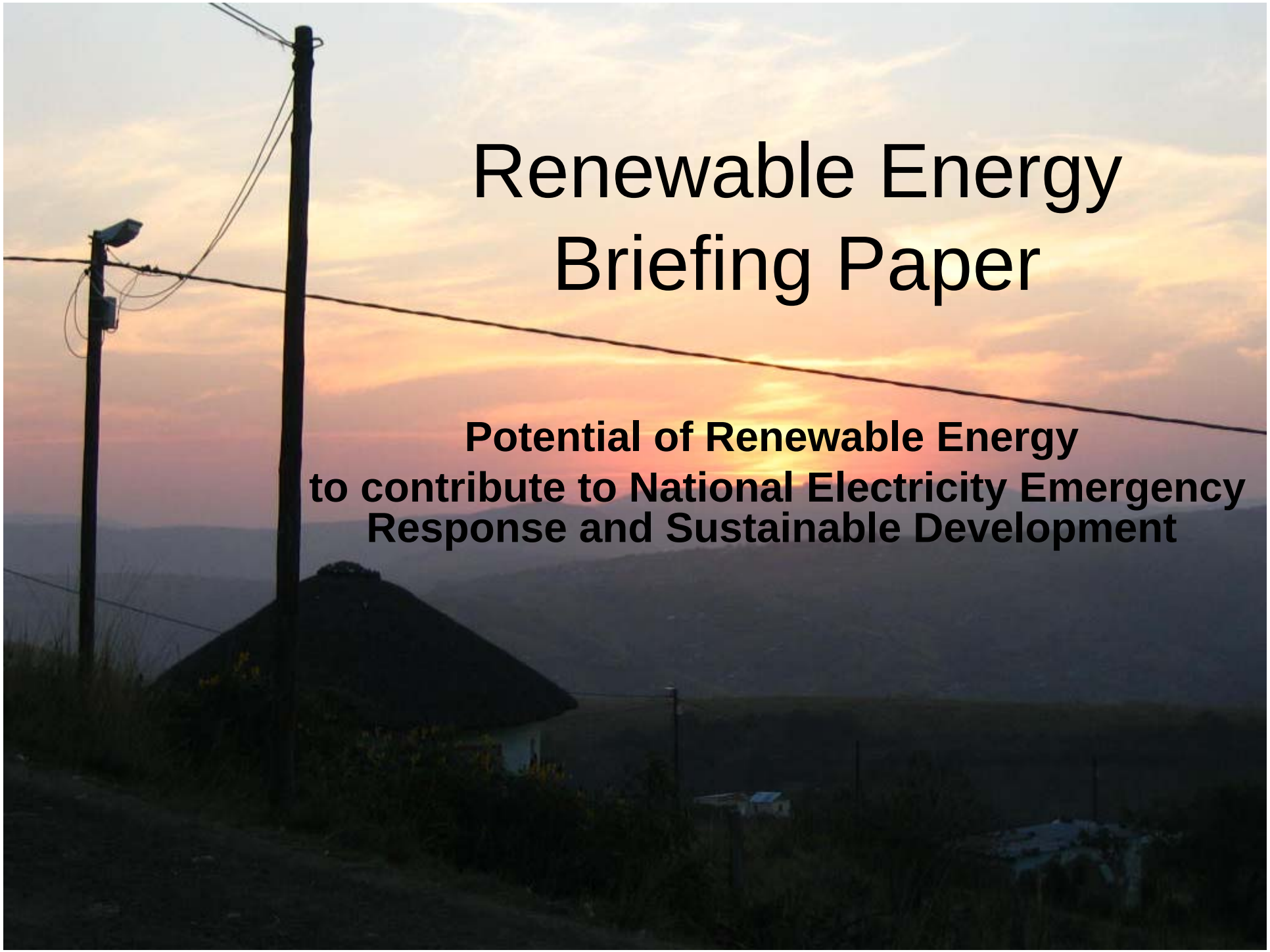
Renewable Energy
Potential and Progress

Presentation to:

Second conference on
Energy in Southern Africa

3 December 2009

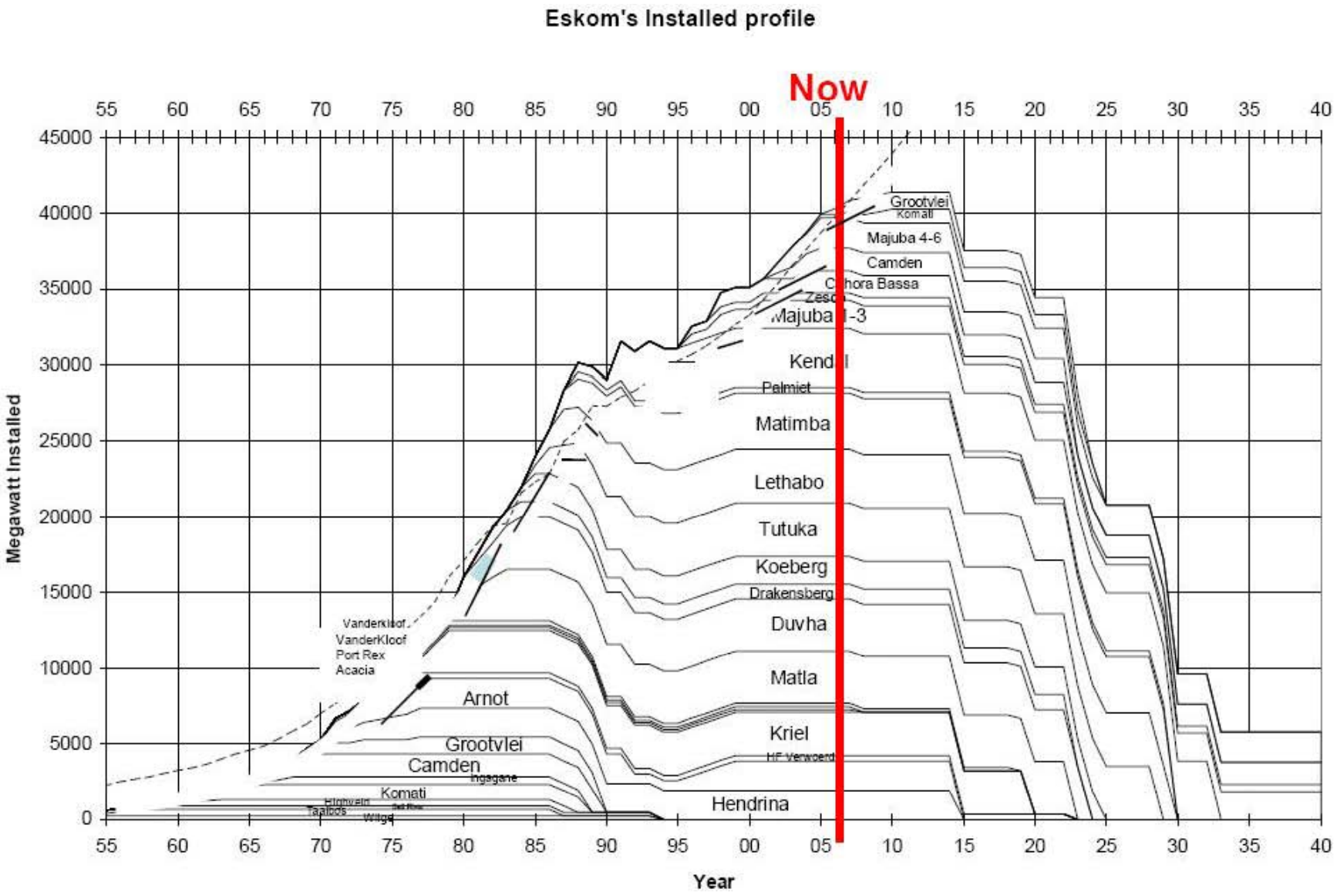
Jason Schäffler
Nano Energy

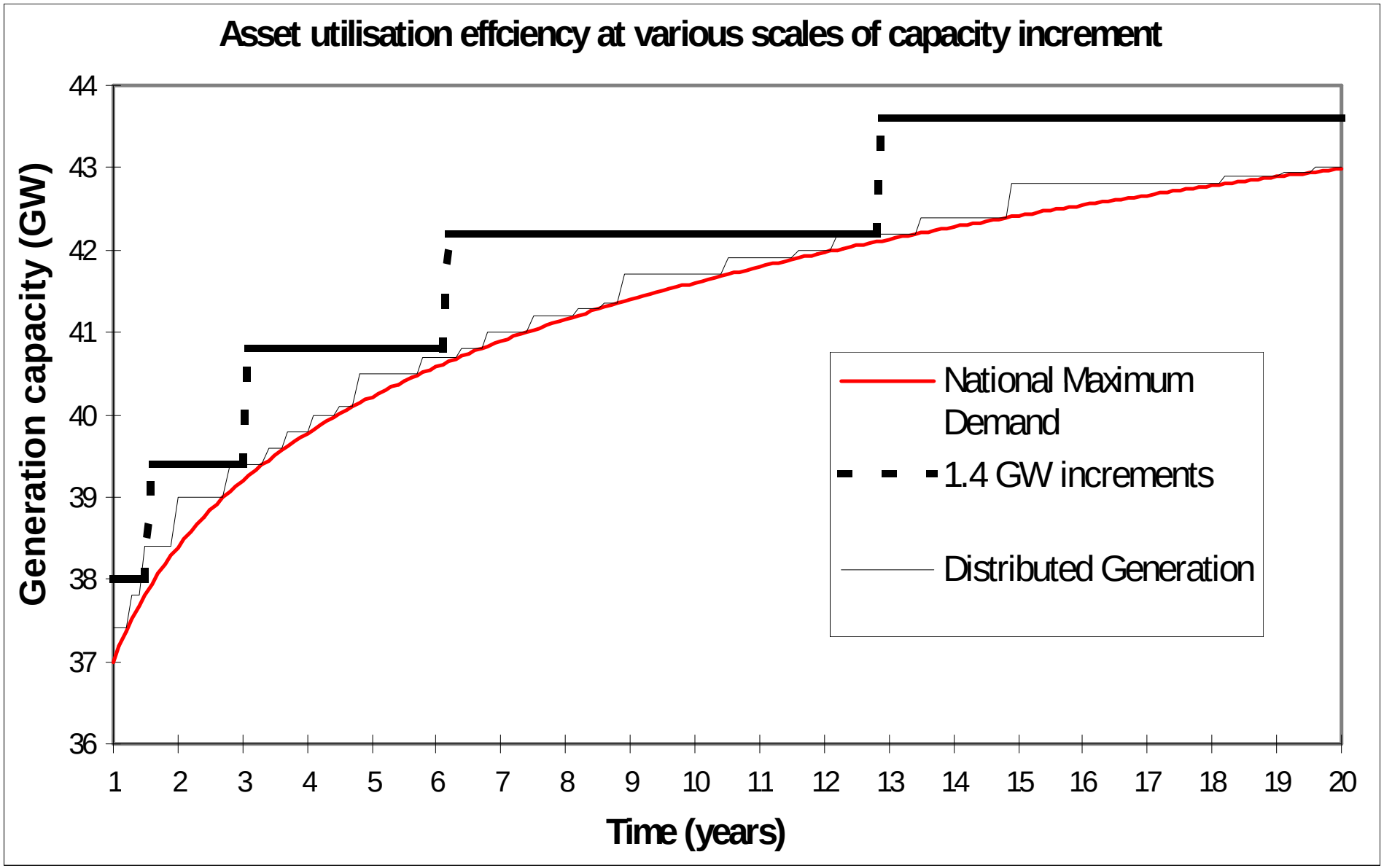


Renewable Energy Briefing Paper

Potential of Renewable Energy to contribute to National Electricity Emergency Response and Sustainable Development

“We knew it 10 years ago”




Asset utilisation effciency at various scales of capacity increment
Generation capacity (GW)
44
43
42
41
40
39
38
37
36
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Time (years)
National Maximum Demand
1.4 GW increments
Distributed Generation

