5th ANNIVERSARY

The Premier Event Dedicated to
Transformative Energy Solutions

energy innovation summit

FEBRUARY 24-26, 2014
Gaylord National Convention Center
Washington, D.C.

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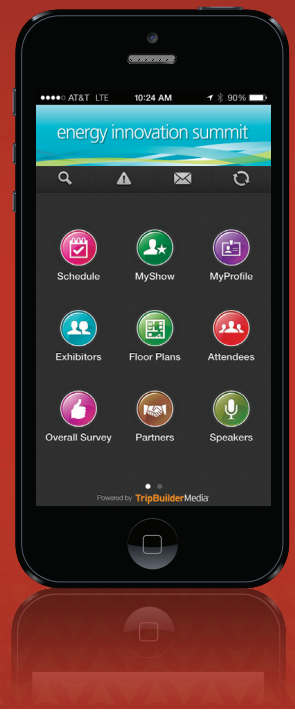

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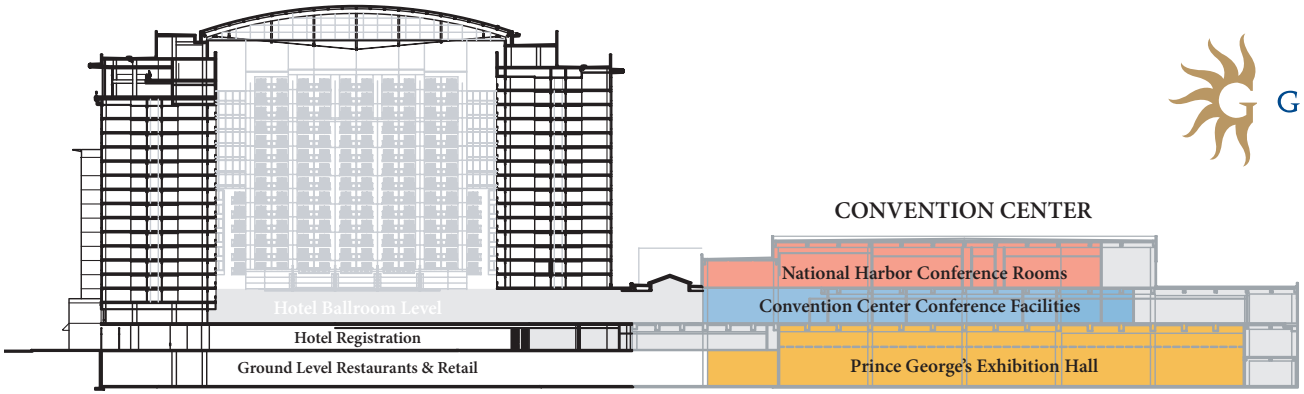
Maximize your time at the show with **TripBuilder EventMobile™**. Easily view the Schedule, Exhibitors, Speakers, City Content, Instant Alerts and more! You can even create personalized lists to target what you want to see, hear and do.

energy innovation summit
February 24-26, 2014 | Washington, D.C.

