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Workforce Development for the Future Grid

- The US Dept. of Labor (DOL) projects that there will be an increase of ~14,000 jobs for electrical power-line installers and repairers from 2014 to 2024. A large part of the growth will be due to upgrading the interstate power grid (Fig. 1).
- Global battery-making capacity is set to more than double by 2021. It has been reported that a large battery production plant could create 7,000 jobs during construction and require 300 full-time jobs after start up.
- Energy storage is not considered an occupational field by the DOL
- Storage Battery Tester description hasn't been updated since 2001.
- Figure 2 is an actual job posting sent to SG in Aug 2017.
- There has been ZERO response for a \$25-30/hr position.
- This journeyman does not currently exist.

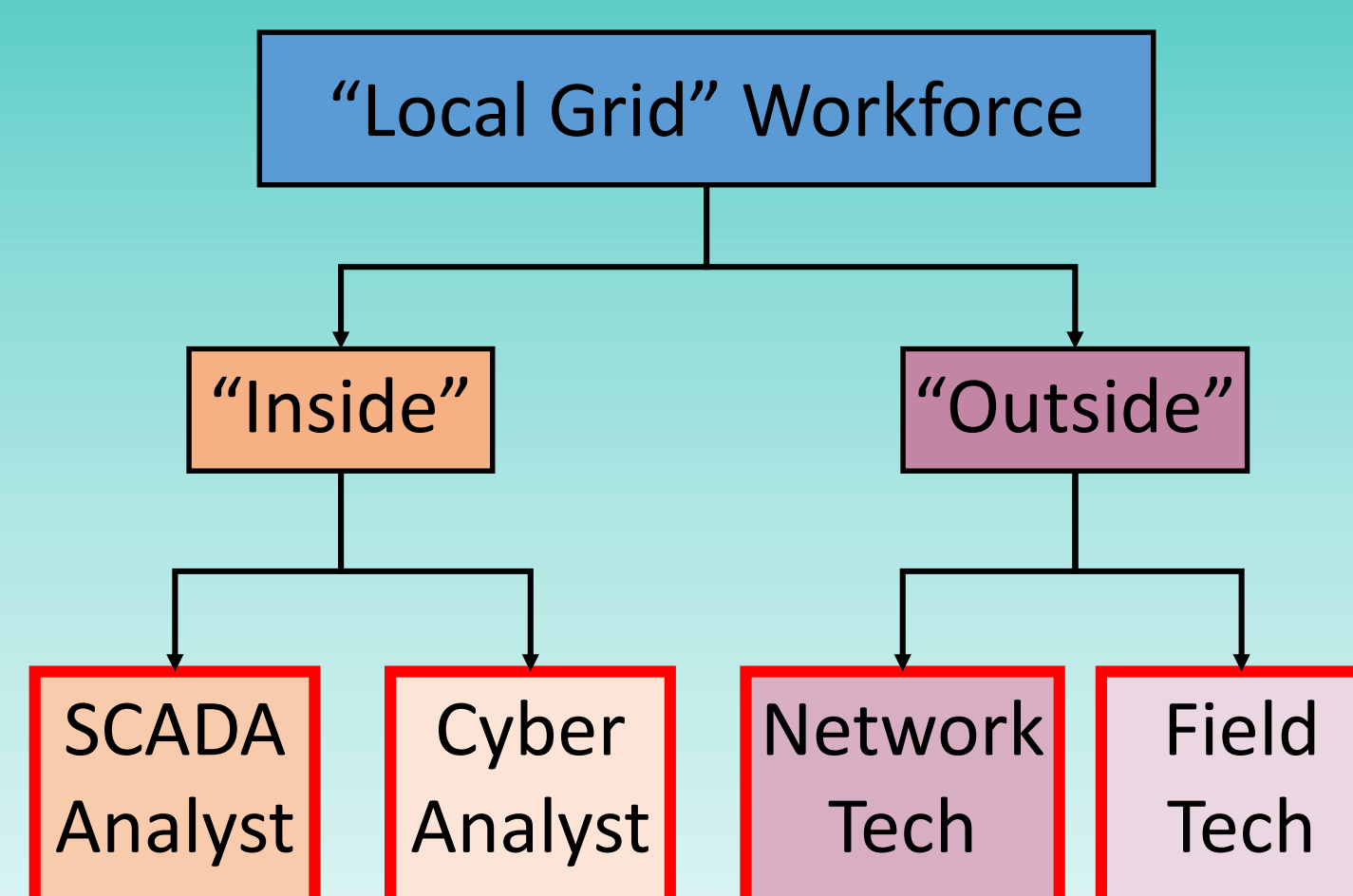


Figure 1. Schematic of generalized occupation categories for smartgrid technicians.

