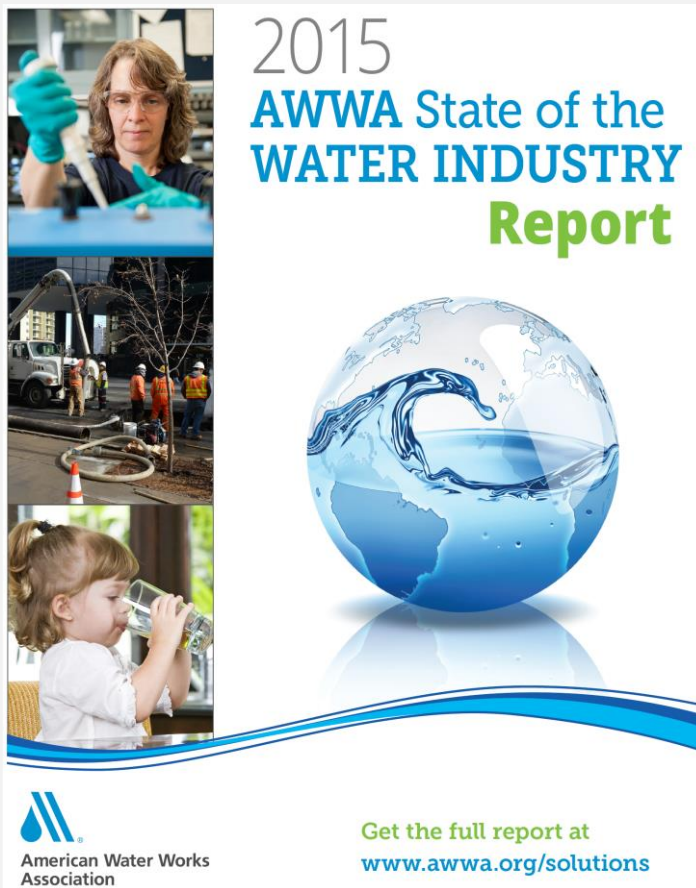# Understanding AMR/AMI Meter Reading Technology – OTCO Dec 8, 2016

Presenter:
Kelly Byrd - NECO

# AWWA State of the Industry Report



Top 4 Issues:

- Infrastructure
  - Cost of replacing an aging infrastructure.

- Financing of Capital Improvements
  - How to justify and benefit from ongoing improvements

- Public Understanding
  - General lack of knowledge regarding the value and importance of water systems and service

- Public Understanding
  - General lack of knowledge regarding the value of water resources

# AMR vs AMI

- **AMR – Automated Meter Reading**

- **AMI – Advanced Metering Infrastructure**

# AMR vs AMI

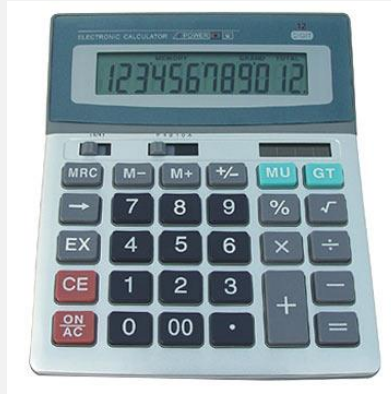- **AMR – Easy Data Entry**
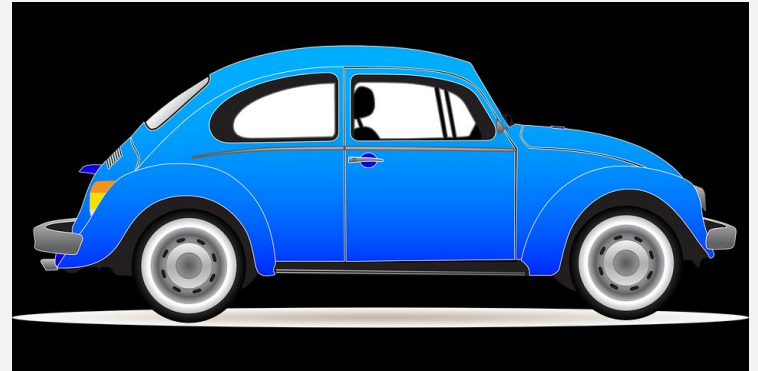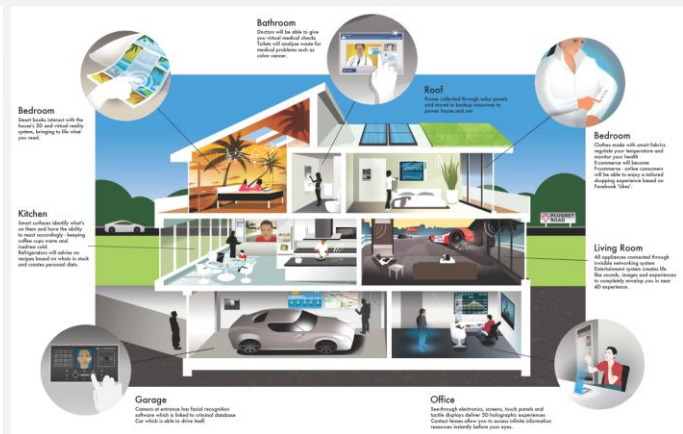
- **AMI – Using Data for a Purpose**

# AMR vs AMI

- **AMR** – Automated Meter Reading



- **AMI** - Advanced Metering Infrastructure
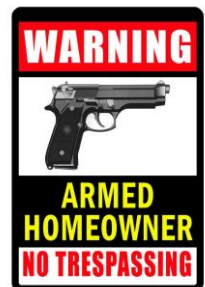
# The Evolution of AMR

# AMR Market Drivers

- Meter reading cost and time
  - Repeated Trips
  - Access to Meter
- Meter reading safety
  - Dogs
  - People
  - Weather
  - Driving
- Liability insurance
- Hard-to-Read meters

# AMR Market Drivers

- Aging infrastructure
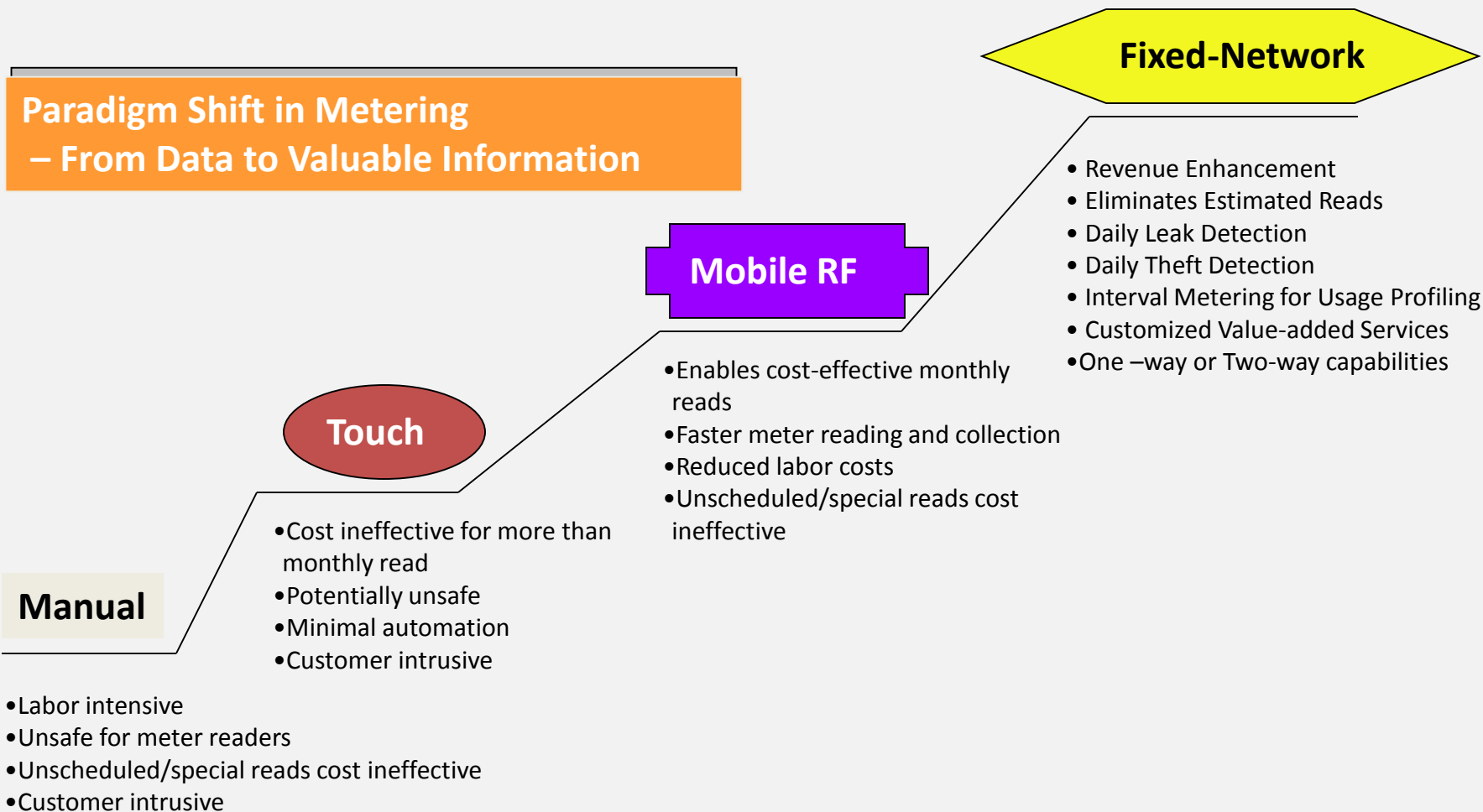  - Main maintenance
  - Fire hydrant maintenance
  - Distribution System Tampering
- Customer Service
  - Eliminate estimated reads
  - High water bill complaints
  - Excessive water use
  - Higher customer expectations
- Department Efficiency
  - What else needs attention?
  - Total Operating Budget
    - Man Hours
    - Vehicle Maintenance
- Increase Cash Flow
  - Shorten billing cycle

# The Evolution of AMR

**Fixed-Network**

**Paradigm Shift in Metering
– From Data to Valuable Information**

- Revenue Enhancement
- Eliminates Estimated Reads
- Daily Leak Detection
- Daily Theft Detection
- Interval Metering for Usage Profiling
- Customized Value-added Services
- One –way or Two-way capabilities

**Mobile RF**

- Enables cost-effective monthly reads
- Faster meter reading and collection
- Reduced labor costs
- Unscheduled/special reads cost ineffective

**Touch**

- Cost ineffective for more than monthly read
- Potentially unsafe
- Minimal automation
- Customer intrusive

**Manual**

- Labor intensive
- Unsafe for meter readers
- Unscheduled/special reads cost ineffective
- Customer intrusive

# Remember This?



8 Day Forecast

| FRI | SAT | SUN | MON | TUE | WED | THU | FRI |
|---|---|---|---|---|---|---|---|
| 30 | 31 | 27 | 21 | 20 | 22 | 20 | 20 |
| 22 | 23 | 16 | 12 | 10 | 12 | 10 | 11 |

COLD WEATHER

I wish we had AMI….

