5th Annual STERG SolarPACES Symposium

Potential of CSP: Namibia and the region

Presented by Margaret Mutschler

Mutschler Consulting Services

Who are we?

Mutschler Consulting Services

Horst Mutschler
Pr Eng (84)
BSc, BEng (Electrical)
42 years experience

Margaret Mutschler
MSc Finance & Financial Law
BSc, BEng (Electrical)
23 years experience

Bjorn Joerges
B Juris
D Juris
35 years experience

Michelle Cilliers
Pr Eng (97)
MCom
B Eng (Industrial)
23 years experience

Gordon Walters
Hons. BCompt
BCom (Accounting)
SAIPA
25 years experience

Petra Müller
Diploma Information Technology
17 years experience

Heinz Ernst Lösch
Pr Eng (09)
BEng (Civil)
13 years experience

It's our PASSION to provide sustainable cross-sectoral engineering, management and development solutions

We use our SKILLS, experience and resourcefulness to save money, reduce risk, maximise sustainability and advance best practices

Our VISION is to assist our clients in developing sustainable projects, processes and structures to support and maintain a healthy community

Core Competencies

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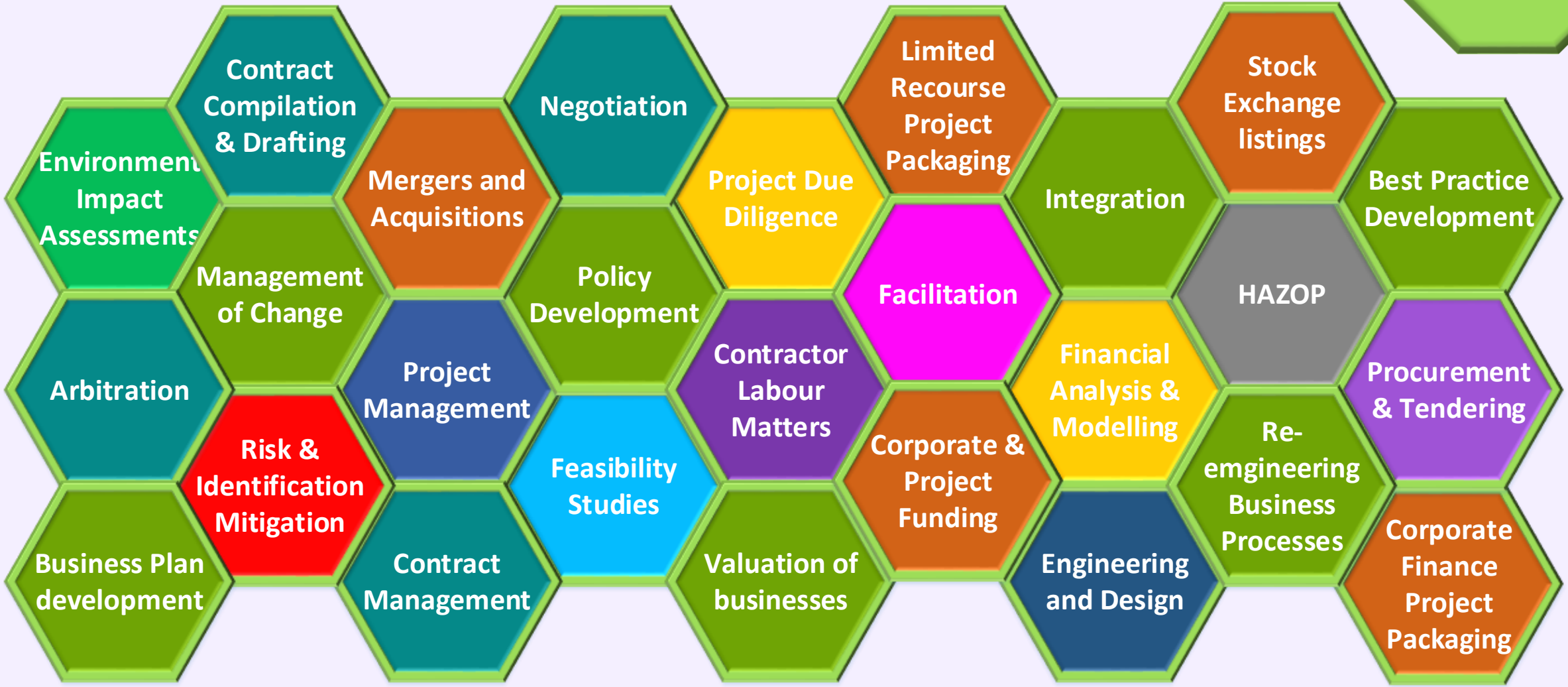