TripBuilder EventMobile

Gaylord National Floorplan



GAYLORD NATIONAL®
RESORT & CONVENTION CENTER
on the Potomac

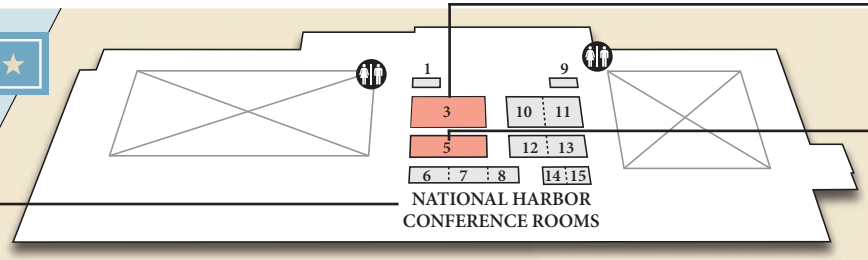
★ CONVENTION CENTER ★

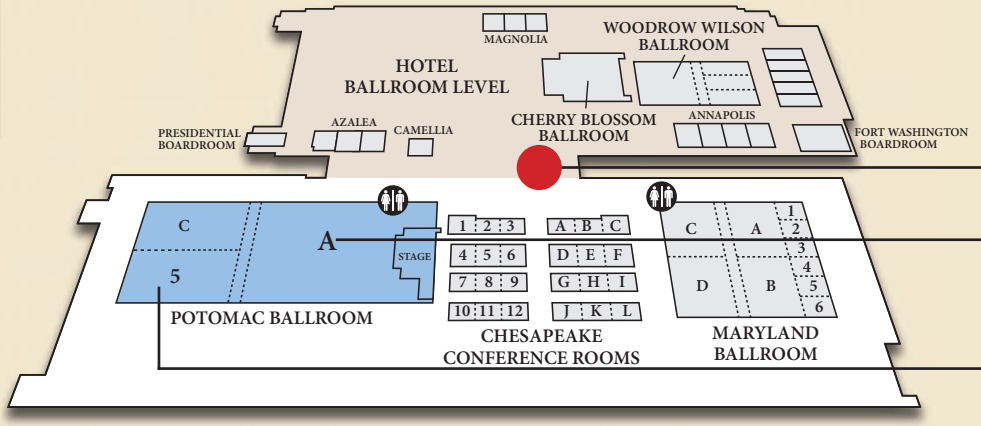
Open Meeting Rooms
See page 9 for the details.

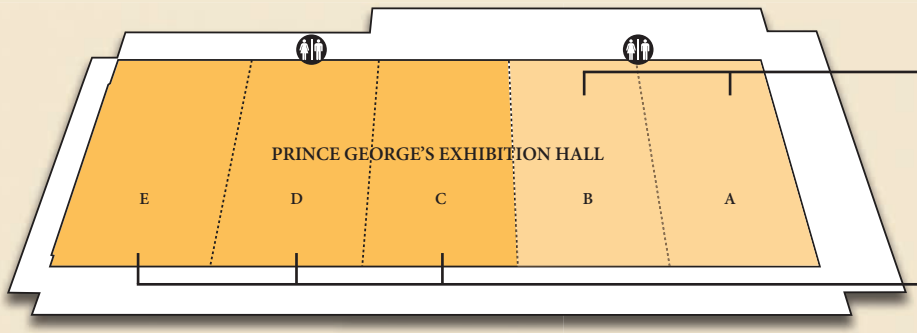
Monday – Wednesday
- National Harbor 1
- National Harbor 6
- National Harbor 8
- National Harbor 11

Tuesday – Wednesday
- National Harbor 10

Potomac River







National Harbor 3
Panel Session Room

National Harbor 5
Student Program Room

Summit Registration & Information Desk

Sunday: 5:00 p.m.-8:00 p.m.
Monday: 7:00 a.m.-6:00 p.m.
Tuesday: 7:00 a.m.-6:00 p.m.
Wednesday: 7:00 a.m.-3:00 p.m.

Potomac A
General Session &
Panel Session Room

Potomac C
Potomac 5
Panel Session Rooms

Prince George's Exhibit Hall A-B
Government Networking
Program and Lunch (Monday)

Prince George's Exhibit Hall C-E
Technology Showcase

Tuesday
Breakfast: 7:00-9:00 a.m.
Lunch: 11:45 a.m. -1:45 p.m.
Reception: 4:30-7:30 p.m.

Wednesday
Breakfast: 7:00-9:30 a.m.
Lunch & Closing: 11:15 a.m.-1:30 p.m.

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Together, we can build an energy-secure future

With the world's population projected to surpass 9 billion by 2050, now is the time to prepare for a secure energy future.

From renewable energy sources like photovoltaics, biofuels and fuel cells to the application of advanced materials making the exploration, production and transportation of oil and gas more efficient, DuPont products and technologies help improve performance, reliability, and safety while reducing cost and lowering our 'footprint.' Our offerings support energy-enabling technologies in energy storage and throughout the electricity generation, distribution and conversion processes.

We're using science to harness tomorrow's energy, and to make better use of today's resources. We invite you to collaborate with our global teams to find science-driven, sustainable energy solutions.

For more, visit dupont.com

SECTION 1

ABOUT THE SUMMIT

Overview of the 2014 Energy Innovation Summit

General Information

About the Technology Showcase

About the Gaylord National

"Two things I loved about the Summit:
1. Sessions specifically for entrepreneurs (IP, strategic partnering, etc.), and
2. Unbelievable numbers and quality of potential partners and collaborators."

