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## **Advanced Metering System: Systems, Applications, Goals Summary Report**

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Presented by:  
Lemmerhirt Consulting  
Framingham, MA

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# 1 Overview

Concord Municipal Light Department (CMLP) is looking to replace its existing obsolescing meter systems with a system that will allow two-way communication with customers for improved billing, customer service, reliability, and that will support the town-wide conservation and management efforts. The new system is expected to gather meter data, enable two-way communications for metered and customer services as well as integrate with the associated software systems and store data for analytics.

To set the direction for the replacement system, it is critical to understand CMLP's and the community's goals and translate those goals into a set of metering system requirements. Moving forward with the deployment of a new metering system is a foundational element to help CMLP meet the goals of its Strategic Plan. An evaluation of the systems, applications and business processes in place is important to identify the starting point. Lemmerhirt Consulting collected comprehensive utility data and interviewed utility staff to get a clear picture of CMLP's environment.

This report evaluates the systems and applications in use by CMLP. This is a current assessment (the "as-is") of business processes, systems, and equipment in place. This report covers both electric and water services.

## 1.1 Company Background

CMLP serves roughly 8,000 customers spread over 26 square miles in the Town of Concord, MA. CMLP manages the distribution of electricity and broadband services. CMLP provides billing and customer services for electricity, broadband, and water. Shown below the breakdown of residential vs. commercial types.

Customer Type	Electric Customers	Water Customers
<b>Residential</b>	7,166	5,144
<b>Commercial</b>	1,286	485
<b>Totals</b>	<b>8,452</b>	<b>5,629</b>

## 1.2 CMLP Systems and Applications

Shown below is CMLP's system overview as it relates to the Metering, Billing and Customer Service. [This graphic has been redacted due to confidentiality; it is available for staff only.]

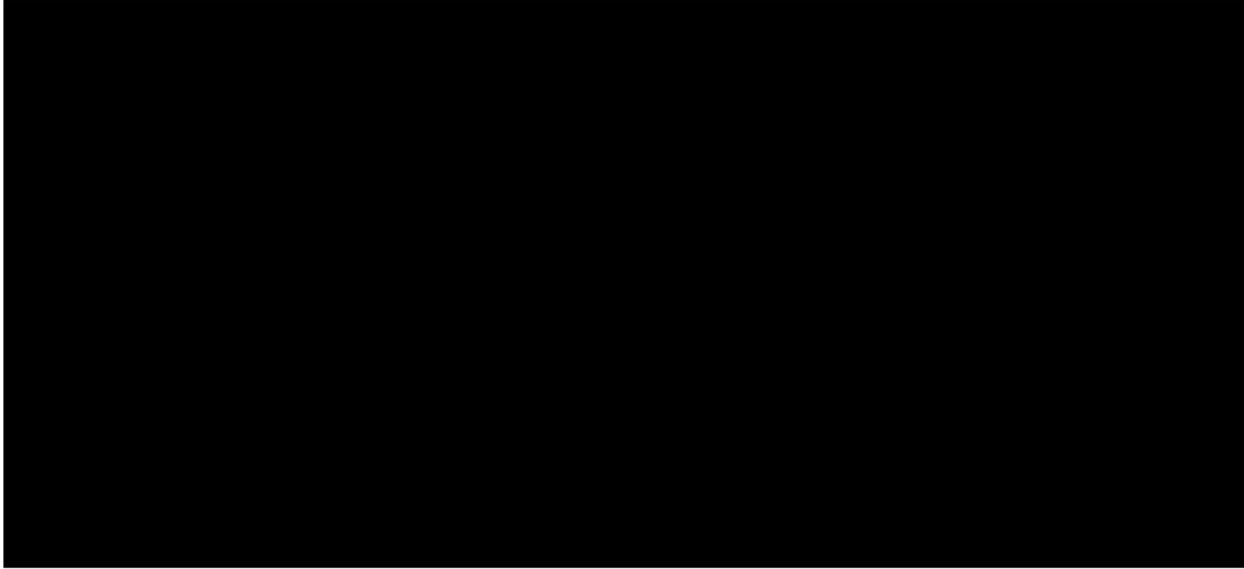


FIG1: CMLP SYSTEM ARCHITECTURE

### 1.2.1 Metering

CMLP's metering infrastructure is a combination of Advanced metering (AMI) and drive-by collection systems (AMR) with some manual collection when needed. The majority of the meters are currently read by the AMR system. Shown below is the breakdown of AMI vs. AMR.