TopSun Award to Namibia

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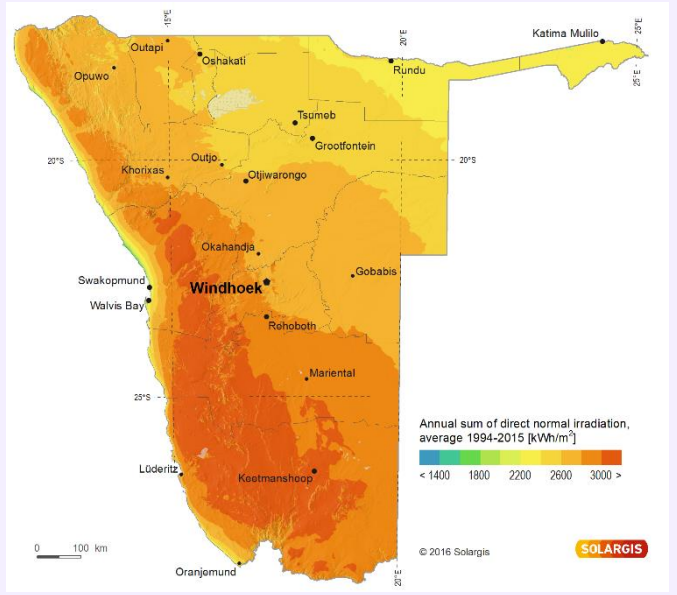
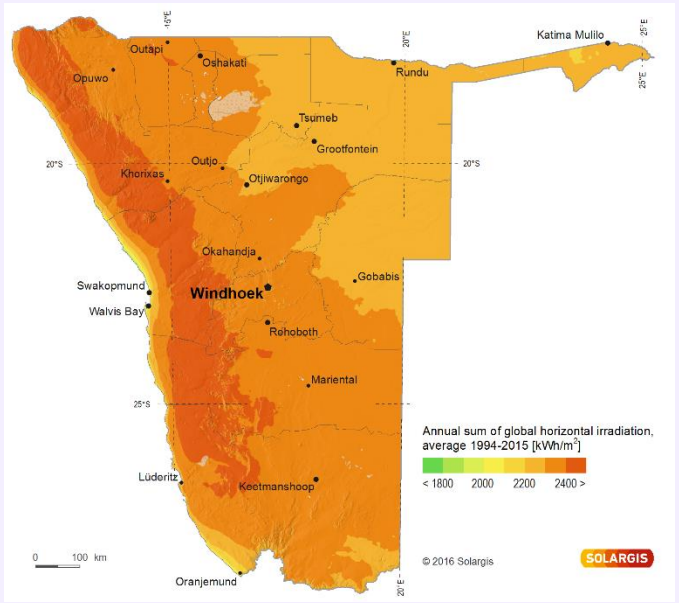
Namibian DNI

Auas	Arandis	Kokerboom
	P50, DNI, 3094	P50, DNI, 3091
	P90, DNI, 2915	P90, DNI, 2913
P50, DNI, 2759	P50, GHI, 2759	
P90, DNI, 2599	P90, GHI, 2599	
		P50, GHI, 2362
P50, GHI, 2293		P90, GHI, 2256
P90, GHI, 2190		





CSP in Namibia

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CSP Development Pillars in Namibia

Electricity

- Utility scale plants (Base Load, Mid Merit and Peaking)
- Hybrids of CSP & PV to maximizing energy collection
- Distributed smaller generation, hybridized with other technology
- Off grid or mini grid options to provide electricity 24/7

Heat energy

- Industrial uses, process heat
- Hybridized to increase efficiency
- Desalination

Innovation Center and Solar Park

- Allow international partners to benefit from extreme boundary conditions to test new technology
- Technology and Knowledge transfer

Utility Scale Projects:
Opportunities to differentiate CSP from intermittent renewables
Use appropriate tariff structure to reward optimum dispatch

