



Reducing peak demand charges with batteries

**Texas State Energy Conservation Office
Presentation to State Agency Energy Advisory Group**
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Forward Looking Statements

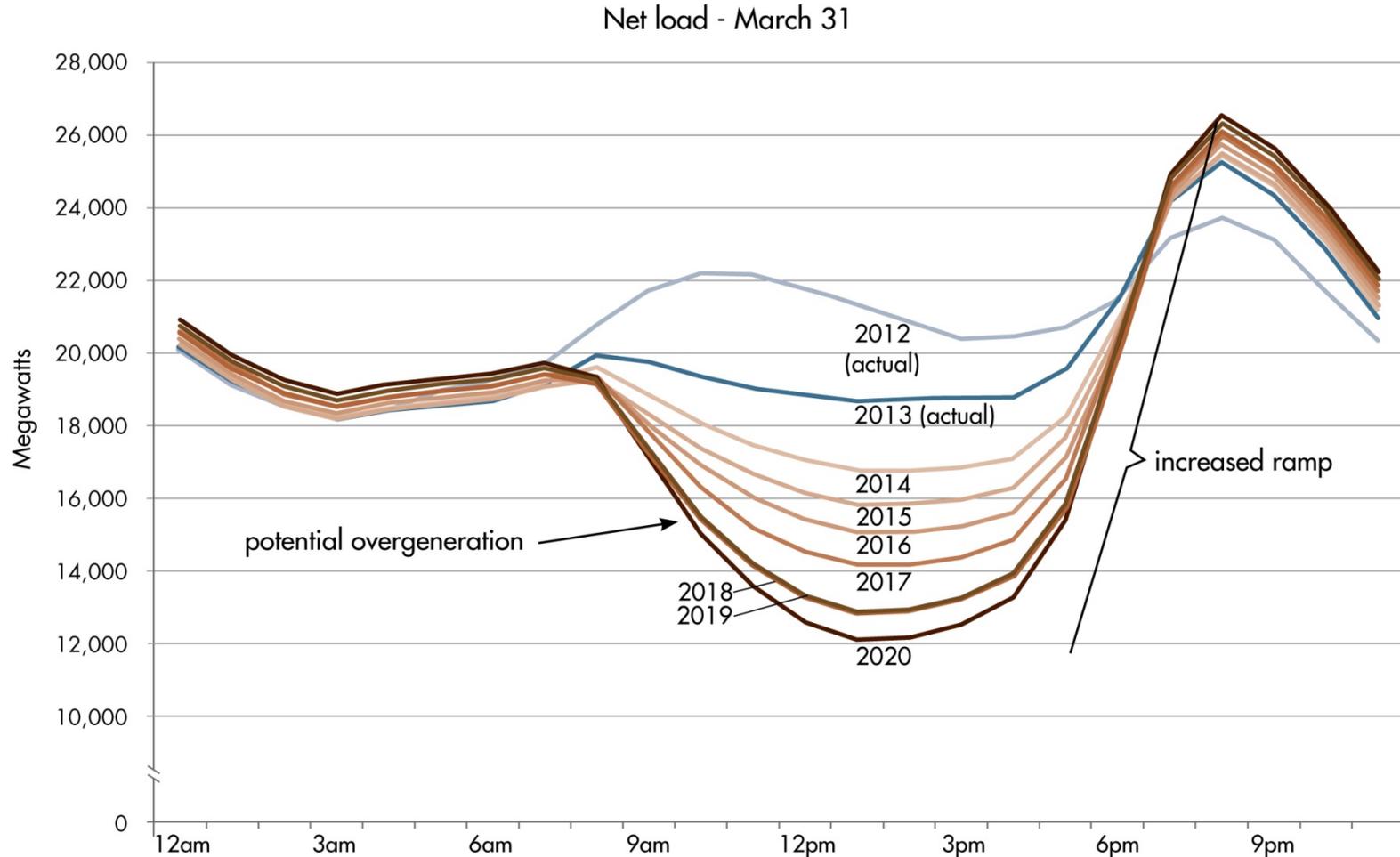
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Agenda

