

## Efficient Energy Management in Wineries

### VinPro Santam Cellar Conference



CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES



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Wine Industry Network of Expertise and Technology  
Netwerk van Kennis en Toeganklikheid vir die Wynbedryf

Prof Alan Brent  
Cebo Silinga & Nadia Sanetra  
06 August 2014  
Goudini Spa, Rawsonville

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The Centre for Renewable and Sustainable Energy Studies was established in 2007 to facilitate and stimulate activities in renewable energy study and research at Stellenbosch University.

The Department of Science and Technology has been funding the Renewable and Sustainable Energy (RSE) Hub at Stellenbosch University since its establishment in August 2006. The aims of the RSE Hub are to develop human capital, deepen knowledge, and stimulate innovation and enterprise in the field of RSE. Currently the DST is still sponsoring the work of the Centre with an annual grant administered by the National Research Foundation.

Stellenbosch University was designated as the Specialisation Centre in Renewable Energy Technology as part of the Eskom Power Plant Engineering Institute (EPPEI). The research and teaching activities sponsored by Eskom focus on concentrating solar power (CSP) and wind energy and also includes the Eskom Chair in Concentrating Solar Power.

The Sasol Technology group sponsored the new facilities for the Centre for Renewable and Sustainable Energy Studies as well as the work and facilities of the Solar Thermal Energy Research Group at Stellenbosch University.



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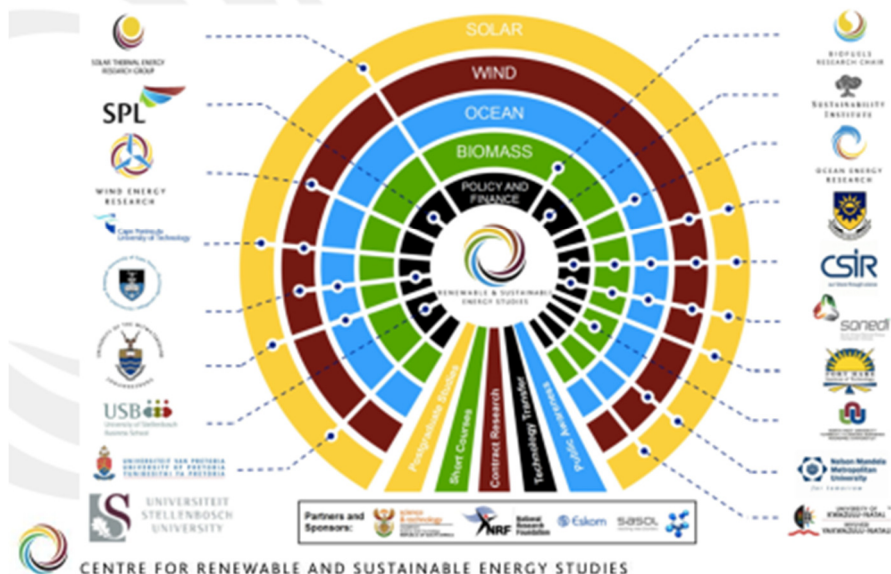
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reaching new frontiers



# CRSES Research Network



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## Background to this project

- 2011 South African Society for Enology & Viticulture (SASEV) conference
  - There is an increasing need to create awareness around the management of energy usage in wineries
  - There is a significant opportunity for energy savings interventions because the South African wine industry is largely reliant on energy intensive solutions



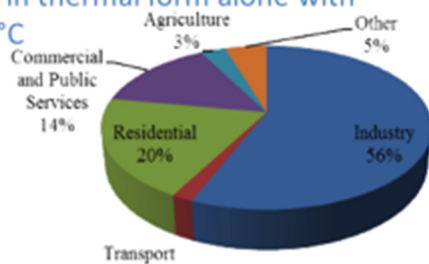
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## Energy in South Africa

- Industrial sector is using around 41% of the total energy and 56% of the total electricity demand of the country
- Majority of this energy – around 66 % – is used for process heating within the industrial sector
- 40-50% of this consumption is in thermal form alone with temperature range below 300°C