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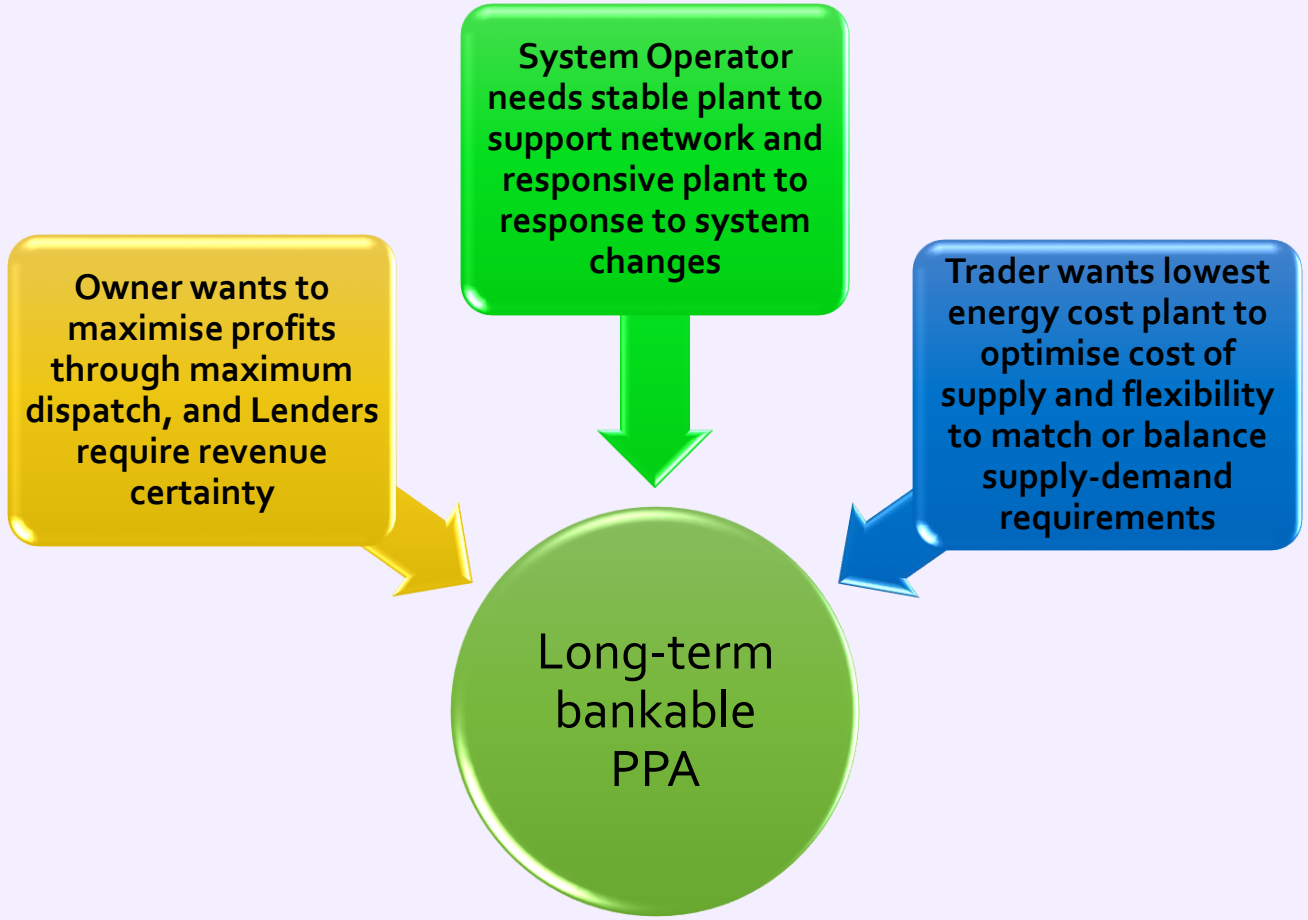
- Balancing interests of :
  - CSP developer/ owner/ investor/ lender/ operator
  - Off Taker and Trader
  - Network Operator
- Technology slave to system not System slave to power plant
- Flexibility vs Revenue certainty
- Future proofing long-term PPA



