DRAFT

Training and Workforce Development Needs
Alaska Energy Authority
October 23, 2012

The following pages contain training needs and workforce development issues as drafted by Alaska Energy Authority's project managers in each of the specialty areas listed below. This is intended as a starting point for identifying job and training needs in the future in Alaska related to energy efficiency and renewable energy, and not a complete list of needs and opportunities. This is presented solely for discussion purposes at the Alaska Workforce Development Investment Board Meeting October 23-24, 2012. Contact: Sean Skaling, Deputy Director Alternative Energy and Energy Efficiency, Alaska Energy Authority, sskaling@aidea.org, 907-771-3079.

Contents: **Page**

Training Needs for Energy Efficiency in Alaska

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A 2010 report by the U.S. Department of Energy estimated that the Energy Efficiency Service Sector (EESS) will increase nationally 2-4% by 2020 (http://eetd.lbl.gov/ea/ems/reports/lbnl-3163e.pdf). This report focused on EESS jobs relating to efficiency improvements in residential and nonresidential buildings; the report did not include manufacturing, wholesale, or retail distribution subsectors, or EE-focused operations and maintenance performed by facility managers. The following synopsis and recommendations come directly from this report.

Synopsis of workforce development needs for the Energy Efficiency Service Sector:

- Challenges to expansion of the EESS: shortage of management-level applicants with experience in EE, shortage of EE engineers, limited awareness of building professionals that the EESS exists and is expanding.
- Currently there are two primary paths for entering the EESS workforce: 1) through existing occupations like HVAC technicians, lighting contractors, construction trades, and project managers,

which are transformed into more EE-focused positions via retraining, and 2) through emerging occupations that are unique to the EESS like home energy raters, commissioning services, etc.

- As EESS expands more new hires will receive training through apprenticeship and through certificate and degree programs offered at community and technical colleges that are directly related to occupations in the EESS.
- Management and professional positions (e.g., energy efficiency engineers, architects, energy efficiency program managers) generally require a four-year college degree at a minimum, while many building and construction trades may require technical training but not necessarily a college degree.
- Program administrators, program implementation contractors, and ESCOs generally use a variety of after-hire training resources because few candidates with specific training in energy efficiency are available. Engineers with knowledge of energy efficiency are in greatest demand. EESS employers face stiff competition with other industries for talented engineering graduates; engineering graduates often are unaware of the opportunities available in the EESS.
- Program administrators and program implementation contractors that target residential customers (e.g., low-income weatherization) typically hire trades workers that are unlikely to have energy efficiency-specific skills. These employees often subsequently receive energy efficiency training through organizations certified by Residential Energy Services Network (RESNET) or through the Weatherization Assistance Program (WAP).

Education/training recommendations:

- Provide energy efficiency education and support targeted at building and construction contractors and tradespeople.
- Increase short-duration, applied trainings to augment on-the-job training and/or introduce new entrants to a field.
- Increase funding to "train the trainers."
- Increase access to on-the-job and other formal training for mid- and senior-level engineers and managers.
- Prepare the next generation of EESS professionals: additional funding to support new EE related, inter-disciplinary programs and expand existing programs and course offerings within 4-year degree programs.

Current EE-related training/education offered in Alaska:

- UAF Bristol Bay Campus Occupational Endorsement in Sustainable Energy
- AVTEC Facility Maintenance Construction program
- AVTEC Plumbing and Heating Program
- AVTEC Power Plant Program

Positions and Training Needs:

1. Energy Efficiency Engineer

2. Energy Rater/Auditor (residential and non-residential)
3. Energy Efficiency Architect
4. Project Manager
5. Energy Efficiency Program Manager
6. Weatherization professionals
7. Building/facility operators
8. Power plant operators
9. Building Resource Manager
10. Building Maintenance (there's an effort currently underway to coordinate building maintenance in the villages, AHFC represents the EE side of things in this discussion)

The "Positions and Training Needs" portion of the EE Training and Workforce Development needs assessment is not yet fleshed out. EE will play an increasingly larger role in the portfolio of clean energy projects around Alaska as energy prices continue to rise. Work is already being done to ensure an appropriately trained workforce is ready to take on new projects as they develop but more planning, coordination, and funding opportunities are certainly in order.