— John Breshears, Architectural Applications

About the Energy Innovation Summit

Overview of the 5th Annual ARPA-E Energy Innovation Summit

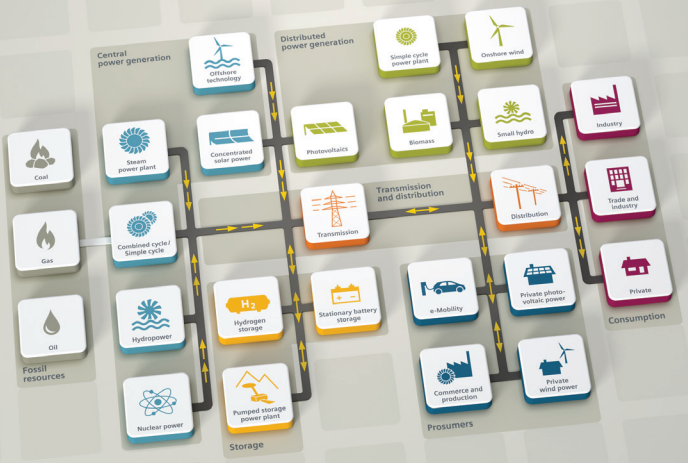
The purpose of the 2014 Energy Innovation Summit is to showcase transformative energy technologies and to encourage collaborative innovation in the field of energy.

For the past four years, the Summit has been the premier event dedicated to transformative energy solutions, and has helped push many breakthrough technologies towards the marketplace. In its fifth year, the Summit features:

- **NEW!** **Pre-Summit Technical Sessions** (Monday): Have you ever thought about working at ARPA-E? Do you know what ARPA- E does within the Department of Energy? Learn about ARPA-E or hear lessons learned in technology development during the Pre-Summit Technical Sessions.
- **Technology Discussions with ARPA-E Program Directors** (Monday): Listen to and engage with the ARPA-E Program Directors.
- **Government Networking Reception & Lunch** (Monday): Have lunch and connect with leaders and program directors from the nation's top federal government agencies.
- **Student/Company Recruiting Lunch Reception** (Monday): Pre-registered companies have the opportunity to meet with pre-vetted graduate students seeking careers in the energy field.
- **Small Group Networking, *optional*** (Monday): During the evening networking event, Summit attendees have the opportunity to meet in the following sub-groups:
  -U.S. State & Global Energy Networking – Potomac Foyer
  -Natural Gas – Potomac A Foyer
  -Efficiency – Potomac C
  -Transportation – Potomac 5 Foyer
  -Generation – National Harbor Foyer

  Look for the appropriate kiosks.
- **Future Energy Pitching Session** (Monday): Back in its second year - watch eight early-stage energy technology startups pitch their products and gain insights from top venture capital investors regarding how to pitch effectively.
- **NEW!** **National Venture Capital Association Networking Event** (Tuesday): During the continental breakfast in the Technology Showcase, Investors and Technology Showcase exhibitors are invited to network and discuss potential commercialization opportunities. Meet in the Technology Showcase Partner Pavilion on the far right side.

SIEMENS



When challenges come in clusters, solutions can't be linear.

One Power Matrix, myriad power solutions.

siemens.com/energy

Today the energy market is global, fast moving and facing increasingly complex challenges. One of its biggest challenges is to balance the need for cleaner energy to slow down climate change, while at the same time satisfy the demand for affordable energy from emerging markets. Achieving this balance requires an increasingly complex and technologically advanced energy system as well as more efficient, cleaner power generation.

With its unique perspective on and experience within the Power Matrix, Siemens is able to provide trendsetting understanding of the global power landscape. To get the full picture of the global energy market, **visit siemens.com/energy/power-matrix.**

Visit us at Booth #702 to learn and discuss energy innovation opportunities.

Answers for energy.

About the Energy Innovation Summit

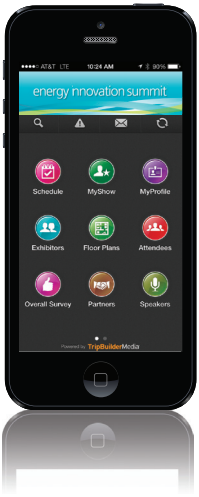
- **Women in the Energy Sector (Wednesday)**: During the continental breakfast in the Technology Showcase, join ARPA-E Acting Director Dr. Cheryl Martin at the ARPA-E booth for a special networking event with women in the energy sector.
- **The Corporate Acceleration Program (Tuesday-Wednesday)**: The Corporate Acceleration Program (CAP) is a unique matchmaking opportunity between corporate partners, investors and Technology Showcase participants. CAP brings together organizations that develop breakthrough energy technology with potential investors and partners.
- **NEW! The Innovation Board (Monday-Wednesday)**: Visit the Innovation Board in the Potomac Foyer and add your unique solution(s) to the questions posted.
- **NEW! Discounted Transportation (Monday-Wednesday)**: Our partner Uber provides attendees with transportation to and from the Summit. Summit attendees receive a $30 Uber discount. Visit **www.uber.com/goARPAE14**
- **Mobile Application**: Use our mobile app to:

–Easily view event information and receive instant alerts right on your mobile phone.

–Interact with other attendees via our messaging and matchmaking tool.

–Maximize your time at the Summit with the MyShow personalization tools.

–Access speaker biographies, panel descriptions, Technology Showcase participant profiles and more!



To use the app, visit **www.arpae-summit.com/app** on your phone's browser. Enhanced networking functions require this year's mobile app to ask for your email and password. Use the email and password you supplied during the Summit registration. If you have forgotten your password, the mobile app will allow you to retrieve your password.

Use the link above or, just snap this QR Code and download the app.


We create chemistry that lets cozy homes love windy days.
When high winds mean clean energy, it's because at BASF we create chemistry.
www.windenergy.basf.com
BASF
The Chemical Company

General Information

Registration & Information Desk Hours (Potomac Foyer)

Sunday: 5:00 p.m. – 8:00 p.m.
Monday: 7:00 a.m. – 6:00 p.m.
Tuesday: 7:00 a.m. – 6:00 p.m.
Wednesday: 7:00 a.m. – 3:00 p.m.

Questions?

For questions or special needs, please visit the Summit Registration Desk during the hours posted above and someone will assist you.

Press/Media Check-in

Check in at the Press Registration counter in the Potomac Foyer. Press must wear their Summit Press badge at all times. Press registration allows full access to the Technology Showcase and any session posted on the agenda. The following rooms are also available for press use:

Press Filing Room – National Harbor 13
Press Conference Room – National Harbor 12

Press Registration Desk hours (Potomac Foyer)

Monday: 8:00 a.m. – 4:00 p.m.
Tuesday: 7:00 a.m. – 2:00 p.m.
Wednesday: 7:00 a.m. – 11:00 a.m.

If you need assistance during non-manned hours, please visit the Registration Desk or call 703-740-1980.

Summit Badges

Summit badges must be worn at all times while attending sessions or special events. Your badge contains a QR code that is only functional for exhibitors and Summit staff who have a special device that reads the code. Allowing your badge to be scanned by an exhibitor will provide them standard business card information including your name, title, organization, address, phone, fax, and email.

NEW! Make sure to have your badge scanned as you enter a session. The sessions you attend will be posted in your individual registration portal and after the Summit you will be able to download a certificate to use for Continuing Education Credits.

As a reminder, please protect your identity – remove your Summit badge before leaving the hotel.

Summit Attire

Summit attire is business casual.

General Information

Agenda Changes

Agenda changes are posted on the mobile app and on a digital monitor located near the Registration Desk.

Visit www.arpae-summit.com/app on your phone's browser. Enhanced networking functions require this year's mobile app to ask for your email and password. Use the email and password you supplied during the Summit registration. If you have forgotten your password, the mobile app will allow you to retrieve your password.

Use the link above or, just snap this QR Code and download the app now!

Summit Twitter Hashtag

The 2014 Energy Innovation Summit uses Twitter in a variety of ways that encourage interaction among speakers, attendees, and the public.

The Summit's official Twitter hashtag is #EIS14. Please include it in your tweets as you share thoughts, speaker quotes, and other information about the Summit.

Tweets using #EIS14 will be displayed on our Idea Wall throughout the Summit, so you are encouraged to use the hashtag to connect with others, promote your booth, and engage in dialogue.

Wireless Access

Summit attendees may enjoy complimentary wireless access in all meeting rooms and public spaces. Be aware before connecting to this wireless network that it is public and unsecured.

In Public Space Areas

In public space areas such as the lobby, lower atrium and guestrooms you will see a prompt for "Gaylord Hotels". You will be prompted to add your hotel room number or log-in as a guest.