Optimum Dispatch factors at different energy tariffs

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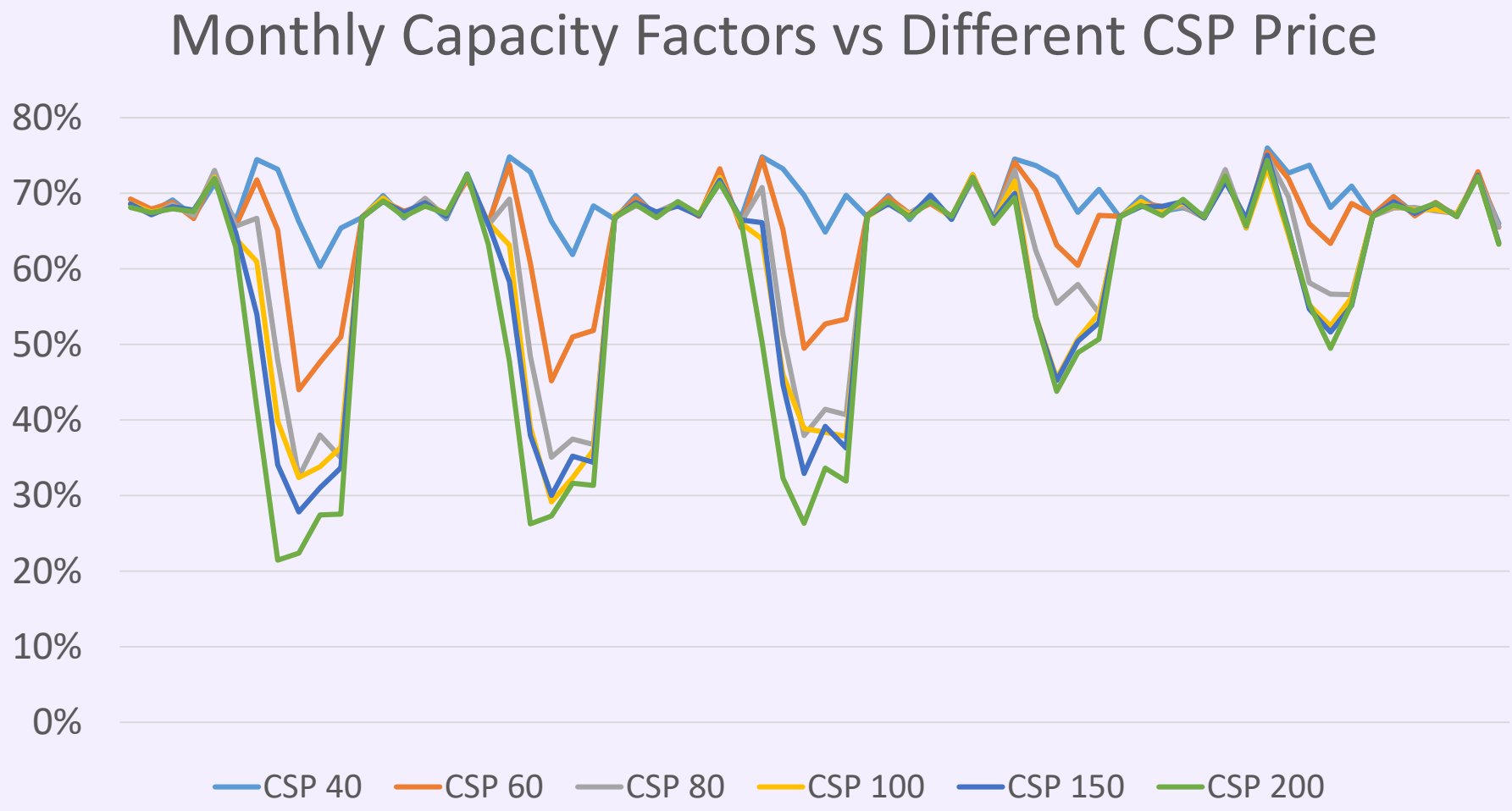

CSP with Thermal Storage

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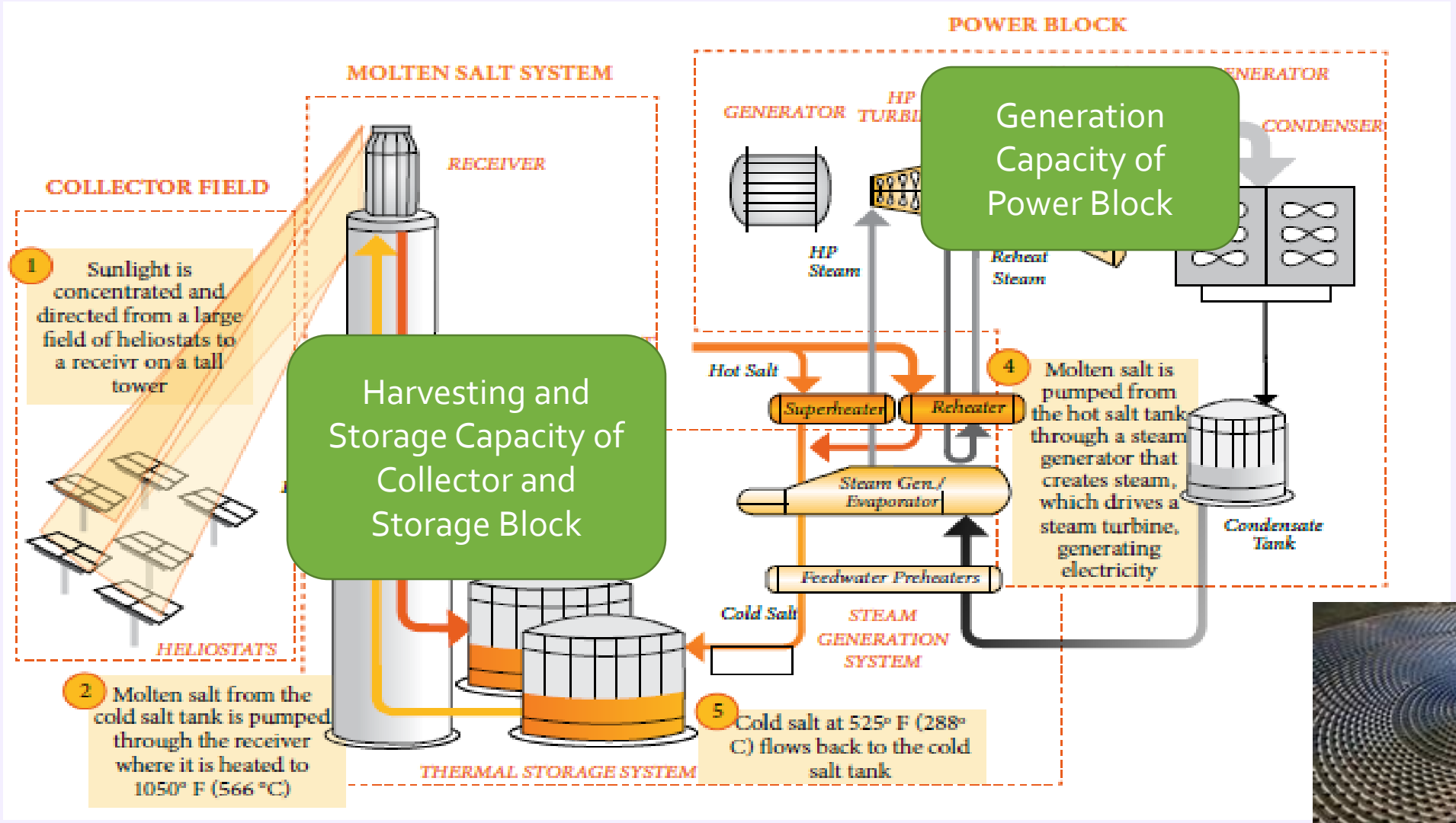

