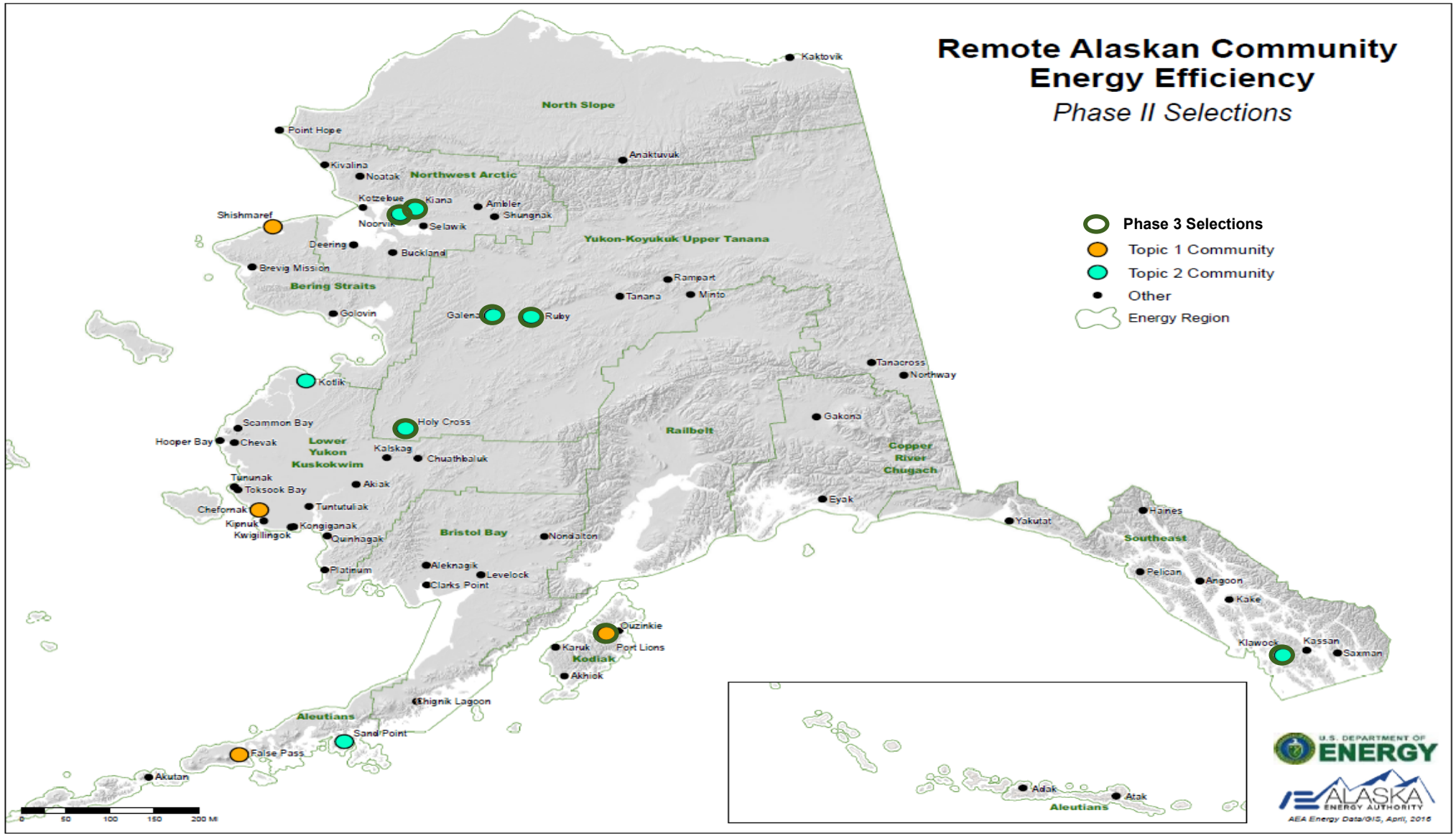
Remote Alaska Communities Energy Efficiency Peer Network

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Webinar Operations

- All participants have been automatically muted.
- If you have a question during the presentation, please type it into the Question panel on the right side of your computer screen, so we can read it out loud at the end.
- Please check the RACEE website mid-March for a link to the recording and transcription of this webinar.

http://energy.gov/eere/racee-competition-peer-exchange-network

- DOE plans to collect information for announcement on the next Peer Network call.
  - This can include useful information on funding and project ideas and opportunities
  - Email your input to Fletcher.Souba@ee.doe.gov.

Welcome to the RACEE Peer Network

- The RACEE Peer Exchange Network is intended to provide a fundamental benefit to the 64 communities that pledged to reduce per capita energy usage by 15% by 2020.
- It will consist of three components:
  - RACEE website
  - Monthly technical webinars
  - In-person meetings
    - For, example, the RACEE Competition Summit at end of RACEE Phase 3
- For more details, see the RACEE Website:

http://energy.gov/eere/racee-competition-peer-exchange-network

RACEE Peer Exchange

- The goal of the network is to empower Alaskan communities and native Alaskan villages to develop effective tools to advance the use of reliable, affordable, and energy efficient solutions that are replicable throughout Alaska and other Arctic regions.

- The Department will leverage the existing convening power of the AEA and other regional energy efficiency organizations to form the Peer Exchange Network to build a community of energy efficiency information sharing and action by peer exchange through webinars, and events.

Future Webinar Topics

- Energy Efficiency First (two-part webinar series)
- Community Experiences with Air Source Heat Pumps
- Indoor Air Quality Issues and How to Avoid Problems
- Biomass Heat Recovery Systems
- Water/sanitation efficiency in Alaska Communities
- Heat Recovery Systems and Benefits
- Diesel Part 1- Efficiency
- Diesel Part 2 - Transition from 2-stroke to 4-stroke Engines
- Line Loss Mitigation
- AKEnergySmart - More about Renewable Energy in Alaska

Energy Efficiency First
Part 2 – Implementation Strategies

Amber McDonough, PE
Account Executive / Siemens

Peter Beardsley, PE, CEA
Principal / Nortech

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Energy Efficiency First

PART 1 – January 2017

- Overall Energy Efficiency Process
- Why Efficiency First
- The Steps
  - Analysis, benchmarking & baselines
  - Project Development

PART 2 – Today

- Implementation Strategies
  - Financing
  - Construction
  - Measurement and Verification