# AMR and AMI Overlap Somewhat

## AMR

- Basic Meter
- Electronic Meter
- Intelligent Meter
- Smart Meter
- Remote Shut-Off Valves
- Leak Detecting Sensors
- Pressure Sensors

## AMI

- Basic Meter
- Electronic Meter
- Intelligent Meter
- Smart Meter
- Remote Shut-Off Valves
- Leak Detecting Sensors
- Pressure Sensors

# Benefits of AMR/AMI

**Leak Detection**
Daily reception of E-Coder® leak intermittent and continuous leak flags

**Customer Service**
Easily accessed and daily reading data allows utilities to improve customer service and resolve billing disputes

**Off-Cycle Reads**
Daily readings from the Gateway are available to support off-cycle readings without rolling a truck, saving time and money

**Reverse Flow Monitoring**
Daily access to E-CoderPLUS flags provides continuous reverse flow monitoring 24 hours per day

**Tamper Detection**
Advanced E-CoderPLUS tamper detection provided daily to the Gateway

**Usage Profile Analysis**
Data received by the R900® Gateway allows a utility to provide more data to industrial/commercial customers so that those customers can manage usage

12

# AMI Fixed Base System Architecture

- Readings Collected from Meter via RF or Cellular Transmission

- R900 or 450-470MHz Licensed Band or 2G/3G/4G LTE

- Full data transmission

- Multiple Backhaul Options

- Server Based or Hosted
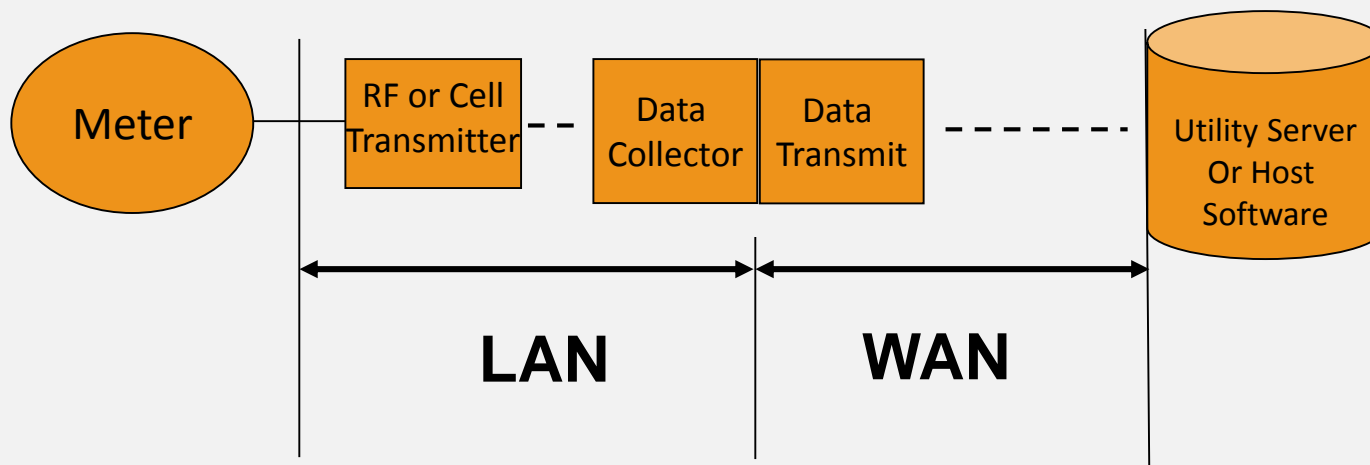
# Fixed Network vs AMI

# Types of AMI Systems

- Tower Based
  - Collector antennas placed strategically throughout the reading area for total collection
  - Normally located on water towers, tall buildings and antenna towers
  - Power Limits

# AMI FixedBase - RF Collector

- Tower-based system
  - $\geq$ 150 feet preferred antenna height
  - Collectors can be located on rooftops of buildings, or telephone poles (lower heights reduce coverage area)
- Antenna is mounted on the top of the tower
- Data collector is mounted at the base of the tower
- 110 V power requirement
- 2G/3G/4G LTE modem standard (Ethernet, Wi-Fi backhauls are optional)
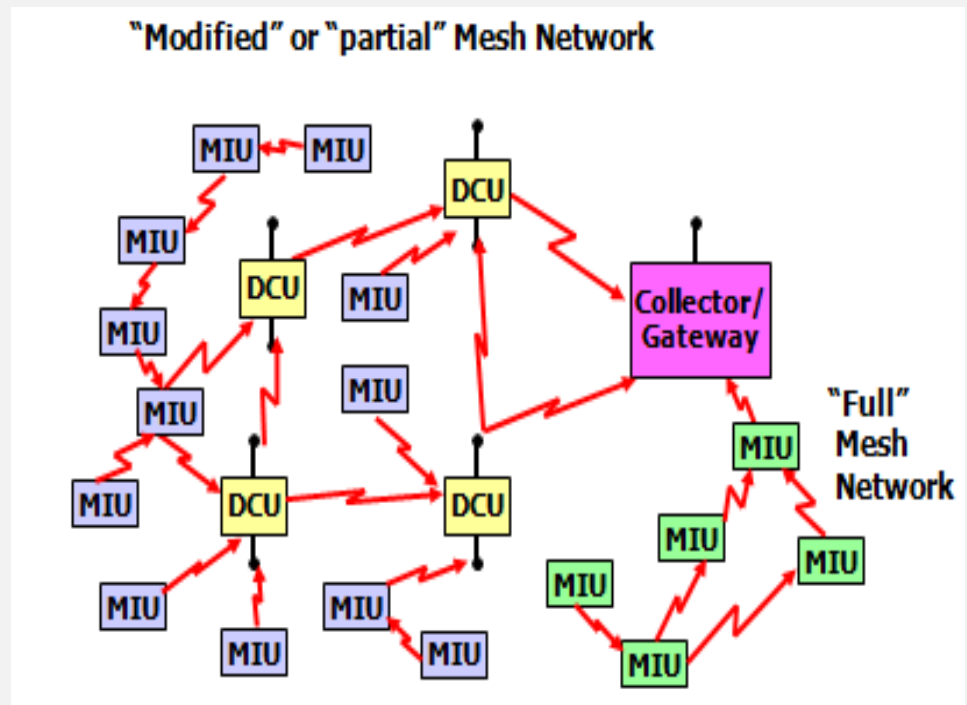
**Benefits**
- **Reduced number of collectors**
- **Ease of access to equipment**
- **Lower maintenance costs**

# Types of AMI Systems
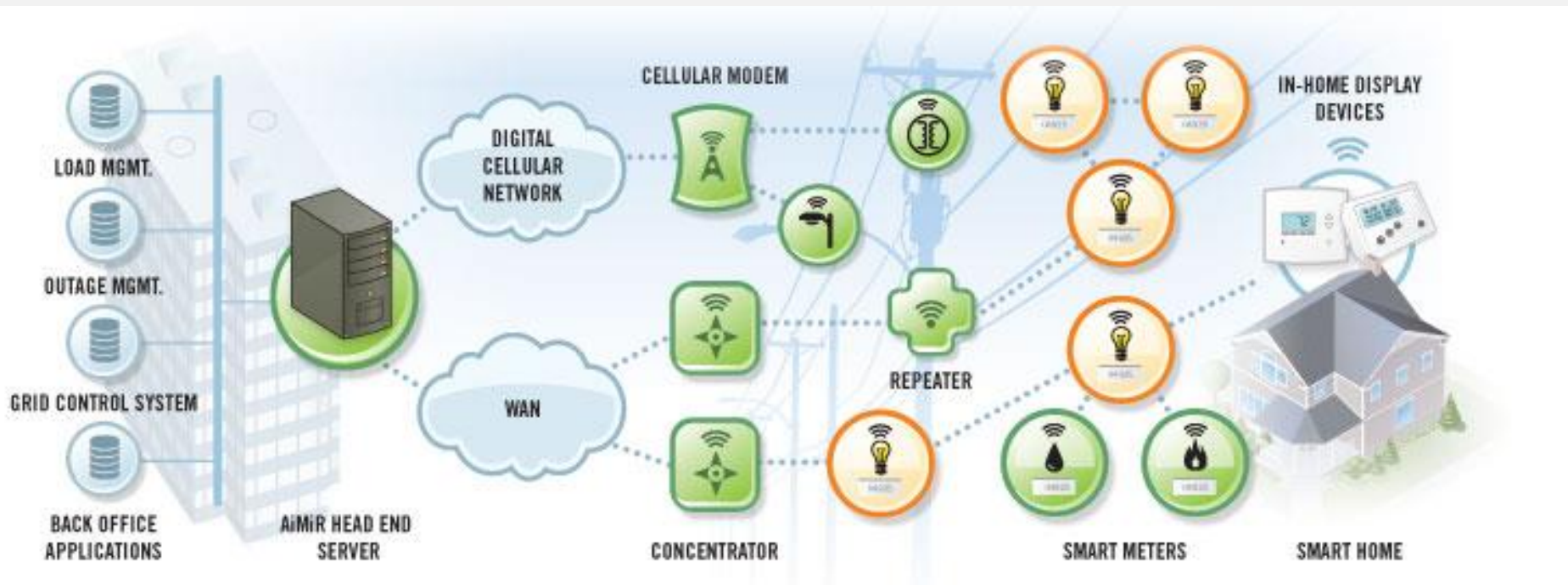
- # Mesh Network

  - Relaying data information from one unit to another to relay the readings to the host computer.