The Technical blocks

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Solar Resource:
Predictable, P50 – P95 certainty on annual resource
kWh/m²/a

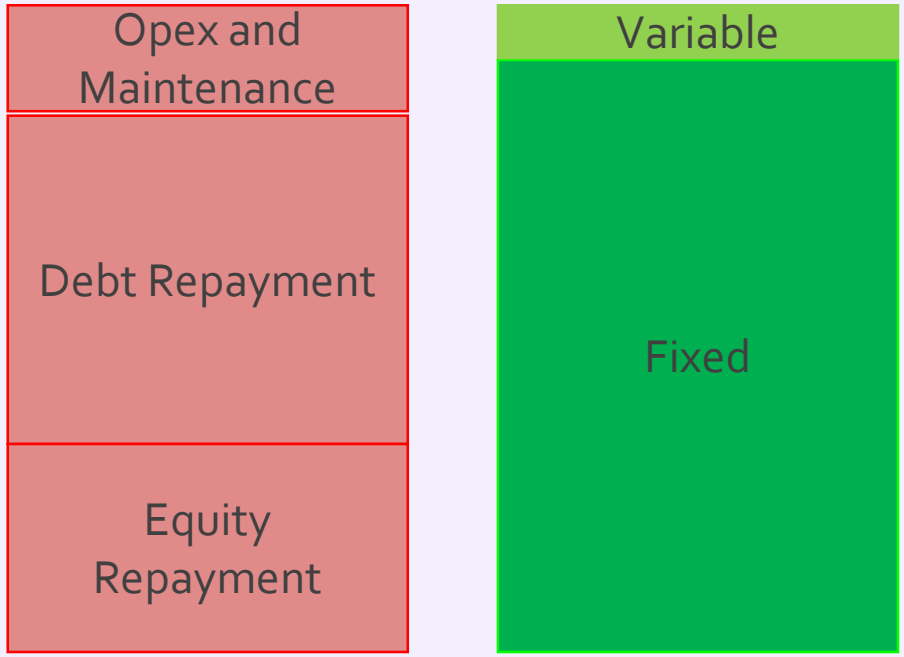
Thermal Energy Harvesting and Storage Capacity
$MW_{thermal}$
Solar multiple, Tank/pipe size and pumping capacity

