



Generator Weatherization Workshop

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Remember.....



2011 Headlines....

Austin American-Statesman
 FINAL EDITION • WEDNESDAY, FEBRUARY 16, 2011 • \$1.00

DRINK, WOOD & LIFE • 62
FARMERS LIST SPOTS TO EAT LOCAL FOOD

BUSINESS IN METRO & STATE • 67
WHOLE FOODS TEAMS WITH GREENLING

AUSTIN • COURTS
Financial adviser indicted by grand jury
 Money laundering, fraud among charges brought in Triton case

TEXAS • ENERGY
Testimony: System unprepared for cold
 'I want confidence that you are making every effort. Who's going to be sure everything is being done?'

WOMEN'S BASKETBALL IN TEXAS GETS WIN OVER NEBRASKA

TESTIMONY: System unprepared for cold
 'I want confidence that you are making every effort. Who's going to be sure everything is being done?'

STATE EYE PAROLES OF FOREIGN, IL PRISONERS

Small percentage bore brunt of outages
 The Feb. 2 power outages occurred mainly in pockets of homes and small businesses throughout Austin, and most were without electricity between four and six hours, according to data Austin Energy released Tuesday.

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Austin Energy outages
 Circuits that experienced outages
 Circuits that were exempt from outages because they serve large, power-intensive industries whose facilities could be damaged by a shutdown
 Circuits serving customers that were deemed too important to shut off
 Circuits that could not be turned off because doing so would destabilize the grid
 Downstream, a grid-within-a-grid that would have to be entirely shut down, putting the electrical systems of some large, power-intensive buildings at risk for damage

POWER: Homes endure the majority of rolling blackouts in Austin
 Continued from A1
 They get plants fully operating again, some real-time

Power plant problems
 Lt. Gov. David Dewhurst said Wednesday that a

About ERCOT

QUESTIONS LOOM ABOUT OUTAGES
 ROLLING BLACKOUTS BLAMED ON POOR COMMUNICATION
 STATE PREPARES FOR SLICK, MESSY MORNING COMMUTE

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 STATE PREPARES FOR SLICK, MESSY MORNING COMMUTE

ERCOT and the historic failure of electric generators
 Before our state's recent experience with rolling blackouts, little public attention was paid to the Electric Reliability Council of Texas. But with an unprecedented number of people losing power Feb. 2, this rating and controlling the state's electricity has found itself the subject of glaring

Natural gas shortage to plants was business decision, expert says
 Some power generators allowed cuts to service amid cold, panel is told

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Extremely Cold Weather Grips Texas