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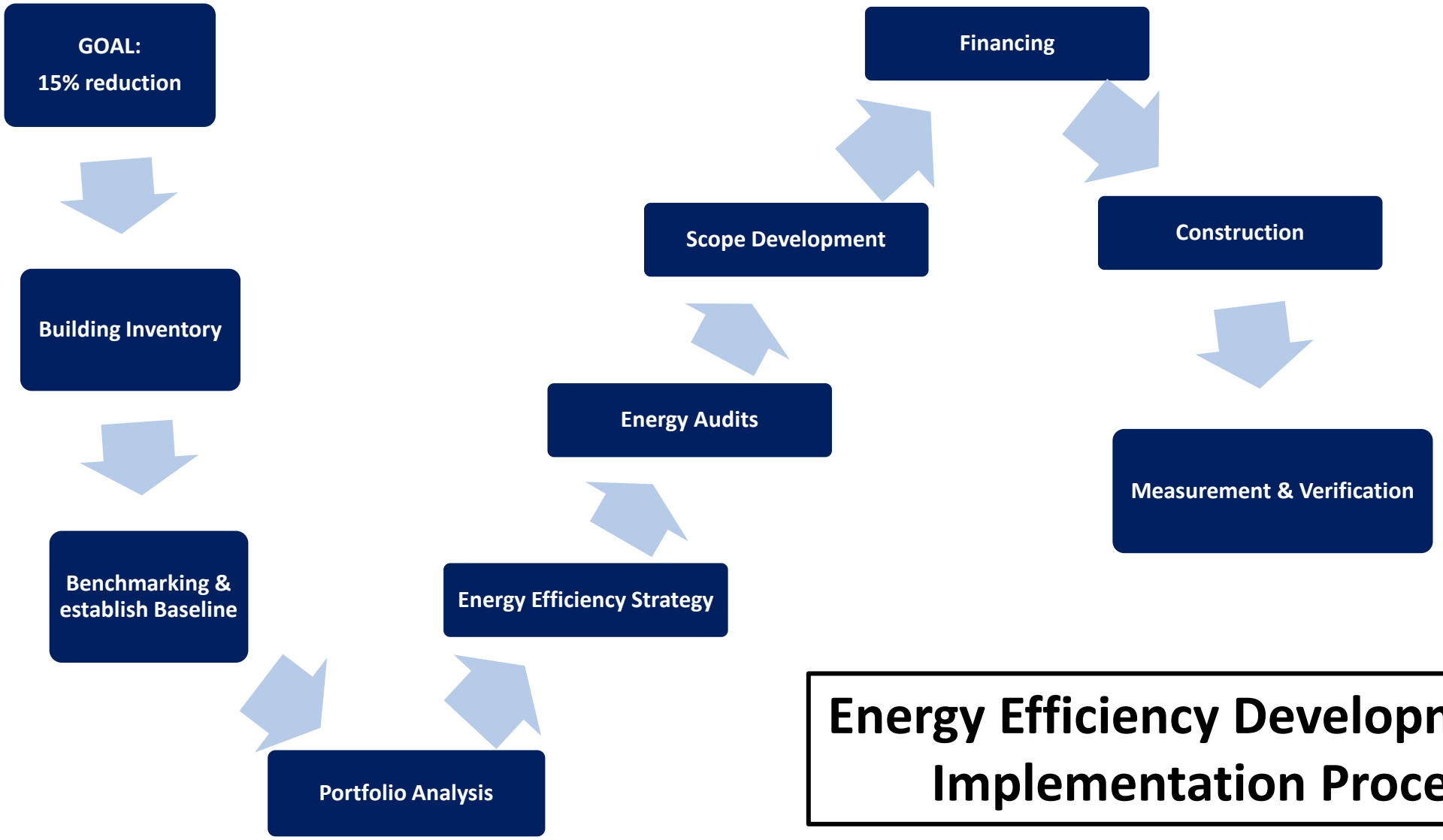

Energy Efficiency Development & Implementation Process

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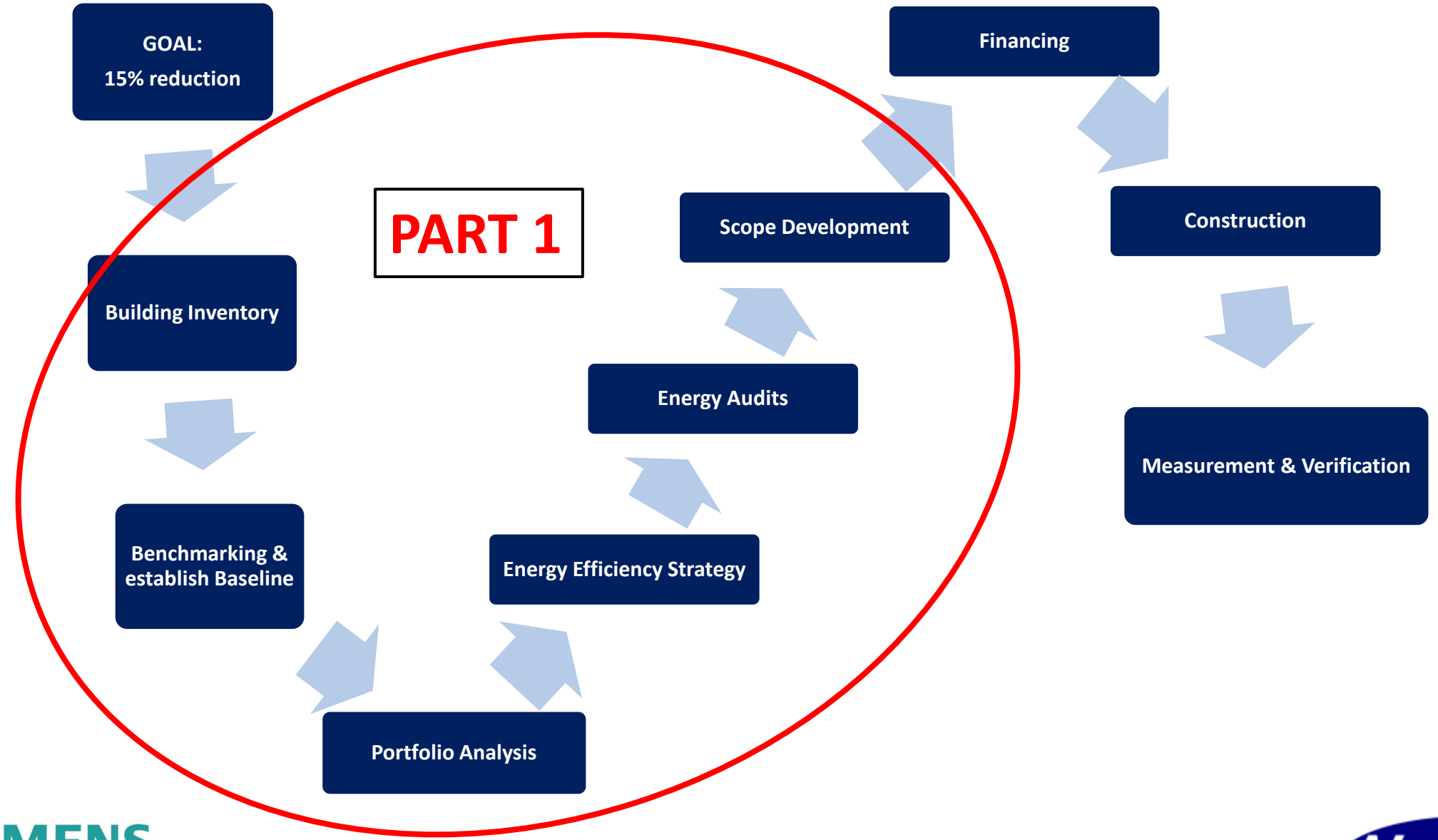

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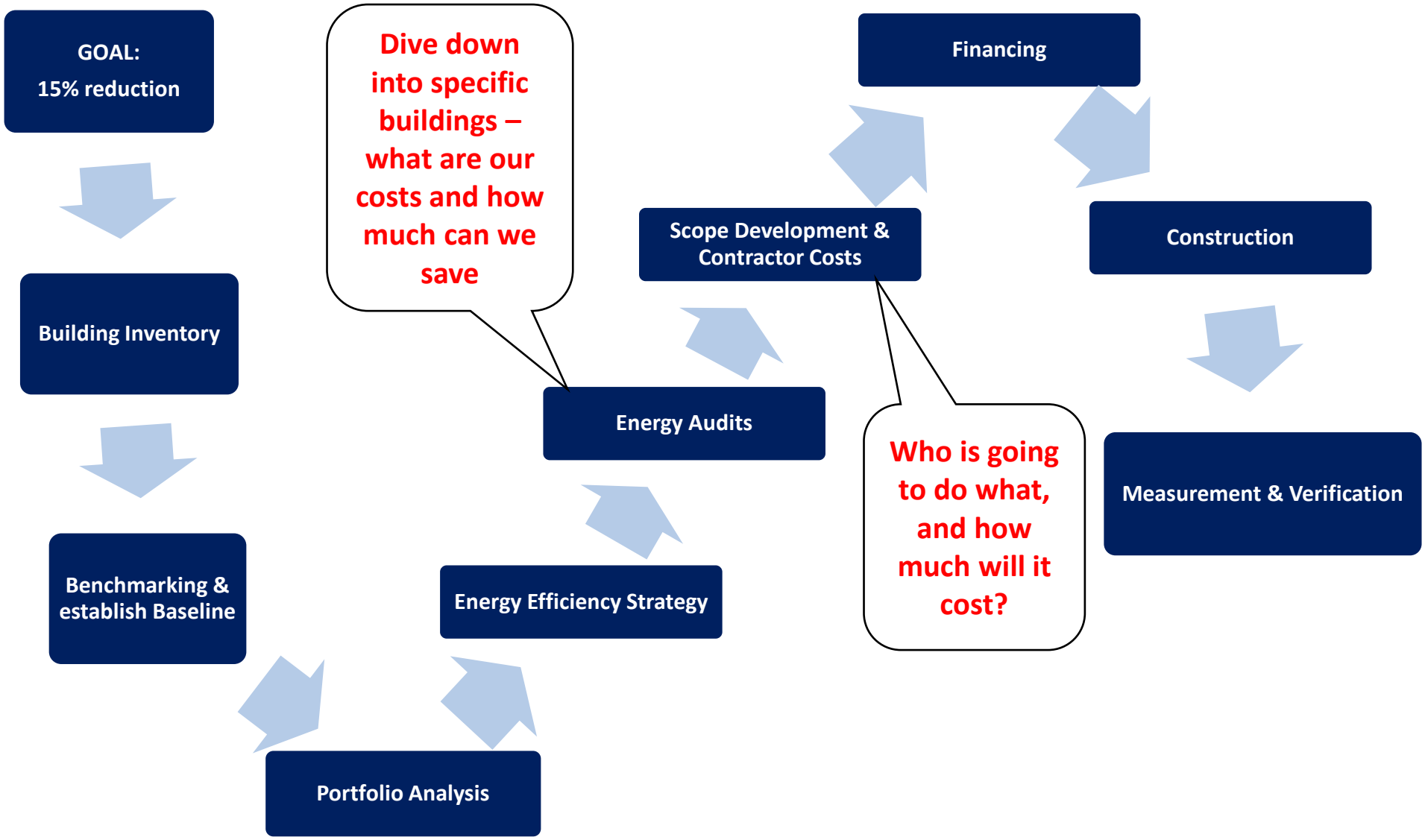

