

Environmental and Munitions Center of Expertise

Environmental Remediation Energy Calculators

Carol Lee Dona, Ph.D, P.E.

Mike Bailey, Ph.D, P.G.

Dave J. Becker, P.G.

Environmental and Munitions Center of
Expertise

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Overview of Presentation

- Importance of Energy Calculations
- Energy Consumers in Environmental Remediation
- Tools to Calculate Energy Use
- Example: SiteWise™ Sustainable Environmental Remediation (SER) tool
- Example: Sustainable Remediation Tool (SRT)
- Conclusions



Why Energy Calculations Are Important

- Cost (affordability)
- Security (reliance on outside source, possible sabotage)
- Relation of energy use to other considerations (greenhouse gases (GHG) and priority criteria pollutant emissions)
- Federal mandates to reduce energy usage (EO 13514 – 30% reduction by 2015) and to set goals for GHG reduction and establish procedures to inventory total GHGs.



What Uses Energy in Environmental Remediation?

- Transportation (personnel, equipment, residuals)
- Equipment (To move, treat, dispose of contaminants; to maintain remediation structures)
- Consumables (Energy used to make the materials/equipment used in the remediation process)



Tools to Calculate Energy Use

- SiteWise™ Sustainable Environmental Remediation (SER) Tool, developed by Battelle, under further development after purchase by the Army and Navy, will be available to the public June 2010 on the Navy website.
 - ▶ Structure: Remedial phase and activity-based – remedial option or alternative built from combination of activities
 - Material Production
 - Transportation (Personnel and Equipment)
 - Equipment Use
 - Residual Handling
- Sustainable Remediation Tool (SRT), developed by the Air Force, available at <http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation/srt/index.asp>.
 - ▶ Structure: Technology-based
 - Excavation
 - Soil Vapor Extraction
 - Pump and Treat
 - In-Situ Bioremediation
 - In-Situ Thermal
 - In-Situ Chemical Oxidation
 - Biowalls
 - Long-Term Monitoring/Monitored Natural Attenuation
- Both tools calculate energy use, as well as greenhouse gas emissions



Basic Question When Calculating Energy Use – What is included?

Both SiteWise™ and SRT include the energy from following

- ▶ Equipment use
- ▶ Energy to manufacture treatment substrates
- ▶ Transportation (personnel, equipment to site, waste from site)
- ▶ Monitoring
- SiteWise™ and/or SRT do not include:
 - ▶ The energy from manufacture of the equipment, i.e. pumps, transportation.
 - ▶ Adjustments for renewable energy in SRT, not in SiteWise™
- If a factor is not included in tool calculations, should indicate in reporting of the analysis. Example: model assumes fossil fuel energy sources.



Example Calculation - SiteWise™

- Optimization of Pump and Treat, with Long-Term Monitoring
- Pump and Treat – Groundwater extracted, treated (air stripping), then disposed to surface



SiteWise™ Input for Energy Calculations

- Can be any of the following
 - ▶ Nameplate
 - Motor size (Horsepower)
 - Estimated percent loaded (*Default value available in the tool*)
 - Estimated motor efficiency (*Default value available in the tool*)
 - Estimated percent run-time (*Default value available in the tool*)
 - ▶ Pump design needs
 - Flow rate
 - Estimated total dynamic head
 - Pump efficiency (*Default value available in the tool*)
 - Motor Efficiency (*Default value available in the tool*)
 - Estimated percent run-time (*Default value available in the tool*)
 - ▶ Pump or blower curves
 - Flow rate
 - Estimated total dynamic head
 - Equipment curve provided by manufacturer
 - ▶ Meter readings
 - Electric consumption (KWh)



Representation of Current Remedy in SiteWise™ – Pump and Treat – Energy Calculations

- Extraction Wells - 20:
 - ▶ Nameplate
 - Motor size (20 HP)
 - Estimated percent loaded (*Default 0.9*)
 - Estimated motor efficiency (*Default 0.9*)
 - Estimated percent run-time (*continuous*)
- Treatment System - 4 Blowers (air stripper)
 - ▶ Nameplate
 - Motor size (25 HP)
 - Estimated percent loaded (*Default 0.9*)
 - Estimated motor efficiency (*10 years old, assumed 0.6*)
 - Estimated percent run-time (*continuous*)
- Treatment System – Three pumps (one to pump water to the top of the air stripper, two pumps to pump water to surface disposal, one primary and one backup)
 - ▶ Nameplate
 - Motor size (80, 115 (primary), 60 (backup) HP)
 - Estimated percent loaded (*Default 0.9*)
 - Estimated motor efficiency (*>10 years old, assume 0.6*)
 - Estimated percent run-time (*continuous except for backup, which is 10%*)
- Transportation – 1 operator, 30 mi round trip by car for 260 work days/year, default mpg for car



