GREENING
our supply chain

A guide to Environmental Sustainability for suppliers and contractors to Garden Cities NPC (RF)

energy

GARDEN CITIES

building green communities

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ENERGY

1. Committing to sustainable energy

Energy for sustainability is a priority for Garden Cities NPC (RF). We support energy processes that are environmentally friendly, reduce greenhouse gas emissions and utilize renewable resources. To help us build more sustainably, we encourage our suppliers and contractors to be innovative in their use of electricity and fuels.

Globally buildings consume **40%** of the world's end use energy.

60% of the world's electricity is consumed in residential and commercial buildings.

Space heating represents **20%** of the total energy consumption of a dwelling in SA.

2. Energy and the environment

LAW OF CONSERVATION OF ENERGY

Energy can be neither created nor be destroyed; it can only be changed from one form to another.

It is useful to remember the law of conservation of energy when it comes to considering how energy impacts the environment and how we can best make use of it to improve our lives. No energy is currently created on Earth - all energy already exists and is transferred between matter and space within the system of the universe.

Energy exists in all things and makes things happen. In physics, we say energy is the property of an object or system that gives it the ability to do work. Energy has a number of different forms such as kinetic, potential, chemical, heat, and light. Throughout human history from the first use of fire, to the age of steam power, and the invention of electrical devices, energy has been a catalyst for social and economic development.

Despite obvious benefits to society, industrial energy production has environmental, health and safety concerns. Nuclear disasters, oil spills and greenhouse gas emissions have triggered much debate worldwide over the best methods to harness energy.

2.1 Energy from fossil fuels

Globally, 80% of energy consumed is generated using processes that burn fossil fuels such as coal, oil and natural gas. Relying on fossil fuels as the primary energy resource for generating electricity and producing power is not considered environmentally sustainable.

Why is fossil fuel energy unsustainable?

1. Requires continuous extraction of a non-renewable resource from the Earth's crust
2. Relies on combustion, a comparatively inefficient transfer of energy from the resource
3. Alters the natural balance of carbon circulating through the air, land and sea
4. Releases CO2, a global warming greenhouse gas, and other pollutants into the atmosphere.

Continuous extraction of non-renewable resources

Continuous and increasing extraction of fossil fuels is inherently ecologically and socially detrimental. Despite improved safety and attempts to support local communities and rehabilitate the surrounding natural areas, mining remains dangerous and often causes permanent ecological disruption. In South Africa mines are especially responsible for widespread fresh water contamination through acid mine drainage. Success in commercial mining also requires ongoing deeper and wider exploration for natural resources in marginal eco-sensitive areas. This is an exponentially costly process that spreads and increases risks to human health and ecosystems.

Combustion is comparatively inefficient and dirty

Burning fossil fuels is an ecologically inefficient way to produce power because it leads to entropy. Entropy refers to the thermodynamic process where available energy is dispersed and less localized. Much of the energy generated when burning fossil fuels is wasted, lost through heat given off but not used. Coal, oil and natural gas also release toxic gases and heavy metals like sulphur dioxide and mercury into the air during combustion. If not filtered correctly, these suspended particles cause air pollution and combine with atmospheric water vapour to produce acid rain. This can damage crops, cause the deterioration of buildings and induce health conditions like asthma and other allergies for people.

Alters balance of the carbon cycle

Coal, oil and natural gas are all geological forms of carbon deposited in the Earth's crust over billions of years. Often referred to as 'ancient sunlight' this fossil carbon is actually decayed plant and animal material. Carbon is exchanged naturally through the Earth's oceans, crust (soil and rocks) and atmosphere in a biogeochemical flow known as the carbon cycle, which, along with the water cycle and nitrogen cycle is essential for sustaining life. For the past 1 million years the global average concentration of CO2 in the atmosphere has remained relatively stable. In the last 250 years, however, there has been a marked increase in CO2 concentration that is changing the balance of the carbon cycle and resulting in significant environmental impacts.

Rising CO2 levels

When fossil fuels are burned, the gaseous form of carbon (CO2) is released into the atmosphere. While this process does occur naturally, such as when a volcano explodes, scientists have identified continuous emissions of CO2 from human activity as the source of unnaturally high levels in recent times. Since the start of the Industrial Revolution in 1755 the concentration of atmospheric CO2 has risen from 280 ppm to 400 ppm (as of 2015). This is the highest level in the past 800,000 years and likely the highest in the past 20 million years.