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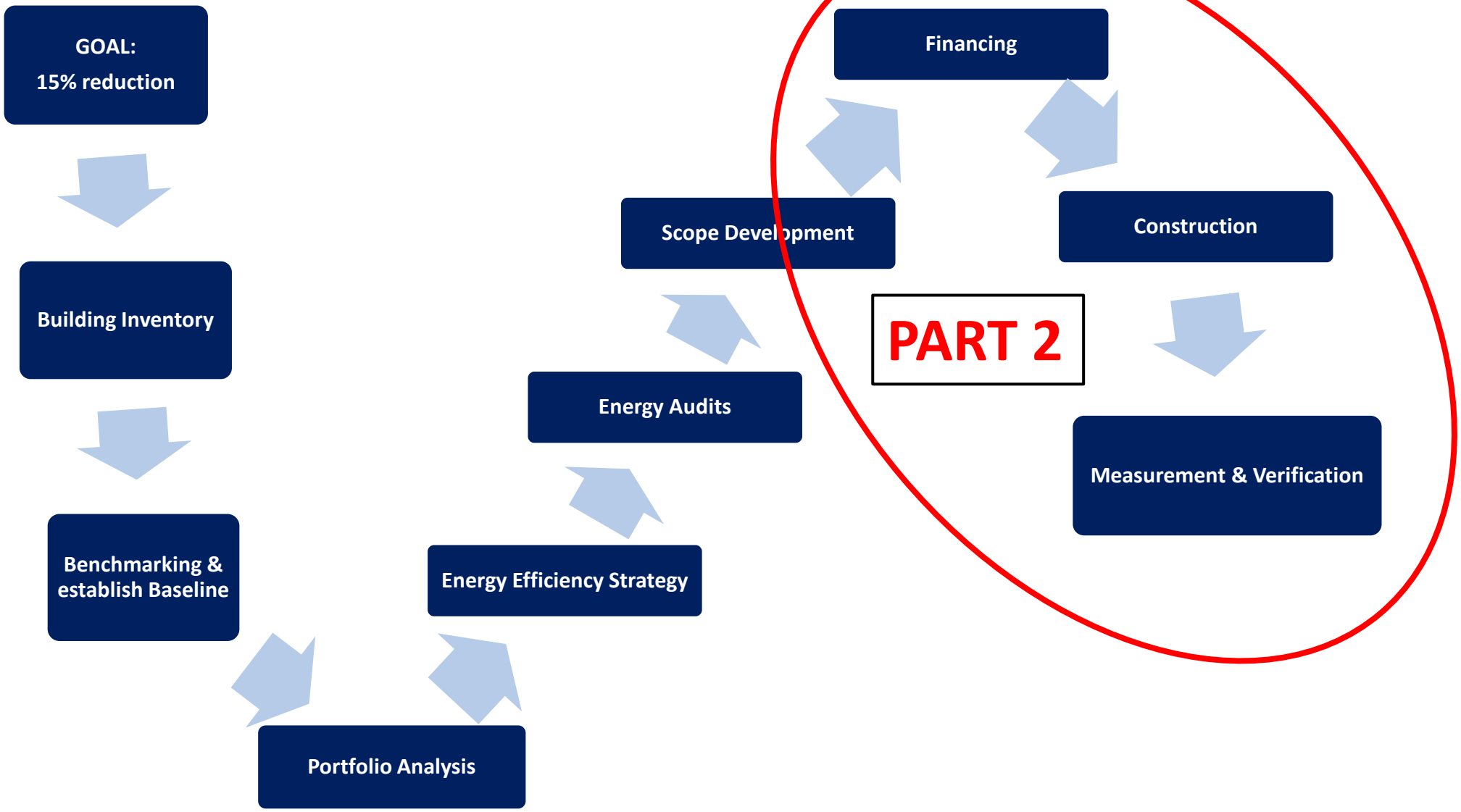

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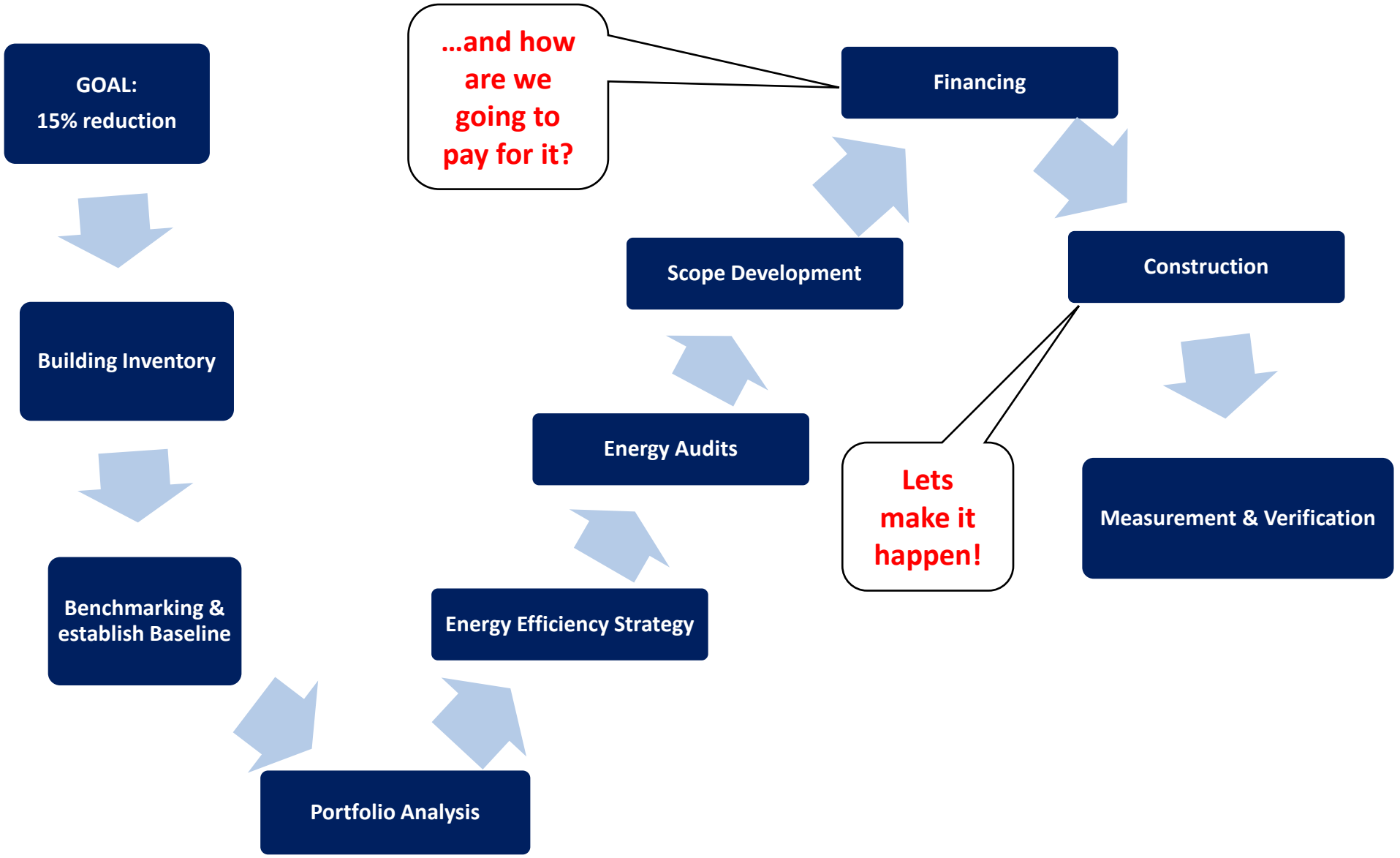