Heat Pump Training Needs

While heat pump installations are becoming more common at both commercial and residential scales, they are generally limited to areas with lower electricity costs and higher heating costs and remain uncommon in rural Alaska.

Heat pumps are generally installed and control systems designed by manufacturers. Refrigerant handling requires certification and is performed by a licensed contractor. Training opportunities could potentially exist in three broad fields: loop field installation, heat pump operation and maintenance, and HVAC systems fundamentals. The general skillsets needed are similar to those of a building operations crew and a drilling or excavation crew.

Loop Field Installation

- Site preparation
- Drilling, ~300-400 ft (vertical loop installations)
- Trench excavation (horizontal installations)
- HDPE pipe installation

Heat Pump Operation

- Equipment Fundamentals
- Operating Theory (heat exchangers and thermodynamic cycle)
- Control Systems
- Normal Maintenance Activities
- Performance Monitoring and Data Collection
- Refrigerant Leak Response Procedures

HVAC Systems

- HVAC Design
- HVAC Maintenance
- HVAC Retrofits (high to low temp radiators)

Training Needs for Wind Systems:

- The priority for wind systems training would be operators. Full technicians would be of lower priority with technician and operator trainers being a future goal.
- Wind turbine operator training should preferably happen at an existing wind farm with the same turbine to be installed in the operator's community. This operator should be cross trained to some level in diesel generator operations and maintenance. If this is not possible training can be performed during the commissioning phase of the wind turbines installation. The operators should be involved in the construction of the foundation, tower erection, turbine installation and commissioning.
- Wind turbine technicians will most likely need to be trained on multiple wind turbines and have at least basic electrical trouble shooting skills. A base knowledge may be best learned at a vocational training school like AVTEC. After the base knowledge is learned turbine manufacturers normally have training programs to learn their turbine's systems.
- As knowledge is gained by the technicians eventually they will be able to train other individuals to become technicians and operators.
- The best case scenario for operator training would be introduction to operations and maintenance on both diesel gensets and wind turbines before installation in their community so that the installation and commissioning becomes the second exposure. Operator training could be handled on a community by community base.
- Technician training should be evaluated from a regional standpoint. Operators would make the first run at repairs after communicating with a technician remotely. After the operator determines the problem or if the operator cannot determine the problem and the technician cannot do so remotely then the technician would be called out to diagnose and repair the problem.
- Operator and Technician Trainers should be the ultimate goal of Wind Systems in Alaska. As the Alaskan Technicians gain knowledge and experience on multiple turbines it should be possible for more Vocational Schools to offer training in the industry.

Position and Training Needs:

1. Operator – Wind Turbine
    - Wind turbine overview/Advantages/Disadvantages
    - Operating Theory
    - Tower Climb and Rescue training
    - Turbine Operation

        - Basic Computer Skills
        - Equipment Fundamentals
            1. Start turbine
            2. Stop turbine
            3. Lock blades
    - Turbine Maintenance
        - Keep Maintenance Schedule
        - Torque Checks
            1. Hydraulic Torque Wrench Training
        - Lubricants
            1. Check and change oils
            2. Greasing components
        - Visual Inspections
        - Turbine Specific Maintenance Needs
    - Turbine Diagnostics and Repair
        - Basic Computer Skills
        - Communicate with Turbine Technician
    - Should be cross trained with power plant and secondary load operations
2. Technician – Wind Turbine
    - Wind turbine overview/Advantages/Disadvantages
    - Operating Theory
    - Tower Climb and Rescue training
    - Tower Maintenance
        - Torque Checks
            1. Hydraulic Torque Wrench Training
    - Turbine Operation
        - Advanced Computer Skills
        - Equipment Fundamentals (All Components)
        - Perform Equipment and Systems Upgrades
    - Turbine Maintenance
        - Keep Maintenance Schedule
        - Torque Checks
            1. Hydraulic Torque Wrench Training
        - Lubricants
            1. Check and change oils
            2. Greasing components
        - Visual Inspections
        - Turbine Specific Maintenance Needs
    - Turbine Diagnostics and Repair
        - Communicate with on-site Operator
        - Advanced Computer Skills

- Advanced Electronics Diagnostic Skills
- Turbine Specific Training

Training Needs for Biomass and Combined Heat and Power (CHP)