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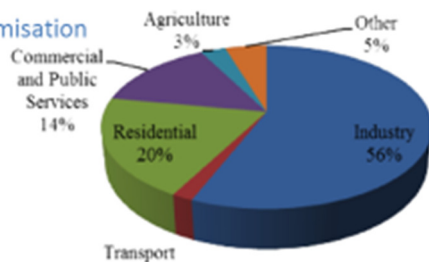


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## Alternative energy options

- Energy efficiency
  - Process optimisation
  - New technologies
- Renewable energy
  - New technologies
  - Hand-in-hand with process optimisation
    - Thus process integration



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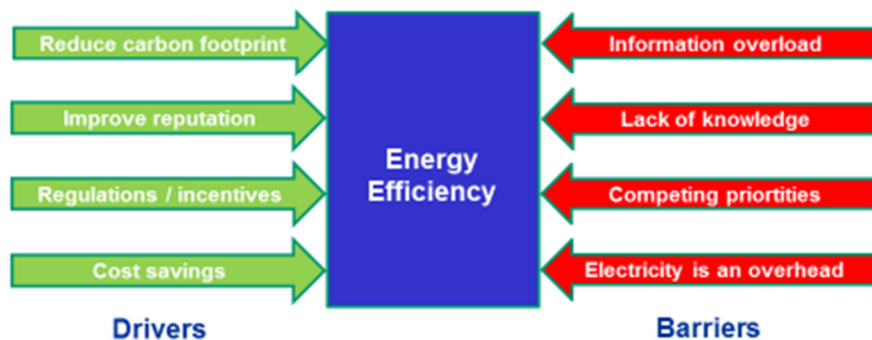
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## Drivers and barriers



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| Elements of international guidelines             | Galitzky et al., 2005 | Commonwealth of Australia, 2005 | Perth Region NRM, n.d. | Ecofys, 2008 | "WineSkills Workbook" Plumpton College, 2012 UK | Smyth & Nesbitt, 2012 |
|--------------------------------------------------|-----------------------|---------------------------------|------------------------|--------------|-------------------------------------------------|-----------------------|
|                                                  | USA                   | Australia                       | Australia              | EU           | UK                                              | UK                    |
| Wine industry energy information                 | x                     | x                               | x                      | x            | x                                               | x                     |
| Information on Billing                           | x                     | x                               | x                      | x            | x                                               | x                     |
| Best Practice Tips                               | x                     | x                               | x                      | x            | x                                               | x                     |
| Significant Energy Users (SEUs) are              | x                     | x                               | x                      | x            | x                                               | x                     |
| Energy in the                                    | x                     | x                               | x                      | x            | x                                               | x                     |
| Workbooks & Spreadsheets                         | x                     | x                               | x                      | x            | x                                               | x                     |
| Technology                                       | x                     | x                               | x                      | x            | x                                               | x                     |
| Costs                                            | x                     | x                               | x                      | x            | x                                               | x                     |
| Energy Efficient Winery Design                   | x                     | x                               | x                      | x            | x                                               | x                     |
| Behaviour change                                 | x                     | x                               | x                      | x            | x                                               | x                     |
| Staff Training & maintenance                     | x                     | x                               | x                      | x            | x                                               | x                     |
| System approach - design/optimisation            | x                     | x                               | x                      | x            | x                                               | x                     |
| Renewable energy                                 | x                     | x                               | x                      | x            | x                                               | x                     |
| Energy Management System                         | x                     | x                               | x                      | x            | x                                               | x                     |
| Includes water                                   | x                     | x                               | x                      | x            | x                                               | x                     |
| Includes examples from other non-wine industries | x                     | x                               | x                      | x            | x                                               | x                     |



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## Why ISO 50001?

