

A decorative graphic on the left side of the slide consists of four overlapping circular frames. The top frame shows a smiling woman on a mobile phone. The second frame shows industrial cooling towers. The third frame shows two workers in blue overalls and hard hats handling a large metal ring. The bottom frame shows a red industrial structure with a large red crane hook against a blue sky with power lines in the background.

## Energy Efficiency Indicators and Target Setting in South Africa Workshop

### Establishing Energy Performance Indicators & Reporting thereon

27 & 28 January 2015

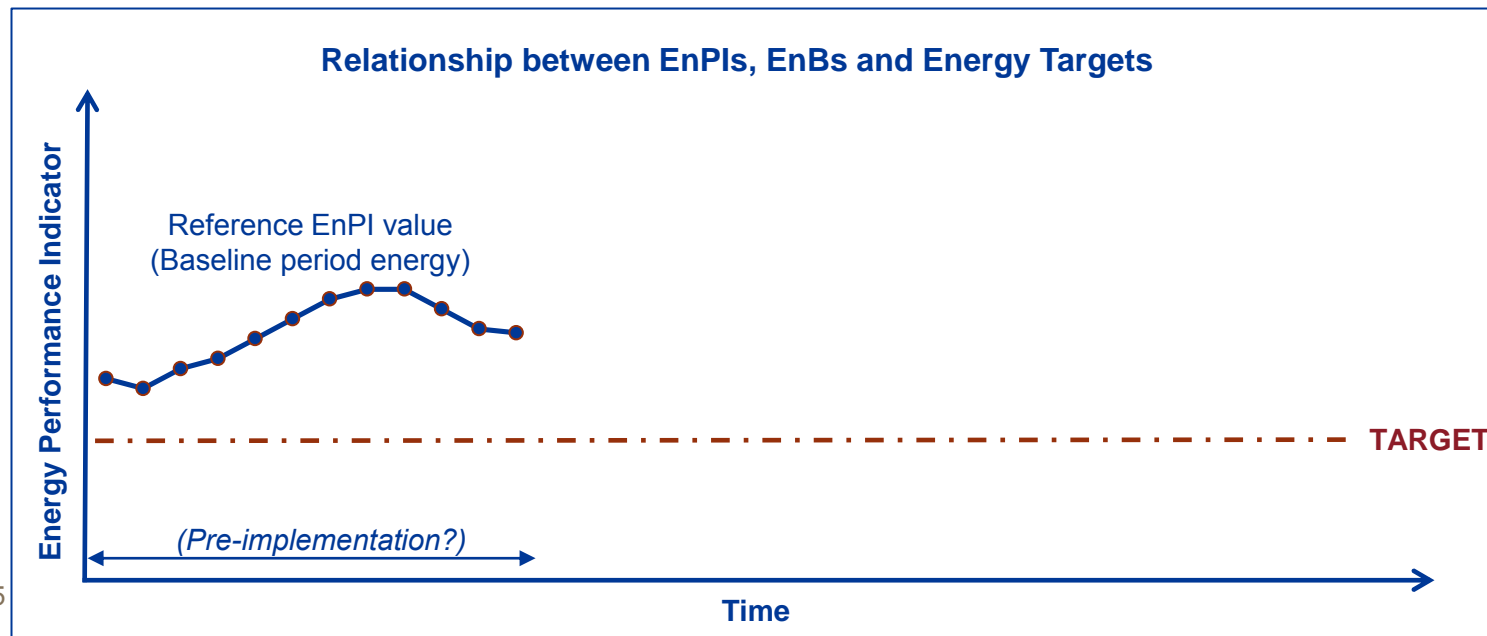
Karel Steyn  
Consultant: Energy Performance Verification

- Energy Performance Indicators (EnPIs) are used **to quantify the energy performance** of the whole organization or its various parts.
- Energy Baselines (EnBs) are **quantitative references** used to compare EnPI values over time and to quantify changes in energy performance.

[Source: ISO 50001:2011]

