US&R Power Grid Partners

Clean Technology for the Nations Power Grid

Wednesday, April 15, 2009

DOCKET 09-IEP-1G	
DATE	APR 15 2009
RECD.	APR 15 2009

VIA USPS and email to docket@energy.state.ca.us

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 09-IEP-1G
1516 Ninth Street
Sacramento, CA 95814-5512

RE: Docket Number 09-IEP-1G, 2009 IEPR - Energy Storage Technologies
Written Comments Subsequent to Staff Workshop on April 2, 2009

As a developer and marketer in energy storage, we appreciate the opportunity to provide written comments for this IEPR.

My firm, Utility Savings & Refund, LLC, has been a sales affiliate for VRB Power and the VRB Energy Storage System for over two years. We formed US&R Power Grid Partners to focus on bulk energy storage development, using the vanadium redox flow battery technology of VRB Power. We are pleased to advise that we will be continuing in the same capacity with Prudent Energy.

Staff requested comments related to availability, cost and other information on energy storage technologies. Prudent Energy has supplied the attached summary and presentation for consideration.

I believe that bulk energy storage is a viable asset for the electric grid today. As I outlined in my presentation on April 2nd, what is missing is a clear path to make such installations economic. Many speakers commented on the numerous benefits and value streams of energy storage. All that is needed is a firm revenue stream for a small subset of these benefits, and energy storage will begin to be implemented in many areas.

Our company has been working with CAISO, the utilities, energy users and generators, the CPUC and others to develop such opportunities. I echo the suggestion of many speakers that energy storage should be included in utility procurement efforts for ancillary services, peak generation, demand response, distributed generation, voltage and VAR support, and other appropriate services. These services are already procured by the regulated utilities under long term contracts. Opening such opportunities to energy storage on a nondiscriminatory and competitive basis would not increase costs

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to ratepayers. Once a system is in place to provide specific services - like peak shaving, resource adequacy, or other services - then the other value services of energy storage can be applied as needed, like frequency regulation, voltage and VAR support, black start capability, emergency power and UPS - and at a lower incremental cost.

Thank-you again for the opportunity to present these comments and updated information on the VRB-ESS. Please feel free to contact my office for additional information or visit our website at www.Utility-Savings.com.

Sincerely,

Charles R. Toca
Manager

Attachments:

VRB One Page Update
Prudent Energy Presentation, 18 pages

Energy Procurement Services - Electricity, Natural Gas, Utility Negotiation
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VRB ENERGY STORAGE SYSTEMS (VRB-ESS™) Flow battery Supplier: PRUDENT ENERGY: Partnering with OEM suppliers in USA

1. Background

Prudent Energy is implementing the VRB technology as follows. Packaged units sized around 150kW with any number of hours of storage – practically though to about 10 hours (to allow for daily charge and discharge). Within the first 18 months systems sized up to about 1.2MW x X hours will be possible. Within 24 months this should be extended to the 2MW range and up to 5MW within 36 months. The maximum size we envisage supplying is around 10MW x 10 hours. The factors controlling the above are tied primarily to material and electrolyte availability, and their cost, in order to get acceptable customer returns. We have set a goal of achieving a cost of $500/kWh inside of 36 months. This is definitely possible but is tied to having sufficient testing of new membrane material. Prior to that proven membranes and material which is more expensive, will be used.

2. Local content

Each system consists of 150kW modules. These will be manufactured in China and shipped to a local partner. The PCS will be sourced to meet USA code (IEEE/ UL). Balance of plant piping, civil works, detailed designs, local construction and testing, will be locally sourced under supervision from a Prudent Energy project team. This portion is about 30% of the system cost. It will specifically include:

- Electrical design
- Mechanical design
- Civil design and environmental permitting
- all construction of the buildings and materials sourced for piping (PVC), HVAC, trades and ongoing service and support staff in large systems under extended warranty.
- Local Project manager/ site supervisor and local trades for construction
- Local (USA) motors/pumps, PCS systems, step up transformers and switchgear

Ongoing service and support will be performed locally for the life of each project - considered to be at least 15 years. It is fully expected that the systems will also be sold in other states and that university research into applications such as systems stability, smart grids and grid integrated storage will need to be performed.