- International best practice for Energy Management
- Continuous improvement



**ISO50001**

**ENERGY  
MANAGEMENT**



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## Elements of the guideline



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## Aims of the guideline

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- Interpret and make available the principles of ISO50001 Energy Management systems to help Wineries to better manage energy
- Save wineries money
- Reduce carbon footprint
- Become more competitive in the market place
- Improve reputation as resource efficient industry/winery
- Capitalise on rebates and/or subsidies being made available through Green Economy initiatives



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## Goals of the Guideline

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- Practical
- User – friendly
- Relevant information



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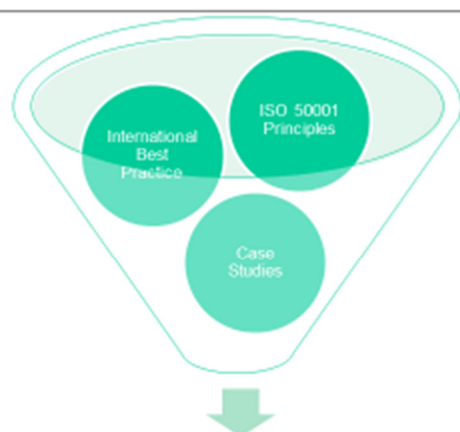
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## Energy Management Guideline for SA Wineries



Guideline + Industry knowledge



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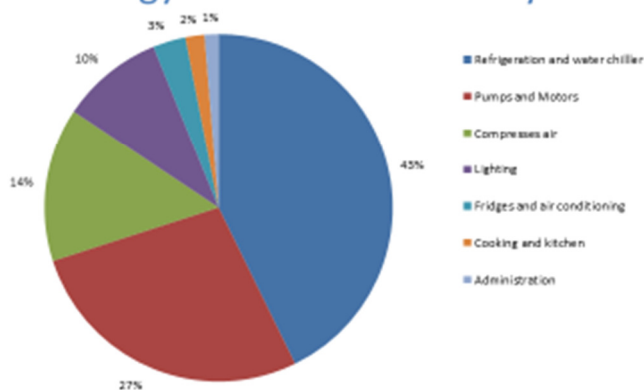


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## Assessment summary

### • Typical energy balance for a winery



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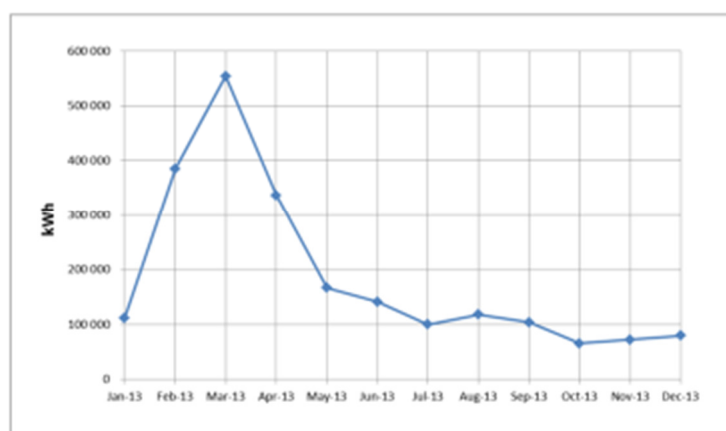


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## Electricity consumption

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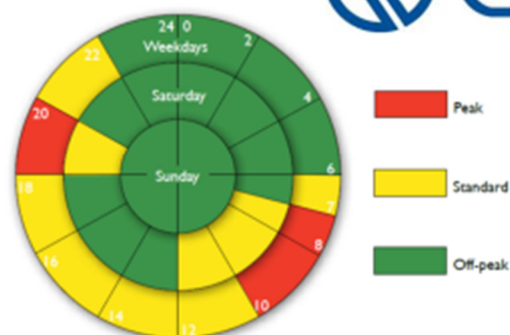


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## Tariff Optimisation



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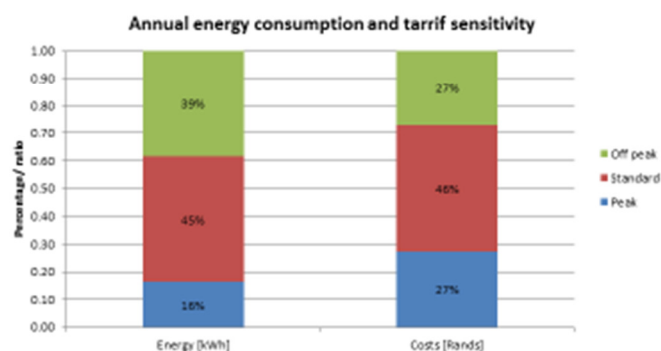


