Strategies and Philosophies - Power

Dr Georgina Harris (per Phil Crosby) ver 1.1

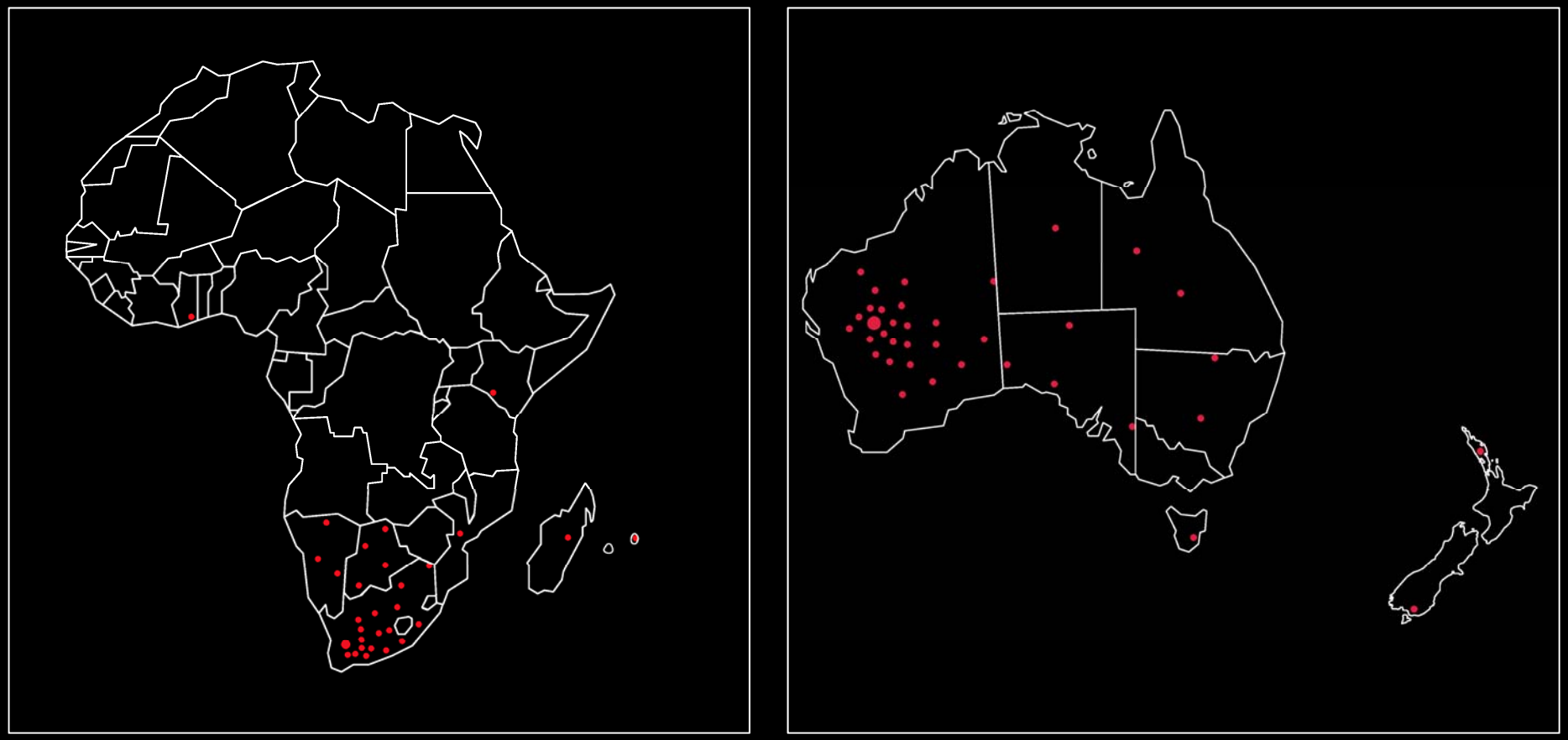
Technical Power Issues

- Generation
- Distribution
- Minimising power demand
- RFI Prevention / Shielding
- A ‘green’ solution

- It’s a joint site/SKA system problem!

