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8-9 October 2015 | CSIR ICC

Smoothing out the volatility of South Africa's Wind and Solar Energy Resources

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Agenda

Background

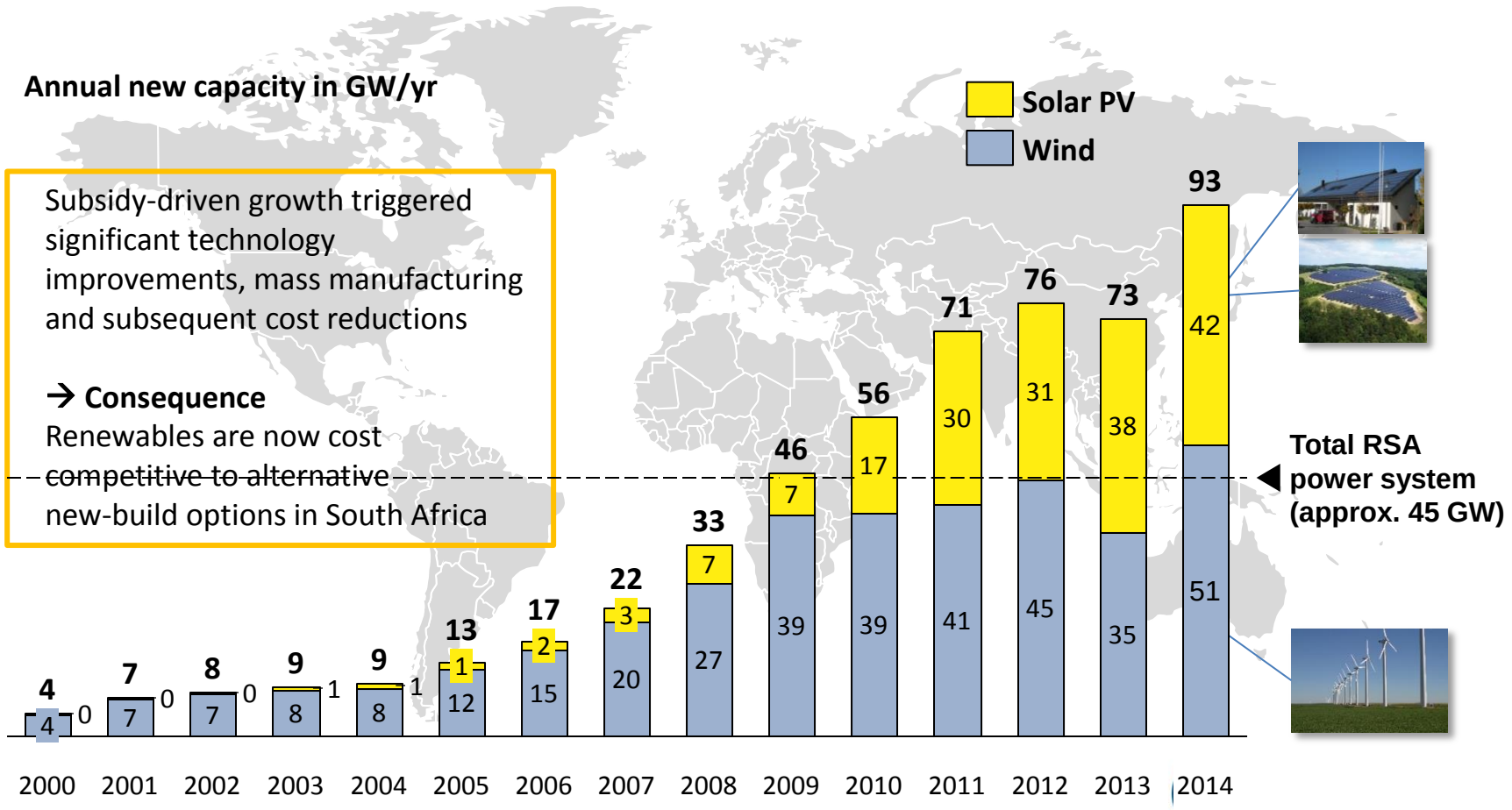
South Africa's wind and solar resource

Wind and solar aggregation study

Acknowledgements/collaborations

Next steps

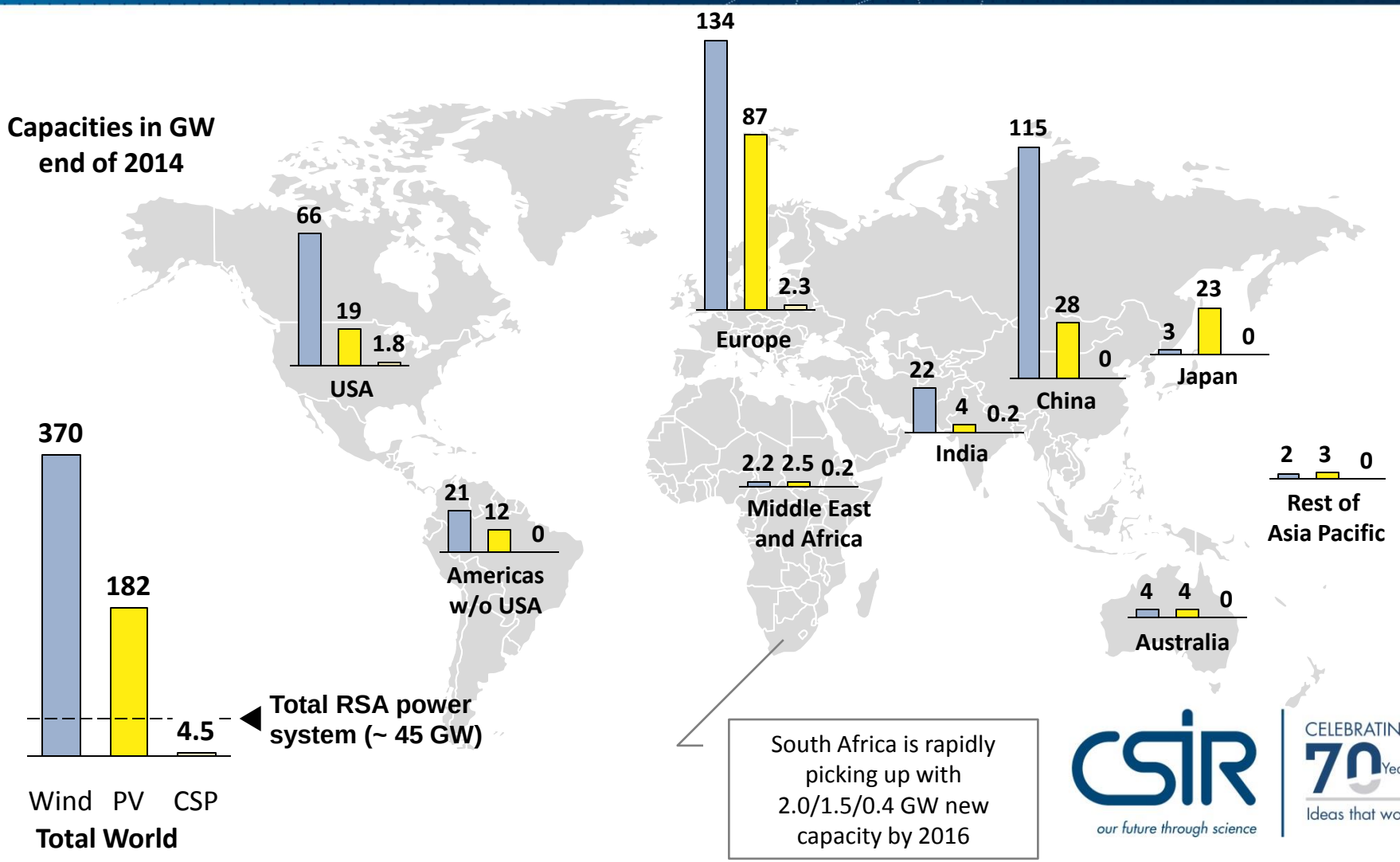
Last year alone, 93 GW of wind and solar PV were installed globally



This is all very new: Almost 90% of the globally existing PV capacity was installed during the last five years alone!

Sources: International Energy Outlook of the EIA; GWEC; EPIA; CSIR analysis

Until today, renewables were mainly driven by the US, Europe and China – South Africa picking up



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Sources: GWEC; EPIA; CSPToday; CSIR analysis

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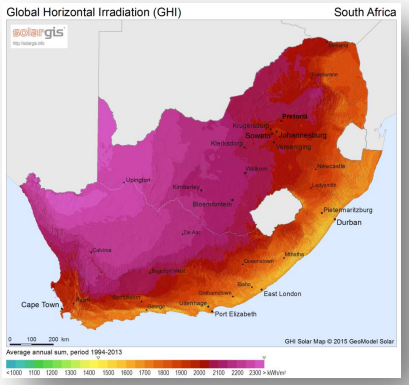
South Africa has abundant solar and wind resources