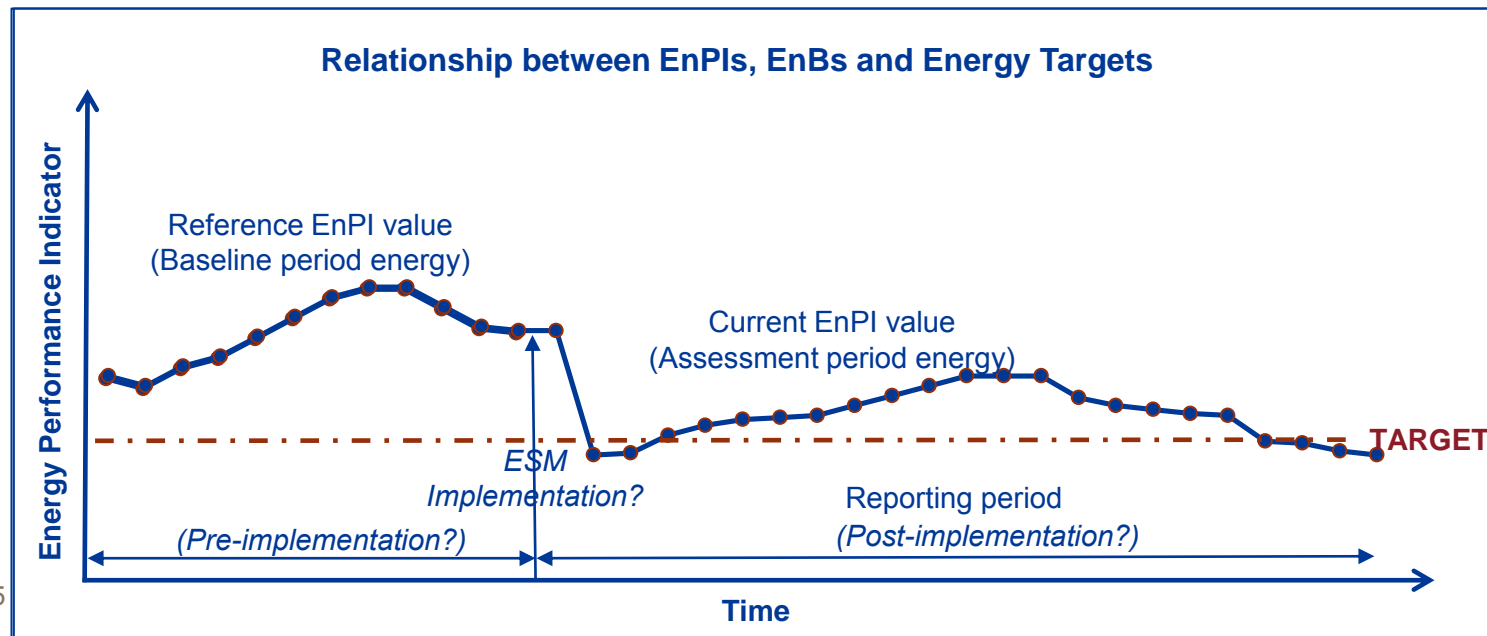
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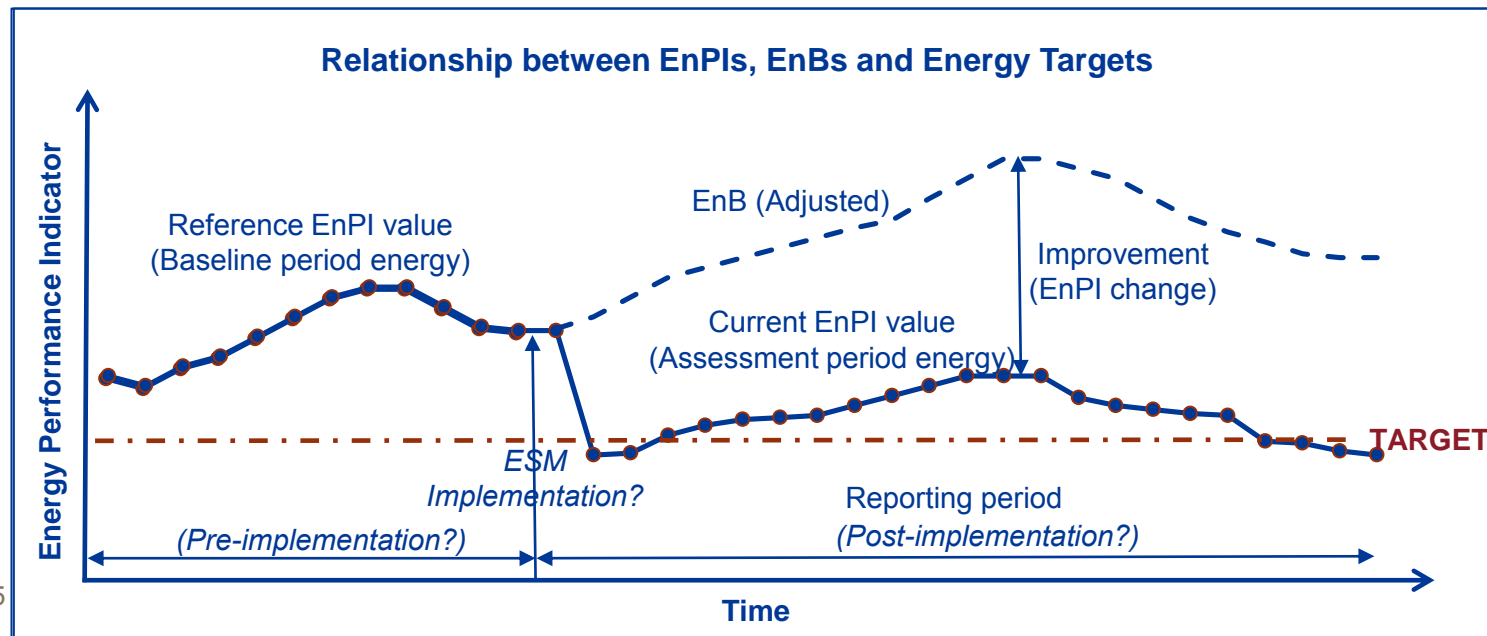
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