METERING LATIN AMERICA

BILLING/CRM LATIN AMERICA

SMARTGRIDS LATIN AMERICA

WATER METER SUMMIT

Smart Metering – What Now?

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Technology for the Utility Industry

October 19 – 21, 2009
Transamerica Hotel,
Sao Paulo,
BRAZIL

Agenda

- The role of metering
- How automated metering has evolved over time
- The motivation and changes throughout this evolution
- Worldwide shipment statistics
- Current events
- Being “Smart” (as in Smart Metering or Smart Grid)
- Impact of deregulation
- The link between metering and payments
- Other Factors
- Where the metering industry is heading

Types of Meter Discussed

- This talk addresses electric, gas, water and heat metering
- It also discusses related topics, such as prepay metering, deregulation, etc.
- Because most of the recent activity emanates from the electric utility industry, electric metering is more often addressed
- In most instances, there are water, gas and heat versions of the examples given for electric

Introduction

- The utility industry worldwide is now going through its greatest change since the late 1800's
- Suddenly, electric utilities want a "Smart" Grid
- Leaders who were trained to be "conservative" are now being asked to make bold changes
- Government funding is available (at different levels) for many of these projects in many countries
- Worldwide financial crisis and stimulus initiatives are changing our marketplace
- Country-to-country differences gradually disappearing

Role of Metering

- Society sets rules for utilities; meters help implement them
- The meter is the point where the technology of the utility begins to provide services to consumers
- All metering products & services relate to people; we must not forget the roles & needs of people as we plan services
- Metering is closely linked to payments; there are many different approaches to both metering and payments
- Technology will evolve over time; we must allow for innovation
- Money is not unlimited; we must balance benefits with costs, risks and the availability of funds

Society's Objectives

- Build a modern utility infrastructure
- Connect infrastructure to homes, businesses
- Cover costs; ensure profit where permitted
- Equitably spread the costs of running the utility
- Evolve to meet society's changing needs (a key driver for Smart Metering, Smart Grid …)

People &Their Problems

- If projects fail, it is usually the result of utilities not dealing with staff needs, or government concerns or the needs of their customers
- Projects rarely fail because the equipment fails; the worst problems occur when project staffs are poorly managed or senior management is not committed to the project
- Therefore, we must remember to focus on the people issues

How Automated Metering has Evolved over Time

- Generation 1: Metering originally created to help utilities bill for services. Advanced Metering started by replacing manual reading with a remote reading system
- Generation 2: Added functionality to AMR systems. Introduce prepay and submetering systems
- Generation 3: Upgraded AMR to AMI – Collected/stored many meter reads
- Generation 4: Smart Metering – Use metering as operations and planning tool; start to integrate prepay and AMR
- Generation 5: Smart Grid – Jointly manage metering & grid
- Generation 6: Smart Utility – Dynamic decision-making

Generation 1 Motivation

Metering originally created to help utilities bill for services. Advanced Metering starts by replacing manual reading with a remote reading system

- Provide an equitable basis for bills
- Lack of access to meters
- Resolve meter reading errors
- Safety for meter reader
- Document how much (electric, gas, water, heat, sewage, etc.) each customer is using

Generation 1 Changes

Replace or retrofit existing meters to introduce AMR communications

- The first time some meters replaced for reason other than failure or accuracy; many are still retrofit; expected meter life approximately 20+ years
- Communication is typically one-way to utility; a few systems support a wake-up signal
- Basic meter data collection system is installed
- Cost justification is primarily staff reduction
- Meter technology primarily electromechanical

Generation 2 Motivation

Add functionality to AMR systems; Introduce prepay and submetering systems

Generation 1 plus:

- Understand how much is unaccounted (usually due to inefficiencies, built-in losses or theft)
- Resolve payment problems
- Identify unknown customer
- Collect and display historic usage information

Generation 2 Changes

Enhance meter functionality, accuracy and communications

Generation 1 plus:

- Some utilities replace electromechanical meters with digital meters (lifetime of meters and meter system shrinks to approximately 15 years)
- Communication is primarily one-way
- Meter data collection systems enhanced, but still basic
- Utilities become willing to consider some “soft costs” in business case

Generation 3 Motivation

Upgrade AMR to AMI – Collect/store many meter reads

Generation 2 plus:

- Collect massive amounts of usage data; store data in Meter Data Management (MDM) system
- Scattered pre-Smart Meter functionality
- Vendor-specific solutions
- Support time-differentiated rates

Generation 3 Changes

Upgrade AMR to AMI – Collect massive amounts of data

Generation 2 plus:

- New digital meters installed in almost all instances; meter lifetime shrinks to approximately 10 years
- Data communications embedded in meters; many vendors cross-license the technology
- Some vendors build basic front-end systems, but bulk of data in Meter Data Management (MDM) system
- For electric meters, two-way comm. widely used
- Reprogrammable meters & remote disconnects common
- Business cases include “soft costs”

Generation 4 Motivation

The future: Smart Metering – Use metering as an operations and planning tool; start to integrate prepay and AMR

Generation 3 plus:

- Frequent meter reads (possibly many times per hour)
- Net-metering (measure flow to and from customer)
- Remotely re-programmable meter
- Remote disconnect (*ensures safety of utility's workers*)
- Standards-based interfaces; less vendor-specific features
- Integrate metering with other utility operations systems
- Meter-driven applications (DR, outage management …)
- etc.

Generation 4 Changes

Smart Metering – Significantly increase meter functionality; begin to integrate utility software systems

Generation 3 plus:

- Total replacement of meter population being considered (meter lifetime shrinks to below 10 years)
- All features on previous slide
- Drives the integration of all utility operations systems
- Utility cost/consumption display devices in home
- *Staff retraining increasingly important*

Generation 5 Motivation

Smart Grid – Jointly manage metering & grid (future)

Generation 4 plus:

- Combine metering, other data and grid sensors (including SCADA) to jointly manage utility operations
- Integrate workforce management tools with operations
- Integrate planning tools for grid and metering
- Use these tools to manage growth, repair, maintenance and service quality
- Dynamically address outages and other utility events
- Deliver more information to utility and customer

Generation 5 Changes

Smart Grid – Jointly manage metering & grid (future)

Generation 4 plus:

- Smart Metering a prerequisite; lifetime of meter no longer an issue
- Cost to replace whole grid too high; sensors and comm. added to existing grid electronics to control costs; massive grid replacements begin
- Consumers install equipment to generate/store power
- Requires major re-design of software systems
- *Significant amount of staff retraining*

Generation 6 Motivation

Smart Utility – Dynamic decision-making (future)

Generation 5 plus:

- Add data mining tools to integrated operations
- Build a common operations system that dynamically tracks system performance, engineering projects, inventory and expenditures, workforce, etc.
- Build dynamic decision-making system based on existing operations rules that automatically recommends moment-by-moment operation of the entire utility

Generation 6 Changes

Smart Utility – Dynamic decision-making (future)

Generation 5 plus:

- Customer service now the key priority
- Requires major new software systems
- Utilities must undergo significant reorganizations; deregulation common worldwide
- Meters can support prepay or postpay, at customer's request
- Utility staffs shrink; on-going staff retraining

Other Factors that Affect Metering

- Deregulation
- Payments
- Technology does not make a utility “smart,” systems do
- People problems
- Paying for all these changes
- Aggregation of vendors

A Real-World Example

- Slides provided by FPL in March 2009
- FPL has been progressive in integrating its operations systems
- Though utility is U.S.-based, it’s lessons are applicable worldwide

Repowering the Future: Building the Smart Grid Amidst a World in Crisis

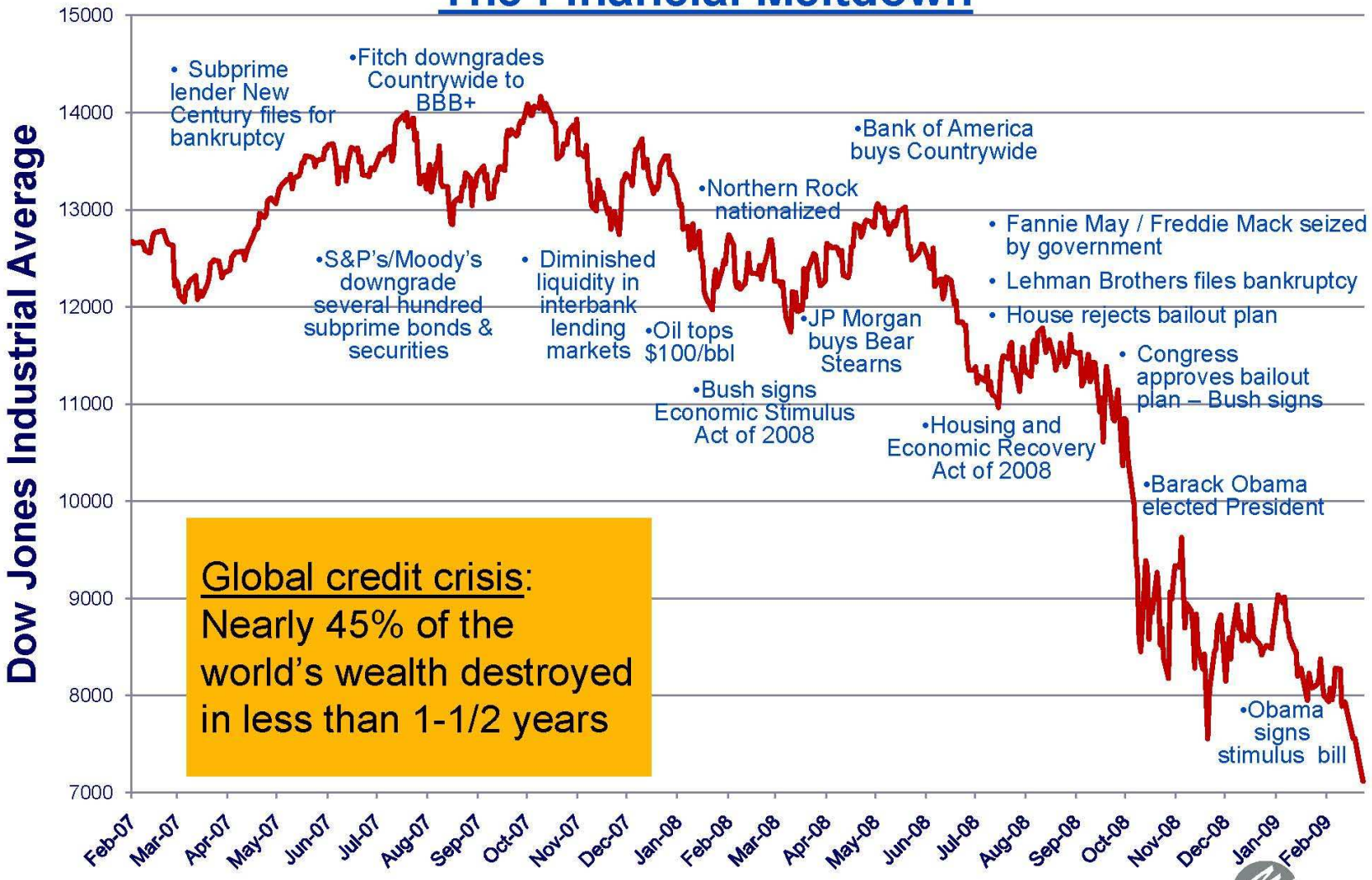
Metering, Billing/CIS America Conference

March 23, 2009

Christopher Bennett
Executive Vice President & Chief Strategy,
Policy & Business Process Improvement Officer
FPL Group, Inc.