Prudent Energy Inc.

Storage for a sustainable future

The Global Leader in Advanced Energy Storage based on the Vanadium Redox Battery (VRB-ESS™)

www.pdenergy.com

World leader in Energy storage

March 2009

Prudent Energy

About Prudent Energy Inc.

- Prudent Energy is based in Beijing China. It is a Private VC funded company founded in 2006
- Staff of approximately 50 including dedicated Vanadium and membrane research scientists
- Investors: DT Capital (www.dtcap.com) DFJ (www.dfj.com)
- Purchased VRB Power Systems Inc. assets, IP and knowhow in January 2009
- Formed Prudent Energy International Inc. a Canadian based company
- Investors see the company's business model as one where systems engineering development is performed in the USA and Canada, whilst the innovation of low cost and rapid manufacturing occurs in China.

About DT Capital Partners

DT Capital Partners provides growth capital to early and expansion stage companies in China. We invest in dynamic businesses that have high growth potential, strong management teams, and demonstrated revenue models in both technology based and traditional industries. DT Capital Partners currently manages over USD$500 Million in capital across multiple US dollar and RMB funds, and also has a close affiliation with Madrone Capital in the US, the investment entity for members of the Walton family.

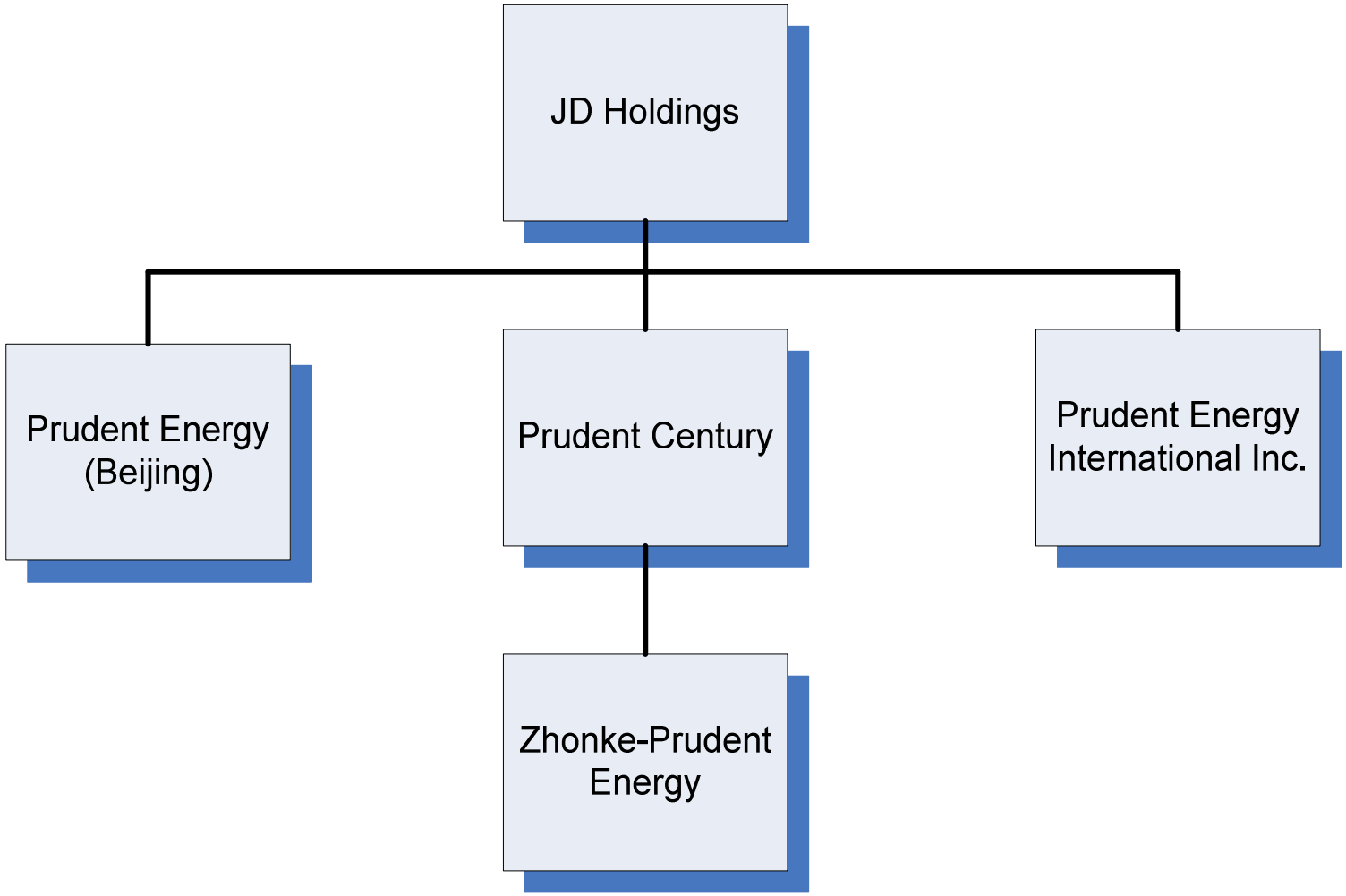
Draper Fisher Jurvetson ("DFJ") backs extraordinary entrepreneurs everywhere who set out to change the world. DFJ achieves its mission through its DFJ Global Network of Partner Funds. Together, DFJ and the Network manage over $6B and have made more than 600 investments on four continents.

