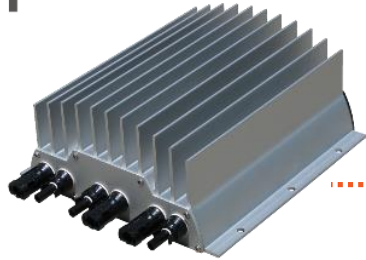


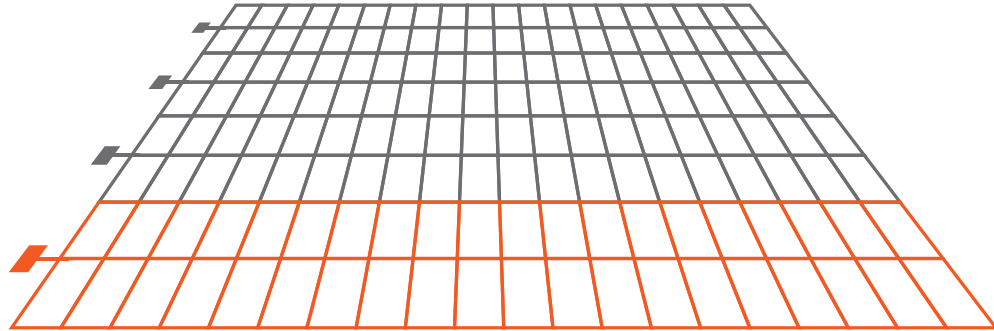


Lower Cost and Higher Performing Systems

DC Power Optimization – A Better Solution



Ampt String Optimizer



1500 VDC

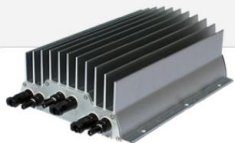
1000 VDC

750 VDC

600 VDC

Optimize new and existing PV systems with Ampt

Products that Deliver Unmatched Value



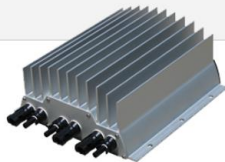
V1500 Series

Max system voltage: 1500 V
Max output voltage: 1500 V
Max output power: 30 kW



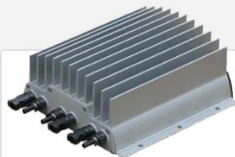
V1300 Series

Max system voltage: 1500 V
Max output voltage: 1300 V
Max output power: 16 kW



V1000 Series

Max system voltage: 1000 V
Max output voltage: 1000 V
Max output power: 12.7 kW



V750 Series