We are living in unprecedented times

The Financial Meltdown



Global credit crisis:
Nearly 45% of the world's wealth destroyed in less than 1-1/2 years

Source: Dr. John Caldwell, Edison Electric Institute; Steve Schwarzman, Blackstone Group LP

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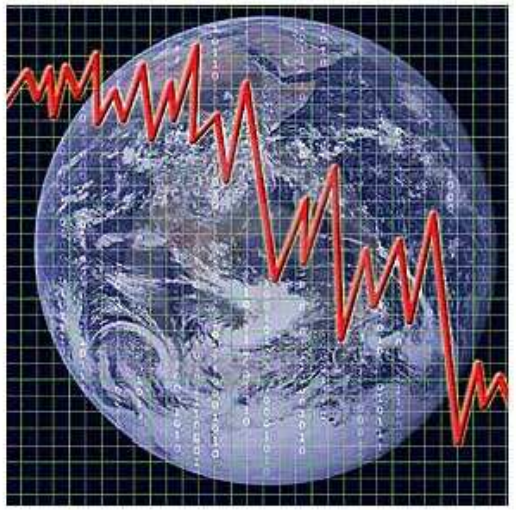
There are many forces driving massive transformation of our industry

Energy Industry Challenges

- Global economic crisis; severe hurdles to capital-raising
- Extreme energy price escalation and volatility
- Backlash from energy consumers
- Urgent need to achieve energy independence and security
- Impending climate change legislation to address greenhouse gas emissions
- Increasing environmental and jurisdictional constraints on siting and permitting
- Uncertain future fuel prices
- Aging infrastructure and workforce



Incredibly difficult environment in which to navigate

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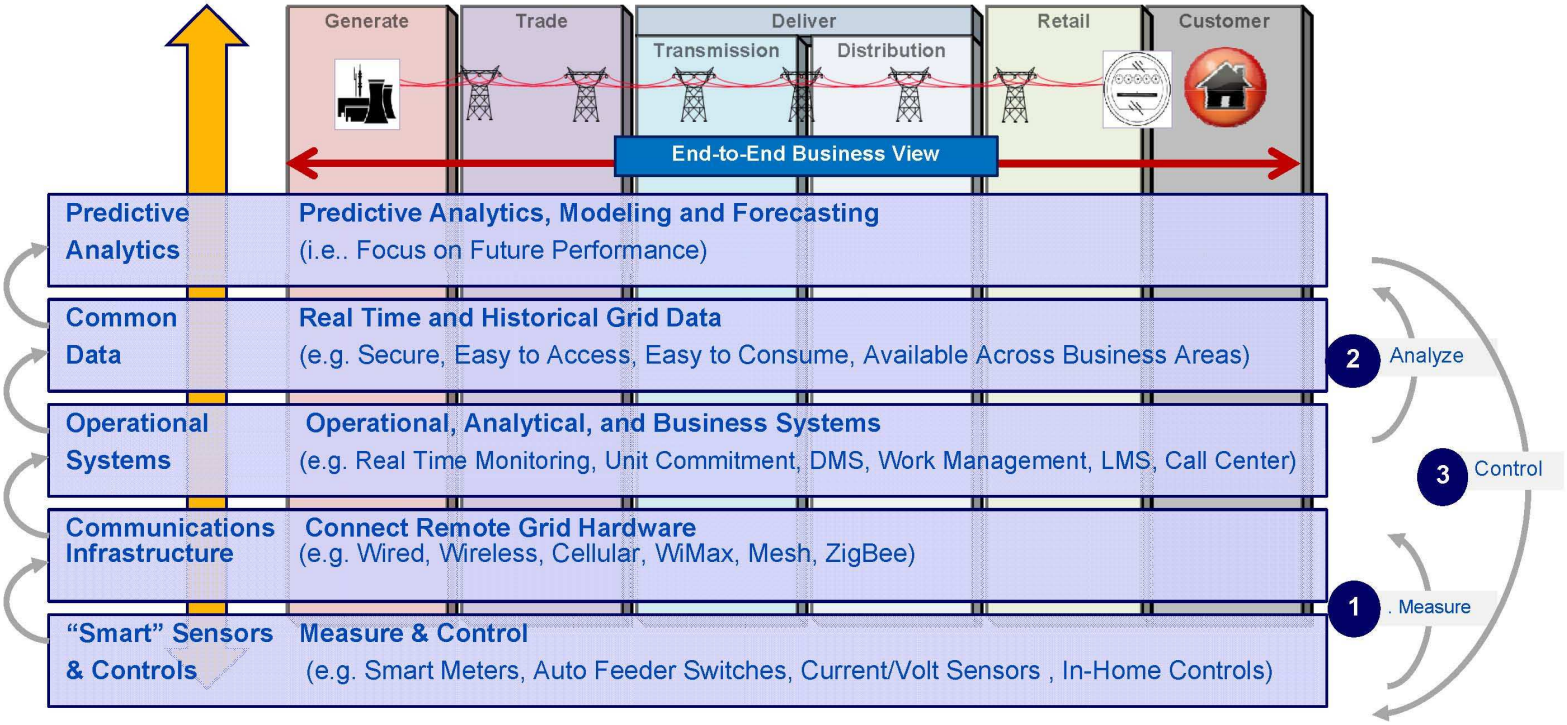
"You never want a serious crisis to go to waste. And what I mean by that is an opportunity to do things you think you could not do before."

- Rahm Emanuel
(President Obama's Chief of Staff)

We have a layered taxonomic view of Smart Grid…

FPL's Smart Grid Vision

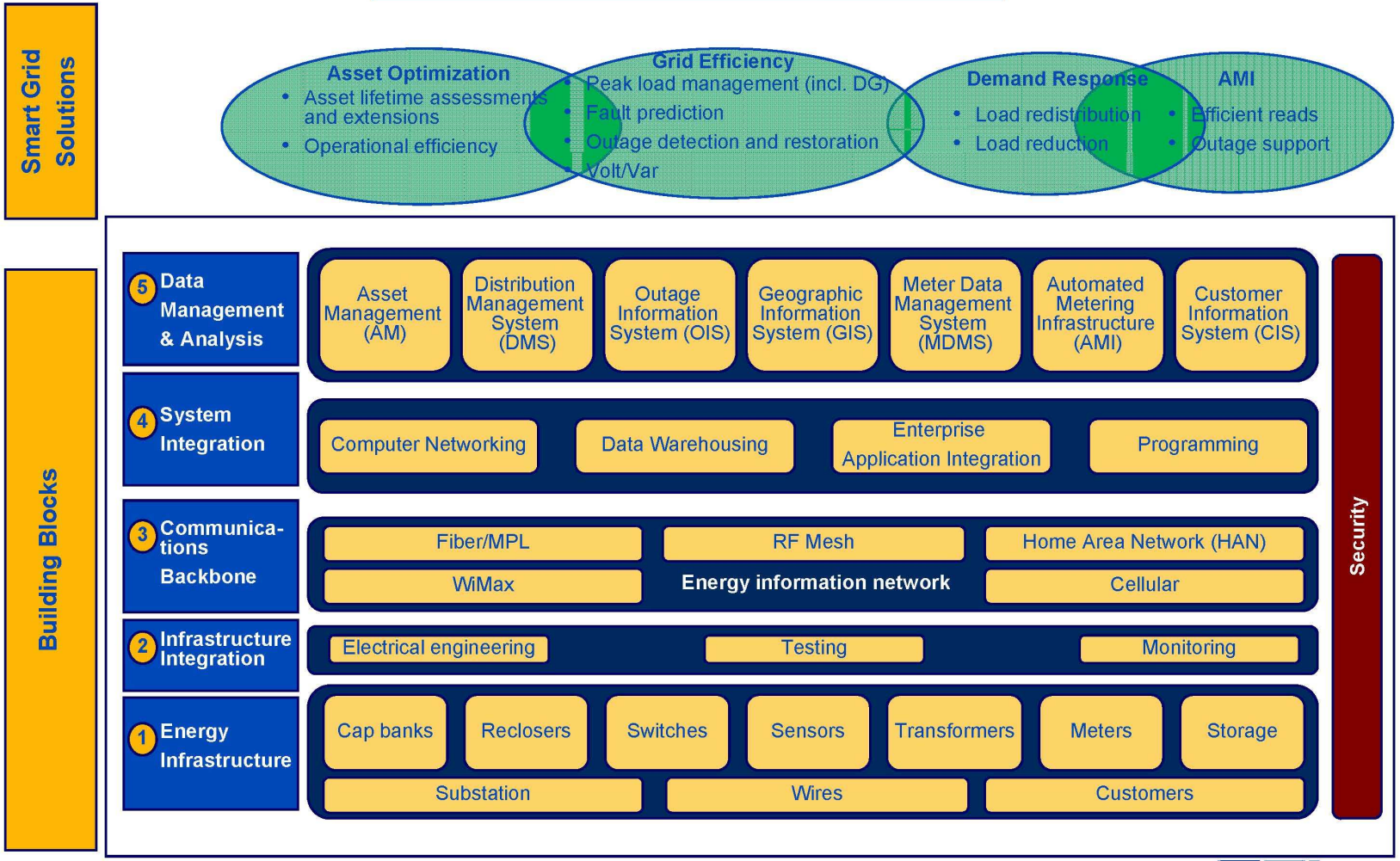


End-to-end business view enables FPL to improve grid performance, drive efficiencies, and enable new customer services

FPL

… and the components underlying it

Smart Grid Building Blocks



Source: McKinsey

Whether we are successful in meeting the challenges of execution depends on our *agility* and *ability* to innovate

Key Factors for Successful Execution

- Customer-centric business models
- Market-driven, breakthrough innovation
- Untraditional partnerships and collaboration – development of industry ecosystem and "complementors"
- Rapid convergence on standards
- Dedication to interoperability
- Tenacious commitment to ongoing cost improvement
- Unrelenting focus on cyber-security
- Development of world-class data analytics

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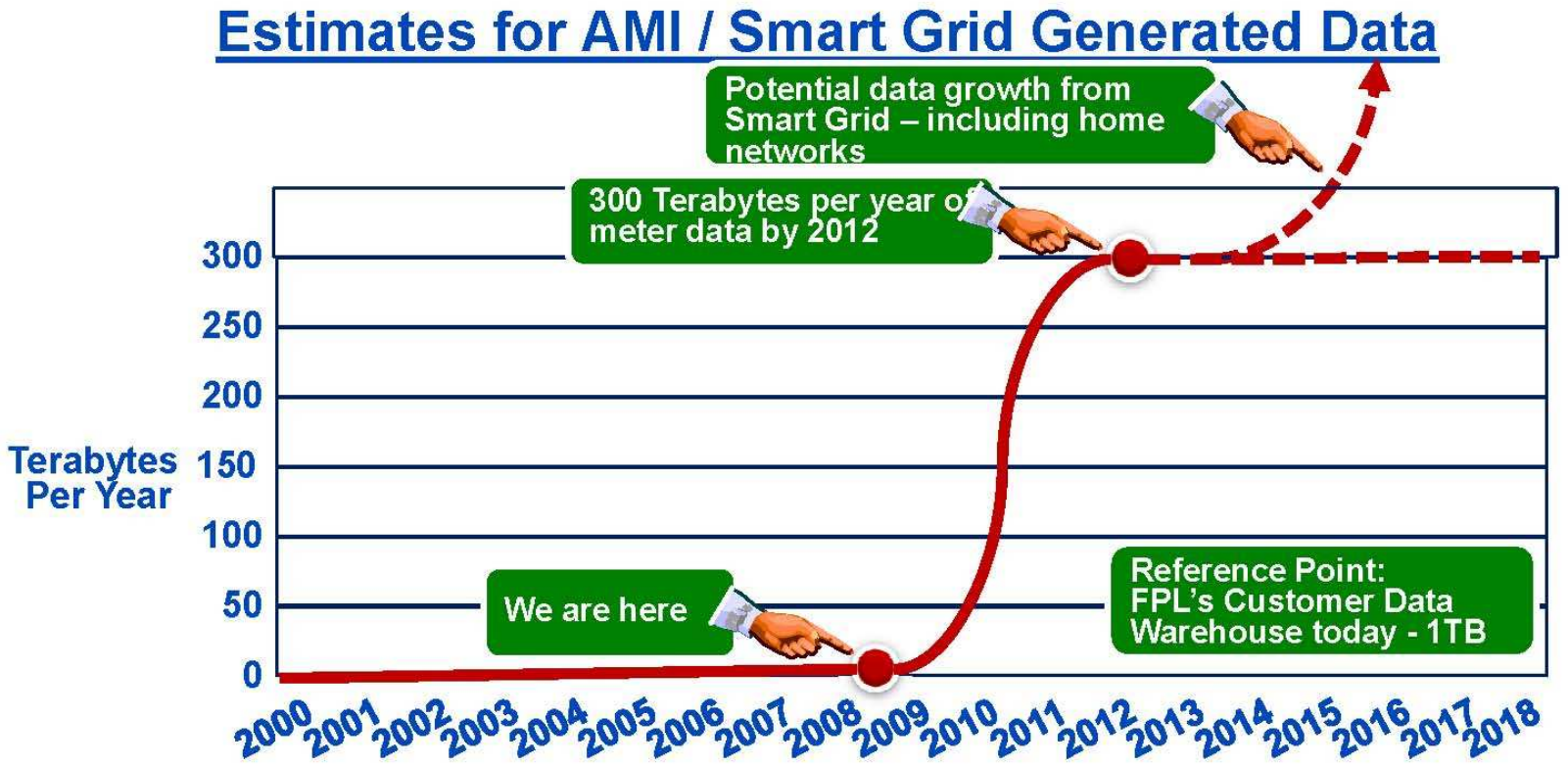
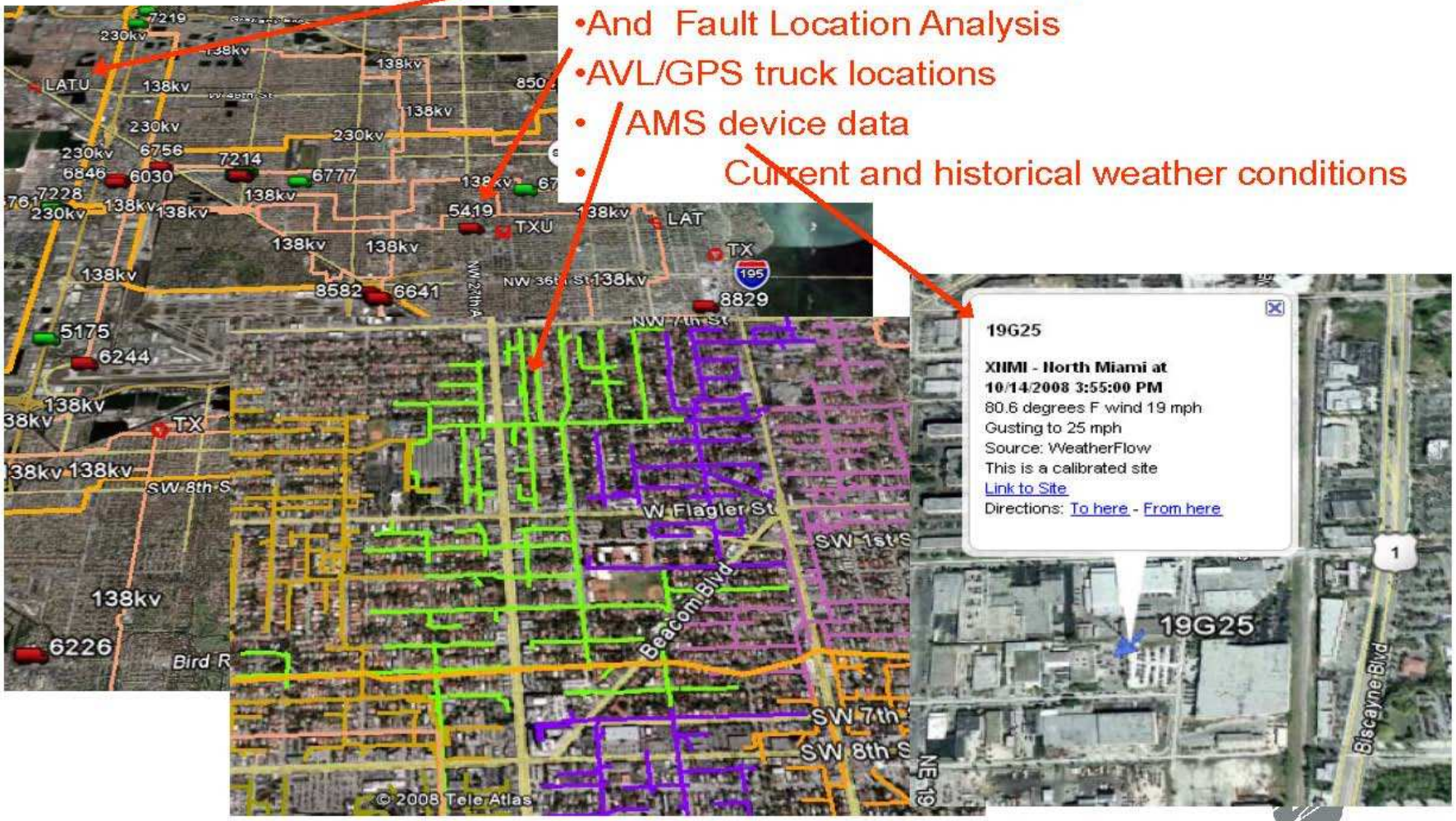
AMI and Smart Grid will generate volumes of data, far beyond anything we experience today



