











ramping and inefficiencies and the storage graph looking like “white noise” over the period of a month.

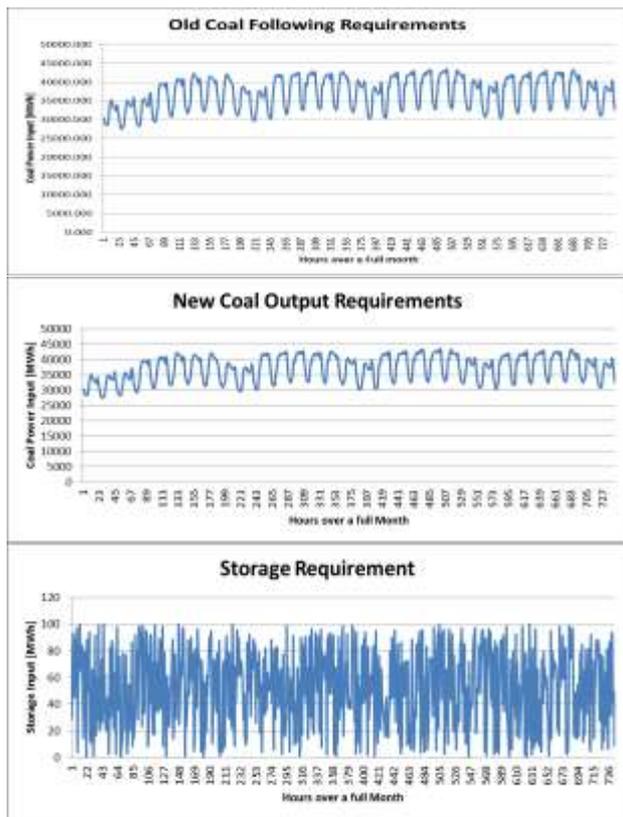


Fig. 8: Monthly results calculation

## 6. Conclusion

The objective of this study was to highlight the importance of storing electrical energy in large instantaneous capacities for both large and small utilization purposes. It investigated other electrical energy storage capabilities and compared them to what capacity is actually required in SA for the years ahead and to evaluate the SA current resources and storage capabilities. The IRP 2010 updates were investigated and it was found that storage does not form part of the major plan to ensure energy sustainability for SA for the future. Although the renewable energy mix will increase over the next 30 years and will take a large portion of the energy responsibility, it is without storage for now. The only big storage projects SA invested in as to date is pumped storage facilities. Taking into consideration the positive effects storage can bring to the SA National Grid, it is a good idea to implement storage into the IRP plan as this will provide flexibility to the National Grid and reduce the time it takes to meet the reduction of CO<sub>2</sub> emissions and energy demand forecasts, as well as extend many asset lives of other stations. Furthermore, integrating the possible storage of renewable electrical energy with current technologies is definitely possible as it has been done across the world on other projects with positive results. The new locations in SA for energy storage will have to be evaluated as the storage phenomenon to South Africans is taken more seriously and more resources must become available to assist in this evaluation because the whole transmission and distribution grid will have to be considered as well as geographical locations. Battery

technology is used on platforms that include households, small businesses, e-mobility (vehicles), railways, etc. SA, compared to other countries is lagging far behind and will most probably, according to us, only catch up by 2030 when the energy race will become entirely green. Investors will need to consider larger hydro projects such as the Inga project, possibly with storage units in the future, to give each neighbouring country a backup supply. This research used real data from 2016 and showed how energy storage could reduce load following requirements from base load stations and emergency reserves and the savings that are possible in terms of costs, time and equipment life time. A basic energy storage and cost savings calculator was built in MS Excel which is useful to do basic estimates.

## References

- [1] S. DOE, "Integrated Resource Plan for Electricity of South Africa (IRP) Update Report," DOE, 2013.
- [2] NERSA, "The South African Grid Code: The System Operator Code," NERSA, 2010.
- [3] S. DOE and IRP2010 Update, "Integrate Resource Plan Update - Assumptions, Base Case Results and Observations," DOE, 2016.
- [4] S. DOE, "State of Renewable Energy in South Africa," Department of Energy, Pretoria, 2015.
- [5] E. H. S. Ltd., "Transmission Development Plan 2016 – 2025 Presentation," Eskom Holdings SOC Ltd., 2016.
- [6] E. H. S. Ltd., "Transmission Development Plan 2012 – 2021", GP Report 11/139," Eskom Holdings SOC Ltd.
- [7] E. H. S. Ltd., "Ancillary Services Technical Requirements for 2017/18 – 2021/22," Eskom Holding SOC Ltd., 2016.
- [8] NERSA, "Grid Connection Code for Renewable Power Plants (RPP's) Connected to the Electricity Transmission System (Ts) or the Distribution System (Ds) in South Africa," NERSA, 2014. [Online]. Available: <http://www.nersa.org.za/Admin/Document/Editor/file/Electricity/TechnicalStandard>.
- [9] E. H. S. Ltd., "A Feasibility Study on the use of Renewable Energy Sources for Black Start," Eskom, 2015.
- [10] DOE, Electricity Storage Handbook in Collaboration with NRECA, Sandia National Laboratories, 2015.
- [11] R. Johnson, "Energy Storage Benefits for Africa," 05 2016. [Online]. Available: <https://www.esi-africa.com/wp-content/uploads/2016/05/Randell-Johnson.pdf>.
- [12] U. S. T. D. A. Parsons, "South Africa Energy Storage Technology and Market Assessment," US Trade and Development Agency and Parsons, 2017.