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Improving energy efficiency in SA industry and reducing emissions in the transition towards a low-carbon economy

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Introduction

- **Energy efficiency (EE)** improvements, or lowering energy intensity - doing more with the same energy, or the same with less energy, all other things remaining the same.

- EE measures have been stimulated globally by various **drivers** and **anticipated developmental benefits**:
  - Energy efficiency improvements renders economic and financial benefits through:
    - elimination of wasteful usage, lowering energy costs, operational costs
    - reduced exposure to electricity price volatility and oil price fluctuation impacts
    - higher income, increased profitability
    - tax savings
    - reputational benefits, market acceptance – loosening the link between production growth and environmental degradation

    → **All factors lead to enhanced competitiveness and performance !**

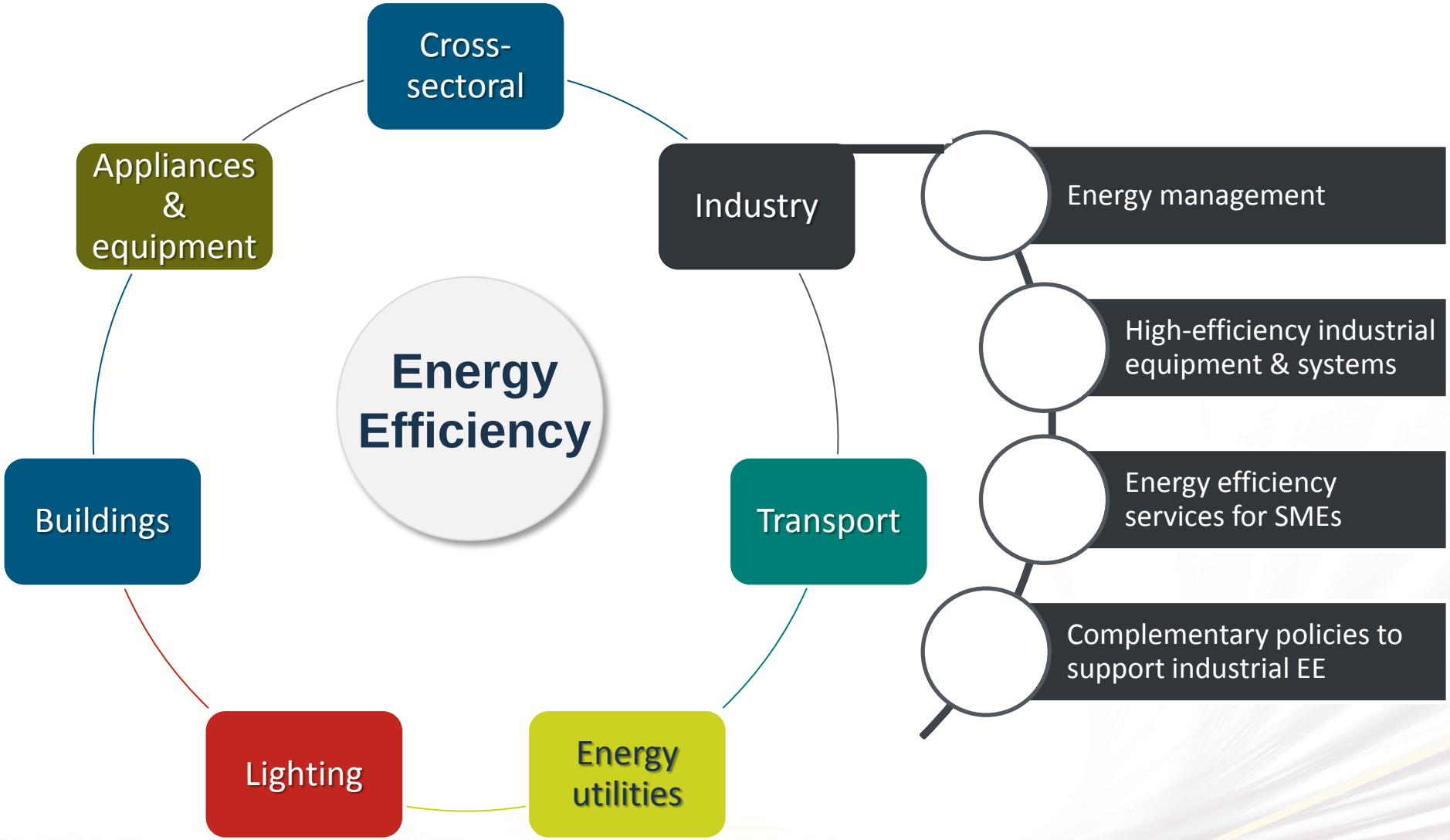
McKinsey Global Institute estimated that an annual investment of US$170 billion in energy efficiency worldwide could generate an average IRR of 17%, and energy savings of up to US$900 billion annually.

Introduction (cont.)

- EE measures have been stimulated globally by various **drivers** and **anticipated developmental benefits** (cont.):
  - Energy saving through improved efficiency is the least costly measure to address energy shortages and results are reached faster than if new power plants are built

    IEA estimated that, by capturing all cost-effective EE measures, the expected increase in global energy consumption over next 20 years could be lowered by 55%-75%.
  - Reduced pressure on the existing energy supply network buys time for building new capacity, for carrying-out of maintenance and permits economic development less constrained by power shortages.
  - International commitments to reduce carbon emissions, environmental sustainability.
  - Stimulation of economic growth, while the potential to create jobs through energy efficiency measures is deemed stronger than through electricity generation.