- The priority for biomass training would be operators and administrators. Engineers, communities, mechanics, and electricians would be of lower priority.
- Biomass training should take place at an existing biomass system to facilitate hands-on training.
- There will be 2 new biomass operations starting this year is the summer/fall time frame - Gulkana and Tok.
- CHP systems will be starting up fall 2010 in Cordova and 2011 in Kotzebue/Unalaska.
- Biomass and CHP training programs already exist in the lower 48. It would be very easy to SWIPE the programs and tailor them to Alaska.
- Trainers would have to be developed for Alaska.
- The Biomass timing of the training would be best if it coincided with the start-up of a facility. New operators could be trained during the start-up and existing operators from other areas could participate. It would be a good opportunity to share learning.
- Heat Recovery training could be included with the Diesel Generator training programs.

Positions and Training Needs:

1. **Operator - BIOMASS**
    - Biomass Overview/Advantages/Disadvantages
    - Fuel Supply
    - Fuel Handling/Storage
        - Seasoning/Moisture
        - Chips
        - Cordwood
        - Pellets
            - Silo storage and handing
    - Boiler Operation
        - Equipment Fundamentals (all components)
        - Operating Theory
        - Control Systems
        - Normal Maintenance Activities
    - Ash handling/Disposition
    - Emissions
        - Requirements
        - Equipment Options
        - Testing
        - Reporting
    - Troubleshooting

1. **Administrator/Manager**
    - Biomass Overview/Advantages/Disadvantages
    - Available Technology/Applications
        - District Heating Loops
        - CHP Technology/Application
    - Fuel Supply
        - Contracts and Negotiations
        - BTU values per species
        - Allowable Cut
        - Required acreage
        - Transportation Considerations
        - Delivered Costs
    - Fuel Storage and Handling Considerations
        - Chips
        - Cordwood
        - Pellets
    - Accounting
        - Fuel Savings
        - Wood Costs
        - Performance Reporting
    - How to develop a BIOMASS/CHP Project
        - Recon/Feasibility Report
        - Conceptual Design
        - Final Design
        - Construction
    - Grant Writing
    - Project Management 101

2. **Operator – Heat Recovery – This should be part of the diesel operator training**
    - Heat Recovery Overview/Advantages/Disadvantages
    - Heat Transfer Basics
    - Equipment Components
        - Mechanical
        - Electrical
    - System Design – Operating Theory
    - System Controls
    - Daily Reporting
        - Pressure
        - Temperature
        - Flow
        - BTU
    - Routine Maintenance tasks (probably part of daily reporting)
    - Troubleshooting
        - Start-up
        - Shutdown
        - Normal operation

Mechanic – standard training with biomass/HR process overview and fuel handling specifics
Electrician– standard training with biomass/HR process overview and control system specifics

Engineer/Designer Biomass

- Biomass Overview/Advantages/Disadvantages
- Available Technology/Applications
    - District Heating Loops
    - CHP Technology/Application
- Fuel Supply
    - BTU values per species
    - Allowable Cut
    - Required acreage
    - Development of Boiler Feasibility Reports
    - Transportation Considerations
    - Delivered Costs
- Fuel Storage and Handling Design
    - Chips
    - Cordwood
    - Pellets
- Boiler Specification/Application
- Building/System Integration
- Permitting
    - NEPA
    - Emissions
    - Building/Fire
    - Other

Community

- Biomass Overview/Advantages/Disadvantages
- Available Technology/application
- How to develop a BIOMASS/CHP Project
    - Recon/Feasibility Report
    - Conceptual Design
    - Final Design
    - Construction
- Grant Writing
- Project Management 101

Training Needs for Hydroelectric Systems:

- The priority for hydroelectric systems training would be operators and administrators. Technicians, operator trainers, engineers, electricians, and communities would be of lower priority.