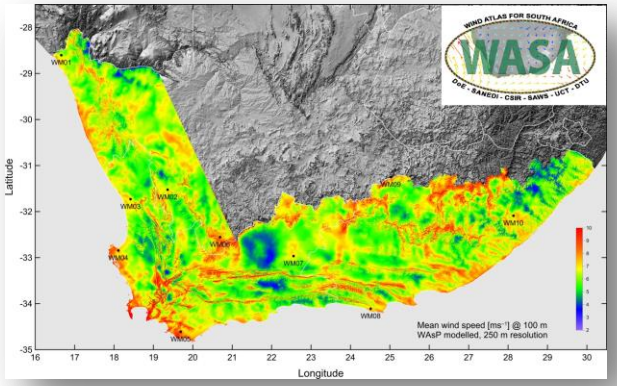
South Africa has some of the world's best solar and excellent wind resources, that until today are largely untapped

The Integrated Resource Plan 2010 plans for 8.4 GW of PV and 9.2 GW of wind by 2030 in South Africa

These targets which were developed five years ago are far below potential

Cost not a barrier anymore: new wind now costs 0.6 R/kWh (< 5 $ct/kWh) and new solar PV costs 0.8 R/kWh (6 $ct/kWh), based on actual PPA tariffs





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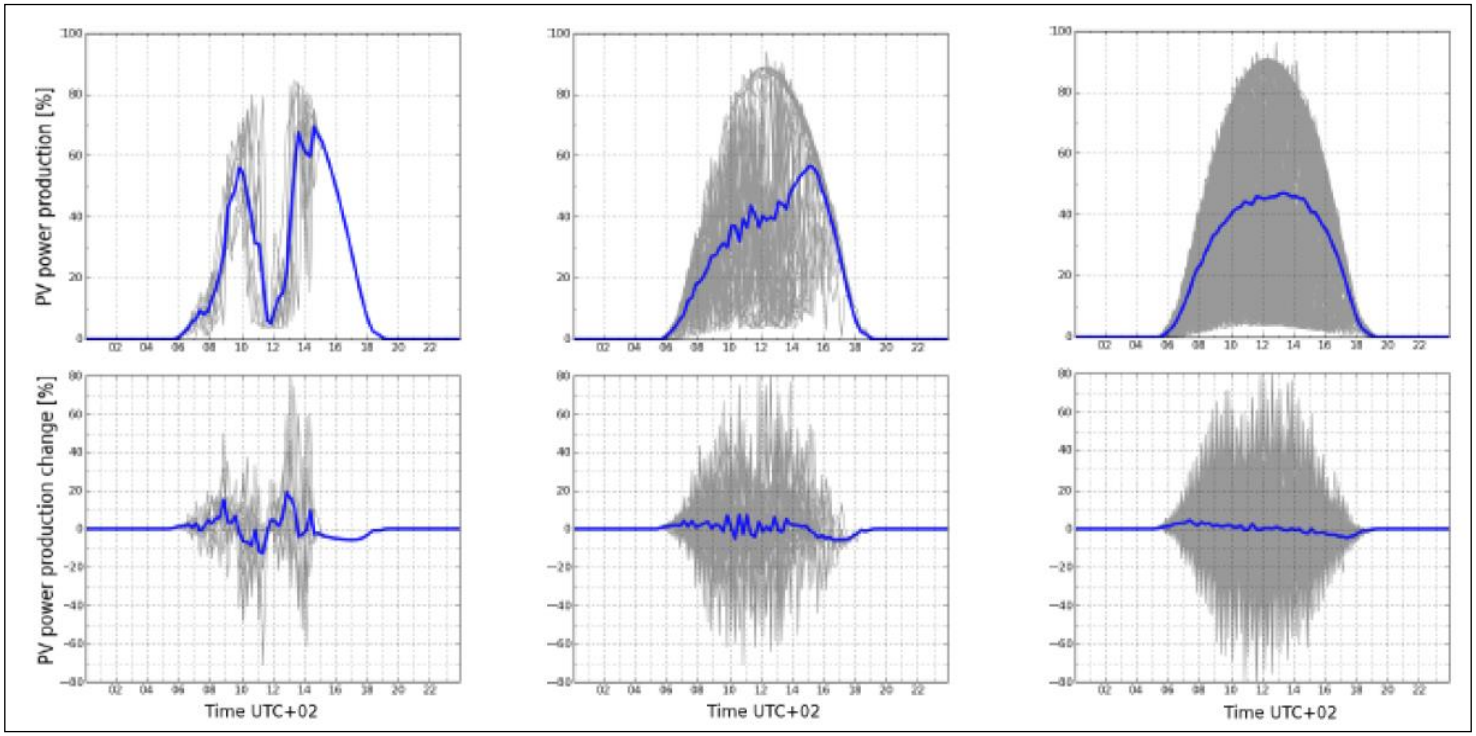
PV study from 2014: Short-term fluctuations completely vanish with spatial aggregation