AMI and Smart Grid will increase the amount of measurement data and number of control points far beyond what we have today

Spatial Control Panel and Google Earth

- Real time and historical outage information
- And Fault Location Analysis
- AVL/GPS truck locations
- AMS device data
- Current and historical weather conditions



The time is right for Smart Grid

Summary

- Economic crisis presents a unique opportunity
- Vision seems clear
- Execution faces great challenges
- Success largely dependent on new competencies and untraditional ways of doing business in our industry

Are we ready to make it happen?

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AMR Worldwide Statistics

AMR Units Are Worldwide as of 1 January 2008

Region	# Cumulative	% Cumulative	# Projects	% Projects
North America	120,756,669	66.3%	12,085	89.3%
Europe	46,055,966	25.3%	883	6.5%
Asia	13,463,739	7.4%	228	1.7%
Central & South America	980,045	0.5%	147	1.1%
Middle East	375,532	0.2%	51	0.4%
Australia/NZ	173,548	0.1%	78	0.6%
Misc.	158,899	0.1%	11	0.1%
Africa	105,358	0.1%	53	0.4%
Total:	**182,069,756**	**100.0%**	**13,536**	**100.0%**

Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

The U.S. as an Example

- The AMR market started in the U.S., the AMI and Smart Meter markets had their first major successes there, and the best statistics showing market growth are from the U.S.
- Over the next 5 years, the U.S. will maintain its lead, and then gradually cede it to Europe and China
- Smart Metering will first have large deployments in the U.S.
- Therefore, we often use the U.S. as an example

NA Shipments of AMR/AMI Units (as of 1 January 2009)

Meter Type	# AMR Units	Market Share	Annual Shipments	# AMR Projects
Electric	68,845,601	48.3%	9,498,236	3,455
Gas	39,220,233	27.5%	5,976,741	777
Water	34,311,793	24.1%	5,673,098	7,806
Misc.	42,163	0.0%	0	47
Total:	142,419,790	100.0%	21,148,076	12,085

Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

Inconsistent Growth Worldwide

Region	2007	2006	2005	2004	2003
North America	18,335,814	16,994,422	13,602,637	10,874,418	11,678,752
Asia	5,565,845	3,749,559	30,416	130,418	87,062
Europe	4,191,715	3,661,636	9,744,787	9,373,480	8,594,934
Central & South America	333,202	406,773	32,526	44,638	6,658
Middle East	75,087	8,573	5,669	13,375	0
Australia/NZ	30,020	32,959	5,887	3,268	1,305
Africa	23,222	15,503	30	1,000	7,450
Miscellaneous	0	0	78,621	0	-3,207
Total:	**28,554,905**	**24,869,425**	**23,500,573**	**20,440,597**	**20,372,954**

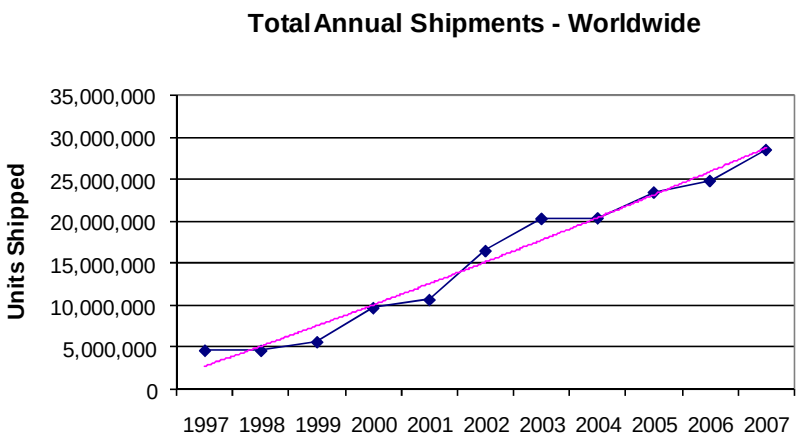
Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

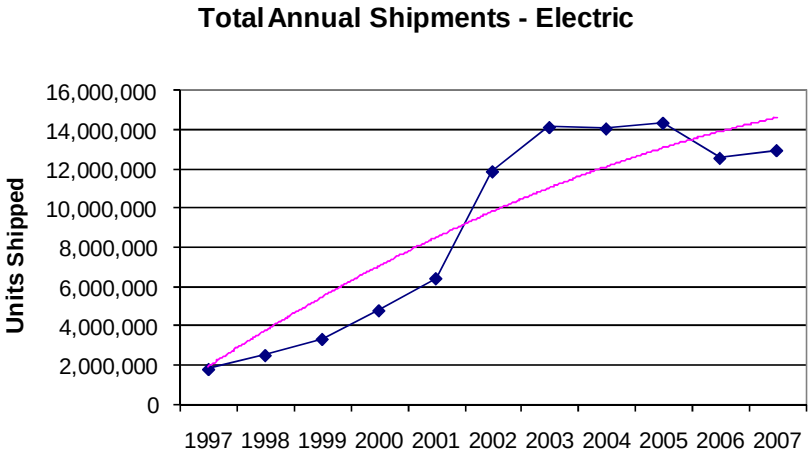
Shipments by Type of Meter

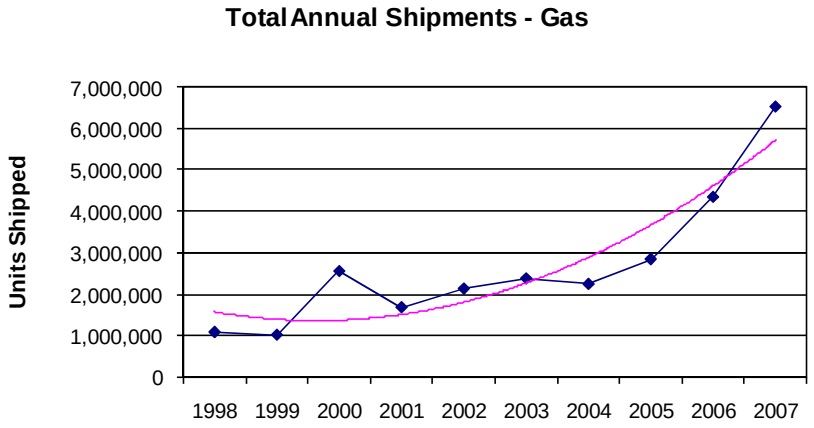
Region	# Units Shipped	# Projects
Worldwide	**182,069,756**	**13,536**
North America	**120,756,669**	**12,085**
Rest of World	**61,313,087**	**1,451**
Electric	**102,714,528**	**4,341**
Gas	**35,272,966**	**831**
Water	**43,411,518**	**8,226**
Heat	**586,059**	**42**
Miscellaneous	**84,685**	**96**

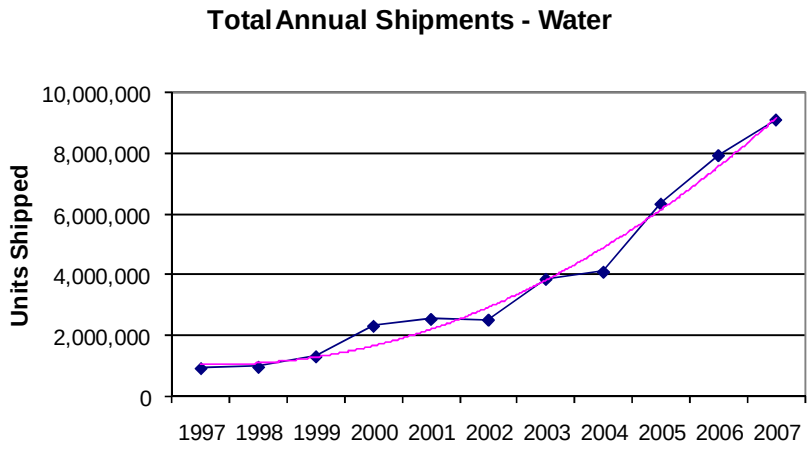
Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

Worldwide Growth





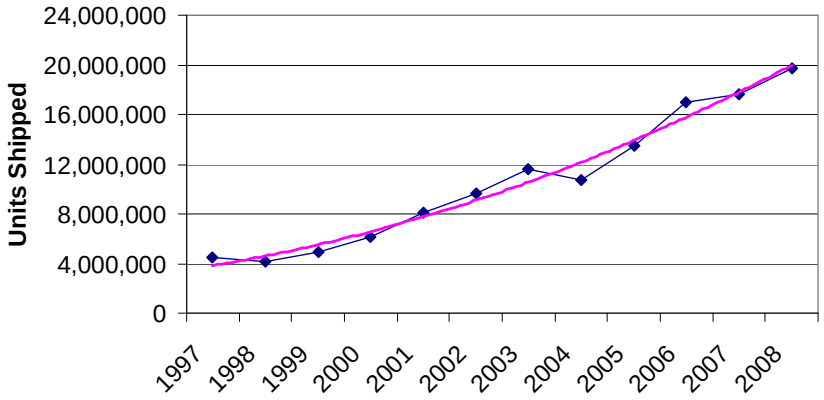




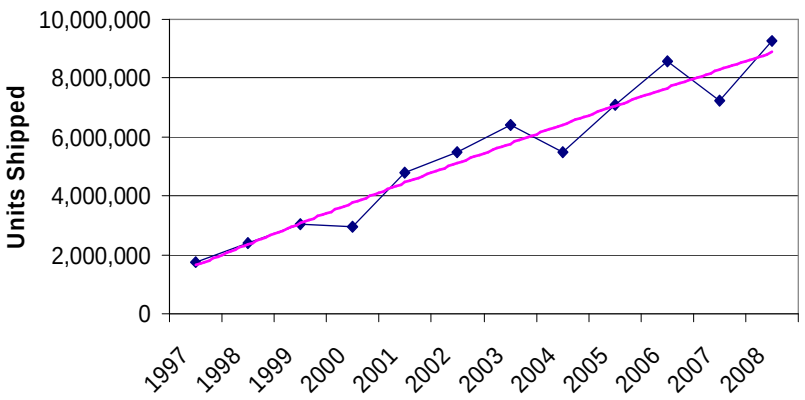
Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