With a 23-year history of success across diverse sectors and market conditions, DFJ has led the way investing in emerging technologies, from the Internet and life sciences to clean energy and nanotechnology.

Merged company strengths – a shared vision

- Active experienced and successful global Investors
- The Combined experience and knowledge of flow batteries from VRB Power, Regenesys and Sumitomo Electric Industries spanning 15 years.
- Low Cost manufacturing base in China and global sales and support locations
- Proven products - Highly skilled staff – including several technical staff who joined from VRB Power
- Chinese Materials science research into membrane technology and vanadium chemistry

The Prudent Group of companies



Prudent Energy

Cost reduction – the Prudent advantage

Prudent Energy has achieved breakthroughs in all the key material area

- **Cost reduction of electrolyte - 50%**
- **Cost reduction of membrane – 80%**
- **Cost reduction of bi-pole – 60%**

Mass produced ion exchange membrane

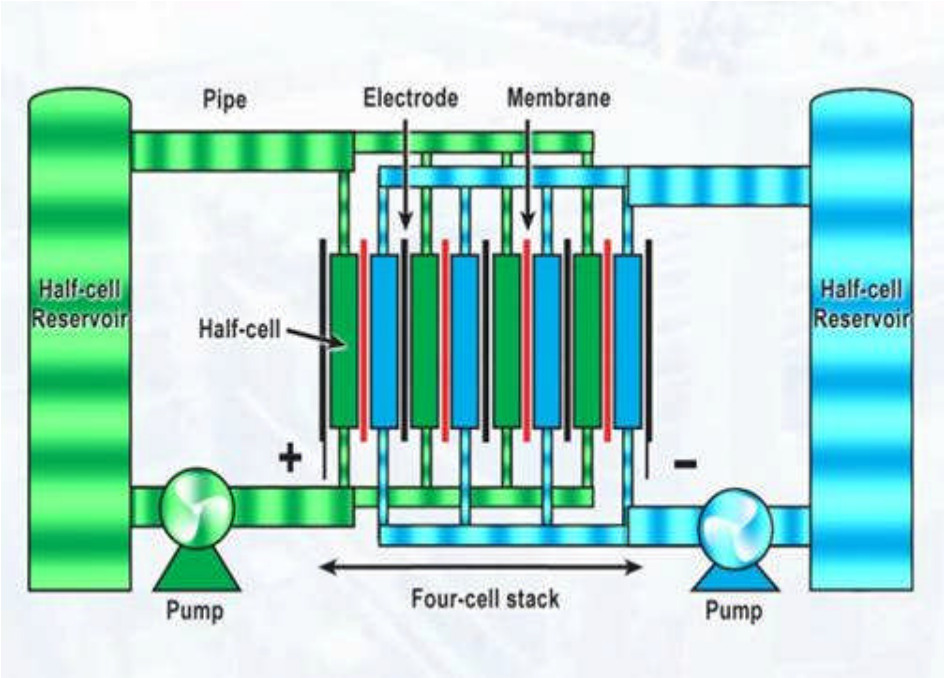
Goal for company is < $500/kWh for 6 hours of storage