International Energy Agency: EE policy recommendations



South Africa: National Energy Efficiency Strategy

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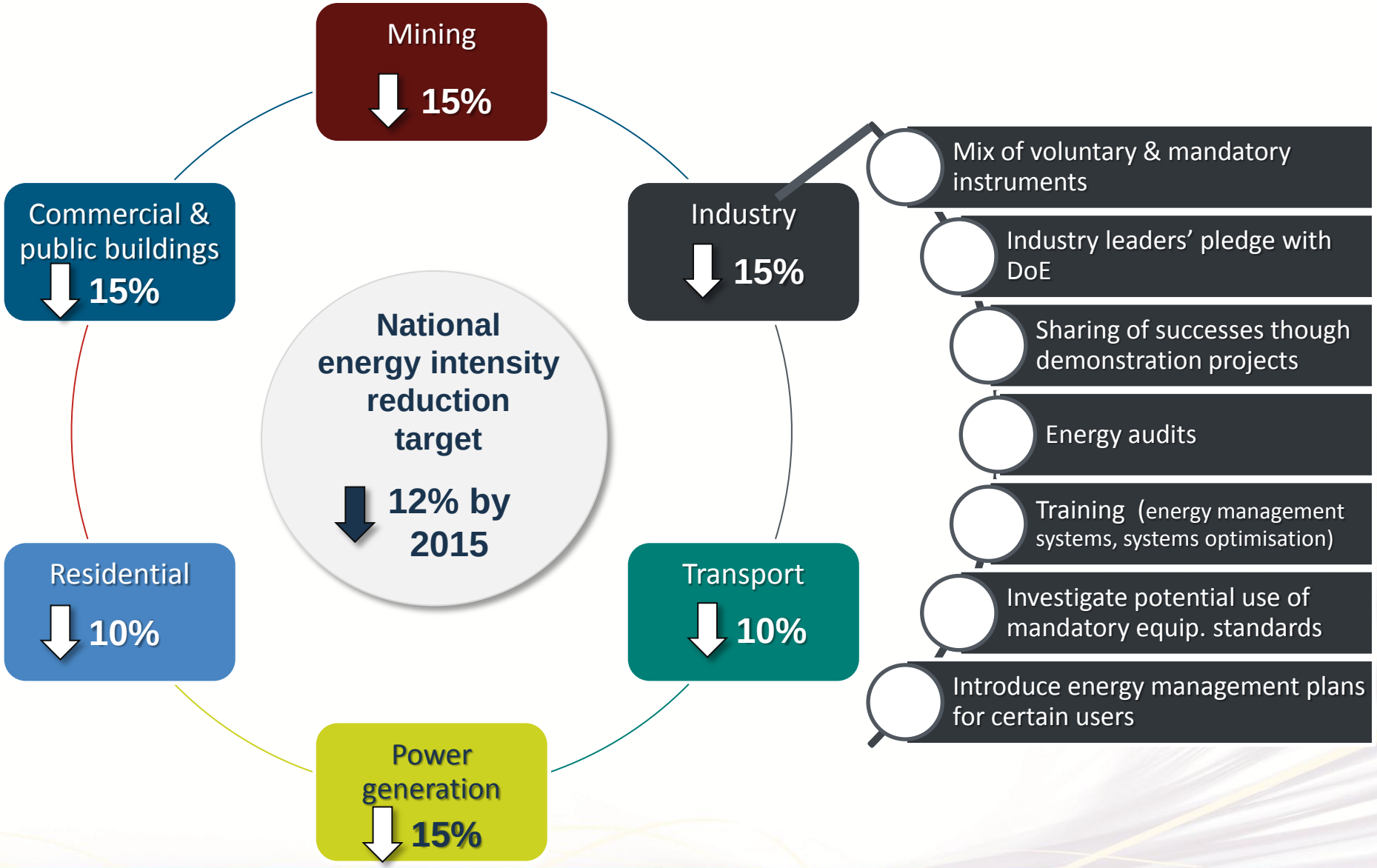


Sector potential of EE measures

- Energy efficiency in the world's industrial sector is presently well below technically feasible levels (in light of commercially available technologies) and the economic optimum.

  IEA estimated that industry has the technical potential to reduce its energy intensity by 26% and emissions by 32%, leading to an 8% decline in global energy use and a 12% drop in CO_2 emissions.

- Energy efficiency applications can be applied in building, industrial, transport and energy supply activities, as well as in agriculture and virtually any other area of economic activity.

- Scope for attaining higher efficiency of energy usage is wide:
  - thermal energy usage
  - power generation, transmission and distribution
  - intelligent application and control of energy flows in industrial processes
  - greener buildings
  - more effective usage of energy in commercial appliances, vehicles etc.

- Improved efficiency can thus be achieved in both the supply and demand side of the energy value chain.

Sector potential of EE measures: Industrial activities

- **Process improvement:** Key energy-saving opportunities exist in the implementation of best practices in energy management through improved process design and optimisation, energy efficiency upgrades to electric motors and variable-speed drives, pump tuning, compressed air and HVAC systems.

  Most sectors offer these opportunities, for example:

  – Iron & steel: improved operation of blast furnaces to minimise thermal energy lost/wasted during operations; improvements in various industrial systems, electric arc furnaces.