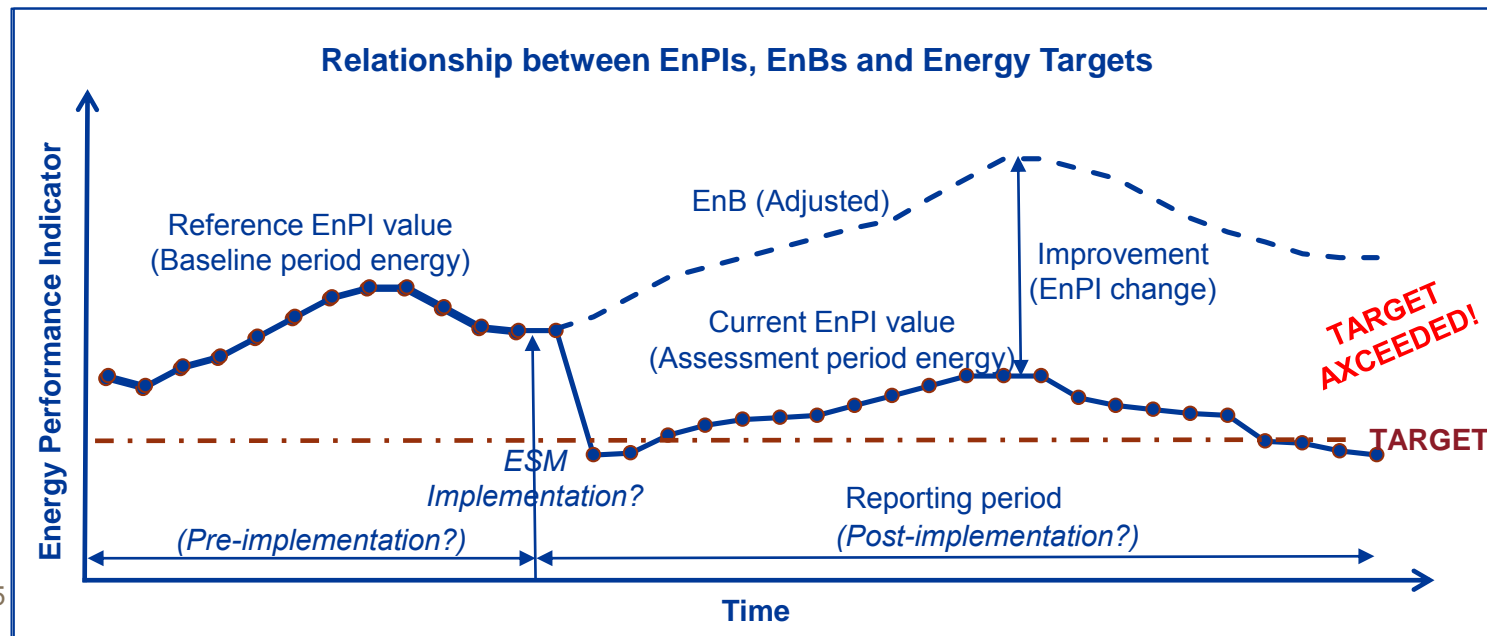
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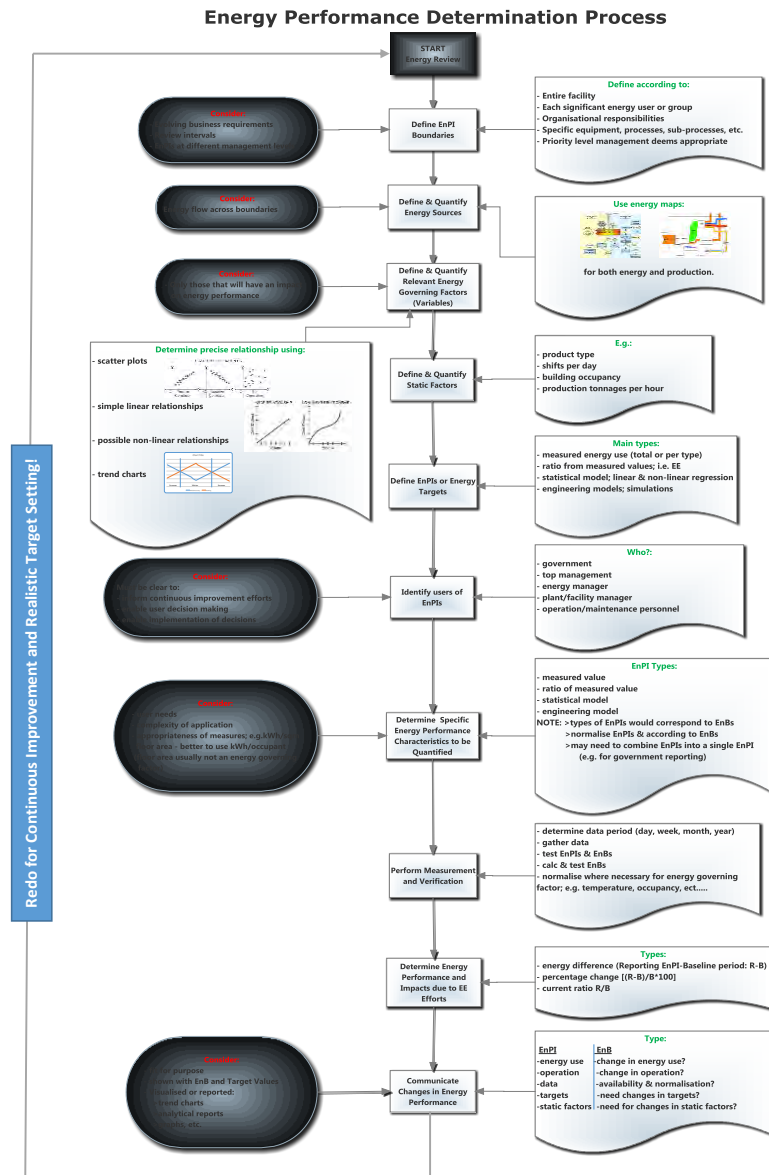


