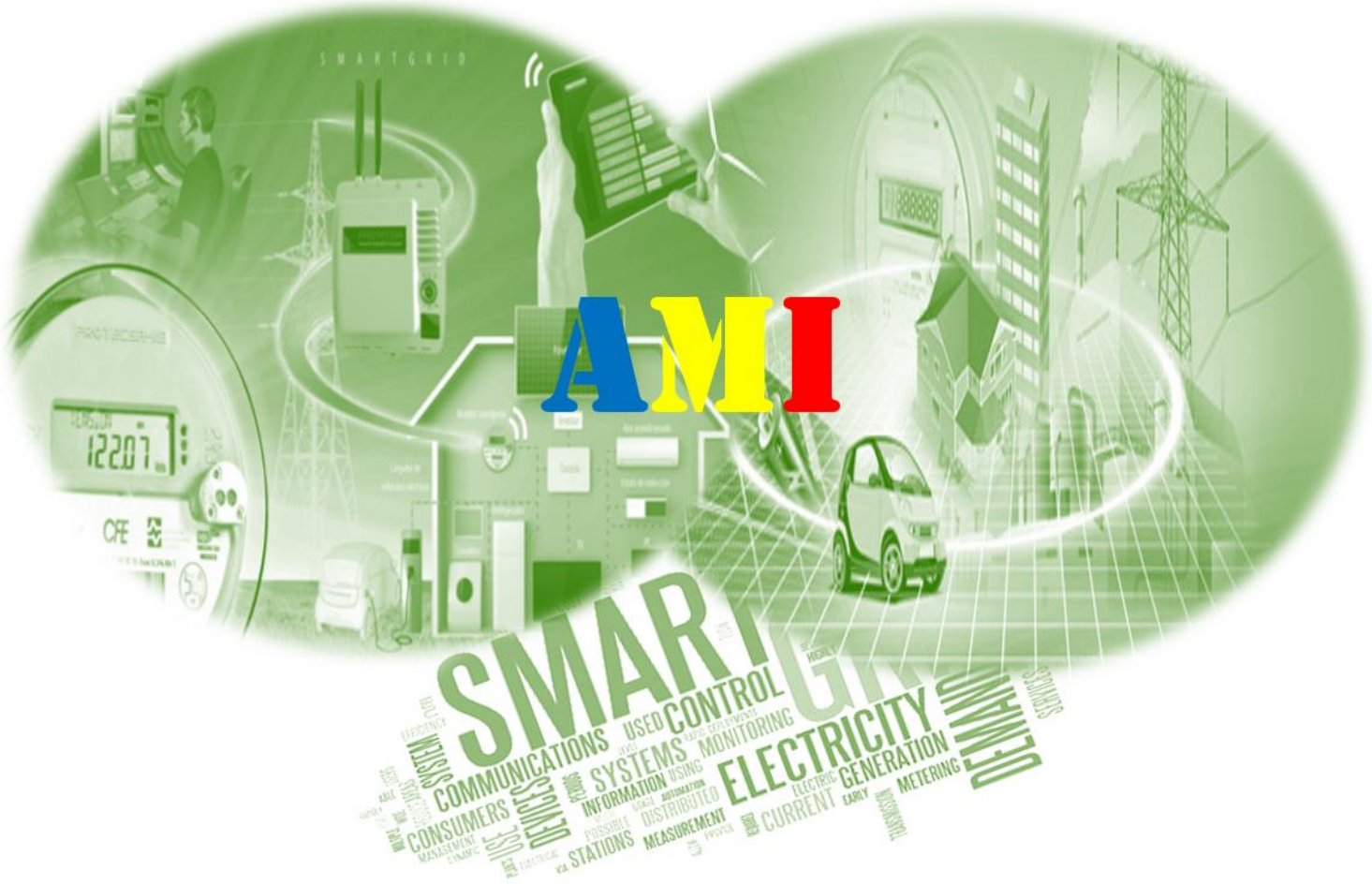
Advanced Metering Infrastructure



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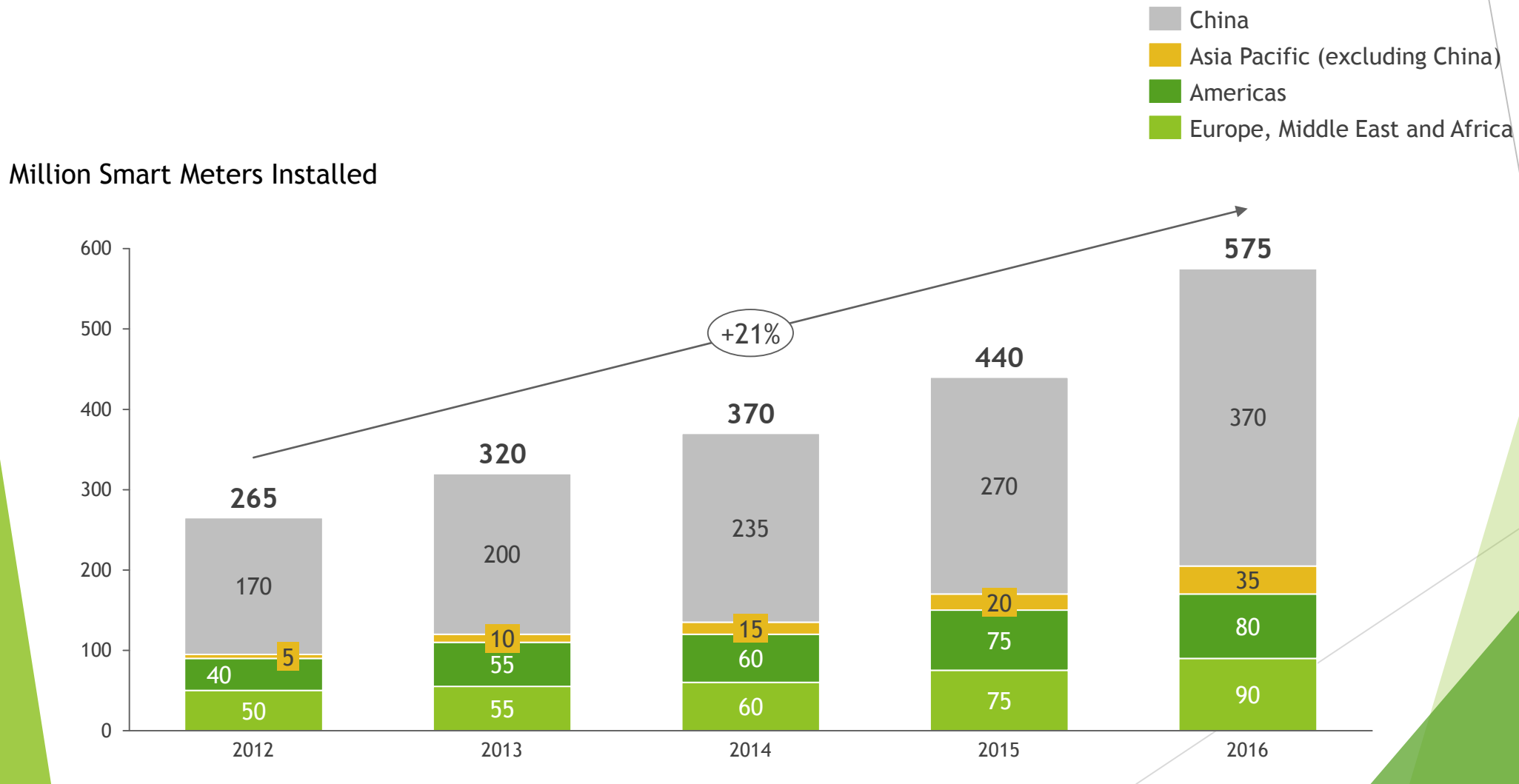
Key Trends

AMI mainly refers to the entire infrastructure from smart meters to the two-way communication network through the various communication and date and processing channel to control the main equipment.it comprises all the applications that permit the assembly and flow of energy usage material on a near real-time basis

- The market was valued at 11,460 million in 2014 and expected to reach 17,600 million by 2019 .
- Global contracted installations of smart meters grew 22% annually from 2012 to nearly 570 million units in 2016.

Smart Meters installation are quickly accelerating



AMI Implementation Benefits Summary

Direct Operational Benefits

- Meter Reading Automation
- Operational Efficiencies in Field & Meter Services
- Reduction in Unaccounted for Energy
- Operational Efficiencies in Billing and Customer Management
- Improvement in Capital Spend Efficiency
- Improvement in Outage Management Efficiency

Quantified Customer/ Societal Benefits

- Enhanced Customer Service
- Billing Accuracy Improvement
- Reduced Consumption on Inactive Meters
- Informed Decisions on Energy Usage
- Reliability - Earlier Identification of Outages Prompts Accelerated Response
- Environmental Preservation through Reduced Peak-Time Usage