Metering System	Electric	Water
<b>AMI</b>	<b>1,049</b>	<b>0</b>
<b>AMR</b>	<b>7,403</b>	<b>5,629</b>

#### 1.2.1.1 AMI (ELECTRIC)

CMLP implemented an Advanced Metering Infrastructure (AMI) System in 2010 to support some of the enhanced customer programs such as load control, Net metering, Electric Vehicles (EV), Electric Thermal Storage (ETS) and Heat Pumps (HP). CMLP has installed about 1,049 AMI meters to support customers enrolled in these programs using a load management software system acquired in 2010. This system collects consumption in 15-minute intervals and daily reads, meter events and alarms from these AMI Meters.

In 2019 CMLP deployed an enterprise-wide software solution from the National Information Solutions Cooperative (NISC) that integrates billing and customer service, metering, accounting and outage management. Billing data from the AMI meters are stored in NISC's Customer Information System (CIS). A Meter Data Management (MDM) system was included as part of the NISC software implementation. The NISC MDM system will be available to store more detailed meter data from the future two-way communicating meters. It is in the process of being configured to support a TOU Rates Pilot program and is expected to be fully integrated.

Note: CMLP installs a separate meter for each of the customer programs. A premise may have a residential meter, a net meter, a meter for electric thermal storage, a meter for electric vehicle, etc. Alternately, CMLP offers a TOU rate option if the customer chooses to consolidate all the programs.

#### *1.2.1.2 AMR (ELECTRIC & WATER)*

Most of the meters are read via a drive-by Itron Field collection system (FCS) once a month. FCS System collects reads for both Electric and Water Services. CMLP reads and bills water services together with electric.

#### *1.2.1.3 MANUAL READS (ELECTRIC & WATER)*

Any mid-billing period ownership changes and account closures (off-cycle) require a trip to the service location to collect a read for billing. In addition to these, seasonal water meters are read manually.

#### *1.2.1.4 BROADBAND*

Broadband services are read and billed via CMLP's billing system.

### **1.2.2 Billing**

#### *1.2.2.1 BILLING (ELECTRIC, WATER, BROADBAND)*

Using the metering data, CMLP bills customers once a month for their consumption. The various rates and programs offered by CMLP are geared towards enabling customers to manage their consumption and thereby keeping the cost for the services low. All services can be combined on a single bill. CMLP reads and bills 3 cycles each month; each service (Electric, Water, Broadband) has their own account. Customers receive a single bill with consolidated services if they elect invoice group billing.

### **1.2.3 Field Work Integration**

CMLP uses tablets in the field to record the details of field work performed, resulting in swifter completion of the work. In addition to meter maintenance work, CMLP staff visit the service location when a customer signs on to various programs such as solar net metering to replace the meter and to support off-cycle billing of service closures and moves.

Service closures, customer moves, final bill service orders are closed by 10:30 am and are ready for billing. For AMI Meters, the required reads are obtained from AMI software to complete the orders. No field visit is required. Only AMR meter orders are dispatched to the field. Water services are never turned off when a customer moves. The landlord is moved back into the account name automatically (per MA rules). CMLP handles approximately 35 finals on average per day, of which one quarter are Water related.

### **1.2.4 Outage Management**

Outage and Restoration for Electric service is managed by NISC's outage management system (OMS.) Broadband outage support is provided by a 24/7 help desk. Overflow and off-hours outage support for Electric are managed by CRC (Call Center).

CMLP shows outage information on its website. Data are shown as Outage zones and not specific locations. Generally, outages occur due to a big storm once a year, a few calls per month are attributed

to squirrels or automobile accidents taking out service lines. CMLP does not call back customers when power is restored or to provide an estimated time of restoration. The Water department uses Reverse 911 to push information out to customers about water safety such as colored water. CMLP has a well-managed budget for vegetation management.

### 1.2.5 KPIs/Analytics

CMLP uses meter data for load research and planning, network management, outage planning and in engineering.

### 1.2.6 Customer Engagement

#### 1.2.6.1 CUSTOMER SELF-SERVICE PORTAL

CMLP customers can actively manage their consumption and cost using the online self-service portal offered by CMLP. The portal offers various dashboards that present usage information to the customer. This information enables the customer to utilize the various programs/rate offerings geared towards cost reduction and conservation. A user can sign up for online access via CMLP's website or by calling CMLP Customer Service.