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# Establishing EnPIs, EnBs & Energy Targets



- **Energy Target Setting and Energy Performance Reporting should consider Energy Governing Factors** (energy variables). Not doing so could result in:
  - Over or under reporting of performance
  - Therefore resulting in inaccurate reflection of performance, and,
  - Inaccurate changes in energy performance (usage, savings, etc.)
- **Energy Performance** should therefore be **normalised for Energy Governing Factors**
- Important: Methodology & Updating of the EnPIs to be **recorded and reviewed regularly**
- Presentation aligned to ISO / DIS 5006(Energy Performance measurement & reporting for ISO 50001). *More detail available from the future finalised document?* [TC 257]



**Thank You**

- **Measurable results** related to the ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy; **or**, Measurable results related to the manner or kind of application of energy; **or**, Measurable results related to a quantity of energy applied."

[Source: ISO 50001:2011]

# Energy Efficiency Reporting - Lessons Learned

Karel Steyn



1. Why do GOOD energy reporting?
2. When using Microsoft Excel
3. Energy reporting lessons:
  - a) Not considering the reader
  - b) No clarity on definitions
  - c) No clarity on terminology, measurements or units
  - d) Not time stamping of targets, impacts or data
  - e) Assumptions VS stipulations
  - f) Using only nameplate/supplier rating information
  - g) Comparisons without considering energy governing factors
  - h) Failing to account for facility changes or pre & post conditions
  - i) Choosing wrong efficiency metric(s)
  - j) Inappropriate methodology or protocol used
  - k) Wrong formulas or calculations
  - l) Not using or adhering to the correct SI metrics
  - m) No consideration or indication of reporting accuracy
4. Conclusion

# 1. Why do GOOD Energy Reporting?

- ✓ Key business **insights** to Decision Makers
- ✓ **Educate** facility users about their energy impacts
- ✓ Establish trends, identify, quantify, assess & track the **performance** of EEDSM project impacts against preset targets
- ✓ Makes **Tracking and Evaluation** (T&E) of project performances and progress possible
- ✓ Enable Analysis of results and to take **corrective action** where necessary (e.g. limits the risk of lost savings due to early identification of operational or maintenance problems)
- ✓ **Avoiding disputes**
- ✓ Help with **proper and full implementation** of projects
- ✓ Identify **focus areas** for EEDSM activities
- ✓ **Improve** design, operation and maintenance
- ✓ Identify strengths and weaknesses in the energy **performance of products**
- ✓ Improves the **performance of projects**, thus improving the **return on investment** (ROI)
- ✓ Creates accurate/realistic baselines with savings **projections** while predicting **future requirements**
- ✓ Generates performance data which can be used in developing **additional projects** at the same location, or at similar locations
- ✓ Identify **new projects** to further reduce energy & costs
- ✓ **Encourage investments** in projects

## 2. When using MS Excel

### Be careful:

Excel has not been developed as a **modeling tool** and cannot easily perform the standards-based energy analysis that's required for accurate energy reporting.