In Convention Center Areas

Please log into the "ARPAE" wireless network. Use the following password to log in:

Username: ARPAE
Password: Summit

Open Meeting Rooms

Open meeting rooms are available for ad hoc meetings. If you would like to reserve any of the following rooms for a meeting, please post information on the sign outside the door as well as on the message board located at the Summit Registration Desk. These rooms are available on a first-come, first-served basis.

Monday – Wednesday

- National Harbor 1 (Conference room setup for 10, no AV)
- National Harbor 6 (U-Shape setup for 20, no AV)
- National Harbor 8 (Classroom setup for 40, screen and projector provided in-room)
- National Harbor 11 (U-Shape setup for 24, screen and projector provided in room)

Tuesday – Wednesday

- National Harbor 10 (Classroom setup for 48, screen and projector provided in room)

Note Regarding Partners

The U.S. Department of Energy (DOE) does not endorse or appear to endorse private entities. DOE is in no way involved in the solicitation of supporters. All supporter opportunities were solicited by eventPower.

Presentation Access After the Summit

The Keynote sessions will be posted by Monday, March 3, 2014. Please visit **www.arpae-summit.com/Press/Media-Gallery** to view the keynote presentations.

Photography and Video Recording

Sessions at the Summit are being recorded and some sessions may be broadcast live to a virtual audience. Also note that videotaping and photographing of general attendance may take place at the Summit. DOE and eventPower reserve the right to copy, edit, exhibit, publish, and/or distribute photos (and videos) of attendees, and as an attendee you waive the right to inspect or approve the finished product wherein your likeness, name, image and sound of voice appears. No compensation is given for participation.

Only approved media may video or photograph any session. Due to strict copyright enforcement, sessions may not be photographed, videotaped, or recorded without express permission of Summit management. Those who do not comply will be escorted from the premises without refund.

About the Technology Showcase

Technology Showcase Hours of Operation

Tuesday:

Continental Breakfast	7:00 a.m. – 9:00 a.m.
Lunch	11:45 a.m. – 1:45 p.m.
Reception	4:30 p.m. – 7:30 p.m.

Wednesday

Continental Breakfast	7:00 a.m. – 9:30 a.m.
Lunch	11:15 a.m. – 1:30 p.m.

About the Technology Showcase

The Technology Showcase at the 2014 Energy Innovation Summit presents America's next generation of transformational energy technologies. The Technology Showcase includes ARPA-E awardees and a select group of other participants.

The Technology Showcase Features:

- Breakthrough technology developments
- Expert entrepreneurs and researchers ready to collaborate
- Tangible innovations on display
- Decision makers looking to invest

Participants in the Technology Showcase must pass a thorough vetting process to be included. This vetting process ensures that you are meeting with the best in the industry.

NEW! National Venture Capital Association Networking Event: **Tuesday, 7:30-8:30 a.m.**

Investors and Technology Showcase exhibitors are invited to network and discuss potential commercialization opportunities. Meet in the Technology Showcase Partner Pavilion on the far right side.

Women in the Energy Sector: **Wednesday, 7:30-9:00 a.m.**

Join ARPA-E Acting Director Dr. Cheryl Martin at the ARPA-E booth for a special networking event with women in the energy sector.

The Corporate Acceleration Program

The Corporate Acceleration Program (CAP) is a unique matchmaking opportunity between Corporate Partners, investors and Technology Showcase participants. CAP brings together organizations that develop breakthrough energy technology with potential investors and partners. If you have questions about the CAP program, please visit the CAP Help Desk located in the back of the exhibit hall.

About the Gaylord National

GAYLORD NATIONAL®
RESORT & CONVENTION CENTER
on the Potomac

2014 Energy Innovation Summit Venue - Gaylord National

Hotel Concierge Services (Hotel Lobby)

Sunday – Thursday	7:00 a.m.-10:00 p.m.
Friday – Saturday	7:00 a.m.-11:00 p.m.

- City Attraction Guides
- Restaurant Reservations

Consider it Done

The "Consider It Done" button, located on all guest phones, is part of the commitment made by the hotel's STAR employees to meet the diverse needs of every hotel guest. By pressing "Consider It Done," guests can ask questions or request a wide range of services.

Technology/Business Center (Main Floor of Convention Center)

FedEx Office Print & Ship Center ® is centrally located on the main floor of the Convention Center.