Distributed Power Requirements

SPDO



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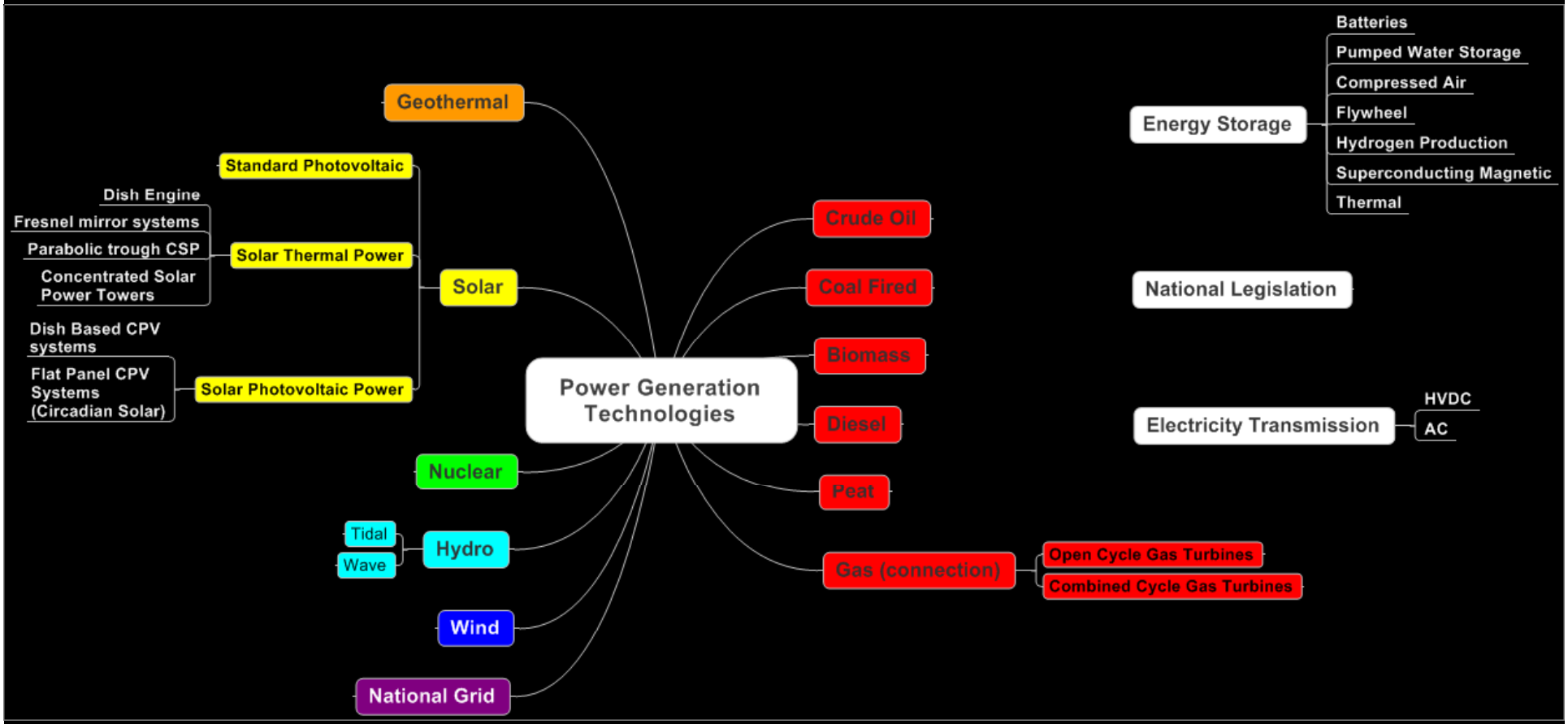
Power Options Overview