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How will I pay for these improvements?

How will I accomplish the upgrades?

How do I know I achieved savings?

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Project Financing

1. **Owner's Existing Capital and Operations & Maintenance Budgets**

2. **State & Federal Grants and Appropriations**

3. **3rd Party Commercial Lenders**
   - Community banks & credit unions
   - Tax-exempt Municipal Lease Purchase Agreements
   - Ex: Bank of America has 10-year, $50B environmental lending goal

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Project Financing (cont.)

4. **Federal Loan Programs**
   - USDA's Rural Development Community Direct Loans

5. **State of Alaska Programs**
   - Alaska Municipal Bond Bank
   - Key Bank (State's preferred lender)
   - AIDEA's Sustainable Energy Transmission and Supply Development Fund (SETS) direct loans & guarantees
   - AHFC's Alaska Energy Efficiency Revolving Loan Fund (AEERLP) for Public Facilities (and soon tribal and non-profit entities)

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Project Financing (cont.)

AHFC Energy Efficiency Revolving Loan Fund Program (AEERLP)

- 2010 AK Legislature authorized bonds up to $250M to finance energy upgrades
- Eligibility = all publically-owned community buildings within Alaska
- Energy projects that cash flow neutral within equipment life (typically 15 years)
- Interest rates term based: Feb-2017 = 2.65% (5-Yr) to 4.125% (15-year)
- Loans repaid with energy savings of building Owners
- ESPC/ESCO savings guarantees preferred on loans greater than $250K
- Loan application requires investment grade audit (IGA) in past 12 months

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Construction / Procurement Methods

1. **Traditional: Design – Bid – Build**
   - RFQ to hire A/E Firm to finalize design/bid documents
   - Bid Project – Low bid contractor builds project
   - Owner on hook for budget overruns / scope changes
   - A/E Firm and Contractor not responsible for savings/performance

2. **Modern: Design-Build**
   - RFP for D-B Team including A/E Firm, Prime and Subcontractors
   - D-B Team responsible for final design & construction
   - D-B Team must work within existing budget
   - Owner may have to settle for “value-engineered” project scope
   - D-B Team not responsible for savings/performance outcome

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Construction / Procurement Methods (cont.)

3. **Focused: Energy Performance Contracting (ESPC)**
   - RFQ for Energy Services Company (ESCO) services
   - ESCO Team includes A/E Firm and subcontractors
   - ESCO works with Owner to finalize scope based on best ROI
   - ESCO provide GMP and savings calculations up front
   - ESCO finalizes design and constructs energy improvements
   - ESCO on hook for budget overruns / scope changes
   - ESCO responsible for savings/performance outcome

4. **Self-Implement / Other Methods**
   - Owner execution limited to availability of existing staff
   - Owner responsible for budget overruns / scope changes
   - Owner responsible for savings/performance outcome

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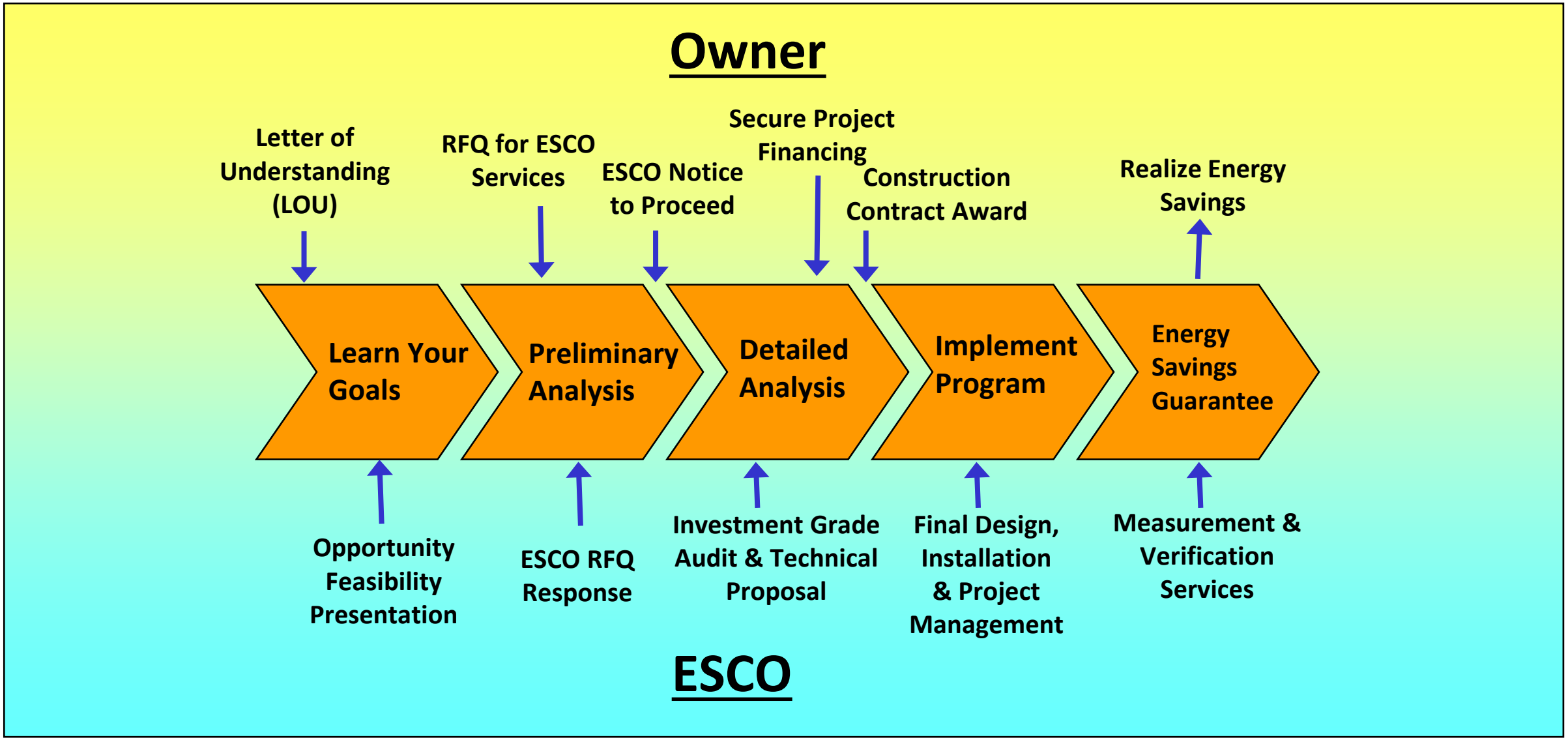
ESPC Energy Project Development Process



Energy Efficiency First

Construction / Procurement Methods (cont.)