Hours of Operations: Open every day, 6:00 a.m. to 9:00 p.m. | 24-hour Internet access | 24-hour self-service printing and copying

Medical Emergency

Gaylord National® Resort and Convention Center maintains a 24/7 security staff trained in basic first aid, CPR, and the use of the automated external defibrillators on the property. In the case of a life threatening event please dial "911" immediately. You may also contact Gaylord National® Safety Services at (301) 965-4500 or extension 333 on any hotel phone.

Gaylord Guest Amenities Included in Guest Room Charge

- High-speed Internet access in guest room
- Twenty-four hour access to fitness center
- Access to indoor junior olympic-sized pool
- Local, toll-free and domestic long-distance phone calls
- Two bottles of water per room, per day
- Daily newspaper at the elevator landing on guest room floors
- Coupon booklet with savings at the resort

Parking

Parking is available at a reduced rate of $14 per day to Summit attendees.

Overnight Guest:

Park in the self-parking garage and the discount will be applied to your guestroom folio.

Daily Guest:

Park in the self-parking garage and make sure to ask for a validation ticket at the Summit Registration Desk. When leaving the parking garage, please provide your validation ticket.

Gaylord National, Interior Atrium

EXPLORE THE NEXT GENERATION OF ENERGY INNOVATION

To solve global energy challenges, we're meeting finite resources with infinite resourcefulness. Lockheed Martin's 60,000 plus scientists and engineers worldwide are committed to reaching the nation's most complex energy goals. Like 25% renewable energy by 2025. And 80% greenhouse gas reduction by 2050. Over 60 major commercial, federal and state customers are working with us for more efficient energy solutions. Through our commitment to results, suddenly the world of energy looks like a world of possibilities. Tap into it at www.lockheedmartin.com/energysolutions.

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SECTION 2

SUMMIT AGENDA

"The Summit brings together a diverse variety of engineers, scientists, and investors under one roof which allowed us to both market our company and make technical contacts which assist in the furthering of our core products."

— Jason Switzern, Dais Analytic Corporation

Agenda at a Glance

Please see pages 50-51 for the Student Program Agenda

MONDAY, FEBRUARY 24

7:00 a.m.-6:00 p.m.	Summit Registration and Information Desk Hours	*Potomac Foyer*
9:00-9:50 a.m.	**PRE-SUMMIT TECHNICAL SESSIONS**	
	Lessons Learned in Technology Development: Pivoting to Avoid Pitfalls *Potomac C*	**Have You Ever Thought of Working at ARPA-E?** *Potomac 5*
10:00-10:50 a.m.	**Lessons Learned in Technology Scaling-Up: Transitioning Science into Production** *Potomac C*	**Change the World with an ARPA-E Award** *Potomac 5*
11:00-11:05 a.m.	**Summit Kickoff**	*Potomac A*
11:05-11:25 a.m.	**Opening Keynote** • *Dr. Sylvia A. Earle, Explorer in Residence of the National Geographic Society and Founder, Mission Blue*	*Potomac A*
11:25-11:30 a.m.	**ARPA-E Awardee Spotlight Video**	*Potomac A*
11:30 a.m-12:10 p.m.	**Fireside Chat - Innovation: Investment and Commitment** • *Moderator: Steve Clemons, Washington Editor at Large, The Atlantic* • *Dr. Stefan Blank, Managing Director and Chief Executive Officer, BASF Future Business GmbH* • *William K. Caesar, President, WM Recycle America and WM Organic Growth, Waste Management Inc.*	*Potomac A*
12:10-12:15 p.m.	**Welcoming Comments** • *Joseph M. Rigby, Chairman of the Board, President and Chief Executive Officer, Pepco Holdings, Inc*	*Potomac A*
12:15-2:15 p.m.	**GOVERNMENT AGENCY NETWORKING PROGRAM AND LUNCH**	*Prince George's Hall A-B*
	See page 45 for the participating government agencies and see pages 76-81 to learn their focus areas.	
2:15-3:15 p.m.	**PANEL SESSIONS**	
	Re-envisioning the Grid from the Ground Up *Potomac A*	**Carbon Capture Technologies: Comparing State-of-the-Art to Reality** *Potomac C*
	Will Big Data Mean Big Energy for the 21st Century? *Potomac 5*	**Beyond Washington: How States are Taking Charge on Energy** *National Harbor 3*
3:15-3:30 p.m.	**Networking Break**	*Potomac Foyer*
3:30-4:30 p.m.	**TECHNOLOGY DISCUSSIONS WITH ARPA-E PROGRAM DIRECTORS**	
	Capturing America's Natural Gas *Potomac A*	**Doing More with Less: Opportunities for Increased Energy Efficiency** *Potomac C*
	Going Places: Prospects for Transportation Alternatives *Potomac 5*	**Generation for the Next Generation** *National Harbor 3*
4:30-6:30 p.m.	**NETWORKING RECEPTION**	
	Opening Networking Reception *Small Group Networking (optional) 4:30-5:30 p.m. See the right box for locations.*	*Potomac Foyer*
5:30-8:00 p.m.	**FUTURE ENERGY PITCHING SESSION**	
	Future Energy Pitching Session *Followed by Coffee and Dessert (optional) in the Potomac Foyer 7:30-8:00 p.m.*	*Potomac A*