  - The individual units gather their own data but also pass other data

# Types of AMI Systems
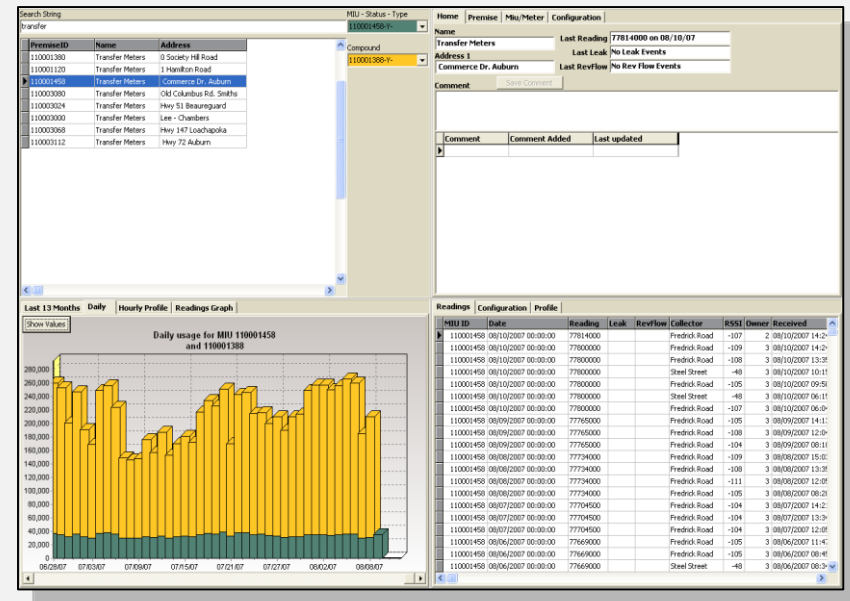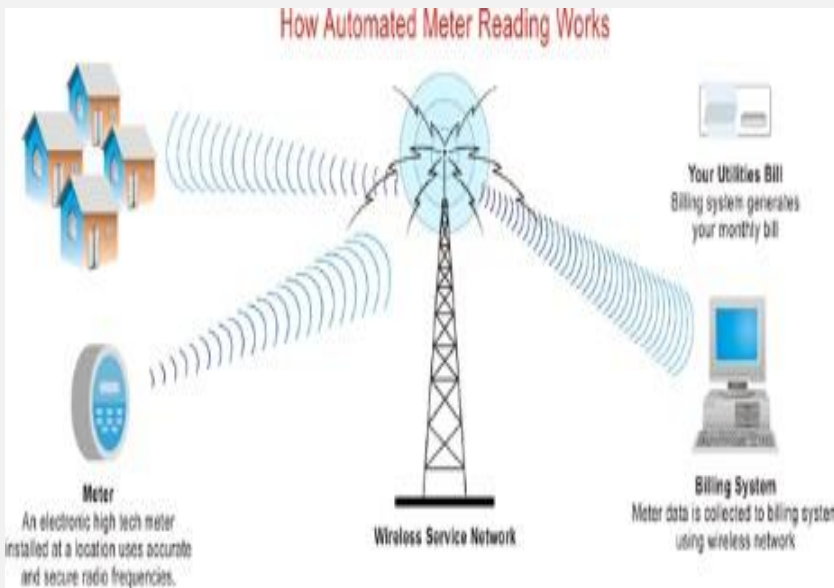
- ## Combined Network

    Relaying data information from one unit to another to a tower to the host computer.

# AMR & AMI Provide Two Major Benefits

- Meter Reading Improvement

- Better Data

# AMI offers more than reading the meter: It's all about the Data

- Precise consumption information

- Clear and accurate billing

- Automatic leak notification

- Better & Faster Customer Service

- Billing disputes are resolved faster because of better information

- Flag potential high consumption before customers get the high bill
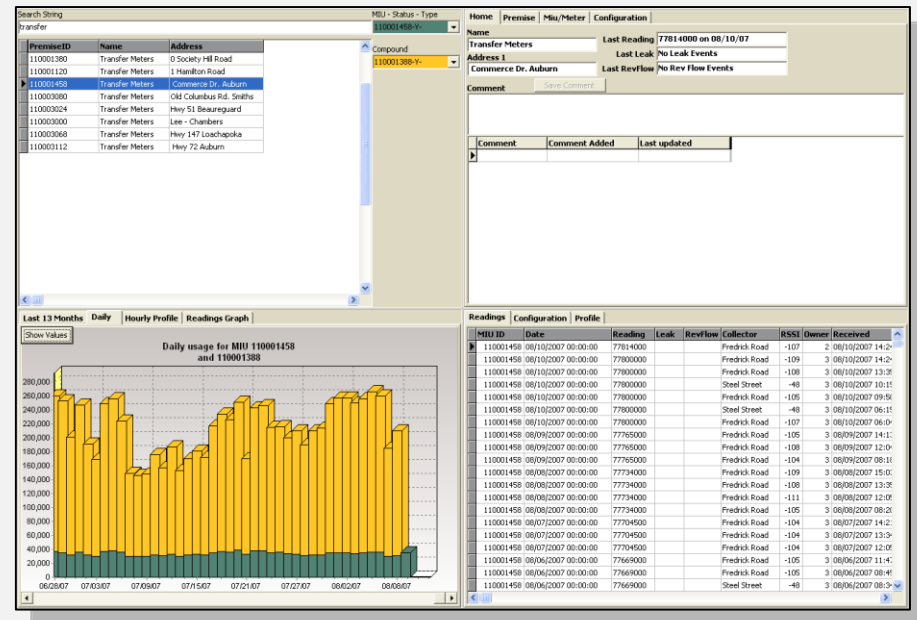
# Improving AMI System Operations

- Meter selection and accuracy

- Non Revenue Water Evaluation

- System Leak Monitoring

- System Backflow

- System Pressure

- Water Quality Monitoring

# AMR Network - RF AMR



2,000-30,000 reads per day

1,000-2,000 reads per day

175-450 reads per day

100-175 reads per day

- Enables existing RF assets to avoid obsolescence
- Allows for easier "fail safe" capture of reads
- Allows the blending of the "Best" technologies to meet the business case objectives
  - Financial
    - Mobile for monthly or bi-monthly meter reading
    - Fixed network for daily or monthly meter reading
  - Operational
    - Address safety and labor issues
    - Reduce non-revenue water
    - Usage profiling
  - Customer Service
    - Eliminates estimated reads
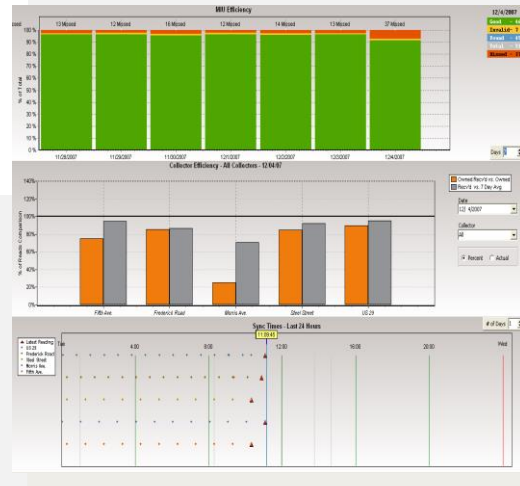    - Ease of unscheduled / special reads

# AMI Fixed Network  RF AMR

Up to 96
Reads  per
Meter per day

2,000-30,000 reads per day

1,000-2,000 reads per day

175-450 reads per day

100-175 reads per day

- **Enhanced meter reading efficiency and safety**

- **Eliminates estimated reads**

- **Ease of unscheduled / special reads**

- **Daily leak / theft detection**

- **Usage profiling**

- **Customized value-added services**

- **Real-time use of smart encoder features**

- **Reverse flow alarm for system security initiatives**

- **Can spot and correct meter and system issues before billing**

# Smart Meters

- **Higher Resolution**
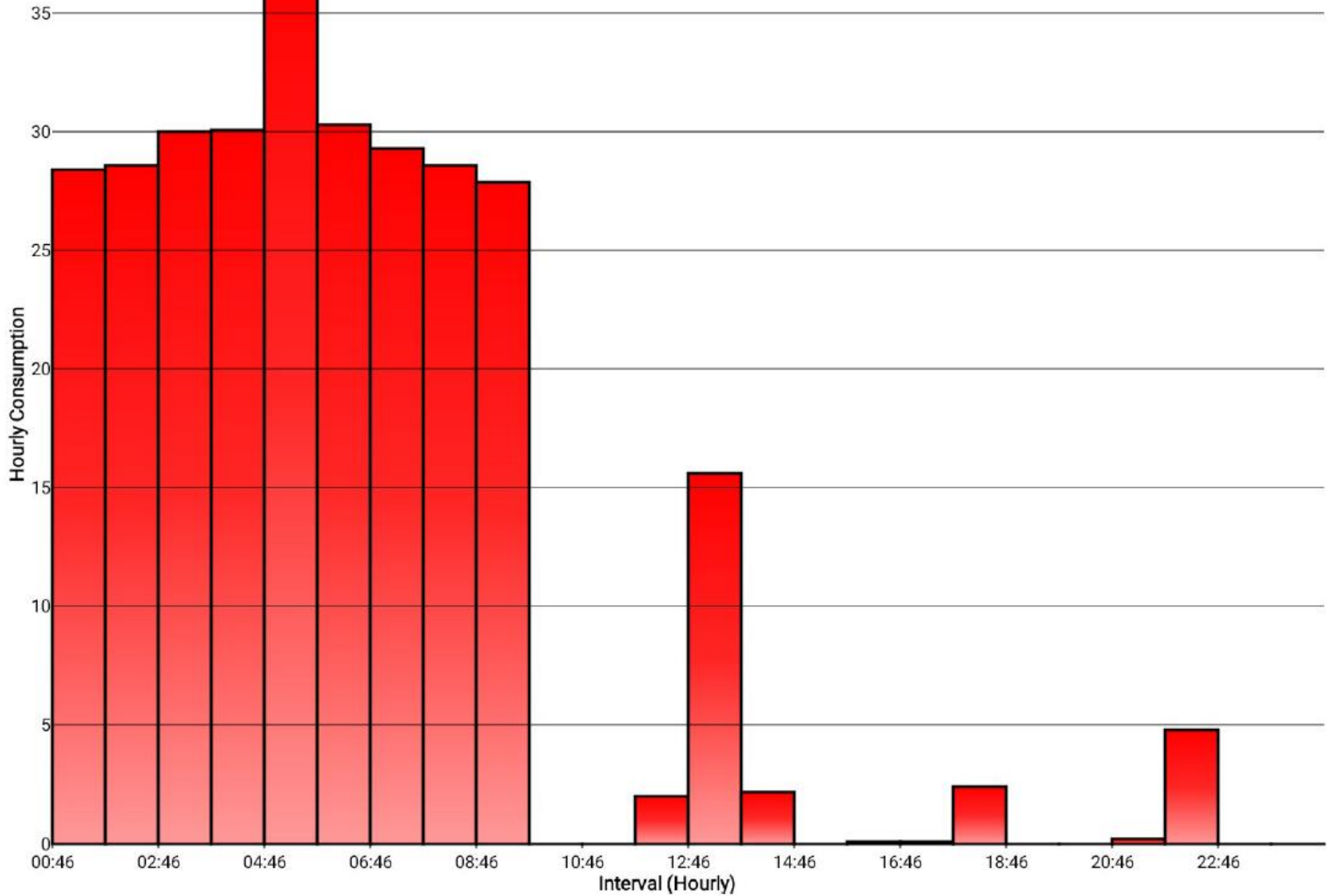- **Leak Detection**
- **Reverse flow Detection**
- **Tamper Detection**
- **Data Logging**