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## Eskom usage data

- Electricity costs are heavily influenced by the type of tariff structure



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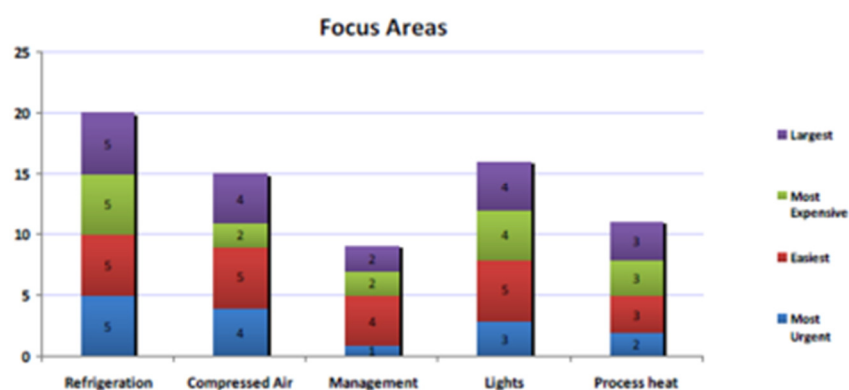
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## Electricity savings areas



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## Some cases – range of wineries



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## Compressed air system

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- Enclose and duct intake air from the cool room



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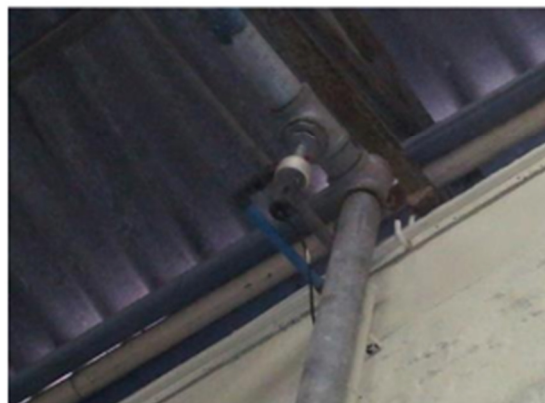


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## Compressed air system

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- Air leaks



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## Compressed air system

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- Clogged inlet air filters



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## Compressed air system

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- Reduce the output pressure of the compressor



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## Chilled water system

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- Set the chilled water at process required temperature



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## Chilled water system

- Valve throttling – Consider Variable Speed Drives



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Network can fundraise or Technology in the Marketplace



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## Water heating

- Consider using heat pumps for smaller geysers
- 70% to 60% efficiency improvement



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## Open doors and ventilation

- Open door ways would lead to additional load



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## Metering

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- Sub Metering – on line monitoring services
- Tariff structure
- Penalties



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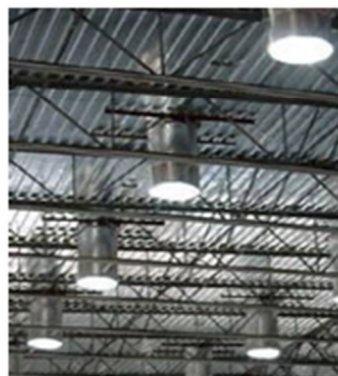
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## Lighting

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- Replace high bay lights with – T5 Fluorescent lights



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## Assessment summary

| Description of Opportunity    | Estimated Savings                           | kWh Saved | Investment       | Potential payback |
|-------------------------------|---------------------------------------------|-----------|------------------|-------------------|
| <b>Compressed Air System</b>  |                                             |           |                  |                   |
| Reduce Intake Temperature     | R 4 365                                     | 4 500     | Low              | Immediate         |
| Repair Leaks                  | R 9 700                                     | 10 000    | Maintenance      | Immediate         |
| Clean inlet filters           | R 3 880                                     | 4 000     | Maintenance      | Immediate         |
| Reduce Pressure               | R 3 880                                     | 4 000     | Settings         | Immediate         |
| Install Blower Fans           | R 72 750                                    | 75 000    | TBA              | Immediate         |
| <b>Chilled Water System</b>   |                                             |           |                  |                   |
| Reduce Storage Capacity       | R 130 950                                   | 135 000   | To be determined | N/A               |
| Increase Temperature          | R 139 680                                   | 144 000   | Settings         | Immediate         |
| Control with VSD              | N/A                                         | N/A       | N/A              | Immediate         |
| Control cooling tower fans    | R 97 000                                    | 100 000   | R 150 000        | 1 year            |
| <b>Other Opportunities</b>    |                                             |           |                  |                   |
| Determine actual requirements | Discussions with winemaster and maintenance |           |                  |                   |