TUESDAY, FEBRUARY 25

7:00 a.m.-6:00 p.m.	**Summit Registration and Information Desk Hours**	*Potomac Foyer*
7:00-9:00 a.m.	**Technology Showcase and Continental Breakfast**	*Technology Showcase*
7:30-8:30 a.m.	**Special Networking Event: National Venture Capital Association** *Investor and Technology Showcase exhibitors are invited to attend.*	*Technology Showcase*
9:00-9:05 a.m.	**Opening Remarks**	*Potomac A*
9:05-9:25 a.m.	**ARPA-E Director Fireside Chat** • *Moderator: Bart Gordon, Partner, K&L Gates* • *Dr. Cheryl Martin, Acting Director, ARPA-E*	*Potomac A*
9:25-10:10 a.m.	**Main-Stage Panel Discussion: Energy Innovation View from the Hill** • *Moderator: Coral Davenport, The New York Times*	*Potomac A*
10:10-10:25 a.m.	**Networking Break**	*Potomac Foyer*
10:25-10:30 a.m.	**ARPA-E Awardee Spotlight Video**	*Potomac A*
10:30-11:10 a.m.	**Fireside Chat - Innovation: Creating Tomorrow's Utility** • *Moderator: Marc Gunther, Editor-at-large, Guardian Sustainable Business U.S.* • *David Crane, President and Chief Executive Officer, NRG Energy* • *Professor Richard Lester, Japan Steel Industry Professor and Head of the Department of Nuclear Science and Engineering, Massachusetts Institute of Technology (MIT)*	*Potomac A*
11:10-11:45 a.m.	**Fireside Chat** • *Dr. Ernest Moniz, Secretary, U.S. Department of Energy* • *Mr. John Podesta, Counselor to the President, The White House*	*Potomac A*
11:45 a.m.-1:45 p.m.	**Technology Showcase and Lunch**	*Technology Showcase*
1:45-2:45 p.m.	**PANEL SESSIONS**	
	Microgrids—Why Are They Tough and Will They Matter? *Potomac A*	**Back to the Future: Advances in Personal Transportation** *Potomac C*
	Driving Deployment: A Global Perspective on Emerging Clean Energy Policy Drivers *Potomac 5*	**Solar at a Crossroads?** *National Harbor 3*
2:45-3:00 p.m.	**Networking Break**	*Potomac Foyer*
3:00-3:05 p.m.	**Congressional Comment**	*Potomac Foyer*
3:05–3:25 p.m.	**Keynote Presentation - The Entrepreneurial State: Rethinking Risks and Rewards in Innovation** • *Professor Mariana Mazzucato, Professor of Economics and RM Phillips Chair in Science and Technology Policy, University of Sussex*	*Potomac A*
3:25–3:30 p.m.	**ARPA-E Awardee Spotlight Video**	*Potomac A*
3:30–4:00 p.m.	**Fireside Chat - Energy and Security** • *Moderator: Steve Clemons, Washington Editor at Large, The Atlantic* • *Vice Admiral Michelle Howard, Deputy Chief of Naval Operations for Operations, Plans, and Strategy, U.S. Navy*	*Potomac A*
4:00-4:20 p.m.	**Keynote Presentation**	*Potomac A*
4:30-7:30 p.m.	**Technology Showcase and Reception**	*Technology Showcase*

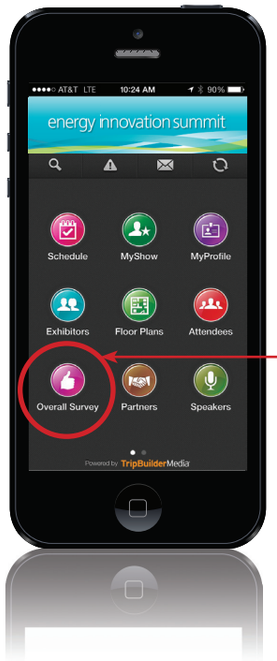
Small Group Networking *(optional)* | Monday, 4:30-5:30 p.m.