### *For example:*

*Simply comparing facilities in different regions requires **linear regression models** for each facility that need monthly updates considering regional weather to be able to have an apples-to-apples comparison amongst facilities. It can be done with Excel, but it's **onerous, often takes a lot of time and is usually prone to data entry or calculations errors.***

Excel is useful for spread-sheet applications, data collection, basic analysis and creating simple charts. It is also useful as a supplementary tool for batch data entry to other energy management software, or for moving data from one system to another, the occasional ad-hoc analysis and reporting, but **should not be relied on for regular statistical analysis and on-going reporting.**

# a) Not Considering the Reader

Readers and, often decision makers, are not always technically oriented or knowledgeable on energy engineering:

Therefore:

- Write the report in such a way that a Grade 8 learner would easily understand it
- Keep it simple (KISS)
- Supply only the pertinent information relevant to the possible readers - nothing less, nothing more!
- Supply real life and simple examples to illustrate where appropriate
- Supply simple pictures, drawings or diagrams where necessary
- Steer clear of energy jargon, abbreviations, or difficult concepts
- If possible, try to present the report and address any questions before formally issuing it

3. Energy reporting lessons:



# b) No Clarity on Definitions

## Energy Efficiency (All Energies)

Energy Conservation

Def: Lessening the Consumption of Energy without impacting on Production and/or Safety

Energy Efficiency

Def: Positive Impact considering  $\eta = \text{Input} / \text{Output}$

Energy Substitution

Renewables

Def: Adding "Green" generation capacity on the demand side of utility supply

Other, e.g. Fuel Switching

Def: Switching energy consumption to more freely available and/or efficient energy source

Re-Generation / Own-Generation

Def: Generating energy from waste/renewables, which is fed into the demand side of the utility supply to lessen the use of the utility supply

Load Shifting? Peak Clipping? Demand? Consumption? Time of Use? AFUE (Annual Fuel Utilization Efficiency)? Balanced Schedule? Base Load? Bi-Fuel? Fuel Switching? Capacity? Cap & Trade? Capacity Factor? Power Factor? COP (Coefficient of Performance), Demand Side? Supply Side? Degree day? etc.

3. Energy reporting lessons:

# c) No Clarity on Terminology, Measurement or Units

## 3. Energy reporting lessons:

The Energy Industry has many terms and measurements, often where multiple terms mean almost the same thing, e.g. consumption, demand, reactive power, commodity fuel prices, etc. with little consistency between various consultants, ESCOs, PDs, etc.

Examples:

- Is gas measured in cubic meters, GJ, BTU, Btu, Therm or KWh equivalents?
- Which is correct for energy; kWh, Wh, MJ, Joule?

It's easy to be confused especially when unit conversions are required. Decide and set the unit preferences upfront in order to ensure all the readers easily understand.

The reporting system must be able to accept data entry values as they appear in the source – which may mean it needs to align to the units in the utility bills.

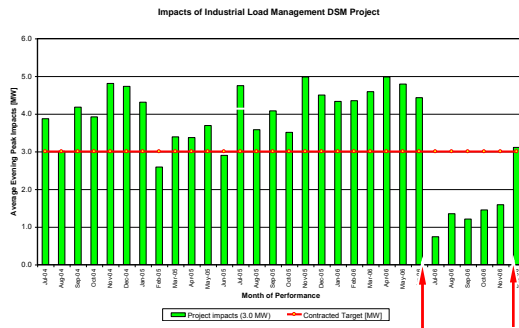
It may be confusing but needs to be understood correctly!

# d) No Time Stamping of Targets, Impacts or Data

A statement like “1 200 PJ have been saved” brings about many questions and does not help in understanding a report. Not **referencing reporting to time periods** is a serious problem and raises many issues and questions. **Advisable to:**

3. Energy reporting lessons:

- Always align reporting with **calendar months** which will then line up with financial reporting and makes consolidation with multiple projects possible
- Report all measures for the **shortest possible intervals/periods**



Consumption (MWh)