Electrical Generation Capacity
$Mw_{electrical}$
Steam Turbine capacity

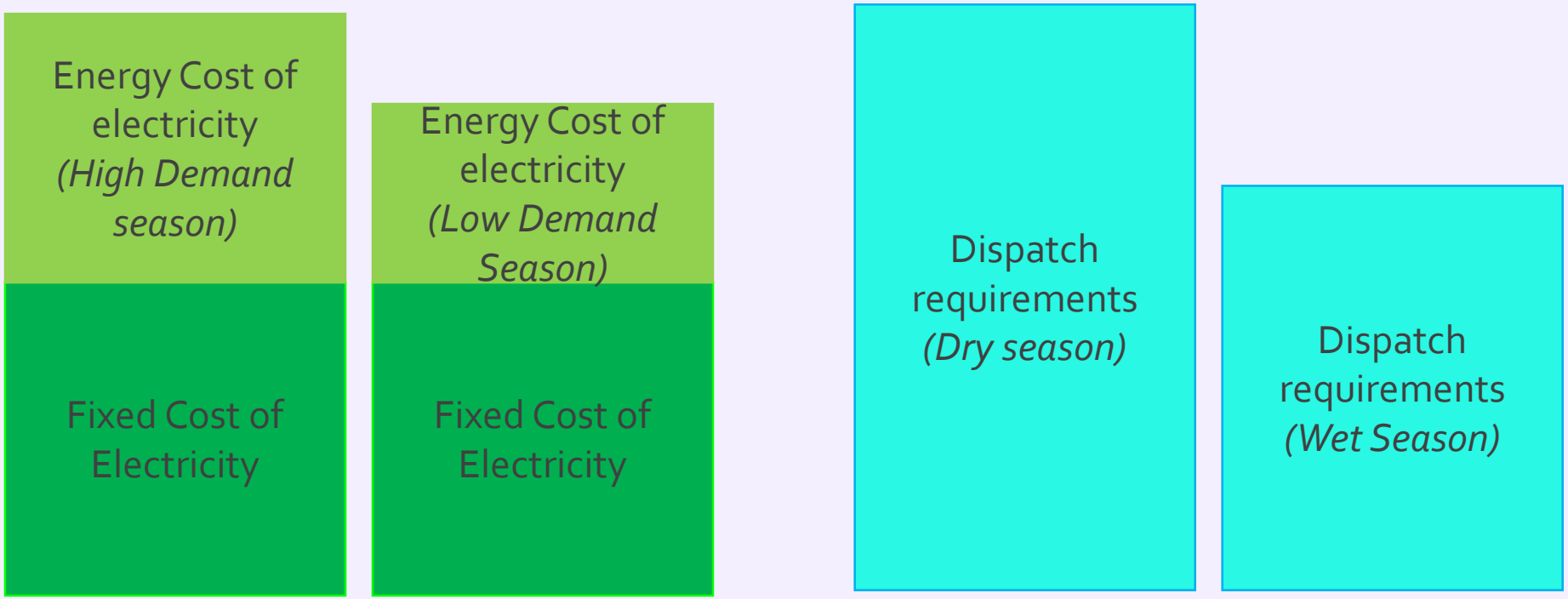
Thermal Energy into storage ($Mwh_{thermal}$)
- Resource on day
- Thermal energy in storage from previous day
- Dispatch of thermal energy (to electrical energy) on the day
- Availability of Collector and Storage block

Thermal Energy to Electrical Energy ($MWh_{electrical}$)
- Thermal Energy from Storage
- Dispatch requirement for electrical energy on the day
- Availability of power block

The Revenue Requirement blocks



The System Requirement blocks



Existing Pricing Methodology in Thermal Power Stations

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- (One tier) **Energy only tariff,** paid when plant could dispatch (or dispatched) with a must take obligation on Buyer
  - This is typical for PV and wind, with no incentive for dispatch meeting the demand requirements/system

- (Two Tier) **Energy payment and Capacity Payment**
  - Depending on the alignment between fix and variable cost with fixed and variable payments payment normally have a Take or Pay component
  - Capacity payment was based on dependable capacity, subjected to tests to proof dependable capacity from time to time
  - Availability declaration (if less than contractual availability) had impact on capacity payment

- (Three Tier) **Energy payment, Availability Payment and Capacity Payment**
  - Take or Pay replaced by an availability payment (availability payment sort of stand by payment), and
  - Energy only paid for if taken, energy payment brackets influenced by dispatch factor
  - Capacity payment based on dependable capacity, subjected to tests to proof dependable capacity from time to time
  - Availability declaration (if less than contractual availability) had impact on availability payment

Proposed tariff structure and underlying technology

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- (Two Tier) **Energy payment and Capacity Payment**
  - **Energy with ToP** or very steep multipliers between different load/dispatch factors
  - **Capacity payment** based on dependable turbine capacity, subjected to tests to proof dependable capacity from time to time

- (Three Tier) **Energy payment, Storage Payment and Capacity Payment**
  - **Energy payment** with less pronounced multipliers to reflect lower dispatch/load factors
    - Interest: Trader of least cost option – expected load/dispatch factors
    - Cover Variable O&M as well as some Fixed O&M
  - **Storage payment** to reward available energy in storage (fixed)
    - Interest: Network operator and trader for Ancillary service, stand by
    - New Business sector Or part of System security?
    - Cover Investment (Equity)
  - **Capacity payment** based on dependable turbine capacity, subjected to tests to proof dependable capacity from time to time
    - Interest: Planning and investment
    - Cover Debt

Summary Tariff Structure

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	Fixed Payments		Variable Payments
Two Tier	**Capacity Payment** based on a Capacity Charge, defined as the dependable export capacity of the CSP Plant		**Energy Payment based on an Time of Use Energy Charge**, with either Take or Pay obligations or different charges for different dispatch factor brackets. The Time of Use (ToU) **multiplication factors** will be used to reflect the value of the energy during specific times of the day (Peak, Standard, Off-Peak), as well as during different seasons (Wet, Dry, High, Low)
Three Tier	**Electrical Capacity Payment** based on an Electrical Capacity Charge, defined as the dependable export capacity of the steam turbine-generator block	**Storage Capacity Payment** based on a Storage Capacity Charge, defined as the dependable storage capacity of the thermal storage plant (field, collector and storage tanks)	

Why should this be of interest to a bunch of post grad students and their prof's?