North American AMR/AMI Market

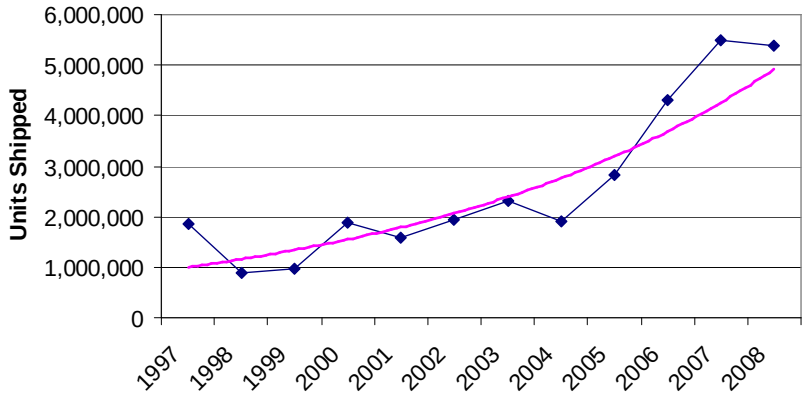
Total Annual Shipments (CAGR 14.4%)



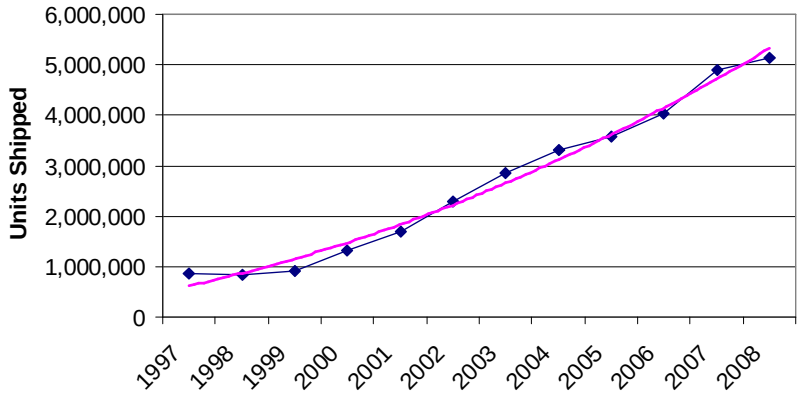
Total Annual Shipments - Electric (CAGR 16.2%)



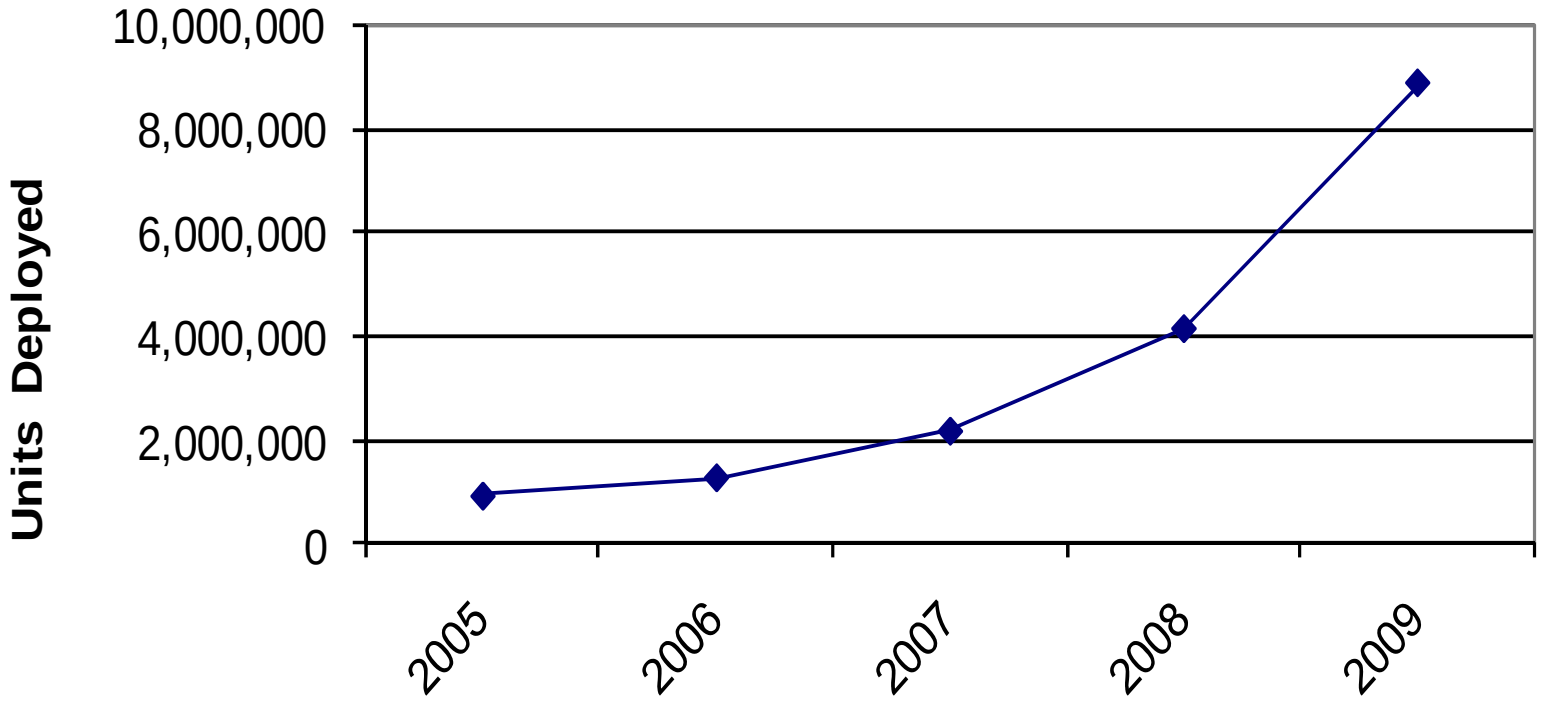
Total Annual Shipments - Gas (CAGR 10.2%)



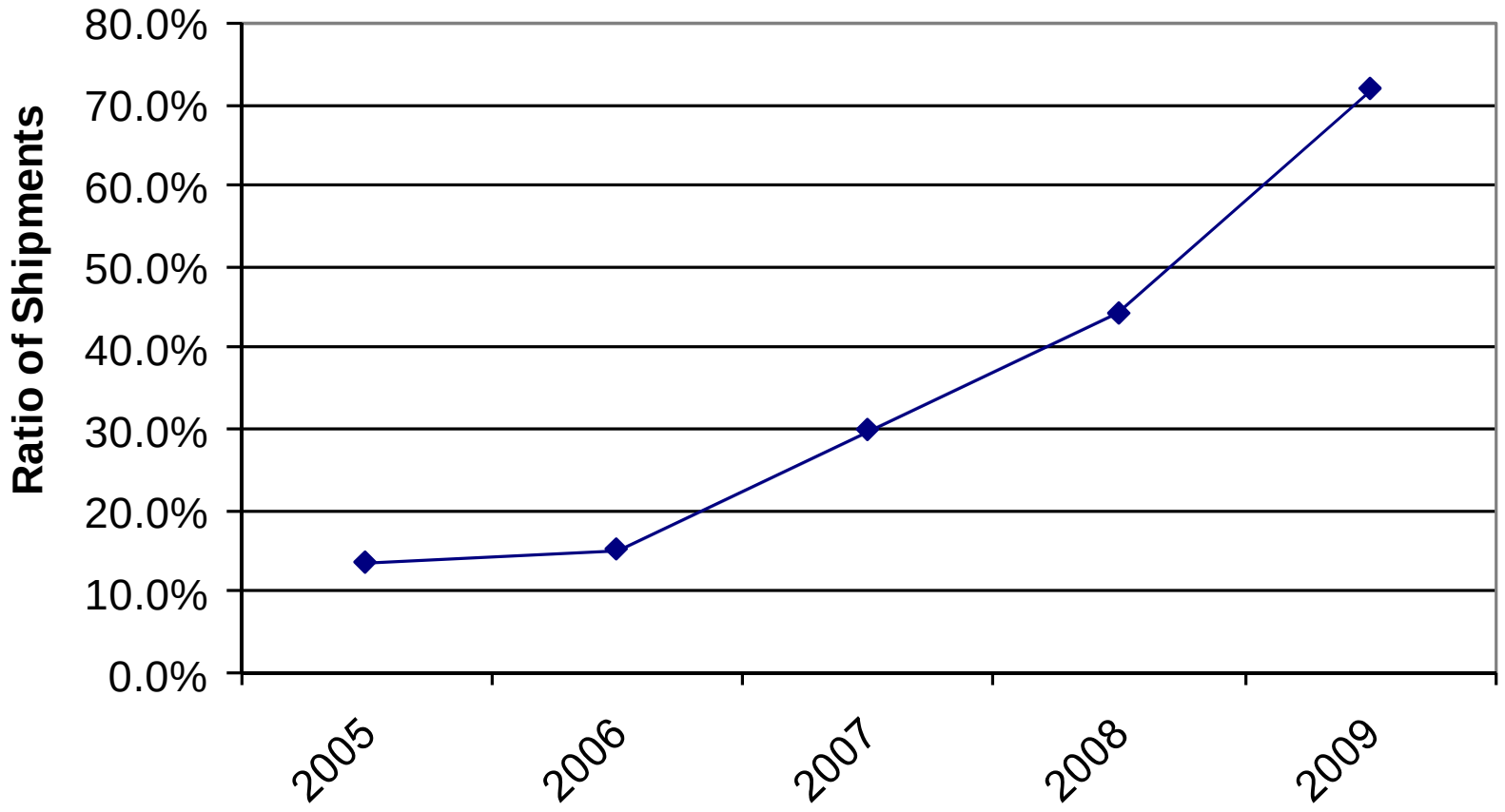
Total Annual Shipments - Water (CAGR 17.5%)