- **Actionable Information**
- **Improved Customer Service**
- **More Information to you**
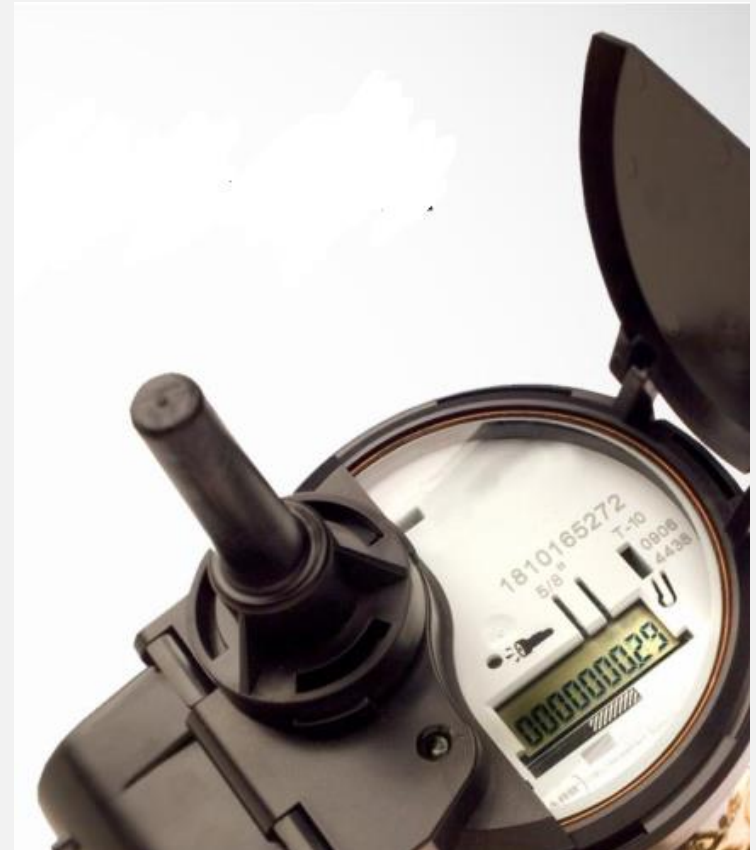
E-Coder R900i Data Logging Report
MIU#: 1542113902 for 03/13/2016 through 03/19/2016 - 5/8" - 1" T-10, GALLONS
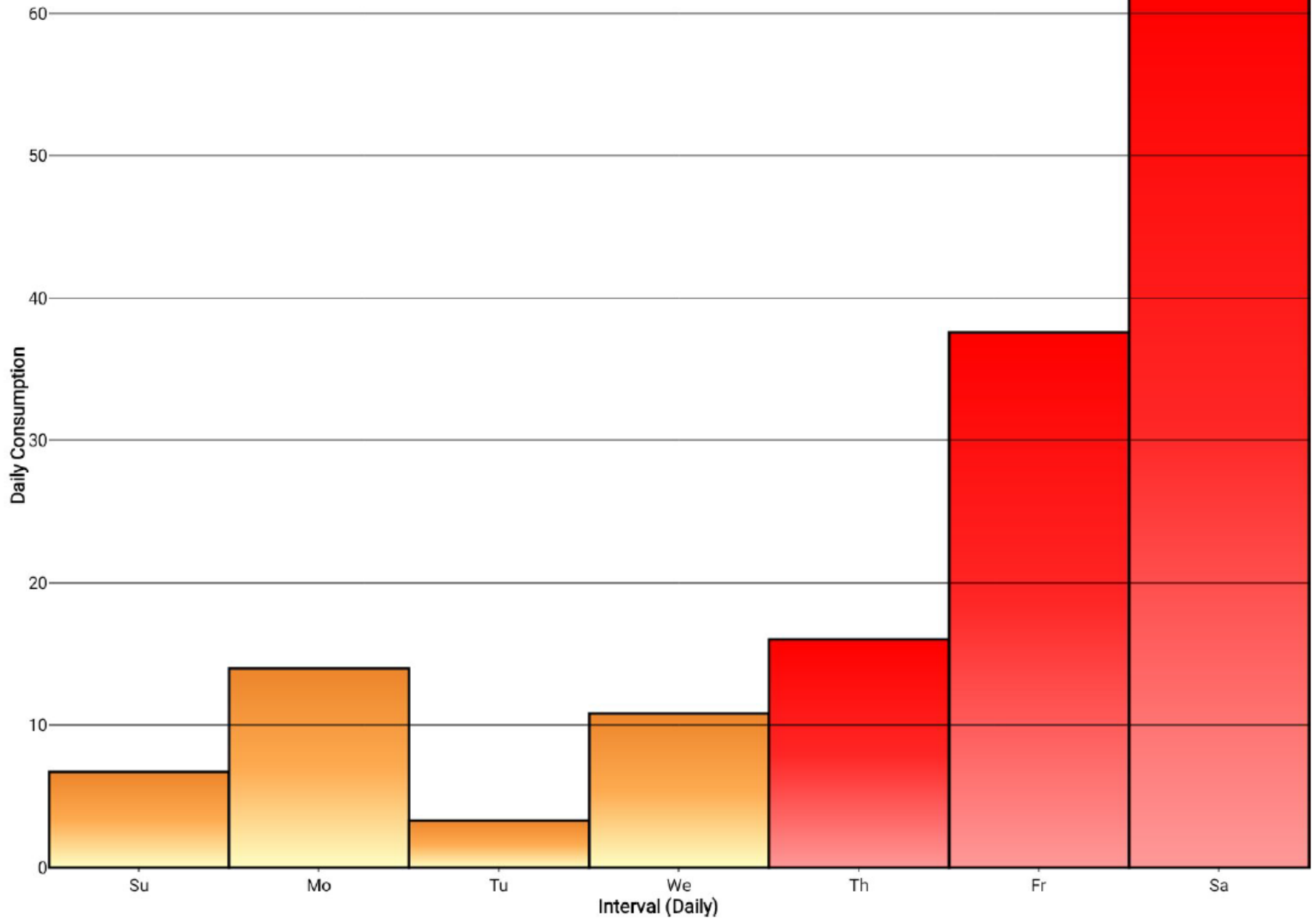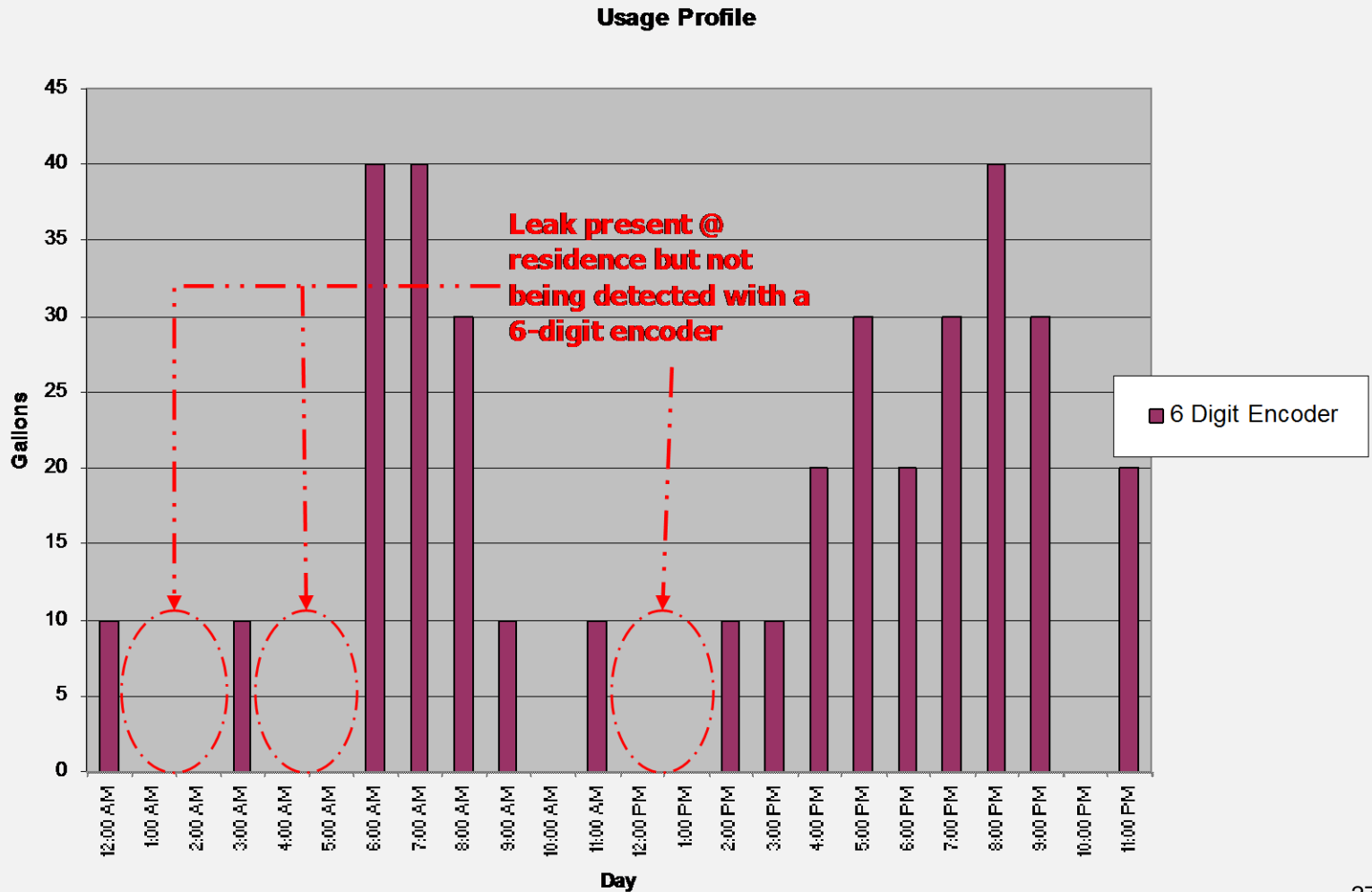
E-Coder R900i Data Logging Report
MIU#: 1542114786 for 03/17/2016 - 5/8" - 1" T-10, GALLONS
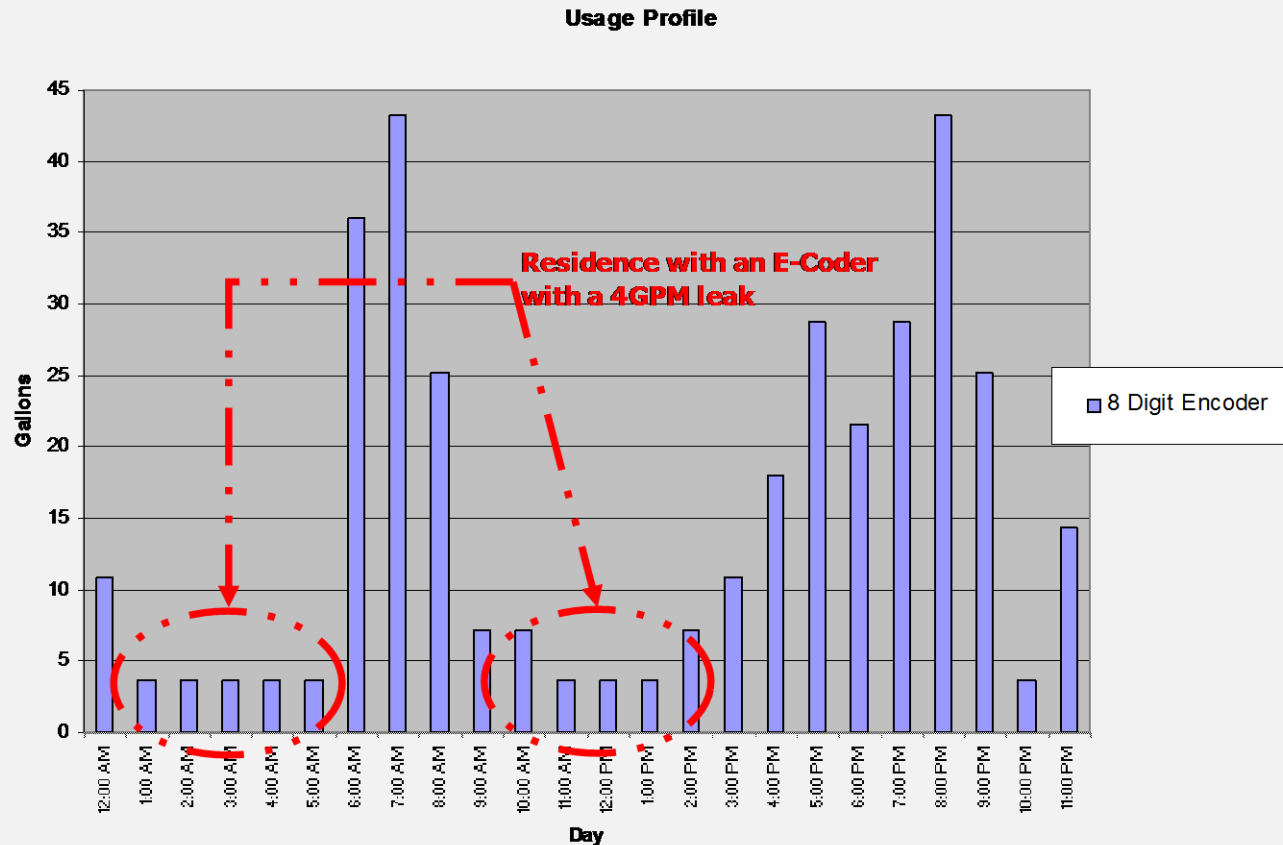
# Leak Detection without High Resolution