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- Commercial signals drive technology development and operating regimes
  - **you get what you are paying for**

AND

- Technology development support commercial competitiveness
  - **design to allow operation of the asset for maximum revenue over its life time**

BUT there is a lag in response time, therefore:

- Proactive, pre-emptive **Research and Development** is required to shorten response time to prevent obsolete technology

Future proofing a long term PPA: What will happen to my CSP PPA?

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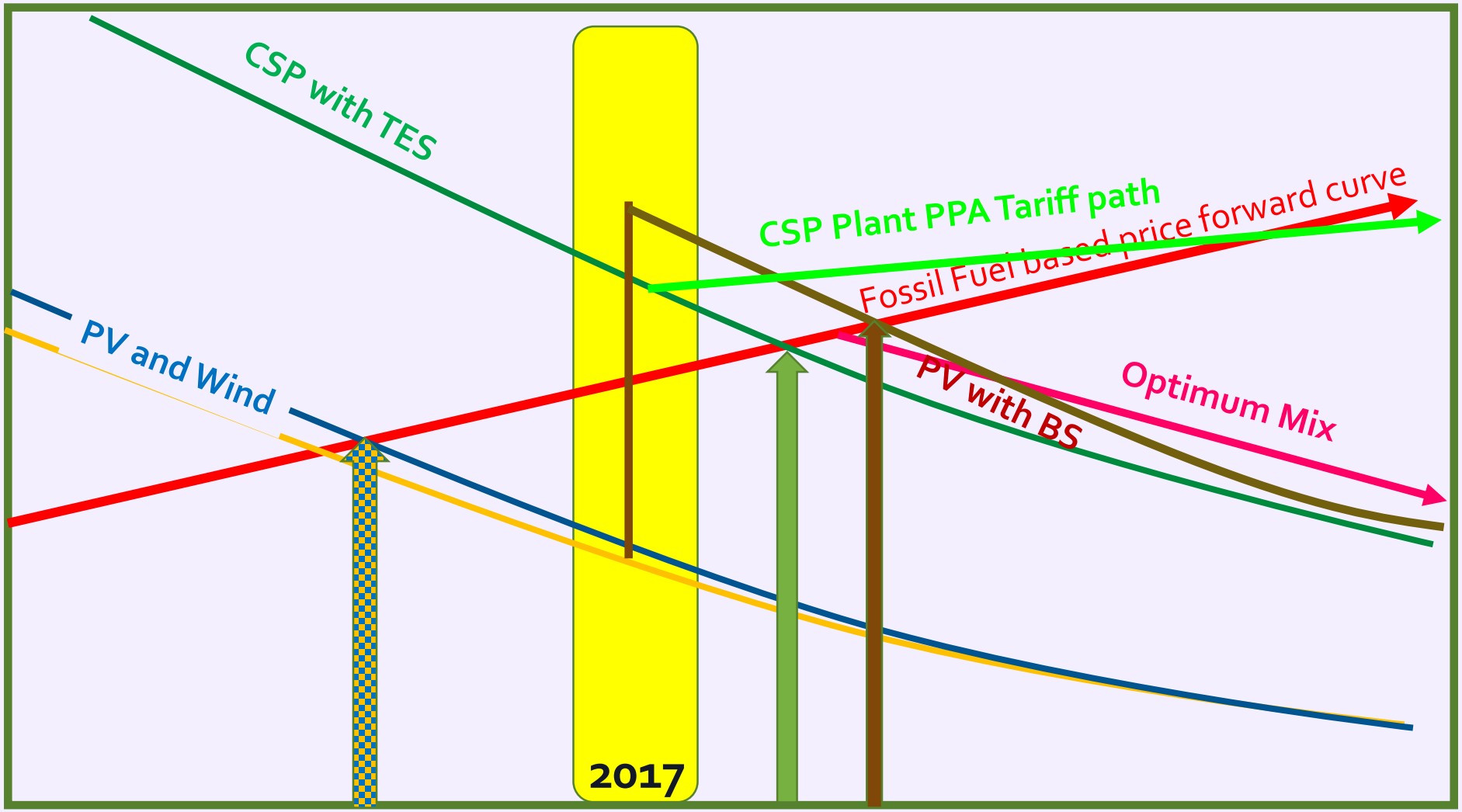

- Above grid parity now
  - More expensive than like-dispatch plants?
- Gap will increase over PPA lifetime
  - PPA renegotiation is certainty
- How can this be addressed?
  - Retrofitting – CAPEX >90% of tariff
  - Dilemma (and potential problem statement for post grad student)

Future proofing a long term PPA: Where are we now?