5. Other Statewide Assistance

a) Alaska DOT&PF Energy Office maintains ESPC Term Agreement

- Supports Agencies with development, financing & implementation
- Available to all public entities Statewide
- 5-year term agreement, pre-negotiated mark-ups & labor rates
- 3 pre-qualified ESCOs compete to develop energy projects via RFP process
- No upper project size limit, must be cost-effective (~15 yr payback overall)
- ESCOs provide min. 3-year savings guarantee for financed projects
- New Term Agreement currently under negotiation (Active ~ March 2017)

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Construction / Procurement Methods (cont.)

5. Other Statewide Assistance

b) AHFC's Energy Efficiency Technical Assistance Center (EETAC)

- Supports local and tribal governments and school districts in Alaska
- Online, in-person, and over-the-phone assistance with:
  - Energy efficiency retrofit how-to guides
  - Easy to use energy use analysis software
  - Financial tools and calculators
  - Operations & maintenance efficiency analysis
  - Project scoping and planning
  - Identification of funding opportunities
  - Acquiring qualified project developers

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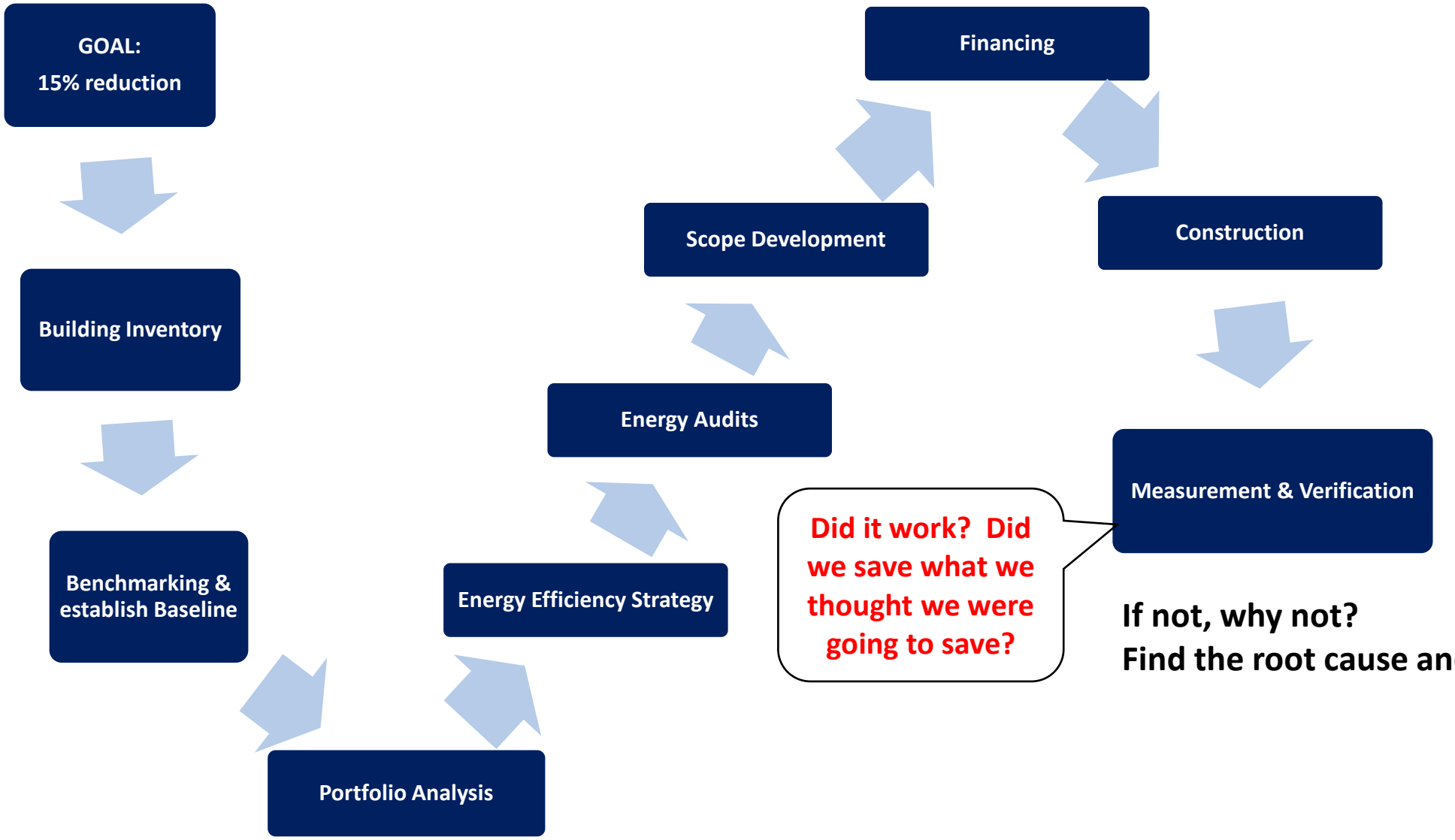

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Energy Efficiency First

Measurement & Verification

- Did our energy efficiency project work?
  - Focus primarily on *use* because energy costs vary with market conditions
    - Are we *using less* electricity?
    - Are we *using less* heating oil, natural gas, or wood?
  - Do we know what the building is doing when we aren't there?
  - Do we feel like we have control of the building systems
  - Are the occupants more comfortable?
  - Do we have fewer maintenance calls?
  - Do we have fewer leaks?
  - Are we spending less repairing fixtures and equipment?

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Energy Efficiency First

Measurement & Verification

- Compare building energy use before and after upgrade
  - Verify that building uses remains similar
  - Verify that building schedule remains similar

- Type of M&V should be aligned with:
  - Evaluating the energy efficiency project during the “payback” period
  - Maintaining performance of efficiency upgrades over the long term
  - Operator’s goals for understanding energy use changes over time
  - Complexity of systems modified to achieve the energy savings

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Energy Efficiency First

Measurement & Verification

- M&V through evaluation of monthly/periodic bills (continue benchmarking data collection)
  - Performed by ESCO to document contract guaranteed savings
  - Required by public funding program (AHFC, USDA, etc)
  - May be required by private bank or funding source
  - Excellent documentation for investors and/or building ownership group

- Show year-to-year energy use on a monthly basis
  - Electrical use is directly comparable (unless significant cooling load)
  - Heating fuel use must be corrected for heating degree days
  - Other utilities (cooking fuel, water, etc) should be directly comparable

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Energy Efficiency First

Measurement & Verification

- M&V data can also be collected recording of major building systems periodically (daily, weekly, etc) by the owner or maintenance staff
  - Boiler hour meter and fuel tank levels
  - Major electrical component hour meters and electric meter

- Allows more frequent reconciliation of "delivered" energy and "consumed" energy
  - Troubleshoot possible energy theft
  - Verify equipment that should operate during hours of occupancy

- Show energy use data more frequently to interested parties, such as
  - Building maintenance staff
  - Users and occupants

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Energy Efficiency First

Measurement & Verification

- M&V through continuous trending of equipment, temperatures, and other data
  - Using existing building control system
  - Third-party monitoring system

- Can be used to verify a wide variety of information
  - Equipment schedules match building occupancies
  - Occupancy and photo sensors are controlling systems appropriately
  - Temperatures are recovering from setbacks and maintained during occupancy

- Data is used to troubleshoot concerns and fine tune building operations
  - Performed by ESCOs with performance guarantees
  - Performed by owners, maintenance, and users to maintain systems