2.2 Greenhouse gases and climate change

Higher concentrations of CO2 in the atmosphere caused by human activity are causing the Earth's temperature to rise. Along with other naturally occurring trace gases, CO2 is an atmospheric greenhouse gas (GHG), which regulates the global temperature by moderating incoming solar and outgoing terrestrial radiation. Although less abundant than other main gases like oxygen and nitrogen, GHGs perform a very important role trapping heat to keep the Earth's temperature constant.

Impacts of climate change

Environmental risks associated with global warming and climate change include:

- Polar ice-melt and sea-level rise putting low-lying coastal areas at risk of flooding
- Greater frequency of intense storm systems increasing risk of damage to infrastructure
- Greater frequency of drought periods threatening agriculture and water supply
- Shifts in regional agricultural practices impacting food security
- Ocean acidification leading to marine 'dead zones'

In the last 100 years the average surface temperature of the Earth has warmed by 1°C. As atmospheric CO2 levels continue to increase, scientists expect this temperature rise to reach at least 2°C by 2050. Predictions show that we are on course for a 4°C to 6°C rise by the end of the century unless global CO2 emissions can be reduced drastically, some say by as much as by 90% from current baselines.

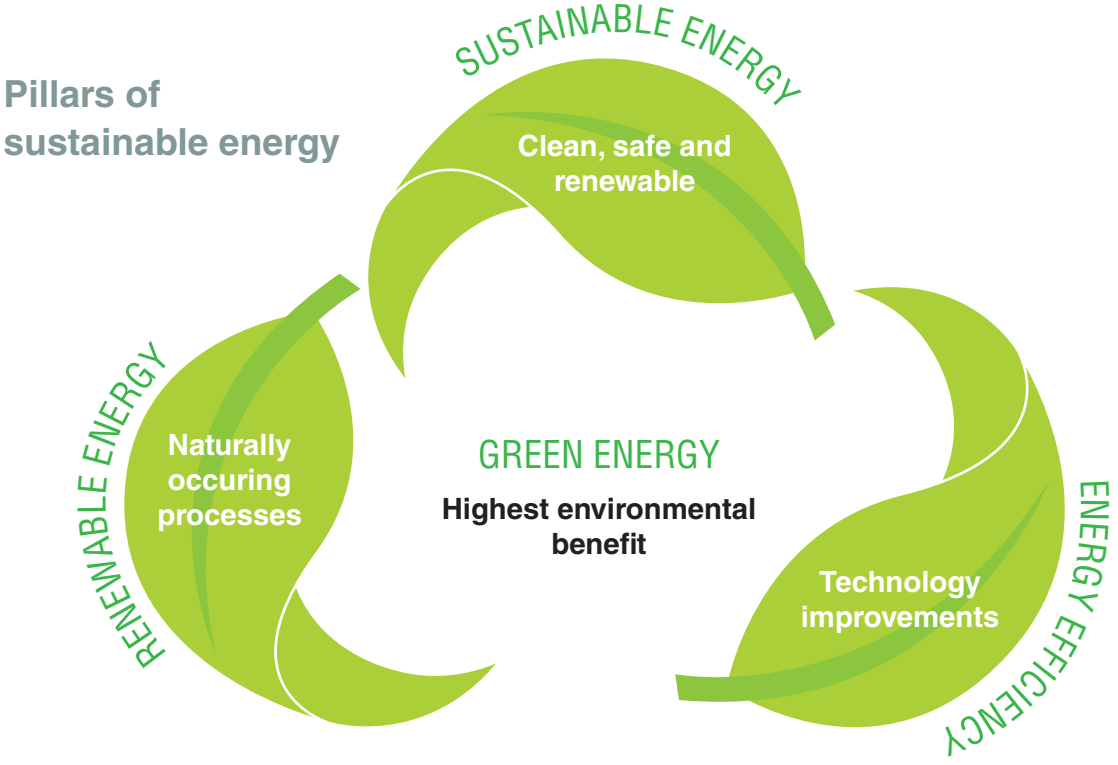
Studies show that a rise in global temperature beyond a 2°C increase will have very serious global consequences, most of all impacting poor and vulnerable communities. Increasing temperatures on the Earth's surface alters the distribution of heat both on land and in the oceans. This in turn affects the general circulation of air masses and ocean currents, which results in changes to existing climate and weather patterns around the world.

3. Sustainable Energy

Globally the demand for energy is growing. Sustainable energy is an approach to energy production and consumption based on using renewable resources and technology that do not significantly degrade ecological systems or harm people, both now and in future.

Examples of sustainable energy include steam, hydropower, solar energy, wind energy, wave power, geothermal energy, bioenergy and tidal power, as well as applications designed to improve energy efficiency. Sustainable energy technologies do still have environmental impacts through their production process but over the long term these are considered less than those involving burning of fossil fuels.