  – Aluminium smelting: efficiency improvements in its very energy-intensive electrolytic processes and furnaces/kilns.

  – Chemicals: improvements to boilers and other process heating equipment;

  – General manufacturing: various industrial system improvements (e.g. conveying, mixing and handling equipment, motors); reduce thermal energy losses by improving refrigeration systems, dryers, ovens, boiler systems etc.

  – Minerals processing: EE achieved by improving the mineral grade, thereby reducing the mill throughput volume and thus the energy demand; optimising and automating compressed air supply and distribution networks in mines.

Sector potential of EE measures: Industrial activities (cont.)

- **Equipment retrofit / replacement:** Results in reduced energy usage opportunities (e.g. through increased efficiency w.r.t. boilers, HVAC equipment and lighting etc.) in many sectors, especially forest products, chemicals and food processing.

- **Combined heat and power:** Sectors with high thermal load processes offer the key opportunity to reduce fuel use through onsite generation of thermal and electric energy. These include paper, chemicals, metals, food, petroleum refining and others.

- **Cleaner fuels:** The potential for reducing energy costs lies mainly in industries such as forest products (biomass fuels), food (bio-waste), chemicals (by-product fuels) and cement (waste fuels).

Industrial EE: Environmental returns

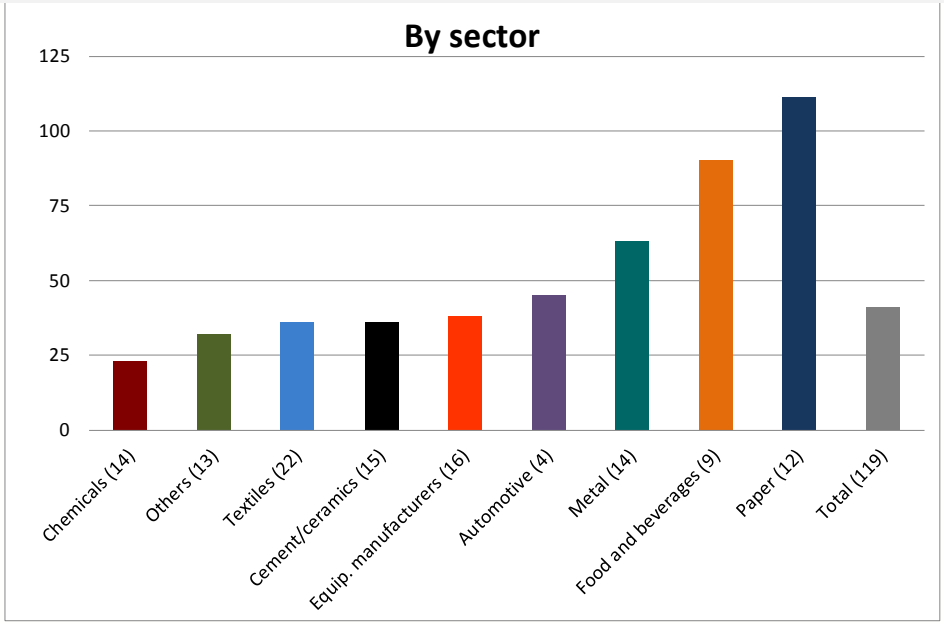
- **Direct environmental impacts:**
  - through reduced energy demands for production processes - industry accounts for 25% of GHG emissions from all sources globally (Bernstein et. al 2007);
  - mitigating natural resource depletion through reduced usage of fossil fuels, raw materials and water in manufacturing processes.

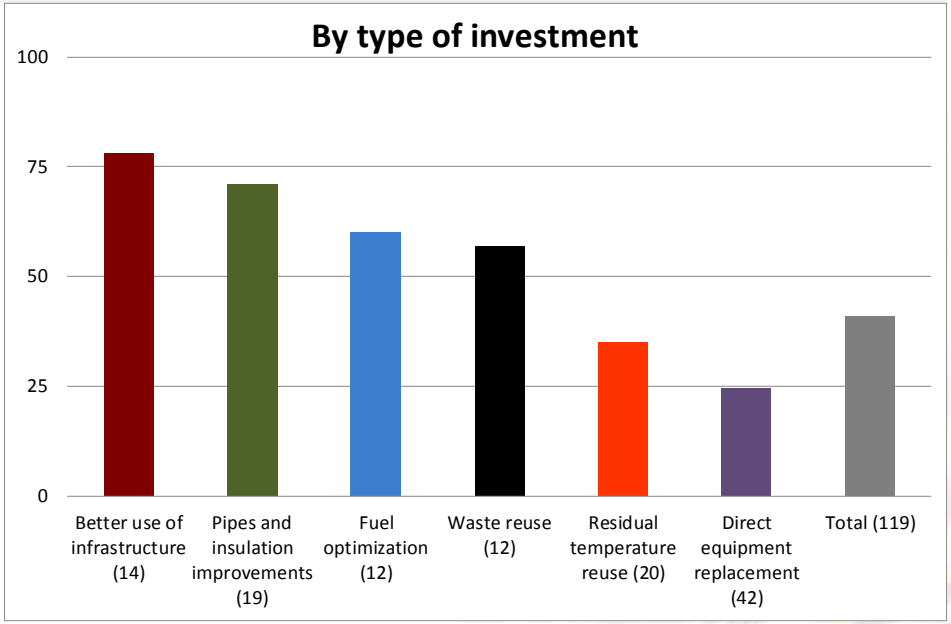
- **Indirect environmental impacts:**
  - through reduced energy demands on power suppliers – according to IEA (2010), when indirect emissions from power generation are allocated by sector globally, manufacturing and construction contribute ca. 37% to CO_2 emissions from fuel-use and industrial processes (47% in developing countries).
  - through reduced use of natural resources (fossil fuels, water etc.) in power generation, transportation of raw materials and goods, industrial waste management.
  - through lesser impact of power generation and distribution facilities on landscapes/seascapes, eco-systems/biodiversity.