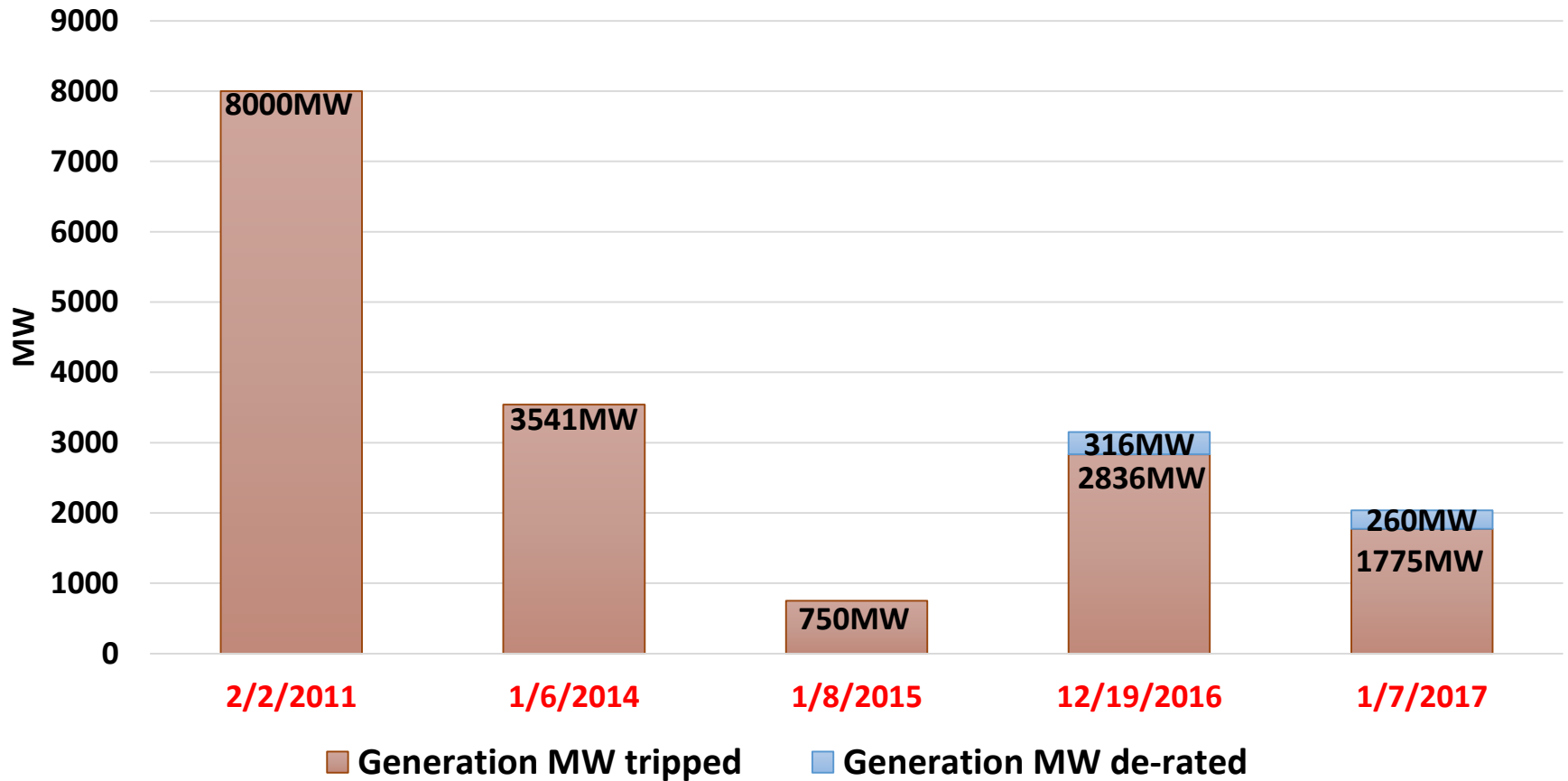
A Federal Electric Reliability Commission (FERC)'s task force looking into the causes of rolling blackouts during cold weather in February 2011 said that “grid operators and power plant operators should have better prepared for extreme winter weather.”

The task force said “the Electric Reliability Council of Texas (ERCOT) region experienced a similar event in 1989 when it also shed firm load, but the lessons learned from that event were not used to prevent outages during the 2011 event.”

What have we learned since February 2011?

- Identify critical components that will derate, trip or fail to start the unit if frozen and incorporate into weatherization plan.
- Detailed testing of heat trace is necessary, identifying critical circuits.
- Verify critical heat trace circuits are still functioning prior to every extreme cold weather event.
- Heat trace failure rates in Texas on average are 10-15% from previous season.
- Insulation inspections, focusing on critical components.
- Plant staff training prior to winter.
- Using wind breaks that can sustain long periods of wind and can last the winter. Avoid off the shelf tarps.
- Continuous improvements to weatherization plan.
- Review scope of contractor work and verify acceptable completion.

Tripped or de-rated capacity due to frozen elements



Comparing Jan 6, 2014 to Jan 8, 2015

3541MW of capacity tripped
that was freeze related.

ERCOT declared EEA2

January 6, 2014

Dallas: 15° (9MPH wind)
Houston: 27° (16MPH wind)
San Antonio: 27° (15MPH wind)
Austin: 20° (13MPH wind)
Brownsville: 37° (17MPH wind)
Abilene: 11° (5MPH wind)
Midland: 14° (12MPH wind)

750 MW of capacity tripped
that was freeze related.

Normal Operations in ERCOT

January 8, 2015

Dallas: 16° (5MPH wind)
Houston: 28° (6MPH wind)
San Antonio: 28° (8MPH wind)
Austin: 21° (7MPH wind)
Brownsville: 39° (16MPH wind)
Abilene: 16° (8MPH wind)
Midland: 20° (7MPH wind)

Weather Source: Chris Coleman, ERCOT

Comparing temperatures Feb 2, 2011 to Dec 19, 2016

8000MW of capacity tripped, failed to start or derated that was freeze related.

February 2, 2011

Dallas: 13° (20MPH wind)
Houston: 21° (16MPH wind)
San Antonio: 19° (25MPH wind)
Austin: 18° (26MPH wind)
Brownsville: 32° (26MPH wind)
Abilene: 7° (16MPH wind)
Midland: 6° (16MPH wind)

ERCOT declared EEA3 – 4000MW of firm load shed.

2836MW of capacity tripped that was freeze related. 316MW of capacity derated.