SPDO

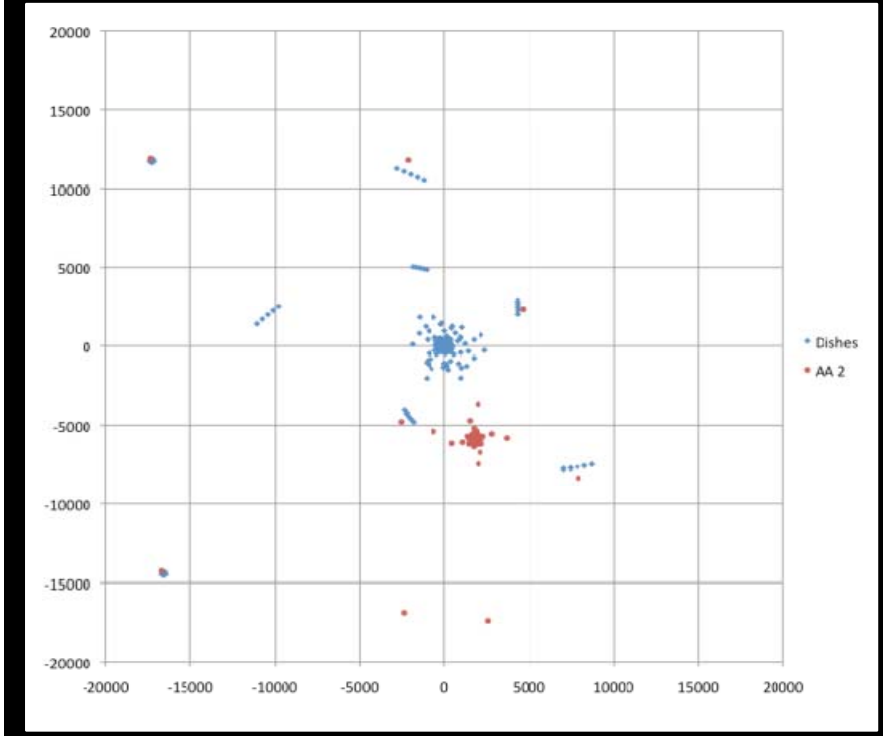


Power Generation

- Power provision for all parts of the site will:
  - need to operate with minimal human intervention (maintenance, refuelling, repair)
  - need to minimise
    - distribution losses
    - cost of cabling
    - production of RFI
- The Core will likely use a ‘standard’ reticulation system – optimised through models.