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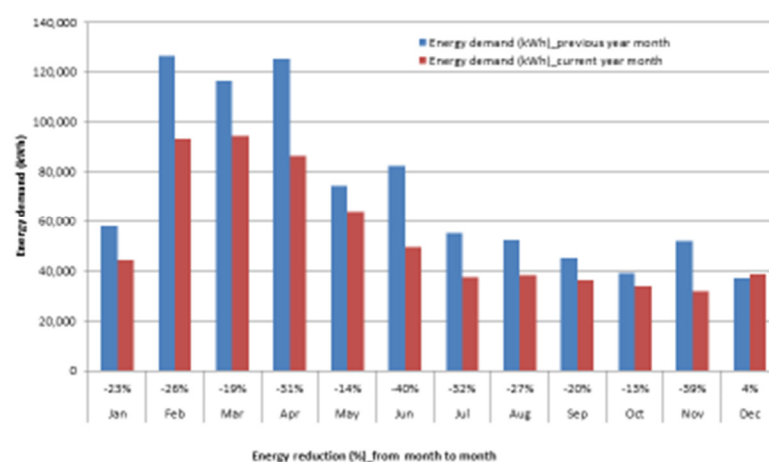
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## Energy efficiency



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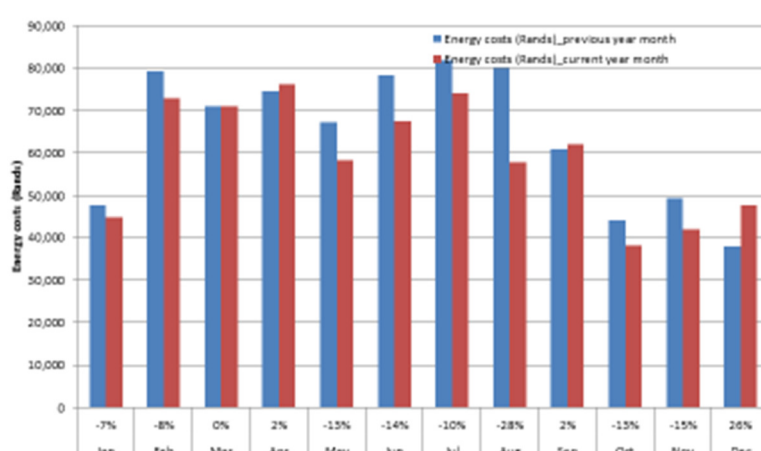
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## Energy costs



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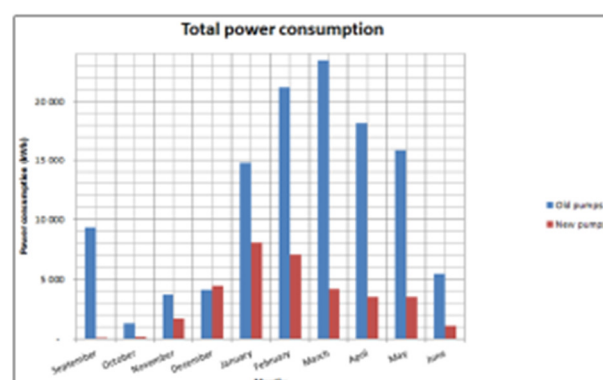


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## Outside the winery – Morgenster

- Requiring less than 1 kWh to irrigate 1 hectare-meter on the farm
- An overall reduction of 72.45% in irrigation costs
- An overall reduction of 71.27% in power consumption



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## Summary of main EE opportunities

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- Tariffs - Changing to TOU, increase/decrease Notified Maximum Demand)
- Management – Exploit TOU, staff behaviour
- Automated controls – VSD's, Timers etc.
- Insulation
- Rationalising requirements – eg. Set points on cooling
- Matching output with requirement (when and how much) – wineries are designed for harvest requirement
- Systems optimisation – look at the system not only the components
- Maintenance – especially leaks