- **CA Grid Demands, a Precursor for TX?**
- **Commercial Battery Energy Storage Systems (BESS)**
- **Ideal Power solution for commercial BESS**
- **Commercial BESS Value Chain**
- **PV + BESS with backup power capability**

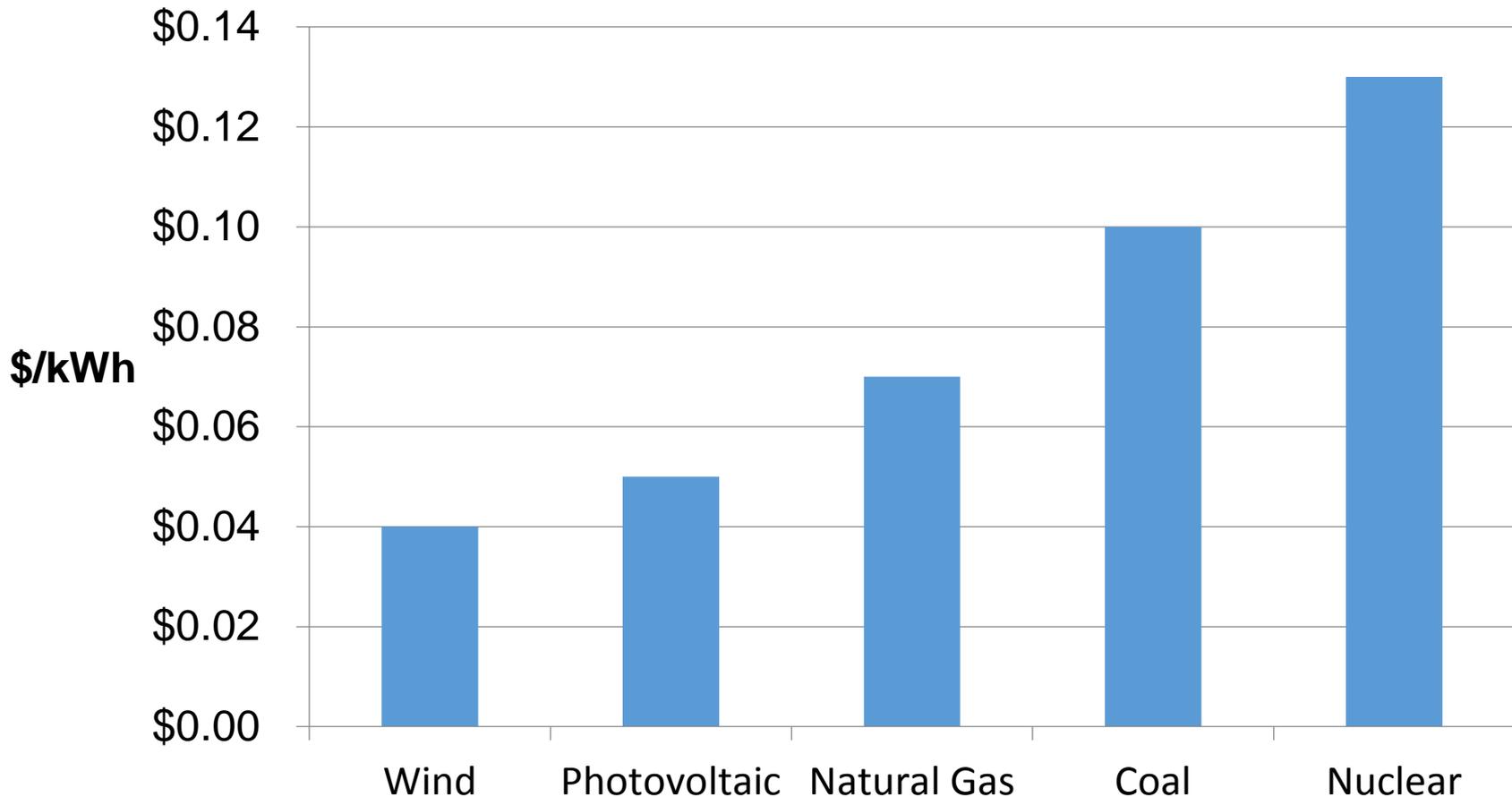
California Grid Demand