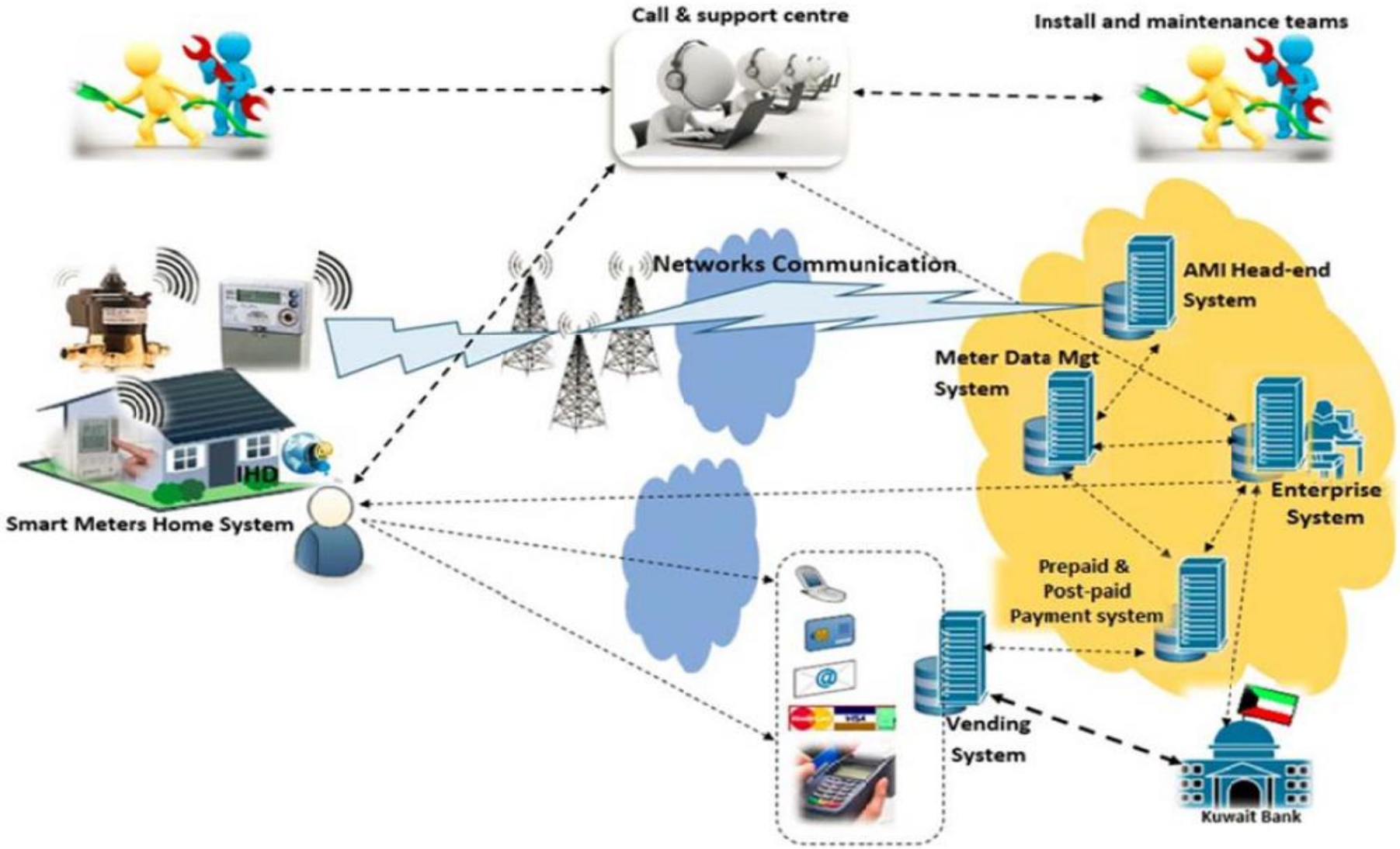
Additional Customer/ Societal Benefits

- Enables Net Metering and Reduces Costs
- Enables New Service (e.g. smart appliances, other load reduction programs)
- Potential to Enable PEVs (Plug-in Electric Vehicle)
- Enhanced Customer Convenience
- Increased Safety for Meter Readers and Field Services Personnel
- Job Boost to Local Economy
- Bolsters Market Competition - Beneficial for Customers