Sustainable energy has two pillars - renewable energy and energy efficiency. Low-carbon energy is not considered part of sustainable energy because it is sustainable only in the sense that it does not add to the CO2 in the atmosphere. Green energy is a subset of renewable energy representing renewable energy resources and technologies that provide the highest environmental benefit.



3.1 Renewable energy

Renewable energy (renewables) is energy that is generated from natural processes that are continuously replenished and cannot be exhausted. This includes sunlight, geothermal heat, wind, tidal, water, and various forms of biomass. Renewable energy technologies range from solar power, wind power and hydro-electricity or micro-hydro, to biomass and biofuels.

3.2 Energy efficiency

Energy efficiency is a way of managing and restraining the growth in energy consumption. It helps counter rising energy costs, both for producer and consumer. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input. Efficient energy use is achieved primarily by means of a more efficient technology or process.

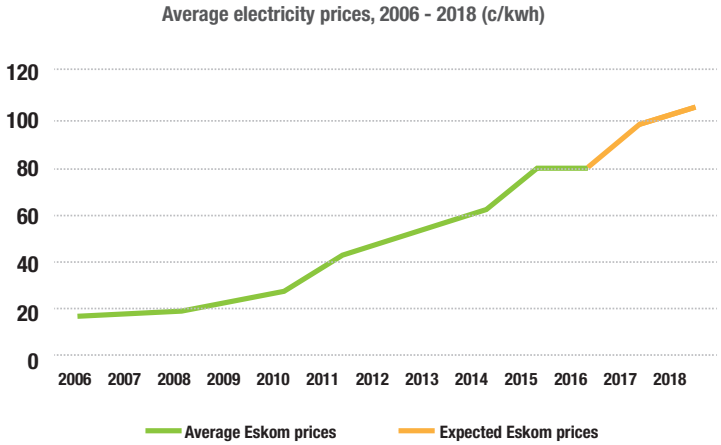
Energy efficient buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help limit global emissions of greenhouse gases.

4. Energy in South Africa

4.1 Drivers for energy management

South Africa is a fossil fuel based economy reliant on coal and imported oil as its key sources of energy supply. With natural abundance of coal and, historically, a comparatively low price of electricity, the South African economy is both energy and carbon intensive. A number of critical issues are driving the focus on energy efficiency and renewables within South Africa, including:

- Energy security
- Rising domestic energy prices
- Climate change commitments
- Changes in policy and regulation

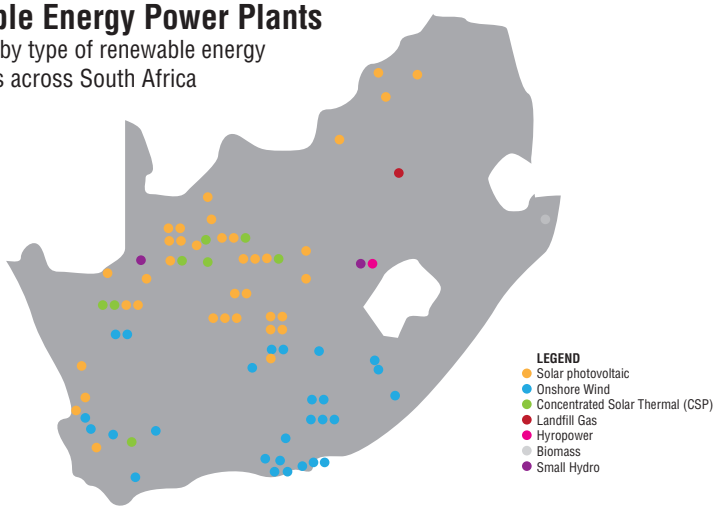


4.2 Developments in renewable energy

REIPPP

The Renewable Energy Independent Power Producer Programme (REIPPP) was developed to encourage private investment to help further the renewable energy sector within South Africa. South Africa, with large levels of sunshine and wind throughout the year, coupled with the availability of large open tracts of land, provides the country with a huge potential to take advantage of renewable energy. The national renewable energy target is for 18 800MW to be supplied by renewable energy by 2030. Since 2012 the REIPPPP alone has already delivered 5 243 MW, throughout 79 different projects, which accounts for over a quarter of the target.

Renewable Energy Power Plants
Distribution by type of renewable energy power plants across South Africa



Solar PV panels at the Vineyard Hotel in Newlands

Rooftop solar PV installation experienced a 330% increase in 2015.