- Storage is required to moderate the increased ramp from PV



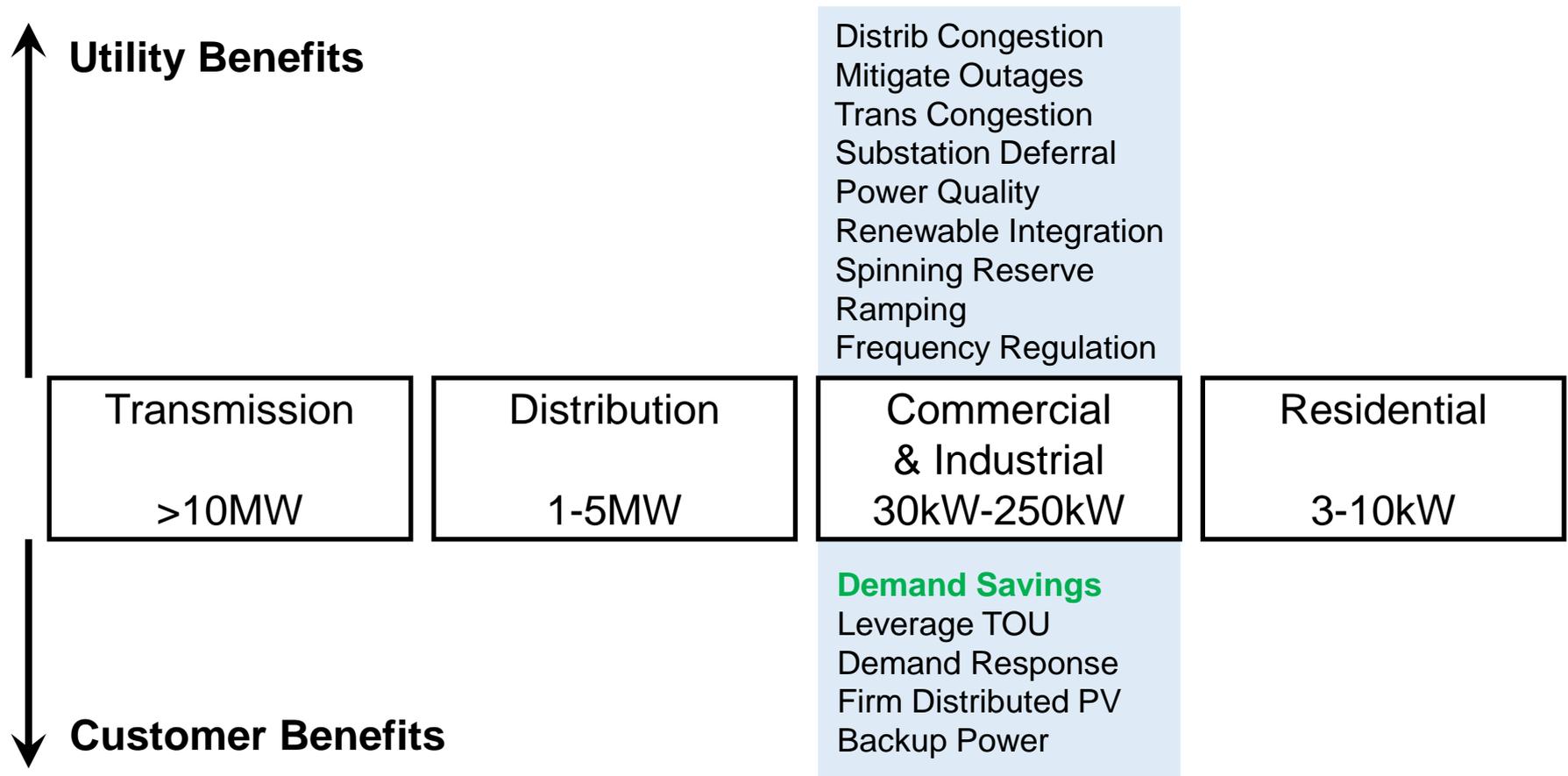
New Generation Costs to Austin Energy

- Wind and PV will dominate new wholesale generation



BESS Value Assessment

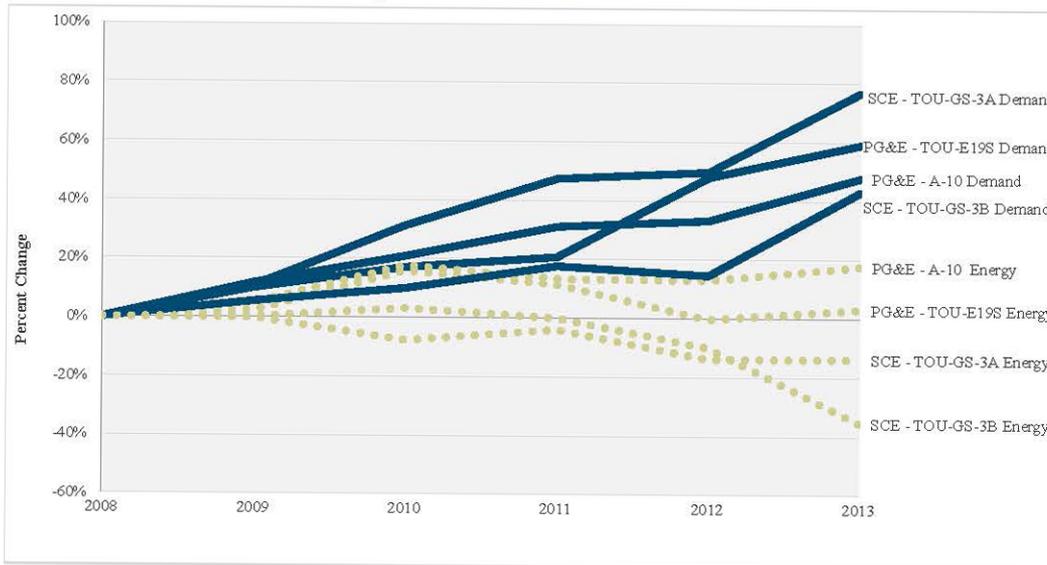
- Commercial BESS has highest value & forecasted growth



Commercial Utility Charges

- Demand charges driving commercial utility costs in CA

Figure 3.4 California Demand Charge Increases, 2008 -2013



➔
\$/kW Demand Costs
Increasing Steadily

➔
\$/kWh Energy Costs
Flat to Down

Source: Stem, GTM Research

Type of Charge

Annual Increase

% of Monthly Bill

Energy (kWh)

-2 to -4%

50-65%

Demand (kW)