Annual Electric Smart Meter Deployments



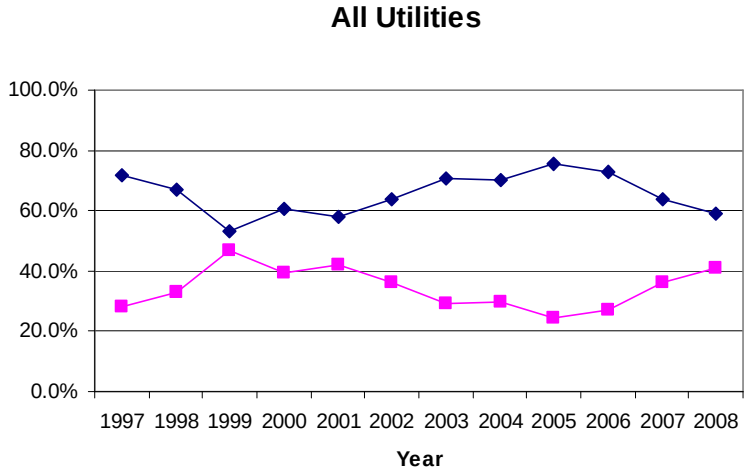
Ratio Electric Smart Meter to AMR

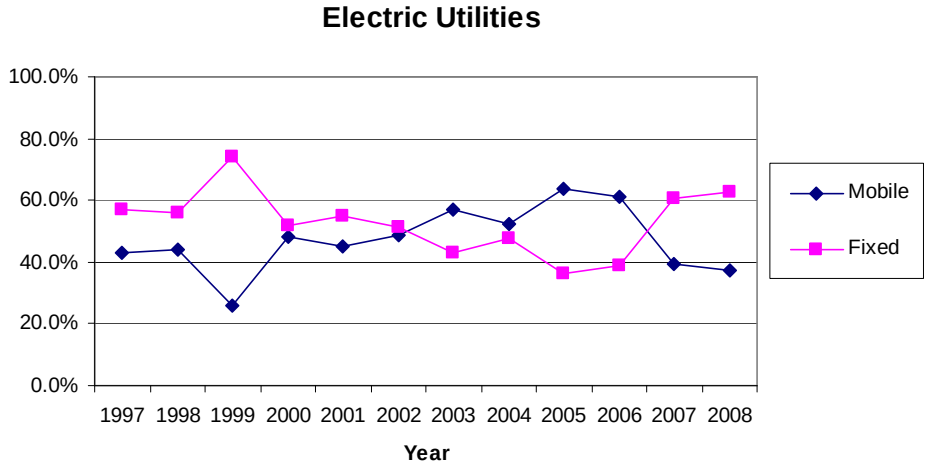


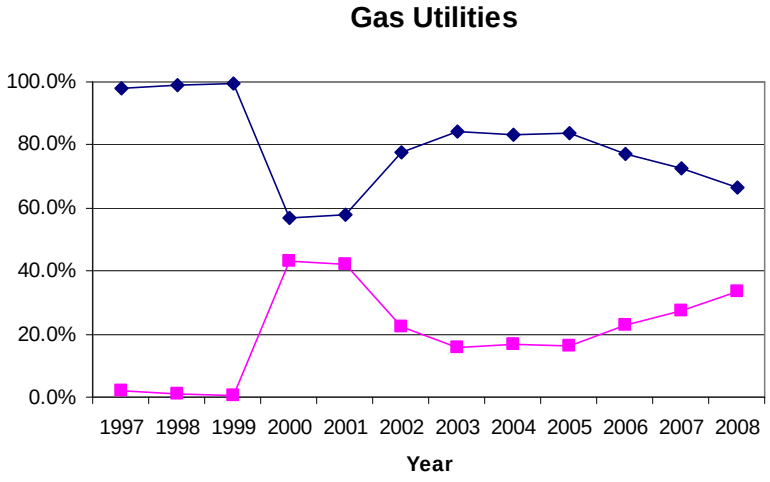
Rapid Evolution to Smart Meters

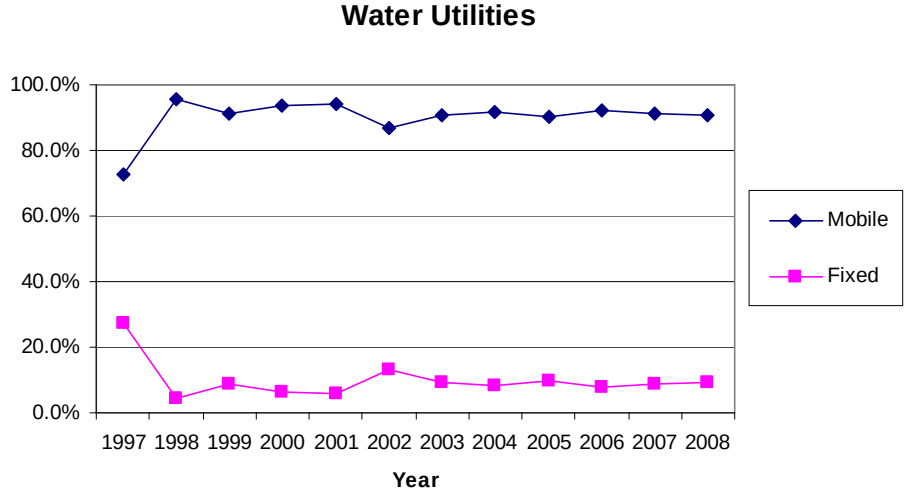
- Three years ago, Smart Meters didn't exist
- Today, they dominate the market in North America
- This evolution will rapidly spread around the world
- Key impacts of this change:
  - Existing meters cannot be modified to become Smart
  - Replacement of most electric meters worldwide is likely
  - The market for recycled meters will quickly disappear
- A new history is emerging: happening now in North America and emerging elsewhere

Fixed/Mobile in North Amer.









Source: The Scott Report: AMR Deployments in North America

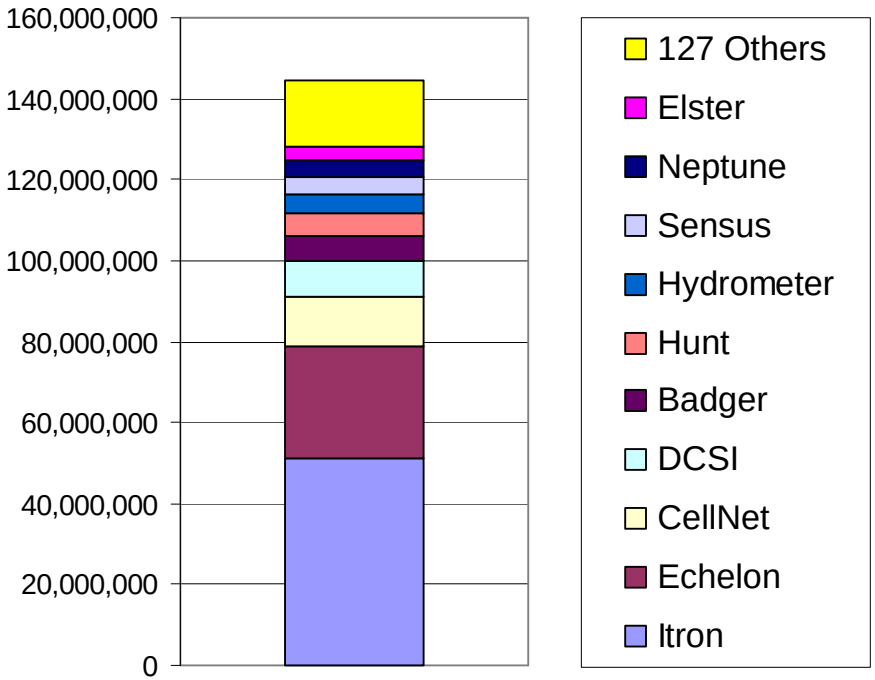
Shipments by Communication Type as of 1 January 2008

Region	Total	RF	PLC
Worldwide	182,069,756	113,977,498	54,528,090
North America	120,756,669	100,878,335	16,613,338
Rest of World	61,313,087	13,099,163	37,914,752
Africa	105,358	17,697	40,584
Asia	13,463,739	366,461	8,731,102
Australia/NZ	173,548	100,088	1,383
Central/So.Amer.	980,045	375,692	548,978
Europe	46,055,966	12,046,530	28,463,765
Middle East	374,532	130,417	32,319
Misc.	158,899	62,278	96,621

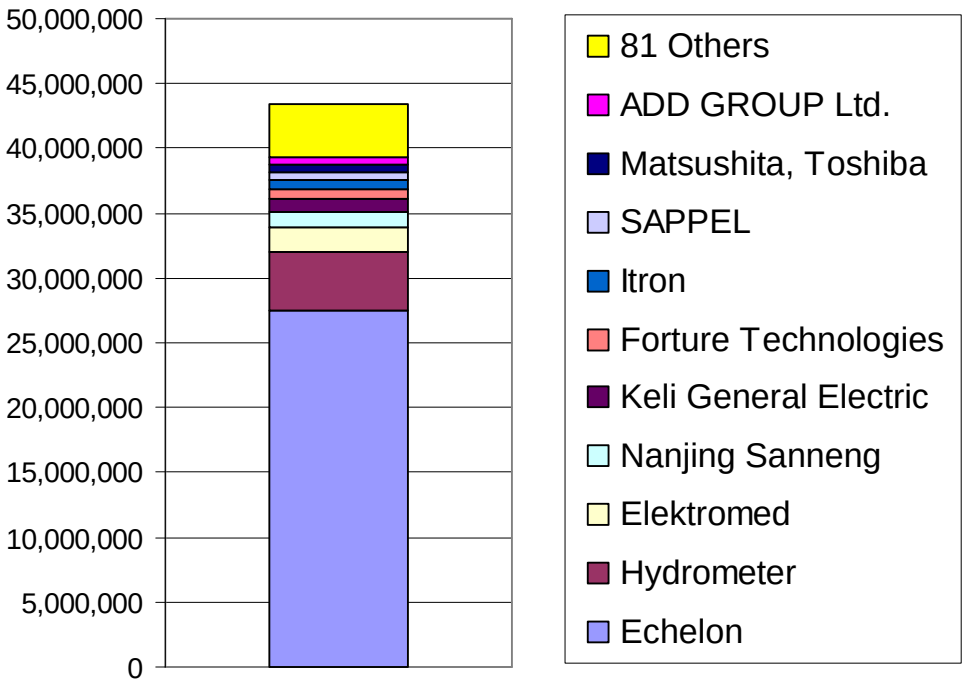
Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

AMR Market is Dominated By a Few Large Vendors

Worldwide

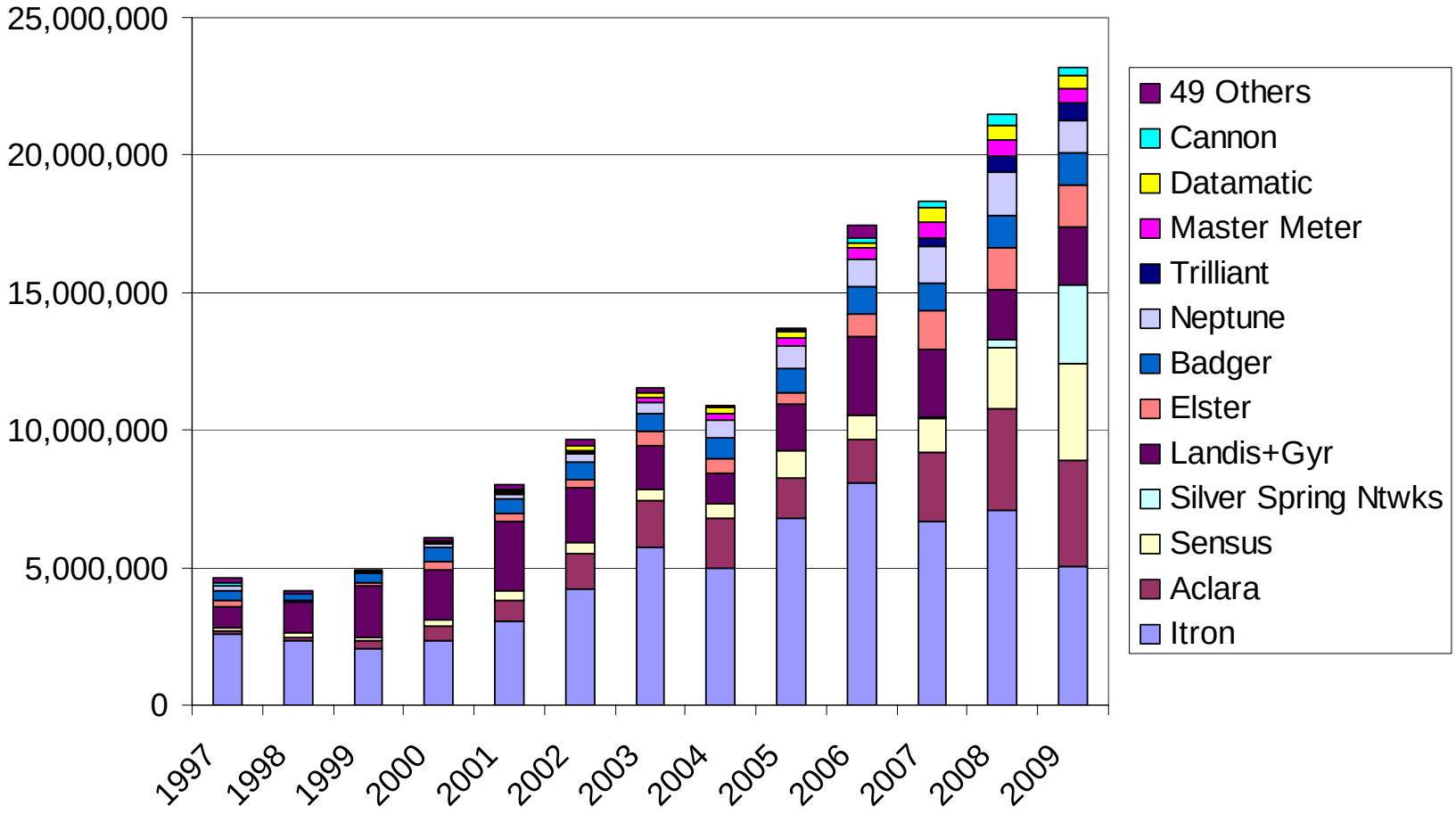


Outside North America



Source: The Scott Report: International Deployments of Automated Metering Devices

AMR Market Has Changed Slowly Over the Years



Source: The Scott Report: AMR Deployments in North America

Latest AMR Shipments (Overall)

Utility Type	2Q09	1Q09	Annual '09	Annual '08	Annual '07	Annual '06	Annual '05
Electric	3,286,121	2,888,582	12,349,404	9,413,148	7,345,375	8,594,920	7,010,186
Gas	1,438,575	1,334,874	5,546,897	6,412,099	5,603,570	4,308,640	2,843,432
Water	1,261,679	1,423,168	5,339,885	5,682,583	5,386,934	4,090,912	3,827,926
Misc	0	0	0	0	0	0	0
Totals:	5,986,375	5,646,624	23,236,186	21,507,830	18,335,879	16,994,472	13,681,544

Utility Type	2Q09 Cum	1Q09 Cum	Cumul. '09	Cumul. '08	Cumul. '07	Cumul. '06	Cumul. '05
Electric	75,024,312	71,738,192	81,199,014	68,849,610	59,436,462	52,091,087	43,496,167
Gas	41,993,682	40,555,107	44,767,130	39,220,233	32,808,134	27,204,564	22,895,924
Water	36,996,641	35,734,961	39,651,678	34,311,793	28,629,210	23,242,276	19,151,364
Misc	42,163	42,163	42,163	42,163	42,163	42,163	42,163
Totals:	154,056,797	148,070,423	165,659,985	142,423,799	120,915,969	102,580,090	85,585,618