- Undetected leak standard with 6-digit resolution



Usage Profile

# E-Coder 8-digit Resolution

- **8 Digit Resolution = 1/100 GPM**

- **True Leak Detection Demands High Resolution**



Usage Profile

# The Need for High Resolution

| Meter Application | Conventional Encoder | | Solid State E-Coder | |
|---|---|---|---|---|
| | Visual | Remote | Visual | Remote |
| **Residential** *(5/8" – 1" T-10)* | 0.1 cubic foot | 1 cubic foot | 0.001 cubic feet | 0.01 cubic feet |
| **Light C&I** *(1½" & 2" T-10; 1½" – 4" HTP)* | 1 cubic foot | 10 cubic feet | 0.01 cubic feet | 0.1 cubic feet |
| **Large C&I** *(6" – 20" HPT, HPPIII, & TF)* | 10 cubic feet | 100 cubic feet | 0.1 cubic feet | 1 cubic foot |

## *High Resolution = High Value*

# Encoder Comparison

## Typical Residential Register

**E-Coder)**

**9-digit**

| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|
| 1M | 100K | 10K | 1K | 100 | 10 | 1 | .1 | .01 |

**Typical 6-wheel**

| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|
| 1M | 100K | 10K | 1K | 100 | 10 | Fixed 0 |
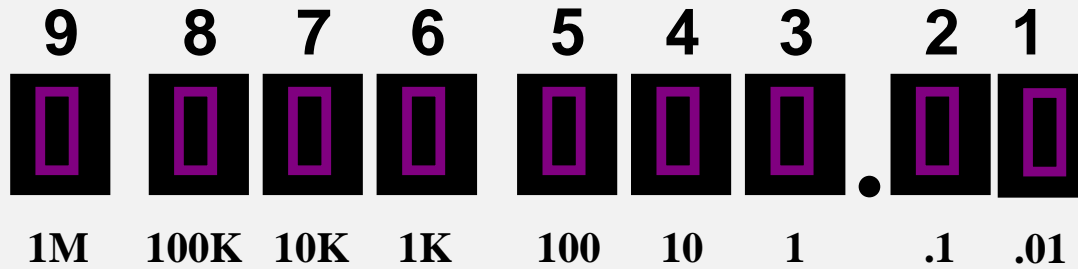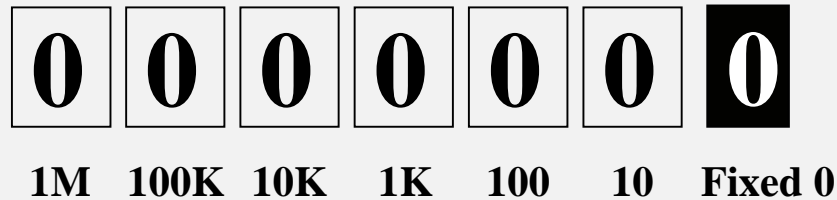
# Smart Encoder: Value Throughout the Utility

**General Management**
- Accurate bills
- Proactive water leak notification
- Financial accountability
- Resource conservation

**Customer Service**
- Improved operational efficiency
- High water bill complaint resolution

**Finance**
- Increased cash flow
- Reduced unaccounted-for-water
- Improved bottom line

**Meter Reading Department**
- Encoder technology
- Guaranteed accurate readings

**Maintenance**
- Service order reduction – leaks, tamper, backflow
- Enhanced trouble-shooting tools

# AMI Can Help Track and Identify Non-Revenue Water

Water Losses

Leaks on Distribution Mains

Unauthorized Consumption

High Water Bill Complaints

Leakage on customer side of the meter

Causes and Sources of Non-Revenue Water

Daily Production – Metered

Distribution Leak Monitoring – Sensors

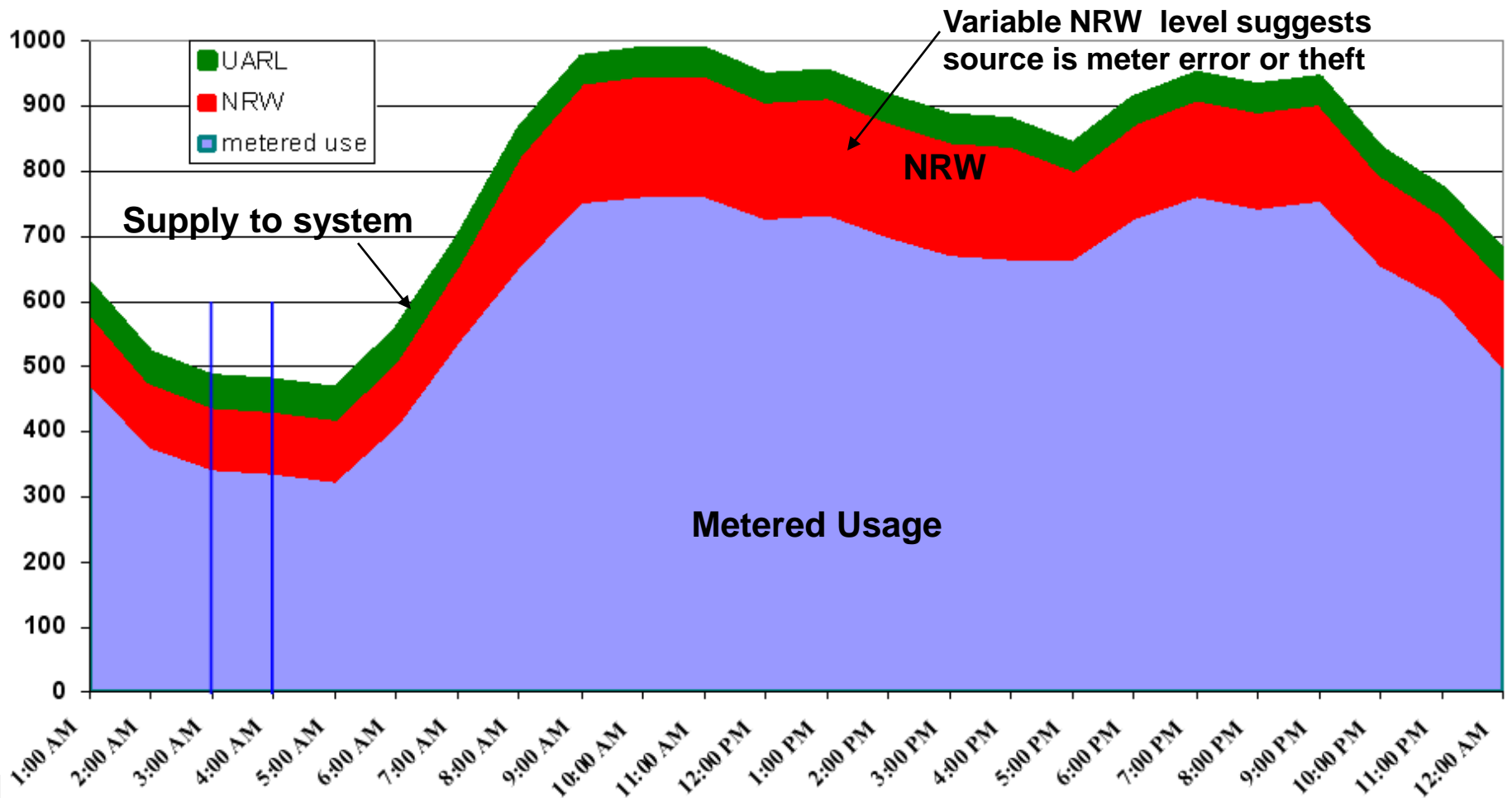Abnormal Consumption – Daily or Hourly Usage Profile