Industrial EE: Economic returns

- Cost savings and enhanced profitability - energy constitutes a large portion of overall costs in many industries, especially those involving continuous processes (e.g. basic metals, non-metallic minerals, chemicals etc.).
- Relatively higher profitability of certain EE projects – some are more lucrative than many alternative investments (e.g. IRR of 119 EE projects assessed by UNIDO in developing countries exceeded 40% for projects with a 5-year time horizon).

Developing countries: Internal rates of return (%) of industrial energy-efficiency projects*



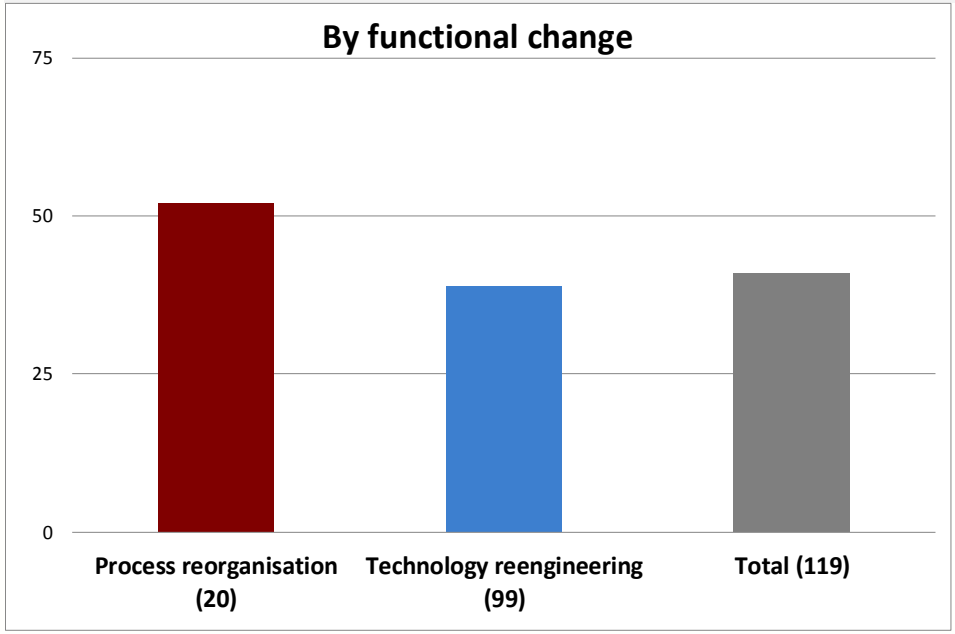


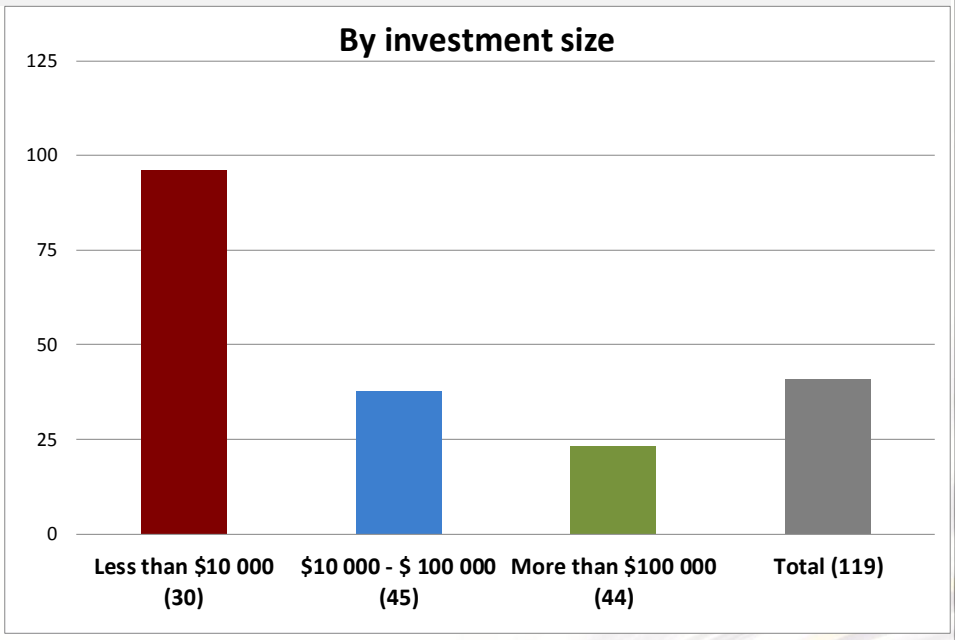
* Projects with an expected life-time of 5 years.
Note: Numbers in brackets refer to number of projects.
Source: UNIDO 2010.