+10 to +15%

35-50%

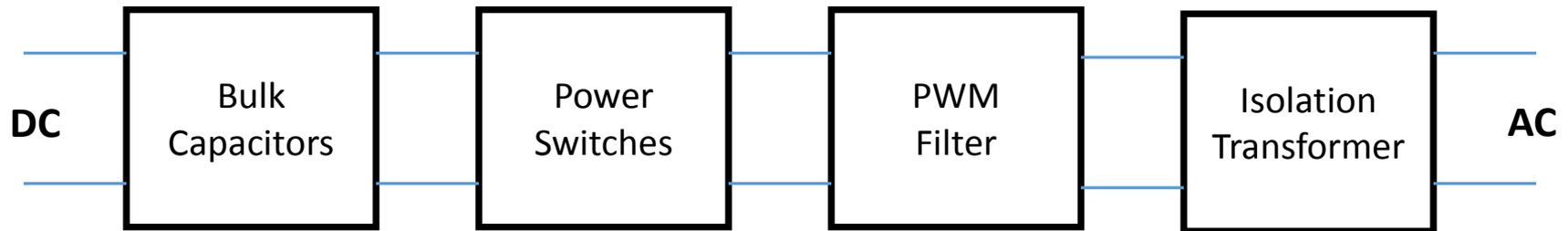
Ideal Power Inc. Overview

- **Develops and commercializes high-value electronic power converter solutions for high growth markets**
 - Industry certified, field tested & commercially available
- **Strong IP protection for its PPSA technology**
 - 19 US and 1 Chinese granted patents
- **Publicly Listed (NASDAQ: IPWR)**
 - only Texas ETF awardee to go public
- **Early leadership in commercial-scale BESS (Battery Energy Storage System) market**

Technology Comparison

Conventional Voltage Source Inverter

- Power flows continuously from input to output
- Passive components drive higher cost & lower efficiency



Ideal Power's Power Packet Switching Architecture™ (PPSA)

- 100% indirect power flow. All power temporally stored in AC link
- Eliminates ~90% of passive components (transformer, inductors, capacitors)



PPSA Technology Advantage

30kW conventional
converter

30kW Ideal Power
converter



Installation at the Austin Convention Center

Higher Efficiency

96.5% vs. 90-94% transformer based battery inverters

Lower Shipping & Installation

Lower weight & size reduces material, manufacturing, shipping & installation costs

Reliability

No electrolytic capacitors
Reduced stress with soft switching

Flexibility

Same hardware for multiple applications

Scalability

Small commercial (<10kW) to utility (>1MW)

Typical Commercial BESS

- **30kW power and 30-40kWh battery storage**
 - Modular systems scalable for larger buildings
 - Indoor and outdoor installation solutions
 - Includes software controls to minimize peak demand charges