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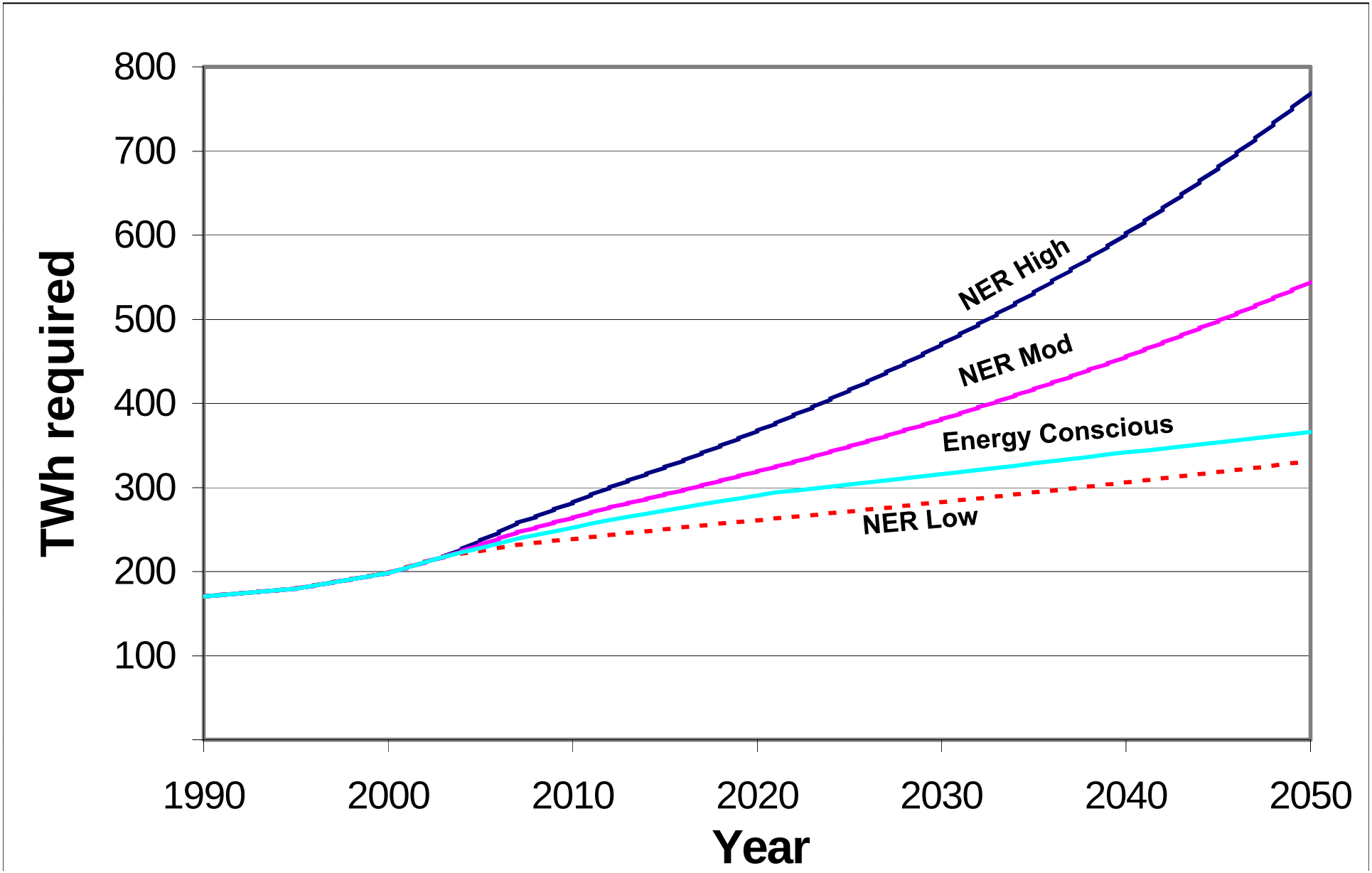
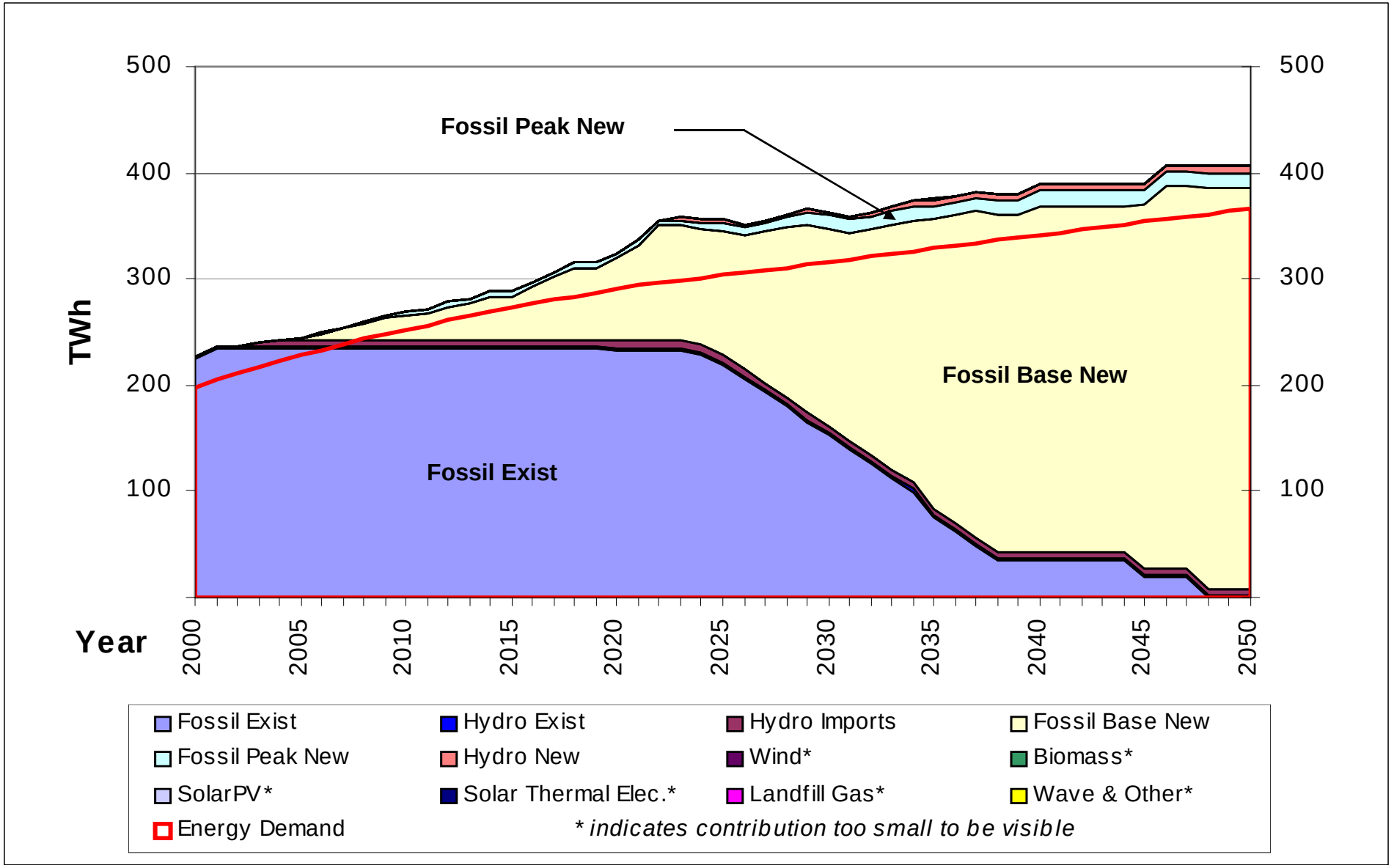
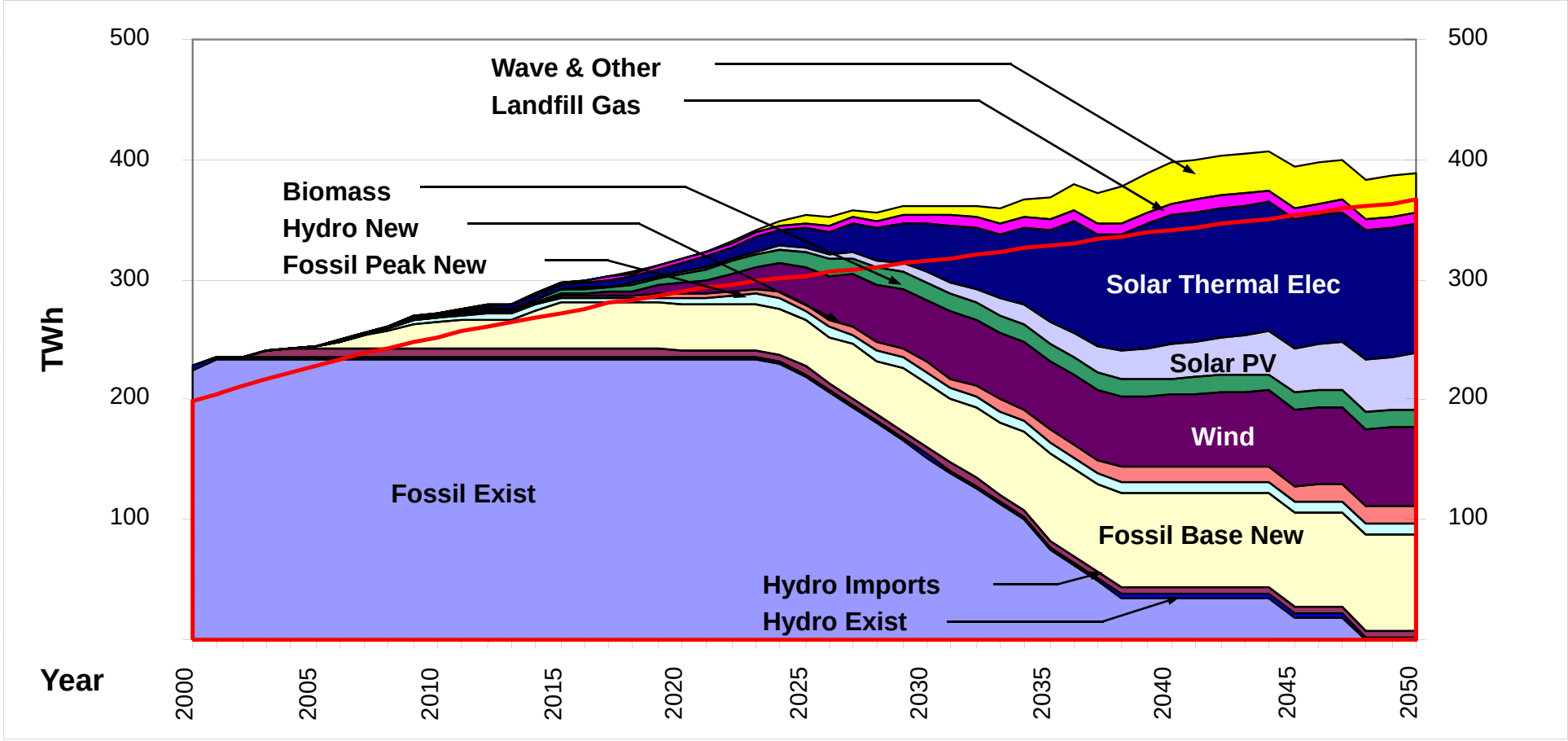
Electricity demand predictions

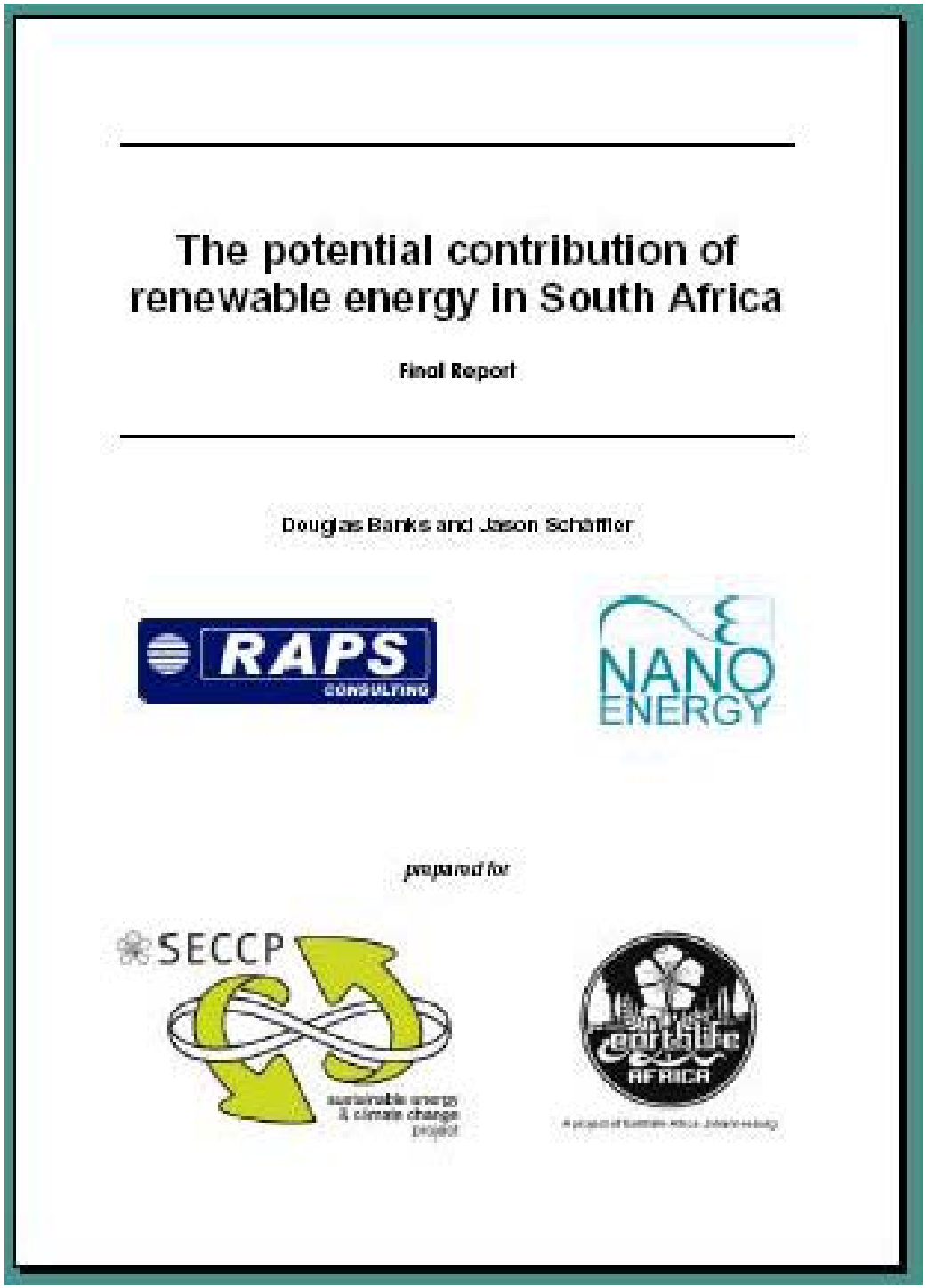


Business as usual – energy demand matching



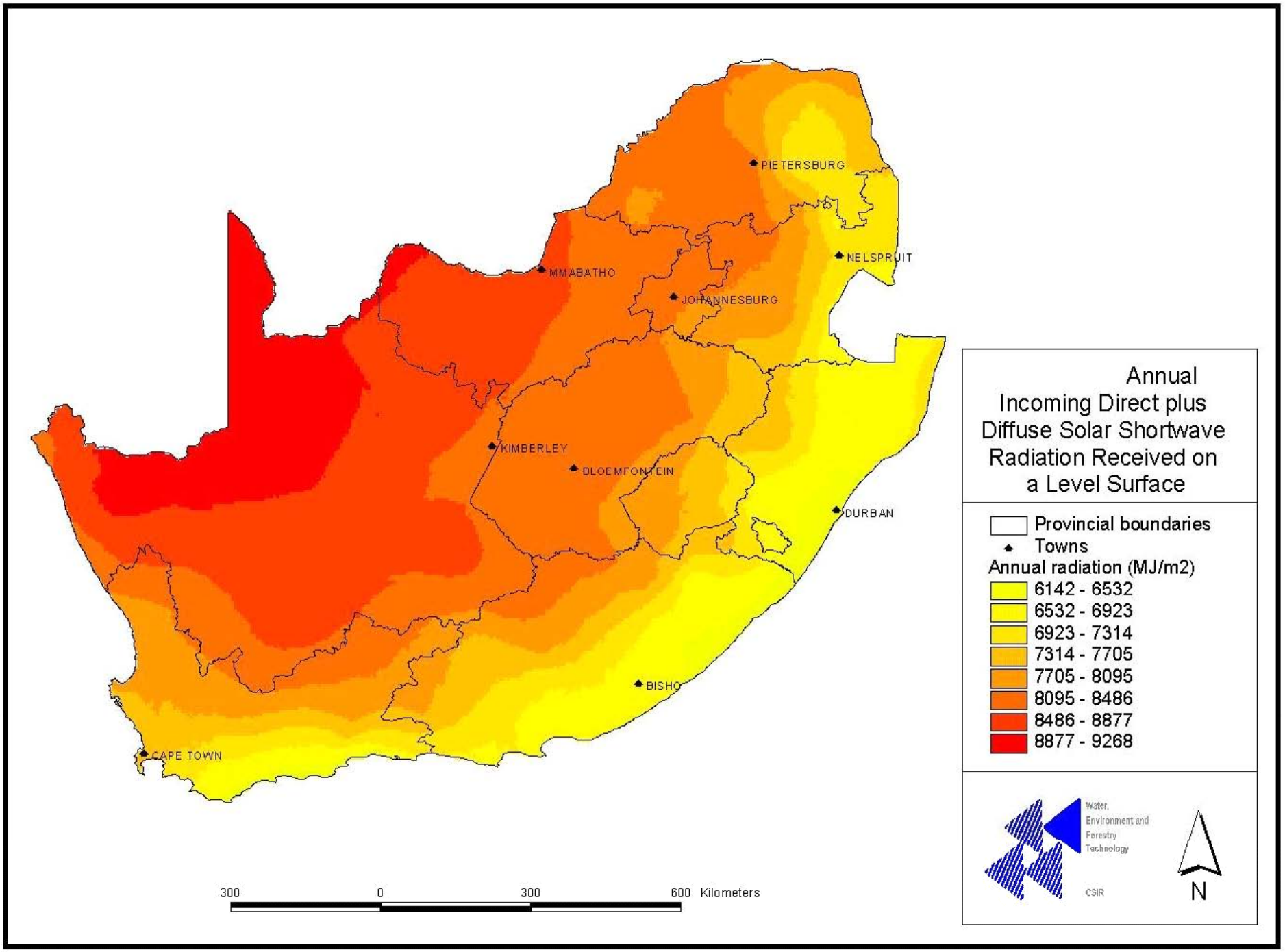
Progressive RE: electrical demand matching





Study

- www.seccp.org.za
- www.restio.co.za
- www.nano.co.za


PIETERSBURG
NELSPRUIT
MMABATHO
JOHANNESBURG
KIMBERLEY
BLOEMFONTEIN
DURBAN
BISHO
CAPE TOWN
300
0
300
600 Kilometers
Annual Incoming Direct plus Diffuse Solar Shortwave Radiation Received on a Level Surface
Provincial boundaries
Towns
Annual radiation (MJ/m2)
6142 - 6532
6532 - 6923
6923 - 7314
7314 - 7705
7705 - 8095
8095 - 8486
8486 - 8877
8877 - 9268
Water, Environment and Forestry Technology
CSIR
N

Solar

- PV electricity generation
  - Resource is excellent, contribution not limited by resource or even land availability but manufacture and intermittency
- Solar thermal electric
  - 25 – 40MW/Km^2, use balanced with other technologies with inclusion of linked thermal storage options
- Solar thermal heating
  - 55TWh by 2050 from conservative extrapolation of World Bank 2004 43TWh annually by 2020.