SKA_1 and SKA_2 Deployment

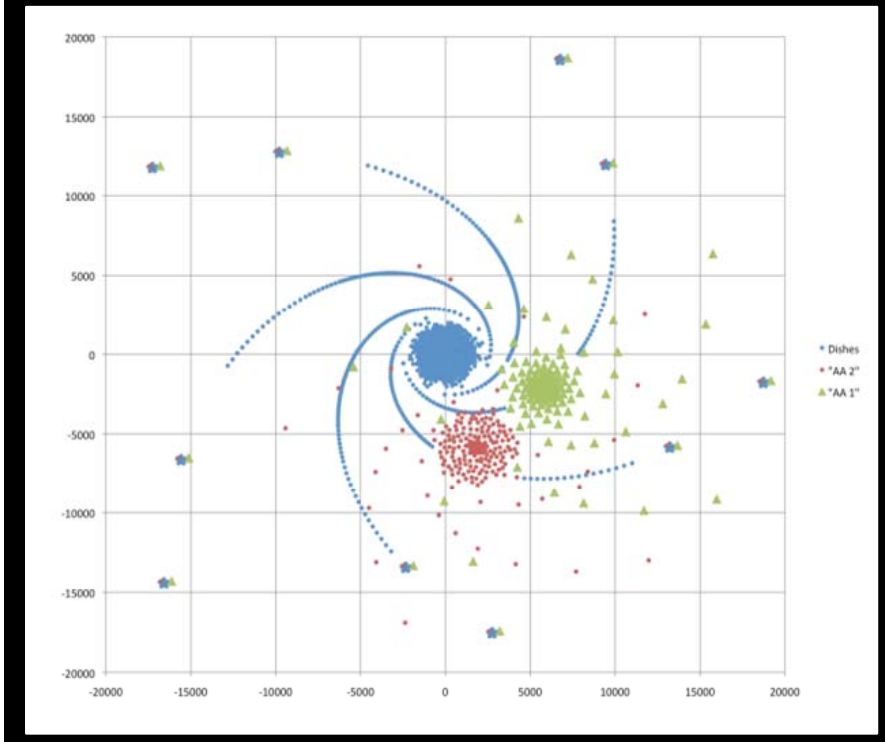
SPDO



- The power infrastructure is to be considered in terms of a planned rollout (scalability)
- Infrastructure planning - SKA_1 or SKA_2 ?
- Also consider any existing power infrastructure in operation on the site
- The aim is to optimise the deployment of the SKA both financially and logistically for both phases

SKA_1 and SKA_2 Deployment

SPDO



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Remote Stations

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‘Stations’ beyond the core site distribution network will require standalone generation – or local grid connection

Some Numbers

	SKA1	SKA2
Core station	3.3 MW	65 MW
Per remote station	70 KW	318 KW
All Remote stations	1.05 MW	8 MW
Total Array	4.35 MW	74 MW
Supercomputer	30MW	40 MW

So, what are the options?

Diesel Engines

- Capacity up to 200MW
- Unit size up to 10MW
- Fossil diesel or palm oil
- Established technology
- Competitive procurement
- $ ~ 1000/kW capital cost
- ca 44% efficiency
- $ 100/ MWh @$500/te
- 570kg/ MWh CO_2 on oil

Balesa Diesels Eritrea

Oil Fired Boilers and Steam Turbines

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- Capacity 10-1000 MW
- Unit size 10-800 MW
- Any oil fuel grade
- Established technology
- Competitive procurement
- Capital cost ca $1500/kW
- Efficiency ca 35%
- $125/ MWh @ $ 500/te
- 710kg/ MWh CO_2

Dubai D Oil Thermal 50MW units

Gas Turbines

Open Cycle

- Capacity 3-400 MW
- Unit size 3-60 MW
- Gas or distillate fuels
- Established technology
- Competitive procurement
- Capital cost $500-700/ kW
- Efficiency up to 42%
- $140/ MWh @$ 700/te oil
- $ 50/ MWh @$ 6/MMBTU gas
- 450kg/ MWh CO_2 on gas

Combined Cycle

- Capacity 40-1500MW
- Unit size 40-450MW
- Gas or distillate fuels
- Established technology
- Competitive procurement
- $1000-1200/ kW capital
- Efficiency ca 52%
- $115/ MWh @$700/ te oil
- $40/ MWh @ $6/ MMBTU gas
- 360kg/ MWh CO_2 on gas

