The Planning and Control Process: Energy Efficiency: A Study Note[1]

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Introduction

This study note has been prepared to assist students in higher education to learn a generic model of how to approach the planning and control cycle for projects, and to apply this generic model to energy efficiency (EE) projects. The study note is designed to complement existing course material in a variety of subjects.

Section one presents a high level overview, with a focus on presenting the context for energy efficiency projects, and describing the steps for generic planning and control cycle. We also consider how the process of planning and controlling EE projects involves collaboration between people from different disciplines and areas of the organisation. Section Two presents a more technical discussion of each of the steps.

Section One: Planning & Control Process for Energy Efficiency Projects

What is an energy efficiency project, and why implement one?

What is energy?

Before considering how energy efficiency projects can be planned and controlled, a rudimentary understanding of what energy and energy efficiency are is necessary. Energy

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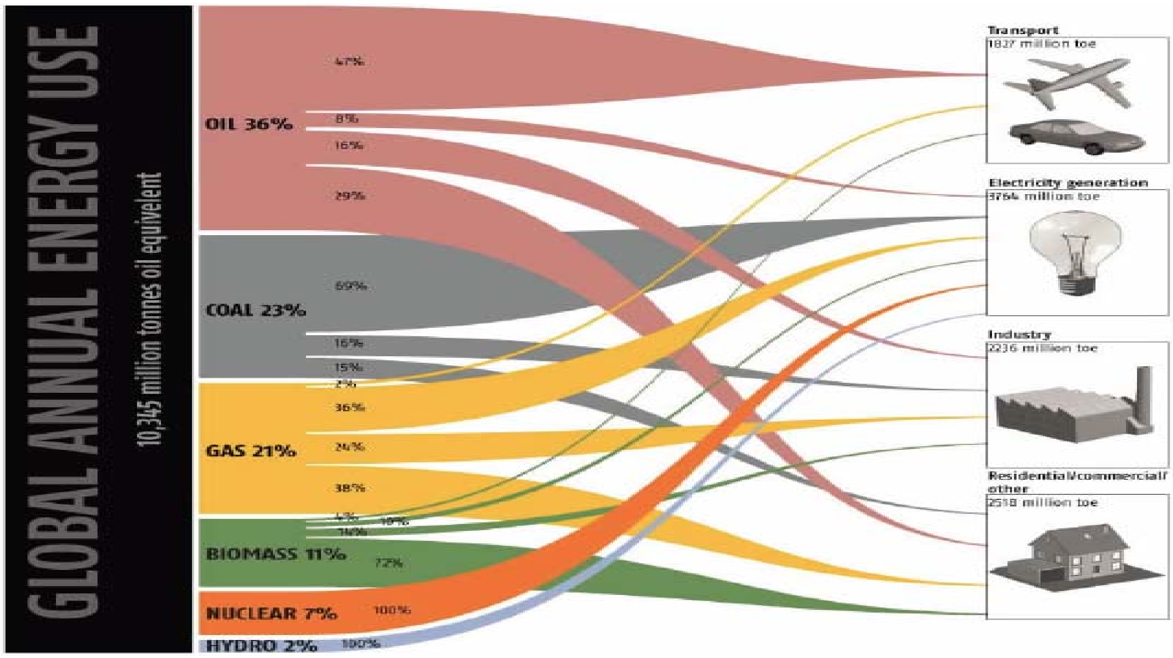
lights our cities, powers our vehicles, and runs machinery in factories. It warms and cools our homes, cooks our food, plays our music, and gives us pictures on television.

Energy is defined as the ability or the capacity to do work, and makes all movements possible. Work includes moving or lifting something and can also include warming or lighting something. There are many sources of energy at our disposal to support our lifestyles and existing economic structures. To some extent the conversion of wood and other fuels into heat and light was instrumental in the development of early societies, through things such as cooking food, melting copper to make implements, and extending the number of usable hours into evening. For several thousand years human energy demands were met by largely renewable energy sources such as sun, biomass (wood, leaves, twigs), hydro (water) and wind power, and to some extent were sustainable.

With the advent of the Industrial Revolution and associated economic structures, the use of energy in the form of fossil fuels grew as more and more industries were set up. This occurred in stages, from the exploitation of coal deposits to oil and natural gas fields. This allowed for rapid productivity growth for the betterment of society at large, with more products being produced per labour hour. It has been only half a century since nuclear power began being used as an energy source. Figure 1 below presents a summary of the key global sources and uses of energy.

Figure 1: Global sources and use of energy



Source: New Scientist (2012)

Figure 2 shows the main sources of energy are oil, coal and gas. These sources are used for transport, electricity generation, industry, and residential use. The key mechanism for producing energy is the burning of oil, gas, or coal, which produces heat and light energy, and waste in the form of pollution.

What is the 'energy problem'?

There are a number of reasons which suggest that the management of energy is a problem which needs to be addressed by organisations. Table 1 provides a summary of some of the key energy related problems.