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Solar Contribution to the Target

(Progressive 15% electric by 2020) – (GWh)

	Wind (GWh)	SWH (GWh)	SWH (1000 m2)	Solar Contrib Total (GWh)	RE Elect Contrib	WindElectricOfRE Elec%	SolarElectricOfREElec%
2003	0	426	467	0	8426	0	0.2
2004	11	511	560	94	8477	0	0.3
2005	11	613	672	201	8581	0	0.4
2006	24	797	874	392	8968	0	0.4
2007	76	1116	1223	718	9874	1	0.5
2008	208	1562	1712	1174	11101	2	0.5
2009	470	2187	2397	2209	12511	4	3.7
2010	612	3062	3356	3500	13583	5	6.5
2011	795	4287	4698	5146	14754	5	8.8
2012	1033	6002	6578	7291	16377	6	10.6
2013	1344	8403	9209	10527	18434	7	13.9
2014	1747	10924	11972	13897	20666	8	16.5
2015	2271	14201	15563	18042	23032	10	18.6
2020	8431	27163	29767	35873	46231	18	19.8

Wind

- Wind resource assessment – early days
- Wind speed data
- Physical land area available
- 4100 km^2 at >6.5$m.s^{-1}$
- Load factors of 24% – 37% yields 106TWh
- Potential for installed capacity of 50GW (30GW/ (80TWh) in High scenario)
- Land avail, electrical storage, peak load management and visual impact

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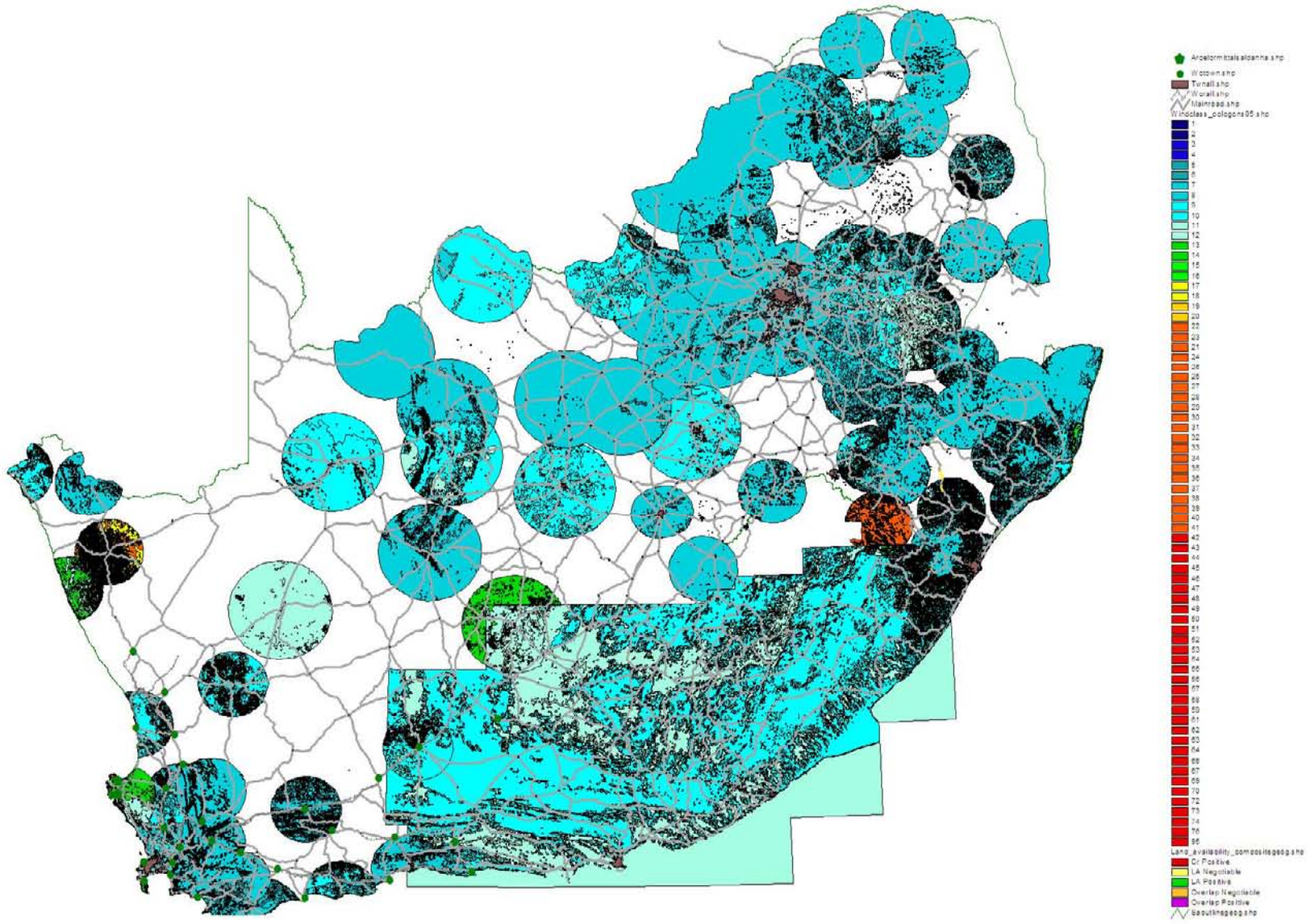
Source: Oelsner Group



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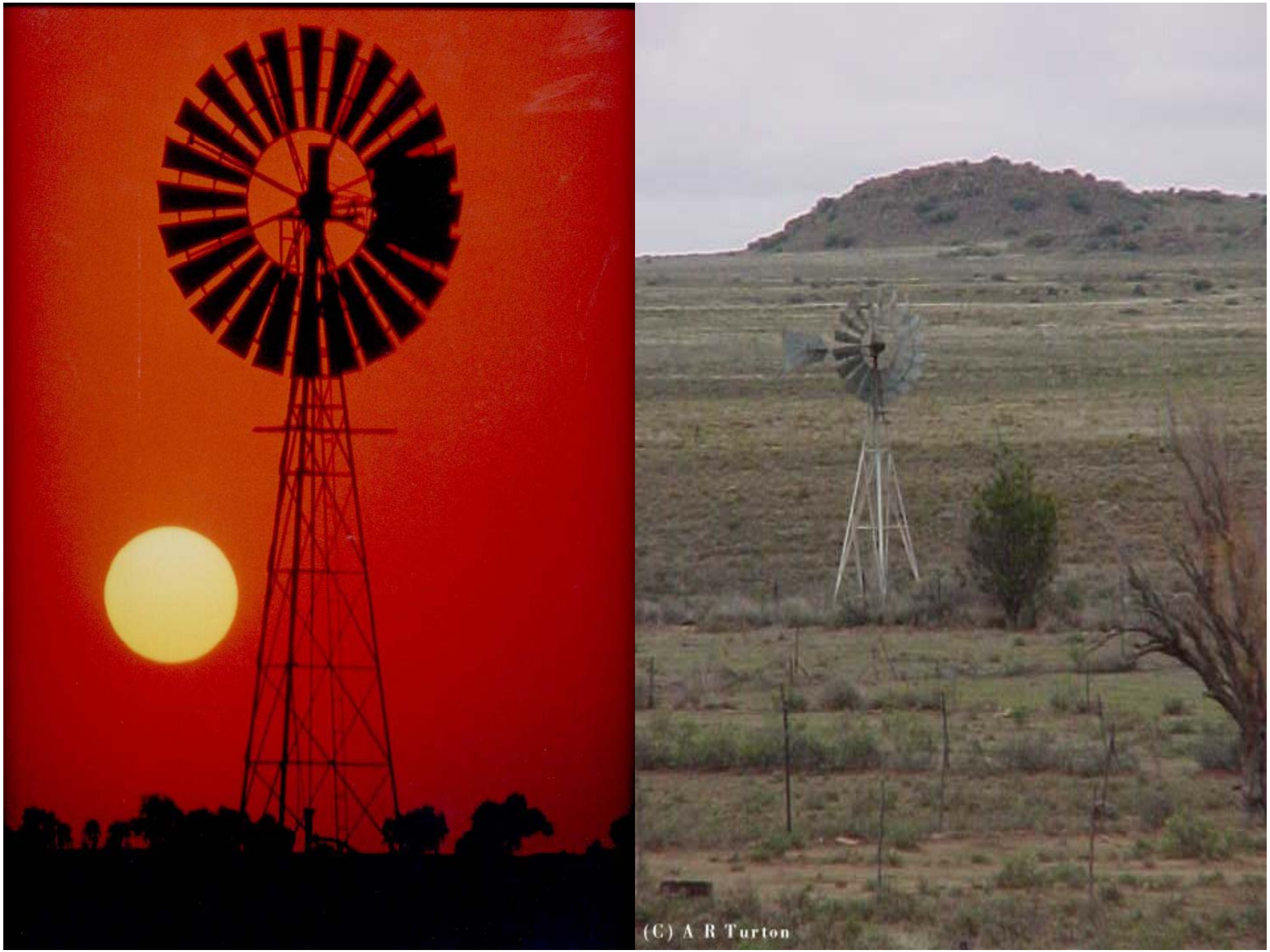
Prepared for: AM

AOI

Wind data adapted from Eskom, CSIR, DME 2004

August 2008

Filename: saldanhareresdbtopogelecapr.apr
Layoutname: LayoutNanoProspect
Prepared by: Jason Schäffler (Nano Energy)

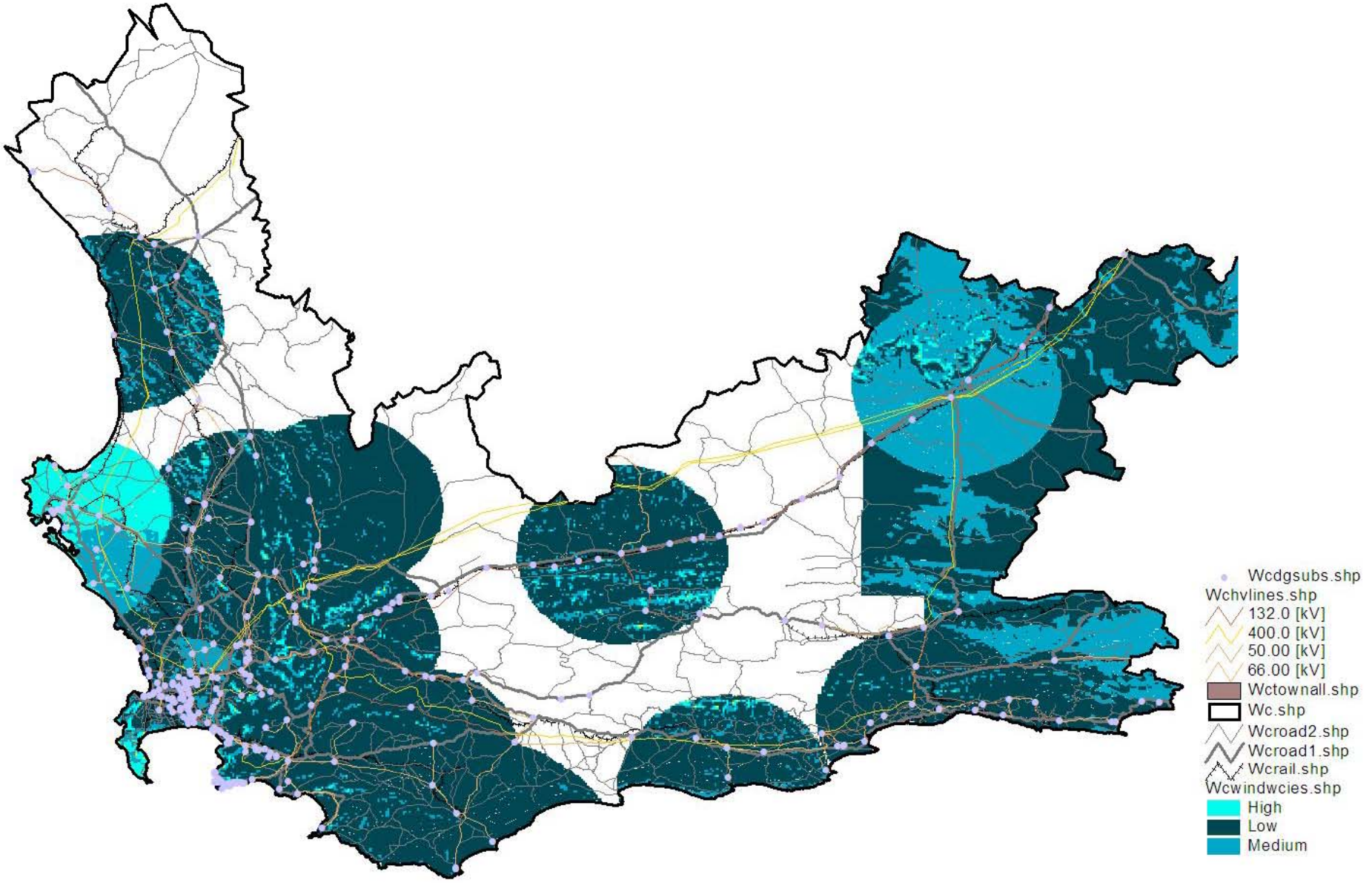

(C) A R Turton

Source: Eigner 2001


Courtesy of Siyathangana Community Projects


Courtesy of Siyathangana Community Projects

Source: CSIR 2000



Western Cape wind resource and relevant transport and electrical infrastucture

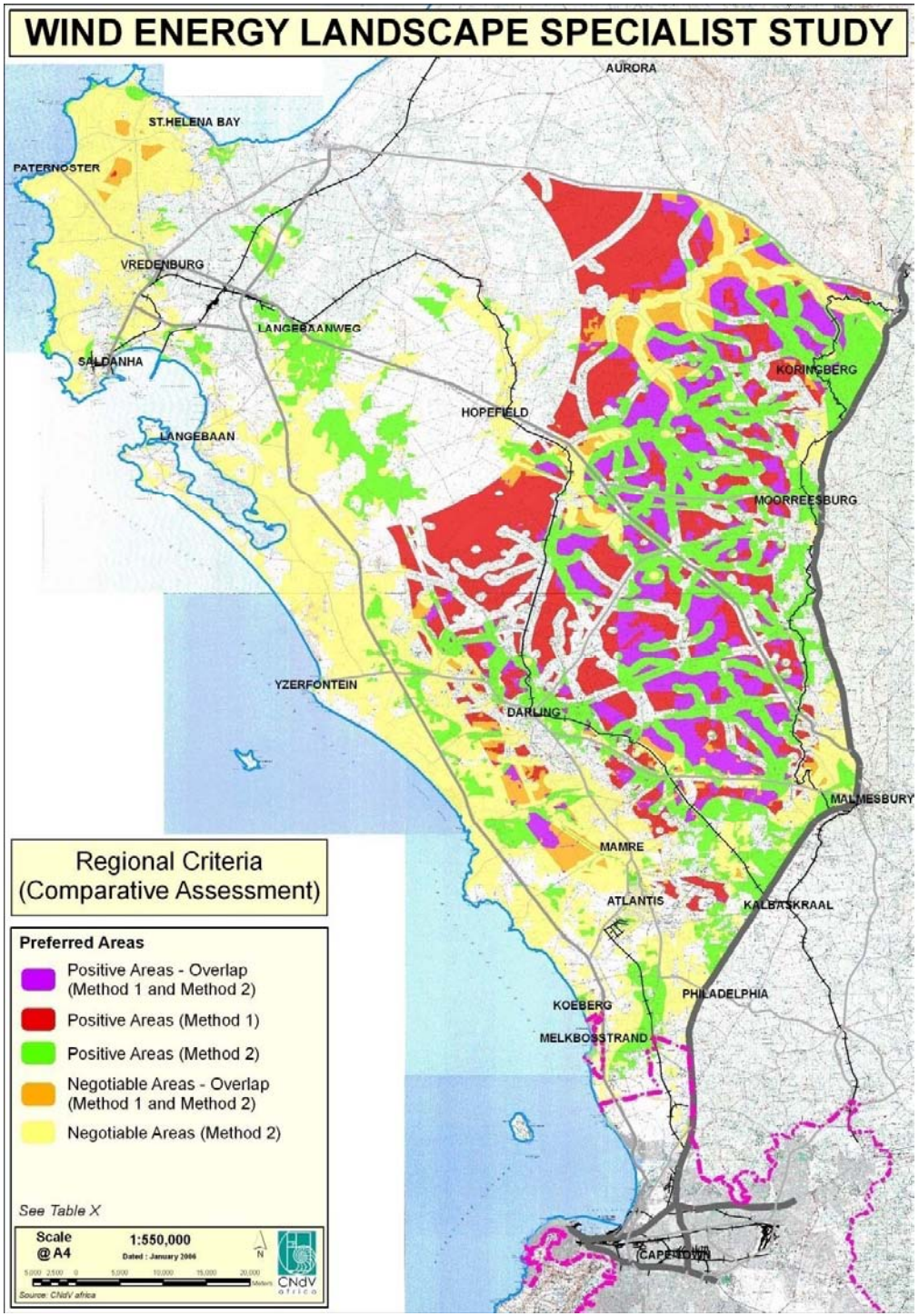
Average annual speed at 10m a.g.l (m.s-1)

Filename: wcwindeconmodeldevstratprojection.apr
Layoutname: AreasLayout
Prepared by: Jason Schäffler (Nano Energy)