Industrial EE: Economic returns (cont.)

- Relative profitability of certain EE projects (cont.) – smaller investments are often the most profitable according to UNIDO, as are EE projects involving process reorganisation.
- Nevertheless, larger investment projects (incl. replacement of machinery & equipment in process industries) can still contribute substantially to corporate profitability.

Developing countries: Internal rates of return (%) of industrial energy-efficiency projects*





* Projects with an expected life-time of 5 years.
Note: Numbers in brackets refer to number of projects.
Source: UNIDO 2010.

Industrial EE: Economic returns (cont.)

- Improved energy security.
- Productivity improvements.
- Release of financial resources for alternative investments.
- Lower taxation costs.
- Reduced vulnerability to adverse response measures.
- Enhanced international competiveness.
- Sustained access to global markets.
- Increased attractiveness as an investment prospect.
- Enhanced reputation amongst customer base and suppliers, improved integration within value chains.

Industrial EE: Socio-economic returns

- Training programmes to enhance EE lead to skills development and productivity improvements.
- Improved health (e.g. lower incidence of respiratory illnesses, asthma attacks) and higher life expectancy due to reduced factory emissions (e.g. sulphur oxides, nitrogen oxides, smoke and airborne particulate matter).
- Increased comfort in working environment (e.g. use of quieter equipment such as variable speed drivers, air blowers, or better ventilation through exhaust heat recovery systems).
- Community-wide benefits.
- Freeing of resources for alternative investments (competitiveness improvements, multi-factor productivity enhancing, growth-inducing, job creating).

Industrial EE: Socio-economic returns (cont.)

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Green Jobs report: estimates of overall direct employment potential

	Short term	Medium term	Long term
Total	**98 000**	**255 000**	**462 000**
Energy generation	13 565	57 142	130 023
% of total	*13.8%*	*22.4%*	*28.1%*
Energy & resource efficiency	31 569	70 193	67 979
% of total	*32.2%*	*27.5%*	*14.7%*
Emissions and pollution control	8 434	13 189	31 641
% of total	*8.6%*	*5.2%*	*6.8%*
Natural resource management	44 512	114 842	232 926
% of total	*45.4%*	*45.0%*	*50.4%*

Source: IDC / DBSA / TIPS

Vulnerability of SA industry and export-oriented sectors

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Carbon intensity measures for aggregate sectors, 2005					
	Carbon intensity (tons CO_2 per R1000 gross output)			Share of national total (%)	
	Total	Direct*	Indirect	Gross Output	Employment
Electricity & gas	3.201	0.295	2.906	1.7	0.3
Petroleum	1.378	0.039	1.339	2.5	0.1
Water distribution	0.539	0.486	0.053	0.6	0.1
Non-metallic minerals	0.490	0.324	0.165	1.0	0.8
Wood & paper products	0.451	0.270	0.181	2.6	1.4
Metal products	0.441	0.257	0.184	4.7	1.9
Chemicals	0.355	0.184	0.171	5.2	1.0
Natural gas	0.339	0.253	0.087	0.0	0.0
Other mining	0.296	0.221	0.074	4.6	3.3
Textiles & clothing	0.250	0.107	0.143	1.3	1.8
Construction	0.206	0.027	0.179	3.7	6.0
Processed foods	0.189	0.066	0.123	5.5	2.0
Machinery	0.186	0.027	0.159	2.6	1.4
Vehicles	0.179	0.023	0.156	4.6	1.2
Transport & comm.	0.170	0.108	0.062	9.1	4.1
Business services	0.161	0.084	0.078	9.0	11.7
Other manufactures	0.157	0.028	0.129	1.2	1.2
Agriculture	0.149	0.062	0.087	2.6	9.4
Coal	0.143	0.071	0.072	1.1	0.4
Trade & catering	0.135	0.040	0.096	9.8	21.7
Other services	0.107	0.027	0.080	9.4	14.5
Government	0.078	0.022	0.057	10.2	12.8
Financial services	0.024	0.006	0.019	7.0	2.9
All products	**0.264**	**0.088**	**0.176**	**100.0**	**100.0**

Source: C. Arndt, R. Davies, K. Makrelov and Thurlow (2013)

- SA is the most carbon-intensive of the world's non-oil producing developing countries, excl. island states (World Bank 2012).
- Huge pressure to reduce GHG emissions.
- Arndt et. al (2013) estimated carbon intensity measures (CIMs) for aggregate sector groupings (tons of CO_2 per R'000 of gross output) in SA economy.
- Analysis distinguished between direct carbon content (direct usage of primary fuels and transformed energy – petroleum and electricity) and indirect components (carbon embodied in intermediate inputs).

Vulnerability of SA industry and export-oriented sectors (cont.)