Max system voltage: 750 V
Max output voltage: 750 V
Max output power: 9.5 kW



V600 Series

Max system voltage: 600 V
Max output voltage: 600 V
Max output power: 6.8 kW



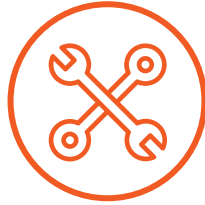
Ampt CU

Two-way Wireless (RF)
String-level data for O&M
Enhanced control for ESS

DC String Optimizers and Optional Communications



Optimize PV Systems



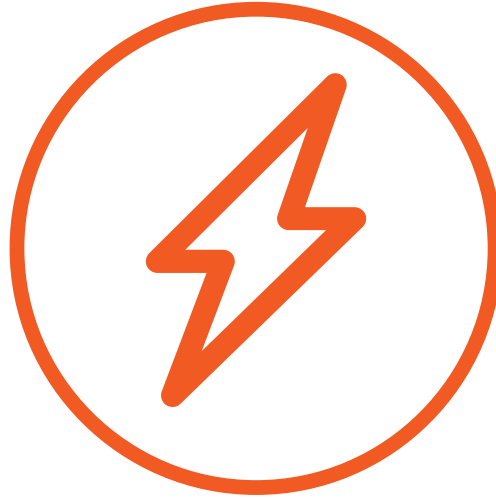
Repower PV Systems



DC-Coupled Storage



Monitoring and O&M



Optimize PV Systems



Optimize PV Systems



Repower PV Systems

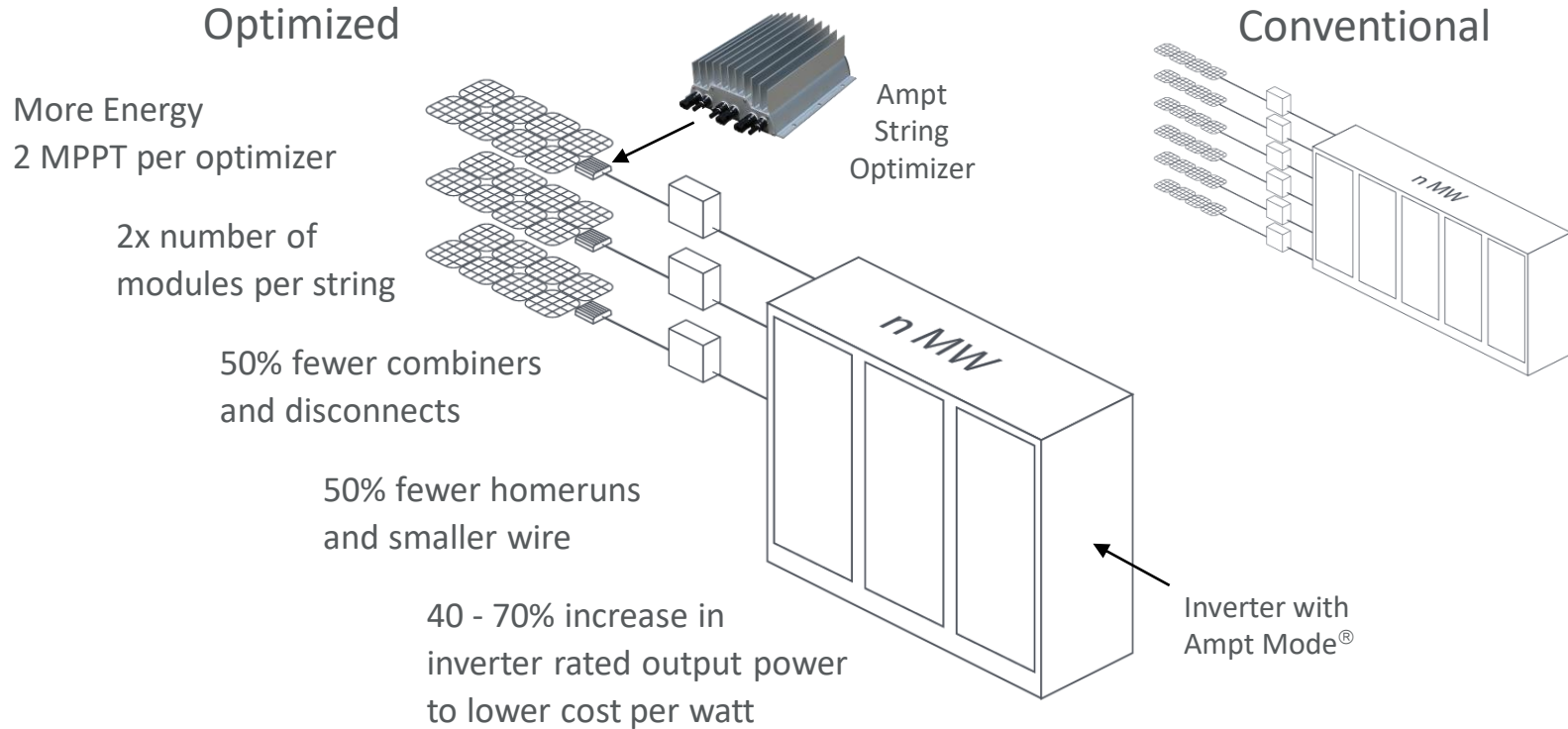


DC-Coupled Storage

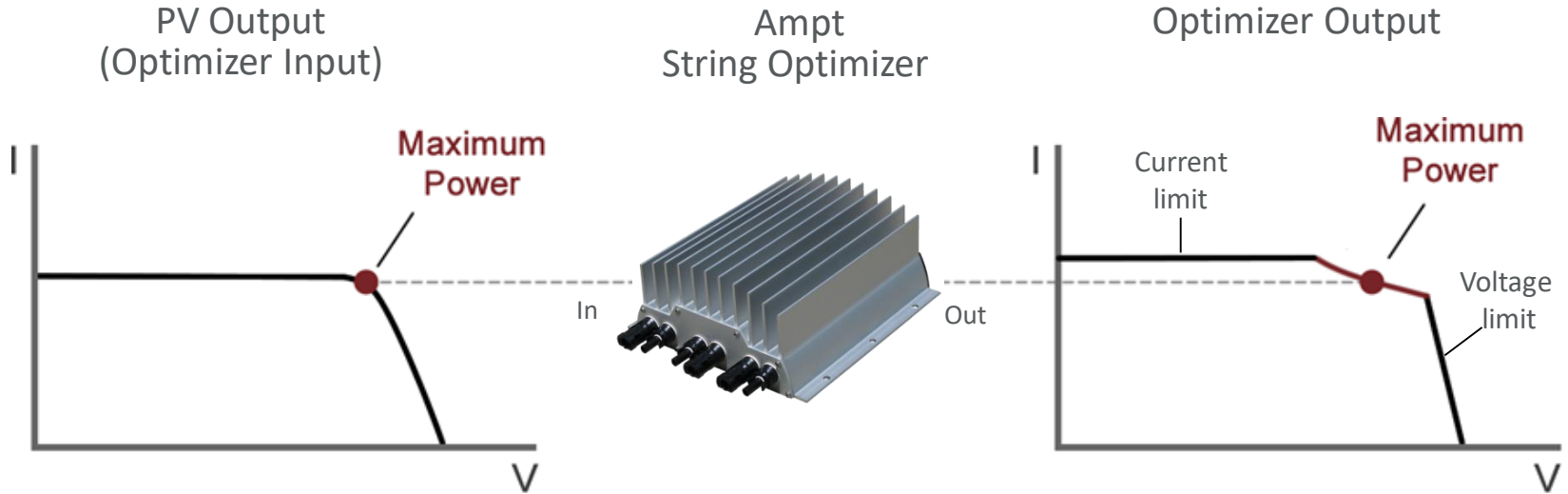


Monitoring and O&M

Advantage of Optimized vs. Conventional Designs



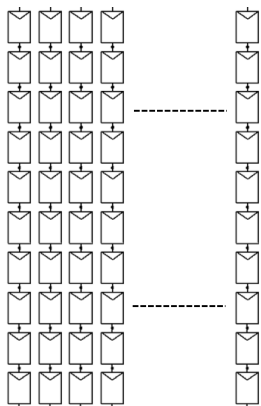