Gas Interconnection

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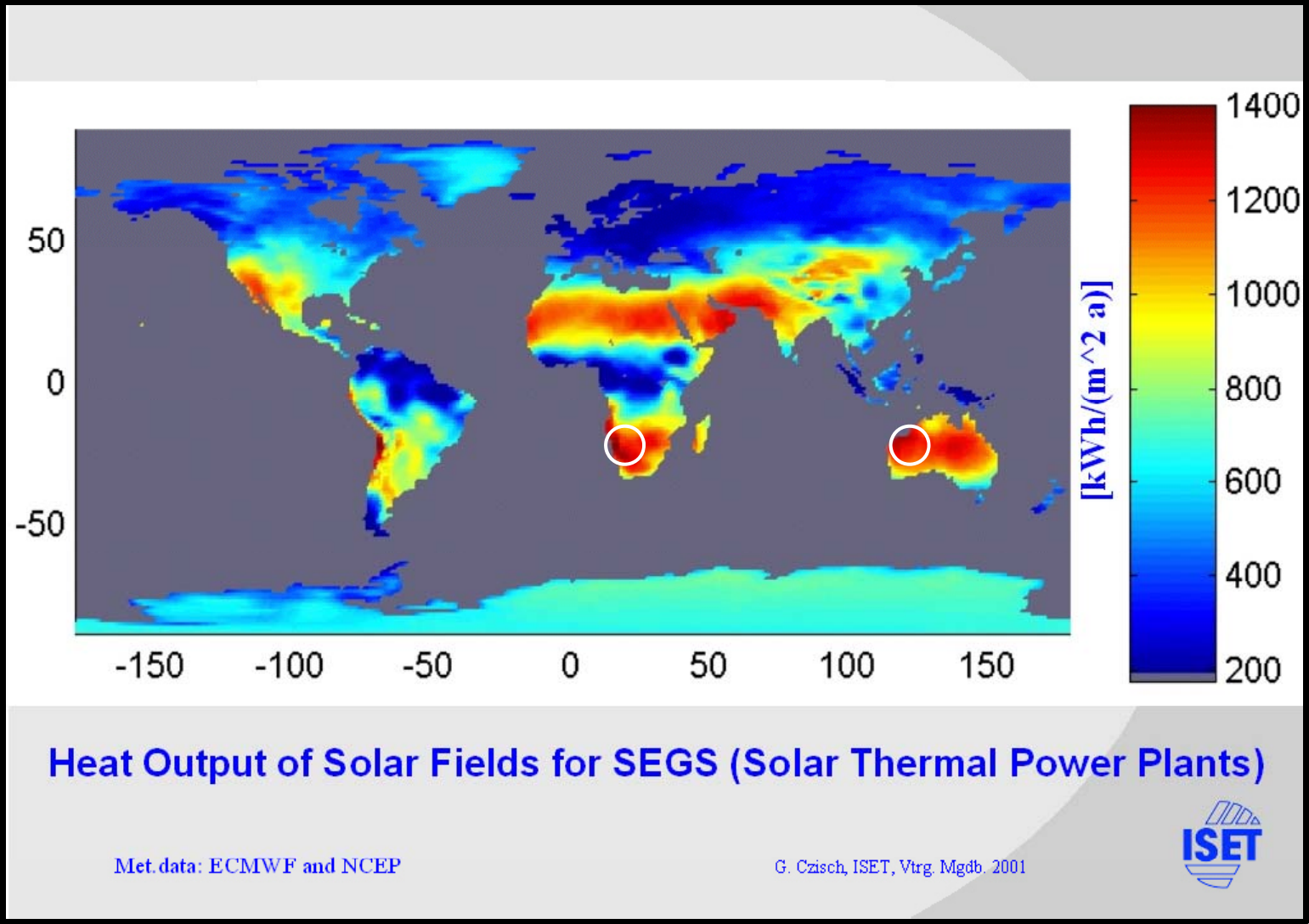
Gas pipeline

- Capacity >400MWt
- Unit size >150mm
- Operating pressure <80 bar
- Established technology
- Competitive procurement
- $300-500k/ km capital
- Pressure loss ~1%/ km
- Lead time of ca 3 years

Solar Energy Resource



Solar Thermal Power

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PS10 (11MW) and PS20 (20MW) power towers in Spain

- Integral power storage (36 hours)
- Capacity up to 100MW
- Unit size 10-20MW
- Technology in demonstration
- Restricted competition
- $3000/ kW capital
- Efficiency 30%
- Daily and seasonal variation
- Capacity factor 10-25%
- Zero fuel cost
- No direct CO_2 emissions