Table 1: Summary of key energy related problems faced by society at large

Air Pollution: Emissions from industry and motor vehicles release smog, ozone, particles, nitrogen oxides and sulphur oxides into our environment. All of these can severely affect human health as well as the health of ecosystems. Reducing air pollution will help us all breathe easier.
Climate Change: Increased amounts of carbon dioxide and other greenhouse gases (GHG) from energy production have been shown to have an influence on the climate (Sherwood, 2010). As a result, the global average temperature has increased by 0.76 degrees Celsius since 1850. The period of 1995-2006 saw 11 out of 12 of the warmest years since humans started recording temperatures back in 1850. As the climate patterns shift, so too does typical weather, rainfall, sea levels, ocean acidification levels, Arctic glaciers, extreme weather events, animal habitats, and species population levels. The effects of climate change are having numerous negative consequences for human communities, especially impoverished people. As a result, many citizens, businesses, governments, and non-profit groups worldwide are calling for and working towards reductions in GHG emissions to halt further change.
Energy Demand outstripping supply: As the global population rises, and more and more people live energy-intensive lifestyles, we need increasing amounts of energy to fuel our lives. The main sources of energy are non-renewable, and therefore demand will eventually outstrip supply, and the sources of energy will be exhausted. This may not seem like much of a problem for some people living today, who have access to large reserves of coal. However, there is evidence that the rate of new conventional oil being discovered is slower than the rate that oil is being consumed.[2] In other words, aside from demand outstripping supply causing oil prices to rise, at some point in the future oil will run out. In part to assess whether this was a conspiracy theory, and what the likely impact on UK economic interests, the UK energy Research Centre produced a report in 2009 to assess the evidence for a near-term peak in global oil production. Based on an extensive review, they estimated that global production of conventional oil is likely to peak between 2009 and 2031, with a significant risk of a peak before 2020 (Sorell, Speirs, Bentley, Brandt and Miller, 2009). Some of the key oil fields which hold the majority of the world's reserves have already peaked.[3] As figure 1 illustrates, since oil is a key source of energy, the depletion of oil has implications for how society operates.
Energy Independence: The world's energy-intensive lifestyles strain global energy supplies and power generation capacity. Many societies are vulnerable because they need energy for a thriving economy, yet do not have direct access to energy rich reserves of oil. Geo-political instability in energy-producing countries, competition over energy sources, attacks on infrastructure, and natural disasters all increase this vulnerability. More 'home-grown' and renewable electricity helps to reduce a country's reliance on external energy sources and thus vulnerability.

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[2] Conventional oil is generally regarded as Crude Oil, condensate and natural gas liquids and is relatively straight forward to extract and refine. Non-conventional oil includes heavy oils, oil shale and oil sands which are more demanding to extract and refine, requiring significantly more capital and energy.

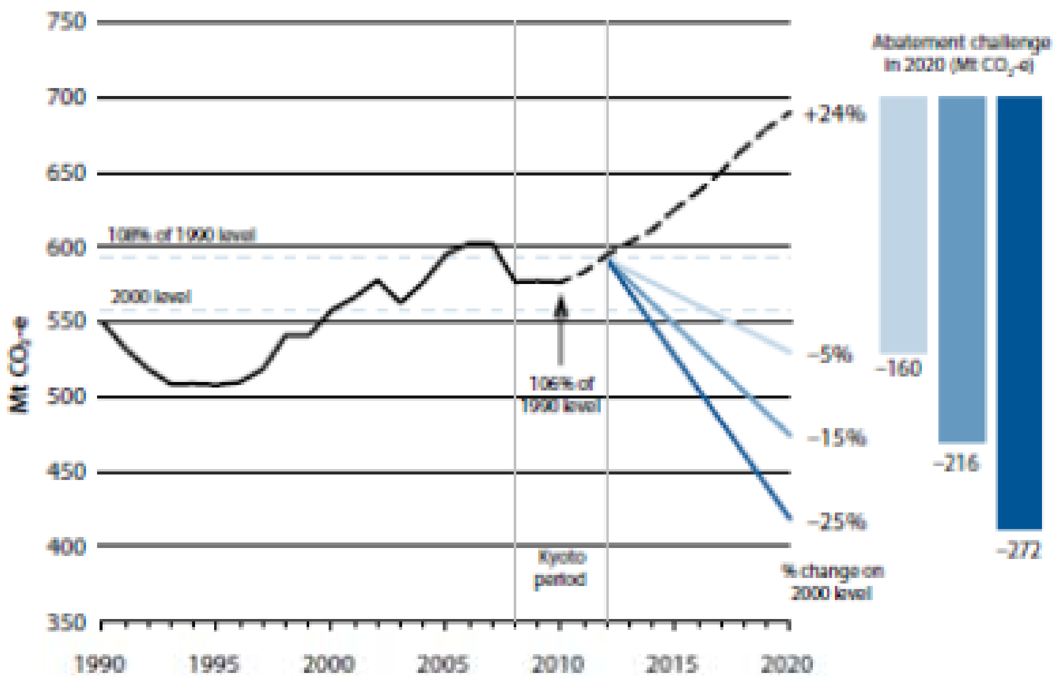
[3] The largest oil field, Ghawar in Saudi Arabia, peaked in 1980 and accounted for about 7% of global oil production in 2007 (IEA, 2008). The second largest oil field, Canterell in Mexico, peaked in 2003 (IEA, 2008).

Source: Part of this table is from Canadian Hydrogen and Fuel Cell Association (2012).

One of the main reasons why the nature of energy production has become a problem for organisations is due to air pollution concerns (Garnaut, 2011). Electricity generated from fossil fuels such as coal and crude oil has led to high concentrations of pollution in the atmosphere which has two main effects. First, there is a direct pollution effect where gas reacts with the atmosphere. An example is acid rain, which is caused by a chemical reaction that happens when the pollution mixes with water in the atmosphere, forming acid, which falls to the earth when it rains. Another example is the dense cloud of pollution which clusters around industrial sites, which may be harmful to people breathing it in.

In addition, the pollution released into the atmosphere affects the way the climate operates, and has led to problems such as climate change (which includes global warming). Global warming has become unmistakably important with widespread melting of ice, noticeable climate changes, and rising sea levels. This is now recognised as caused by greenhouse gases, mainly carbon dioxide, produced by burning fossil fuels such as petroleum, coal, and natural gas (Garnaut, 2011). Largely due to the recognised need to take steps to reduce the impact of our way of life on the environment, many societies have been implementing strategies to reduce air pollution. Table 2 presents a few of these, and data on the type of goals they are setting.