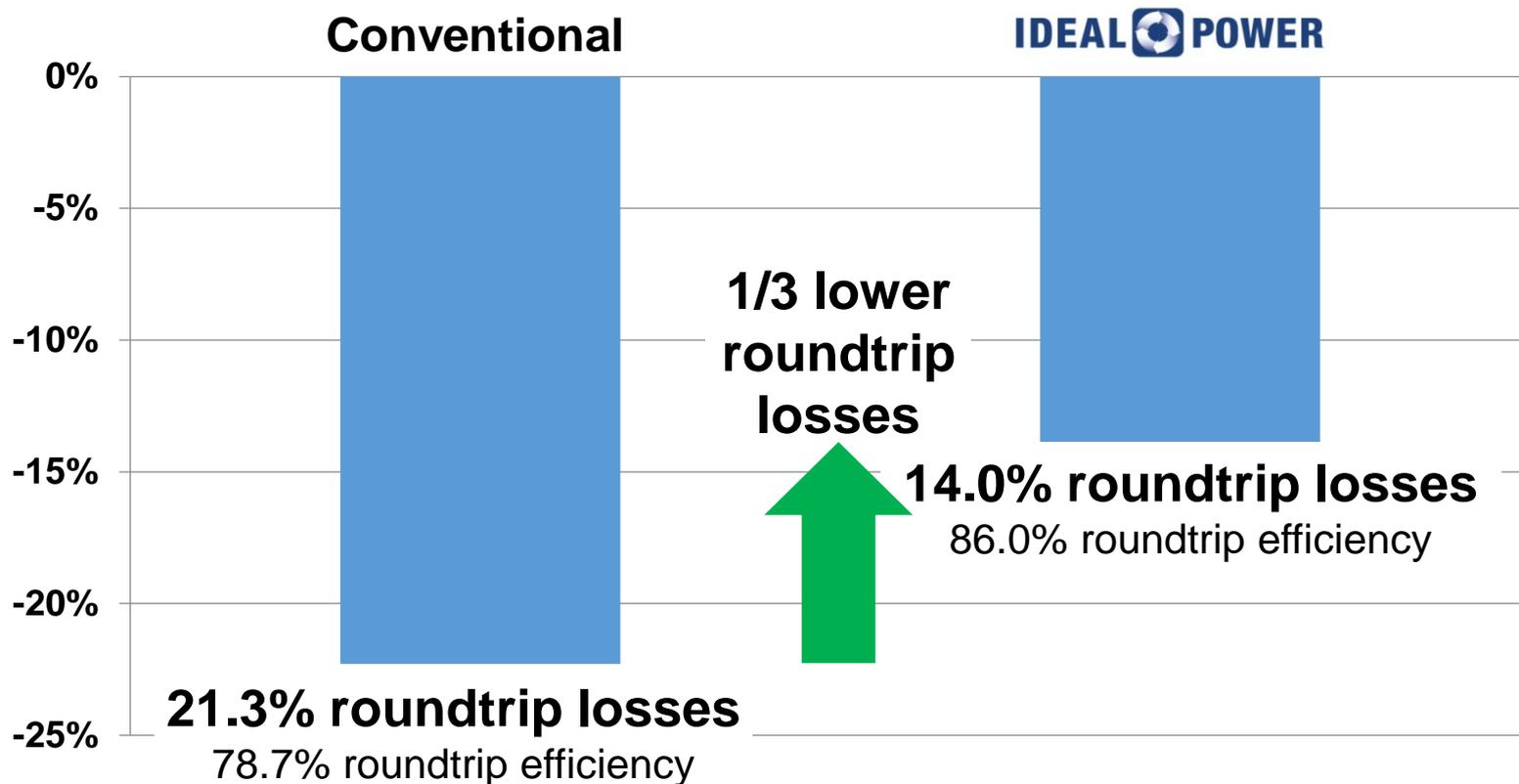


Advantages for Commercial BESS

- **Higher Roundtrip Efficiency** (>\$0.05/W lifetime savings)
- **Lower Weight & Size** (>\$0.05/W ship & install savings)
- **Inherently More Reliable**
- **Modular and Flexible Product Family**
- **Early Market Leadership**

Third Party BESS Efficiency Testing

- IPWR reduces BESS roundtrip efficiency losses by 1/3

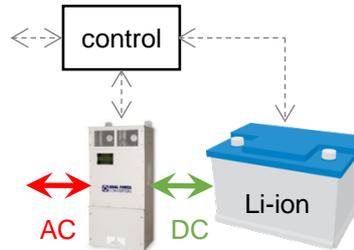


Sources: Sandia Labs – August 2013
100kW Princeton Power GTIB
lithium ion batteries

Bonneville Power Authority – June 2013
Powin Energy 4x 30kW IPWR Battery Converters
lithium ion batteries