Solar Thermal Power

SPDO

Parabolic trough CSP plant (150MW), Kramer Junction, California

Solar Photovoltaic Power

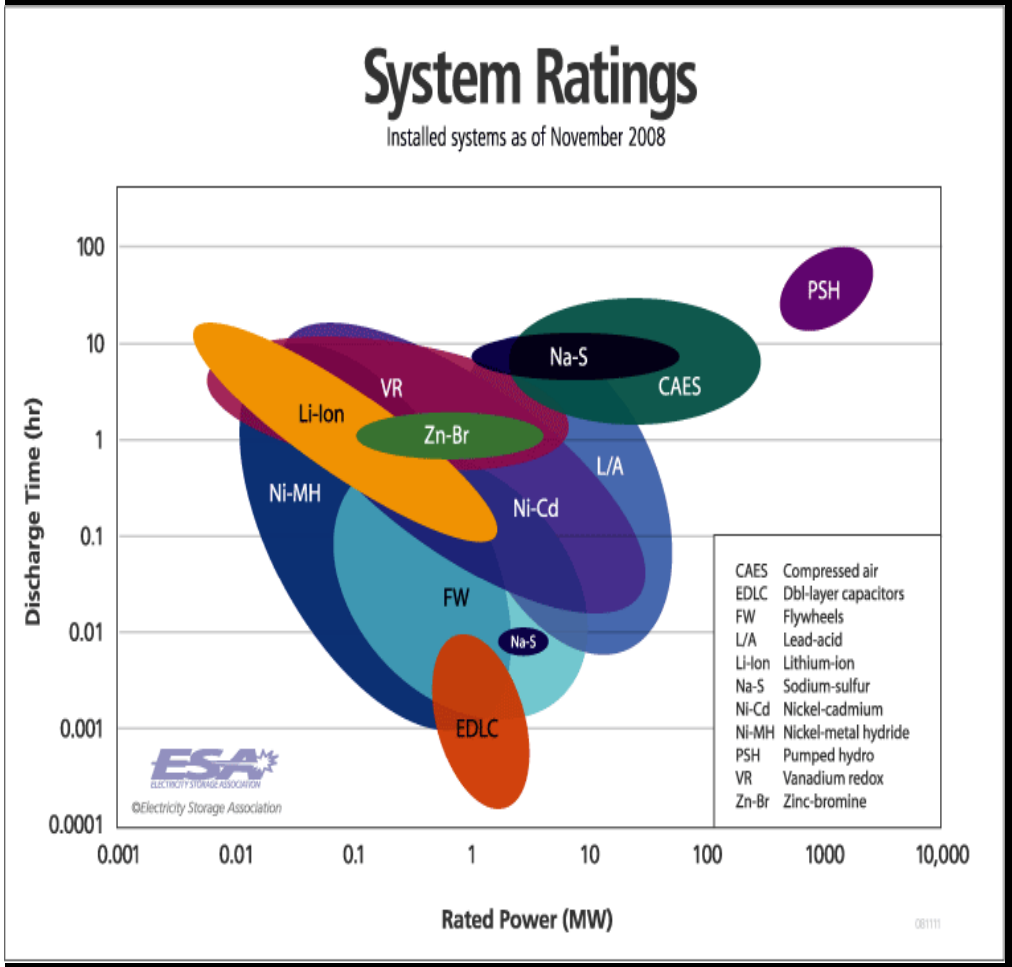
Sevilla PV

- Capacity up to 10MW
- Unit size 1kW-1MW
- Solar
- Technology in demonstration
- Restricted competition
- $6000/ kW capital
- Efficiency ~10%
- Daily and seasonal variation
- Capacity factor 10-20%
- Zero fuel cost
- No direct CO_2 emissions