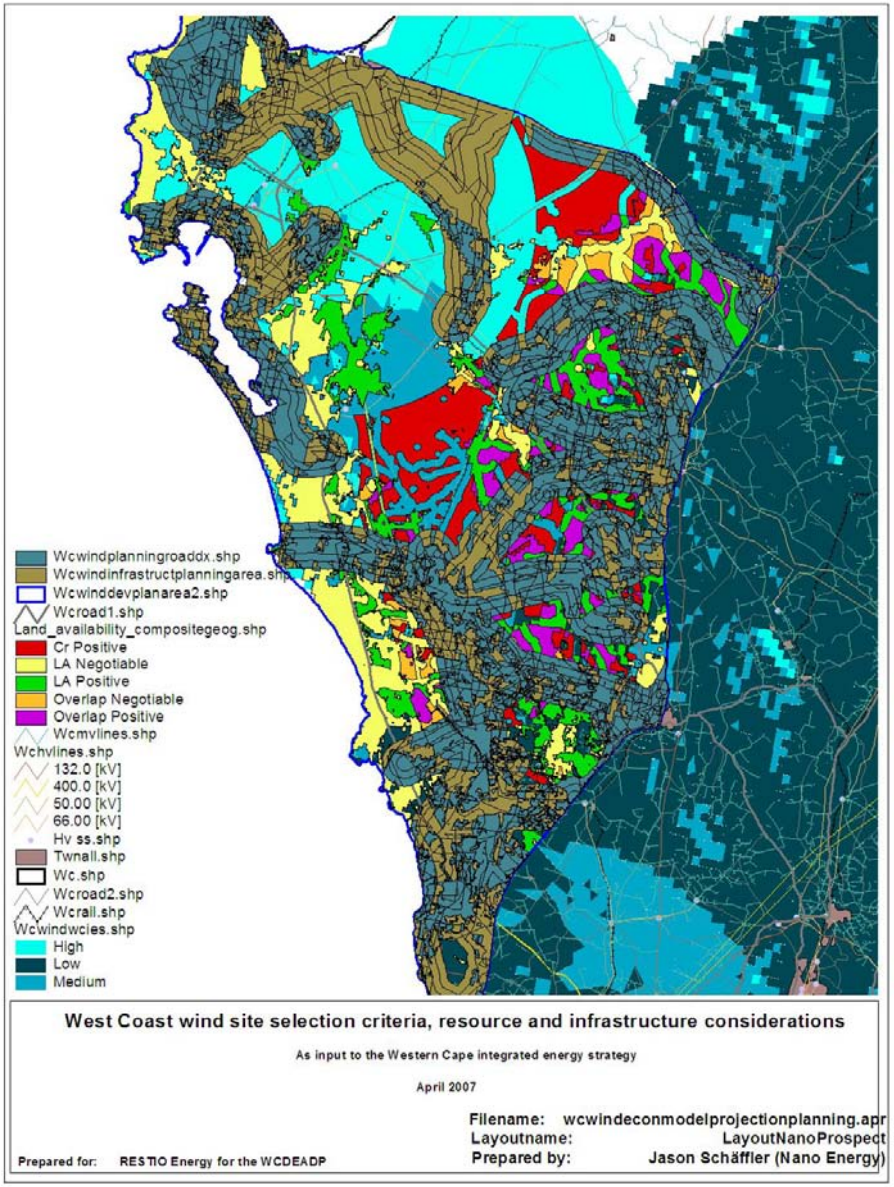
Prepared for RESTIO Energy and WCDEADP

Adapted from CSIR, Eskom Corporate Technologies and DME (2004)

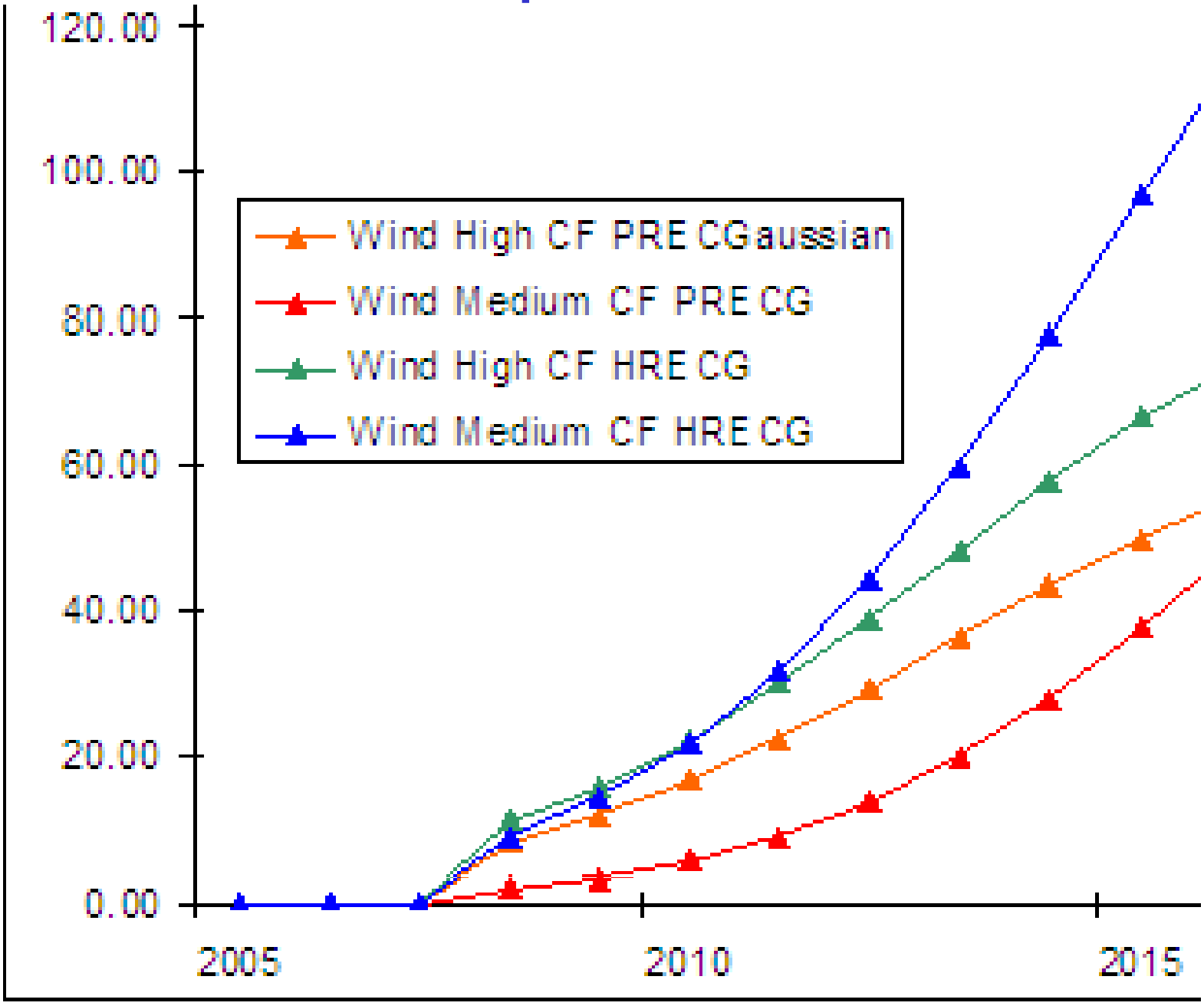
WIND ENERGY LANDSCAPE SPECIALIST STUDY



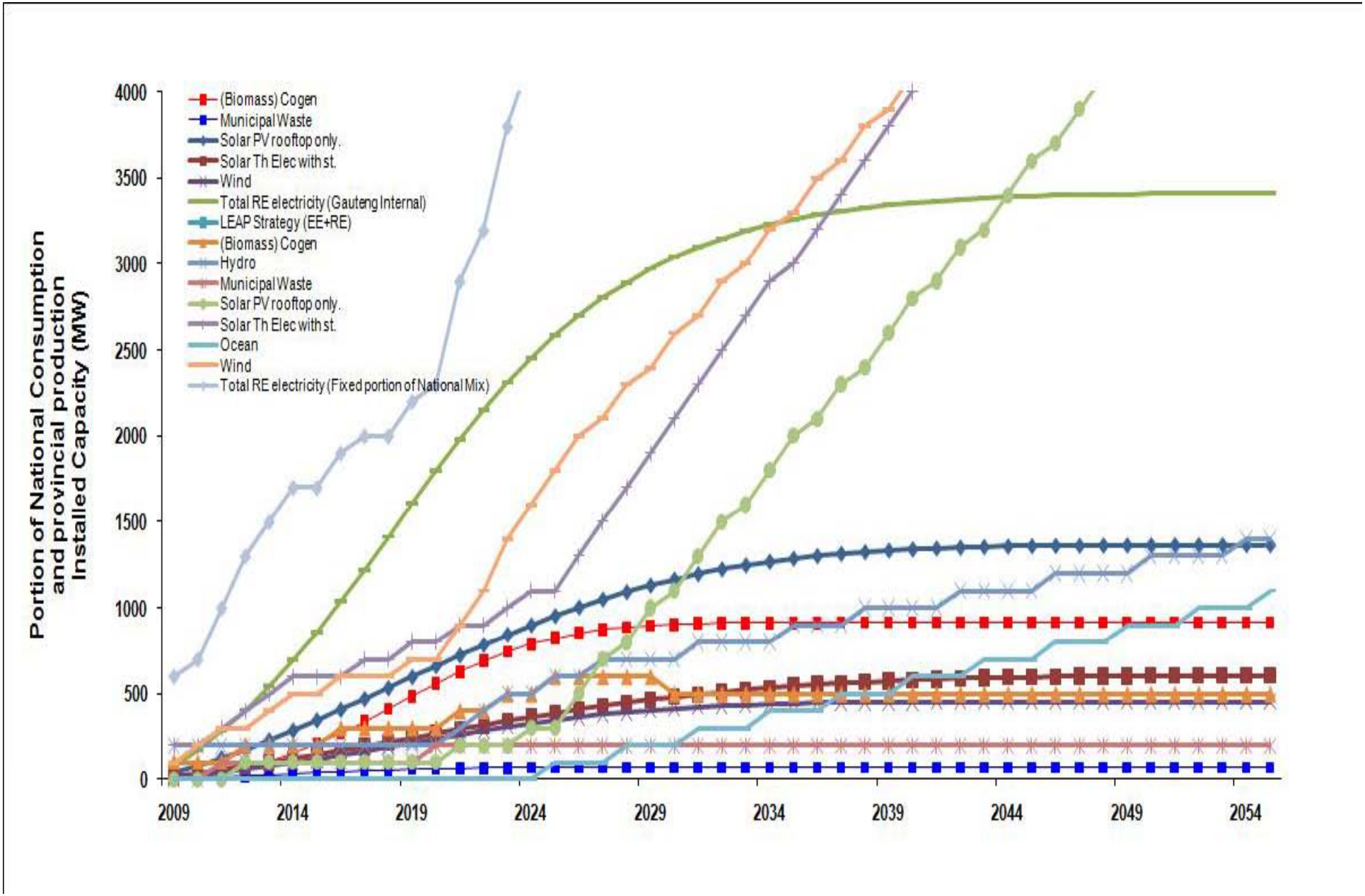
Western Cape Resource Assessment



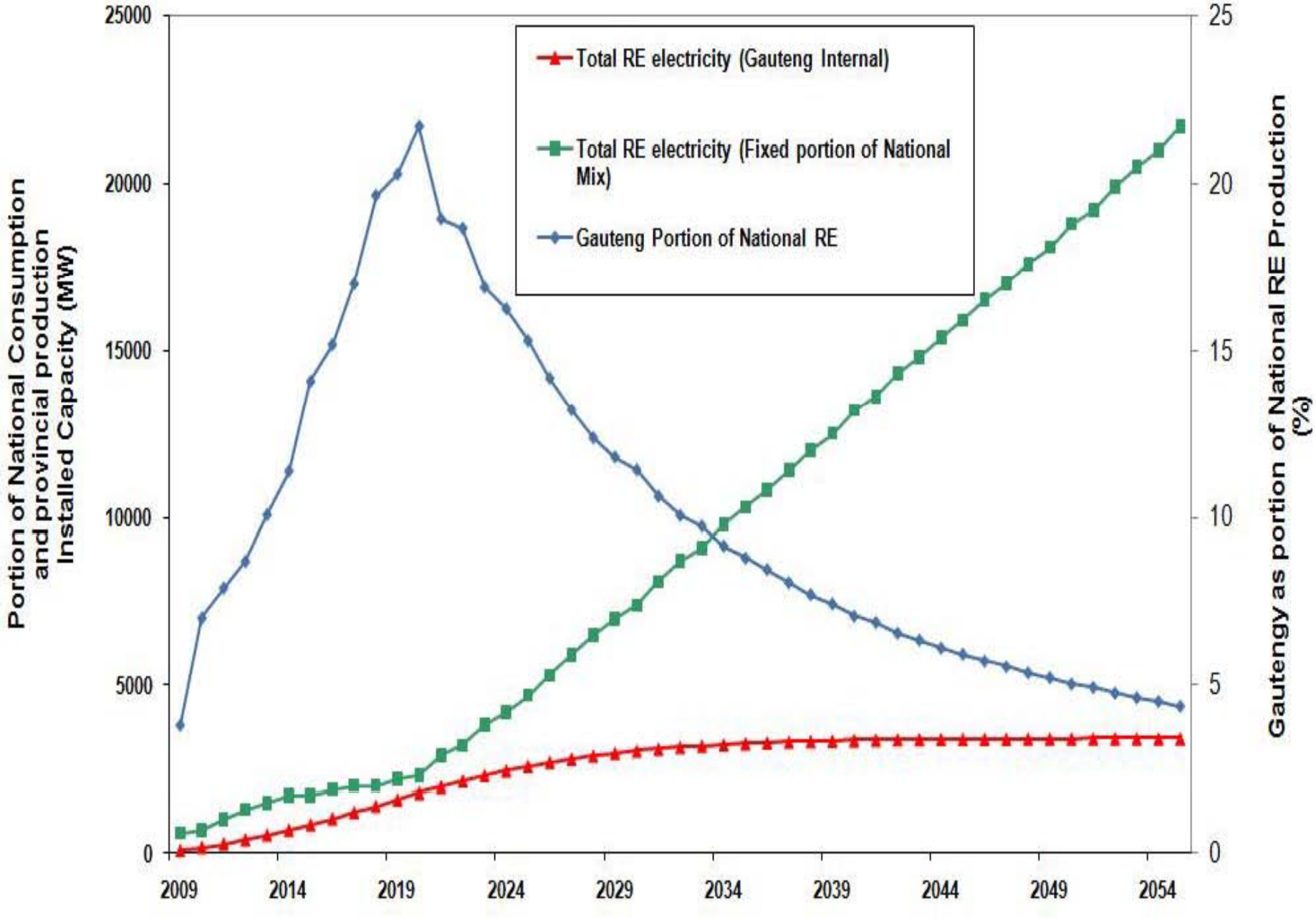
Western Cape Annual Build



Gauteng Energy Strategy



Gauteng Annual Build



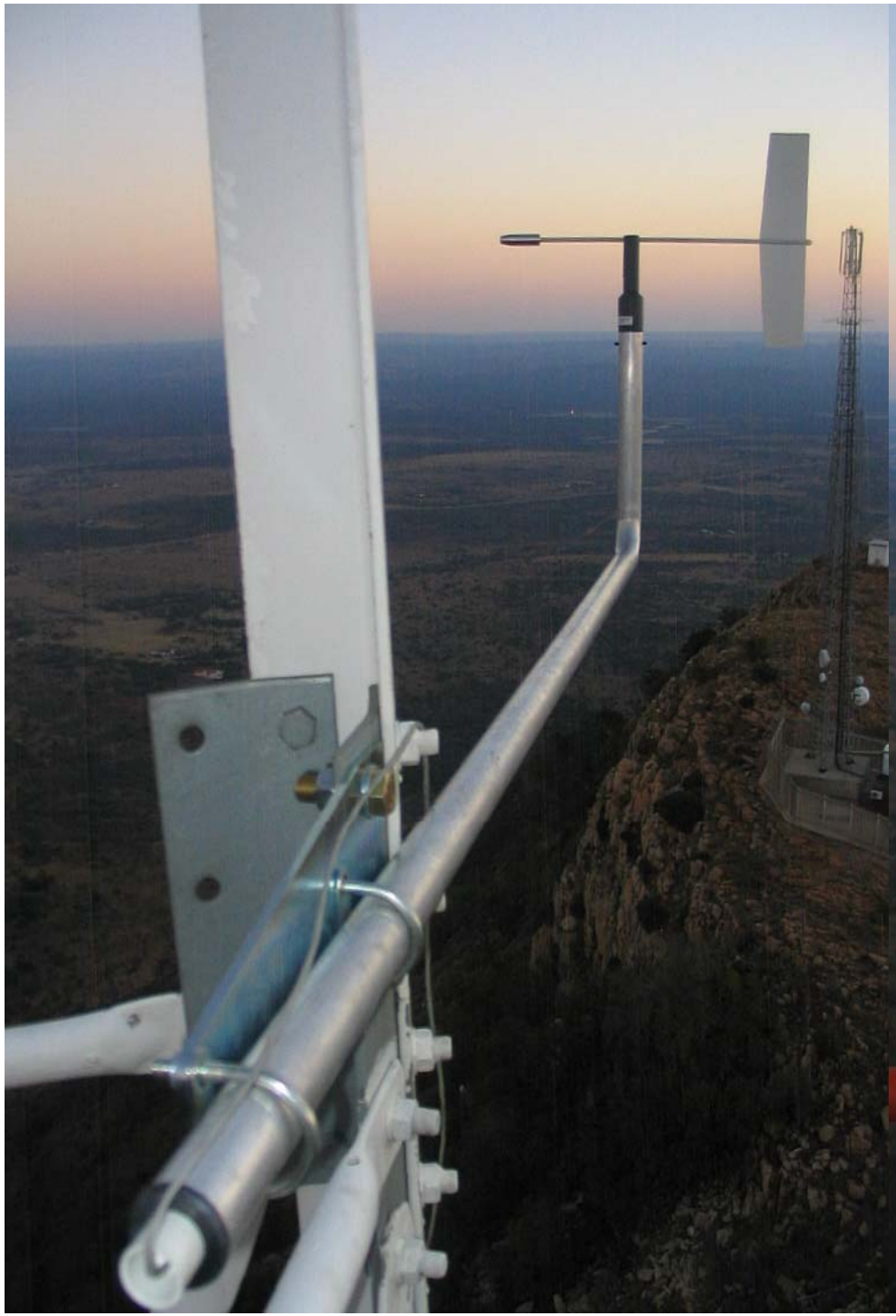

Vestas

Progressive renewable: generation technology capacities

Year	Conventional and Nuclear Existing	Hydro existing	Hydro imports [1]	Fossil Base New	Fossil Peak New	Wind	Hydro New	Biomass	Solar PV	Solar thermal electricity	Landfill gas	Wave and Other generation	Storage (PS or Other)
2003	35 623	641	556						8				1 580
2004	35 623	637	781			4			12				1 580
2005	35 623	633	781	380 [2]		4		8	14				1 580
2006	35 623	629	781	760	720	9		16	17		5		1 580
2007	35 623	625	781	1 518	720	29		30	21		35		1 580
2008	35 623	621	781	2 186	1 200	79	20	90	25		65		1 580
2009	35 623	617	781	2 953	1 920	179	34	150	32	100	72		1 580
2010	35 623	613	781	3 256	1 920	233	56	180	42	200	140		1 580
2011	35 623	613	781	3 559	1 920	303	82	210	55	300	154	1	1 580
2012	35 623	613	781	3 559	2 640	393	113	240	71	400	169	2	1 913
2013	35 623	579	781	3 559	2 640	511	150	276	92	600	186	4	2 912
2014	35 623	579	781	4 491	2 640	665	195	331	120	800	205	8	3 911
2015	35 623	575	781	5 423	2 640	864	230	397	156	1 000	225	12	3 911
2020	35 523	571	781	5 423	3 360	3 208	1 070	989	580	2 000	363	100	4 910
2025	33 423	571	781	5 423	4 800	11 911	1 570	1 649	1 443	4 147	585	800	6 110
2030	23 191	571	781	7 595	4 800	19 934	2 576	1 929	3 590	10 320	942	950	6 110
2035	11 391	571	781	10 391	4 800	21 781	4 076	1 929	8 188	19 660	1 143	2 250	7 310
2040	5 391	571	781	11 323	4 800	22 892	4 576	1 929	13 186	27 311	1 201	4 250	7 310
2045	2 891	571	781	11 323	4 800	24 059	5 076	1 929	16 829	27 311	1 238	4 250	8 510
2050		571	781	11 323	4 800	25 287	5 576	1 929	21 479	27 311	1 238	4 250	8 510

