENERGY EFFICIENCY

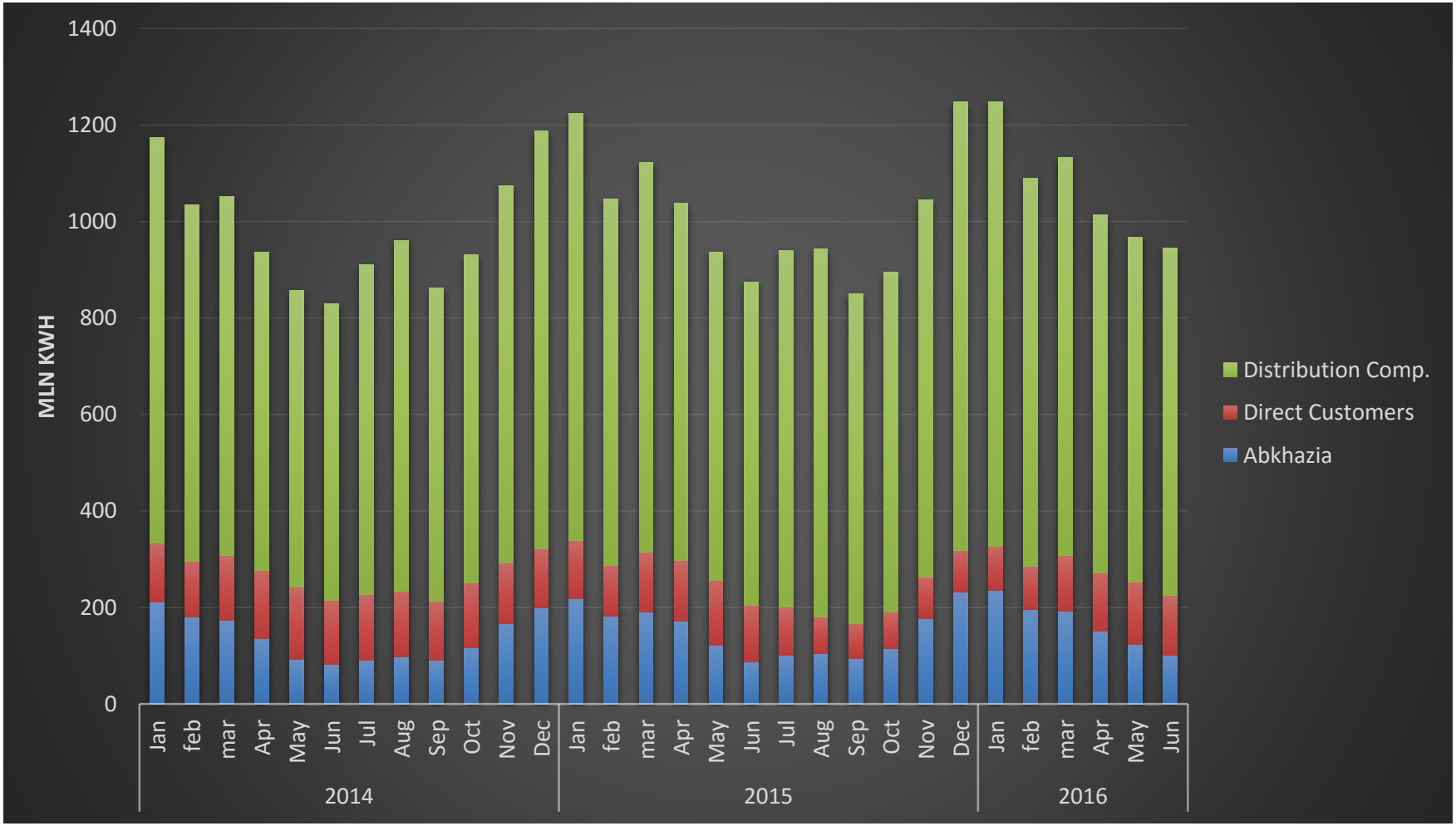
- Energy efficiency measures can have a **significant** effect on demand growth