Sales of VRB–ESS units – a proven technology

- VRB-ESS systems have been operating throughout the world for over 10 years.
- Sumitomo Electric Industries (SEI) completed about 12 projects ranging from 4MW wind smoothing to MW scale UPS systems.
- VRB Power systems sold and have history of utility scale systems operating unmanned for over 5 years.
- PacifiCorp (USA), Risø, Alaska, National Research Council Of Canada, Safaricom (Kenya) – two telecomm systems
- Israel, Romania, Denmark, Germany, New Zealand

VRB Flow Battery Technology

A liquid electrolyte that is separate from the electrode.



Positive Electrolyte		Negative Electrolyte
$V^{4+} \Rightarrow V^{5+} + e^-$	Charge ←	$V^{3+} + e^- \Rightarrow V^{2+}$
$V^{5+} + e^- \Rightarrow V^{4+}$	Discharge →	$V^{2+} \Rightarrow V^{3+} + e^-$

- An electrochemical energy storage system operating at **ambient** temperatures
- Reversible fuel cell – reduction and oxidation of single unique element: Vanadium (no catalysts)
- **No cross** contamination
- Electrolyte **never wears out** – high residual value
- Very low maintenance
- Deep cycles >**unlimited or ten years**
- Sized 5kW to 10MW – indefinite energy storage
- Energy can be recovered instantaneously
- Battery can recharge as almost as fast as it discharges (1.5 to:1)
- Power and Energy separately scalable

Prudent Energy

Cell stack evolution - 2002: 2009

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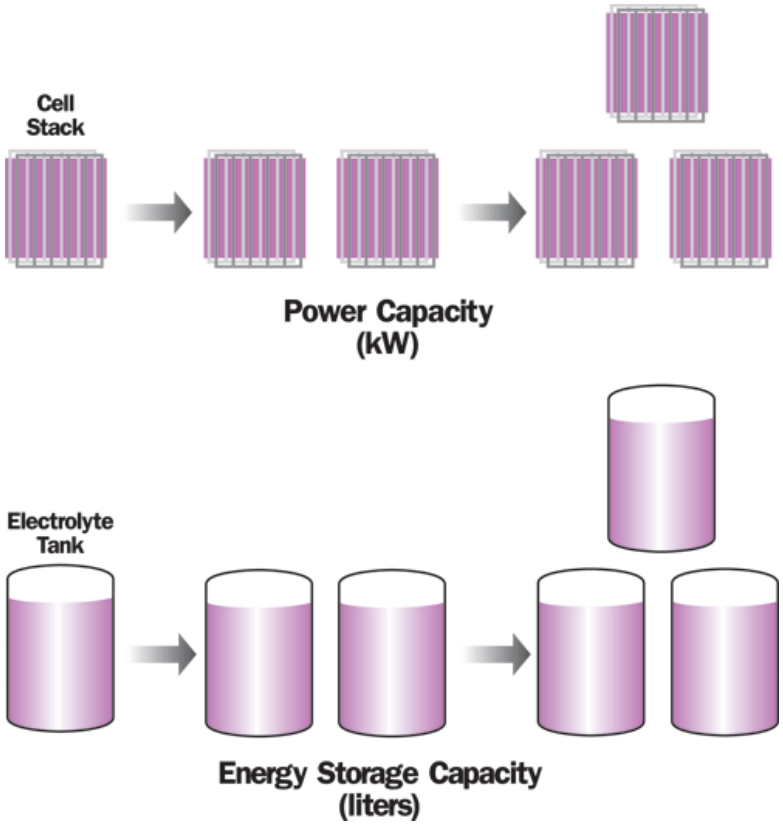
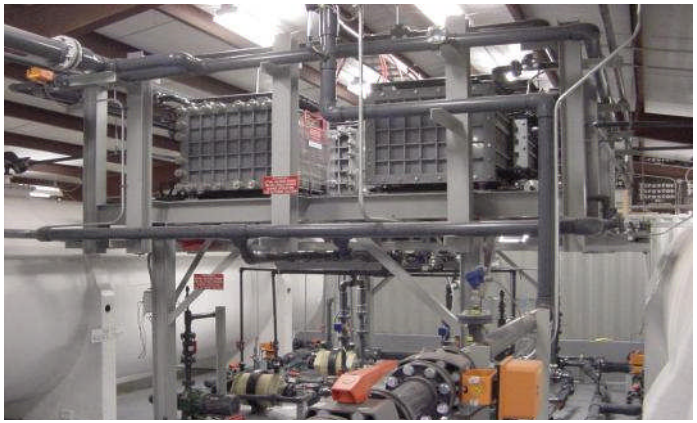
VRB Technology – the evolution - Scaleable / Flexible