December 19, 2016

Dallas: 17° (7MPH wind)
Houston: 30° (14MPH wind)
San Antonio: 25° (13MPH wind)
Austin: 24° (12MPH wind)
Brownsville: 37° (17MPH wind)
Abilene: 15° (3MPH wind)
Midland: 21° (4MPH wind)

Normal Operations in ERCOT

Weather Source: Chris Coleman, ERCOT

Hours below freezing comparing Feb 2, 2011 to Dec 19, 2016

<u>City</u>	<u>2-Feb-11</u>	<u>19-Dec-16</u>
Dallas	24	12
Houston	12	8
San Antonio	24	10
Austin	24	9
Brownsville	1	0
Abilene	24	12
Midland	24	12

Weather Source: Chris Coleman, ERCOT

December 18-19, 2016 lessons learned

- Eight generators experienced outages or derates.
- ERCOT followed up with spot checks.

December 18-19, 2016 lessons learned

- Plant 1 – trip; ten critical components froze
 - GT1 performance heater froze
 - GT1 compressor bleed valve air regulators froze
 - GT2 performance heater froze
 - HRSG1 HP flow transmitter sensing line froze
 - HRSG2 HP flow transmitter sensing line froze
 - HRSG2 LP flow transmitter froze
 - HRSG3 HP attemperator HP bypass froze
 - Condensate hotwell level flow transmitter froze
 - Instrument air compressor coalescing filter froze
 - Instrument air compressor air dryer froze
- Cause – Incomplete list of critical components.
- Corrective action – Critical components list is being revised to include all critical components and mitigations measures.
- ERCOT recommendation from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, wind break installed or transmitter cabinet and heater inspection.

December 18-19, 2016 lessons learned

- Plant 2 – trip; steamer
 - Steam seal pressure transmitter froze
 - Cause – lack of heated wind break enclosure for transmitter
 - Corrective action – enclose transmitter in heated enclosure
 - ERCOT recommendation from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.
- Plant 3 – Derate
 - HP superheated attemperator valve frozen to the valve seat
 - Cause – loose connection on associated heat trace cable
 - Corrective action – improve details of heat trace inspection
 - ERCOT recommendation from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.

December 18-19, 2016 lessons learned

- Plant 4 – trip; main turbine throttle pressure control
 - Two of three main turbine throttle pressure transmitters valve bonnets froze
 - Cause – valve bonnets of the root valves were not adequately insulated
 - Corrective action – replaced insulation on the valves and sensing lines and the insulation was extended to cover the entire valve and bonnet. New self-limiting freeze protection wiring was also installed on the sensing lines and valves.
- ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.

December 18-19, 2016 lessons learned

- Plant 5 – trip; drum level transmitter
 - One of four drum level transmitters froze
 - Cause – main breaker tripped in heat trace sub-panel for a ground fault on one of the circuits, resulting in heat trace not energized to one drum level transmitter.
 - Corrective action – potential voltage indication lights were added to sub-panel to assist operator in rounds.
 - Replaced faulty circuit breaker that failed to trip.
 - ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.
 - ✓ Verify critical heat trace circuits are still functioning prior to each extreme cold weather event.
 - ✓ Develop simulator training for control room operators for the loss of drum level transmitters.

December 18-19, 2016 lessons learned

- Plant 6 – trip; boiler feed pump “A” and “B” suction strainer differential pressure.
 - Boiler feed pump “A”
 - Cause – Damage to the power connection boot for the heat trace cable on the root valves was cracked and brittle. This damage indicated the cable totally failed in service.
 - Corrective action – Replaced heat trace cable with Ametek rated at 0DegF.
 - Boiler feed pump “B”
 - Cause – Heat stress cracks and brittle heat trace cable around the root valve.
 - Corrective action – Replaced heat trace cable with Ametek rated at 0DegF.
 - ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit audit for each critical component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.
 - ✓ Verify critical heat trace circuits are still functioning prior to each extreme cold weather event.

December 18-19, 2016 lessons learned

- Plant 7 – temporary derate
 - Moisture in instrument air
 - Cause – frozen moisture in the instrument air line caused the pressure transmitter to show a false low pressure reading. Mechanical room louver vents were left open, vent fan in manual and mechanical room space heaters were not functioning.
 - Corrective action – Weatherization plan was revised to include closing louver vents, vent fan in auto and verification of space heaters functioning in mechanical building prior to winter.
 - Corrective action – install a mechanical building thermometer for telemetering temperature to the control room.
 - ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.

December 18-19, 2016 lessons learned

- Plant 8 – trip
 - Deareator level frozen transmitter
 - Cause – deareator heat trace circuit failure due to corrosion on termination to fuse block.
 - Contributing factor cause – control room operator was not aware that the deareator level was in single element control.
 - Corrective action – Update heat trace inspection to include connections to fuse block, verify critical heat trace is functioning before every extreme cold weather event.
 - Corrective action – Provide additional training to control room operators.