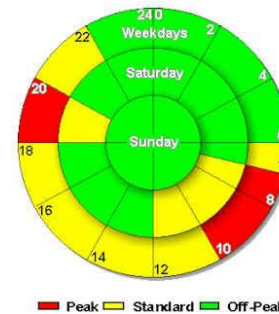
	Weekday						
	Morning Off-peak	Morning Standard	Morning Peak	Midday Standard	Evening Peak	Evening Standard	Evening Off-peak
Baseline	7123.311	966.349	2433.998	7696.614	1860.509	1992.971	2316.031
Actual	6091.334	995.201	1924.235	10090.246	1041.600	2117.513	2129.654
Impact	1031.977	-28.853	509.763	-2393.632	818.909	-124.542	186.378

	Saturday					Sunday
	Morning Off-Peak	Morning Standard	Midday Off-peak	Evening Standard	Evening Off-peak	Sunday Off-peak
Baseline	1813.303	952.180	1460.287	451.862	960.632	3541.081
Actual	1671.804	990.885	1764.571	208.135	1002.868	3541.081
Impact	141.499	-38.706	-304.284	243.727	-42.236	0.000

Demand (MW)

	Weekday						
	Morning Off-peak	Morning Standard	Morning Peak	Midday Standard	Evening Peak	Evening Standard	Evening Off-peak
Baseline	6.984	5.684	4.773	5.659	5.472	5.862	6.812
Actual	5.972	5.854	3.773	7.419	3.064	6.228	6.264
Impact	1.012	-0.170	1.000	-1.760	2.409	-0.366	0.548

	Saturday					Sunday
	Morning Off-Peak	Morning Standard	Midday Off-peak	Evening Standard	Evening Off-peak	Sunday Off-peak
Baseline	6.168	4.534	5.795	5.379	5.718	3.689
Actual	5.686	4.719	7.002	2.478	5.969	3.689
Impact	0.481	-0.184	-1.207	2.902	-0.251	0.000



F.Y.I.  
Some software can do calendar alignment automatically when data gets loaded

# e) Using Assumptions and not Stipulations

An **assumption** is usually not tested, also referred to as “thumb-suck”! A **stipulation** is based on some fact but not measured, e.g. an assumption that the lights get switched off manually VS a timer switching lights off at certain times.

3. Energy reporting lessons:



*School: Lights originally never used, never confirmed & now used all the time!*

*Mine: 80% of Light fittings already replaced, only one level checked and presumed to represent total shaft!*

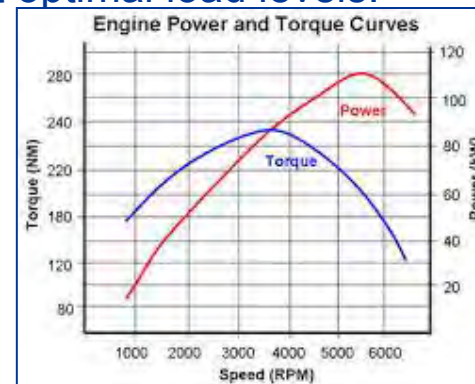


# f) Using Only Nameplate/Supplier rating Information

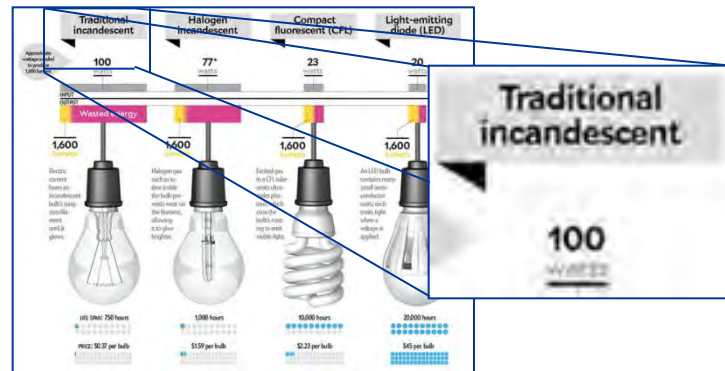
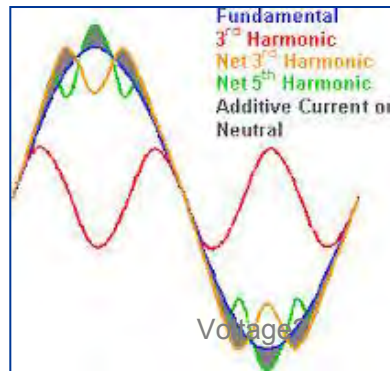
3. Energy reporting lessons:

Nameplate or manufacturer rating information stipulates the ratings, or energy use, under ideal energy supply and equipment load conditions.