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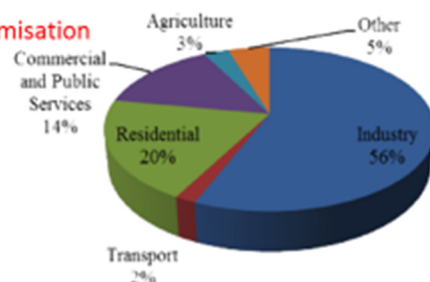
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## Alternative energy options

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- Energy efficiency
  - Process optimisation
  - New technologies
- Renewable energy
  - New technologies
  - Hand-in-hand with process optimisation
    - Thus process integration



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## Three steps with process integration

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- Component – consider individual components.
  - Options are identified to achieve the same desired effect
- System – consider interaction between components
  - Energy distribution is modified/optimized
- Supply – generation technologies
  - Options and how to integrate



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## An example: Conventional crate washing

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- Component – consider individual components

| current                  | possibilities                                  |
|--------------------------|------------------------------------------------|
| washed with heated water | Alter dye on crate then cold water can be used |

- System – consider interaction between components

| current                  | possibilities             |
|--------------------------|---------------------------|
| heated effluent to drain | heat recovery of effluent |

- Supply – generation technologies

| current     | possibilities                        |
|-------------|--------------------------------------|
| coal boiler | solar water heaters, heat pumps, etc |



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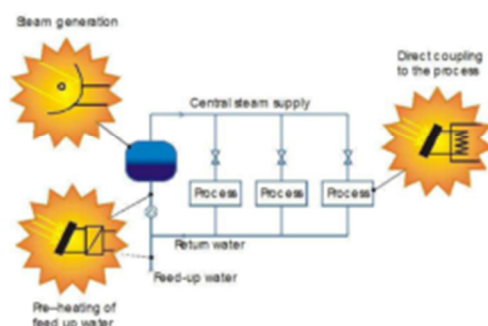
## An example: Addressing steam generation

- Let's assume SWH. How to integrate?

- Pre-heating of FW
- Actual steam generation
- Direct coupling

- Things to consider

- Current situation
- Operating temperatures
- Back-up



- Oversized system if steps 1&2 not employed first



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## An example: Addressing steam generation

|                                       | Solar thermal | as is       | Coal                                    |                                          |
|---------------------------------------|---------------|-------------|-----------------------------------------|------------------------------------------|
|                                       |               |             | carbon tax @<br>R75/ton CO <sub>2</sub> | carbon tax @<br>R200/ton CO <sub>2</sub> |
| Initial capital cost                  | R 488 000     |             | not considered                          |                                          |
| Total cash cost over lifespan         | R 673 000     | R 2 180 000 | R 2 380 000                             | R 2 720 000                              |
| Annual thermal energy saved – process | 260 MWh       | –           | –                                       | –                                        |
| Annual thermal energy saved – boiler  | 361 MWh       | –           | –                                       | –                                        |
| Savings incurred                      | –             | R 1 510 000 | R 1 710 000                             | R 2 010 000                              |
| Project IRR                           | –             | 14%         | 15%                                     | 18%                                      |
| Project NPV                           | –             | R 150 000   | R 215 000                               | R 324 000                                |
| LEC                                   | R 0.12/kWh    | R 0.37/kWh  | R 0.40/kWh                              | R 0.46/kWh                               |
| Payback                               | –             | 8           | 7                                       | 6                                        |



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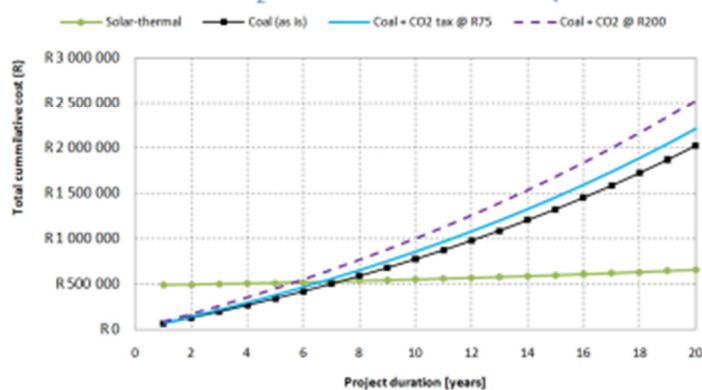