Commercial BESS Value Chain

- Our efficient, lighter converters enables commercial BESS



IDEAL POWER
Battery Converter

Commercial BESS
Integrator

Commercial
Building Owner

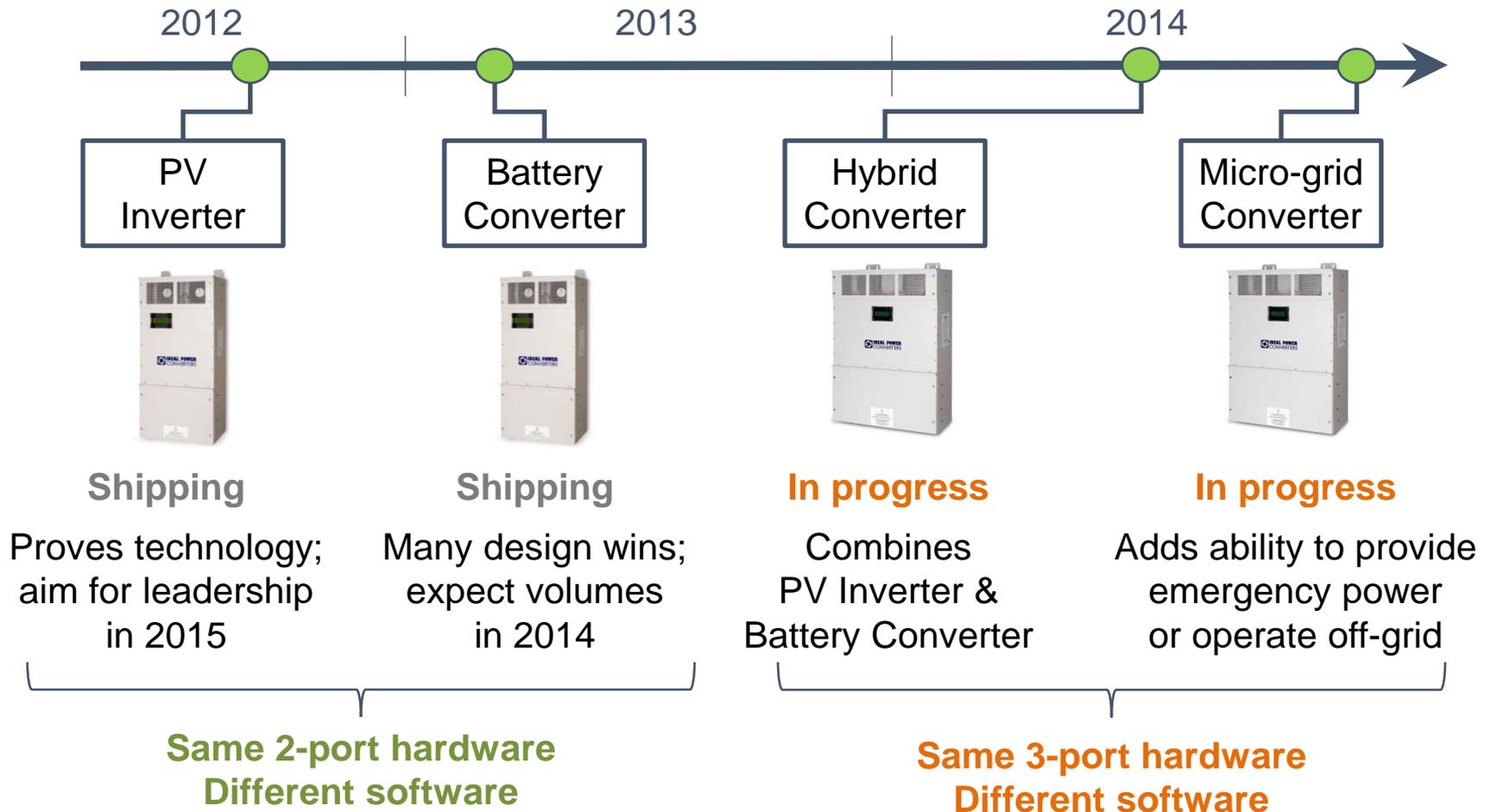
- Higher Roundtrip Efficiency
 - 7 percent pts lower loss
- 6X lighter
- Superior Roadmap
 - PV & Battery Integration
 - Backup power
- Lower OpX
 - 7% less electricity
- Lower Materials
 - 3.5% less batteries
- Lower Installation Costs
- Smaller real estate footprint
- Peak Demand Reduction
 - 20-25% IRR (in CA with SGIP)
 - 3 year payback (in CA with SGIP)
- Ancillary Service
 - Frequency Regulation
 - FERC Order 784

Commercial Fleets with V2G

- **Commercial trucks & buses are attractive for EVs**
 - Routes are short, predictable and often stop-start
 - Migrating to electric saves fuel & maintenance
- **Opportunity for value-added Vehicle-to-Grid capabilities**
 - High bi-directional chargers allow EVs to be used as BESS
 - Recent joint announcement with Coritech Services
 - To be installed at several DOD bases starting 3Q14 – Ft Hood?
 - Pentagon is driving system deployment and early deployment
 - Military non-tactical vehicles
 - GSA/Federal fleets
 - Commercial fleets