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Carbon intensity measures for aggregate products, 2005			
	Carbon intensity (tons CO_2 per R1000 final demand)	Share of carbon content from marketing margins (%)	Export intensity (%)
Coal	12.288	0.1	31.8
Natural gas	5.747	0.0	0.0
Electricity & gas	3.290	0.0	5.5
Crude oil	0.963	0.0	0.0
Water distribution	0.772	0.0	0.0
Petroleum	0.659	5.1	12.6
Metal products	0.396	6.4	32.8
Wood & paper products	0.372	9.8	8.1
Non-metallic minerals	0.312	7.7	4.1
Other mining	0.278	1.5	60.5
Chemicals	0.267	8.6	9.9
Trade & catering	0.194	1.1	5.0
Construction	0.188	0.0	0.2
Transport & comm.	0.171	0.5	7.0
Processed foods	0.154	16.0	4.9
Other manufactures	0.145	16.6	25.4
Business services	0.142	0.2	1.0
Agriculture	0.138	8.7	9.9
Other services	0.137	0.1	2.1
Textiles & clothing	0.115	14.9	3.6
Vehicles	0.115	18.0	11.5
Machinery	0.092	23.4	11.4
Government	0.080	0.0	0.0
Financial services	0.031	1.3	3.4
All Products	**0.265**	**7.1**	**9.3**

Source: C. Arndt, R. Davies, K. Makrelov and Thurlow (2013)

- Study also estimated CIMs for aggregate products.
- Coal dominated product list due to direct carbon content of coal per se, plus carbon embodied in coal mining process (i.e. goods and services involved in resource extraction and supply to market).
- Heavy-industry related products (e.g. metal products, non-metallic minerals, other mining), as well as wood & paper products dominate carbon-intensive non-energy products rankings.
- Analysis also compares carbon- and export-intensities of aggregate product categories, indicating that SA's principal export products are amongst the more carbon-intensive (e.g. metals, other mining).

Vulnerability of SA sectors (cont.)

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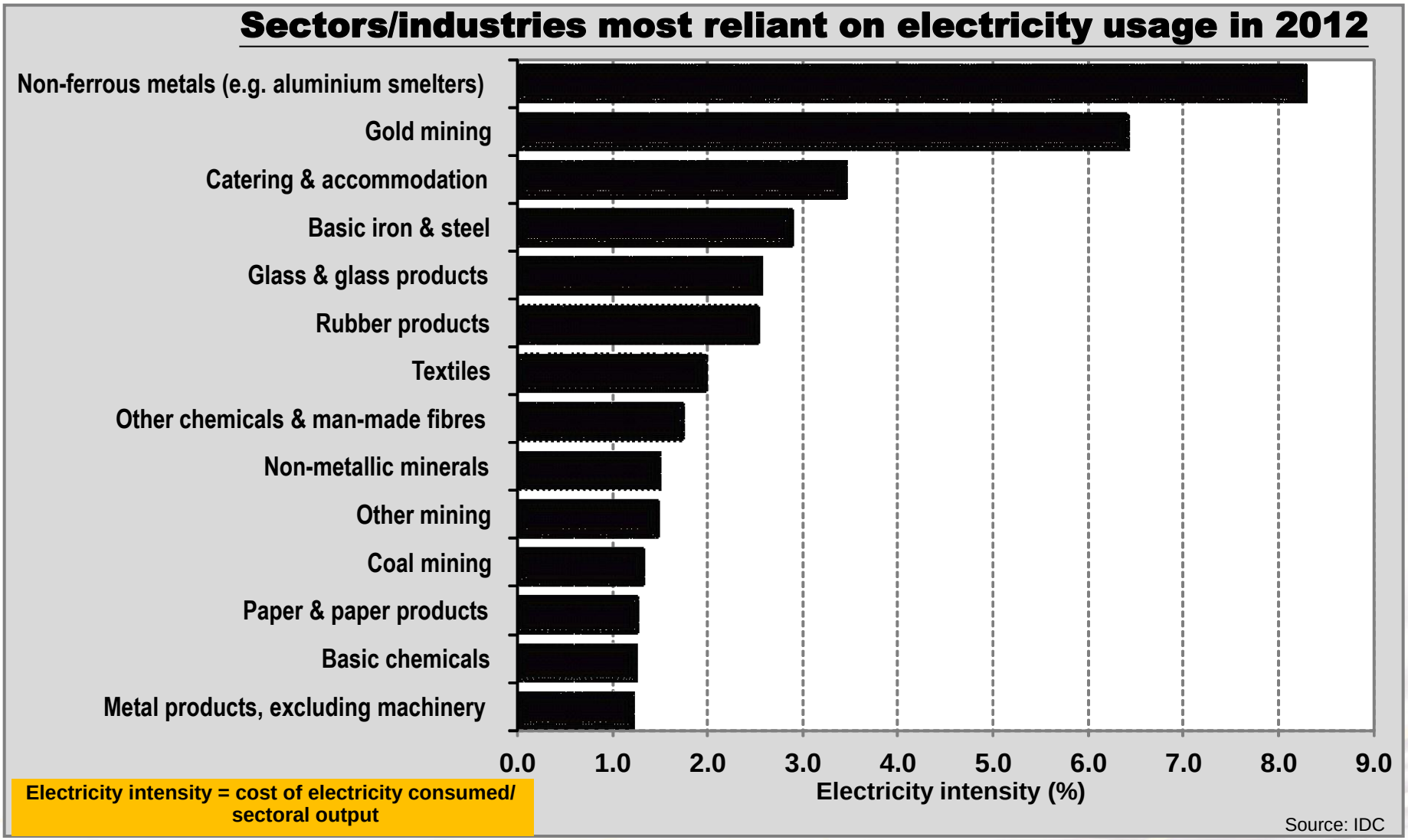