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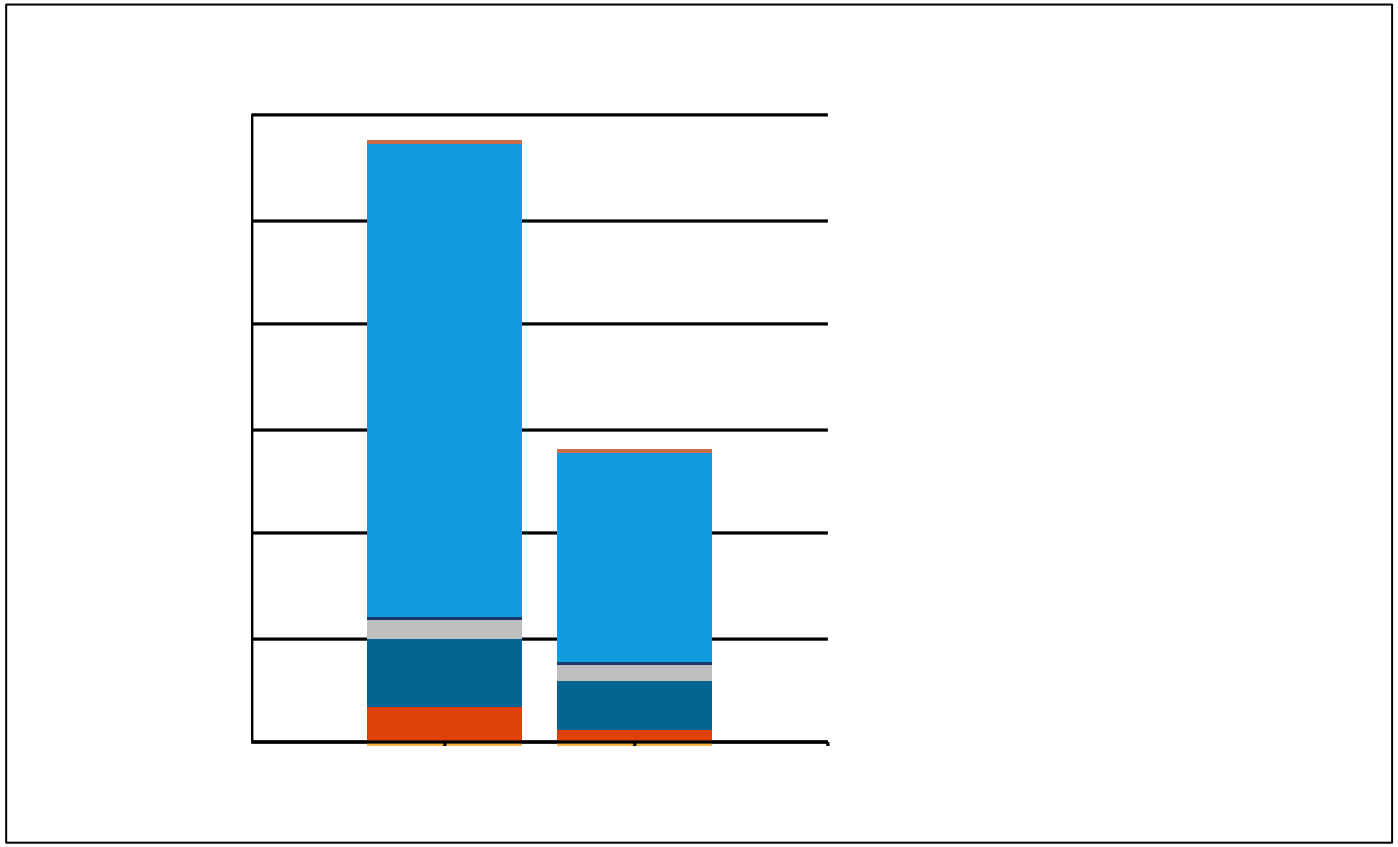
Measurement & Verification

Tri-Valley School – Healy, Alaska

- Audit shows large potential reduction in heating oil use/cost
- Install heating loop to heat Elementary Wing from underutilized coal boiler
- Doesn't reduce energy use significantly, but reduces energy cost through displacement of heating oil
- Easily measured through reduction in heating oil use/cost
- Continued benchmarking is appropriate to evaluate this upgrade



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Energy Efficiency First

Measurement & Verification

YKHC Community Health Services Building
Bethel, Alaska

- Benchmarking shows increasing annual energy use
- Existing Building Commissioning (EBCx) undertaken to regain control of building systems
  - Installed/replaced missing or failed sensors
  - Scheduled air handling equipment to be off during unoccupied hours
  - Programmed heating system pumps and motors to be off when no heat requested
  - Repaired broken outside air dampers to properly limit outside air intake
  - Programmed setbacks for unoccupied hours and weekends/holidays
- Monthly benchmarking adequate to document savings
- Controls system programmed to monitor operations

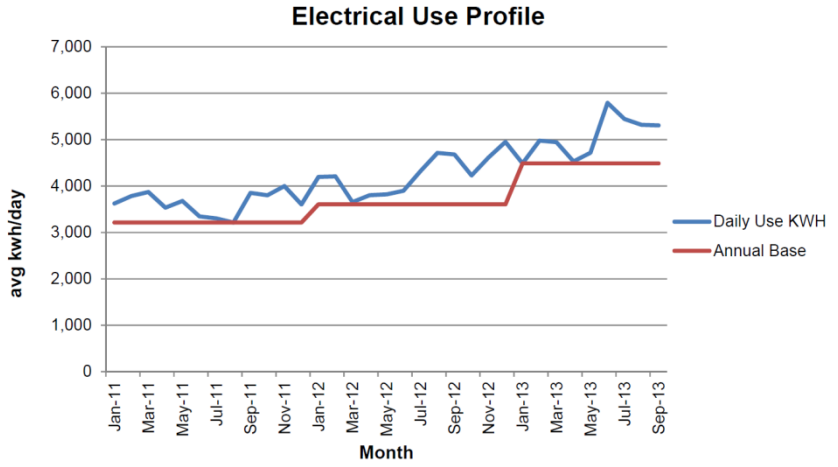

Table 1. Fuel Oil Comparison

Month	HDD	Gallons	Cost[1]	Gal/HDD	% Change from 2012	% Change Prev. Month
Jan-12	2544.4	8,410.4	$ 45,248	3.3		
Feb-12	1444.1	4,130.4	$ 22,222	2.9		
Mar-12	1929.3	4,858.9	$ 26,141	2.5		
Jan-16	1345.8	8,493.0	$ 45,692	6.3	91%	
Feb-16	1257.6	7,586.0	$ 40,813	6.0	111%	
Mar-16[2]	1368.5	2,831.0	$ 15,231	2.1	-18%	-66%

1. Fuel cost based on avg $5.38/gallon
2. RCx adjustments made on March 1

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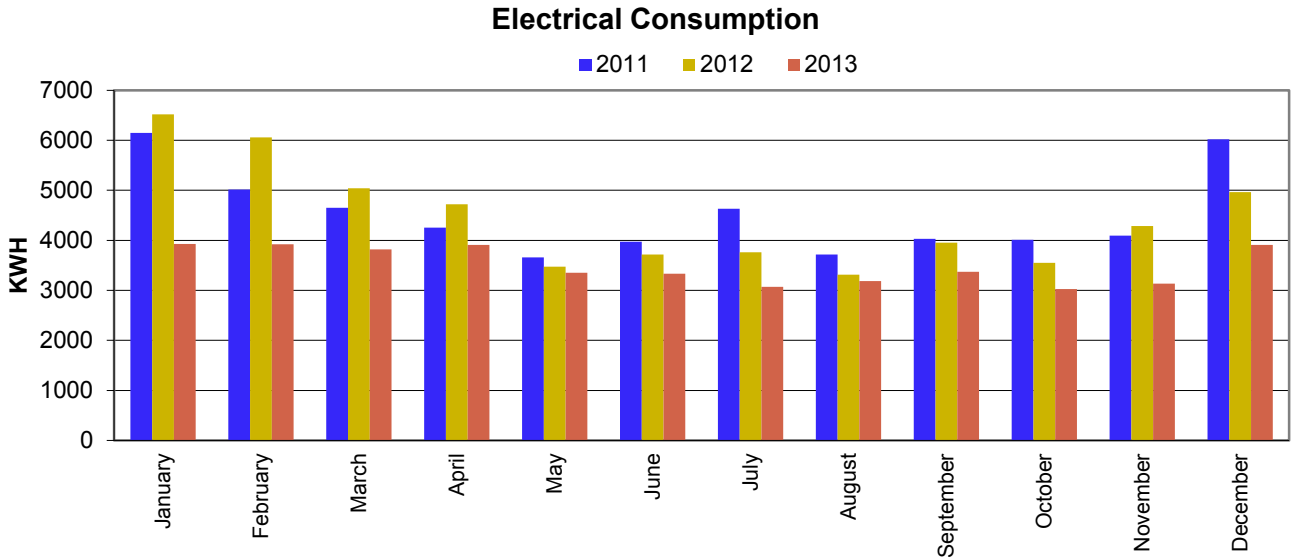
Energy Efficiency First

