# Section 5: *Resources*

# Manual Contents:

## Intro to BMON

### Acknowledgements

### Introduction

**Visual:** *Basic Architecture of the BMON System*

**Video:** *Intro to BMON*

### Purpose of this Manual

## How to Choose/Set Up Sensors

### Selection and Setup of Sensors

#### Introduction

**Visual:** *LoRaWAN Wireless Sensors*

**Visual:** *LoRaWAN Sensor Comparison*

**Visual:** *Types of Electrical Outputs Found in Sensors*

Temperature

**Visual:** *Potential BMON-Guided Energy Savings of Measuring Temperature*

**Visual:** *Retrieval from the Building Control System*

**Photo:** *Retrieval from Ecobee Thermostats*

**Photos:** *Wireless Sensors Tested to Work with BMON*

**Photos:** *Wireless Temperature Sensor Weather Data*

**Visual:** *Installation Guidelines for Temperature Sensors*

Light Levels

**Visual:** *Potential BMON-Guided Energy Savings in Measuring Light Levels*

**Photos:** *Recommended Wireless Light Level Sensors*

Indoor Carbon Dioxide (CO2) Levels

**Visual:** *Potential BMON-Guided Energy Savings in Measuring CO2 Levels*

**Photo:** *Elsys Sensor Calibration*

**Visual:** *What to Consider When Installing CO2 Sensors*

Boiler and Domestic Hot Water Temperature

**Visual:** *Potential BMON-Guided Energy Savings in Measuring Water Temperature*

**Photos:** *Wireless Temperature Sensor Options With External Temperature Probes*

**Visual:** *A Temperature Probe Correctly Installed on a Pipe*

Building Electric Power

**Visual:** *Potential BMON-Guided Energy Savings in Measuring Electricity Use*

**Video:** *Wiring External Sensor to Elsys ELT LoRaWAN Sensor*

Building Fuel Use Data

**Visual:** *Potential BMON-Guided Energy Savings in Measuring Fuel Use*

**Photos:** *Pulse Output Unit*

**Photo:** *Flow Meter in the Fuel Line*

**Photo:** *Boiler Burner Fuel Solenoid Showing Placement of a Dry Contact Sensor*

**Photo:** *A Motor Sensor Used to Sense Whether a Motor is On or Off*

Typical Sensor Wiring Examples

**Photo:** *Voltage Output or Switch Closure Sensor Wiring*

**Photo:** *Converting a 4-20 mA Current Output Sensor to Voltage with a Resistor*

**Photo:** *Wiring for a Sensor that Needs to Receive Power from an Elys ELT-Lite Battery*

**Photo:** *Wiring a Temperature Sensor Inside the ELT-Lite*

Gateways for Wireless Sensors

**Visual:** *Gateways for Wireless Sensors*

**Visual:** *Pros and Cons of Select LoRaWAN Gateways*

**Visual:** *Solutions for Potential Sensor Connection Issues*

**Photo:** *Simple External Antenna That Can Be Mounted on a Wall Or Roof Fascia*

**Photo:** *A Properly Installed Exterior Antenna for a LoRaWAN Gateway*

## How to Set Up Your BMON System

### Setting Up Your BMON System

**Visual:** *What You Need to Set Up a Basic BMON System*

#### The BMON User Interface vs the System Administrator Interface

**Visual:** *Ways to Interact with the BMON Software*

LoRaWAN Wireless Sensor Configuration

Overview of the System Administrator Interface

**Visual:** *A View of the BMON System Administrator Interface*

**Visual:** *How to Access the Administrator Interface*

**Video:** *System Administration Interface*

Adding a Building

**Visual:** *Essential Information Needed to Add a Building in BMON*

**Video:** *Add a New Building, Basic Information*

**Visual:** *Adding More Detailed Information*

**Video:** *Adding More Detailed Information*

Adding a Sensor and Assigning it to a Building

**Visual:** *Information Needed to Add a Sensor to the BMON Software*

**Video:** *Setting Up Separate Sensors in BMON*

**Video:** *Basic Steps for Adding a New Sensor*

Editing Information for an Existing Sensor

**Video:** *Editing Sensor Information*

Adding Weather Data from the Internet

**Video:** *Getting National Weather Service Temperature and Wind Data*

Assigning Sensors used by Energy Reports

**Video:** *Setting Up Key Sensors for Energy Reports*

Creating a Dashboard

**Visual:** *Example of AHFC Headquarters Dashboard*

**Visual:** *Guidelines for a Useful Dashboard*

**Videos:** *Guidelines for a Useful Dashboard*

Using and Creating Alerts

**Visual:** *Examples of What to Use Alerts for in BMON*

**Visual:** *How to Create an Alert*

**Video:** *Creating Alerts and Assigning Recipients*

Editing and Cleaning Sensor Data

**Video:** *Sensor Data Utilities*

## How to Use BMON Sensor Data

### Creating a Monitoring Plan

#### Step 1: Define goals

Step 2: Establish a baseline

Step 3: Identify a monitoring strategy

**Visual:** *Key Steps to an Effective Monitoring Strategy*

Step 4: Implement improvement actions

Step 5: Verify results and adjust strategy

### Analyzing Data

Overview of BMON Tools for Data Analysis

Graphs and Reports

**Visual:** *Drop Down Menu in the Graph/Report Tab That Allows Selection of Available Data Visualization Tools*

**Visual:** *Commonly Used BMON Graphs and Reports*

**Visual:** *Top Portion of a Current Sensor Values Report*

**Visual:** *Example of a Plot Sensor Values over Time Graph Used to Measure Temperature of Selected Building Areas Over a Period of Months*