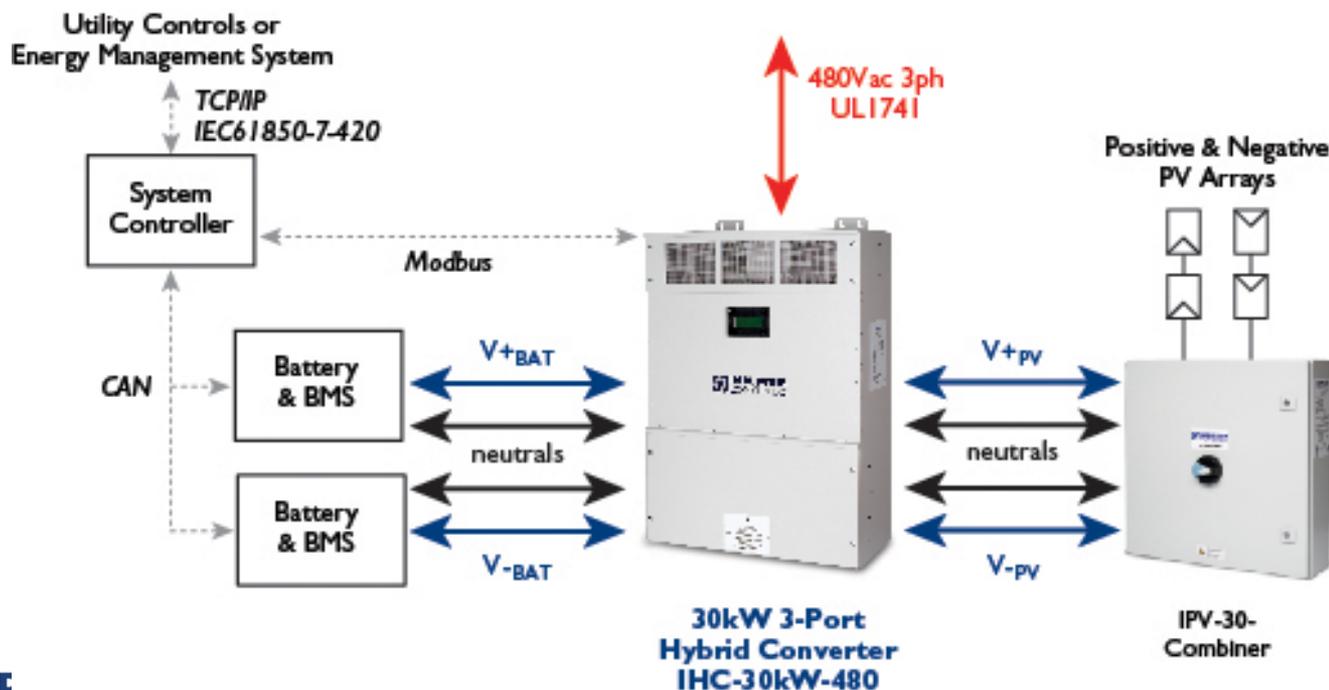
Product Roadmap

- Aggressive roadmap increases PPSA customer value



New Product: 3-Port Converter

- Improves cost and efficiency for integrated PV-Storage
- Firmware variations create different products for
 - Off-Grid (grid forming for remote locations)
 - Grid-Tied (requires strong power grid)
 - Grid-Resilient (provides battery backup during grid failures)



Summary

- **Commercial BESS is cost-effective today in CA**
 - Industry will be driven by 3rd party financing by late 2014
 - BESS will likely be cost-effective in TX in 2015
 - IPWR does not sell BESS, but supplies a key component
 - IPWR can recommend BESS suppliers
- **Interested in continuing collaboration with SECO and Texas Universities**
 - Successful PV projects with SECO and UT-Austin & UT-SA
 - Developing solutions to integrate PV, BESS and backup power
 - Currently working on a joint project proposal in San Antonio with UTSA, Southwest Research Institute & OCI (Korean polysilicon)