#### 1.2.6.2 CUSTOMER PROGRAMS/RATES

CMLP offers a variety of programs and rates geared towards supporting self-generation and energy management. The programs can be found on CMLP's website. The existing AMI system supports these program offerings. CMLP has enthusiastic customers who focus on conservation by participating in these programs:

- **Heat Pumps:** Customers who install heat pumps receive CMLP's lowest Residential rate for all their heat pump usage in the winter. The consumption is tracked by installing a separate meter.
- **Solar Net Metering:** CMLP offers net metering for customer-sited solar generation. The generation and net consumption are tracked by installing separate meters. Currently, 350-400 users are enrolled.
- **Electric Vehicle (EV):** To support the Town's sustainable energy plans, CMLP offers special rates for EV charging. This is managed via separate meters.
- **Electric Thermal Storage (ETS):** Off-peak charging of Thermal Storage Units is managed via separate meters to record off-peak charging. About 150 customers have signed up for the thermal storage.
- **Controlled Water Heating:** CMLP controls load (~1.7MW) by remotely shutting off water heaters during peak time. This is managed by AMI meters/remote switch operation. Roughly 350 users are currently enrolled in this program.
- **Overhead-Underground conversion rebate:** Service line conversion rebate capped at \$2500.
- **Summer peak Time Demand Response:** This is a voluntary program. CMLP calls 8-10 events per year. The weather forecast is the primary driver for the events. The event is called between 2 pm and 6 pm for the next day.
- **Water rebates:** Water rebates can be found here <https://concordma.gov/357/Water-Saving-Rebates>. Focus of the Water department is on Conservation.

### 1.2.7 Remote Operations

Per Massachusetts rules, CMLP cannot remotely shut off a customer’s power source unless they notify the customer at the customer's premises. However, the controlled water heating and ETS programs are managed by remotely operating the shutoff switch as part of the load shedding.

### 1.3 CMLP processes Review

S. No	Module/Process	Sub-Process	Wants/Concerns with Current Systems	Advanced Metering System Considerations
1	Metering	AMI (Electric)	The existing smart meter infrastructure is not fully deployed, and this results in weaker AMI Network scenarios. The smart meter software that enables remote controlling of the Water heaters and ETS units is not robust, which has created performance issues for customers.	A newer advanced metering solution combined with deployment of meters for all customers should provide a stronger network and improved response.  It also should ensure remote operation capabilities to all customers for customer convenience and cost savings to CMLP.
2	Metering	AMR (Electric & Water)	None	Opt-out numbers will define the need for sustaining the AMR system
3	Metering	Manual Reads (Electric & Water)	None	Minimize the need for manual reads by replacing them with an advanced metering system
4	Metering	Broadband		N/A
5	VEE/ Pre-bill Validation	Validation; Estimation	The billing team spends extra time managing the estimations produced by NISC CIS. There is room for improvement in the estimation rules	When implementing MDM to support the advanced metering system project:  Establish a robust set of validation and estimation rules to better review and flag consumption.  This will provide cleaner billing data for the CIS system and reduce the need for estimating in CIS. By obtaining meter data more frequently than once a month, estimated usage may be closer to reality due to availability of closer bookend reads.  For Water, VEE (Validation, Estimation, and Editing) validations are especially

S. No	Module/Process	Sub-Process	Wants/Concerns with Current Systems	Advanced Metering System Considerations
				useful in identifying leaks in short time than waiting an entire billing period.
6	Meter Exception Management	AMI Alarms		<p>Tightly integrate advanced metering system outage and restoration notifications with OMS real-time to reduce Outage durations.</p> <p>Configure voltage alarms to support the network reliability goal.</p> <p>Consider setting meter health alarms to steer meter maintenance via service orders including water leak alerts.</p>
7	Meter Exception Management	FCS Trouble Codes		Same as above
8	Billing	Electric Water Broadband	Water - Would like to add temporary service for renovation	<p>CMLP is considering consolidating billing into 1 or 2 cycles with the implementation of the new advanced metering system.</p> <p>Integrate final read service order completion with MDM to avoid trips to the field. Since CMLP is doing this for the AMI meters, the change will be minimal while the benefits will be greater.</p>
9	Field Work Integration	Move in/Move out Final Billing Check reads for high bill complaints	<p>AMI meters enable automation of data retrieval and meter events.</p> <p>Meters with remote connect and disconnect support any meter shut off during a customer move in or move out process. Reconnection of</p>	Re-structure processes with the perspective of using advanced metering alarms/events/meter data to better manage services instead of rolling a truck to the field. Service closure/final