Representation of Current Remedy in SiteWise™ – Long-term Monitoring – Energy Calculations

- Monitoring Wells with Dedicated Submersible pumps -170:
 - ▶ Nameplate
 - Motor size (0.5 HP)
 - Estimated percent loaded (*Default 0.9*)
 - Estimated motor efficiency (*Default 0.9*)
 - Estimated percent run-time (*8 days, 10 hrs/day, yearly*)
- Personnel Transportation – 4 teams (2 people) in two light trucks, one car, one SUV – default mileage, 30 mile roundtrip, 8 days of sampling
- Material Production – 3 40 ml VOA vials/ sampling location (VOA vials)
- Residual Handling (Waste) – 4 gal IDW/well, transferred to 55 gal drums (4 drums total), hauled away by heavy truck, 30 miles round trip, default mpg



Energy Calculation Results

- **Two scenarios –**
 - ▶ **Current Treatment System/Monitoring (dedicated submersible pumps, low-flow sampling)**
 - ▶ **Optimized: Two blowers removed, passive diffusion bag sampling replacing low-flow sampling**
- **Differences in SiteWise™ input**
 - ▶ **Same Name Plate quantities but 2 instead of 4 blowers**
 - ▶ **0.06 gal IDW per well, one 55 gal drum total, light truck hauling**
 - ▶ **One team (2 people) sampling for 10 days (assume that passive sampling is on-going and when bag is removed, another is placed for next sampling event)**



Energy Use

ACTIVITY	Total Energy Usage (MMBTU)		Reduction Due To Optimization (Percent)
	Current	Optimized	
System Operation			
Transportation-Personnel	40	40	0
Transportation-Equipment	0	0	NA
Equipment Use	41,000	36,000	11
Residual Handling	0	0	NA
Operation Sub-Total	41,040	36,040	11
Monitoring			
Transportation-Personnel	7	2	72
Transportation-Equipment	0	0	NA
Equipment Use	0.91	0	100
Residual Handling	0.60	0.25	58
Monitoring Sub-Total	8.5	2.2	73
Total	41,048	36,042	11



Greenhouse Gas Emissions

ACTIVITY	Total CO2e Emissions (Metric Tons)		Reduction Due To Optimization (Percent)
	Current	Optimized	
System Operation			
Transportation-Personnel	2.9	2.9	0
Transportation-Equipment	0	0	NA
Equipment Use	4000	3500	11
Residual Handling	0	0	NA
Operation Sub-Total	4003	3503	11
Monitoring			
Transportation-Personnel	0.44	0.11	74
Transportation-Equipment	0	0	NA
Equipment Use	0.088	0	100
Residual Handling	0.052	0.016	69
Monitoring Sub-Total	0.58	0.13	76
Total	4003	3503	11



Conclusions – Optimization Using SiteWise™

- Equipment usage in the treatment system the largest energy user
- The energy consumption of the remediation would drop ~11% if 50% of the blowers are not used.
- Lower energy with passive sampling bags due to no pumps, less time on site, less IDW and smaller haul vehicle (higher gas mileage)
- Monitoring energy consumption small compared to treatment energy consumption



Energy Calculation Using SRT

- Optimization of Tailings Pile Remediation included excavation of pile
- Area of pile – 200 Acres (~8,000,000 ft²)
- Height – 100 ft
- Distance to disposal (one-way) – 30 mi
- Transport by heavy truck
- 20,000 trips by workers to site over project life, 10 mi round trip
- Default mpg used
- Tier II (more site information) used, Tier I with more defaults also available



Results SRT – Tailings Pile Excavation

- Total project energy use – 800,000 MMBTU
- Total Greenhouse Gas Emissions – 63,000 Tons



Conclusions

- Energy calculators for environmental remediation are available publicly (SRT) or will soon be (SiteWise™). Training on both is offered at the 2010 Battelle Monterey Conference, also USACE is planning web-based training on SiteWise™
- SiteWise™ identifies which activities are impact drivers (highest energy use)
- The calculators can be used with basic remedial option information and are relatively easy to use
 - ▶ Both SRT and SiteWise™ allow a number of default assumptions
 - ▶ SRT has two tiers: Tier 1 (~2 hrs to complete), Tier II (up to 2 days)
 - ▶ SiteWise™ and SRT are flexible in terms of input data for energy calculations
- Assuming the source for the energy is fossil fuel, greenhouse gas emissions closely track energy use



Questions?
Contact Carol Lee Dona
carol.l.dona@usace.army.mil