Innovative DC Power Management



More Energy Through Mismatch Correction

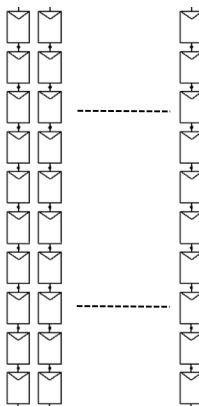
Central Inverters

1000's of Modules per MPP Tracker



Large String Inverters

100's of Modules per MPP Tracker



Ampt String Optimizers

10 - 20 Modules per MPP Tracker (72 cell)



More Energy

Smaller MPP zones = better correction for mismatch



Optimize PV Systems



Repower PV Systems

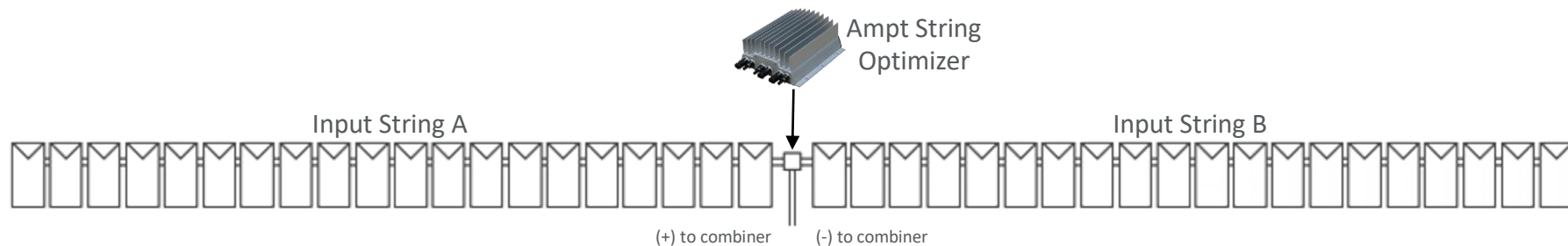


DC-Coupled Storage



Monitoring and O&M

String Stretch[®] Technology Allows 2x Longer Strings



- Voltage output limits allow longer strings
- Up to 40 modules per string (72 cell, 1000V)
- Current output limits allow cable ampacity to be reduced as it no longer requires margin for “over sun” conditions