Figure 2: Carbon emission trends 1990 to 2020



Note: Mt CO_2-e is megatonnes of carbon dioxide equivalent; 'abatement challenge' means the reduction in greenhouse gas emissions required to reach specific targets; and the bars represent the levels of abatement (in Mt CO_2-e) that would be required to reach the three targets for 2020: minus 5 per cent, minus 15 per cent and minus 25 per cent of 2000 levels.

Source: Australian Government 2010, Australia's emissions projections 2010, Department of Climate Change and Energy Efficiency, p. 8. In : Garnaut, (2011, p. 27).

Table 2: Mitigation pledges to 2020 by selected major developed countries under the Cancun Agreements

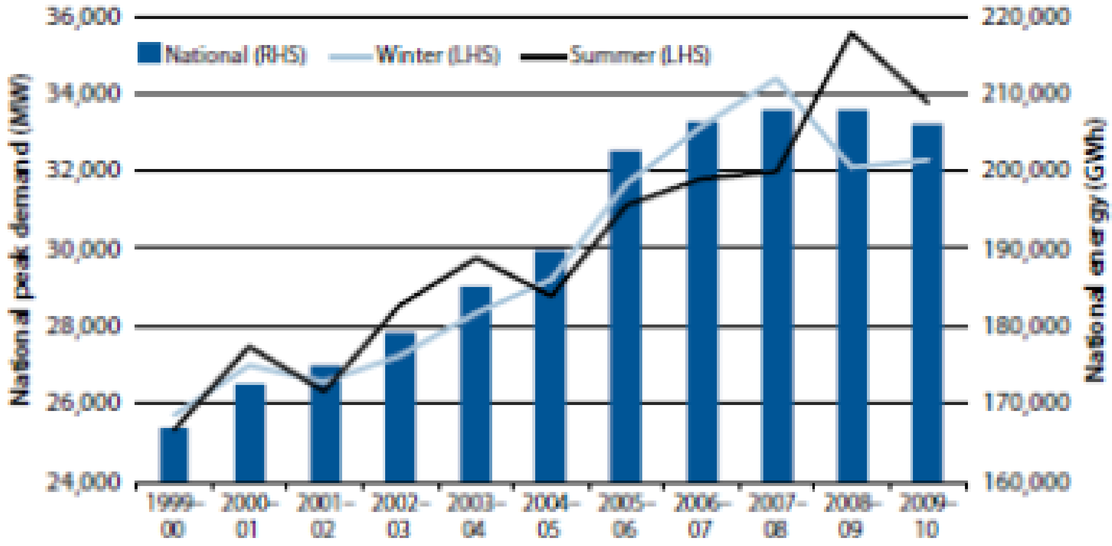
Country or region	Pledge
Australia	• 5% reduction relative to 2000 unconditional • Up to 15% reduction if there is a global agreement that falls short of securing stabilisation of greenhouse gases at 450 ppm carbon dioxide equivalent and under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's • 25% reduction if the world agrees to an ambitious global deal capable of stabilising levels of greenhouse gases in the atmosphere at 450 ppm carbon dioxide equivalent or lower
Canada	17% reduction relative to 2005; to be aligned with the final economy-wide emissions target of the United States in enacted legislation
European Union	20% reduction relative to 1990; 30% reduction as part of a global and comprehensive agreement, provided that: • other developed countries commit themselves to comparable emissions reductions • developing countries contribute adequately according to their responsibilities and respective capabilities
Japan	25% reduction relative to 1990, premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets
New Zealand	10% to 20% reduction relative to 1990, conditional on a comprehensive global agreement to limit the temperature increase to less than 2°C, with effective rules for land use, land-use change and forestry regulation, recourse to a broad and efficient international carbon market, and advanced and major emitting developing countries taking comparable action commensurate with their respective capabilities
Russia	15% to 25% reduction relative to 1990, conditional on appropriate accounting of the potential of Russia's forestry sector, and legally binding obligations by all major emitters
United States	Reduction in the range of 17% relative to 2005, in conformity with anticipated US energy and climate legislation, recognising that the final target will be reported to the UN Framework Convention Secretariat in light of enacted legislation

Source: Garnaut (2011, p. 49).

Table 2 shows that Australia has committed to a 5% reduction of GHG emissions from 2000 levels by 2020. as illustrated by Figure 2. It is worth noting that GHG emissions in Australia are expected to grow by 24% above 2000 levels if organisations take no action to reduce energy use, or generally reduce GHG emissions.

The Australian targets presented in Figure 2 can be compared to the trend in Australian National energy demand. Figure 3 shows that since 1999, the demand for energy in Australia has been increasing significantly. **This begs the question, given that energy production is the main cause of GHG pollution in Australia, and that energy demand has been increasing since 2000, how will it be possible for Australia to meet its target of a 5% reduction in GHG emissions on 2000 levels?**

