The Feasibility of Advanced Metering Infrastructure (AMI) as A Universal Metering Strategy in a Caribbean Water Utility

Purpose of Presentation

- To examine the technical and economic feasibility of implementing an Advanced Metering Infrastructure (AMI) system.

- The case of Water & Sewerage Authority (WASA) in Trinidad & Tobago

Presentation Outline

- Background
- What is AMI
- AMI Implementation Options
- Cost/Benefit Analysis of AMI
- Comparison of Other Metering Options
- Conclusion

Background

- WASA is the sole water utility in Trinidad & Tobago with over 360,000 customers
- WASA uses a flat fee system to bill most customer

Major Disadvantages:

- Billing is de-coupled from consumption
- Does not encourage conservation
- Puts economic burden of leaks & losses on the utility

Universal Metering

- Introduce universal metering system
- In this system:
  - All customers billed based on volumetric consumption
  - Losses on customers' premises borne by customers

Results:

- Reduce water loss
- Encourage conservation

USEPA: *"metering can reduce consumption by 20 to 40%"*

What is AMI?

A metering system in which a fixed network is used to communicate between meters and utility.

Features:

- Two-way communication
- Hourly consumption data
- Meter status information
- On-demand readings
- Control of network elements

Network technology includes:

- Radio Frequency, Power Line Carrier, Broadband over Power Line

Benefits of AMI

- Reliable Delivery of Data
- Water Conservation
- Customer access to near real-time usage information
- Real-time Leakage Detection & Monitoring
- Remote utility management
  - Supply management
  - Tamper notification
  - Theft detection
- Environmental Benefits

Other Metering Options

- Conventional Metering
  - A manual system
  - Meter records consumption
  - Meter reader visits each premises
  - Submits readings to billing dept

- Automatic Meter Reading (AMR)
  - Meter stores hourly consumption & status data
  - Data is read wirelessly by handheld or mobile reader
  - Data is submitted electronically to billing dept

AMI Implementation Options

WASA has two implementation options:

- Option A - Build own AMI Network
- Option B - Use existing AMI Network of T&TEC

AMI Implementation Options

Option A – Build Own Network:

- Feasibility Analysis
- Design system
- Acquire, install and commission network hardware & software
- Acquire & install 360,000 two-way smart meters

AMI Implementation Options

Information & Assumptions:

- Life of systems is 20 years
- Costs inflation of 5% per annum
- NPV discount rate of 8.24% (cost of embedded debt)
- Cost of AMI network @ $125 per meter
- Cost of 360,000 meters @ $250 each
- Cost of installing 360,000 meters @ $150 per meter
- Maintenance cost of 0.1% of capital cost per annum

All amounts in US$

AMI Implementation Options

Option A – Build Own Network:

- **Cost of system:**
  - Capital cost - $189 million
  - Operating cost - $1.02 million
  - Maintenance cost - $1.35 million

  - **TOTAL COST: $191.4 million**

AMI Implementation Options

Option B - Use Existing AMI Network of T&TEC

- Acquire & Install 360,000 two-way smart meters
- Data & payment arrangement with T&TEC

AMI Implementation Options

Option B - Use Existing AMI Network of T&TEC

- Questions to consider:
  - Are uses of both utilities Compatible?
  - Can system provide needed functionality?
  - Is there sufficient Capacity for both utilities?
  - What type of data delivery & payment arrangements?

AMI Implementation Options

Option B - Use Existing AMI Network of T&TEC

- Compatibility
  - Collectors in T&TEC's AMI Network are designed to handle Water, Electric and Gas simultaneously
  - Must use Itron endpoints – available for most meters
  - Preliminary tests demonstrated compatibility

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

☑ Compatibility

❑ **Technical capability**

- Can T&TEC's system provide the functionality needed by WASA?
  - Meter reading
  - Supply management
  - Leakage detection & monitoring
- Ascertain WASA's needs & whether modules installed

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

☑ Compatibility
☑ Technical capability
☐ **Capacity**

- Can the system accommodate data transfer demand of both utilities for current & future needs?

- T&TEC uses about 20% of capacity
- WASA is expected to use even less
- Both combined will use less than 40% of capacity
- Will take 40 years to reach 80% capacity

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

☑ Compatibility
☑ Technical capability
☑ Capacity
❑ **Contractual Arrangements**

- How will data transfers be handled?
- Procedure for remote control functions?
- How will WASA pay for service?
- Negotiated or mandated by shareholder?