50% fewer combiners and less cabling to save on cost



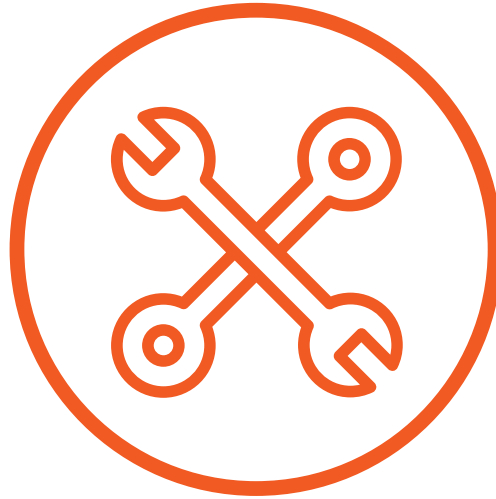
Lower Cost Inverter with Ampt Mode®



	Standard	Ampt Mode®	
DC electrical			
Max array input voltage	1000 V	1000 V	
Input voltage range	500 - 850 V	775 - 850 V	Narrow
Rated input voltage	500 V	775 V	Higher
Max operating input current	1097 A	1097 A	
Typ. string length (72 cell)	20	40	↑ 100%
AC electrical			
Rated output voltage	320 V	480 V	Higher
Rated output current	902 A	902 A	
Rated output power	500 kW	750 kW	↑ 50%

Increase in inverter rated output power lowers cost per watt in Ampt Mode®





Repower PV Systems

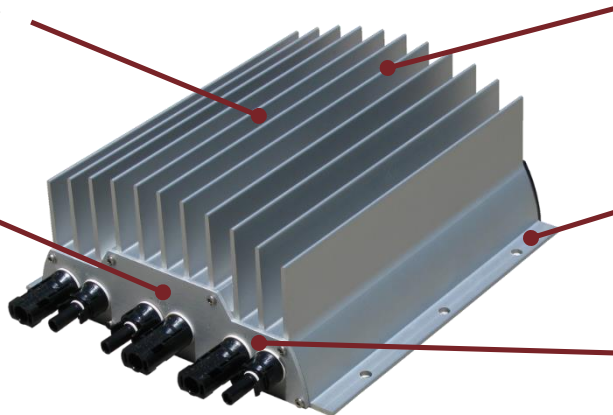


Repower Existing PV Systems

Improve System Performance

More energy with dual MPPT

Ampt delivers full available power at voltage set by existing inverter
(no communications required)



Low Cost Solution

Enhanced O&M with string-level data via optional wireless communication

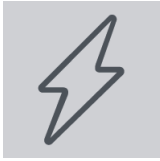
Mounts easily

Low cost retrofit uses existing cables and half the number of combiner circuits



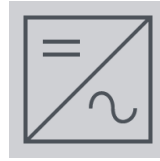
3 Ways to Repower Systems with Ampt

Repower Systems



Recover energy lost from mismatch and degradation to increase production.

Upgrade Inverters



Upgrade inverters over time as each one ends its lifecycle with the newest inverter technology

Expand to High DC/AC Ratio

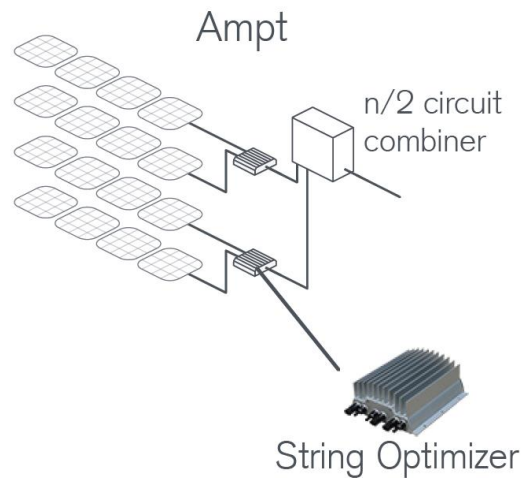
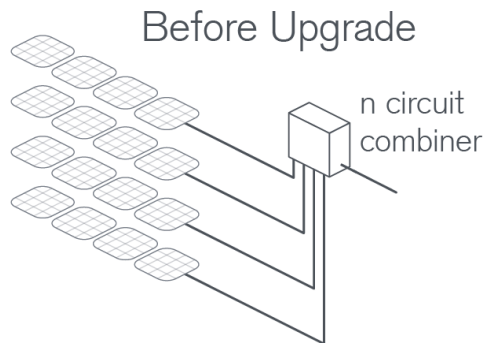
2:1

Expand array size mixing new and legacy modules without overloading inverter to increase revenue