- 5kW – 10MW
- Prudent Energy controls worldwide patents*
  (*excludes Japan)



Original concept - Built on site

Current systems - Modular Packaged

Prudent Energy

Our market focus, and the benefits of VRB-ESS™

Renewable Energy and utilities

- Smooth power output
- Grid Stability – Frequency reserve balancing
- Higher payments for output
- Ability to capture 'spilled wind'
- Higher market based payments

Remote Area (RAPS)

- Significant fuel / emission reductions
- Reduced maintenance costs
- Enables coupling of wind / solar at high penetration levels
- Payback < 4 yrs / IRR approx 30%

HYBRID Telecom

- Lowest life cycle cost (10 yrs +)
- Low Maintenance costs
- Ability to deep discharge
- Best environmental footprint
- Displace diesel usage – IRR>30%

Renewables – VRB-ESS™ Proven with wind

- 4MW x 1.5 hour (50% pulse factor) VRB-ESS Grid-Coupled Wind Smoothing Tomamae, Japan
- One of several Sumitomo VRB-ESS installations in Japan
- 270,000 cycles in 3 years

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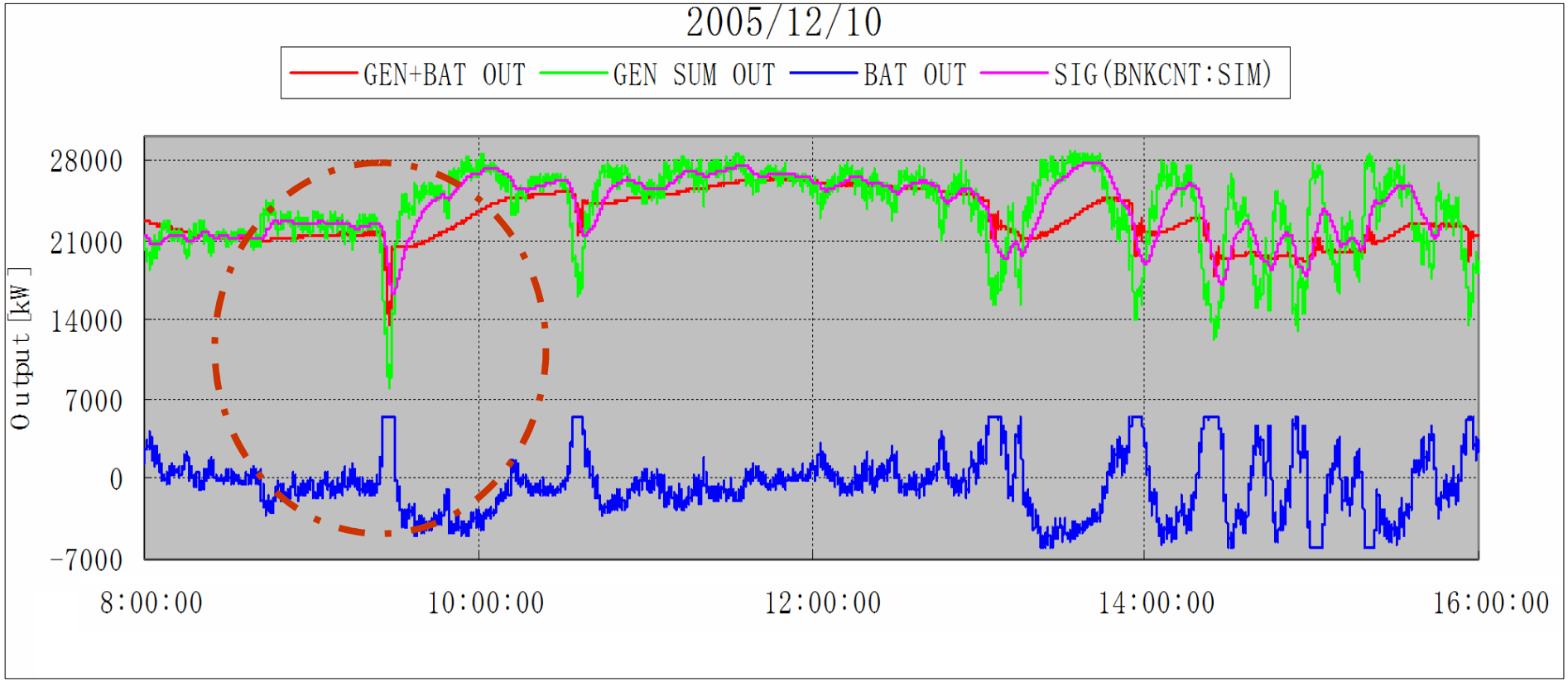
Daily Wind Output Smoothing - Japan



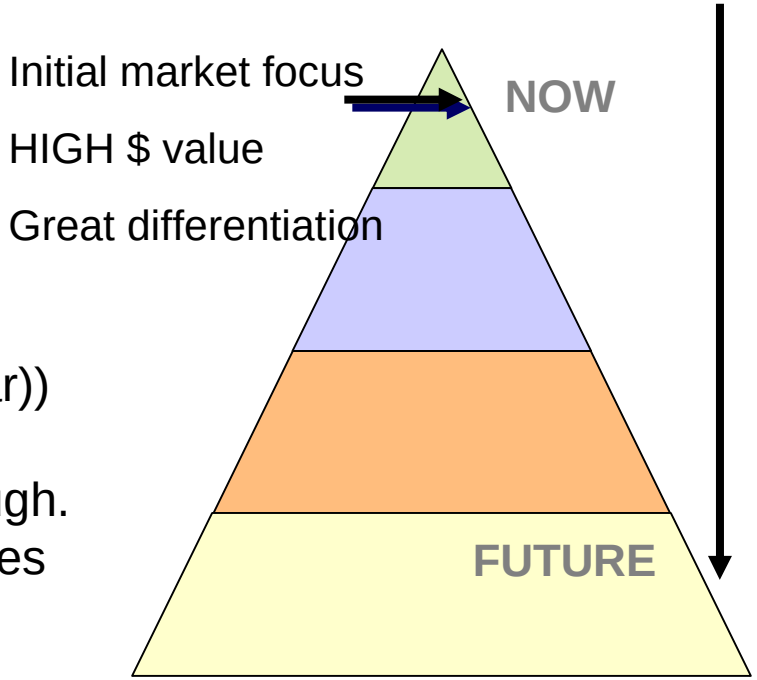
- The VRB-ESS (blue line) runs continuously to smooth wind farm production (green line).
- At only 20% of the wind farm's nameplate capacity, the VRB ESS has a significant smoothing effect to total wind farm + battery output (red line)
- The VRB-ESS intelligently recharges throughout the day so that it maintains 50% SOC