- Equipment would typically not operate at optimal load levels:



- The quality of the supplied energy is almost never ideal and vary substantially depending on the type of energy and the transmission/transport thereof



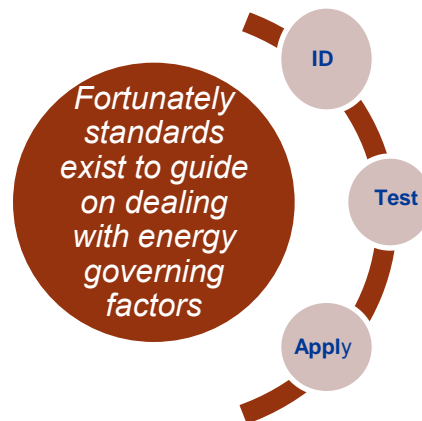
Actual measurements is more realistic!

# g) Comparisons without Considering Energy Governing Factors (variables)

Energy use and efficiency impacts goes up and down often due to energy governing factors outside of our control, the most common being the weather.

## 3. Energy reporting lessons:

- Make provision for all important independent energy governing factors
- Do not oversimplify or be tempted; e.g. using the same heating and cooling balance point temperatures for all meters/facilities in different geographical areas. Always normalise (adjust) for weather...
- Not only weather but many other energy governing factors exist, e.g. cold storage warehouse exposed to the number of times doors are opened and how long they stay open, the weight and average temperatures of product brought in, the time it stays within the warehouse, etc.
- Energy governing factors always influence energy consumption and therefore need to be tracked and considered in proposals, assessments and baseline adjustments.



*Some software could automatically download identified energy governing factors and compute each facility's normalised baseline !*

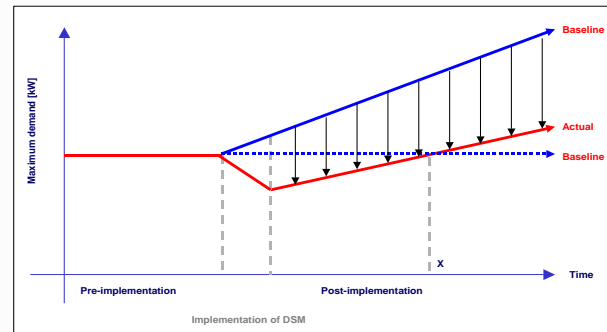
# h) Failing to Account for Facility Changes or Pre & Post Conditions

## 3. Energy reporting lessons:

An exceptional physical or operational change will result in substantial change in energy use. Not an independent energy governing factor but a permanent reconfiguration related to the facility or the way a process is used.

Examples:

- A wing of a building is taken out of service – will bring about a decrease in energy use
- Production shifts are changed from two to three – will bring about an increase in energy use



Baselines adjustments required for these conditions, both during the initial baseline period and also during the measurement periods after the energy efficiency project has been implemented.

Note that baseline adjustments may however in itself be affected by independent energy governing factors (like weather).

Metrics must be defined, understandable, simple, but accurate

Examples:

- Measurement and Verification – report on energy or demand savings within a defined period, e.g. month, YTD, ITD.
- Energy Intensity – includes both production and project efficiencies
  - Difficult and therefore careful consideration of the correct denominator to use, e.g. kWh/ton, kWh/m<sup>2</sup>, kWh/°C, MW/ton, MW/ m<sup>2</sup>, etc.
  - Consider funding sources and comparison measures, e.g. for:
    - Schools & universities it may be more appropriate to use kWh/student?
    - Data Centers floor areas has a limited impact since computing is continually fitted into smaller and smaller floor spaces, the productivity (# transactions against energy used) of the data center might be a more appropriate measure to use?

Note the interaction (interactive effects) between the Energy Intensity measure and the independent energy governing factors, e.g. data center cooling energy will increase in summer due to a higher ambient temperature on cooling plant efficiency. Overly simple use of energy intensity will make that facility look less efficient at times (summer). Normal M&V is often more appropriate as it provides for baseline adjustments and more accurate reporting of savings.

The protocol and methodology used to arrive at the savings or consumption impacts is a most important consideration. To get to a correct methodology the following should be carefully considered:

## 3. Energy reporting lessons:

- The project boundaries
- The interactive effects
- The independent energy governing factors
- Available or required data
- Project size (high risk - more to be spend on reporting)
- Reason(s) for reporting, e.g. Climate Change (CDM), Performance Contracting, Management of energy use, Level of decision making? etc.
- Funds available for reporting?
- Complexity of processes or measures involved
- etc.