Figure 3: National energy demand



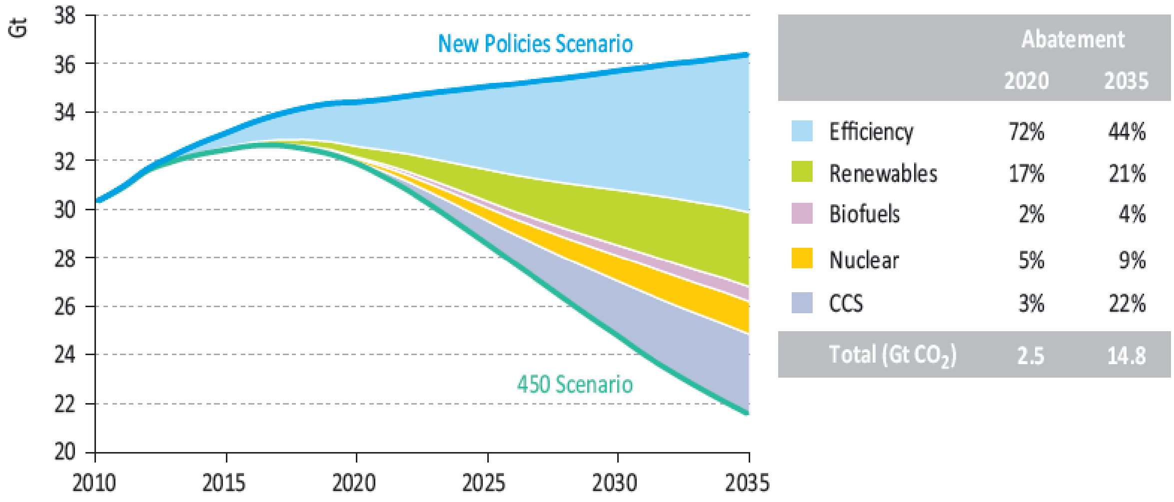
Source: Australian Energy Regulator 2010, State of the Energy Market 2010 and www.aer.gov.au/content/index.phtml/tag/MarketSnapshotLongTermAnalysis. In Garnaut (2011, p. 152).

Energy Efficiency

Energy efficiency has been identified as one of the lowest cost strategies available to reduce GHG emissions. Figure 4 presents a list of five key GHG emission reduction mechanisms, and an assessment of how much they are expected to contribute to the global effort in reducing GHG emissions. The figure identifies energy efficiency as being the lowest cost mechanism to reduce 72% of global emissions abetment up to 2020. Although this is only a forecast of possible policy options, policy makers are acting on the analysis by implementing policy to support energy efficiency in organizations. For example, the carbon tax and other mechanisms in operation in Australia.

Energy efficiency involves delivering equal or greater levels of “energy services” with less energy supply. Improvements in energy efficiency are most often achieved by adopting a more efficient technology or production process. For example, insulating a building allows it to use less heating and cooling energy to achieve and maintain a comfortable temperature. Installing fluorescent lights or natural skylights reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs.

Figure 4: World energy-related GHG emissions abatement in the 450 Scenario relative to the New Policies Scenario

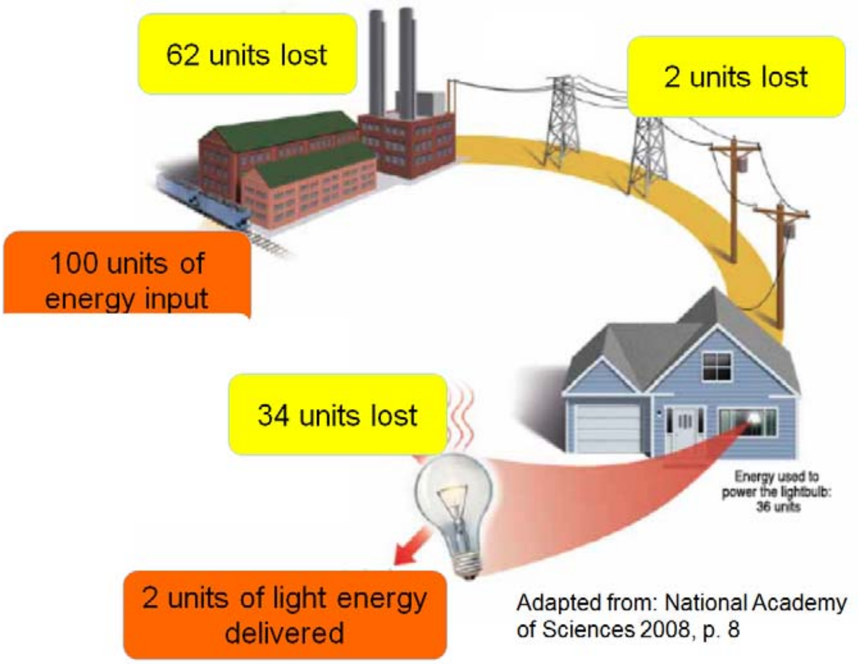


Source: IEA (2011, p. 214).

The primary goal of an energy efficiency program is to reduce the amount of energy used to achieve a certain outcome. This is mainly concerned with the minimisation of *energy waste* that arises from the use of energy in the production process. Figures 5 illustrates two principles in energy efficiency analysis.

Figure 5 illustrates that end use efficiency delivers benefits across the electricity supply chain. In the example, to deliver 2 units of light energy, 100 units of energy input is supplied, with 34 units of energy lost in heat at the light bulb end. Accordingly, if a more efficient light bulb which produces less heat is installed, less input energy is demanded. This reduces the amount of energy along the entire supply chain. Also, a significant amount of energy is lost in the conversion of raw energy inputs into electricity. By generating electricity with less energy waste also makes the supply of electricity more energy efficient.

Figure 5: Estimate of energy lost in supply of lighting



Adapted from: National Academy of Sciences 2008, p. 8

The Business Case for pursuing Energy Efficiency

Before organisations spend money on energy efficiency projects, decision makers will usually have to consider the benefits to the organisation. This is termed the 'Business Case'. There are at least four common reasons given by managers when justifying investing in energy efficiency projects:

1. Cost savings: a reduction in energy costs increases profit.
2. Reduced environmental impact
3. Stakeholder pressure: to enhance their reputation with customers, staff and other stakeholders
4. Carbon pricing: a reduction in energy use reduces carbon pricing burden.

Unfortunately, as energy efficiency involves many different disciplines, such as engineering and management, it is easy for people preparing the business case for energy efficiency investment to miss key benefits due to a lack of expertise. Academic literature has identified a range of benefits which firms may get from investing in energy efficiency. These can be broadly categorised as reduce cost and reduced risk. Table 3 and 4 provides a list of these.