Table 5-1,

p 44



Wave, Ocean Current, Geothermal and other

- Wave 25 – 50 MW/Km over ~900 Km
- With 75% suitable for converter installation we get 18 GW generating 70 TWh.
- Have assumed 500 MW for geothermal
- Progressive scenario 4.2 GW
- High scenario 8.7 GW

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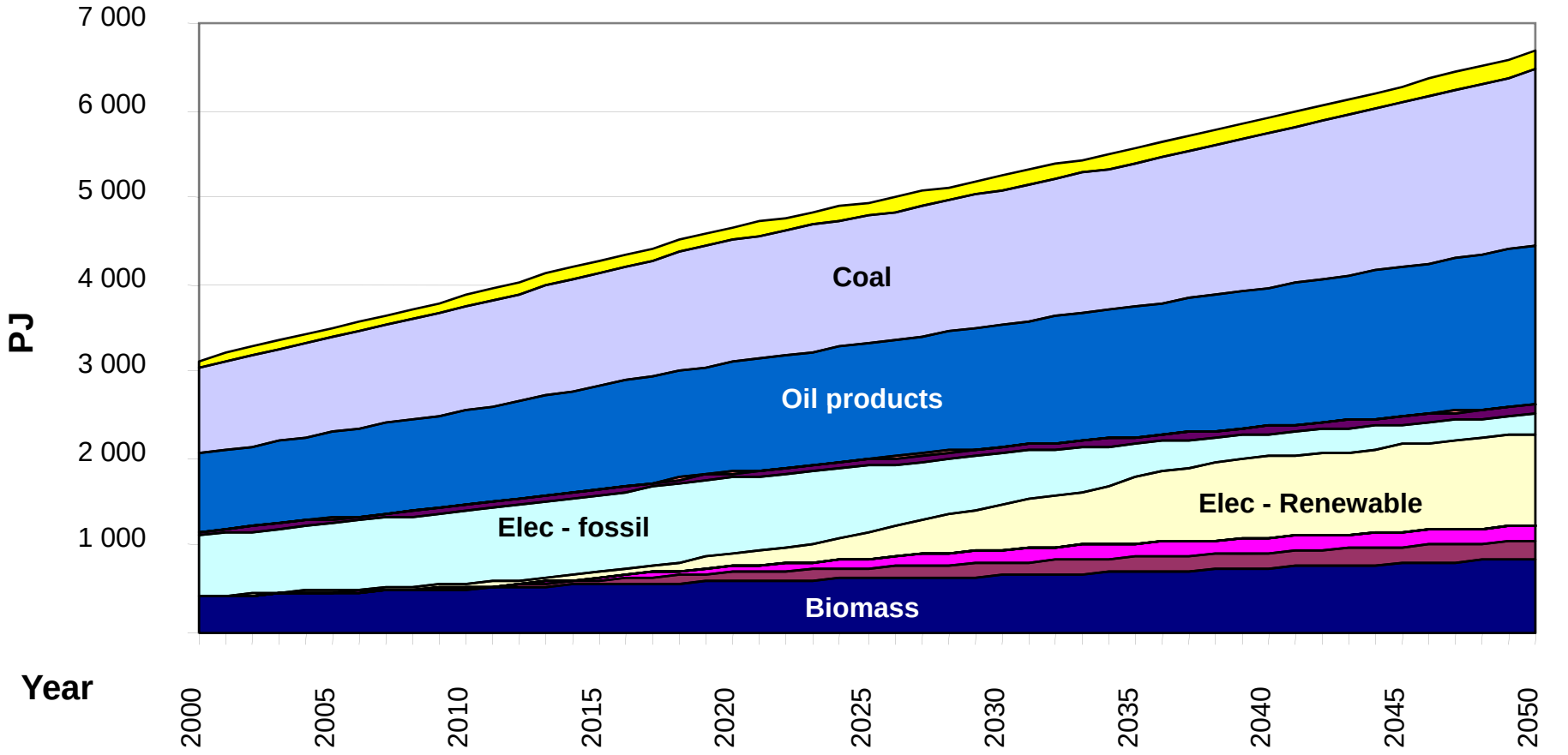
Resource overview

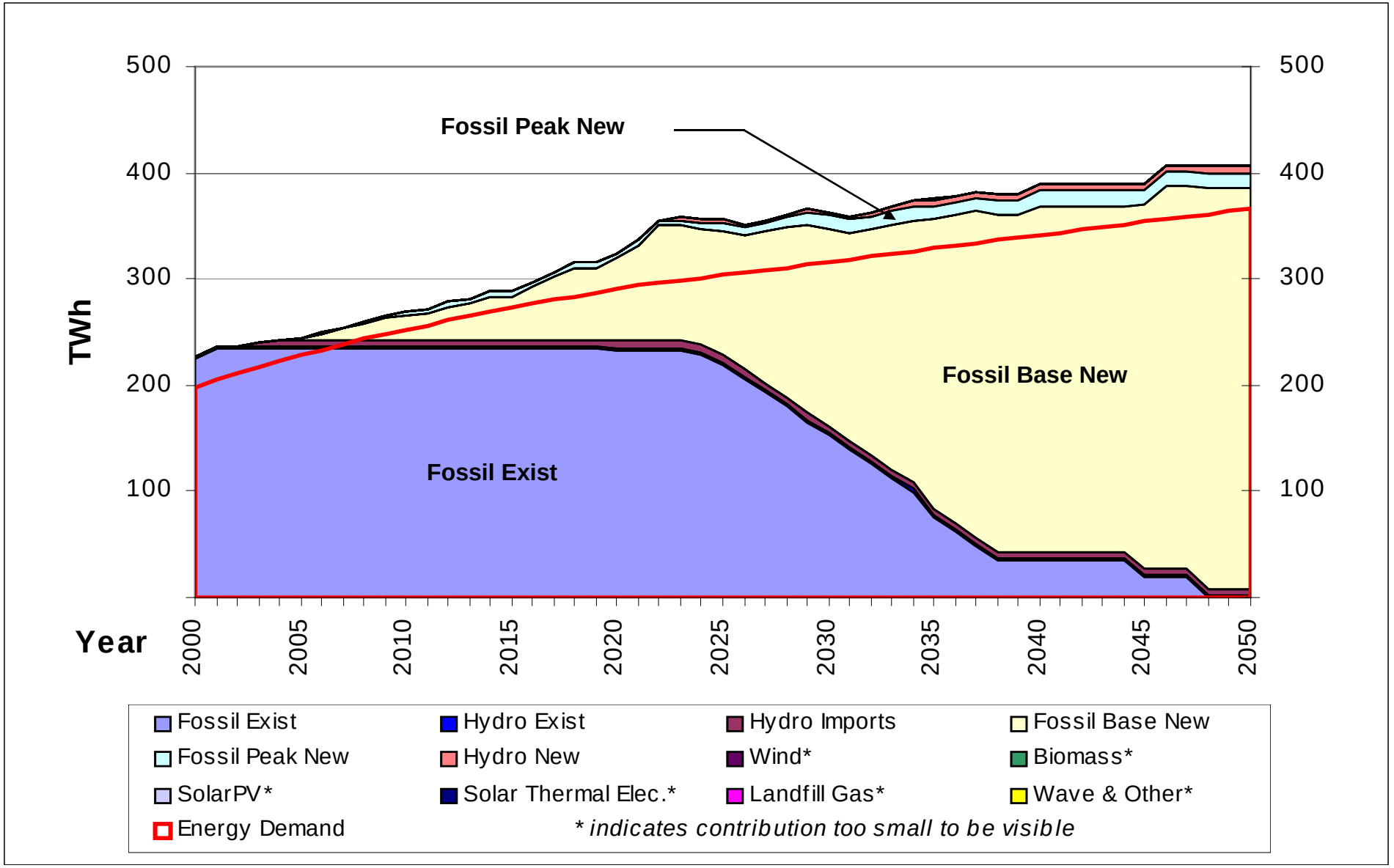
Category	Current energy (TWh)	Total potential (TWh annually)	Maximum scenarios (TWh annually)
Hydro	1	15	15 (43 Import)
Wind	-	106	80
PV	-	-	85
Solar thermal	0.5	-	56*
Solar Thermal Electric	-	-	184
Wave,Geo,Ocean	-	70	70
Biomass	106	44 (375*)	94*
Landfill Gas	-	10	10

Progressive RE: energy by resource

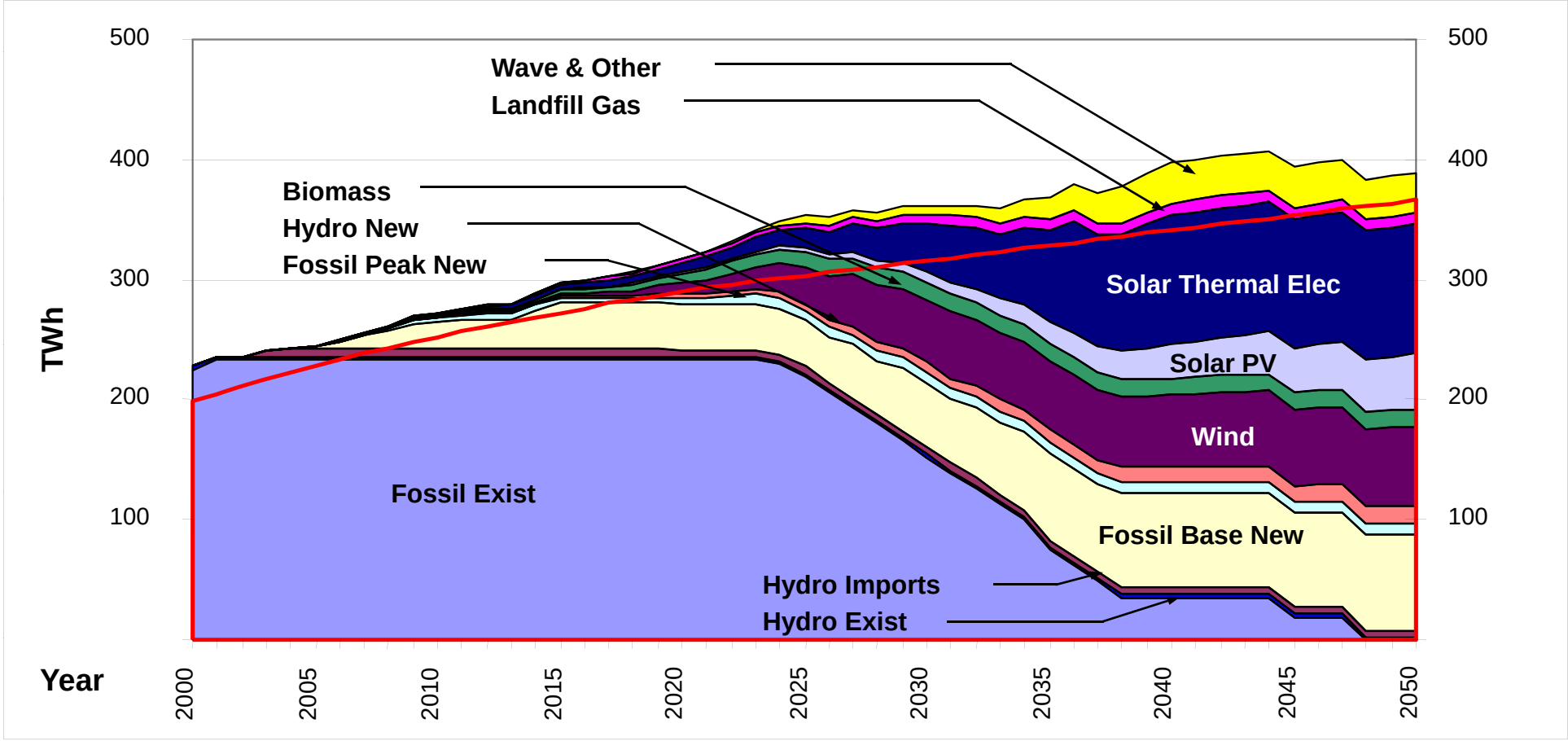


** indicates contribution too small to be visible*

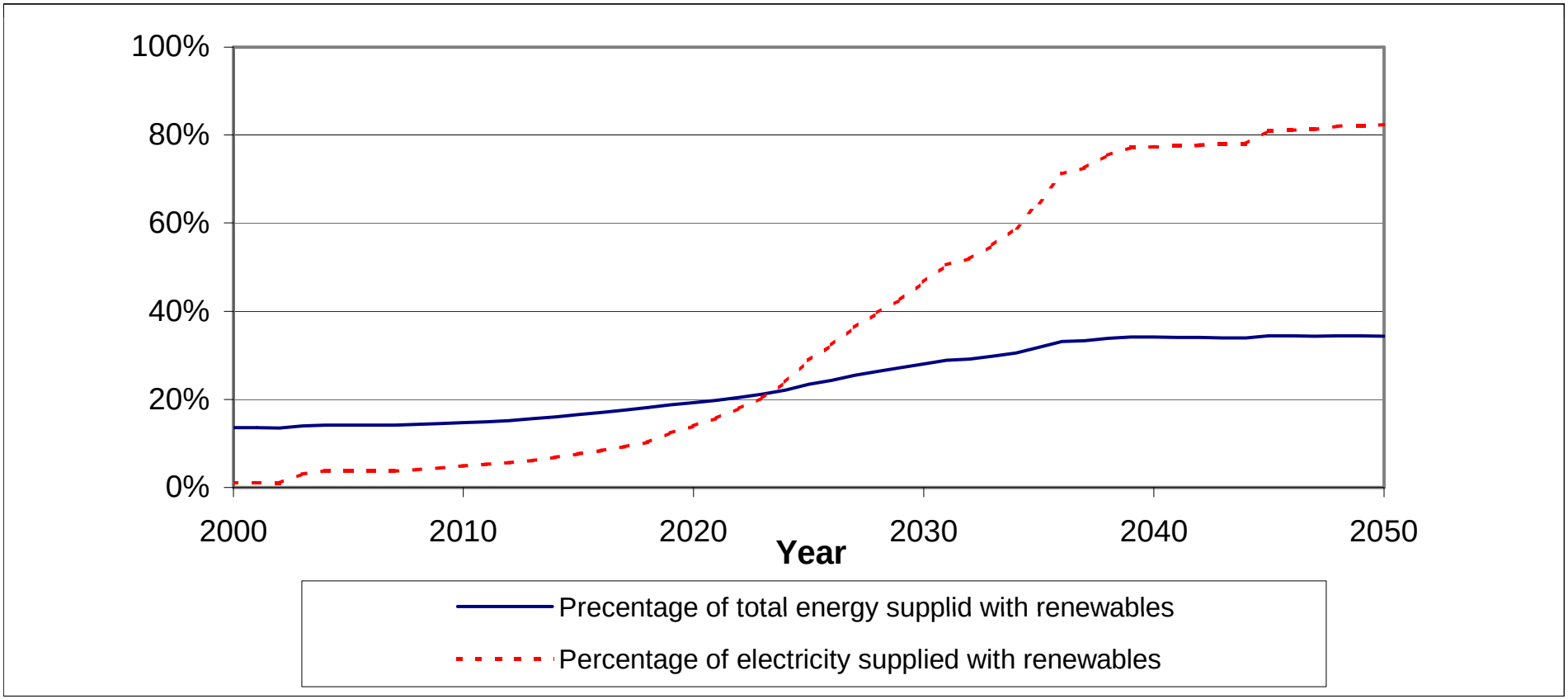
Business as usual – energy demand matching