Sent: Tuesday, August 22, 2017 12:59 PM
To: Stephen Gomez
Subject: Job Posting for Trades Building

Hi Steve,
I am with [redacted] and we are seeking a qualified journeyman electrician. I have been tasked with this recruiting effort and it seems we are having a bit of difficulty finding a qualified person for this role. I am not sure what the problem is specifically but I hope we can get some response from a job post on the trades building job board. Below is the fundamental job requirements for the Journeyman Electrician person that we are seeking.

A rapidly expanding solar energy company is seeking a professional Journeyman Electrician with at least 2+ years of solar experience with:

- PV to grid interconnection
- Battery storage and off-grid systems experience
- Ability to lead a crew in field and proven supervisory skills
- Project management skills with great organizational ability
- Customer service, good interpersonal skills
- Controls experience a plus
- NM Journeyman card in good standing & valid NM driver's license

If you consider yourself a top notch and conscientious employee, we are interested. Please submit a resume and 2 professional references or call 505-[redacted] for more details on applying.

**Job Type: Full-time
Salary: \$25.00 to \$30.00 /hour with PTO**

Thanks Steve. Call me with any questions at 505-[redacted]

Figure 2. Job posting sent to SG in Aug 2017.

- Local grid and energy storage industry is growing rapidly, but the line workers and technicians of today do not possess the skill sets for these new jobs and this aging workforce is unlikely to undertake the training required to acquire these new skills.
- SFCC is a HSI that is 80% energy sovereign and has developed a new 2-yr *Certificate in Electrical, Smart Grid and Micro Grid Technologies* (22 hrs) embedded in the Engineering Technologies AAS degree.
- Courses have been developed in generation/transmission/distribution and management (ELEC 151, ELEC 201), but not in energy storage.
- Curriculum for an energy storage class developed during a summer faculty sabbatical at SNL for a 16-week class directed towards the 2-yr technical student is shown in Fig. 3.

1 st 4 weeks		2 nd 4 weeks		3 rd 4 weeks		4 th 4 weeks	
Week 1	1 Admin/Grading/Safety/Energy Storage Intro	Week 5	1 Pumped storage	Week 9	1 Lead Acid – Current Technology	Week 13	1 Fly Wheels/Compressed air
Week 2	2 Energy/Electricity/US Generation Mix/Trends	Week 6	2 Intro to batteries (discovery, chemistry/half-cell, hurdles)	Week 10	2 Lead Acid – Research/Future Technology	Week 14	2 Field Trip/Guest lecture (dates adjustable)
Week 3	1 Generation/Transmission/Load Balancing/Distribution Review	Week 7	1 Battery types (wet cell, dry cell, flow cell, fuel cell, “microbial”?)	Week 11	1 Li-ion – various chemistries/optimal uses	Week 15	1 Field Trip/Guest lecture (dates adjustable)
Week 4	2 North American Grid/Reliability/Security/Failures/“Ideal” grid	Week 8	2 Battery Commissioning	Week 12	2 Li-ion – advantages and disadvantages	Week 16	2 Student Presentations (start large class) Lecture (small class)
Week 5	1 Conservation/Efficiency/Line loss/HVDC transmission	Week 9	1 Storage-Load Balancing/Peak smoothing/Arbitrage	Week 13	1 Flow Batteries – types/optimal uses	Week 17	1 Student Presentations (finish large class) Start (small class)
Week 6	2 Energy Markets/Arbitrage/ROI for energy storage systems	Week 10	2 Codes - overview	Week 14	2 Flow Batteries – advantages and disadvantages	Week 18	2 Exam Review
Week 7	1 Energy Storage (overview of types of storage, details later)	Week 11	1 Midterm Exam	Week 15	1 Others – Molten NaS, Zebra, ZnMnO ₂ , Salt Water	Week 19	1 Final Exam
Week 8	2 Microgrid/Smartgrid (overview how storage makes it possible)	Week 12	2 Review Midterm – Choose project (Adopt A Technology)	Week 16	2 Fuel Cells	Week 20	

Figure 3a. 16-week curriculum for Energy storage at the 2-yr technician level.

Week 2 Day 1 (Lecture 3)	
1 st 15' module	Electrical Generation (19 slides) • Concepts • Generation • Types of power plants • Types of energy sources • Parts of power plants • Size and cost of generators
2 nd 15' module	Electrical Transmission (13 slides) • Concepts • Transmission components • AC vs HVDC transmission • Phase Angle • ROW • Network Structures/Resiliency
3 rd 15' module	Distribution (15 slides) • Concepts • Step up/down voltage • 110 vs 220 V/ 50 vs 60 Hz • Generator to consumer • Line losses • Smart meters
4 th 15' module	Load Balancing (13 slides) • Concepts • Load Matching • Daily Peak Demand Reserve • Grid Energy storage • Base load vs Peaking power plants • “Duck” curve

Figure 3b. Example of 15' lecture modules for a single day's lecture. Modules are designed to be readily convertible to on-line courses.