Source: The Scott Report: International Deployments of Automated Metering Devices

Latest AMR Shipments (Vendor)

Vendor	2Q09	1Q09	Annual '09	Annual '08	Annual '07	Annual '06	Annual '05
Itron	**1,273,608**	**1,256,737**	5,060,690	7,113,574	6,683,705	8,101,083	6,784,383
Aclara	**966,121**	**945,314**	3,822,870	3,648,529	2,512,398	1,584,766	1,491,248
Sensus	**936,503**	**836,774**	3,546,554	2,248,979	1,203,374	844,965	969,199
Silver Spring Ntwks	**845,402**	**570,000**	2,830,804	256,600	53,600	0	500
Landis+Gyr	**537,766**	**513,898**	2,103,328	1,849,360	2,479,835	2,853,392	1,720,113
Elster	**419,294**	**367,491**	1,543,760	1,530,033	1,385,390	857,316	366,329
Badger	**252,027**	**328,181**	1,160,416	1,180,435	1,019,865	955,656	889,462
Neptune	**280,909**	**296,922**	1,155,662	1,553,157	1,372,656	1,001,765	819,011
Trilliant	166,119	**166,119**	664,476	578,002	296,201	28,454	5,320
Master Meter	129,445	129,445	517,780	609,532	565,060	394,757	306,624
Datamatic	128,439	128,439	513,754	513,754	513,754	181,637	203,454
Cannon	42,098	94,030	272,256	386,835	241,049	167,719	72,261
SmartSynch	**1,717**	**6,347**	16,128	11,331	8,862	2,986	31,079
First Point Energy	3,470	3,470	13,880	13,880	0	0	13,885
muNet	1,639	1,639	6,556	6,556	0	6,621	5,432
Eka Systems	902	902	3,608	3,608	65	50	286
Metretek	816	816	3,264	3,264	0	3,255	2,572
Reactel	100	100	400	400	0	0	0
Current Technology	0	0	0	0	0	0	100
41 Others	0	0	0	0	65	10,050	286
Totals:	5,986,375	5,646,624	23,236,186	21,507,830	18,335,879	16,994,472	13,681,544

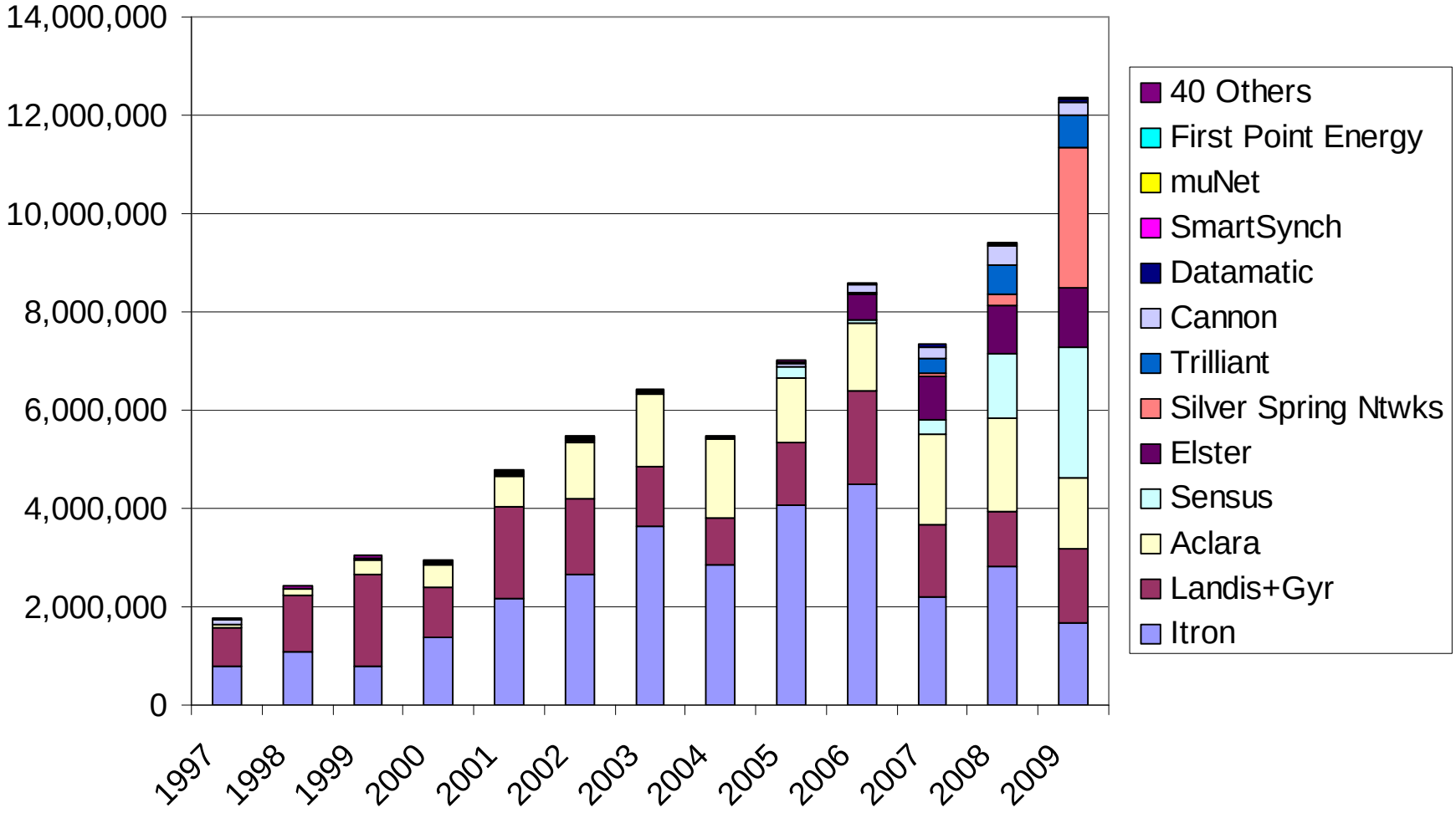
Source: The Scott Report: International Deployments of Automated Metering Devices

Latest AMR Shipments (Arch.)

Architecture	2Q09	1Q09	Annual '09	Annual '08	Annual '07	Annual '06	Annual '05
Itron	**1,361,067**	**1,350,832**	5,423,798	7,624,038	7,087,775	8,556,677	7,428,878
Sensus - Flexnet	**865,229**	**700,818**	3,102,284	1,654,360	480,998	97,791	81,326
Silver Spring Ntwks	**845,402**	**570,000**	2,830,804	256,600	53,600	0	500
Hexagram	**629,599**	**621,361**	2,501,920	2,031,909	761,612	231,042	182,625
TWACS	**355,144**	**348,767**	1,407,822	1,703,055	1,800,436	1,375,237	1,329,685
EnergyAxis	**326,051**	**276,766**	1,205,634	989,618	911,217	556,027	0
Neptune - RF	**260,958**	**271,030**	1,063,976	1,472,950	1,341,001	997,519	814,708
Orion	**194,957**	**269,023**	927,960	926,610	764,714	622,219	464,647
CellNet	**234,815**	**157,601**	784,832	1,082,361	1,339,616	1,354,831	884,909
Trilliant - Wireless	165,669	**165,669**	662,676	577,102	258,333	26,853	4,052
Master Meter - 3G	129,445	129,445	517,780	609,532	565,060	394,757	306,624
Datamatic	128,439	128,439	513,754	513,754	513,754	181,637	203,454
Hunt TS2	**134,811**	**119,020**	507,662	317,545	437,565	494,155	279,128
CellNet - AMI	**71,840**	**172,160**	488,000	161,088	0	0	0
Sensus - RF	**79,958**	**139,498**	438,912	532,387	663,328	700,476	659,336
Cannon	42,098	94,030	272,256	386,835	241,049	167,719	72,261
Airpoint	**71,518**	**43,815**	230,666	216,670	530,591	736,610	188,081
AMCO/Elster (Trace)	**49,742**	**43,563**	186,610	254,823	263,641	130,595	208,409
Hunt TS1	**24,995**	**23,332**	96,654	116,645	160,730	297,823	465,143
Badger - Galaxy	**4,210**	**6,197**	20,814	26,731	2,046	2,084	47
SmartSynch	**1,717**	**6,347**	16,128	11,331	8,862	2,986	31,079
First Point Energy	3,470	3,470	13,880	13,880	0	0	8,685
muNet	1,639	1,639	6,556	6,556	0	6,621	5,432
Neptune - 450	**1,521**	**1,454**	5,950	11,979	0	0	0
Eka Systems	**902**	**902**	3,608	3,608	65	50	286
Metretek	816	816	3,264	3,264	0	3,255	2,572
Trilliant - Telephone	**450**	**450**	1,800	900	37,868	1,601	1,268
Reactel	100	100	400	400	0	0	0
Sensus - Telephone	**0**	**1**	2	55	93	82	568
Badger - Telephone	**0**	**0**	0	0	1	1,235	1,880
First Point/Mozart	0	0	0	0	0	0	5,200
Neptune - Telephone	**0**	**0**	0	0	0	0	23
Current Technology	0	0	0	0	0	0	100
Sensus - Fixnet	**-187**	**79**	-216	1,244	491	-11	8,035
48 Others	0	0	0	0	111,433	54,601	42,603
Totals:	5,986,375	5,646,624	23,236,186	21,507,830	18,335,879	16,994,472	13,681,544

Source: The Scott Report: International Deployments of Automated Metering Devices