Progressive RE: electrical demand matching



Progressive RE: RE contribution



Absolute contributions to the energy mix

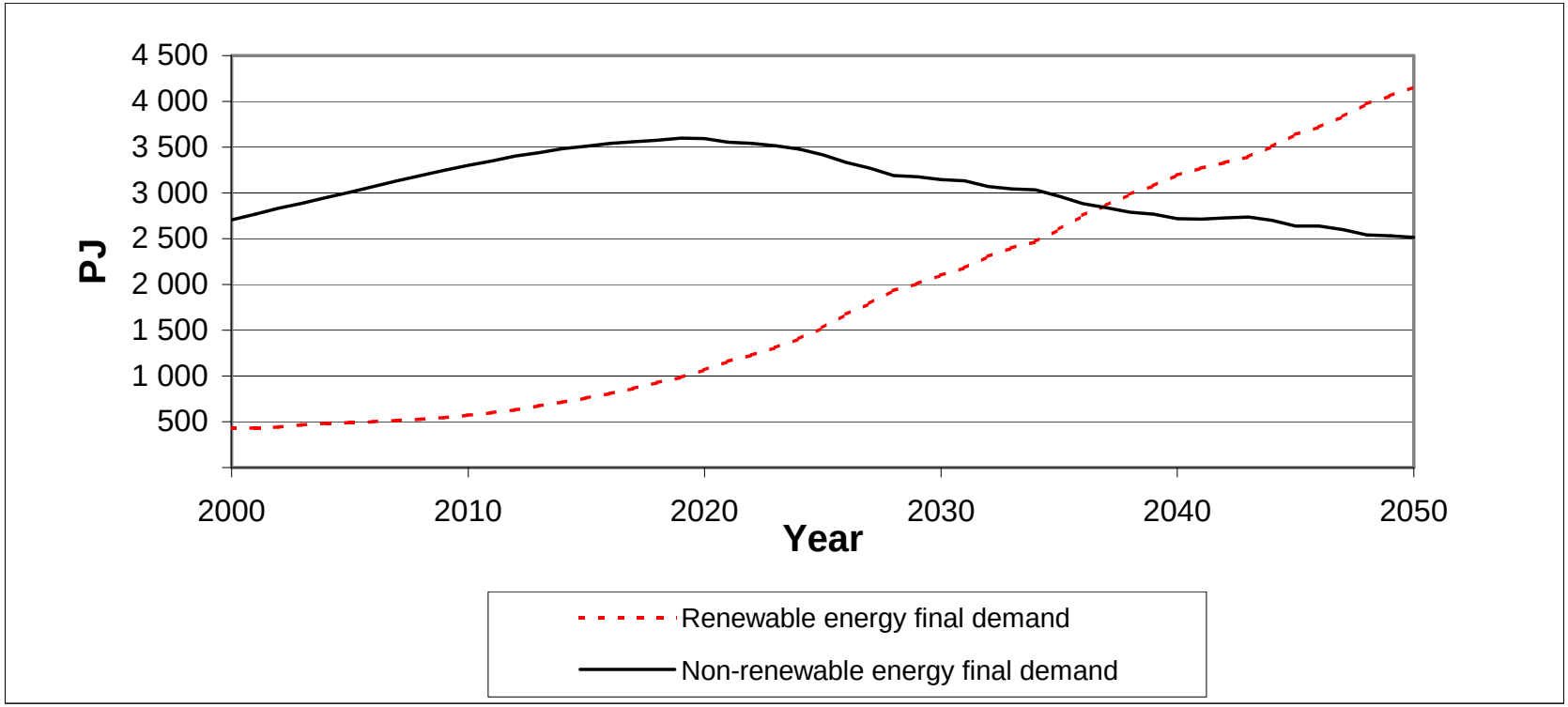


Fig 5-13,

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Least-cost vs. Portfolios

- Models tend to bring in least cost options, subject to limited constraints
- It is important to value the risks associated with different generation and demand side options
- Bring in portfolio risk assessment methodologies

Findings

- 2020: 15 to 20% electricity is possible
  - Total energy > 20% more difficult
- 2050:
  - Renewable electricity >> 50%
  - Renewable contribution to total energy: 35 to 40%

  However, fairly bold steps could be taken that would allow reduction in fossil fuel usage
  - Greater electricity usage (provided using RE)
  - Hydrogen production (or equivalent easily stored and transported fuel)
  - Renewable electricity: > 70%
  - Renewable contribution to total energy: > 50%

A Lot: but not enough?

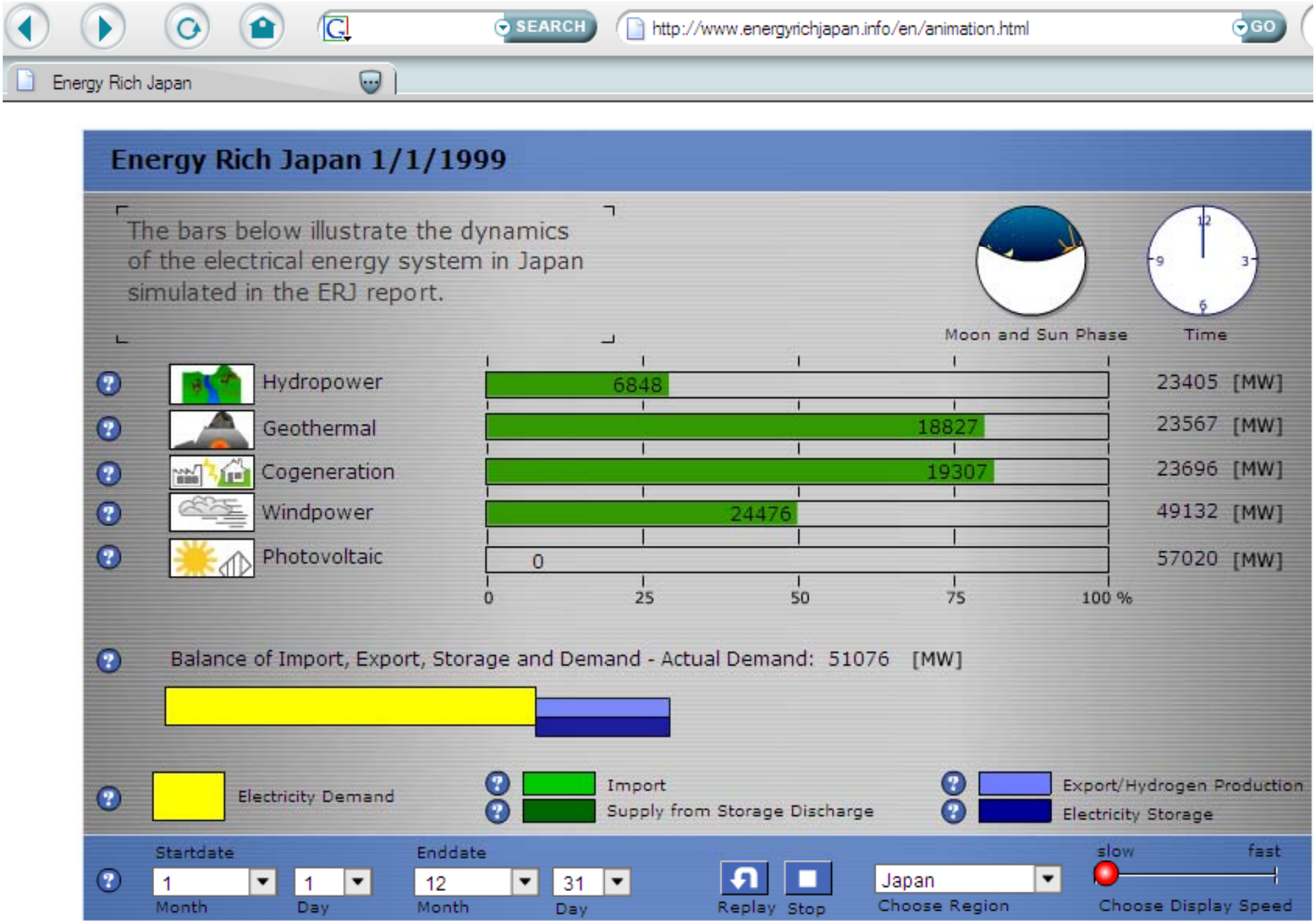
- Electricity can be largely renewable >70%
- Renewable energy portion of total energy demand can grow >30%
- Total demand growth has been restrained
- Yet- fossil fuel consumption grows!
- Does not significantly mitigate climate change contribution

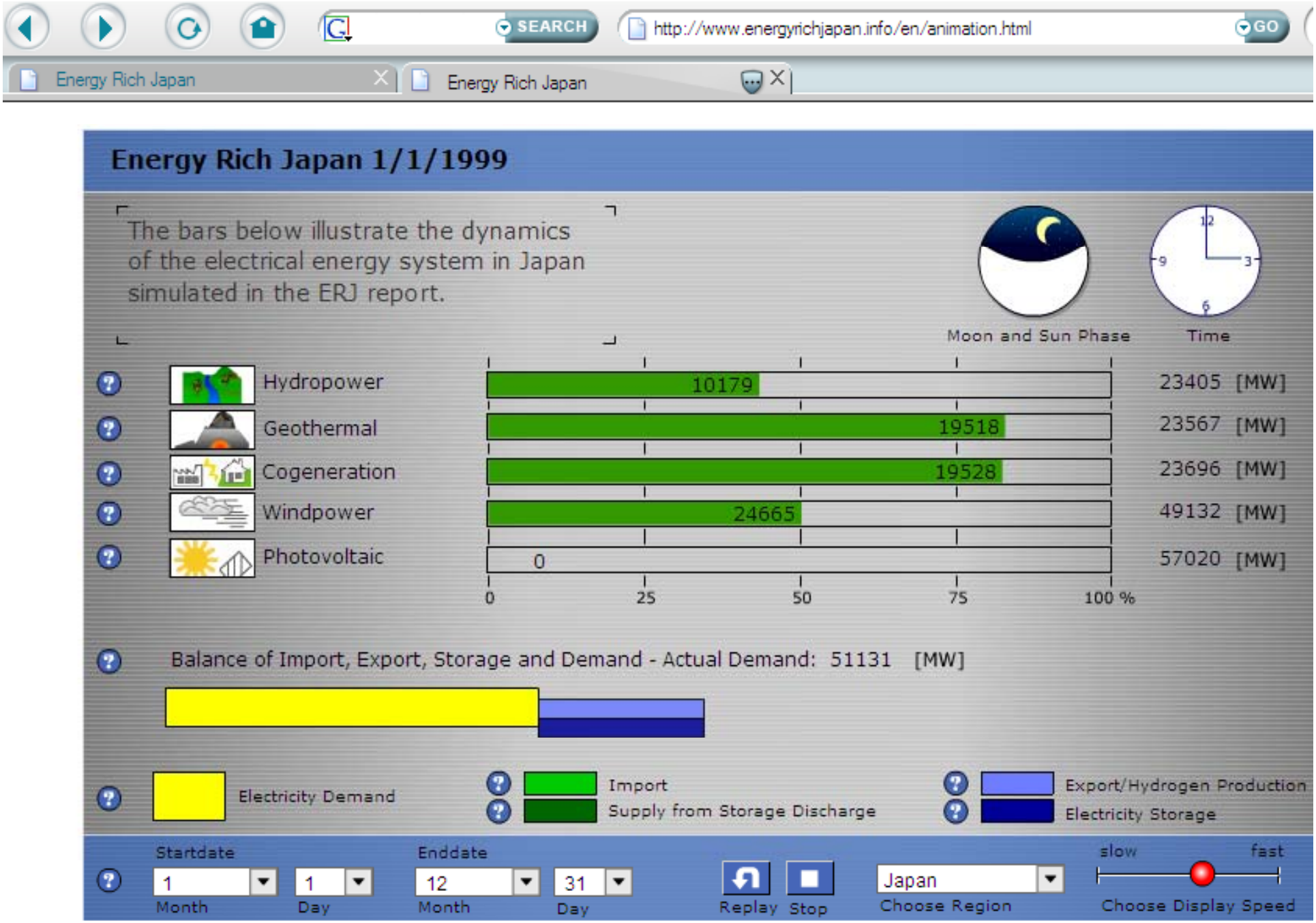
‘High Renewables’ scenario

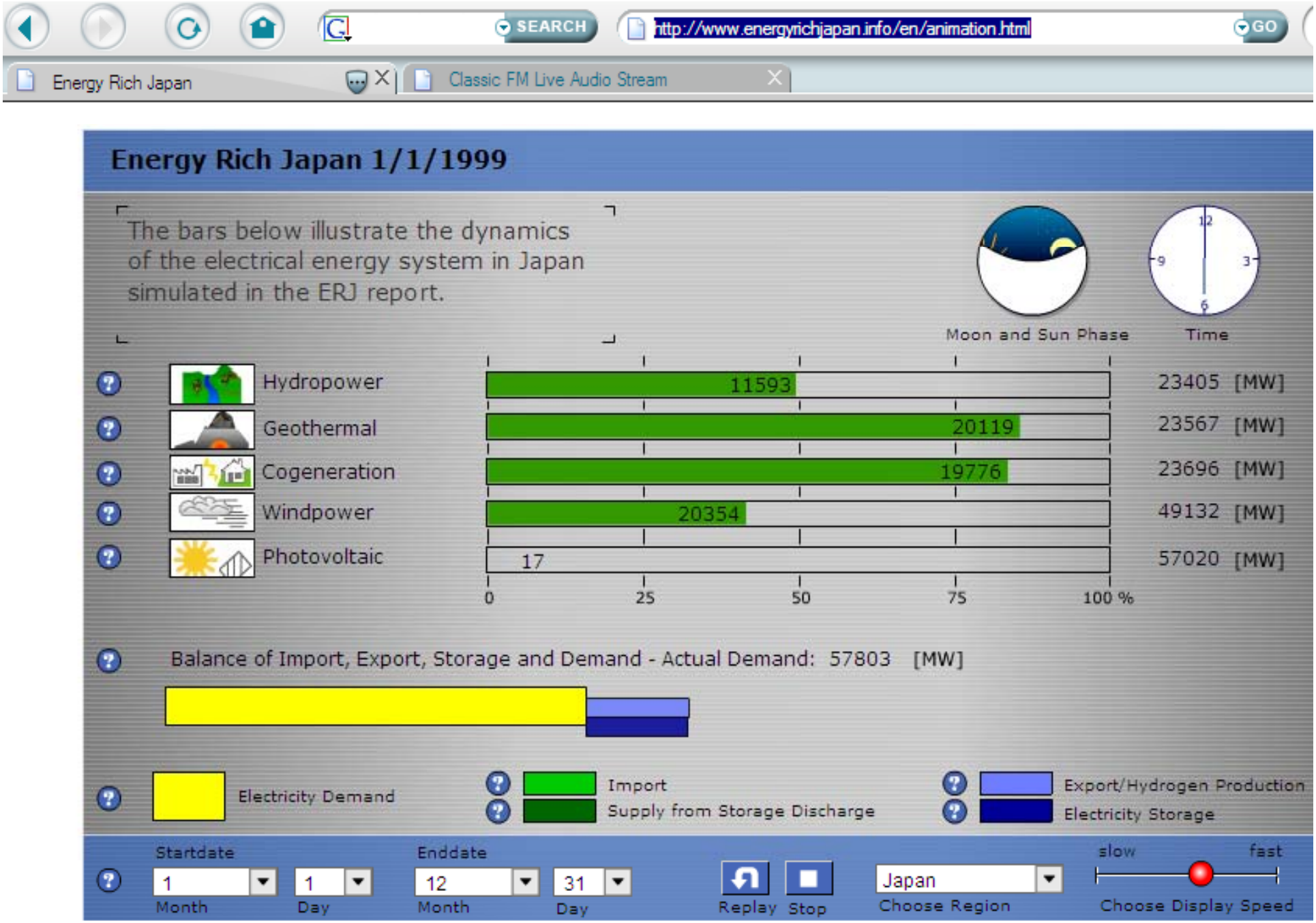
- ***Increase*** *renewable* electricity production
  - Electricity can substitute for coal and other fossils in industry, transport, domestic and other sectors
  - This can be done using renewable resources more easily that direct substitution
- Produce ***Hydrogen*** using renewable resources – in large quantities
  - Direct fossil fuel substitution