December 18-19, 2016 lessons learned

- Plant 8 – trip (continued)
 - ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.
 - ✓ Update plan to verify critical heat trace circuits are functioning prior to every extreme cold weather event.
 - ✓ Revise cold weather plan to schedule additional staff during extreme cold weather.
 - ✓ Develop cold weather training for operators focusing on checks during extreme cold weather.
 - ✓ Revise operator freeze protection checklist to provide clarity for the operators.
 - ✓ Develop refresher training for control room operators focusing on actions due to frozen transmitters and verifying transmitters are in average and not single element control as a normal operating mode.
 - ✓ Develop a display for boiler critical transmitters as a “windshield look” for the control room operators.
 - ✓ Replace all references in weatherization plan from “may perform” to “shall perform.”

Comparing Feb 2, 2011 to Jan 7, 2017

8000MW of capacity tripped, failed to start or derated that was freeze related.

1775MW of capacity tripped that was freeze related. 260MW derate due to ice damage to FD fan.

February 2, 2011

Dallas: 13° (20MPH wind)
Houston: 21° (16MPH wind)
San Antonio: 19° (25MPH wind)
Austin: 18° (26MPH wind)
Brownsville: 32° (26MPH wind)
Abilene: 7° (16MPH wind)
Midland: 6° (16MPH wind)

ERCOT declared EEA3 – 4000MW of firm load shed.

January 7, 2017

Dallas: 14° (6MPH wind)
Houston: 21° (11MPH wind)
San Antonio: 20° (6MPH wind)
Austin: 19° (10MPH wind)
Brownsville: 30° (27MPH wind)
Abilene: 9° (3MPH wind)
Midland: 10° (4MPH wind)

Normal Operations in ERCOT

Weather Source: Chris Coleman, ERCOT

Hours below freezing comparing Feb 2, 2011 to Jan 7, 2017

<u>City</u>	<u>2-Feb-11</u>	<u>7-Jan-17</u>
Dallas	24	12
Houston	12	11
San Antonio	24	10
Austin	24	11
Brownsville	1	5
Abilene	24	11
Midland	24	12

Weather Source: Chris Coleman, ERCOT

ERCOT sets new winter peak demand and January peak demand records

- AUSTIN, TX, Jan. 9, 2017
 - ERCOT set another new winter demand record on Jan. 6, 2017. Electricity demand reached 59,650 MW during the 6-7 p.m. hour, exceeding the previous winter record of 57,924 MW set just a couple weeks earlier on Dec. 19, 2016.
- It is ERCOT's expectation that for every extreme cold weather event, some generation is going to experience freeze related derates or trips.

January 6-7, 2017

- ERCOT requested information related to the cold weather event on Jan. 6-7, 2017 from 9 generation units.
- Six generation units were outaged due to cold weather.
- ERCOT followed-up and performed a spot check on three of the six units.

January 6-7, 2017 lessons learned

- Plant 1 – trip; boiler feed pump trip
 - Boiler feed pump “B” suction strainer differential pressure transmitter sensing line froze which resulted in a pump trip signal and subsequent unit trip.
 - Cause – heat trace failure
 - Corrective action – replace heat trace bundles and install wind break for additional protection for wind
- ERCOT recommendations from follow-up spot check
 - ✓ Identify all critical components in weatherization plan. Include associated heat trace circuit for each component, insulation inspection, transmitter wind break installed or cabinet and heater inspection.
 - ✓ Verify prior to every extreme cold weather event that critical heat trace circuits are functioning.
 - ✓ Install wind break as additional measure to prevent freezing.

January 6-7, 2017 lessons learned

- Plant 2 – derate
 - Steam seal leak
 - Cause – lower steam coil developed a leak inside the force draft fan intake resulting in ice forming on the bottom side of steam coil. This ice damaged the FD fan blades.
 - Corrective action – Inspect steam coil for leaks on a weekly basis during winter months. When temperatures are forecasted below 36 degrees, additional operational rounds will be made during the shift.
 - ERCOT did not perform a follow-up spot check
- Plant 3 – trip
 - HRSG HP steam flow transmitters froze
 - Cause – heat trace panel control modules 8 and 9 failed resulting in two heat trace circuits not being energized
 - Corrective action – replace modules 8 and 9
 - Corrective action – follow-up with vendor to engineer an alarm for module failure
 - ERCOT did not perform a follow-up spot check

