Greenhouse Gas & Energy Assessment for your Operation

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Overview

- Introduction
- Greenhouse Gas and Energy Assessment
- Case Study – Motor Sizing & Efficiency
- Conclusions

Delivering sustainable solutions in a more competitive world

ERM

Introduction

- Climate change and the global challenge;
- Two of the largest global sources of CO_2 are electricity production/heating (32 percent), and transportation (17 percent);
- The extractive industry relies heavily on purchased electricity and transportation for the successful operation of its businesses;
- Energy Efficiency and Opportunities Act 2006, Greenhouse Challenge Plus and Victorian Protocol for Environmental Management (PEM) - Greenhouse Gas Emissions and Energy Efficiency in Industry;

Introduction

- Assessment of greenhouse gases now an important component of any environmental impact assessment for major project approvals;
- Cost management and mandatory energy assessment programs are increasingly driving organisations to look for cost effective ways to reduce energy and associated greenhouse gas emissions; and
- This presentation discusses the methodology, outcomes and key implementation issues of a greenhouse gas and energy efficiency assessment for a hardrock quarry.

Greenhouse Gas & Energy Assessment

- Victorian hardrock quarry required the assessment to meet legislative compliance;
- Operation Statistics:
  - Up to 1.2 MT per annum of aggregates through the following operation sequence:
    - Removal of soil and overburden;
    - Extraction of hardrock by drilling and blasting;
    - Loading and hauling;
    - Crushing and screening;
    - Stockpiling and sale of products; and
    - Transport of products by conventional road trucks.

Methodology

- Objectives
  - To quantify energy and greenhouse emissions;
  - To benchmark operation performance;
  - Develop options for minimising energy and GHG's;
  - Assess reduction options; and
  - Develop energy action plan.
- Quantify Energy and Greenhouse Emissions
  - Assessment boundary;
  - Energy audit in accordance with the Australian /New Zealand Standard AS/NZ 3580, Energy Audits; and
  - Report results.

Methodology

- Benchmark Performance
  - Commitment, targets, KPI's, accountability, resourcing, purchasing procedures, maintenance, monitoring and reporting, feedback and control;
  - KPI's:
    - Total energy per unit production (GJ/kt);
    - Total energy per unit mined (GJ/kt);
    - Total energy per unit milled (GJ/kt);
    - Total CO_2 per unit production (t CO_2-e/kt);
    - Total CO_2 per unit mined (t CO_2-e/kt); and
    - Total CO_2 per unit milled (t CO_2-e/kt).

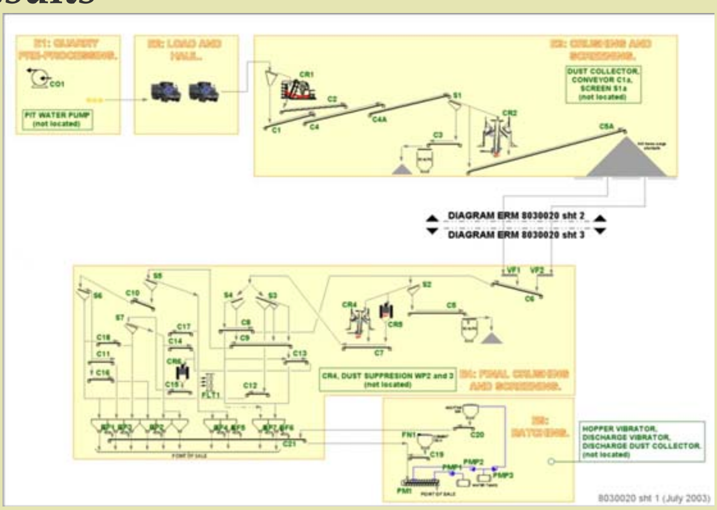
Methodology

- Options for Minimising Energy and GHG's
  - Development with operations staff, engineers and management;
  - Assessing options for sustainability, feasibility and policy compliance;
  - Assessing the cost-effectiveness of options; and
  - Prioritising preferred options.
- Energy Action Plan
  - Prioritised actions, completion dates, capital costs, cost savings, payback periods and responsibilities.

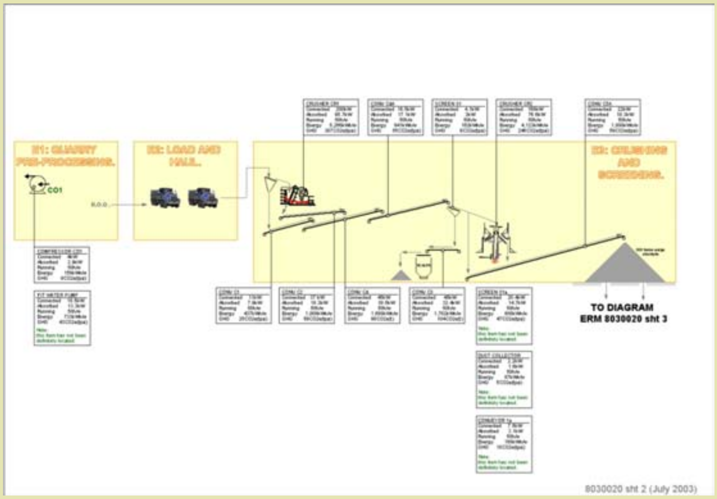
Results

- Major activities contributing to large energy use included:
  - Quarry pre-processing including topsoil and overburden stripping and drill and blasting (E1);
  - Load and haul (E2);
  - Crushing and screening (E3);
  - Final crushing and screening (E4); and
  - Batching (E5).