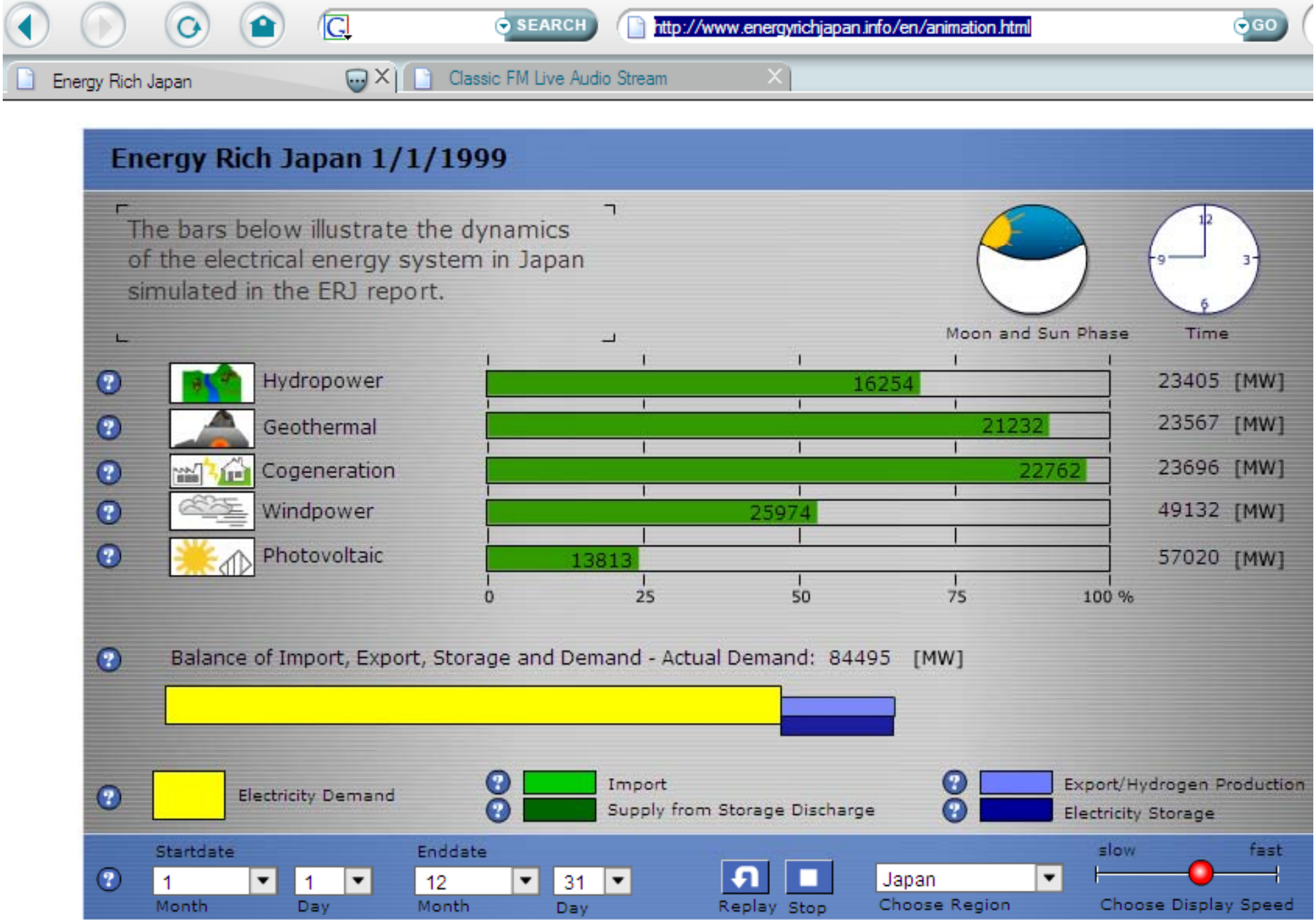
Hydrogen

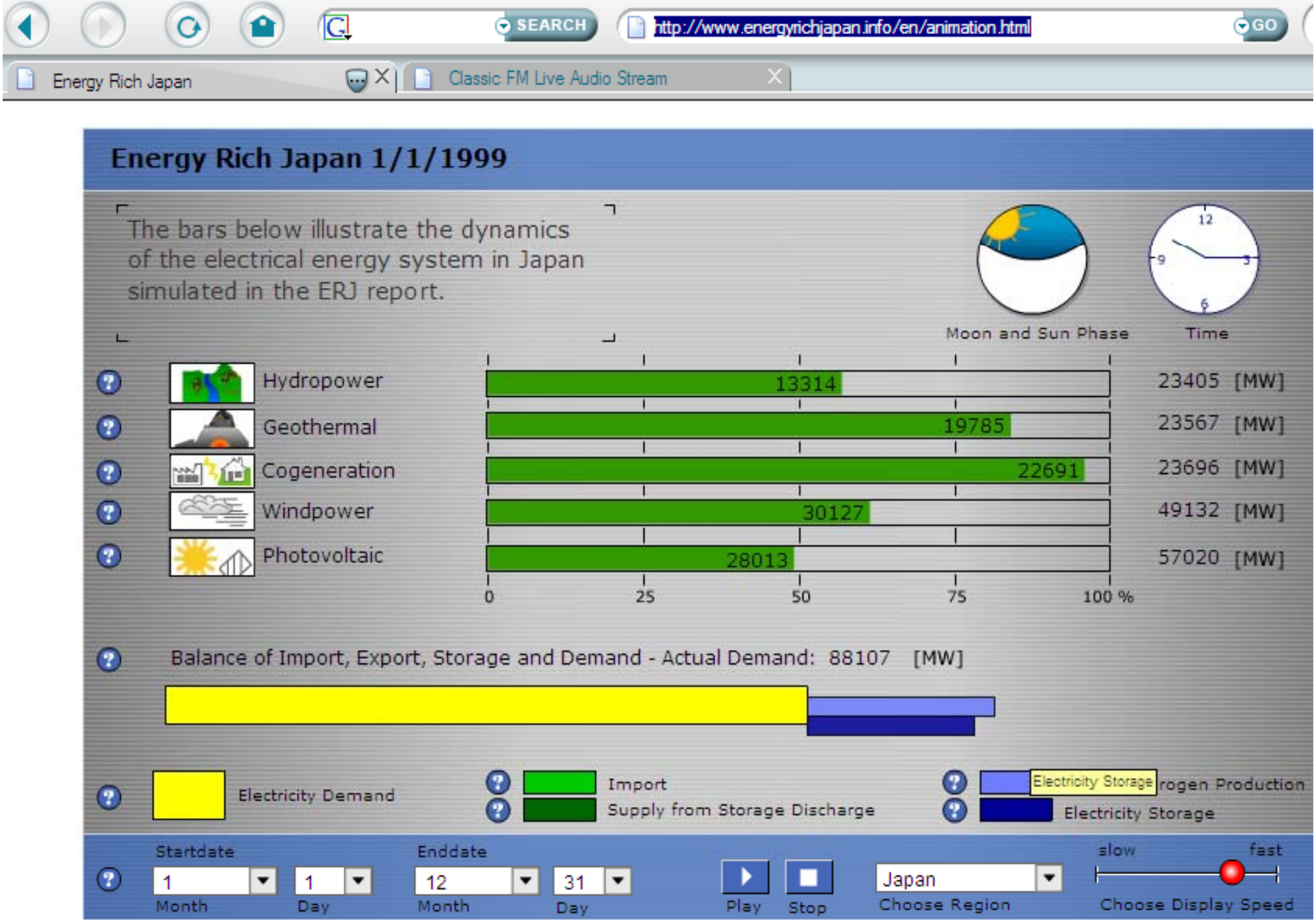
- Versatile energy carrier – readily stored and transported
- Hydrogen economy concept
- http://www.energyrichjapan.info/en/animation.html ,
  Pacific Islands, United States level of effort
- Several possible methods of production
  - Electrolysis (RE electricity)
  - Solar thermal water splitting
  - photoelectrochemical
  - Reforming biomass
  - Photosynthesis cycle (using sea-based mariculture)
- Non – electrical renewable contribution in High renewable scenario



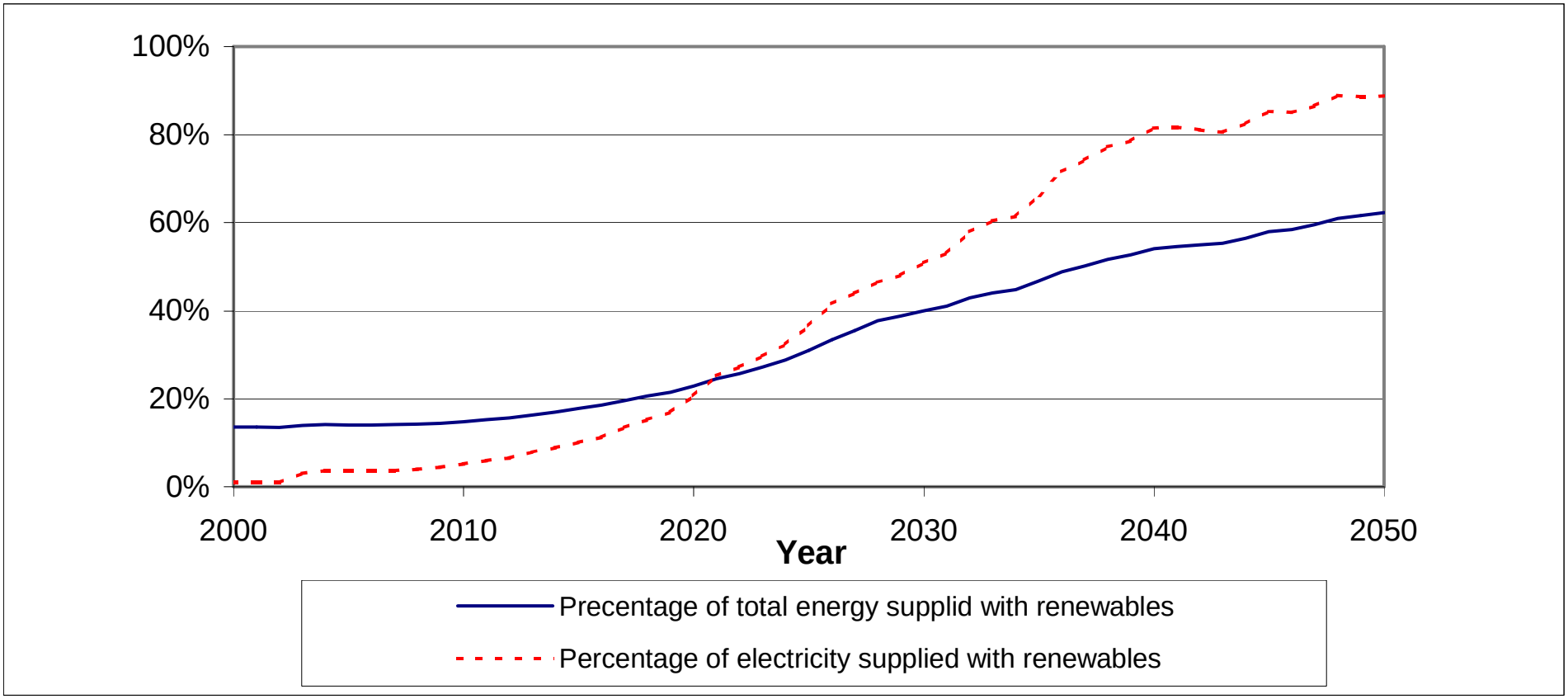








High RE: RE contribution



Absolute contributions to the energy mix

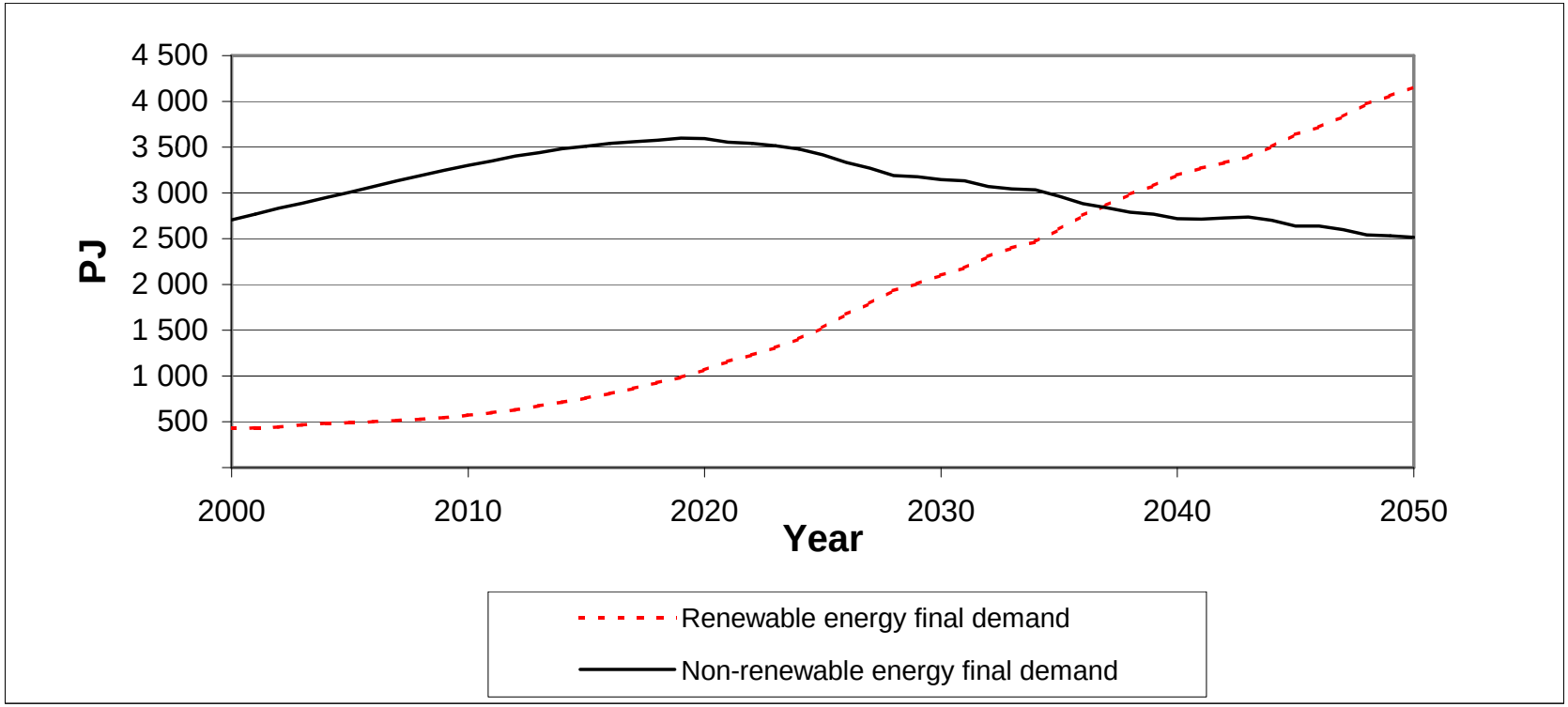


Fig 5-13,

p 53

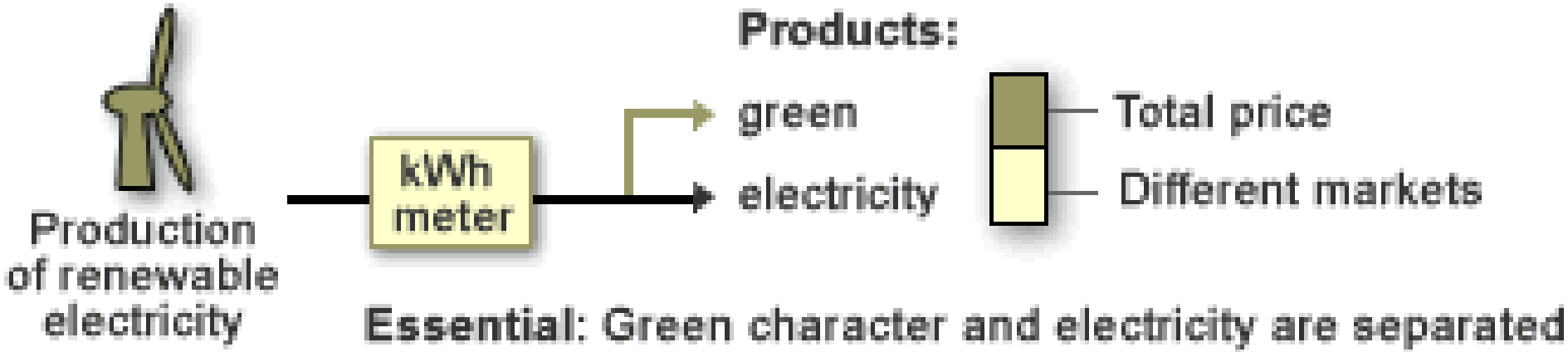
Initiatives on this path

- SWH, SAWEP, and Biofuels
- RE and EE Target Monitoring (Phase 2)
- National Integrated Resource Planning (NIRP3)
- Second Integrated Energy Plan
- Subsidy Office in the DME
- Renewable Energy Market Transformation (REMT)
- Renewable Energy Regulatory Framework for a feed-in tariff
- Renewable Energy Certificates (RECs)