•EASILY SCALABLE

Solar Energy Storage

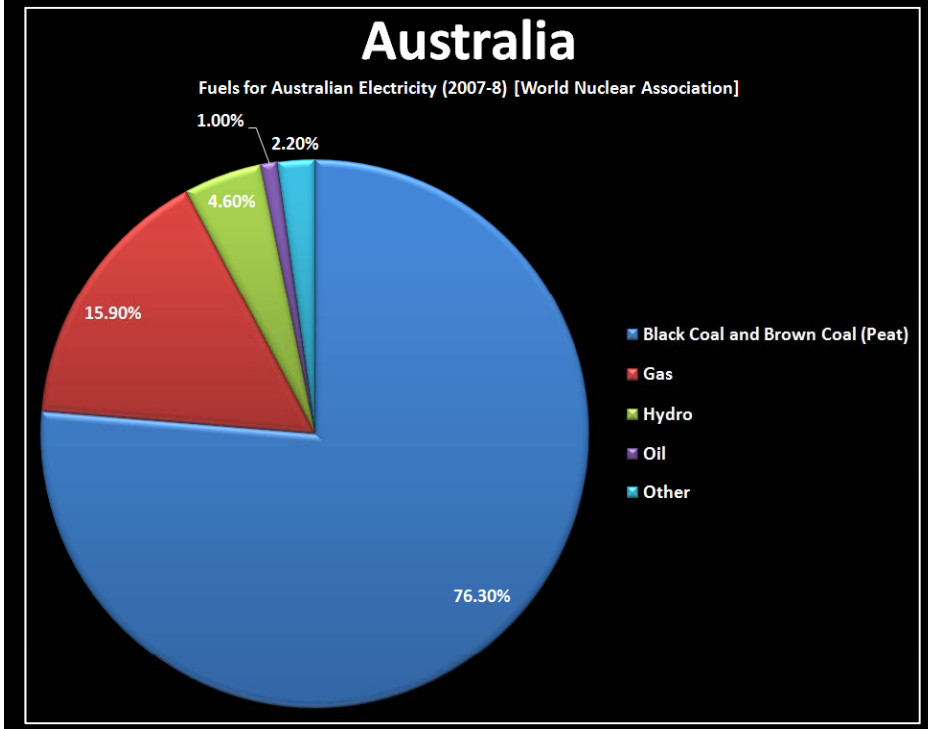
SPDO

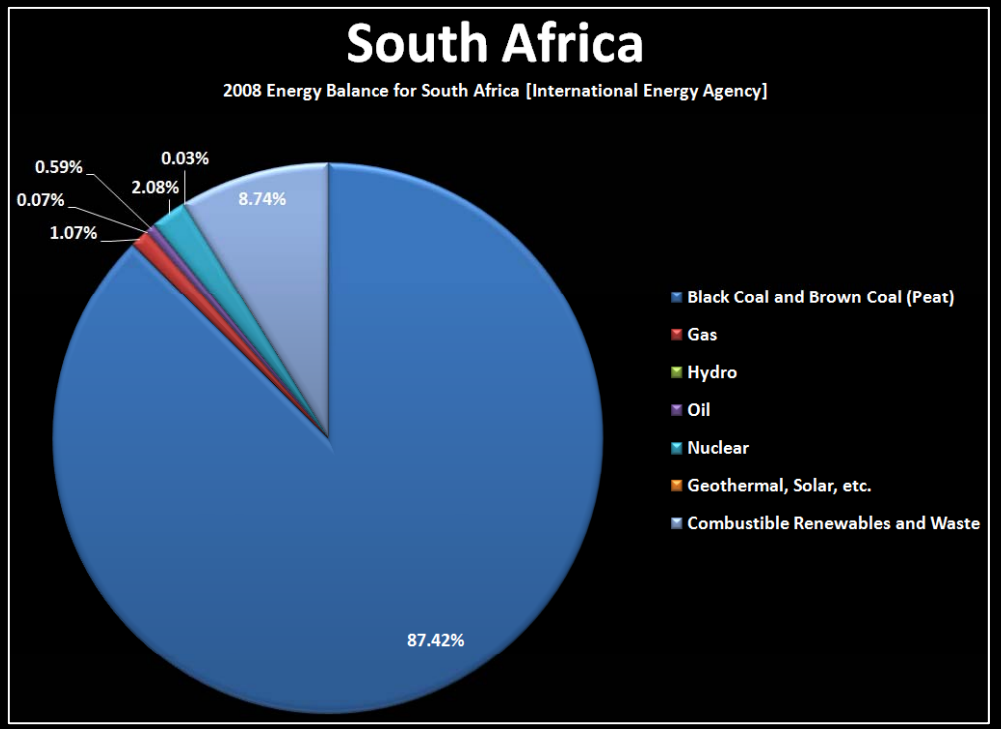


- Solar heat may be stored in melted salts
- NAS (sodium sulfur) battery
- Zinc-Flow® advanced energy storage
- - Vanadium Redox Battery (VRB)
- VRB – EASILY SCALABLE
- Optimised Generation / storage system – storage may be half of cost!

Political Power Issues

- National carbon policy
- Collaboration with national power providers
- Excluded or preferential generation options





The SKA Power Challenge

THANK YOU