- GreenCape

5. Energy policies and regulation

The National Energy Regulator of South Africa (NERSA) together with its custodian, the Department of Energy (DoE), regulates the electricity sector in South Africa. A number of acts and policies guide the development of the sector through the Integrated Resource Plan (IRP) 2010 – 2030, which outlines the planning, sourcing and quantities of electricity sources contributing to the country's generation mix.

5.1 Key changes in policy

Mandatory reporting of energy

In 2015 the DoE introduced a mandatory reporting regulation for large users of energy. It is mandatory for all energy users consuming above 180 Tera Joules (TJs) per annum to submit their energy consumption data to the DoE. Companies using 400 TJ or more per annum will be required to submit a detailed energy management plan. The reporting requirement is applicable to all forms of energy. It is recommended that this data be collected by a trained energy professional and it may be required that data be verified by an external auditor. This regulation is anticipated to affect mostly heavy industries such as mines and smelters, which are largely based in the Gauteng, North West and Mpumalanga provinces.

Energy efficiency tax incentives

The DoE has introduced the 12L Income Tax Allowance on Energy Efficiency Savings to safeguard the country's energy security through energy efficiency mechanisms. The tax allowance makes it viable for businesses to offset their energy savings against their annual corporate tax in a given year. The offset is calculated against the 28% tax rate. Tax incentives are currently offered for one assessment year of kWh savings and are only applicable to registered businesses.

Guidelines on embedded generation

Across South Africa, local and national government are working towards developing Small Scale Embedded Generation (SSEG) rules and regulations to support the growth of the EG market. The purpose of these rules and regulations is to give each stakeholder relevant guidance regarding the connection of SSEG installations smaller than 1 MWp to the municipal electrical grid. In the Western Cape, ten municipalities allow embedded generation to feed electricity back onto their grid. Within these municipalities there are three experimental feed-in tariffs and one NERSA approved tariff. The national utility (Eskom) does not allow embedded generation on their low-voltage network but they do permit the connection of embedded generation to their medium-voltage and high-voltage (Genflex tariff) network.

Carbon Tax on emissions

The Carbon Tax draft Bill is part of South Africa's commitment to reduce greenhouse gas (GHG) emissions below business as usual by 34 per cent by 2020 and 42 per cent by 2025. It is anticipated that the carbon tax will come into effect in 2017 at a marginal rate of R120 per ton CO2e, increasing by 10% per annum until 2020. The tax will be administered as an environmental levy as contemplated in the Customs and Excise Act.

Calculation of the tax base is closely linked to the Department of Environmental Affair's (DEA's) mandatory reporting requirements of emissions for all economic sectors in South Africa, in which entities will be liable for their:

- Fossil fuel combustion emissions,
- Industrial processes and product use emissions, and
- Fugitive emissions (e.g. fugitive emissions from coal mining).

Accelerated depreciation

The accelerated depreciation program allows a business to depreciate any qualifying asset over a three year period at a rate of 50:30:20 rather than the normal 5 years or longer.

5.2 Key standards

The South African Bureau of Standards (SABS) has assisted with the development of several new or improved standards, raising the requirements for energy efficiency in both the built environment and consumer products.

SANS 10400-XA New building codes

Published and promulgated as a national building code in 2012, these construction standards require mandatory compliance on energy efficiency and energy use with all new buildings before receiving municipal approval.

Part XA1 specifies maximum energy consumption for specific buildings per square meter. This sets certain minimum and maximum specifications for fenestration, roof insulation, and double cavity wall construction. It aims to shift design towards more energy efficient construction.

Part XA2 specifies that at least 50% by volume of the annual average hot water heating requirement shall be provided by means other than electrical resistance heating. This includes but is not limited to solar heating, heat pumps, heat recovery from other systems or processes and renewable combustible fuel.

SANS 941 Energy performance and labelling of electrical apparatus

Covers energy efficiency requirements, measurement methods and appropriate labelling of energy efficiency electrical and electronic apparatus such as washing machines and fridges. This standard was published in 2012 to ensure that at the time of purchase, buyers have all the relevant energy consumption information at their disposal.

SANS 1544 Energy performance certificates for buildings

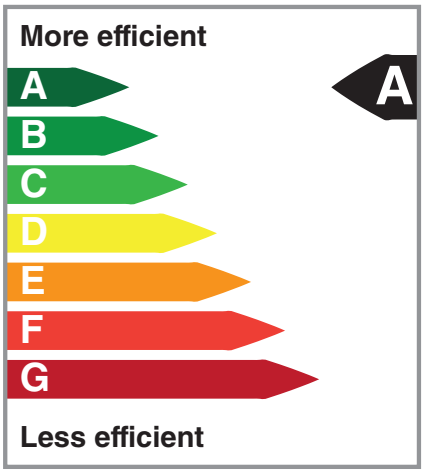
Specifies the methodology for calculating energy performance in existing buildings. This standard is mandatory for all public buildings and will be implemented in 2016.