Corporate SA: increasing focus on EE initiatives

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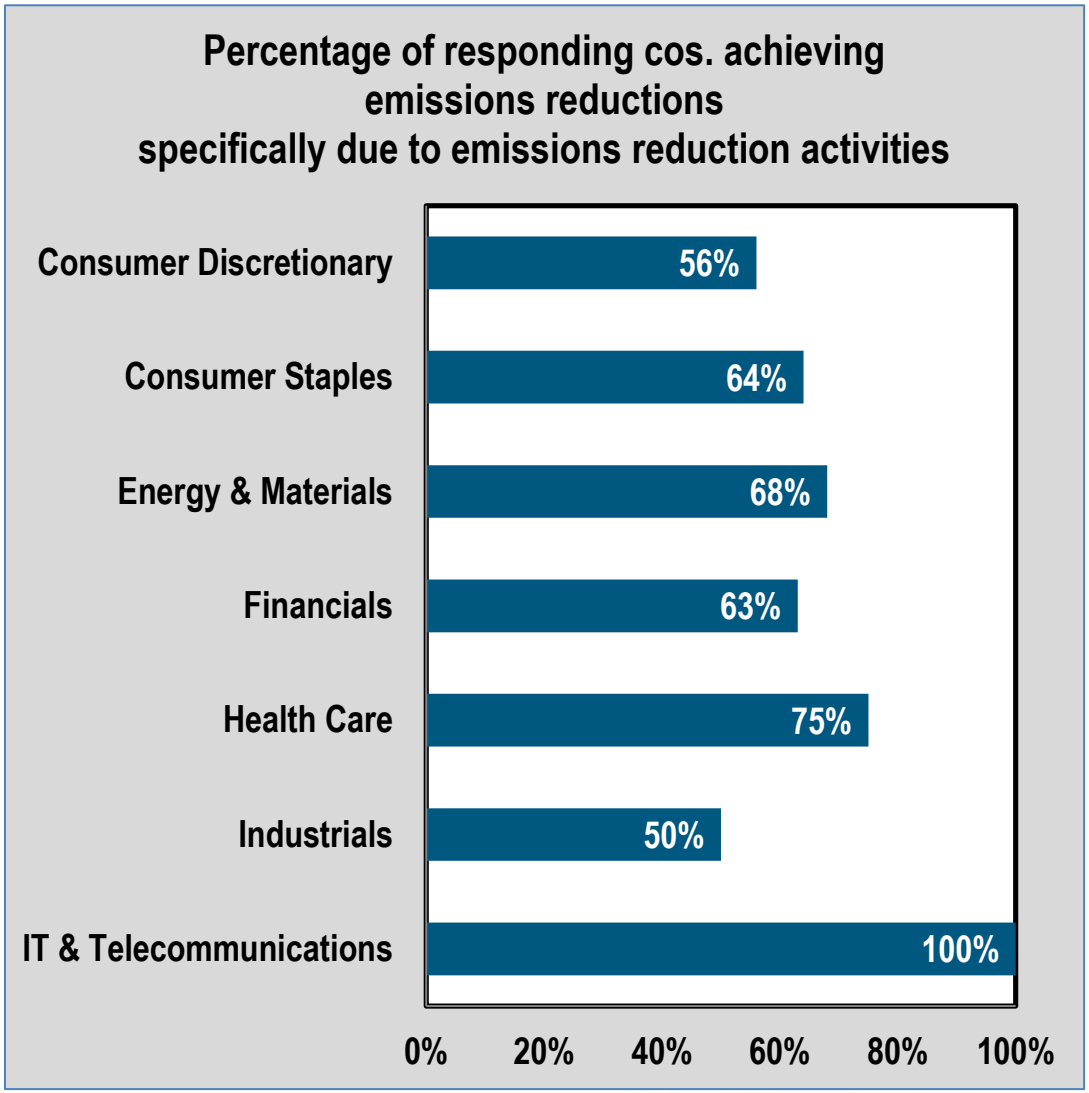

Source: Carbon Disclosure Project South Africa 2012

- Rising energy prices, electricity generation constraints, emissions reduction pressures setting the context.
- CDP SA 2012 - increasing responsiveness of local business sector to climate change issues.
- Continuous improvements in performance and disclosure.
- 43 cos. with GHG emissions reduction targets (40 in 2011).
- EE a core focus: 57 cos. (75% of total) implementing EE initiatives.
- Most common EE initiatives related to processes, building services.
- Other activities: Behavioural-change activities, recycling and switching from paper to electronic communication.

Corporate SA: increasing focus on EE initiatives (cont.)

Several cos. again reported relatively short pay-back periods associated with their EE initiatives.

PAYBACK PERIODS FOR EMISSION REDUCTION INITATIVES			
Emission reduction activity	**<1 year (%)**	**1-3 years (%)**	**>3 years (%)**
Transportation: use	75	0	25
Transportation: fleet	17	33	50
Product design	50	50	0
Process emissions reductions	27	36	36
Low carbon energy purchase	0	0	100
Low carbon energy installation	26	30	43
Fugitive emissions reductions	20	0	80
Energy efficiency: processes	30	34	37
Energy efficiency: building services	28	38	34
Energy efficiency: building fabric	18	18	64
Behavioural change	79	7	14

Source: Carbon Disclosure Project South Africa 2012

Possible reasons for reluctance towards EE at firm level

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Attractiveness of project

- Dimension of project.
- Capex requirements not necessarily budgeted for.
- Firm-specific decision-making process (approval cycle) for long-lasting equipment.
- Pay-back period of project.
- Suppliers.