50x50 km (9 power plants) 250x250 km (49 power plants) 500x500 km (225 power plants)

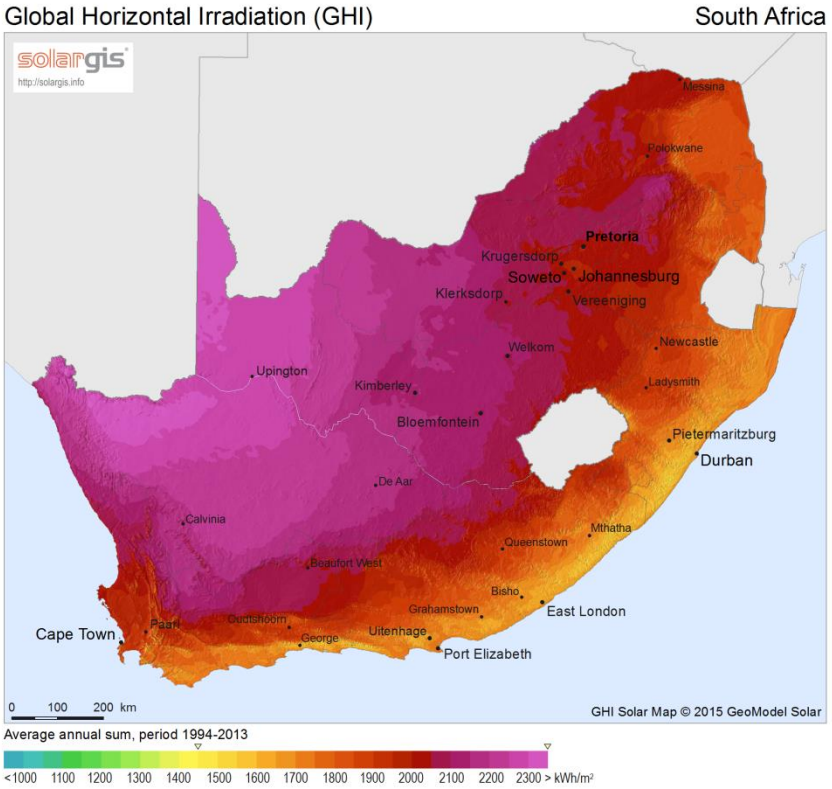


Widespread spatial aggregation reduces short-term volatility

Sources: Eskom study by Geomodel Solar Study on Cloud Cover Impact on PV production in SA

South Africa has almost 2-times the solar resource as Germany, where PV is close to cost competitiveness

Solar resource in South Africa…



SA's planned PV capacity by 2030: 8.4 GW target too low

… as compared to Germany

Germany's status today: almost 40 GW PV installed capacity (roughly one Eskom)

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Wind and solar aggregation study: Main objective to quantify the effects of spatial distribution on output

Increase the fact base and understanding of aggregated wind and PV power profiles for different spatial distributions in South Africa

Generate data sets that can be used for various studies (IEP, IRP, TDP, SEA etc.)

Resulting in:

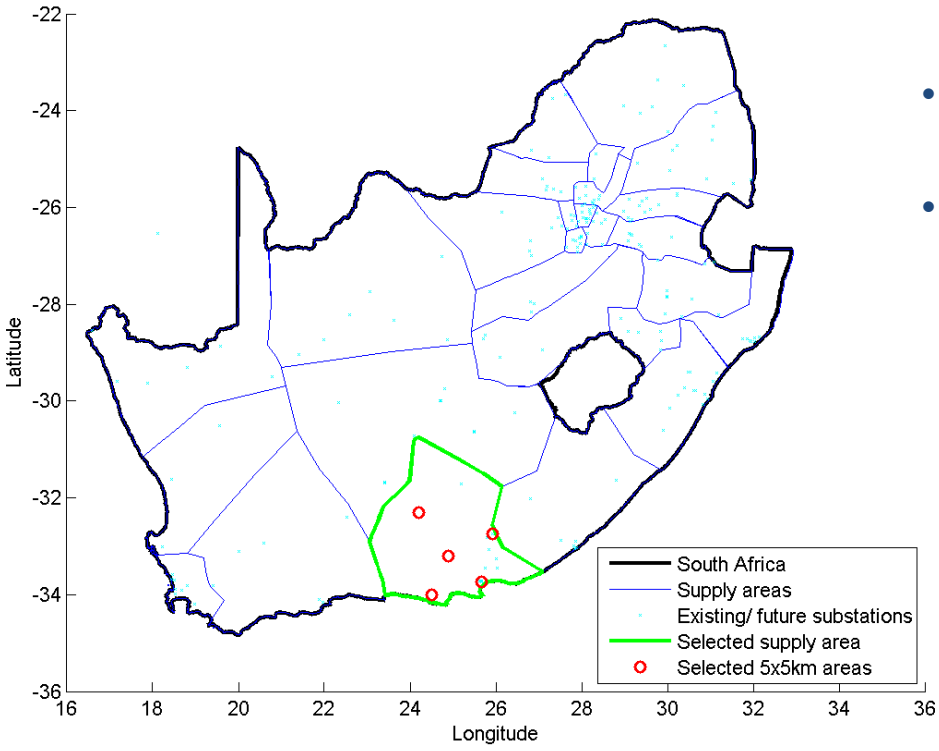
- Confidence in integrating higher renewables shares
- Optimal mix of wind and PV, to minimise cost and maintain grid stability easier

Transfer of knowledge and skills on utilising wind data in energy-planning activities

The study is currently being conducted for South Africa

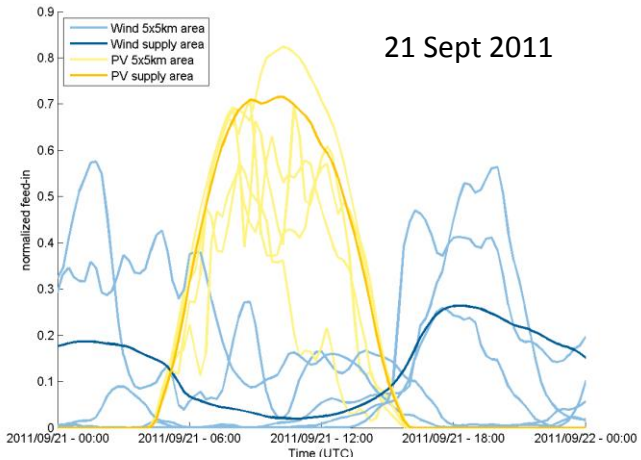
- Wind and solar data sets covering the entire country
- 5x5 km spatial resolution, 10-minute time resolution, 5 years of data
- Spatial load data for the entire country

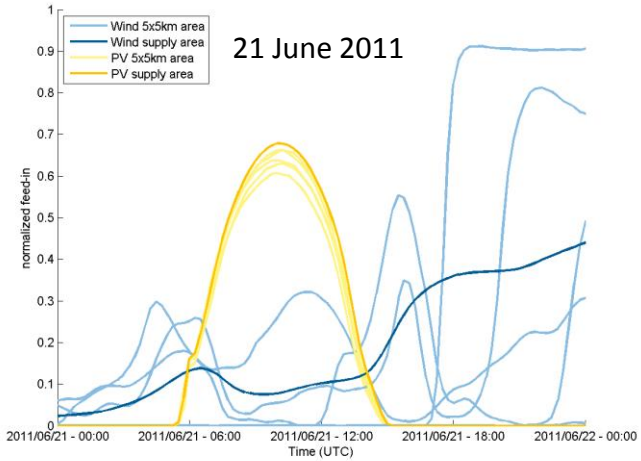
Preliminary study for the Port Elizabeth area



- Five areas/sites (5x5km each) selected as generation sources
- 2011 Wind (WASA) and solar PV profiles (Geomodel Solar) used

First results show on two specific days how volatility of wind and solar reduces with spatial aggregation