Deploy on Existing Wiring, Combiners & Inverter

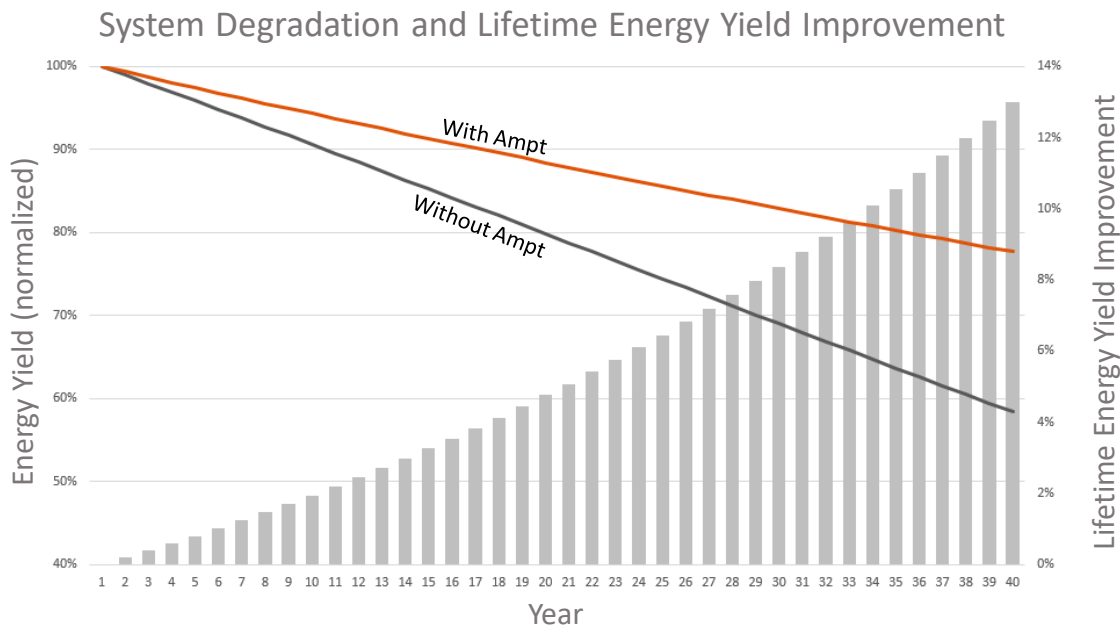


Simple drop-in use for low-cost installation





Increase Production Over Remaining Life



Recover ~60% of losses caused by mismatch as system degrades





Upgrade Inverters



As each inverter ends lifecycle:

- Replace legacy inverters with the newest inverter technology
- Use 1000-volt inverters at full rated power in 600-volt systems
- Use 1500-volt inverters at full rated power in 1000-volt systems

Ampt avoids costly re-wiring and re-trenching while lowering the cost of replacement inverters





Use Modern Inverters as Low-Cost Replacements



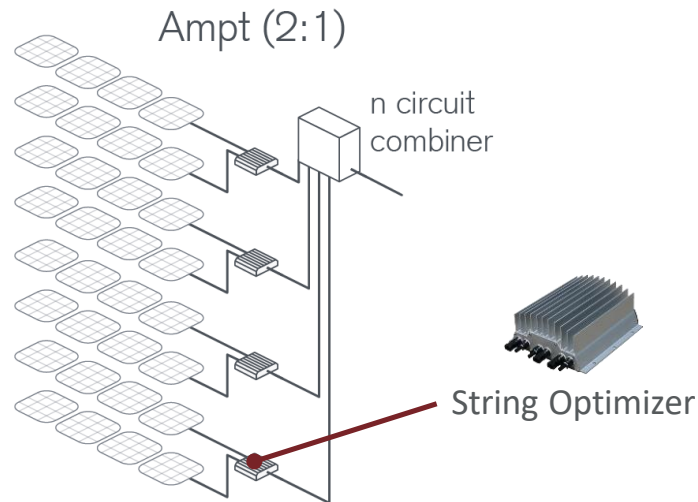
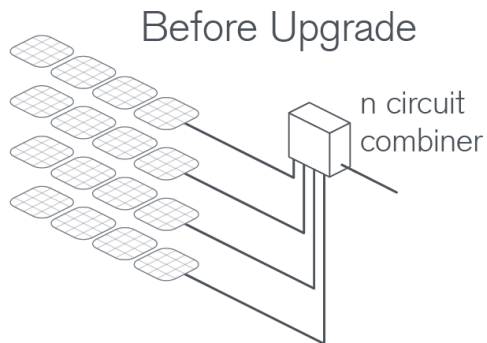
	1000-volt inverter (standard)	1000-volt inverter (with Ampt)
Maximum Input Voltage	1000	1000
Inverter operating range	480-920	500 – 550
Output Power	500kW	500kW
Maximum system voltage	1000	600

With Ampt, use low cost per watt 1000V central or string inverters to replace legacy 600V inverters