Table 3 show that some energy efficiency projects can make a firm less risky. Table 4 shows that many projects reduce cost, mainly via the fact that less resources are being used, and hence costs go down.

Table 3: Benefits from energy efficiency projects which reduce risk

Project outcome	Risk reduced
Reduced hazardous waste	Decreased liability
Reduced dust emissions	Legal risks
Reduced CO, CO2, NOx, SOx emissions	Carbon & energy price risks
Increased facility reliability	Disruption of energy supply
Reduced wear and tear on equipment /machinery	Commercial risk

Source: Worrell et al 2003 and Cooremans, 2011

Table 4: Benefits from energy efficiency projects which reduce cost

Project outcome	**Cost reduced**
Use of waste fuels	Decreased liability
Reduced product waste	Reduced need for personal protective equipment
Reduced waste water	Improved lighting
Materials reduction	Reduced turnover, absenteeism and health costs (improved worker morale, reduced noise, improved air quality and temperature control)
Increased product yield	Reduced needs for engineering controls
Improved equipment performance	Lowered cooling requirements
Shorter process cycle time	Reductions for labor requirements
Reduced dust emissions	Delaying or reducing capital expenditure
Reduced CO, CO2, NOx, SOx emissions	Additional space
Reduced wear and tear on equipment, machinery	

Source: Worrell et al 2003 and Cooremans, 2011

Despite the fact that many energy efficiency projects have the potential to benefit organisations, and society at large, not all projects are planned for effectively; and in some cases, once projects are selected they are not controlled well. This is not just a problem for energy efficiency projects. Poor planning and control are responsible for many firms not being as successful as they could be, and in some cases has caused them to close down. Effective planning and control involves cooperation between many different people in an organisation, as shown below.

Planning & Control Process for Energy Efficiency Projects

Figure 6 presents an overview of a generic Planning and Control Cycle applied to EE projects. It is important to note that many organisations have a different planning and control cycle, and may add or omit steps, or even have different steps. The process should begin with baseline performance measurement. This allows managers to find out how energy is used in the organisation, and provides a baseline from which to compare the effect of new initiatives.

Table 5 provides a description of each stage of the process, and table 6 illustrates each step using a simple lighting project, where old inefficient light bulbs are replaced with new energy efficient bulbs.