Results

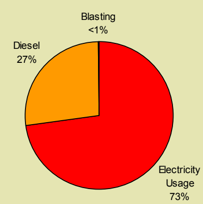


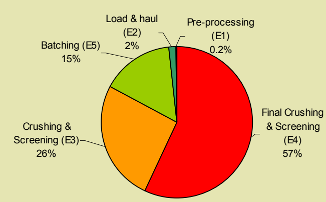
Results



Results

- Major sources of greenhouse gases were derived from electricity consumption (particularly motors), diesel usage and blasting activities;
- Final crushing and screening was a significant processing unit.





Results

- Benchmarking
  - Assessment against other business unit operations;
  - Assessment against industry benchmarks:
    - *National Stone Associations, Energy Conservation in the Crushed Stone Industry* (0.035 GJ/tonne);
    - Quarry energy consumption per tonne of product was 0.031 GJ/tonne.

Case Study – Motor Sizing & Efficiency

- Motors are found on almost every piece of equipment used to perform a process within the quarry;
- A small improvement in electricity motor efficiency can produce significant savings in energy costs and GHG's;
- Motors subject to loads that do not match their designed operating point are inefficient and more likely to fail;
- The maximum efficiency of a standard electric motor is achieved at 70-80% of its nominal load; and
- It is common practice to install a motor with a larger capacity than is really required.

Case Study – Motor Sizing & Efficiency

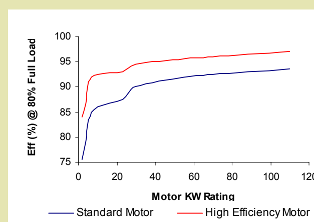
- Analysis indicated that some motors were operating outside the range of optimal load;
- Annual energy consumption of inefficient motors was 917,000 kWh ($66,334) per annum; and
- Potential for 29% reduction in energy consumption and costs with appropriately sized and operating motors.

Conveyor Type	Nameplate (kW)	Absorbed (kW)	Load Factor (%)
C1	11.0	7.9	72
C1a	**7.5**	**3.1**	**41**
C2	**37.0**	**18.3**	**50**
C3	45.0	32.4	72
C4	**45.0**	**30.5**	**68**
C4A	18.5	17.1	92
C5	**9.3**	**3.1**	**33**
C5A	22.0	18.3	83
C6	**37.0**	**23.2**	**63**
C7	**37.0**	**48.9**	**132**
C8	15.0	9.8	65
C9	**18.0**	**3.1**	**17**
C10	**5.5**	**6.1**	**111**
C11	**5.5**	**1.2**	**22**
C12	**7.5**	**4.3**	**57**

1. Bold indicates load factor out of optimum range

Case Study – Motor Sizing & Efficiency

- Motor efficiency losses occur as core losses, stator losses, rotor losses, stray load losses and windage and friction losses;
- High efficiency motors (HEM) are designed and manufactured to reduce these losses; and
- Cost premiums are high for HEM but the saving potential is enormous.



Case Study – Motor Sizing & Efficiency

- Payback period calculation is a simple and approximate method of evaluating the benefits of implementing energy saving measures;
- It takes no account of the magnitude or timing of cash flows during or after the payback period.

Description	Standard Motor	HEM
Output Power (kW)	10	10
Price per motor	$500	$5,500
Efficiency at average load[3]	60%	92%
Operation (hours per day)	10	10
Operation (days per year)	250	250
Power consumption per year (MWh)	41.7	27.2
Annual energy saving (MWh)	0	14.5
GHG saving (t CO_2-e per yr)	0	18,840
Annual Energy Cost	$3,015	$1,967
Energy Cost Saving	-	$1,048
Payback Period[4]	-	4 yrs 8mth

1. Emission factor for purchased electricity 1.299 kg CO_2 –e/kWh
2. Electricity rate assumed to be $0.0723/kWh
3. Standard motor average load based on average of load factors in *Table 3.2*.
4. Simple payback period, i.e. cashflows not discounted

Case Study – Motor Sizing & Efficiency

- Action Planning for HEM
  - All new installations;
  - When purchasing equipment packages such as compressors, heating ventilation and air conditioning (HVAC) systems and pumps;
  - When major modifications are made to the site or process;
  - Instead of rewinding older standard efficiency units;
  - To replace oversized or underloaded motors; and
  - As part of a preventive maintenance or energy conservation program.

Case Study – Motor Sizing & Efficiency

- Implementation Issues
  - Motors were operating in sequence and poor energy efficiency can still be demonstrated with one high efficiency motor in between many underperforming motors;
  - Business case appears quite straightforward, but often not obvious from routine costing and traditional project cost benefit analysis (simple payback calculation);
  - Approach does not consider all the financial issues (depreciation, investment allowance and tax issues);
  - Running costs (consumables, maintenance, labour for operation, maintenance and administration etc.) not included; and
  - Highlights that organisational inertia, including established management accounting practices and engineering protocols, might in fact be greater obstacles to energy efficiency implementation then fundamental technology constraints.

Conclusion

- Energy and greenhouse gas assessments are an innovative mechanism to identify, quantify and reduce energy and greenhouse gases from your operation;
- Opportunities for energy efficiencies are particularly apparent within the extractive industry, primarily due to aging equipment and traditional engineering mindsets; and
- Effective energy management protects your profits and the environment through efficient and economic use of electricity on your site.