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

- Managed Service Contract:
  - T&TEC is responsible for system
  - T&TEC provides consumption & status data to WASA
  - T&TEC processes remote utility activities
  - WASA pays a monthly fee for the services
    - Monthly fee of $0.20 per meter per month

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

- ☑ Compatibility
- ☑ Technical capability
- ☑ Capacity
- ☑ Contractual Arrangements

AMI Implementation Options

Option B – Use Existing AMI Network of T&TEC

- **Cost of System:**
  - Capital cost - $144 million
  - Operating cost - $6.5 million
  - Maintenance cost - $1.03 million

  - **TOTAL COST: $151.5 million**

AMI Implementation Options

TABLE 1 - COST OF AMI OPTIONS

NPV of AMI COSTS		
	Option A	**Option B**
Capital Cost	189,000,000	144,000,000
Operating Cost	1,021,918	6,489,244
Maintenance Cost	1,346,717	1,026,070
TOTAL COST	**191,368,635**	**151,515,315**

AMI Implementation Options

Benefits Analysis

- Projected Benefits include:
  - Reduced Consumption
  - Reduced leakage & theft
  - CAPEX Avoidance
  - Reduced CO_2 Emissions ⟹ Carbon Credits
  - Reduced security cost of High Risk Areas
  - Increased Operational Efficiency

AMI Implementation Options

Information & Assumptions:

- WASA's unit operational cost per m^3: $0.6641
- Water supply accounts for 800k tons of CO_2 at $8/ton
- Total Water production: 220 mgd
- Desalination produces 12% of supply
- Leakage & theft: Reduced from 51% to 25%
- Improved Operational efficiency: 5%
- AMI reduces High Risk Security cost by 20%
- CAPEX Avoidance: $74 million

AMI Implementation Options

TABLE 2 - BENEFITS OF AMI

NPV of BENEFITS OF AMI		
	Option A	**Option B**
Reduced Consumption	423,138,547	423,138,547
Reduced Leakage & Theft	449,044,989	449,044,989
CAPEX Avoidance	74,218,750	74,218,750
Carbon Credits	34,211	34,211
Reduction in High Risk Areas Security cost	2,062,829	2,062,829
Increased Operational Efficiency	86,354,806	86,354,806
TOTAL BENEFITS	**1,034,854,132**	**1,034,854,132**

AMI Implementation Options

TABLE 3 - NET BENEFIT OF AMI OPTIONS		
	Option A	**Option B**
Capital Cost	(189,000,000)	(144,000,000)
Operating Cost	(1,021,918)	(6,489,244)
Maintenance Cost	(1,346,717)	(1,026,070)
Reduced Consumption	423,138,547	423,138,547
Reduced Leakage & Theft	449,044,989	449,044,989
CAPEX Avoidance	74,218,750	74,218,750
Carbon Credits	34,211	34,211
Security cost Avoidance	2,062,829	2,062,829
Operational Efficiency	86,354,806	86,354,806
NET BENEFIT	**843,485,497**	**883,338,817**

AMI Implementation Options

TABLE 3 - NET BENEFIT OF AMI OPTIONS		
	Option A	Option B
NET BENEFIT	843,485,497	883,338,817

- Both options show positive net benefit over life of system
- Option B – "Use Existing AMI Network of T&TEC" is preferred:
  - Greater net benefit of approx **$40 million** more
  - Lower capital cost

Comparison of Systems

INFORMATION & ASSUMPTIONS

- NPV discount rate 8.24%
- Cost inflation rate 5%
- Life of systems 20 years
- **AMR**
  - Reduces consumption by 20%, leakage from 51% to 35%
  - Increases operational efficiency by 1%
  - CAPEX Avoidance: $63.5 million
  - Cost of meter & installation @ $398 each
  - Maintenance cost @ 0.1% of capital cost
- **Conventional**
  - Reduces consumption by 10%, leakage from 51% to 40%
  - CAPEX Avoidance: $52.3 million
  - Cost of meter & installation @ $300 each
  - Maintenance cost @ 0.1% of capital cost

Comparison of Systems

TABLE 4 – COMPARISON OF NET BENEFIT OF METERING OPTIONS

	AMI			
	Option A	**Option B**	**AMR**	**Conventional**
Cost	(191,368,635)	(151,515,315)	(144,501,344)	(113,846,464)
Benefit	1,034,854,132	1,034,854,132	526,556,560	326,961,172
Net Benefit	**843,485,497**	**883,338,817**	**382,055,216**	**213,114,708**

Comparison of Systems

- All metering options provided net positive economic benefit
- AMI has highest overall Cost but provides greatest net benefit
- AMI is technologically advanced
  - Reduces risk of obsolescence
  - Increases learning curve

Conclusion

- AMI provides advanced tools for reducing losses, increasing operational efficiency and improving customer service
- AMI has high capital cost that can present financing challenge
- Use of existing AMI Network offers pragmatic way to reduce capital cost & avoid steep learning curve while retaining benefits
- AMI represents best economic option for WASA and customers


THANK
YOU