SANS10106 Installation of solar hot water systems

This standard was revised and the new version published in 2014. It updates the requirements for installation of domestic solar water heaters.

SANS 50010 Measurement and verification of energy savings

Published in 2011, it specifies the methodology for calculating energy savings. This is a required tool for calculating savings for projects submitted on the 12L energy efficiency tax rebate programme.



Example of an energy efficiency label for appliances

6. Industry Bodies and Associations

6.1 Sustainable Energy Association of South Africa (SESSA)

SESSA is dedicated to the use of renewable energy and energy efficiency including all solar-based energies such as photovoltaics, thermal heating and cooling, wind, biomass and hydro. SESSA also promotes passive building design and energy efficiency.

Founded in 1974, SESSA is one of 50 National Sections of the International Solar Energy Society (ISES). ISES is regarded as the premier body in solar energy with members in over 100 countries. SESSA is the duly appointed African office of ISES.

Website: www.sessa.org.za

6.2 South African Solar Thermal Technology Platform (STTP)

The STTP was launched in 2013 in Pretoria as part of the SOLTRAIN 2 programme. This initiative brings together academia, research institutions, industry, government and all other interested parties to work towards knowledge sharing and promotion of all aspects of the solar thermal industry in South Africa. It provides a neutral platform for discussion and transparent decision making that includes all stakeholders and is open to anyone who is interested.

Website: www.soltrain.co.za/

7. Garden Cities Green Building Guidelines

As part of its commitment to green building, Garden Cities NPC (RF) recommends the following sustainable energy criteria in the design and construction of its developments.

Criteria	Focus areas
Passive solar design	1. Use passive solar design principles. 2. Orientation: orientate rooms to the north for effective summer shading and winter solar access. 3. Orientation: use short E-W facades and longer N-S facades. 4. Reduce solar gain in summer and allow solar access in winter with shading, orientation, glazing ratio, building fabric performance and thermal mass. 5. Create optimally ventilated spaces, using natural ventilation. 6. Provide dual aspect windows to occupied spaces for effective natural ventilation. 7. Shading: use fixed shading devices on windows, deep eaves or awnings to block high angle sun in summer and allow low-angle solar access in winter. 8. Use deciduous trees for seasonal shading or facades and outside spaces. 9. Select appropriate glazing materials and provide suitable fenestration.
Energy efficient materials	1. Select materials that are energy efficient. 2. Select materials with low embodied energy. 3. Combine materials effectively (i.e. reflectivity and insulation) to mitigate solar gain in summer and retain warmth in winter.
Thermal mass	1. Increase thermal mass through design and material selection. 2. Provide and insulate ceilings effectively in houses. 3. Make use of thermal mass to balance heat gains and losses between day and night. 4. Make use of exposed thermal mass to provide radiant heating or cooling to improve occupant comfort. 5. Be mindful of the heat island effect.
Insulation	1. Insulate roof and ceiling constructions. 2. Insulate hot water cylinders and pipework. 3. Insulate walls and windows. 4. Select insulation with high recycled content. 5. Select insulation with zero-ozone depleting potential in manufacture or composition. 6. Check insulation installation with respect to overall compliance with SANS10400: XA and SANS 204.

Tight construction	1. Seal openings properly. 2. Prevent infiltration and leakage of air. 3. Design to prevent draughts.
Electrical appliances	1. Spec energy efficient products. 2. Spec products with an Energy Rating labelling system. 3. Consider non electrical powered appliances.
Lighting	1. Design buildings with effective natural lighting e.g. a daylight factor of greater than 2% for at least 30% of floor areas as a minimum. 2. Provide daylight, occupancy and dimmer controls to artificial lighting systems. 3. Select CFL lamps instead of incandescent. 4. Select LED lamps for task lighting and some architectural lighting initiatives.
Water heating	1. Install solar hot water heaters. 2. Install gas instantaneous heaters. 3. Install efficient shower heads, taps and appliances. 4. Install insulation in the form of geyser blankets and pipe insulation on hot water cylinders and pipes. 5. Install geyser timers to only provide hot water during times when it is required and check temperature settings
Space heating	1. Consider gas, oil and solid fuel space heaters instead of electrical. 2. Consider energy efficient space heaters such as ECO-heaters. 3. Install timers on all space heating equipment.
Renewable Energy	1. Consider biogas digesters. 2. Consider PV systems.
Energy Sub metering	1. Install energy sub-meters on common property infrastructure. 2. Install home energy monitoring systems.