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## An example: Addressing steam generation

- 45 tonnes of coal can be avoided annually
- 2 100 tonnes of CO<sub>2</sub> omitted over the lifespan



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## Biomass option - Backsberg



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## Direct electricity from PV

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- PV is low risk technology
- Not new to RSA wine farms
- Results in real savings
  - Typically 6 to 8 year pay-back
- Increases access to overseas markets



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## Feasibility study

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- Done prior to large capital commitment
- Used as an evaluation tool to determine financial feasibility
- Consists of :
  1. Site selection
  2. Solar resource estimation
  3. Technology selection
  4. Initial design and layout
  5. Yield report
  6. Financial modelling



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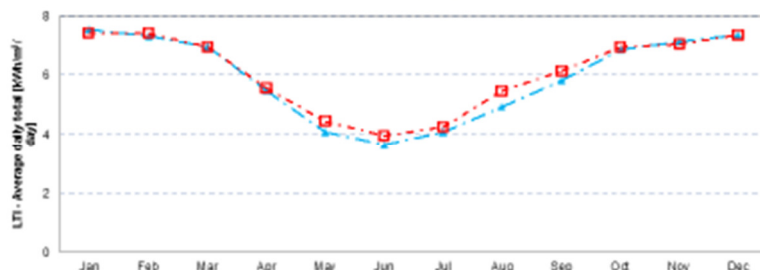


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## The solar resource is good

- Current solar irradiance annual graph



- Average - 4.76 kW/m<sup>2</sup>



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## The solar resource is good

- Capital cost (CC) estimated at R 33/W – for 15 kWp
- Inverter cost estimated as 10% of CC
- O&M cost estimated as 0.38% of CC
- Project life of 20 years
- Eskom price increase of around 8%
- Average cost of electricity (at time of analysis)
  - Site 1 = R 0.80/kWh
  - Site 2 = R 0.86/kWh

Site 1 tariff rate usage



Site 2 rate usage



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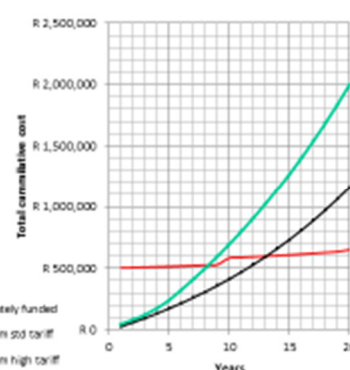
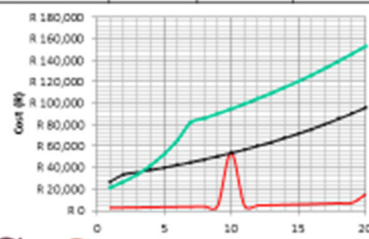


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## Outcomes – Site 2

|                                       | Eskom std | Eskom high | Privately |
|---------------------------------------|-----------|------------|-----------|
| Total cash cost over 20 years         | R1.3m     | R 2.1m     | R 640k    |
| Saving incurred against utility power | R 500k    | R 1.6m     | -         |
| Project IRR                           | 7%        | 12%        | -         |
| Project NPV                           | R -300k   | R -280k    | -         |
| LEC (R/kWh)                           | R 2.34    | R 3.77     | R 1.24    |



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## RE conclusion

- Generates 25000 kWh per year  
– 1.6% of current usage
- Annual savings from R 26k to R 200k
- Project cost of R 500k
- Project IRR of 7% to 12%
- Payback period around 8 to 9 years

Overcome the fear of the pre-paid notion



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## Overall conclusion

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- Good opportunities exist
  - Reduce consumption first
  - Measure
- Longer pay backs
  - But we expect grid-parity within 2 years



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## Efficient Energy Management in Wineries

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acb@sun.ac.za  
<http://www.crses.sun.ac.za>



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