Measurement & Verification

Rivendell Hall – Nortech's Fairbanks Office

- Multiple Efficiency and Renewable Energy upgrades undertaken between 2011 and 2016
- Electrical benchmarking looks good
- Won REAP's Great Alaska Energy Challenge for Heating Oil Reduction



- What more could we monitor?
  - Installed thermal solar heating system and controller for space heating and domestic hot water
  - Installed pulse meters on heating oil boiler and photovoltaic array sized for peak summer load
  - Installed monitoring system to combine these inputs into a user friendly dashboard

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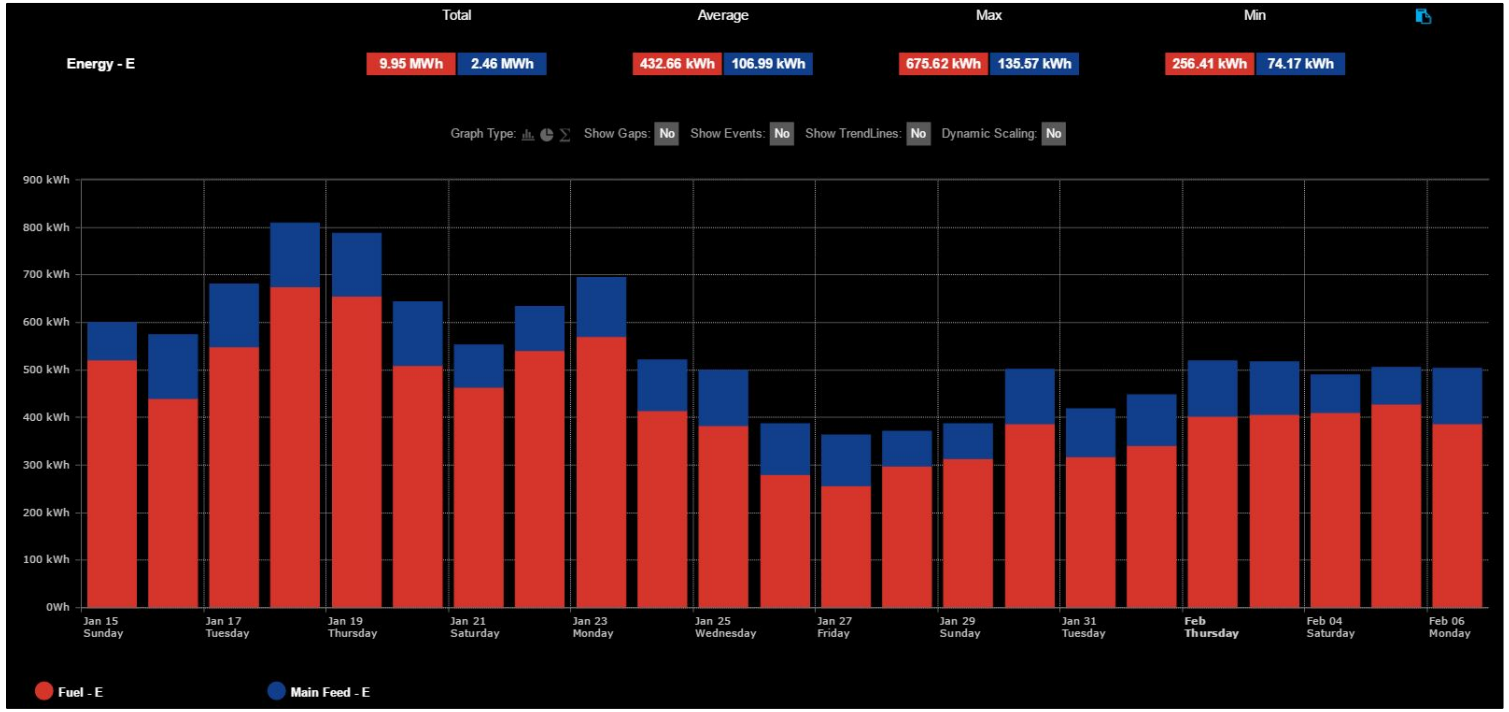
Measurement & Verification

Nortech Office Total Energy Use

- Blue: Total Electric Use
- Red: Heating Oil Use

- Consistent with expectation that most energy used in Jan/Feb is for space heating

- kWh for electric makes more sense for electric than heating oil



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Measurement & Verification

Gallons per day of heating oil and outdoor temperature

- Significantly higher heating oil use with lower temperatures
- Boiler burns about a gallon an hour, meaning boiler ran about 16 hours on coldest day
- Temperature sensor is reading a little high as actual temperature was closer to -50

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Energy Efficiency First

Measurement & Verification

Multiple temperature graphs, from top to bottom:

Light Blue: Post-Boiler Glycol

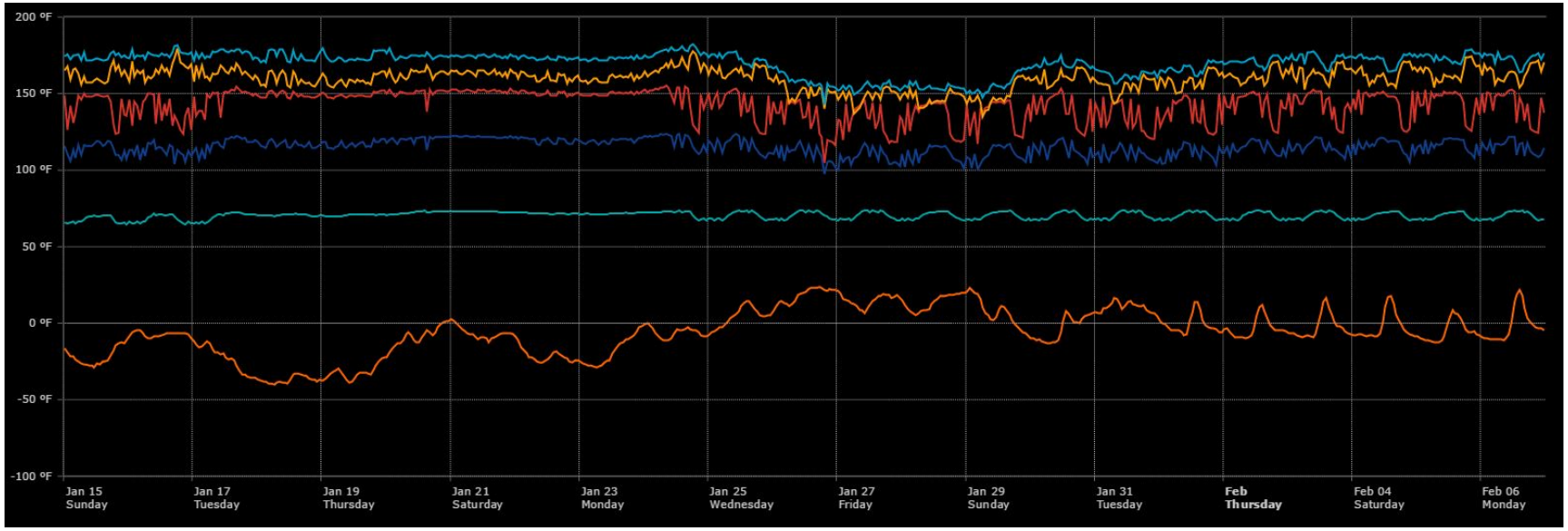
Light Orange: Pre-Boiler Glycol

Red: Zone 1 Supply

Blue: Zone 1 Return

Aqua: Zone 1 Temperature

Orange: Outdoor Air



- Outdoor reset lowers boiler temperature with warmer outdoor air
- Glycol return shows significantly less heat used by building during warmer period
- Stability of supply/return indicates zone is running almost constantly during cold
- Nighttime Setbacks manually turned off during extreme cold
- Longer setback recovery times (lower slope) with colder temperatures
- Return of diurnal pattern of warmth and solar gain in early February