Figure 6: Planning and Control Cycle for Energy Efficiency projects

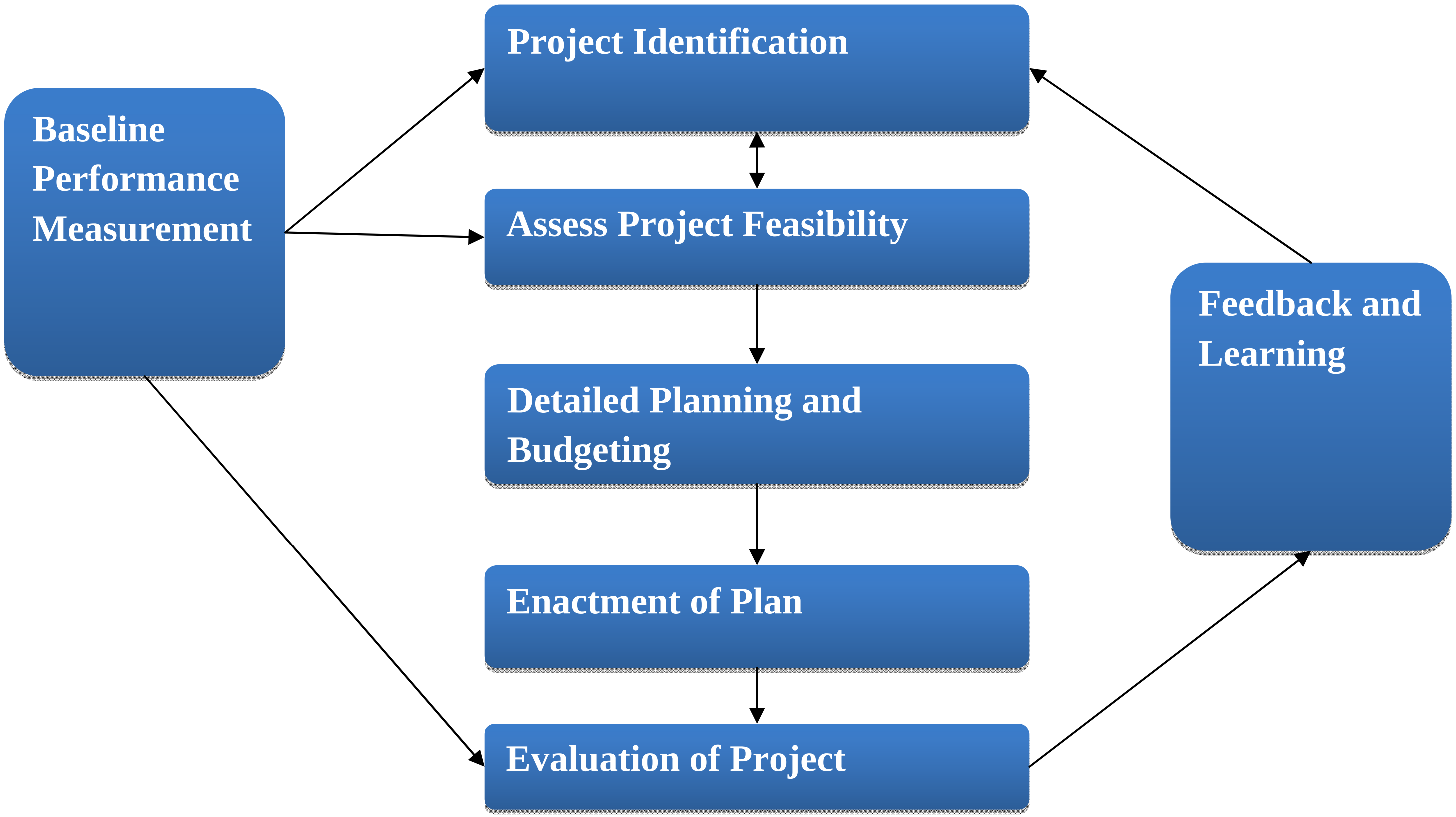


Table 5 Planning and Control Cycle for Energy Efficiency projects

Stage	Title	Description
One	Baseline Performance Measurement	Defining current performance to use as a point of comparison for future performance.
Two	Project Identification & Feasibility	Managers are typically presented with a range of projects to choose from. They then select the best option and determine the project's feasibility. Project feasibility is an assessment of the costs and benefits attached to the project. If the project is not considered feasible, the manager will not approve the project.
Three	Planning and Budgeting	A detailed project plan is prepared. The benefits and costs of the project are systematically identified and usually quantified in terms of cash flows.
Four	Enactment	In this stage the plan is carried out. Control systems are used to monitor and control the project's progress to ensure expenditure is within the budget and outcomes are satisfactory.
Five	Evaluation	Following completion, the actual project results are compared with the expected project results detailed in the budget. The extents to which the budget is exceeded and to which project goals are met are two measures used in evaluating project success.
Six	Feedback and Learning	Organizations gain valuable lessons from the overall results of a project, as well as any feedback provided by personnel involved in the project. They use this as guidance for selecting, planning and controlling future projects.

Successful projects tend to possess the following qualities:

- Support from top management
- Sufficient resources allocated to the project
- A reasonable, accurate budget
- A cross-functional team where different individuals contribute their unique skills.
- to the project

Table 6: Planning and Control Cycle for simple lighting project

Stage	Title	Description
One	Baseline Performance Measurement	The baseline performance measurement variables needed would be: -Number and type of light globes and where they are located -An estimate of usage patterns, or direct measurement if possible. Key questions are: how many hours a day are the lights on? Is the type of light bulb too bright, or not bright enough for the area?
Two	Project Identification & Feasibility	A range of energy efficient light bulbs is identified. The lowest total cost light bulbs are identified (purchase price, life of bulb, and energy consumption are considered).
Three	Planning and Budgeting	Managers decide who is responsible for purchasing the new bulbs, replacing and disposing of the old ones. They then approve the amount that can be spent on the project.
Four	Enactment	People responsible purchase the new bulbs, replace and dispose of the old ones. The manager checks to see if the job has been done.
Five	Evaluation	The cost of the bulbs and the energy saved is compared to the budget.
Six	Feedback and Learning	If certain brands of bulbs are found to be of poor quality, these can be avoided in the future.

Section Two: Planning and Control Process in Energy Efficiency Projects

In this section, the Planning & Control Process described in Section 1 will be applied in the context of Energy Efficiency projects. A real business case, Iluka Resources Ltd, is used as an example to further illustrate the use of this process in large-scale energy efficiency projects and how different organisations have different Planning and Control processes.

Stage One – Baseline Performance Measurement

Prior to commencing planning for a specific project, a company must first measure its *current* performance as a point of comparison for the *future* performance of any project undertaken. The measurement of existing energy consumption is typically undertaken by engineers who collect data which are then converted into simple metrics. However, engineers may not know the usage patterns, so they normally have to work with other staff members to find out usage patterns.

Stage	Title	Description
One	Baseline Performance Measurement	Collate what you have, ie form monthly statements.
Two	Project Identification & Feasibility	In the first instance apply Rule 1 and 2 inhouse, and make these the project.
Three	Planning and Budgeting	
Four	Enactment	In this stage the plan is carried out. Control systems are used to monitor and control the project's progress to ensure expenditure is within the budget and outcomes are satisfactory.
Five	Evaluation	Following completion, the actual project results are compared with the expected project results detailed in the budget. The extents to which the budget is exceeded and to which project goals are met are two measures used in evaluating project success.
Six	Feedback and Learning	Organizations gain valuable lessons from the overall results of a project, as well as any feedback provided by personnel involved in the project. They use this as guidance for selecting, planning and controlling future projects.

For example, a business wanting to implement a company-wide, energy efficient project must first measure its current energy usage, energy costs, and energy wastage. This requires communication between various departments of the company, and a good understanding of what assets the organisation is using, and how they are used. The maintenance staff can measure current energy usage and identify the main activities and assets which use the most energy; the accounting department can calculate energy costs from energy bills and work with engineers to develop more detailed information about energy use; and engineers can measure the current energy waste. Combining all this information, the company can measure its current performance at the present time as a baseline for evaluating a new project.

Stage Two: Project Identification and Feasibility

Management will initially assess how practical a given project will be in terms of potential benefits and costs. The Feasibility Stage requires management to perform the following key tasks:

- Identification of what physical and human resources are need for each project
- A basic forecast or budget outlining potential costs and benefits, as well as a rough estimate of the project cash inflows and outflows.

- It is prudent to include the key people who will be affected by a project at the feasibility stage. This will allow them to feel involved, and to point out any challenges to the project idea.
- Preparation of a formal feasibility report which contains enough information to allow decision makers to decide whether the project is 'feasible', and to allow different projects to be compared in order to identify the best projects.
- Comparison of all the projects available, and the selection of the best projects. Usually the more expensive the project, the greater the level of responsibility of the decision makers. The largest projects require approval from the board of directors, whilst some projects can be implemented by lower level managers without formal approval.

