This presentation is from Ampt’s participation in a panel discussion at:
Solar Asset Management – North America
Session 7A – Repowering: What Is It and How Does It Impact the Bottom Line?

13-14 March 2018 - San Francisco
Innovative DC Power Management

Lower cost and higher performing PV systems

Optimize PV Systems
Repower PV Systems
DC-Coupled Storage
Monitoring and O&M
Repowering and the emerging role of Solar Asset Management

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**Traditional Role**

### Monitor
- Alert setup / response
- Data analysis / insights
- Issue identification
- Reporting
- Forecasting

*Knowledge management*

### Maintain
- Site upkeep (routine)
- Repairs
- Replacements
- Warranty management
- Contracting

*Operational management*

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### Activities

#### Optimization Focus

### Decisions
- Limited visibility
- Lack of granular control

### Cost
- Equipment availability
- Component compatibility

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Repowering and the emerging role of Solar Asset Management

### Activities

**Monitor**
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**Maintain**
- Site upkeep (routine)
- Repairs
- Replacements
- Warranty management
- Contracting

**Revenue Engine**
- Asset divestitures
- Asset acquisitions
- Performance enhancement
- System expansion
- New business models

### Optimization Focus

**Decisions**
- Knowledge management

**Cost**
- Operational management

**Production**
- Portfolio management

### Challenges & Constraints for Repowering

- Limited visibility
- Lack of granular control
- Equipment availability
- Component compatibility
- Systems degrade over time
- Hard to add array capacity (voltage imbalances & ampacity limits)
### Repowering and the emerging role of Solar Asset Management

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### Challenges & Constraints for Repowering

- Limited visibility
- Lack of granular control
- Equipment availability
- Component compatibility
- Systems degrade over time
- Hard to add array capacity (voltage imbalances & ampacity limits)
- Affordable technology did not exist to build in flexibility for the future

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Technology is evolving to meet emerging Repowering opportunities.
Repowering advantages using DC Power Management

Maintain

- Inverter Replacement
- EBOS Rework
- Module Replacement

Cost Optimization

- Available & compliant
- Backward compatible
- Minimize component cost
- Minimize labor cost
- Minimize downtime
- Minimize mismatch

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Repowering advantages using DC Power Management

Maintain

- Use modern inverters:
  - Lower cost/W; more efficient
  - 1000V inverters in 600V systems
  - 1500V inverters in 1000V systems
  - Use central inverters
  - Use string inverters as "virtual centrals"

- Leverage existing EBOS
  - Use existing DC cables
  - Use existing combiners
  - No retrenching

- MPPT on every string
  - Mix old & new strings
  - Flexible inventory

- String-level communication
  - Improved O&M
  - Programmable outputs (future-proofing)

Inverter Replacement
EBOS Rework
Module Replacement

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**Revenue Engine**
- **Improve performance**
- **Prep system for sale**
- **Minimize component cost**
- **Minimize labor cost**
- **Minimize downtime**
- **Minimize mismatch**
- **Cost Optimization**
- **Production Optimization**

**EBOS Rework**
- Use existing DC cables
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**Module Replacement**
- Mix old & new strings
- Flexible inventory

**Inverter Replacement**
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**String-level communication**
- Improved O&M
- Programmable outputs (future-proofing)
Repowering advantages using DC Power Management

Maintain

Cost Optimization

- Minimize component cost
- Minimize labor cost
- Minimize mismatch

Revenue Engine

Production Optimization

- Mine existing assets
- Backward compatible

Improve performance

- MPPT on every string
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Leverage existing EBOS

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**Cost Optimization**
- Minimize component cost
- Minimize labor cost
- Minimize mismatch
- Minimize downtime

**Production Optimization**
- Available & compliant
- Backward compatible
- Mine existing assets

**Revenue Engine**
- Improve performance
- Prep system for sale
- Grow asset base
- Acquire distressed assets

**Recover system degradation losses**
- 7% energy increase over remaining life of 10-year-old system
- Energy increase significantly higher for underperforming systems

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Repowering: What is it and how does it impact the bottom line?

- The roles of SAMs and repowering are expanding
- Innovative technology is enabling new opportunities
- Repowering has emerged as a revenue engine (vs. cost)
- Develop a vision for “Portfolio” and “Future” management
- Build in flexibility – options have value
- New systems can be designed for repowering while lowering upfront system cost using DC power management