*SABS Guideline to establish suitable protocols & methodologies to be published soon!*

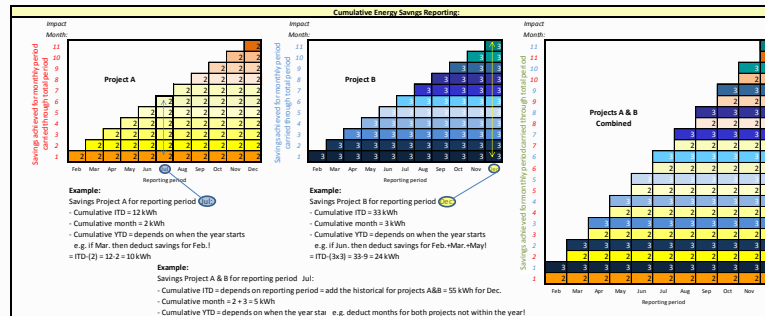
# k) Wrong Formulas & Calculations

Reported figures must be based on scientifically/mathematically correct formulas and calculations. Non-specialists often gets this wrong:

Example:

- Cumulative energy saved would be the sum for applicable period (remember time stamped data):

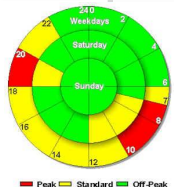
$$\text{Cumulative Energy Consumption} = \int \text{Half-hourly energy consumption} \text{ over Integration Period}$$



- Demands cannot be added together:  
 Average real power (demand) is not the average of the different demands registered by a specific meter – mathematically incorrect to average averages!  
 Rather use the formula:

$$P = \frac{\text{Cumulative energy for the averaging period} \left[ \frac{\text{MWh}}{\text{h}} \right]}{\text{Cumulative duration of the averaging period} \left[ \frac{\text{h}}{\text{h}} \right]}$$

**NB: Careful when using YTD demand!!**



Many other examples of wrong formulas being used exist ...

3. Energy reporting lessons:

# I) Not Using or Adhering to the correct SI Metrics

## 3. Energy reporting lessons:

Not adhering to the correct SI metric can be come extremely confusing. Different functions and different countries have different ways in dealing with SI metrics.

Examples:

What is the difference between the following figures:

1.100 kWh; 1,100 kWh and 1 100 kWh (... the same?)

Accountants usually use the R1,100 format, while MS Excel can be set to the preferred (but is often not done), which further complicates matters.

The correct approach for South Africa would be:

- A space for thousand separator, e.g. 1 100 (One Thousand and One Hundred) kWh
- A point to split for decimals, e.g. 1 100.33 (One Thousand, One Hundred, point thirty three) kWh or 1 100 330 Wh

# m) No Consideration or Indication of Reporting Accuracy (Uncertainty)

## 3. Energy reporting lessons:

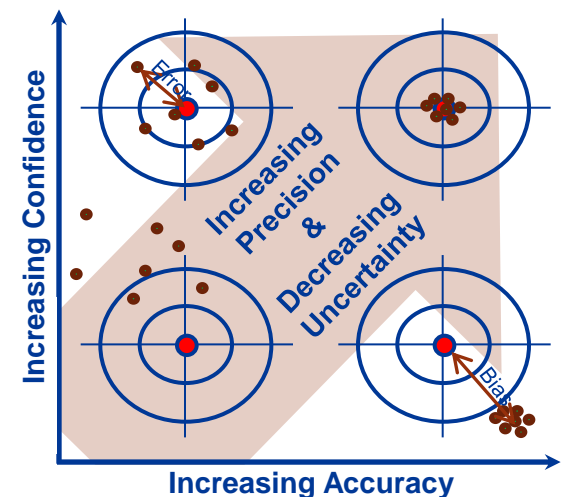
Most can accept this fact, however; “**How inaccurate is the report?**” then becomes the obvious question? The simplest way in dealing with this is to report its **precision** (metering?) and **confidence or trueness** (sample?) **levels**, e.g. 1 100kWh, with  $\pm 4\%$  precision and 86% confidence level. This topic is the field of study for statisticians, but not difficult to use.

**Energy meters are prone to inaccuracies** and are usually classified according to the inaccuracies. It is therefore a fact that no meter is always a 100% accurate.

Notwithstanding the mentioned, the **methodology used** usually also does not make it **viable or possible to measure all energy governing factors**, especially on facility level or a complete process. The largest energy governing factor, energy consumers and the point of largest impacts expected are therefore usually measured with other measures stipulated (or *often assumed?*). Therefore often only **a samples** of all the possible measures are used.

All these, and other issues brings about that energy reporting is **never a 100% accurate** but the savings can still be guaranteed if the following is considered:

SANS 50010 stipulates that savings shall not be overstated!



## 4. Conclusion

- Energy reporting does not have to be complicated or unnecessarily elaborate but needs to be correct, relevant and understood
- The value of good energy reporting should not be underestimated
- Use the correct software, tools, definitions, mathematical/scientific, etc. approaches
- Reporting should serve a purpose – establish the purpose and ensure that the reporting is aligned and always credible
- Stick/adhere to standards and universally acceptable norms
- Only some reporting mistakes were covered, many others and energy governing factors of the mentioned exist



**Thank You**