It is also prudent to begin negotiations early with key personnel across the organisation regarding who will have responsibility for doing the work involved in the project. It is imperative to explain to the key departments the impact of the proposed project on existing operations. Employees must be aware of the benefits that will arise from the project, as compensation for any loss of work, their time, or expenses they may incur. This will ensure that goals are aligned across the organisation when proceeding with the project enactment (Stage 3). Although management accountants are involved in this process in many organisations, in some organizations the tasks are completed by other professionals.

Returning to the lighting upgrade example, the parties involved in the implementation of a lighting project would typically be engineers, maintenance staff, the finance/accounting department and senior management. In the Feasibility phase, discussions between these parties would revolve around the feasibility of the project scale (engineering and maintenance), personnel requirements (senior management), and expenses and costs (finance department). Overall, a consensus among involved parties is necessary to proceed with more detailed budgeting and project enactment.

Stage Three: Planning and Budgeting

The planning and budgeting stage incorporates the information collected from the Feasibility Stage, namely the information gathered from consultations with key parties. The opportunity costs and benefits are then quantified and budgeted in terms of cash inflows and outflows, in order to confirm the economic feasibility of the project (i.e. profitability). Budget preparation typically involves the following steps:

- Detailed planning of the project, including a forecast of key physical and human resources needed
- Identification of who will be responsible for doing what activities.
- Estimates of the cost of the physical and human resources needed
- Identification of key benefits which are expected to arise from the project

In the Budgeting Stage, the decision to undertake the project is re-evaluated based on the budgets prepared. The decision to continue with the project will depend on whether the projects have more benefits than costs. The cost benefit analysis is usually quantified by accountants, and used to estimate the payback period, the Net Present Value, and the Accounting Rate of Return.

Building on the lighting upgrade example, an analysis of the energy savings arising from the replacement of light globes would be a prime cash inflow relevant to the analysis, while initial outlay costs relating to the purchase and installation new light globes would comprise a major cash outflow. A basic consultation with maintenance staff about energy savings and suppliers about initial outlay costs provide an accurate estimate of the potential cash flows associated with undertaking the project. In some cases, as energy efficient lights last so much longer than traditional light fittings, the maintenance savings are greater than the savings of energy.

Stage Four: Enactment

The Enactment Stage is concerned firstly with the implementation of the project, and secondly, systems of control (management control systems) used to monitor and control activities to ensure the project meets budgetary estimates and is completed within the budgeted timeframe. This stage also entails the collection of information which informs management about potential areas of improvement, for example additional resource controls and monitoring requirements.

In the lighting project example, fiscal controls and active monitoring are a necessity in attempting to manage unnecessary spending and wastage. Unnecessary spending may arise from the over allocation of staff during the installation phase while energy wastage can result when new light globes are not properly maintained. These issues can be addressed by appropriately budgeting for the number of required staff in addition to scheduling maintenance jobs and monitoring staff to ensure these tasks are properly undertaken. The control of the project may simply involve having an independent staff member walk around the site to check and see if the lights have been upgraded. Also, maintenance staff may have to provide documentation that the old light fittings were disposed of in an environmentally safe manner. There also needs to be a system in place to identify and prevent cases of theft, such as a physical check by an independent staff member to see if the bulbs have been upgraded, and safe storage of the new globes.

Stage Five: Evaluation

Once complete, the project is evaluated in terms of its outcomes relative to the expected results established in the budgeting and baseline performance stage. A qualitative comparison of the expected and actual incomes yields a variance which highlights the effectiveness of the project. In the Evaluation Stage, actual expenditure is compared to budgeted expenditure. If actual exceeds budgeted, then an unfavourable variance has occurred. An unfavourable variance could be the result of waste or inefficient use of resources. Alternatively, an unfavourable variance could be due to miscalculations in the budget of the actual resources required. This provides information useful for the Feedback and Learning stage.

An unfavourable variance in the lighting project may relate to actual labour hours exceeding budgeted labour hours. This may be due to the workers' lack of technical knowledge required to install light fittings, or due to unanticipated work required to ensure the safety of procedures. Alternatively, the budgeted values may be over or underestimated due to inaccuracies in its calculation which may need to be addressed in subsequent projects. Overall, the outcomes are then assessed and utilised in the final stage (Feedback and Learning) in order to improve future decision making. For many energy saving projects, it may not be easy to measure the exact amount of energy saved, so accountants may need to work with operating staff and engineers to calculate the savings from these projects.

Stage Six: Feedback and Learning

The information gathered in Enactment and Evaluation Stages is utilised through Feedback and Learning. This stage is used to collate feedback gathered from the current project in order to accurately assess future projects. Information to facilitate learning procedures may also come from general feedback obtained by interviewing personnel involved in the project or, more generally, from examining the source of variances between budgeted and actual results which may result from inaccuracies in calculation or wastage.

In the case of lighting projects, many firms have found that the projects are so successful that they automatically approved a full lighting upgrade at all sites.