Motivation

- Firm-specific behavioural characteristics - EE not business as usual.
- Lack of awareness.
- Legacy of historically low energy costs.
- Opportunity costs.
- Uncertainty - operational and implementation risks.
- Non-market pricing.
- Regulatory issues (e.g. cogeneration, fuel rebates, tax depreciation, tariff levels).
- Prevailing market conditions.

Execution capabilities

- Access to internal funds.
- Access to external sources of finance at competitive rates.
- Access to information (energy management tools, best practice, etc.).
- Supply chain issues.
- Innovation effort and related costs.
- Skills and training requirements.

Key success factors of EE programmes

- Incentive packages that reflect the real costs of energy and efficiency improvement measures.
- Development of specific tools for investment funding, promotion of innovative measures.
- Appropriate regulatory framework in place, as well as coordination and integration of related policies, albeit with administrative simplicity.
- Collaboration between all role players in the public and private sectors, including an exemplary role played by the public sector.
- Need to address all end-users with energy efficiency potential.
- Ex-post monitoring and evaluation of implemented measures, including quality control of equipment, certification of processes.

IDC: Investing in the Green Economy

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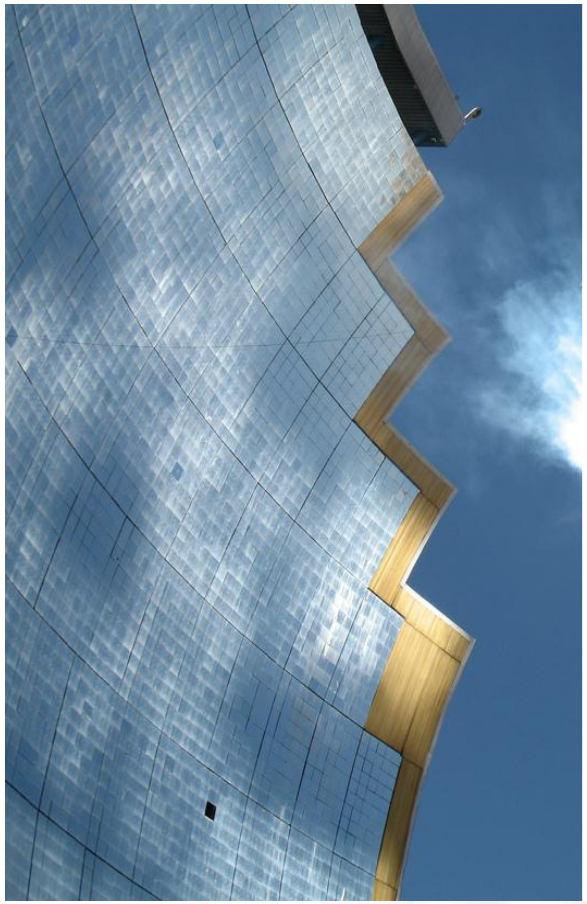
The IDC's role in growing the **Green Economy** is through investments in:

- Clean production
- Clean and renewable energy
- Energy efficiency
- Demand-side management interventions
- Emissions and pollution mitigation
- Waste reduction
- Bio-fuels



- Focus on early phase project development.
- Develop specific funding interventions (e.g. GEEF).
- Support and development of emerging industries at various levels.
- Value chain approach, with emphasis on industrial development (incl. localization), job creation and the development of long-term sustainable industries.

IDC-funded case study 1: 25% reduction in grid electricity consumption by installing a solar photovoltaic (PV) system

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- Cape Town-based company producing sportswear and leisurewear under license to an international brand.
- Embarked on a project to install a grid-connected (grid-tied) rooftop PV system to generate 25% of its annual electricity requirements.

Sector	**Textile industry**
Province	**Western Cape**
Goals	**Reduced reliance on coal-based electricity from grid**
Investments	**Solar photovoltaic (PV) system – 30kW peak**
Financial savings	**Investment cost covered by energy and cost savings**
Other benefits	**Positive image as a progressive, environmentally-friendly company**
CO_2 reduction	**50 CO_2 tons per annum**

"Electricity accounts for more than 90% of our carbon emissions and is a scarce resource that is vital to the successful operation of our business. We are confident that the solar installation will generate 30% to 40% of our energy requirements, thereby reducing our carbon footprint, save money and improve our sustainability into the future." (William Hughes, MD, Impahla Clothing)

IDC-funded case study 2: Energy savings from utilisation of waste gas to feed a Combined Heat and Power (CHP) plant

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- The chemical production company wants to use its waste gas as fuel for a 7.8 MW CHP plant to replace part of the power supply from the grid.
- This results in 18% savings from using the waste gas to feed the CHP plant.

Sector	**Chemical industry**
Province	**KwaZulu-Natal**
Goals	**Reduced reliance on coal-based electricity from grid**
Investments	**• 4 co-generation units • Scrubber plant**
Financial savings	**Investment cost covered by energy and cost savings**
Other benefits	**Increased reliability from own energy supply**
CO_2 reduction	**46 000 CO_2 tons per annum**

"The company spends close to R7-million on electricity a month, and this new co-generation plant will cut this bill by about 20%. The additional 8 MW capacity will enable the company to operate at full production, compared with the 70% capacity because of electricity constraints." (Claudio Siracusano, GM, SACC)

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Thank you