January 6-7, 2017 lessons learned

- Plant 4 – trip
 - Deareator (DA) flow transmitter sensing line froze. Unit has three DA transmitters using two sensing lines.
 - Cause – The condensate (feedwater) to DA flow transmitter sensing line froze creating a false high flow rate, closing the DA level control valves which allowed the level in the DA to drop resulting in a Master Fuel Trip (MFT) of the boiler.
 - Heat trace on one of the circuits was found to be working but with one section that was not. The other heat trace circuit was working but out of specifications for self regulating heat trace.
 - Corrective action – During the spring 2017 unit outage, these transmitters were relocated to the DA level and provided with new weatherized transmitter enclosures, new insulation, new heat trace and sensing lines shortened from 75' to 6'.
 - Corrective action – OEM specified current and power information for all critical freeze protections circuits will be added to the critical transmitter freeze protection preventive maintenance work orders for comparison to actual operating conditions.

January 6-7, 2017 lessons learned

- Plant 4 – trip (continued)
 - ERCOT recommendations from follow-up spot check
 - ✓ Update plan as follows; prior to every extreme cold weather event, verify critical components heat trace are functioning.
 - ✓ For winter 2017-2018, verify heat trace circuit alarms are correctly programmed into system used by operators to monitor performance.
- Plant 5 – trip
 - Loss of instrument air
 - Cause – The loss of instrument air was caused by the freezing of the air dryer pre-filter, which restricted air flow to the instrument air system resulting in the gas trip valve closure.
 - Corrective action – Install a wind break with heater for additional protection to prevent freezing.
 - ERCOT did not perform a follow-up spot check

January 6-7, 2017 lessons learned

- Plant 6 – trip
 - HRSG HP Feedwater high range flow transmitter, low side sensing line froze.
 - Cause – The contractor that performed the fall audit on heat trace did not terminate the associated heat trace circuit in a junction box correctly.
 - Corrective action – Verify contractor work and only hire a contractor that has a quality control program in place.
 - ERCOT recommendations from follow-up spot check
 - ✓ Update plan as follows; prior to every extreme cold weather event, verify critical components heat trace are functioning.
 - ✓ Hire contractor with QC program for heat trace testing.
 - ✓ Add associated heat trace circuit to critical component list.

Identifying critical components or equipment is required

- §25.53. Electric Service Emergency Operations Plans.
 - (c)(2)(B) A plan that addresses any known critical failure points, including any effects of weather design limits.
- Nodal Protocol 3.20 (3)
 - ✓ No earlier than November 1 and no later than December 1 of each year, each Resource Entity shall submit the declaration Section 22, Attachment K, Declaration of Completion of Generation Resource Weatherization Preparations, to ERCOT stating that, at the time of submission, each Generation Resource under the Resource Entity's control has completed or will complete all weather preparations required by the weatherization plan for equipment critical to the reliable operation of the Generation Resource during the winter time period (December through February).
 - ✓ If the work on the equipment that is critical to the reliable operation of the Generation Resource is not complete at the time of filing the declaration, the Resource Entity shall provide a list and schedule of remaining work to be completed.
- Section 22, Attachment K, Declaration of Completion of Generation Resource Weatherization Preparations
 - ✓ "I hereby attest that all weatherization preparations for equipment critical to the reliable operation of each of the above-listed Generation Resources during the time period stated above are complete or will be completed, as required by the weatherization plan applicable to each Generation Resource."

Comments

- ERCOT will be focusing on critical components as required by §25.53, Nodal Protocol 3.20 (3), generator attestation and measures to mitigate freezing during spot checks for winter 2017/2018.
 - ✓ Critical components list as part of weatherization plan.
 - ✓ Heat trace audit testing and identifying critical components.
 - ✓ Insulation inspections on critical components.
- Best practice
 - ✓ Prior to every extreme cold weather event, verify critical components heat trace circuits are functioning.
- ✓ ***It is ERCOT's expectation that for every extreme cold weather event, some generation is going to experience freeze related derates or trips.***

Food for thought....

- *“do or do not; there is no try.” Yoda – Star Wars*
- *... you say to yourself, “OK, why did it happen? Why did we make those bad engineering decisions we made in 1986 with Challenger?” I’ll tell you. It’s the human element. I suggest that there’s a **complacency** there that comes from success. — Alan Shepard*

NERC Reliability Guideline Approved

- Generating Unit Winter Weather Readiness
Current Industry Practices – Version 2
- [Reliability Guideline: Generating Unit Winter
Weather Readiness – Current Industry Practices
– Version 2](#)
- Copies are available in the back of the room

Resource weatherization objective

“By failing to prepare, you are preparing to fail.” -- Benjamin Franklin

Questions?