Prudent Energy

Market and Sales for Hybrid Telecoms

- Telecoms World-wide market
  – In the **developed world** bureaucracy dictates the pace of new technology adoption – Risk averse
  – Power grids are reasonably strong so OUR focus is on markets where grids are weak or non existent

- Initial focus is:
  – **reducing diesel consumption for off-grid sites and integration with solar and wind**
  – the HYBRID model – emission reductions



- Already have PROVEN systems in Africa (> 1 year)) reducing diesel cost by close to 70%/year.
- Lead acids simply cant cycle nor charge fast enough.
- Value proposition is lower first cost than alternatives

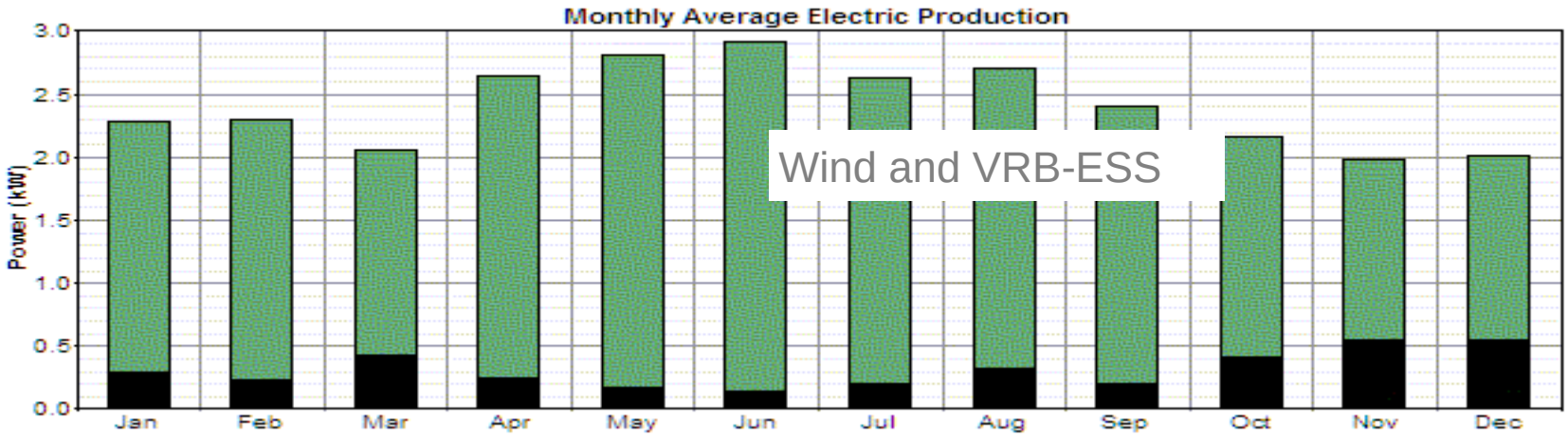
Wind - Solar – VRB-ESS - Small off-grid Hybrid Installations

Opportunity

- Africa 18,000 units in next 10 years
- India 60,000 units in next 8 years
- Latin America

Benefits

- reduced Diesel emissions by 90%
- Paybacks in 3 years – Why? Diesel displacement!



Diesel

Prudent Energy

Management Team

- Johnson Yu, Chairman CEO and founder

Mr. Yu is an experienced entrepreneur. After graduating from Tsinghua University in 1997, he went on to start his own company, (V2 Technology) which is currently the number one developer of video-conferencing software in mainland China. Mr. Yu holds a MBA degree from Pepperdine University.