- Hydroelectric operator and administrator training should preferably happen at an existing hydroelectric project. If this is not possible training can be performed during the commissioning phase of the hydroelectric project. The operators should at least be involved in the construction of the intake, switchgear and controls, turbine and generator installation, and commissioning. This operator should be cross-trained to some level in diesel generator operations and maintenance. Administrators, preferably, would be involved from the project development phase to operations.
- The best case scenario for operator training would be introduction to operations and maintenance on both diesel and hydroelectric gensets, and before installation in their community so that the installation and commissioning becomes the second exposure. Training could be handled on a community by community base.
- Hydroelectric technicians will most likely need to be trained on multiple hydroelectric turbines and projects, and have at least basic electrical trouble-shooting skills. A base knowledge may be best learned at a vocational training school like AVTEC. After the base knowledge is learned turbine manufacturers normally have training programs to learn their turbine's systems.
- As knowledge is gained by the technicians eventually they will be able to train other individuals to become technicians and operators.
- Technician training should be evaluated from a regional standpoint. Operators would make the first run at repairs after communicating with a technician remotely. After the operator determines the problem, or if the operator cannot determine the problem and the technician cannot do so remotely, then the technician would be called out to diagnose and repair the problem.
- Operators, administrators, technicians, and trainers should be the ultimate training goal for hydroelectric programs in Alaska. As the Alaskan technicians gain knowledge and experience on multiple turbines it should be possible for more vocational schools to offer training in the industry.

Position and Training Needs:

3. Operator – Hydroelectric
    - Introduction to Hydropower Production/Advantages/Disadvantages
    - Electrical Theory
    - Project Equipment Components
        - Dam/Diversion Structure
        - Intake
        - Penstock/Tunnels
        - Generators
        - Transformers
        - Circuit Breakers
        - Switches
        - Drawings
            1. Schematics

        2. Wiring Diagrams
    - Turbines
        1. Impulse
        2. Reaction
        3. Water wheel
    - Governors
    - Valves
- Operation
    - Standard operation procedures
    - Synchronization
    - Load Control
    - Logs
    - Meter readings
    - Inspections
        1. Temperature
        2. Pressures
        3. Vibrations
        4. Noise
        5. Oil levels
    - Diagnostics and Repair
- Maintenance
    - Reservoir
    - Dam
    - Intake
    - Penstock
    - Valves
    - Turbines
    - Governor
    - Generator
    - Excitation
    - Circuit Breakers
    - Transformers
    - Switchgear
    - Distribution
    - Oil Tests
    - Load
    - Auxiliary Equipment
- Safety
    - Start-up
    - Shutdown
    - Training

        - Safety Plan
        - First-Aid/CPR
    - Inspection and Records
        - Annual
        - Federal FERC
        - AK Dam Safety
        - Record keeping
    - Basic Computer Skills
    - Should be cross-trained with power plant and secondary load operations

4. Administrator - Hydroelectric
    - Introduction to Hydropower Production/Advantages/Disadvantages
    - Electrical Theory
    - Project Equipment Components
        - Dam/Diversion Structure
        - Intake
        - Penstock/Tunnels
        - Generators
        - Transformers
        - Circuit Breakers
        - Switches
        - Drawings
            1. Schematics
            2. Wiring Diagrams
        - Turbines
            1. Impulse
            2. Reaction
            3. Water wheel
        - Governors
        - Valves
    - Operation
        - Standard operation procedures
        - Synchronization
        - Load Control
        - Logs
        - Meter readings
        - Inspections
            1. Temperature
            2. Pressures
            3. Vibrations
            4. Noise

5. Oil levels
    - Diagnostics and Repair
- Maintenance
    - Reservoir
    - Dam
    - Intake
    - Penstock
    - Valves
    - Turbines
    - Governor
    - Generator
    - Excitation
    - Circuit Breakers
    - Transformers
    - Switchgear
    - Distribution
    - Oil Tests
    - Load
    - Auxiliary Equipment
- Safety
    - Start-up
    - Shutdown
    - Training
    - Safety Plan
    - First Aid/CPR
- Inspection and Records
    - Annual
    - Federal FERC
    - AK Dam Safety
    - Record keeping
- Accounting and Budget
    - Annual
    - Equipment Replacement
    - Reserves
    - Performance Reporting
- Project Development
    - Permits
    - Site Evaluation
        1. Flow
        2. Head
        3. Power Generation

        4. Construction Costs
        5. Land Status
    - Reservoir
    - Dam/Diversions
    - Intake Structures
    - Penstocks/Tunnels
    - Reconnaissance/Feasibility Report
    - Conceptual Design
    - Final Design
    - Construction
- Grant Writing
- Project Management 101
- Basic Computer Skills
- Should be cross-trained with power plant and secondary load operations

Training and Job Needs for Susitna-Watana Hydroelectric Project:

To be added