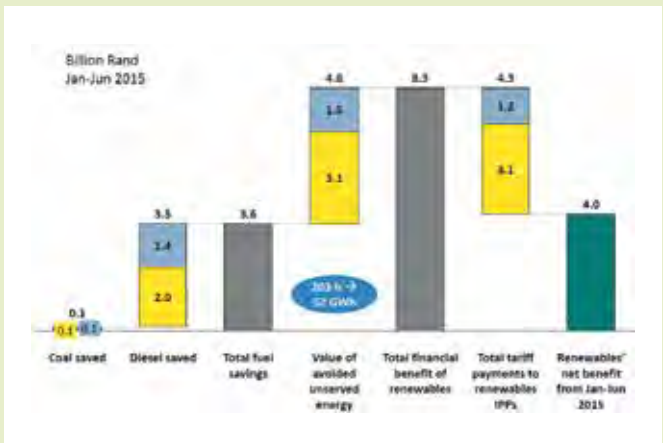
# QUANTIFYING THE FINANCIAL BENEFITS OF WIND AND SOLAR ENERGY PROJECTS IN SOUTH AFRICA

By Joanne Calitz, Crescent Mushwana and Dr Tobias Bischof-Niemz

The first wind and solar photovoltaic projects that were connected to the South African national power grid in 2014 resulted in a net financial benefit to the country of R0.8 billion. In a subsequent study the CSIR has determined that in the first six months of 2015, wind and solar projects created R4 billion more financial benefits to the country than what these projects cost. This seems to indicate a trend where the financial benefit of renewables in South Africa far exceeds their cost.

The CSIR has quantified the financial benefits of the first solar and wind renewable energy projects (such as this wind farm in the Western Cape) that were connected to the South African national power grid in 2014. A subsequent study calculated the benefits of renewables from January to June of this year.




This graph shows how the total net benefit from renewable energy projects was calculated for the period from January to June 2015.

**AN INDEPENDENT STUDY BY THE CSIR** has found that renewable energy from South Africa's first wind and solar photovoltaic projects created R4 billion more financial benefits than what these projects cost during the first six months of 2015 (January to June). Without these wind and solar projects, South Africans would have had to endure a higher stage of load shedding during 15 extra days during this period.

The study is an update and continuation of an initial study that was published in January 2015 that covered the 2014 calendar year. In that initial study, it was shown that renewable energy projects generated 2.2 TWh (terawatt-hours) of electricity in 2014, which saved R3.6 billion worth of fuel for the conventional fleet (mainly coal and diesel fuel). The availability of renewables furthermore avoided the curtailment of customer load, with an additional macroeconomic value of R1.7 billion. The total financial benefit of renewables to the country was therefore R5.3 billion in 2014, compared to R4.5 billion in tariff payments to the owners of the wind and solar photovoltaic projects in the same year. This resulted in a net financial benefit to the country of R0.8 billion in 2014.

In the follow-up study, for the period from 1 January to 30 June 2015, the benefits earned from renewables were again two-fold. The first benefit, derived from diesel and coal fuel cost savings, is pinned at R3.6 billion (or R1.82 per kWh of renewable energy). This is because 2 TWh of wind and solar energy replaced the electricity that would have otherwise been generated from diesel and coal (1.5 TWh from diesel-fired open-cycled gas turbines and 0.5 TWh from coal power stations).

The second benefit of R4.6 billion (or R2.33 per kWh of renewable energy) is a saving to the economy derived from 203 hours of so-called 'unserved energy' (a total of 52 GWh = 0.05 TWh) that were avoided. During these hours the supply situation was so tight that some customers' energy supply would have had to be curtailed ('unserved') if it had not been for the renewables. As a consequence, during 15 days from January to June 2015, load shedding was either entirely avoided, delayed, or a higher stage of load shedding was prevented thanks to the contribution of the wind and solar photovoltaic projects.

These direct cash savings on fuel spending to Eskom and the macroeconomic benefits of having avoided 'unserved energy' are countered by the tariff payments to the independent power producers of the first wind and solar photovoltaic projects. They amounted to R4.3 billion from January to June 2015.

The CSIR's first solar photovoltaic (PV) power plant was constructed between June and August 2015 on its Pretoria campus. This one-hectare, ground-mounted 558kW PV facility feeds power directly into the CSIR's grid and provides for around 4% of the energy needs of the campus. It is one of the first steps taken in the CSIR's quest to become a leader in the era of distributed energy generation. The solar power generated by the facility will equate to an annual carbon dioxide saving of approximately 1 200 tonnes, which will significantly reduce the CSIR's carbon footprint.

Therefore, renewables contributed a total net benefit of R4.0 billion (or R2.0 per kWh of renewable energy) to the South African economy.

The study was based on actual hourly production data for the different supply categories of the South African power system (e.g. coal, diesel, wind, photovoltaics). The CSIR has developed a methodology to determine whether at any given hour of the year, renewables have replaced coal or diesel generators, or whether they have even prevented 'unserved energy'.

This CSIR methodology was fed with cost assumptions from publicly available sources, such as Eskom's 2015 financial results for coal and diesel costs, the Department of Energy's publications on the average tariffs of the first renewable energy projects and the Integrated Resource Plan on the cost of unserved energy.

Because the study is an 'outside-in' analysis of the system operations, conservative assumptions for the system effects and for the costs of coal were chosen. The actual cost savings that renewable energy sources brought during the first six months of 2015 may be higher than shown by the study.

The study shows that in the first six months of 2015, the trend that started in 2014 – that renewable energy provided a huge net financial benefit to the country – continued and accelerated.

Without the first solar and wind projects, the country would have spent significant additional amounts on diesel, and energy would have had to be 'unserved' during more than 200 additional hours from January to June 2015. What is more, the cost per kWh of renewable energy for new projects is now close to 80c for solar photovoltaics and between 60c and 70c for wind projects. That will keep the net financial benefits of renewables positive, even in a future with a less constrained power system.

Energy generated by any new wind and photovoltaics project will generate electricity at approximately 65% less than the first projects that came online during 2014. The drop in the prices of wind and photovoltaics is in line with global observed trends over the past five to ten years, which can be attributed to mass manufacturing, improved production processes and technological advancements.

By quantifying for the first time the financial costs and benefits of renewables in South Africa, based on actual hourly production data, the CSIR's ongoing study is contributing to the discussion around the power-system capacity expansion for the future. The CSIR will continue to monitor the fuel-saving and security-of-supply benefits of renewable energy in the country.



**Enquiries:**
**Dr Tobias Bischof-Niemz**
**tbischofniemz@csir.co.za**