ILUKA RESOURCES LIMITED

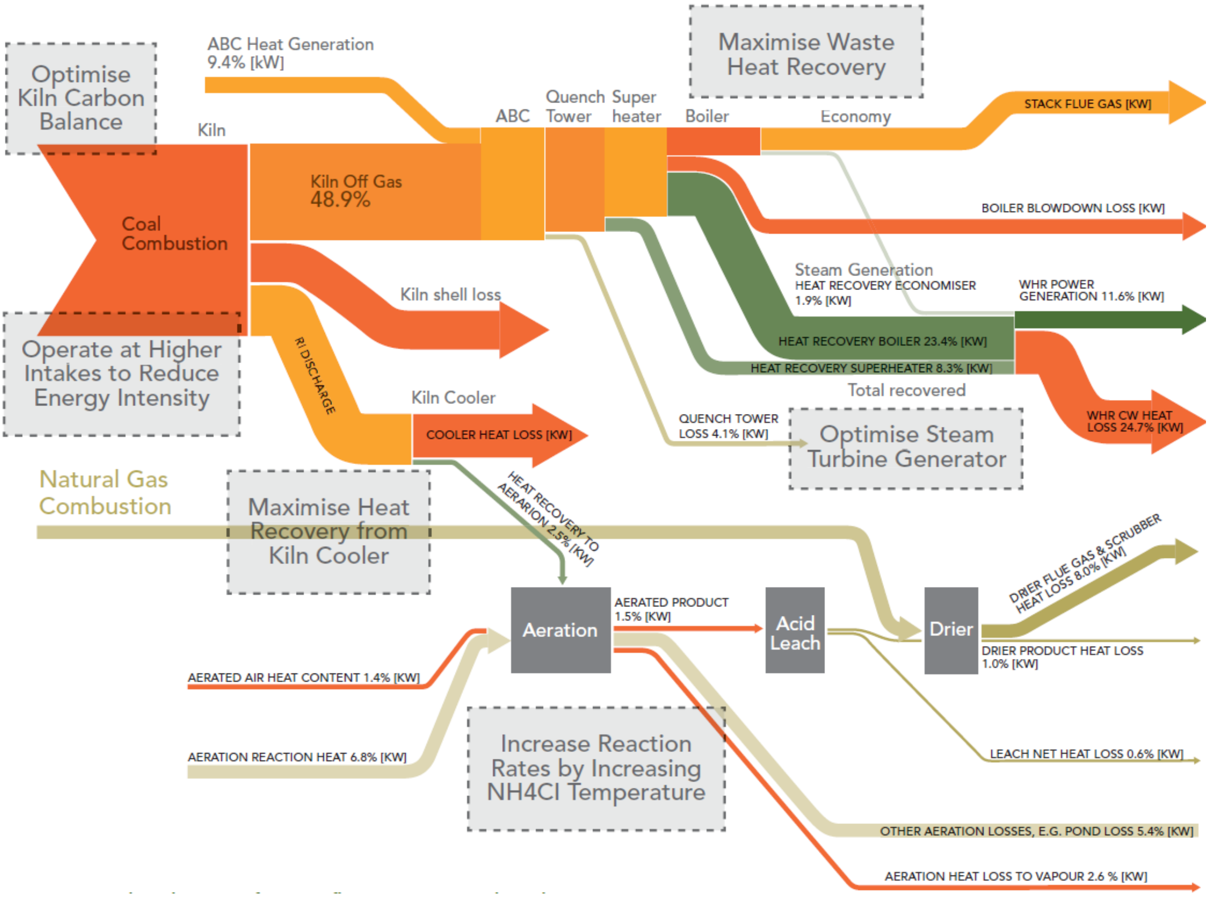
This example is based on RET (2011). Iluka Resources Limited is a multinational mining and exploration company specialising in the production of Zircon and Titanium dioxide products. Iluka is highly reliant on energy consuming machinery used to extract minerals and therefore incurs substantial energy bills as a result. As Iluka's total energy consumption in 2010 was 10,071 TJ, the company recognised that significant benefits could be realised by pursuing improvements in the way energy is used in its operations. Iluka's Managing Director highlighted the company's position towards the Energy Efficiency project: "Iluka is committed to the process of improving energy efficiency within Iluka operations as it is the responsible thing to do and it makes good business sense." The potential for further optimisation of the Waste Heat Recovery Plant was identified as a key benefit of the energy-mass balance modelling process.

Before pursuing their Energy Efficiency project, Iluka Resources Limited gained a detailed understanding of the organisation's present energy consumption and the key factors that influence overall energy performance. To do this, Iluka employed an analytical technique called Energy-Mass Balance (EMB). An EMB is a description of energy and mass flows in a given process system. It demonstrates where energy enters into the system, where it is transformed and where it exits the system, even in streams where direct measurement may be difficult. This allowed Iluka to gain accurate measurements of their current energy ‘performance’. Figure 7 is a Sankey diagram which represents the EMB at the site.

To capture the benefits of the project, Iluka’s overall approach was to communicate the business requirement, plan the project, allocate skilled personnel to conduct the work and provide support, and ensure that the appropriate tools and data resources were available to produce the desired result. Iluka also established a multi-disciplinary team to ensure that all relevant perspectives were represented. They did this by including team members from the environmental, engineering, technical and finance departments. Consistent with other projects at the company, Iluka drew up a project charter (i.e. budget) which detailed the business need, scope, project outcomes, timing, constraints, and key members of the project team. The Energy Efficiency project was incorporated into the company’s performance objectives and goals.

Iluka has a culture of continuous business improvement and their existing project management systems were used to track the project’s assessment process. The project successfully resulted in a greater understanding of energy use, the identification of energy efficiency opportunities and the evaluation of those opportunities. It has also been valuable in communicating the outcomes of the energy efficiency program. The results of the project also indicated that the proper assessment of energy use added significant operational value and that its implementation improved the overall business and engineering process.

Figure 7 Energy Mass Balance (EMB) represented using a Sankey diagram of energy flows at Iluka site



Source: RET (2011, p. 16)

Iluka highlighted the following as the key lessons learned from conducting the project:

- The EMB model provides real and quantifiable business benefits
- A multi-disciplinary approach is crucial to a good outcome
- General inclusion of staff helps to improve team engagement with energy efficiency projects

The EMB model used in the project has been fully documented for future use, and due to its success, will be applied at other Iluka sites in over a five-year period using what the company has learned from this project. Experience gained and lessons learned from this initial project mean that Iluka is well positioned for the next Energy Efficiency Project.

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