AMI COMMUNICATIONS METHODS

Technology	Applications	Frequency Band	Data Rate	Specifications/Standards
NB-PLC	Indoor/Outdoor command & Control services, AMI	3–490 kHz	~200 kbps	PRIME, G3-PLC/IEEE 1901.2, ITU-T G.hnem (Higher Data Rates) IEC 61334-5-1, IEC 62056-21, ISO/IEC 14908-1, Meters & More (Lower Data Rates)
BB-PLC	In-home applications, Home Networking	2–30 MHz	~100 Mbps (IEEE 1901) ~200 Mbps (HomePlug AV) ~1 Gbps (ITU-T)	HomePlug 1.0 (14Mbps), HomePlug Turbo (85Mbps), HomePlug AV (200Mbps) TIA-1113, IEEE 1901, ITU-T G.hn
DSL	Data Transmission over telephone lines	ADSL: 25–1104 kHz VDSL: 25 kHz–12 MHz	256 kbps–100 Mbps	ITU G.991.1, ITU G.991.2 (SDSL) ITU G.992.1, ITU G.992.2 (ADSL) ITU G.993.1, ITU G.993.2 (VDSL)
ZigBee	AMI	2.4 GHz (worldwide)	250 kbps	ZigBee Home Automation
Wireless Mesh	For communication networks made up of radio nodes	900 MHz, 2.4 GHz	54, 48, 36, 24, 18, 12, 9, 6, 4, 5, 1.5 up to 300 Mbps for outdoor	IEEE 802.11, IEEE 802.15, IEEE 802.16
GSM/GPRS	Mobile functionality—voice, data transfer	900 MHZ, 1.8 GHz	14.4 kbps (GSM) 56–114 kbps (GPRS)	EN 301349, EN 301347, EN 301344
3G	Mobile functionality—voice fast data transfer	450 MHz, 800 MHz, 1.9 GHz	over 0.2 Mbps up to 14.7 Mbps (CDMA, EVDO)	UMTS, CDMA 2000, EV-DO, EDGE
LTE	High speed data for mobile phones and data terminals	700–2500 MHz	100 Mbps (requirement) up to ~320 Mbps	
WiMAX	Mobile Broadband or at-home broadband connectivity, Alternative to DSL	2–11 GHz	up to 75 Mbps (IEEE 802.16d) up to 15 Mbps (IEEE 802.16e)	IEEE 802.16, IEEE 802.16d, IEEE 802.16e
LPWAN	IoT, Smart metering applications	868 MHz (SigFox), 433, 868, 915 MHz (LoRaWAN), 700, 800, 900 MHz (NB-IoT)	lower than 100 kbps	SigFox, LoRaWAN, NB-IoT

Smart Meters Solution Overview and Architecture



Some of the technologies used by country for smart metering data transmission.

Country	Technology	Standard(s)/Specifications (If Available)
Italy	NB-PLC	Meters & More
Spain	NB-PLC	Meters & More, PRIME
France	NB-PLC	G3-PLC, IEC 61334-5-1
UK	NB-PLC, WAN	IEC 62056-21, Communication based on open standards (some cases)
Germany	PLC, GPRS	
Sweden	NB-PLC, GSM/GPRS	IEC 62056-21, IEC 14908 (some cases)
Greece	NB-PLC, GSM/GPRS	

Summary of Smart Metering Application projects and their main characteristics

Project	Aim	Characteristics	SM Technologies Used
InvoGrid	Control and Management of the grid	Provide with equipment for grid control	PLC DCSK, PLC PRIME, GPRS
MeRegio	Smart Metering installation	Sending SM data through customer's Internet	
Hook Norton	Examine energy consumption and monitor the distribution substations	Examine Customer involvement to energy reduction	NB-PLC (first link) Wireless (second link)
EDRP	Impact of customer feedback on reduction of consumptions	Smart Meter and In-home display installation	GSM (both links) PLC at small extent (first link)

Summary of projects for Grid Monitoring and Control through Smart Metering and their main characteristics.

Project	Aim	Characteristics	SM Technologies Used	Other Technologies
E2SG	Smart Grid Monitoring and Control	PMUs used for network monitoring, Smart Meters application, optimum power transfer to the grid	Smart Meters with wireless transceiver (some cases)	
NOBEL	Grid Monitoring	Smart Meters form a wireless sensor network	Wireless for communication among smart meters	
Mirubee	Grid Monitoring through smart meters	Identifying electricity consumption of each device connected to grid	PLC (first link)	Wi-Fi for transmitting device consumption to a cloud server

Smart metering is the first step on the digital journey

1. Grid Visibility and Automated Operations
   “Greater Grids”
2. Converging IT / OT
   “Seamless Technology”
3. Pro-active Data Analysis
   ”Perfectly Predicting”
4. Advanced Asset Management
   “Asset-Intelligent”
5. Beyond the meter
   “Intelligently connecting”
6. Managing Disruptive Demand & Generation
   “Flexible Green”
7. Experience Engineering
   “Effortless engagement”
8. Innovative proposition
   “Unboxing to demand”

The Smart metering

Thank you

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