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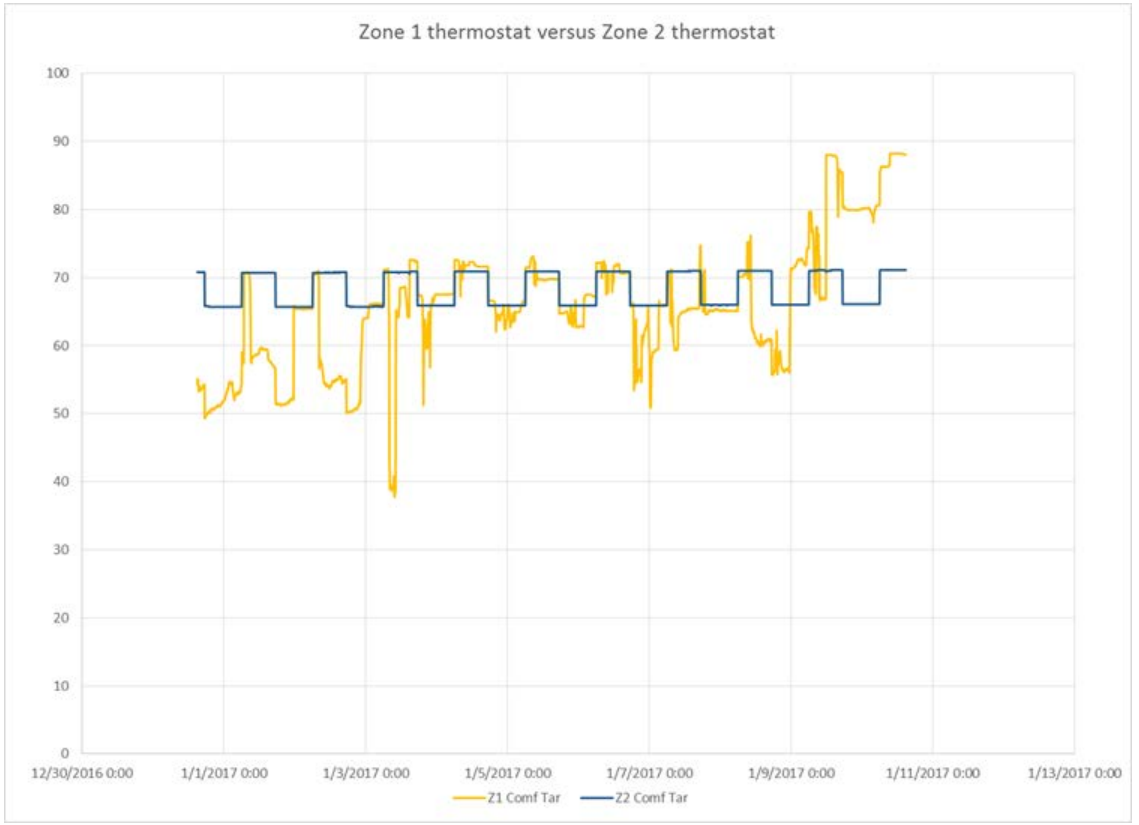
Energy Efficiency First

Measurement & Verification

Troubleshooting Occupant Comfort

- Weeks of complaints about temperature instability
  - Periodic observations at the thermostat showed that the temperature setpoint had occasional minor fluctuations
  - Control system trending data showed clear setpoint variability
- Switched thermostats with another zone and both functioned correctly
- Conclusion:
  - Loose wiring was the problem
  - No hardware replacement necessary



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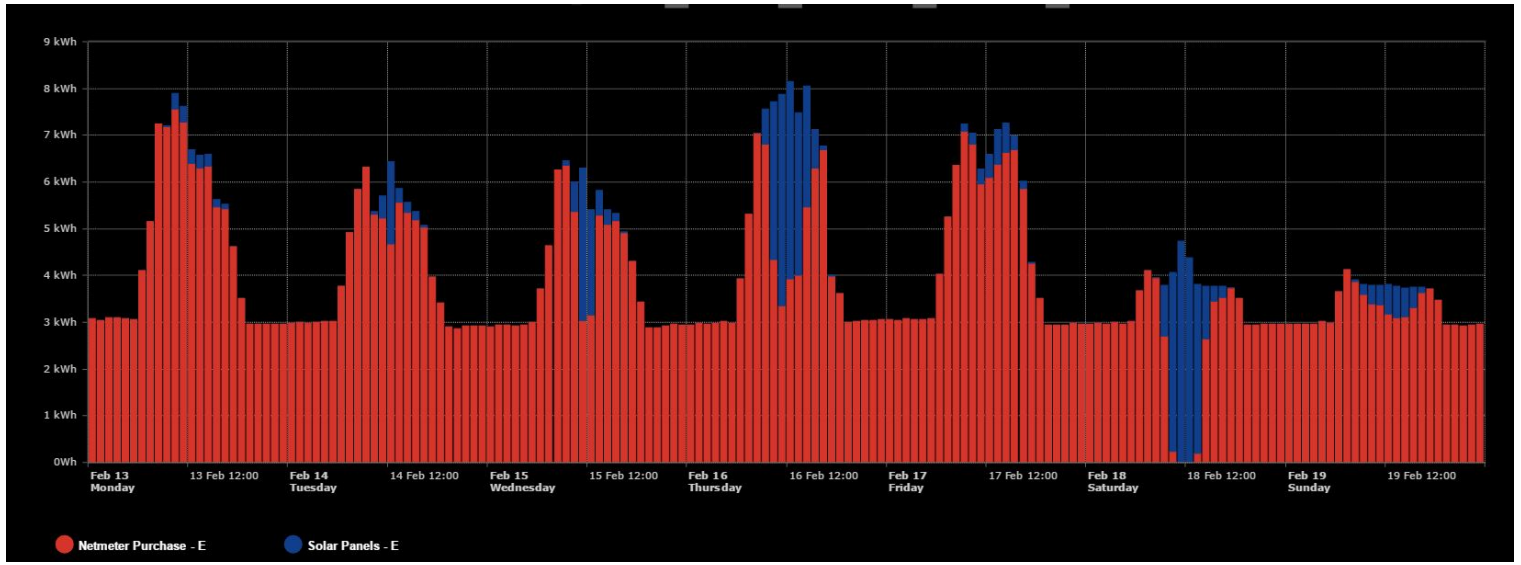
Measurement & Verification

Hourly Electrical Use in kWh

- Red: Purchased Power (GVEA)
- Blue: Solar Generated (6kW Array)



- Overnight baseload is consistent
- Daytime increases less pronounced on weekends
- Weekend increase is primarily vehicle plugins on timers

- Difference between sunny and cloudy days very obvious
- Operating off the grid for a two hours on Saturday

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Energy Efficiency First

Measurement & Verification

Highlights of Electrical Consumption

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Energy Efficiency First
Measurement and Verification Conclusions

- Measurement & verification are important parts of energy efficiency projects
- Continued benchmarking after upgrades is the easiest form of M&V
  - Entering energy use data in a spreadsheet helps facilitate an understanding of a building over time
  - Software, such as Portfolio Manager, can help automate comparisons to previous periods and similar buildings
- Trend data may be developed from building controls or stand-alone M&V packages
  - Controls personnel or consultants experienced with the programming may be necessary to access proprietary systems
  - Trending data can be useful to troubleshoot a wide variety of concerns
- Knowledgeable and engaged users reduce energy consumption
- Energy consumption data should be presented to building occupants with requests for input on building operation

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Energy Efficiency Conclusions

- Auditing and measurement are the key to documenting and maintaining success
  - Measurement is necessary for understanding
  - No project too big or small

- If you have a success story:
  - Small successes: light replacement, appliance upgrade
  - Large success: schools, clinics, etc.
  - Spread the word!

- Remember:
  - Energy costs are NOT controlled by YOU!
  - Energy use CAN BE controlled by YOU!