Expand to High DC Ratio



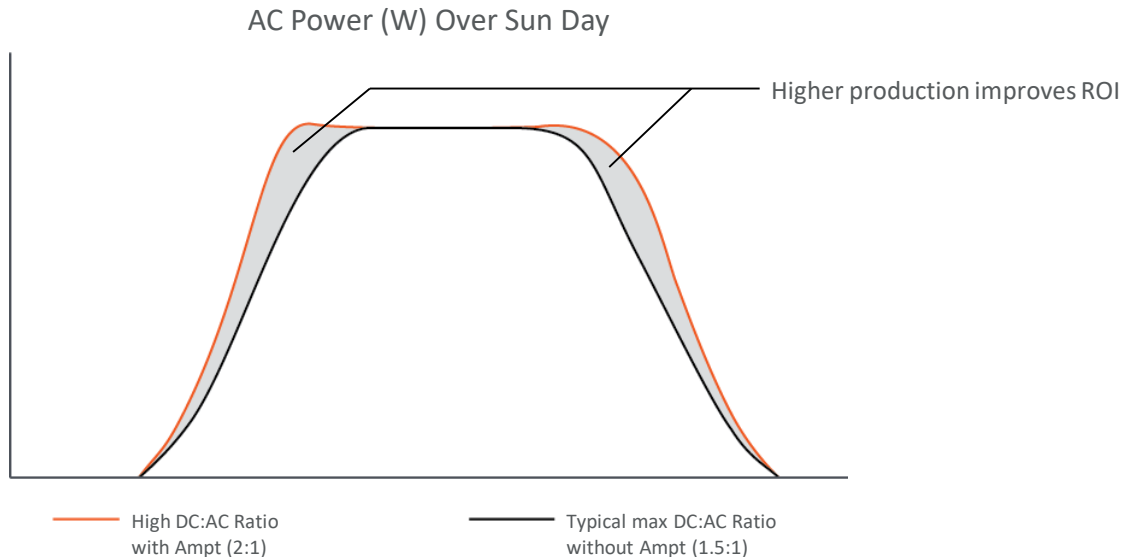
- Enables DC ratios of 2:1 or more
- Increase the size of a PV array on existing inverters
- Mix new and legacy modules





2:1

Higher DC/AC Ratio Delivers More Energy



With Ampt, deploy high DC/AC ratio systems without overloading existing combiner boxes, cables, or inverters



Ampt Repowering Solution Delivers a High Return on Investment



15-30% return on investment

- Typical return projected over the system life

Maximized annual project revenue

- Generate more energy over the system life

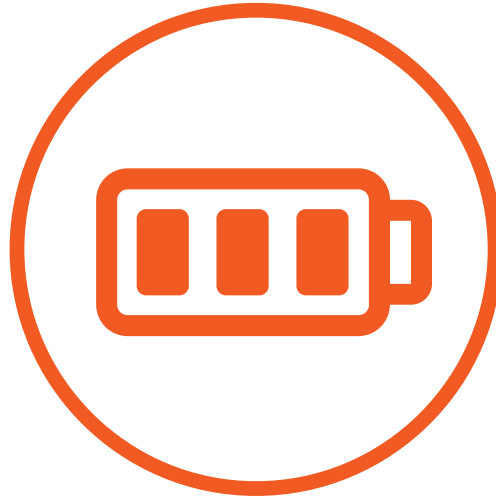
Lowest cost upgrade option

- Use existing wires & combiners
- Use existing inverters

Future-proof inverter replacement

- Upgrade with low-cost, modern string or central inverters
- No re-wiring or re-trenching