SURVEY RESULTS IN INDUSTRIAL AND COMMERCIAL SECTORS

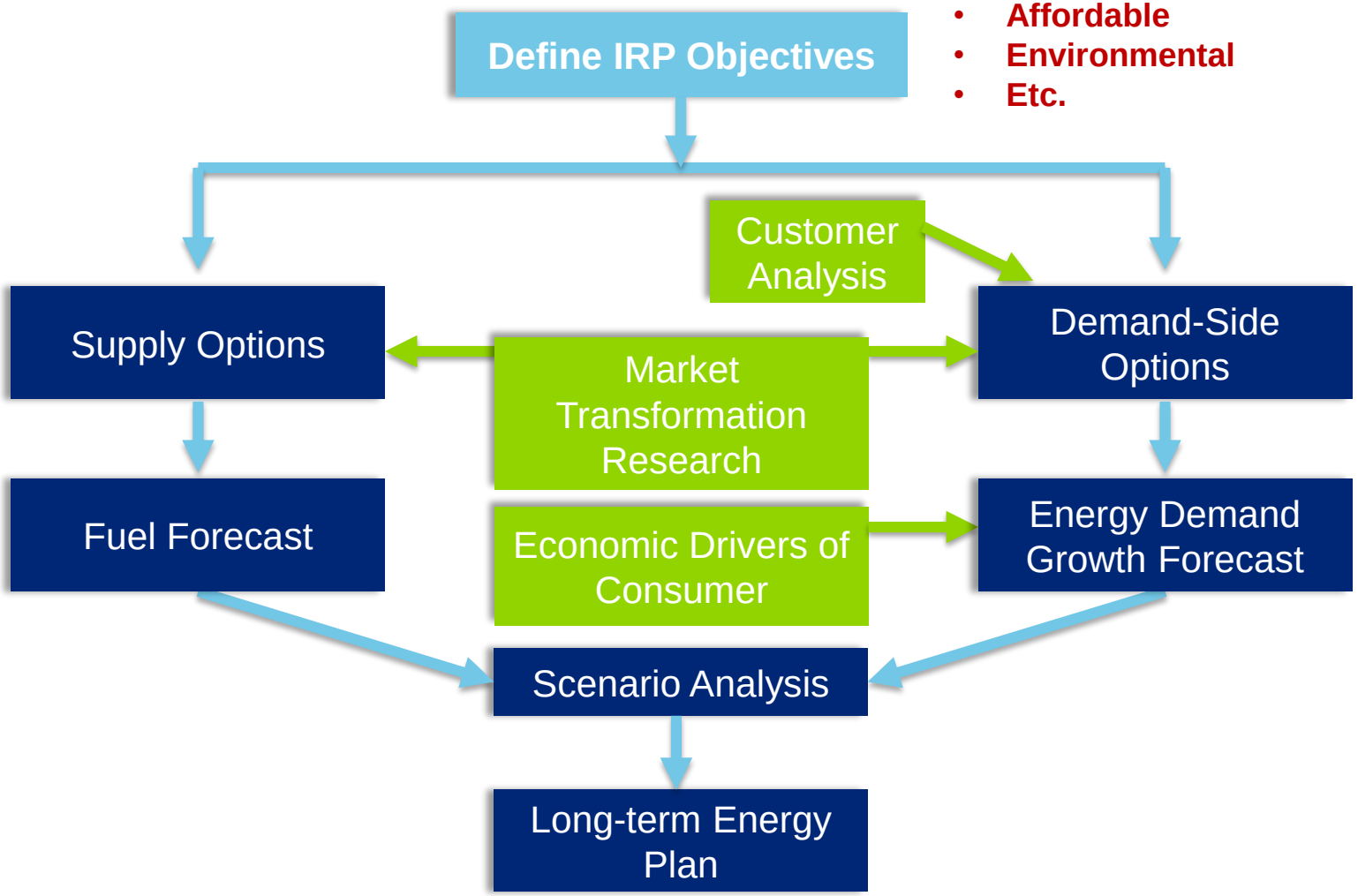
- Big potential of fuel switching
- Lack of energy efficiency programs
- Load growth is low that could be caused by several factors, such as low economic growth or electricity price increase

Source: World Experience for Georgia (WEG)

ELECTRICITY CONSUMPTION



M-CEP PROCESS



CONCLUSIONS

- Planning must be market-centered:
  - **Perform** more nuanced demand forecasting
  - **Consider** the likely retail rate increase associated with large infrastructure projects and subsidy programs
  - **Investigate** customer alternatives
  - **Integrate** distributed generation with network
  - **Embrace** the potential of customer generation as operating reserves

THANK YOU!

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