Introduction to RECs

REC = Renewable Energy Certificate

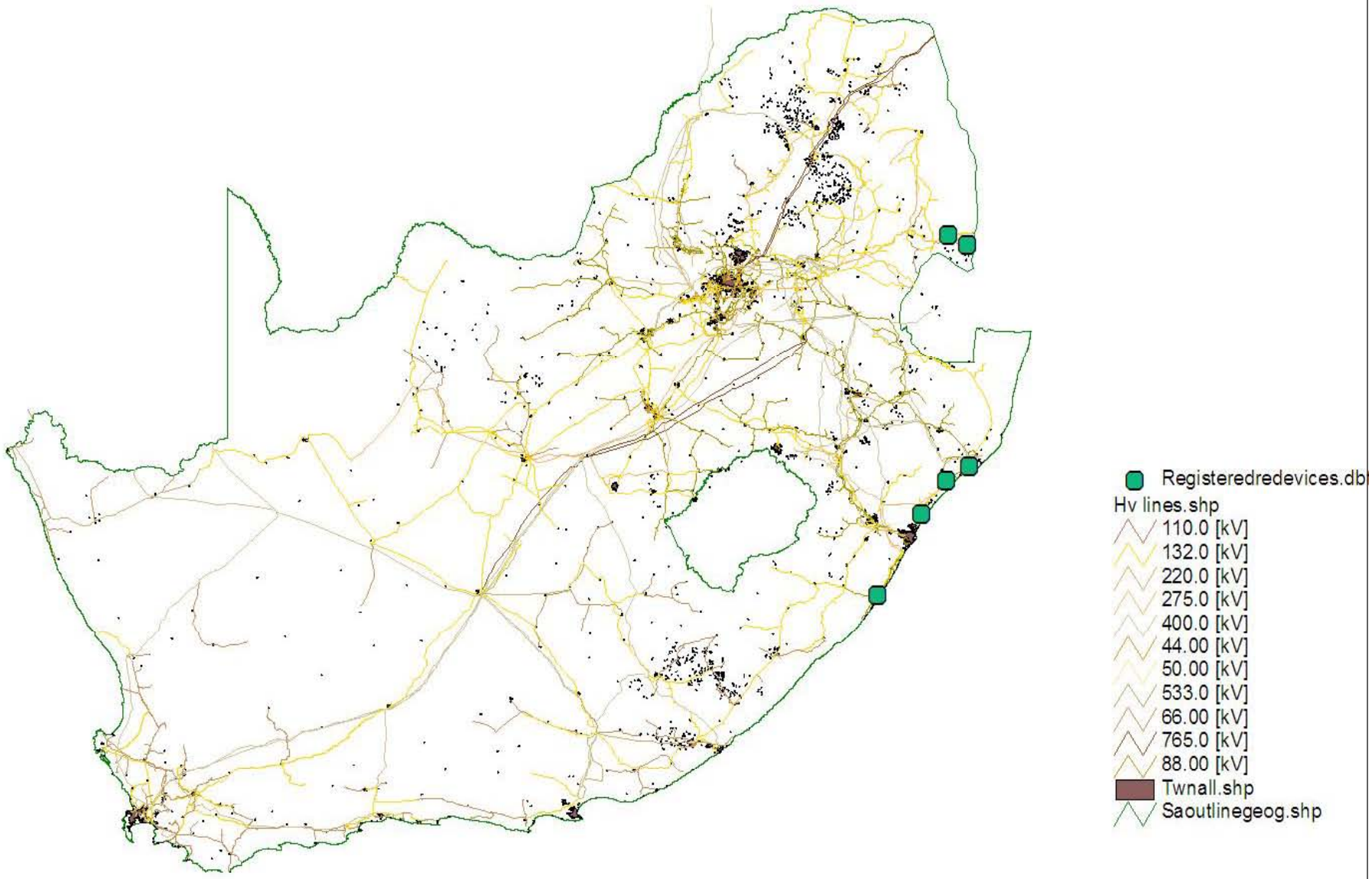
- In practice, RECs are
  electronic records that
  verify the origin of energy from
  registered renewable energy facilities.



Source: EC 2000

Different revenue streams

- Physical power
- Emissions reductions
  - consideration given to use of existing infrastructure (Designated National Authority (DNA) or generation licensing)
- RECs – ‘green’ attributes
  - Attributes include:
    - Local environment (local action for local benefit/avoided damage)
    - Public good (benefit) – job creation, economic stability,
    - Other externalities – avoided morbidity
    - Small is profitable, diverse is robust.



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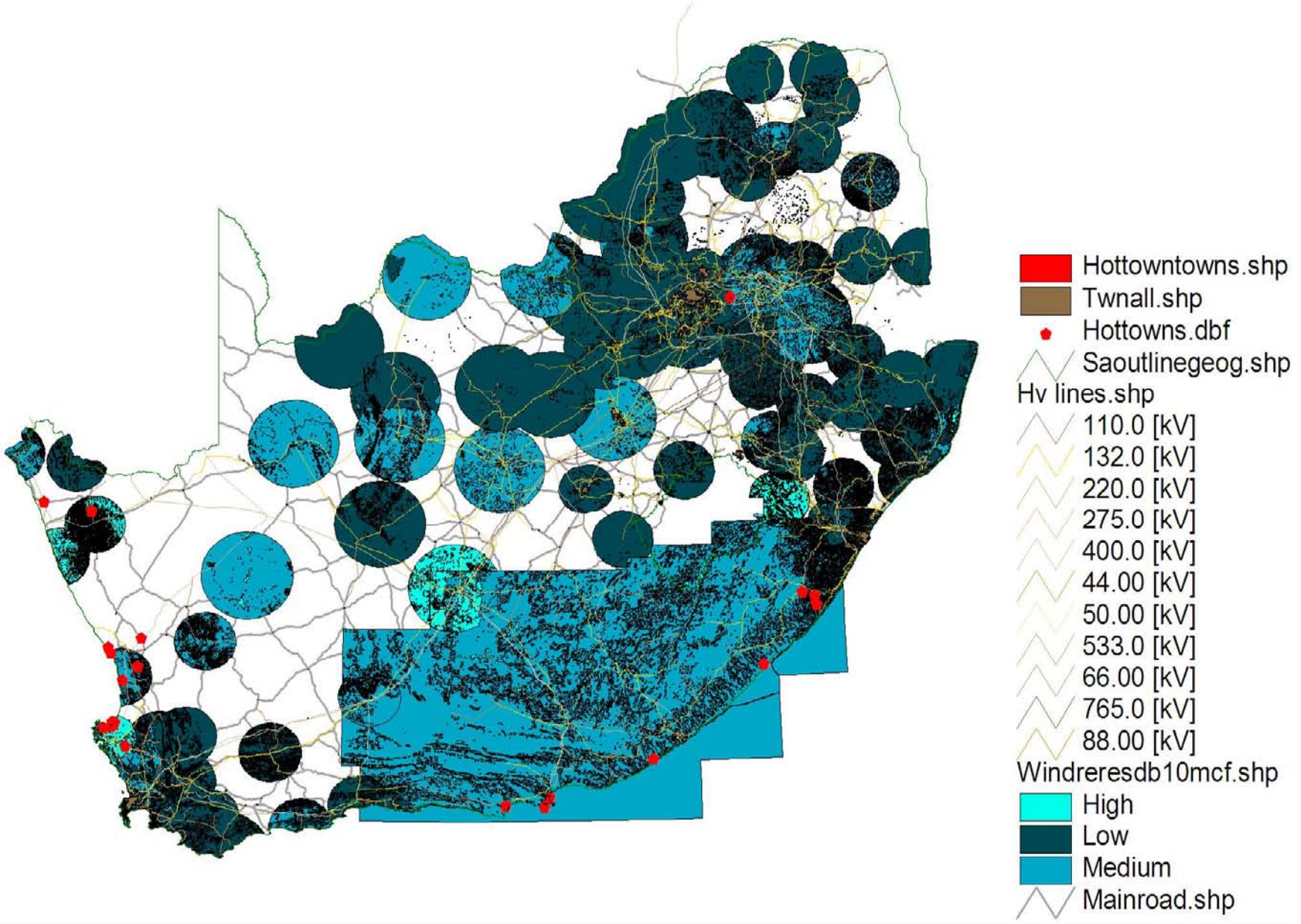
Prepared for: SANTRECT

Registered renewable energy devices

28 September 2007

Filename: RegisteredREDevices.apr
Layoutname: LayoutNanoEnergy
Prepared by: Jason Schäffler (Nano Energy)



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Prepared for: SAWEP

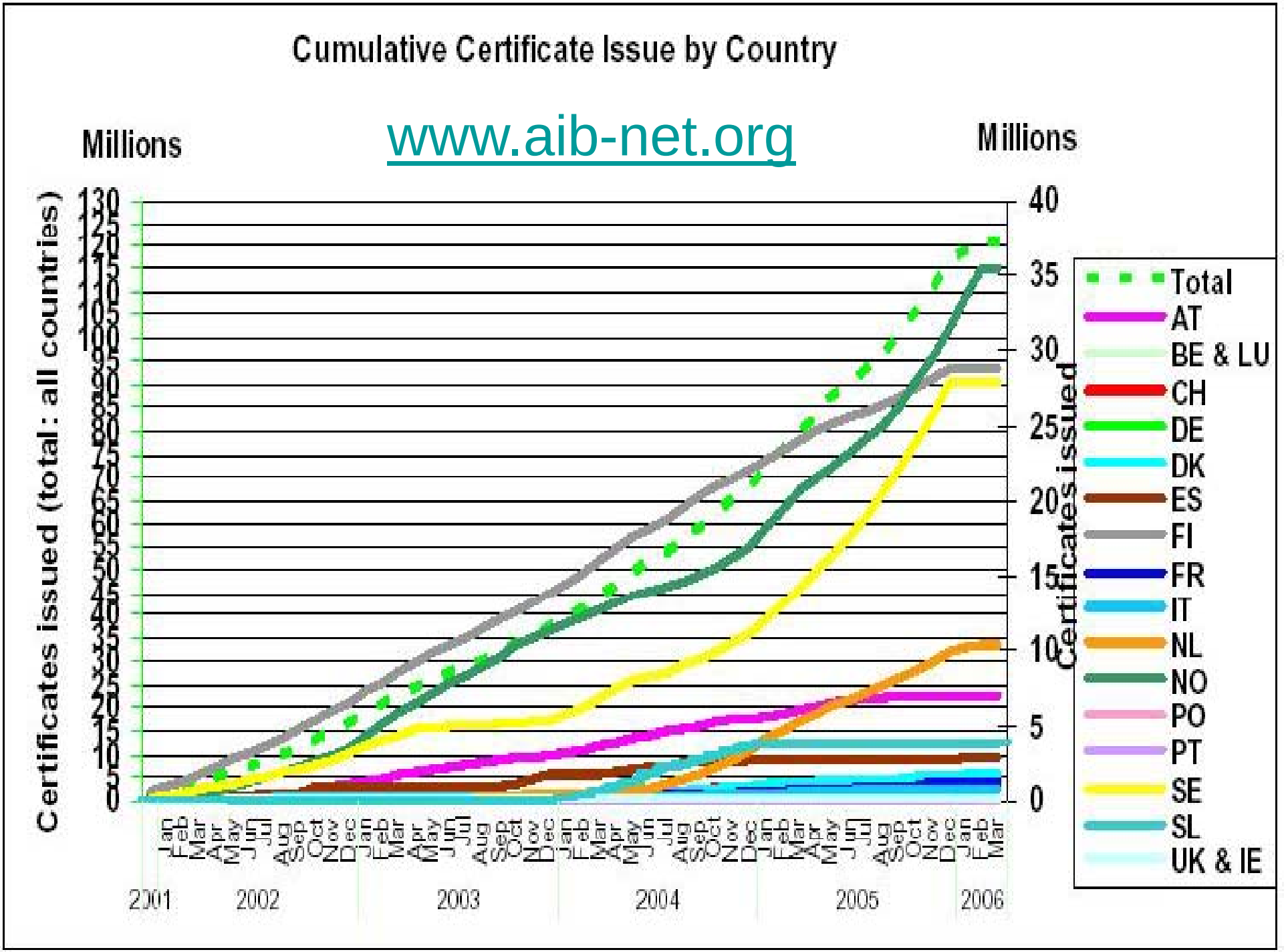
UNDP RFI Hot Towns

Area Of Interest

Data adapted from REResDB (CSIR, Eskom, DME 2004)

July 2008

Filename:	UNDPRFIJul08.apr
Layoutname:	LayoutNanoProspect
Prepared by:	Jason Schäffler (Nano Energy)


Cumulative Certificate Issue by Country
www.aib-net.org
Millions
Millions
Certificates issued (total: all countries)
Certificates issued
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25
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Total
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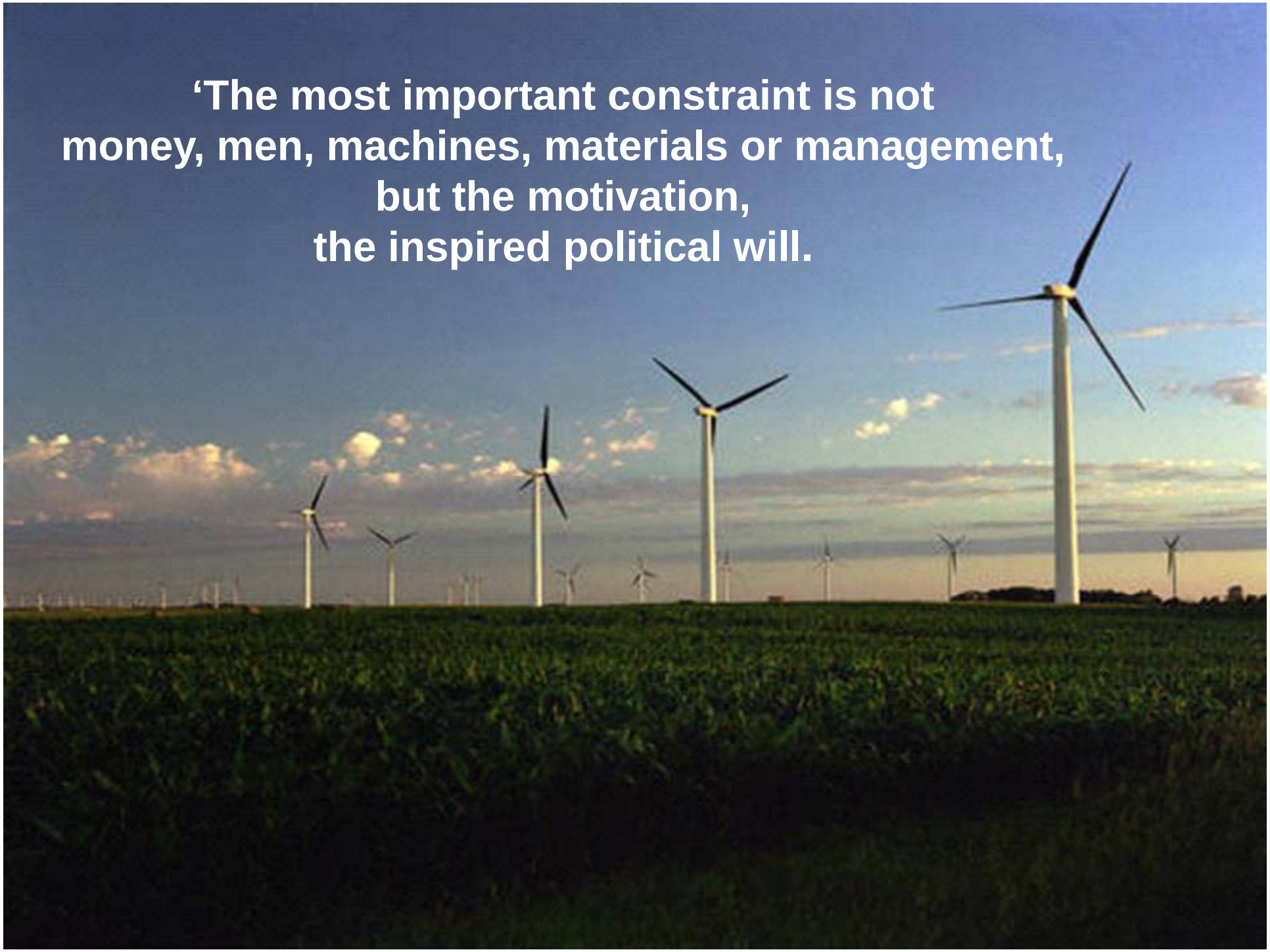
‘The most important constraint is not
money, men, machines, materials or management,
but the motivation,
the inspired political will.

Thank you.

Jason Schäffler
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