DC-Coupled Storage



Optimize PV Systems



Repower PV Systems



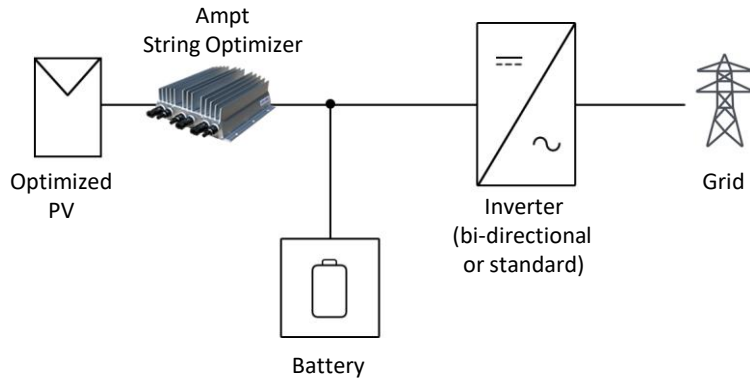
DC-Coupled Storage



Monitoring and O&M

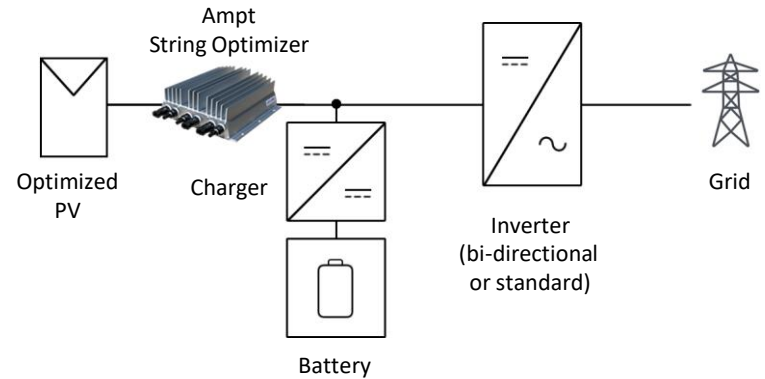
Optimized Storage Architectures with Ampt

Direct-to-Battery™



- Minimizes charging hardware to lower cost
- Fewer power conversions to improve efficiency
- Optimized PV array

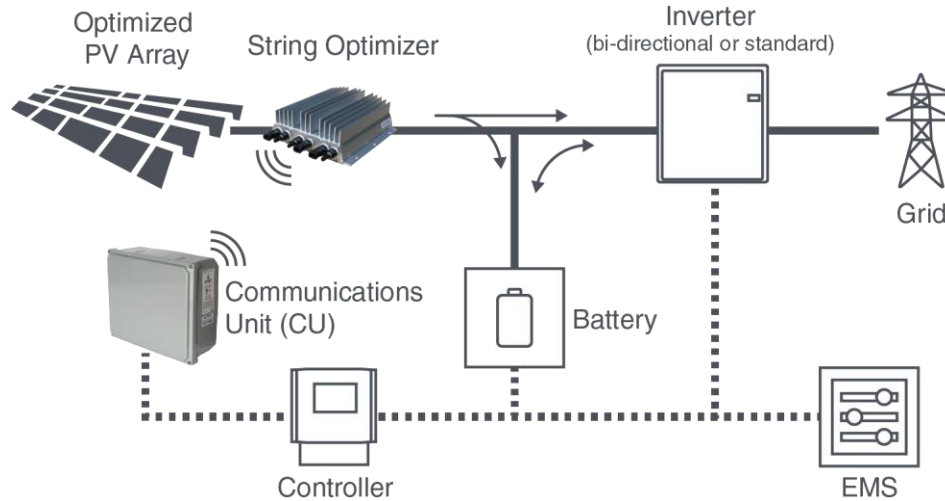
Direct-to-Charger™



- Lower cost per watt charger and inverter
- Higher efficiencies with fixed DC bus voltage
- Optimized PV array



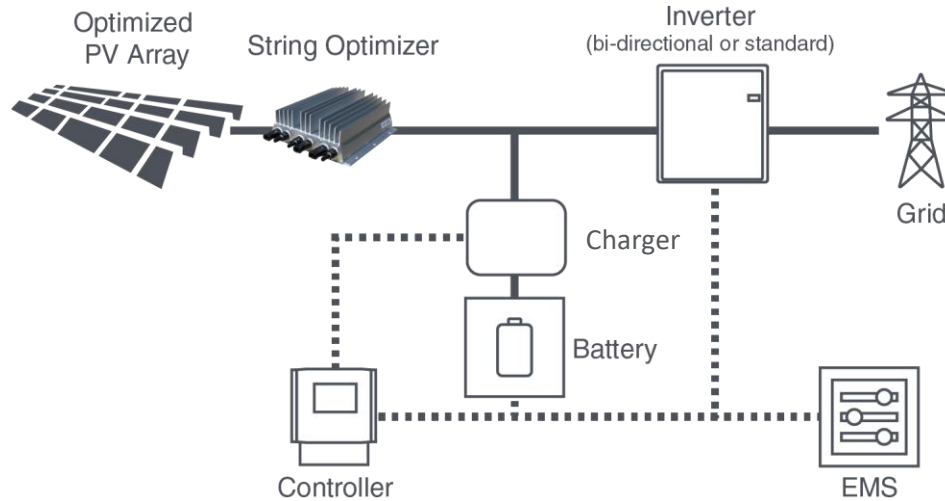
Direct-to-Battery™ Detailed View



- EMS is the primary system controller
- Controller sends signals to the battery, inverter, and optimizer (via the CU)
- String Optimizer performs MPPT to deliver more energy from the array
- The output voltage of the optimizer follows the battery bus during charge and discharge
- The CU sends commands it has received from the Controller to dynamically curtail optimizer output as determined by the EMS