S. No	Module/Process	Sub-Process	Wants/Concerns with Current Systems	Advanced Metering System Considerations
			a meter after receipt of a customer payment is supported without a field visit.	<p>billing/Move process is one such example.</p> <p>Addressing high-bill complaints is another area where advanced metering and MDM can be better used</p>
10	Outage Management	Outage & Restoration	<p>No call backs to customers with estimated restoration times are needed.</p> <p>Customers have asked for notice on restoration time so they can plan their day</p>	<p>Using advanced metering real-time events for Outage and restoration notifications to NISC's OMS will help triangulate outage cause and work on restoration quickly.</p> <p>Using historical outage information will also help plan for outage during storm planning or peak demand management.</p> <p>Systems can offer text notifications to customers on outage status and an estimate on restoration time via outage page and customer engagement portal.</p> <p>Regarding callbacks to customers, NISC's Call Capture function is implemented but not used yet. This could help with customer notifications via calls and SmartHub Messenger could be configured for texts to targeted segments.</p>
11	Geographic Information System Integration	Map Integration		With MDM integrated with GIS, the advanced metering system data can be presented in many forms as needed by each consumer of the data
12	KPIs/Analytics	Meter Event Analytics		Advanced metering systems with MDM offer a variety of Analytics dashboards
13	KPIs/Analytics	Load Research		Load Research can download advanced metering system data or utilize MDM in analyzing them for planning purposes. 15-minute interval data enable more precise

S. No	Module/Process	Sub-Process	Wants/Concerns with Current Systems	Advanced Metering System Considerations
				planning than monthly usage from CIS.
14	KPIs/Analytics	Engineering		Engineering can make use of voltage alarms, high frequency, and other engineering data from advanced metering systems
15	KPIs/Analytics	Adhoc reporting		Advanced metering systems with MDM offer a variety of Analytics dashboards
16	Customer Engagement	SmartHub		<p>SmartHub is one of the customer-facing applications that can help CMLP provide customer benefits of the advanced metering system project from the very beginning as the meters are deployed. With CMLP's Smart Hub customers can manage their usage and review analytics, integrating advanced metering system data with Smart-Hub will be very beneficial.</p> <p>Water customers will benefit by viewing their detailed usage to help them identify leaks and enable conservation.</p>
17	Customer Engagement	Customer Programs/Rates		<p>Minimize the need for multiple meters each supporting a different program.</p> <p>Streamline advanced metering system configuration to provide all the required data for customer applications. For example - if a meter can be configured to collect delivered and received, it reduces the need to swap out the meter if the customer signs up for the net metering program.</p> <p>Configure the MDM to support peak demand response / credits so maximize participation.</p>

S. No	Module/Process	Sub-Process	Wants/Concerns with Current Systems	Advanced Metering System Considerations
				Advanced metering system interval data supports the calculation of Time-of-Use rates for electric and water customers.
18	Remote Operations	Remote Disconnect/Connect for Non-Payment		By installing all advanced meters with disconnect capability, remote, disconnect/connect operations and procedures are enabled.

## 2 CMLP Strategic Goals

In 2017 CMLP developed its strategic plan describing its path forward from 2018 through 2025. The high-level strategic goals included:

- Maintain System Reliability
- Maintain or Increase Customer Satisfaction
- Provide Energy Related Services to as Many Customers as Possible
- Increase Revenue, Increase Net Income
- Increase Net Operating Income
- Reduce Greenhouse Gas Emissions

To achieve these goals, CMLP identified two enabling investments: a new integrated billing system and town wide adoption of smart meters. The new billing system from NISC was implemented and is now operational. The new billing system is an enabling technology to implement the initiatives required to meet CMLP’s customer-focused and new rate initiatives.

A new smart metering and communications system is also a foundational enabling technology required to meet CMLP’s goals. CMLP recognizes the need to adopt smart meters in offering more customer services such as time-of-use rates for all customers and self-service options; measuring and monitoring new technology - electric vehicles, distributed generation; distribution grid improvements by adopting programs like Conservation Voltage Reduction, Volt/Var Reduction or Transformer Load Management.