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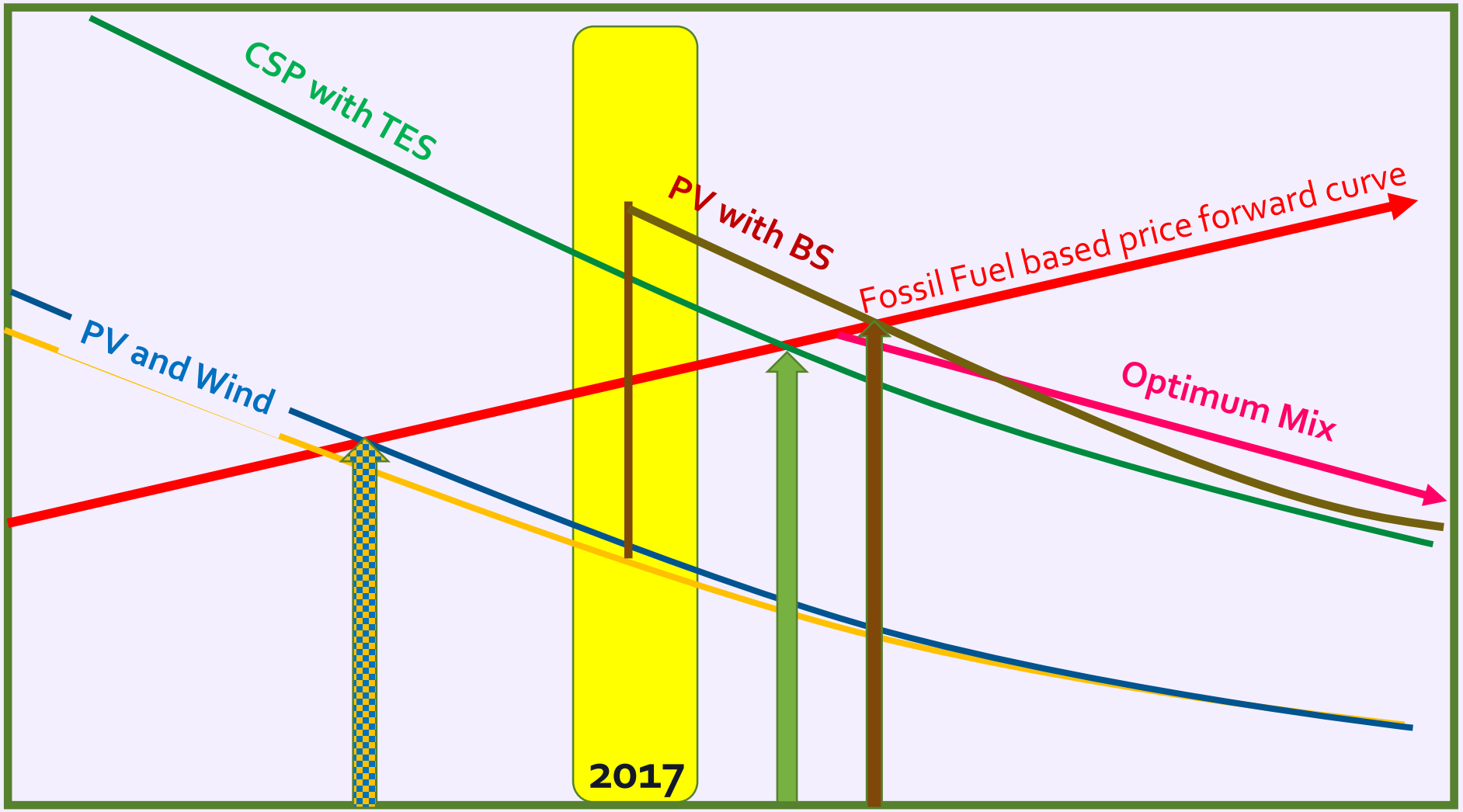

- Opportunity to see real price path decline with Optimal Mix
  - Least cost NIRP 70% RE
- Storage Opportunity to add value to intermittent plants
- CSP still not on grid parity
- CSP close to like-dispatch plants in correct dispatch-technology match

Opportunities for CSP, beyond the obvious

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- Distributed Generation
  - Distribution Grid parity >> Transmission Grid parity
  - Simple, reliable and robust solutions
    - 24/7 Solar, VAST Solar, Helium balloons, etc
- Off grid and mini grid applications
  - Modular, plug and play black box approach
  - Synchronise between resource, habits and user profiles
- ACEC (Africa Clean Energy Corridor)
  - Interconnected gird for optimum mix
  - Plants locations informed by resources
  - Borderless approach
- Industrial Heat processes
  - Part of Optimum ENERGY mix
- Desalination

What do we need in the region

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- CSP plants that are competitive in:

1. Specific niche market – not necessary base load
2. Asset Life Cycle Value - Maintainable, reliable, design life and retrofitting, MTBF
3. Meet Fit-for-Purpose specifications
4. Optimal utilisation of resource certainty and predictability
5. Providing Ancillary services
6. Responsive to market and grid code changes

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Thank You

margaret@mutschlercs.com

mcs@mutschlercs.com