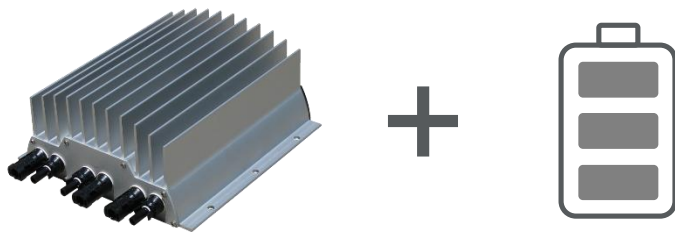
Direct-to-Charger™ Detailed View



- EMS is the primary system controller
- Controller sends signals to the battery, inverter, and charger
- String Optimizer performs MPPT to deliver more energy from the array
- The optimizer enables the DC bus to operate at a fixed high voltage
- The charger and inverter have a higher power density to lower cost per watt



Superior Storage with Ampt



Higher Efficiency

- Fewest conversions

Reduced system cost and complexity

- Lower cost power conversion
- Standard or bi-directional inverter
- Lower cost EBOS

Scalable and flexible

- Micro-grid to large power plants
- Add storage over time with less hardware cost
- Battery technology independent

With Ampt, the PV array is Storage-Ready™ and scalable in the future





Monitoring



Optimize PV Systems



Repower PV Systems

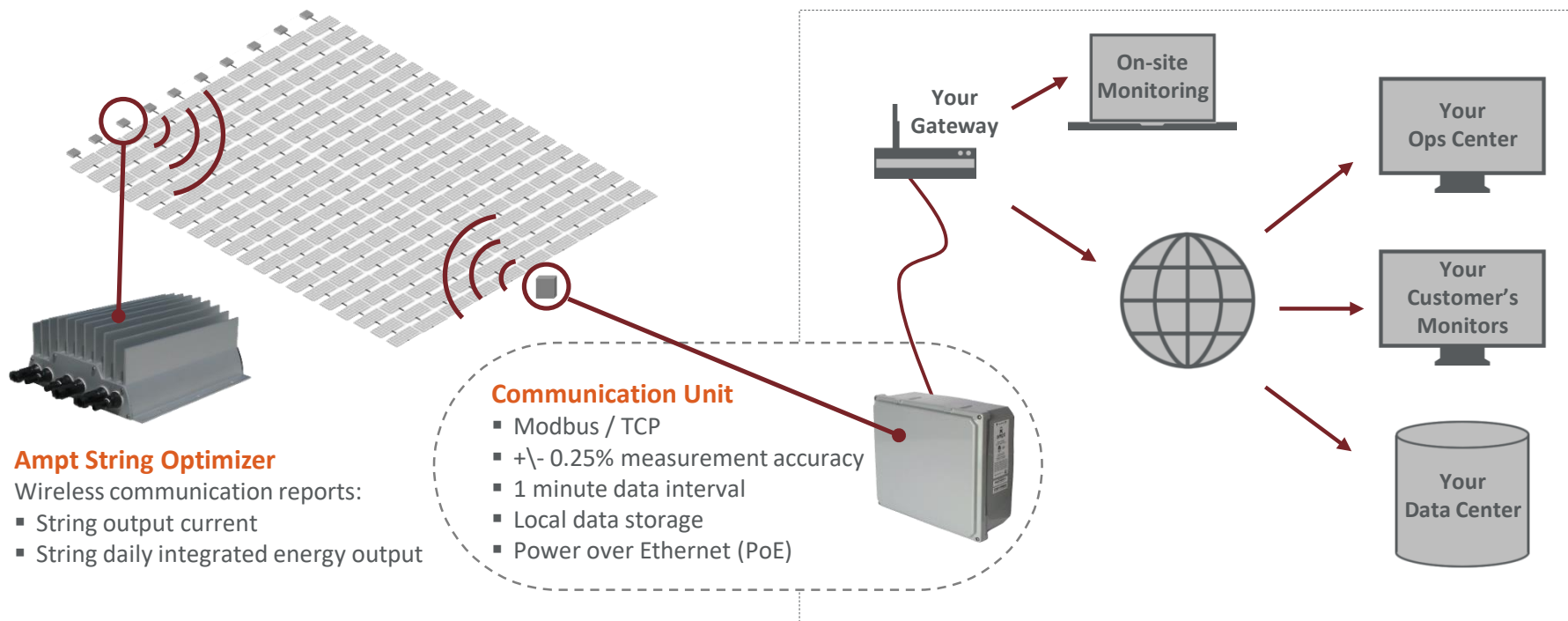


DC-Coupled Storage



Monitoring and O&M

Optional String-Level Data for Improved O & M





ampt.com



hdpv.org