A metering and communication system can meet CMLP goals as follows:

### **2.1.1 Maintain System Reliability**

- Meter data on every customer and associated with the CMLP distribution system provide greater visibility to monitor and manage the grid and optimize the infrastructure through analyses such as transformer sizing and voltage management.
- Smart meters provide outage notification and restoration alerts. These alerts enable more efficient outage restoration through a faster response with meter-specific notifications; when integrated with the customer facing outage map, the time and labor for customer call backs can be reduced or even eliminated.
- Other alerts from the smart meters include voltage alerts and blink counts. With this data, CMLP can reduce cost of vegetation management by targeting areas with voltage issues.
- With detailed meter data on every customer, CMLP can calculate distribution and water losses more accurately, then identify areas for loss reduction.

### **2.1.2 Maintain or Increase Customer Satisfaction**

Maintain or Increase Customer Satisfaction through improved service delivery and offering new services.

Customers' expectations are high and are growing in all business sectors. Because of technology advancements, customers expect that their utility will provide similar services as other businesses and will automatically know of problems in service delivery. Smart meters can help CMLP meet customer expectations by:

- Delivering better Outage Services - reducing outage time by getting targeted notifications from all meters and providing up-to-date outage information on a web portal or mobile application.
- Alert customers to water leaks detected by the meter via an opt-in text or email program.
- Providing a self-service portal to customers containing detailed electric and water usage data for better insight to manage bills.
- Offering Customer Alert Services, much like a bank or credit card company, such as a high bill alert, high usage alert, water leak alerts or usage exceeding a customer set threshold
- Enabling the measurement of onsite generation and making possible favorable net metering treatment. Providing New Energy-Related Services to help customers manage their utility bill through more direct rates and better energy management.
  - Time of use promotes fairness in revenue recovery and can help customers reduce usage during peak times lowering expensive power purchases thereby reducing bills.
  - Targeted rates: Time of Use and peak demand controls
- Offering the Potential for future behind-the-meter products/services such as but not limited to smart thermostats, appliance controls, and other smart home features.

### **2.1.3 Increase Revenue, Increase Net Income**

The system wide adoption of smart meters improves the financial picture of a utility. Since CMLP has invested in metering over the last five years, the impact will not be as significant as for utilities that have not modernized metering. CMLP invested in a limited deployment of smart meters as well as a drive-by radio system. There are still gains to be made in metering including:

- Reducing meter reading costs from a mixed system spanning software and support
- Improving meter reading efficiency with one common system for all electric and water customers.
- Ensuring accurate meter readings especially for water meters by replacing older, end-of-life meters in the field
- Reducing labor and vehicle costs for meter reconnects, meter checks, move in and out for final billing.
- Improving detection of tampering and theft to capture unbilled revenue.
- Reducing need for estimated bills due to inaccessible meters
- Improving safety for employees at risk with on-site premise visits.

There are other areas of financial gain such as:

- Avoiding expensive Power Purchase during peak pricing periods by expanding energy management and rate programs to all customers
- Identifying leaks on the water distribution system from more detailed usage measurement with the goal of reducing water loss.

#### **2.1.4 Reduce Greenhouse Gas Emissions**

- Enabling net metering for customers who install onsite generation (net metering makes onsite generation less expensive.)
- Promoting Electric Vehicles to customers with the ability to monitor and apply fair and equitable rates for use with data from metering.
- Reducing the use of non-electric company vehicles with fewer visits to customers.
- Decreasing distribution losses by rightsizing transformers and voltage management thereby reducing energy waste
- Enhancing the value of customer-sited battery storage

#### **2.1.5 Implement a Modern Infrastructure**

While not a stated strategic goal, this is a foundational initiative to enable all of the goals discussed above. Cybersecurity and customer data privacy have never been more important than they are today. Any new system must adhere to best practices to prevent data breaches and hacking. On the positive side, there is potential with a data network to expand customer services as the Internet of Things (IoT) become pervasive.

- Expanding municipal and IoT services with the metering data network
- Using a Service Oriented Architecture, standard integrations and cloud services reduces costs while expanding applications.
- Ensuring security and privacy is critical.

The recognition of how a metering and communications system impacts CMLP's strategic goals can inform CMLP in its business decision to pursue a system wide smart meter implementation.