End User Leaks – High Resolution Meters

ARB® N_SIGHT™

Daily Tools to Analyze your System

# AMI Can Help Track and Identify Non-Revenue Water



DM A HOURLY M ETER DATA UTILITY 2

Variable NRW level suggests source is meter error or theft

NRW

Supply to system

Metered Usage

# Utility View - Example Group Detail

Consumption of every meter in the system compared to the water Pumped from the Water Plant

Water Pumped – Total Water Used = Unaccountable Water (non-billed water)

# System Health Screen

- "At-a-glance" view of the efficiency of the system
  - MIU efficiency
  - Collector efficiency
    - Orange bar represents "Owned" MIUs (MIUs the collector is receiving the strongest signal strength from)
    - Grey bar represents all of the MIUs the Collector has received transmissions from
  - Collector sync times
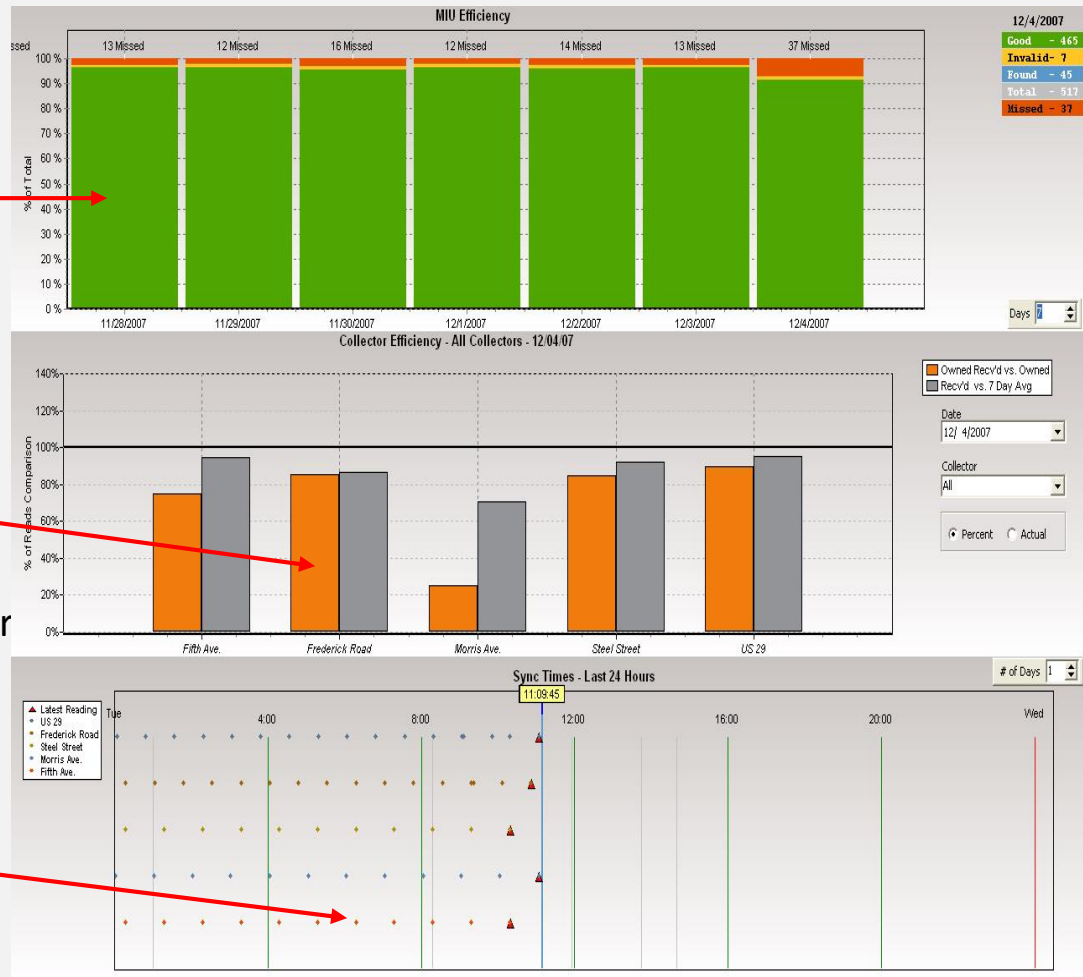
# System Health Screen

- "At-a-glance" trouble-shooting
- Missed Reads 103
- Collector down
- Collector failed to sync with Host at 2:00PM Monday
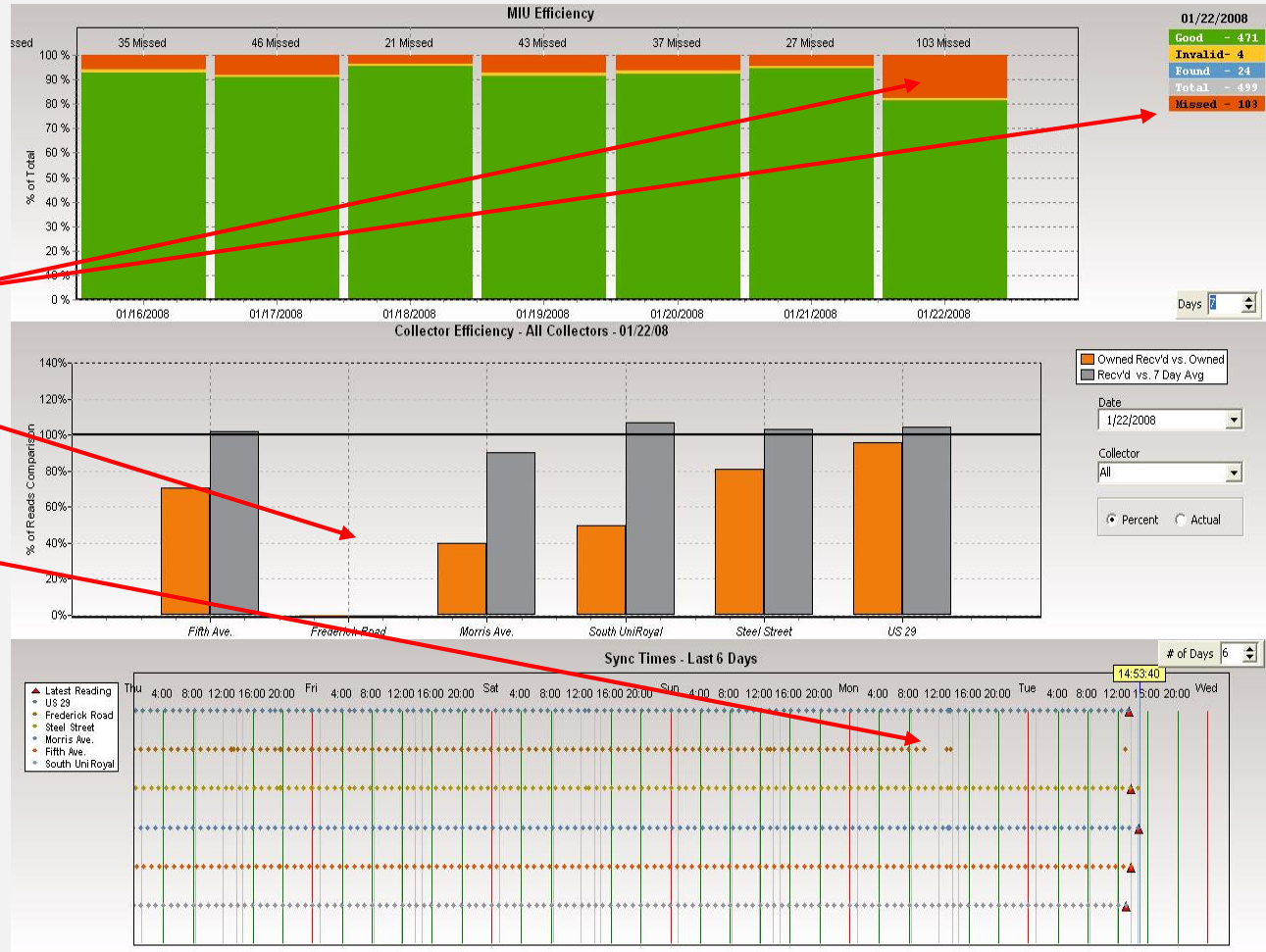
# AMI Host Software – Customer Service Screen