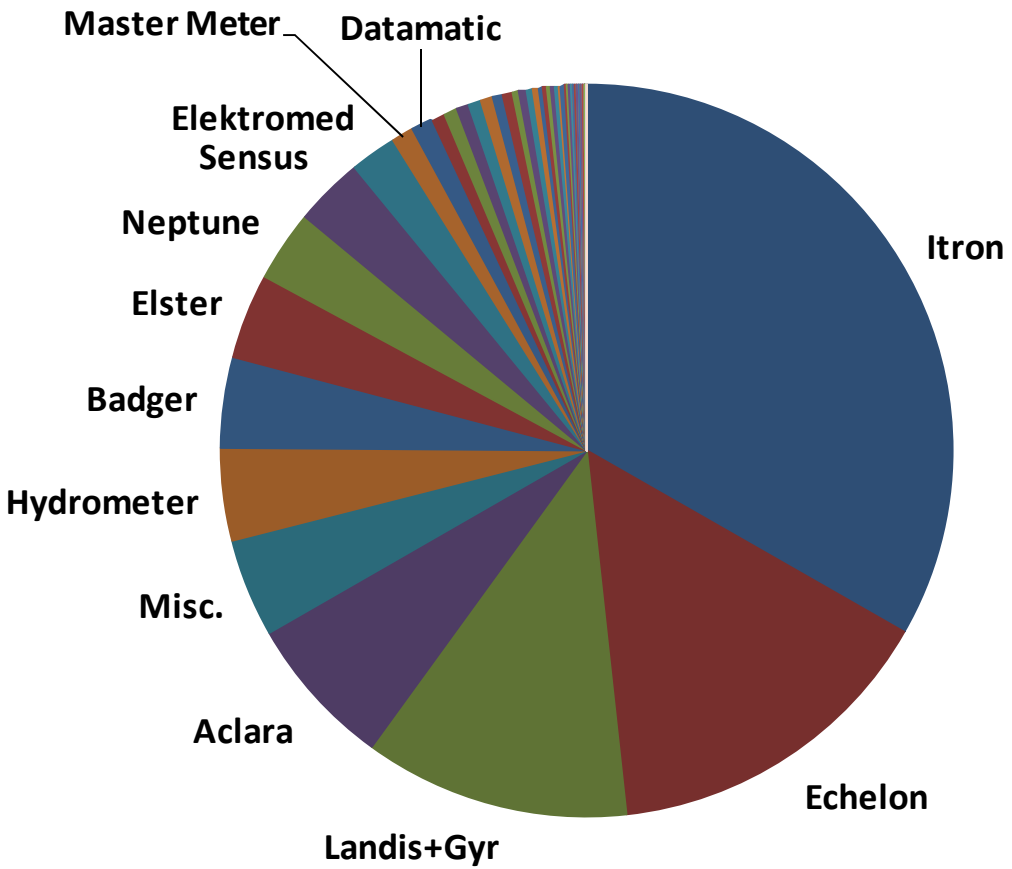
Electric AMR Market



Source: The Scott Report: AMR Deployments in North America

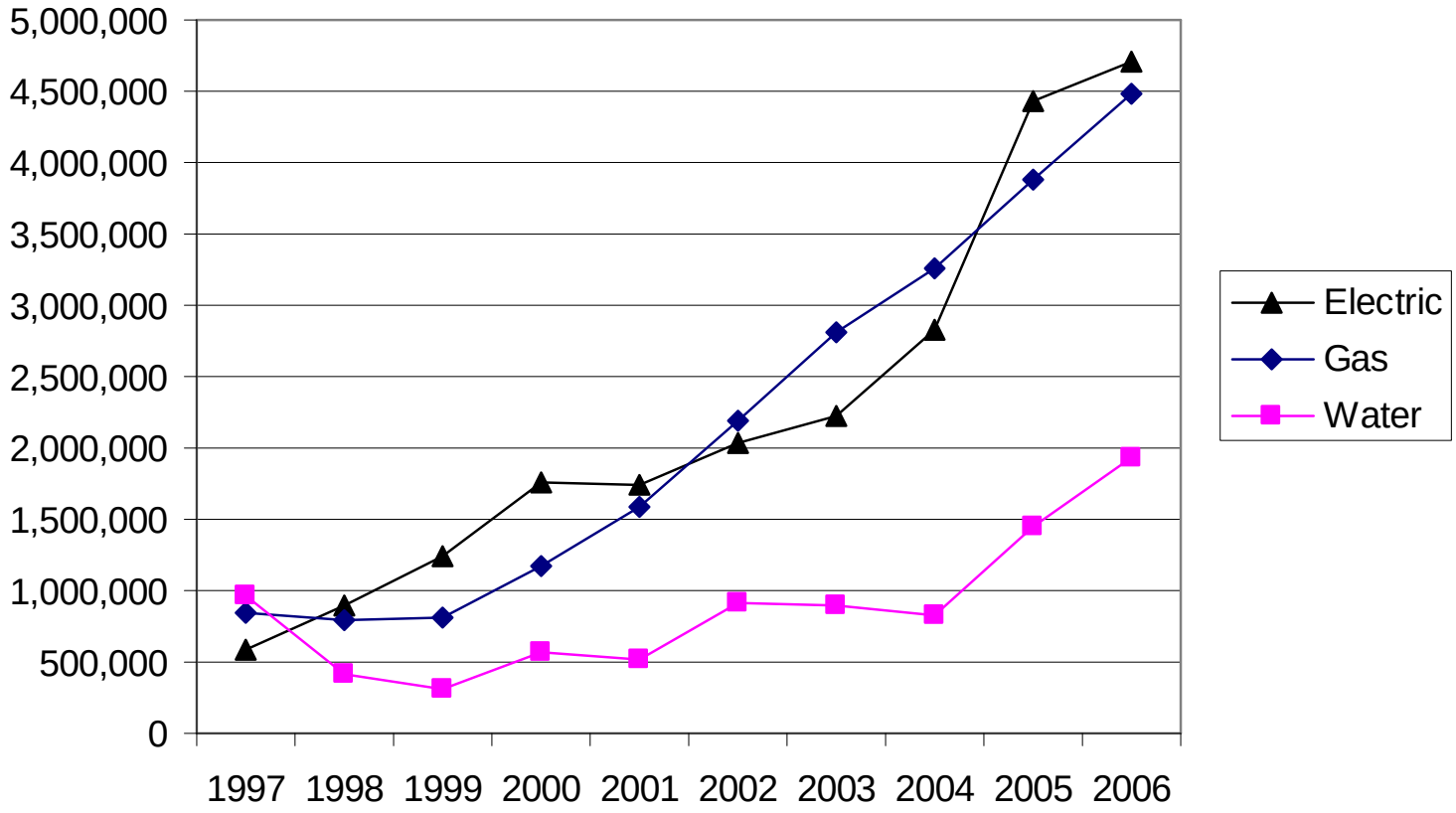
Total AMR Shipments by Vendor

182+ Million Installed as of January '08



Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

North American Utilities <500K Customers



Source: The Scott Report: Worldwide Deployments of Automated Metering Devices

Compound Annual Growth ’97–‘09

- Overall : 14.7% (’97 – ’09)
- Electric utilities : 17.6% (’97 – ’09)
- Gas utilities : 9.6% (’97 – ’09)
- Water utilities : 16.3% (’97 – ’09)
- Investor owned : 7.4% (’97 – ’07)
- Publicly owned : 17.4% (’97 – ’07)
- Cooperatives : 41.8% (’97 – ’07)
- RF : 15.4% (’97 – ’07)
- PLC : 23.2% (’97 – ’07)
- Telephone: (--21.7%) (’97 – ’07)

Penetration Driving Gas & Water Shipments; Irrelevant for Electric

- At the end of 2008, 68.4% of all customers in U.S. have AMR on at least 1 meter
- The growth of this penetration has ranged from 5% to 7% per year
- With the advent of electric Smart Metering, AMR penetration will be irrelevant for electrics, but Smart meter penetration will become a factor
- Once electric Smart Metering become significant (over 50% in an area), it will become a driver for water and gas AMR to become Smart

Source: The Scott Report: Insights on AMR Deployments

Smart Metering vs. AMR Conclusions

- Smart Metering is growing on the success established by AMI
- Electric Smart Metering is growing so fast that little of the non-Smart Meter market will survive
- Vendors must get Smart Metering right the first time. The risks here are much higher than previous technologies because the market is growing so rapidly.

Electric Meter Saturation in U.S.

- At expected deployment rates, all of U.S. will be fully served with Smart electric Meters in 6 – 7 years
- Expected lifetime of meters is 10 years
- So U.S. market will go into hiatus for 3 – 4 years
- Only largest international meter companies will survive thus downturn, and continue developing their products for the next generation

Topics Discussed

- What is happening politically
- What Smart Metering offers
- The role of deregulation and prepayment
- What is happening in the U.S. and Europe
- The likely outcome of these efforts

Though this talk addresses electric, gas, water and heat metering, the focus is on electric metering because Smart Grid is a major political goal

Current Events

- Petroleum prices peaked in early July 2008; by mid-October 2008 they were 50% of peak
- DJIA's 2008 peak was in late April; by early March 2009 they were almost 50% of peak
- After Obama's election in November 2008 he committed to Stimulus with Smart Metering as part of the solution
- Most European leaders agreed to reforms, refused to follow Obama's Stimulus, but committed to Smart Metering (late April 2009)

American Recovery and Reinvestment Act of 2009

- Electricity Delivery and Energy Reliability: "$4.5 Billion …expenses necessary for electricity delivery and energy reliability … to include demand response equipment, enhance security and reliability of the energy infrastructure, energy storage research, development, demonstration and deployment, and facilitate recovery from disruptions to the energy supply …"
- "… establish and maintain a smart grid information clearinghouse…"
- "… utilize open protocols and standards …"
- "The Secretary shall, 'within 60 days after the enactment of … establish procedures by which applicants can obtain grants of not more than one-half of their documented costs"

Obama Transition Team's Request to Me

- Determine:
  - How many Smart Meters could be produced in existing plants
  - If meter vendors could produce 30 M Smart Meters per year (if given 12 months to ramp-up)
  - Smart Meter Definition:
    - Net metering, time stamp of usage, open standards, remote disconnect, downloadable code
  - If product could be built in U.S.
  - The total cost of doing this (my answer: $18 B plus at leads as much $ in system integration)

Changes to my Recommendation

- Took my $18 B and required 50 – 50 match by utilities (cuts my number to $9 B)
- Took my 4 year analysis and assumed 2 years of funding (cuts my number to $4.5 B)
- Inserted words “Smart Grid” for “Smart Meter”
- Requires “Open Protocols and Standards … if available and appropriate”

How Will Money be Spent?

- DOE has not finalized its answer
  - Appointed NIST to announce standards
- Some obvious decisions were not applied:
  - The goal was to create jobs quickly, but they announced that projects could run to 2015
  - “Shovel ready” projects should have had priority, but too much focus on “demonstration projects,” research and technology
- State regulators should have taken the lead, but seem reluctant to drive the process
- The outcome is far from clear

How Will $ Impact Utility Decisions?

- Utilities always develop a business case that must have attractive financials
- Stimulus $ will offset the amount of money that the utility must invest
- The funding requires matching $ from utility, and will be no better than 50 – 50
- Utility must be able to find its share of the funding
- For utilities that get Stimulus funding, almost all such projects will be cost-effective

Impact of Obama Stimulus Package

- Gas and water AMR deployments will follow historic patterns and probably accelerate after worldwide financial crisis eases
- Electric deployments will restart from zero:
  - Almost all deployed electric meters are not Smart Meters, so they must be replaced to support Smart Grid
  - Because metering is a prerequisite for the Smart Grid, expect the whole U.S. to be served within 5 – 7 years
  - Large IOUs are probably best prepared to implement Smart Grid so smaller utilities will install it later
- So many smaller utilities will not get funding, that a second funding round for them is likely

Current Events

- U.S. initiatives:
  - President Obama says his Stimulus Package will add 40 million Smart Meters
  - U.S. Congress changes focus to Smart Grid; delays by Department of Energy as it insists on standards
- European Union's 20-20-20 mandates:
  - By 2020 reduce greenhouse gases by 20% below 1990 levels, improve energy efficiency by 20% and increase the % of renewable energy by 20%.
  - European Union mandates that 80% of electric meters must have Smart Meters by 2020; 100% by 2022; no deadlines for gas
- China announces plans to install 200 million Smart Meters in next 3 – 5 years

U.S. Metering Market

- Except for deregulation, entire market is very consistent
- As of 1 January 2009, ~132 million advanced meters deployed (~44% meter penetration)
  - ~62 M electric (~42% electric meter penetration)
  - ~38 M gas (~55% gas meter penetration)
  - ~32 M water (~35% water meter penetration)
- ~ 5% Smart Meter penetration of electric meters
- If Smart Meters are mandated, then entire market will shift to Smart Meters except for 5% that's already Smart

European Metering Market

- Fragmented market
  - Nordic countries
  - Baltic countries
  - Central Europe
  - Southern Europe
  - Eastern Europe
  - U.K.
- As of 1 January 2008, ~31 million advanced electric meters deployed (~10% meter penetration)
- ~9% Smart Meter penetration (electric)
- Smart Meters (electric) are mandated by 2022 for 100% of customers

European Activity by Country

- Full compulsory smart electricity meter roll out:
  - Italy – electric by 2011 and gas by 2013
  - Sweden – electric to finish in 2009
  - Spain – full rollout by 2018
  - Portugal – electric by 2015 (not law yet)
  - UK – electric and gas by 2020
- Partial policies:
  - Denmark and Finland – electricity & gas
  - Norway, Estonia, Portugal and Turkey – electric
- Studying what to do:
  - Austria, Belgium, Cyprus, Denmark, Finland, France, Hungary, Ireland, Netherlands, Northern Ireland (also gas smart meters), Norway, and Spain (gas meters)

Lessons from Historic Shipment Data

- Historical data can give insights on future growth, but not the rate of future growth
- If Smart Metering is mandated (as in Europe and parts of China), **all** older meters will be replaced, irrespective of their age
  - Reason: Smart Meters permit energy to flow from customer to grid. Meters must measure this flow and also contain disconnects to protect utility workers
- Without mandates, AMR grew by 14+% annually; with mandates growth will take a different shape – rapid growth in Year 1 followed by relatively flat thereafter

Being "Smart"

- Systems do not become "Smart" by having smart endpoints
- They become "Smart" by having software systems that help them act smart
- Yes, it is important to have highly capable endpoints, but without the right systems they are hardly more capable than dumb endpoints

“Smart” Attributes

- Smart systems methodically compare data from meters and sensors against predetermined settings
- More advanced systems perform “data mining,” which looks for patterns in the data
- Smart systems couple metering system data with other system data such as Customer Information System (CIS), Geographic Information System (GIS), Outage Management System (OMS), Meter Data Management (MDM) system, Help Desk support system, Workforce Management system, Billing System, Inventory Management System, engineering systems, etc.
- “Smart” utility systems are networked together
- For most Smart Metering projects in the U.S., 55-60% of all project costs are for software upgrades

Smart Metering

- Provides detailed information on what is being consumed/delivered on a quasi-real-time basis
  - Supports in-home displays
- Provides the data for consumers and utilities to make smart energy choices
- Improves utility operations by (for example):
  - Identifying where energy is being consumed
  - Helping to localize outages
  - Highlighting areas with possible energy theft
- Helps customers deliver energy to grid
- Eliminates the need to change meters when services or features are modified (such as time-of-use)
- Provides a pathway to the Smart Grid

Smart Metering Functions

- Active/Reactive energy
- Net-metering
- Tariffs
- Remote disconnect
- Load profile
- Prepayment
- Import/export capability
- Supervision and recording
- Synchronization
- 2-way communications
- Tamper/fraud detection
- Provide information to consumer
- Remote transactions
- Remote software upgrade
- Interoperability between different meter models and different types of meters (e.g., gas, water, heat)
- HAN functionality

May apply to electric, gas, water or heat meters

What Makes a Grid “Smart”?