**Video:** *Plot Sensor Values over Time Graph*

**Visual:** *Example of an X vs Y Scatter Plot Used to Measure the Correlation Between Fuel Use and Outdoor Temperature*

**Video:** *Sensor X vs Y Scatter Plot*

**Visual:** *Example of an Hourly Profile Plot Used to Measure Differences in a Building’s Electric Use on Occupied and Unoccupied Days*

**Video:** *Hourly Profile Plots*

**Video:** *Overview of Other Available Reports/Graphs*

**Video:** *Custom Reports*

**Visuals:** *Example of an Indoor Temp Energy Report*

**Visual:** *Lighting Energy Report Showing Several Light Sensor Patterns Through a Week*

**Visual:** *Lighting Energy Report Showing a Single Light Sensor*

**Visual:** *Using the Heat Map Hourly Profile to Analyze Lighting Data*

**Visual:** *Examples of Energy Reports That Focus on Displaying and Analyzing Electric and Fuel Data*

**Visual:** *Comparisons of Current and Past Data of the Same Building*

**Visual:** *Analyzing Unoccupied Energy Use*

**Visual:** *Is Your Building Boiler Being Used for Space Heating?*

**Visual:** *Using the X vs Y Plot to Verify Outdoor Temperature Reset*

**Visuals:** *Measuring Boiler Temperature for Alert of Failure*

**Visual:** *Indoor Air Quality (IAQ) Energy Reports*

### 

## Configuring LoRaWAN Sensors for BMON

### Configuring LoRaWAN Sensors for BMON

**Visuals:** *Registering a Sensor on the Things Network*

**Visual:** *Import End Devices link on the End Devices Page*

### Configuring an Elsys Sensor

**Video:** *Configuring Elsys Sensors with your Smartphone*

**Visuals:** *Screenshots of Important Settings in the Elsys Sensor App*

**Notes About External Sensors Connected to the Elsys ELT-Lite or ELT-2**

**Visual:** *Elsys External Sensor Wiring and Configuration Table*

### Miscellaneous Sensor Wiring and Configuration

**Visual:** *Use and Configuration of Selected LoRaWAN Sensors Table*

### Configuring Dragino LoRaWAN Gateways

**Visual:** *System Diagram for Dragino LoRaWAN Gateway*

**Visual:** *Key Settings for Configuring the Gateway for US Operation on the Things Network*

**Visual:** *System Diagram for Dragino LoRaWAN Gateway with Green Checkmarks*

## Other Resources

Other web resources helpful for developing a monitoring plan and implementing BMON:

[BMON User Forum](https://forum.bmon.org/) - A forum for all users to post questions, answers and tips on hardware, software or anything else related to BMON and energy use in buildings.

[Analysis North](http://www.analysisnorth.com/) - The primary software developer, contains links to other related projects such as the [heat pump calculator](https://akheatsmart.org/resources/calculator/) and [AkWarm energy modeling software](https://www.ahfc.us/efficiency/tools/akwarm-energy-rating-software).

[BMON documentation](https://bmon-documentation.readthedocs.io/en/latest/) - Detailed software documentation for more complex situations and network administrators.

[AHFC SEMP Manual](https://www.ahfc.us/application/files/9414/5193/2592/SEMP-Master_Manual_FINAL_AHFC_12.31.15.pdf) - A manual to introduce public facility owners and managers to tools and resources that can be used to complete successful energy efficiency retrofit projects.

[LoRa Alliance](https://lora-alliance.org/?gclid=CjwKCAiA9vOABhBfEiwATCi7GLt4J4GiNHHCqJsDrNvlfHuLOuvDYP5YykZtjRnmmy6ssL1ra7BzpxoCu3YQAvD_BwE) - the group representing the communication technology LoRa (Long-Range wireless communication).

[The Things Network](https://www.thethingsnetwork.org/) - The web service that enables LoRaWAN devices to communicate with BMON.

[Monnit](https://www.monnit.com/) - A wireless sensor manufacturer utilizing a proprietary technology.

[Dragino](https://www.dragino.com/) - A wireless sensor manufacturer utilizing LoRaWAN technology.

[Elsys](https://www.elsys.se/en/) - wireless sensor manufacturer utilizing LoRaWAN technology.