- Jeff Wang, Co-founder & executive director

Mr Wang is a serial entrepreneur having launched and operated several start up companies in China. He holds an MBA and a BSc

- Mr. Tim Hennessy, President

Mr. Hennessy was the former CEO of VRB Power Systems Inc., which was the global leader of VRB technology. Before VRB Power, he served as Vice President of Engineering and Operations and Managing Director of LECTRIX LLC (a Bechtel Siemens AEP JV), Vice President of PacifiCorp's Energy Services, Quality of Supply Manager for ESKOM and was a founder and Principal of Power Quality Technology. Mr. Hennessy has published and presented more than 20 international papers and was the editor of the Power Quality Blue Book (South Africa), a text for engineers in industry and holds six patents. He serves on the board of Schmitt Industries (Nasdaq: SMIT). He is a chartered engineer in the UK and a registered professional engineer in South Africa. He holds an MSc. Eng (Elect)

- Mr. Gary Lepp – VP technology

Mr. Lepp is an experienced technology leader who, in 3 years at VRB, has successfully built a team that initiated VRB's stack and system product development activities and advanced them to the point of commercial readiness. Mr. Lepp brings over 20 years of experience in mechanical engineering and product development regarding electrochemical power generation. Mr. Lepp holds a Masters of Applied Science and Bachelor of Applied Science in Mechanical Engineering from the University of British Columbia and is a registered member of the Association of Professional Engineers and Geoscientists of B.C. and the American Society of Mechanical Engineers.

Management Team continued

•Edmund Liu – VP Sales and Marketing

Edmund is in charge of business operation in Prudent. Before Prudent, he has three years of experience in Private Equity, three years of Management Consulting experience in Accenture, and eight years of experience in state owned company in high tech field. Edmund is Candidate of Ph.D. and holds MBA from Tsinghua University in 2000 and B.S. Automotive Engineering of Tongji University in 1993.

•Eldon Mou - VP Products & solutions

Mr. Mou brings to Prudent Energy more than 10 years of experience in marketing, management consulting, and product management. He has previously worked at Motorola, Lenovo, and UT Starcom business consulting services. Mr. Mou earned a BS from Beijing University of Science and Technology, and a MS from University of International Business and Economics.

•Andy Li, VP- financing

Mr. Li is Prudent Energy's Financial Affairs Manager, and brings over 7 years of financial and accounting experience. Previously, Mr. Li was employed by KPMG Financial Services (Shanghai) as an auditor, and has worked as a consultant for internal controls and management for the China office of Yum Brand, Inc. In 1999, Mr. Li completed his undergraduate education at Fudan University in Shanghai with a degree in Financial Management. He was awarded a full-ride academic scholarship to Pepperdine University, where he earned his MBA.

R&D Team

- **Mr. Andy Klassen - R&D director**

Mr. Klassen leads and directs the VRB stack development team and had been with VRB for the past 3 years. He has successfully focused on improving cost, manufacturability, operability and performance, achieving improvements in all. He has 11 years experience in technology / product development including 5 years of PEM fuel cell experience with Ballard Power. Prior to this, he worked as a Chemical Process Engineer for 10 years designing and starting large process. He holds a B.Sc. in Chemical Engineering.

- **Dr. Huang, Key material research manager**

Dr. Huang is responsible for leading Prudent Energy's research and development of ion exchange membrane and key materials. Before Prudent,He has extensive experiential background in ion exchange membranes for 5 years before Prudent, and is the inventor of two ion exchange membrane patented technologies. Dr. Huang earned a PhD in Chemical Engineering and Technology from Tianjing University.

- **Mr. Li, Electrolyte manufacture manager**

Linde Li has over 15 experience in Vanadium industry. He previously worked for Panzhihua Iron & Steel on the project "Industry Study of Vanadium Redox Flow Battery and its Key Materials." While there, Mr. Li was Panzhihua's chief vanadium electrolyte patent inventor. Mr. Li is responsible for Prudent Energy's vanadium electrolyte production and performance optimization study.