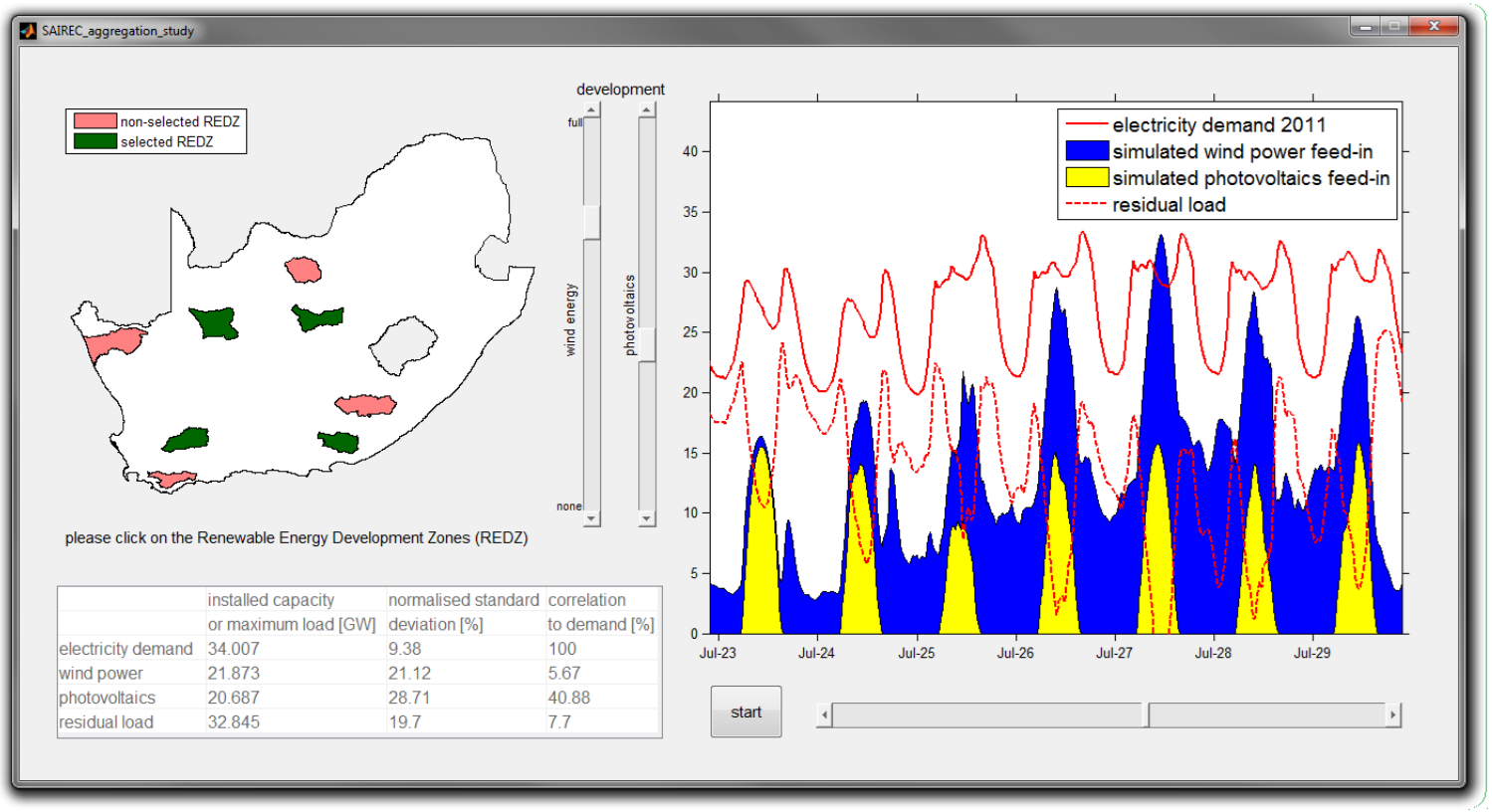




- Individual plants have high ramp rates
- Individual plant power output very volatile; low predictability

- Area (aggregated) output is much smoother with low ramp rates
- Aggregated plant output is more predictable

Animated graphical user interface to "blend your own wind/solar mix"



	installed capacity or maximum load [GW]	normalised standard deviation [%]	correlation to demand [%]
electricity demand	34.007	9.38	100
wind power	21.873	21.12	5.67
photovoltaics	20.687	28.71	40.88
residual load	32.845	19.7	7.7

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Acknowledgements and contribution

Fraunhofer IWES

Eskom

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South African National Energy Development Institute.

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Analysis for the for 27 load areas covering the whole country

Include the load profile in the analysis to determine the residual load (Load – PV – Wind) – Done!

Country wide analysis for different shares of wind and PV

Determine residual metrics that can be used to determine the capability of conventional plants

Estimate the resource potential – Done!

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Thank you

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