- A grid is “Smart” when it can dynamically change its performance based on insightful operating information
- Though existing grids make some dynamic decisions, they usually require human intervention
- “Smart” grids will make real-time data-driven decisions
- But very few utilities have fully integrated operations systems; they must evolve to access more robust data
- The only available data are meter measurements and limited status indicators
- Key operational data such as weather, equipment operating temperatures, etc. are rarely reported and are not embedded into integrated operation systems
- Thus, true Smart Grids do not exist anywhere

Controlling Consumption

- Controlling consumption a key motivation for Smart Grid
- Requires the ability to communicate between the grid and the customer's premises (in both directions)
- This assumes that devices will be placed in the customer's premises that can react to outside stimuli:
  - A display that indicates consumption
  - Disconnect devices on domestic equipment
  - Possibly a HAN (Home Area Network)
- Many in-home devices will require total replacement, e.g.
  - Hot water heaters
  - Furnaces
  - White goods (clothes washers, dryers, dishwashers, refrigerators
- The cost for domestic changes exceeds utility costs !!!

The Role of the Consumer

- Before Smart Metering, the utility generated the energy and the consumer used it – there was little opportunity for the consumer to do much else
- With Smart Metering, the consumer's role changes:
  - Can generate energy that is consumed on-site or delivered to the grid – via solar panels, wind generators, etc.
  - Can decide when to use energy – price signals report when power is expensive, and can avoid usage at peak times
- Some countries treat the consumer like a small generator, even if they only avoid usage

What Will Likely Happen?

- The U.S. will probably deploy 40+ million Smart Meters in next 5 years
- Europe will mostly start after the U.S., but achieve many more deployments by 2015
- China will deploy 200 million Smart Meters over next 5 years and will be the first to learn how to operate massive electric utility networks
- Smaller first-world economies like Australia, New Zealand, Canada will also deploy early
- Smart Grids will be deployed in major cities in other countries with strong economies, such as Brazil, South Africa, Indonesia, etc.

Automated Metering

- Smart Metering is the only mature part of Smart Grid industry and is required for a Smart Grid
- Since ‘97, electric AMR shipments in U.S. have grown by 17.6% CAGR
- Since ‘97, electric AMR penetration in U.S. climbed from 7% to 46%
- It makes no sense to accurately read an inaccurate meter, so AMR growth has driven sales of new meters (few new electric meters don’t have AMR)
- Thus, Automated Metering was thriving, even before Smart Metering

Definition: Automated Metering = any form of remote meter reading including AMR, AMI, Smart Metering, Prepayment metering, submetering

Smart Metering

- Most existing electric meters cannot act like Smart Meters
- 40 Million Smart Meters already ordered in U.S.; Stimulus Plan could push this to 60 Million (out of 150 Million) – the tipping point has been passed
- The move to Smart Metering has killed conventional metering
- All non-Smart electric meters in U.S. will likely be replaced (~140 M in U.S.)
- At current rates, Smart Metering will be fully saturated in U.S. & Canada in 5 – 7 years
- After 7 years, U.S. utilities will only buy meters for replacements, growth and to fill-in the few stragglers
- Thus, for metering companies to thrive into the future, they must expand their business to international markets

Other Factors that Affect Metering

- Deregulation
- Payments
- Technology does not make a utility “smart,” systems do
- People problems
- Paying for all these changes
- Aggregation of vendors

The Challenge of Deregulation

- Deregulation complicates possible solutions
- In deregulated markets, customer can buy power from retailers instead of a regulated utility. Power is delivered over the same grid to customer.
- It is more prevalent in Europe than in U.S., but exists in both marketplaces
- Grid company, customers, governments want Smart Metering, but have differing willingness-to-pay
- Unresolved questions (such as):
  - Who owns the meter?
  - Change the meter when change supplier?

The Link Between Metering and Payments

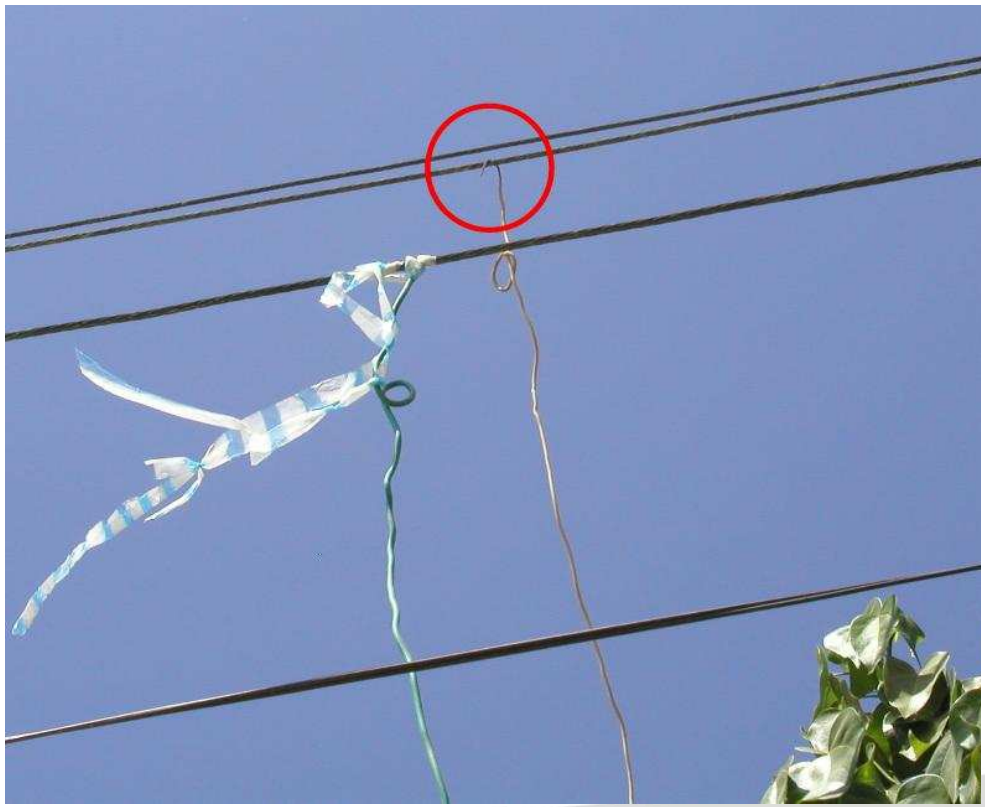
- Historically, the reason to meter usage is to determine how much money each user should pay
- In many developing countries >20% of all energy generated is unpaid; >50% unpaid has occurred
- This is often called “energy theft,” but calling it “theft” may over-simplify the problem
- In many of these countries, poor people are cause of most non-payment, but wealthy people also don’t pay
- Poor people often don’t pay because they cannot afford to do so; with wealthy people, it’s just theft

Utilities Face a Dual Challenge

- Metering
- Payments (A problem for many poor customers)
  - Meters typically report what was used – provide little information to plan usage
  - Poor people often have problems getting to a utility office or other locations to make payments
  - Many poor countries have terrible postal systems
  - Many customers come from subsistence backgrounds with no tradition of making payments
  - Many poor customers barely have enough money to live, and often cannot afford the utility bill
  - Almost all poor people are “unbanked”

Examples of Electric Power Theft

South America



Africa

How Do Poor People Pay for Services?

- 80% of the world is “poor” – most of mankind
- Poor people often have problems getting to a utility office or other locations to make payments
- Many poor countries have terrible postal systems
- Many poor customers come from subsistence backgrounds with no tradition of managing money
- Many poor customers barely have enough money to live, and often cannot afford the utility bill
- Almost all poor people are “unbanked”
- Economists now view “unbanked” a huge new market
- A “Payments” industry is emerging; it will help utilities collect money and help users manage their money better

Prepayment/Postpayment

- Prepayment permits customers to pay for services before they use them
- Postpayment permits customers to pay for services after they use them
- Prepayment meters usually track money spent or KWH consumed; rarely provide meter reading
- Postpayment meters provide meter readings but don't permit customers to plan future usage
- Many countries offer prepayment services to help users manage their money better
- Smart Meters have the potential to do both forms of metering simultaneously, but the challenge of payments must still be resolved

People & Their Problems

- If projects fail, it is usually the result of utilities not dealing with staff needs, or government concerns or the needs of their customers
- Projects rarely fail because the equipment fails; the worst problems occur when project staffs are poorly managed or senior management is not committed to the project
- Therefore, we must remember to focus on the people issues

Project Management

- For projects with several hundred thousands (or more) meters, the greatest challenge is project management
- Consider the challenge of sending crews to do daily installs. Giving them the right equipment, the right instructions and verifying their work is a staggering challenge.
- Large, highly automated staging depots will be needed to support installation crews.
- Each installer will need highly automated handheld support tools to ensure that each install is correct and all related data is correctly recorded.
- In the U.S., this has been the most important feature of a successful meter automation project – a world-class project management system.

Paying for Future Changes

- Moving to Smart Metering automatically implies that the utility will forever operate differently:
  - Smart Metering capabilities will gradually evolve; equipment placed today may have to be replaced in 5-10 years
  - As all operating systems get integrated, they will operate slightly differently. Also, new features will be introduced. Anyone employee using these systems will need retraining whenever a change is made.
  - Utilities will operate more efficiently with Smart Metering, but new jobs will also be created.
- Replacement equipment, retraining and new jobs all cost money on an ongoing basis. Though special funding may be provided to install the Smart Meters, funds may not be provided for these new items.

Where is the Metering Industry Heading?

- Acquisitions
- Aggregation
- Other factors
- My crystal ball
- What's next?

Investors Aggressively Buying Metering Companies

- High growth has attracted significant interest from investors
- The metering industry is in the midst of rapid acquisition worldwide
  - 2003 – Roper Industries acquired Neptune Technologies
  - 2003 – The Jordan Company bought Sensus Metering
  - 2004 – Bayard bought Landis+Gyr
  - 2004 – GTCR acquired Cellnet
  - 2004 – Itron bought Schlumberger Electricity Metering
  - 2005 – CVC bought Elster
  - 2005 – Bayard bought Enermet
  - 2005 – Schneider Electric acquired Power Measurement
  - 2006 – Bayard bought Hunt Technologies
  - 2006 – Bayard Group bought Cellnet
  - 2006 – Sensus bought AMDS
  - 2006 – Cooper Industries acquired Cannon Technologies
  - 2007 – Itron bought Actaris
  - 2008 – Roper acquired Technolog
  - 2008 – Elsewedy Cables bought Iskraemeco
  - 2009 – Elster bought EnergyICT
  - 2009 – Silver Spring bought Greenbox

Aggregation of Vendors

- The metering industry outside Asia has already been through a period of aggregation. Outside Asia there are now fewer than 10 major metering vendors.

Impact of These “Other” Factors

- Smart Metering focus on more than just metering
- It requires significant software support and continual retraining
- It has the ability to address historical payment issues, but only if the utility focuses on them
- It requires careful project planning, including the impact that Smart Metering has on customers and staff
- It initiates more than short-term changes; new work is created that requires staffing and on-going expenses
- It alters how utilities operate and what vendors they use

My Crystal Ball

- Huge near-term growth in Smart Meter market is inevitable (could be 30% or more for next few years); Smart Grid will follow
- Then U.S. metering market goes flat; after 7 years U.S. metering market falls; Smart Grid business gradually grows long-term
- European metering market has huge growth (like in the U.S.) 4 – 5 years from now
- Like U.S., Europe metering market goes flat approaching 2020; drops after that
- Most major cities in developing world will deploy Smart Metering and then Smart Grid
- Overall Metering Market Trend: Ragged long-term shape with periods of steep growth followed by flat years; little chance for dips over next 15 – 20 years
- Overall Smart Grid Market Trend: Smooth market growth trailing Metering Market

What Will Happen Next?

- Aggregation within the industry is actively underway
- Large players emerging (Itron, Landis+Gyr, Elster) that are:
  - Very strong in electric; may also be strong in water and gas
  - Provide meters, automated metering systems, data analysis software
  - Have a major presence worldwide
  - Have very deep pockets (or access to them)
  - Will sell their companies in next few years, or offer IPO
- Other significant players will likely be sold (Sensus, others)
- Within 2 - 4 years, all major industry players will be publicly traded
- Though needs differ by country, world products will soon appear (addressing different regional needs; e.g., Smart Metering is universal, but prepayment only outside U.S.)
- “Smart” tools will begin to emerge
- Huge revenues will be generated (Smart Meter sales, $ from selling new smart tools)

How Can I Be So Confident About My Claims?

- For the past few years, I made predictions like this and then they all happened several months later –someone must be listening!
- Continued growth is guaranteed for at least the next four years
  - 40 million Smart Meters already ordered; EDF will happen no later than 2 years from now
  - Huge companies (Google, IBM, Intel, Cisco, etc.) already hyping the Smart Grid business
  - All the hype has to generate some new business
- 68% of all U.S. households have AMR on at least one of their meters. Customers can now see service differences between utilities, and they like AMR!! Smart Grid will encourage customer participation – will put more pressure on water, gas
- Even a major recession did not stop this!

Questions?

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