- Group prefix – "transfer" pulls up all transfer meters
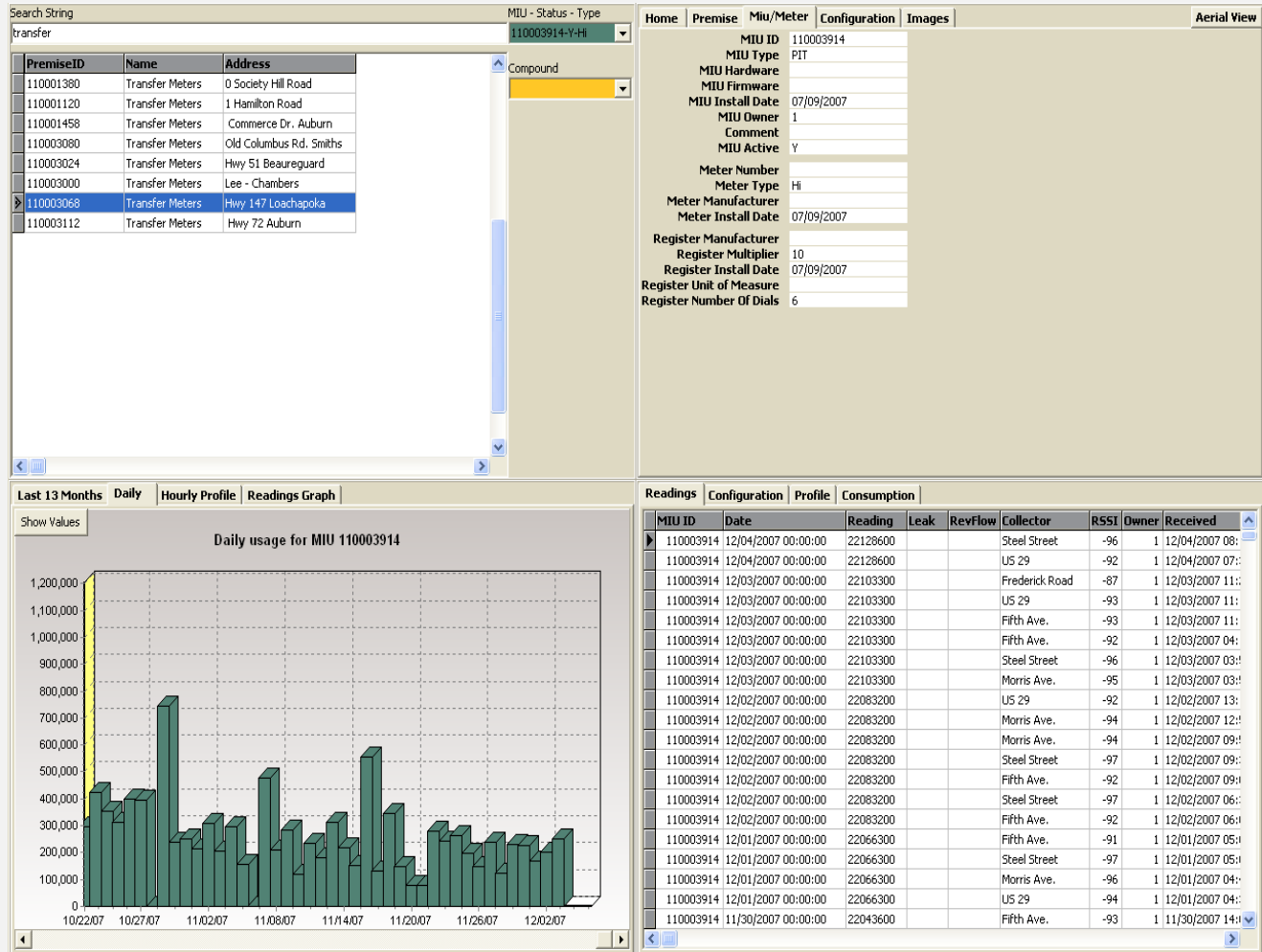
- Usage graph
  - Daily profile

# How Does Daily Meter Readings Benefit Customer Service?

- Example
- 10,000 meter Utility
- Currently reading monthly – 9,000 x 12 months =
- 120,000 reading/per year

- With AMI Customer Service will have hourly meter reading data
- One customer - 8,760 meter readings/per year
- All customers - 87,600,000 meter readings/per year

# 24-Hour Usage/Consumption Profile

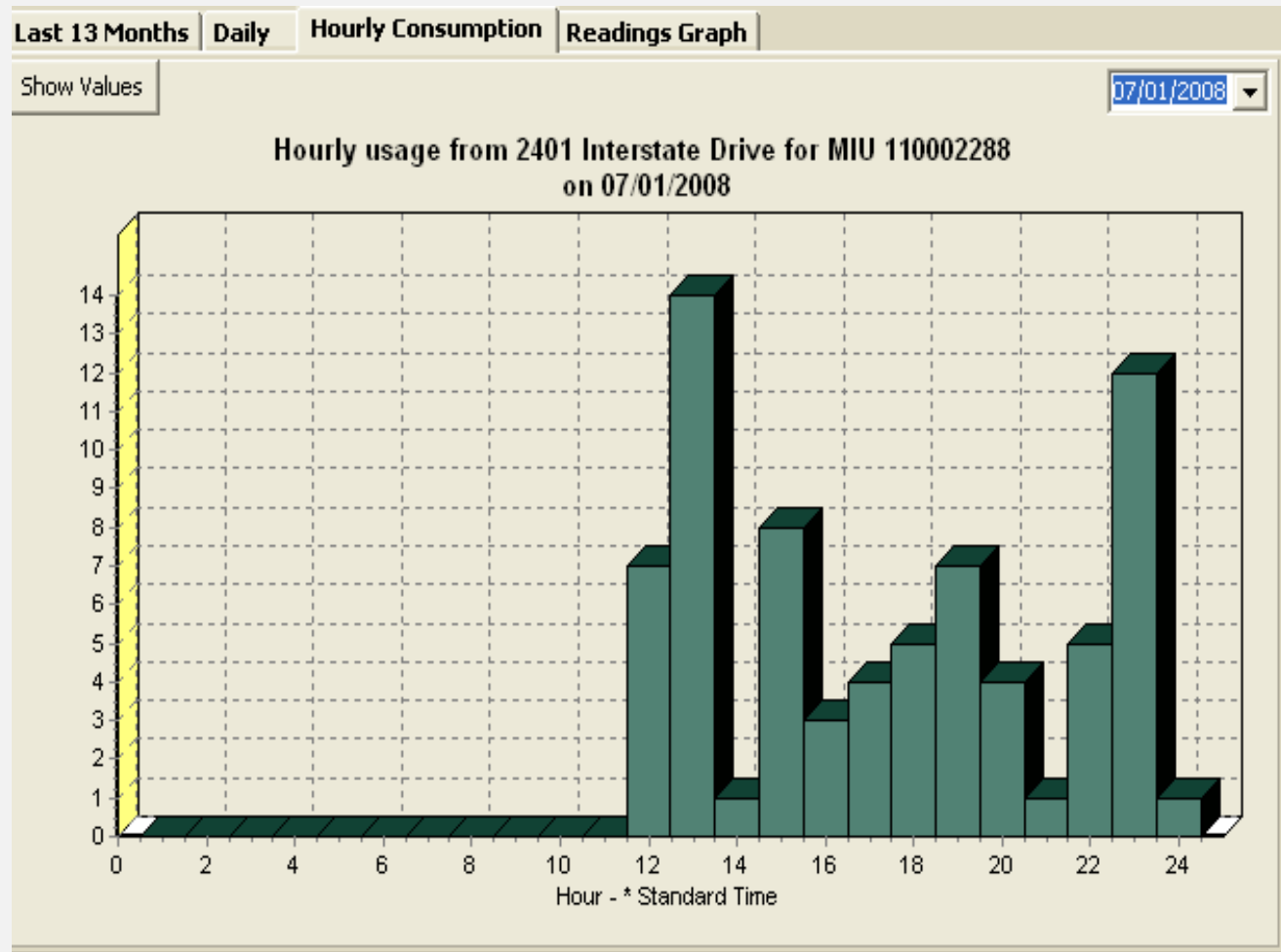- Hourly usage is presented in graphical form

# 24-Hour Usage/Consumption Profile

- Hourly usage data is also presented as consumption totals in a table by hour

| | Date | Consumption | Hour 1 | Hour 2 | Hour 3 | Hour 4 | Hour 5 | Hour 6 | Hour 7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Readings | Daily Consumption | Hourly Consumption | Alarms | Configuration | | | | | | |
| ▶ | 07/14/2008 | 101000 | 0 | 3000 | 6000 | 7000 | 8000 | 2000 | 0 | |
| | 07/13/2008 | 165000 | 820 | 0 | 820 | 0 | 820 | 4140 | 5800 | |
| | 07/12/2008 | 165000 | 820 | 0 | 820 | 0 | 820 | 4140 | 5800 | |
| | 07/12/2008 | 165000 | 820 | 0 | 820 | 0 | 820 | 4140 | 5800 | |
| | 07/12/2008 | 93000 | 0 | 0 | 930 | 0 | 0 | 0 | 0 | |
| | 07/11/2008 | 244000 | 19420 | 14560 | 21850 | 6060 | 8490 | 7280 | 25490 | |
| | 07/10/2008 | 244000 | 19420 | 14560 | 21850 | 6060 | 8490 | 7280 | 25490 | |
| | 07/10/2008 | 208000 | 14650 | 4500 | 4500 | 6760 | 1120 | 13520 | 12400 | |
| | 07/09/2008 | 206000 | 5670 | 5670 | 3400 | 1130 | 6810 | 5670 | 1130 | |
| | 07/08/2008 | 477000 | 72810 | 72810 | 72810 | 72810 | 72810 | 12550 | 2510 | |
| | 07/07/2008 | 1675000 | 67000 | 67000 | 67000 | 67000 | 75370 | 75370 | 75370 | |
| | 07/06/2008 | 1586000 | 64080 | 64080 | 64080 | 64080 | 64080 | 64080 | 64080 | |
| | 07/05/2008 | 1578000 | 71360 | 71360 | 71360 | 63430 | 63430 | 63430 | 63430 | |
| | 07/04/2008 | 1627000 | 73210 | 65080 | 65080 | 65080 | 65080 | 65080 | 65080 | |
| | 07/03/2008 | 1627000 | 73210 | 65080 | 65080 | 65080 | 65080 | 65080 | 65080 | |
| | 07/03/2008 | 1627000 | 73210 | 65080 | 65080 | 65080 | 65080 | 65080 | 65080 | |
| | 07/01/2008 | 1624000 | 65940 | 65940 | 65940 | 74190 | 74190 | 82430 | 74190 | |
| | 06/30/2008 | 1675000 | 66330 | 74630 | 74630 | 82920 | 91210 | 82920 | 74630 | |
| | 06/29/2008 | 1693000 | 70720 | 70720 | 79560 | 79560 | 4420 | 88400 | 79560 | |

# Mapping

- Identify areas of concern or interest such as:

  - Leak
  - Reverse Flow
  - Zero Consumption
  - Soft-Disconnect
  - Not Heard From
  - Major Reverse Flows
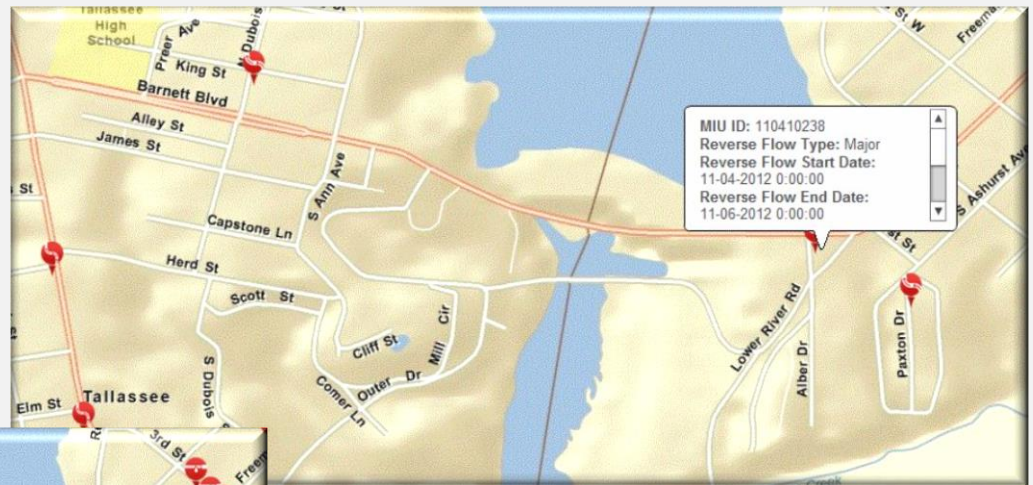




  - Missed
  - Inactive with Usage
  - Collector Types
  - Collector Status
  - All Endpoints
  - Continuous Leaks
  - Endpoint Groups

# Customer Service Web Interface
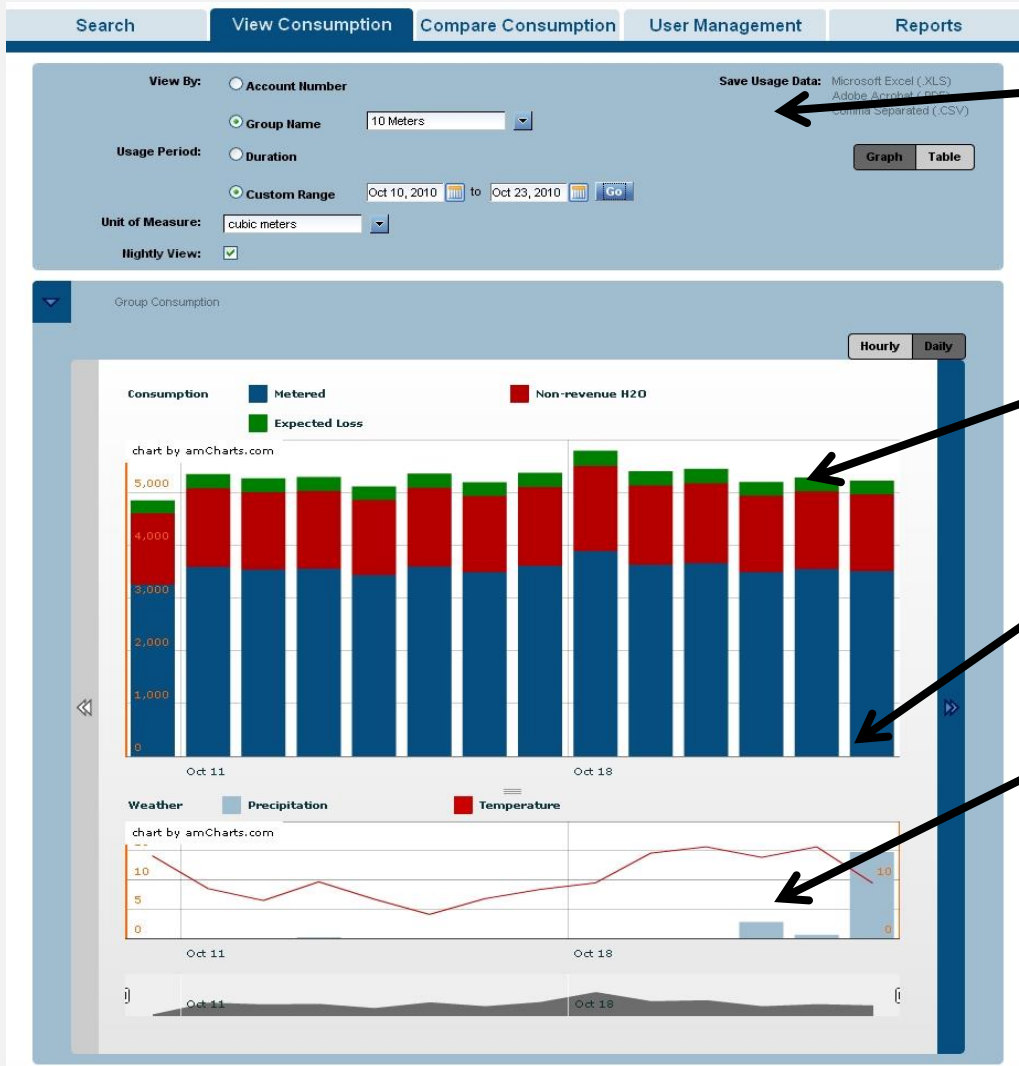
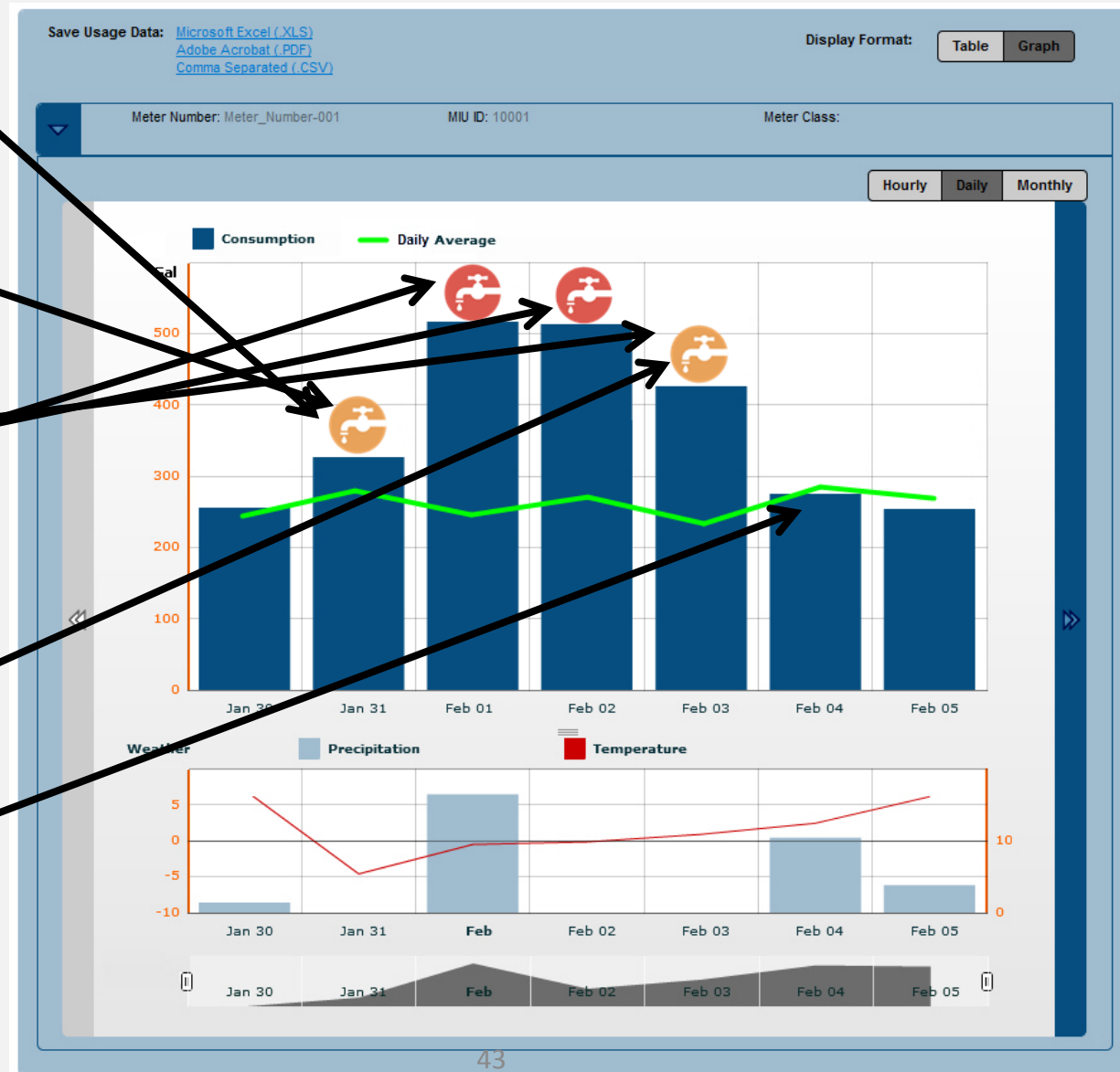# Customer Service Web Interface – Customer Example



Customer leak starts

E-Coder® intermittent leak alert triggered

E-Coder continuous leak alert triggered

E-Coder intermittent leak alert triggered

Usage back to normal

Save Usage Data: Microsoft Excel (.XLS) / Adobe Acrobat (.PDF) / Comma Separated (.CSV)

Display Format: Table | Graph

Meter Number: Meter_Number-001    MIU ID: 10001    Meter Class:

Hourly | Daily | Monthly

Consumption — Daily Average

Jan 30  Jan 31  Feb 01  Feb 02  Feb 03  Feb 04  Feb 05

Weather    Precipitation    Temperature

Jan 30  Jan 31  Feb  Feb 02  Feb 03  Feb 04  Feb 05

Jan 30  Jan 31  Feb  Feb 02  Feb 03  Feb 04  Feb 05

# Is AMI Right for You?

# Things to Consider

- Evaluate what type of system works best in for YOUR Utility
- What is the total real cost?  Up-front and long-term
- Review  a long-range plan with various departments (Distribution, Customer Service, IT)
- Determine if you want to use the existing assets (meters & existing mobile RF) or replace everything
- Compare the system offerings & weigh Pros and Cons
- Communicate with other Utilities who have systems installed
- Determine if you have personnel to evaluate the additional data

QUESTIONS?

# Roundtable

➢What type of meter do you use?

➢How old is the system?

➢Describe the meter reading process

➢Describe the billing process

➢What is your greatest challenge?

➢Has Funding projects been a challenge?

➢What have you done that has worked particularly well?

➢What questions do you have for other utilities?

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