- U.S. State & Global Energy Networking – Potomac Foyer
- Natural Gas – Potomac A Foyer
- Efficiency – Potomac C
- Transportation – Potomac 5 Foyer
- Generation – National Harbor Foyer

Agenda at a Glance

Please see pages 50-51 for the Student Program Agenda

WEDNESDAY, FEBRUARY 26				
7:00 a.m.-3:00 p.m.	Summit Registration and Information Desk Hours			*Potomac Foyer*
7:00-9:30 a.m.	Technology Showcase and Continental Breakfast			*Technology Showcase*
7:30-9:00 a.m.	Special Networking Event: Women in the Energy Sector			*ARPA-E Booth 629 in Technology Showcase*
9:30-9:35 a.m.	Opening Remarks			*Potomac A*
9:35-9:50 a.m.	Keynote Presentation • *Dr. Ernest Moniz, Secretary, U.S. Department of Energy*			*Potomac A*
9:50-10:00 a.m.	ARPA-E Awardee Spotlight Video			*Potomac A*
10:00-10:40 a.m.	Fireside Chat - Innovation: Education and Entrepreneurship • *Moderator: Amy Schatz, Senior Editor, Tech Policy, Re/code* • *Carmichael Roberts, General Partner, North Bridge Venture Partners* • *Barbara R. Snyder, President, Case Western Reserve University*			*Potomac A*
10:40-10:50 a.m.	Congressional Comment			
10:50-11:15 a.m.	Keynote Presentation			*Potomac A*
11:15 a.m.-1:30 p.m.	Technology Showcase and Lunch			*Technology Showcase*
1:30-2:30 p.m.	PANEL SESSIONS			
	Lab 2.0: New Models for Breakthrough Energy R&D *Potomac A*	Combinatorial Discovery in Energy: The Quest for the Next Big Hit *Potomac C*	Opportunities Abroad: The Role of International Markets in U.S. Energy Innovation *Potomac 5*	Your Technology Will Change the World, but Can it Power a Laptop at my Forward Operating Base? *National Harbor 3*
2:30-3:30 p.m.	Closing Networking Reception			*Potomac Foyer*



THANK YOU

for Attending the 5th Annual ARPA-E Energy Innovation Summit. Please fill out the attendee survey located on the mobile app.

Please see pages 50-51 for the Student Program Agenda.

MONDAY, FEBRUARY 24

7:00 a.m.-6:00 p.m.
Registration and Information Desk Hours ..... Potomac Foyer

9:00-10:50 a.m.
PRE-SUMMIT TECHNICAL SESSIONS

9:00-9:50 a.m.
Lessons Learned in Technology Development: Pivoting to Avoid Pitfalls..... Potomac C

In order to have R&D grounded in commercial relevance, ARPA-E's unique model requires each project to include a technology-to-market set of tasks. Panelists examine ARPA-E projects that have successfully pivoted toward market relevance and impact.

- *Moderator: Jeff McAulay, EnerNOC*
- *Dr. Joanna Aizenberg, Harvard University*
- *Dr. Venkat Srinivasan, Lawrence Berkeley National Lab (LBNL)*
- *T.J. Wainerdi, University of Houston*

9:00-9:50 a.m.
Have You Ever Thought of Working at ARPA-E? .....Potomac 5

Panelists examine the variety of limited term positions at ARPA-E and how each one is unique in how it contributes to the overall mission of ARPA-E. Learn more about each of these positions.

- *Moderator: Dr. Eric Rohlfing, ARPA-E Deputy Director for Technology*
- *Josh Gould, ARPA-E Technology-to-Market Advisor*
- *Dr. Ilan Gur, ARPA-E Program Director*
- *Dr. Elizabeth Santori, ARPA-E Fellow*

10:00-10:50 a.m.
Lessons Learned in Technology Scaling-Up: Transitioning Science into Production..... Potomac C

Once technology has been validated, entrepreneurs must meet the next great challenge of successfully scaling up their innovations. Panelists explore the paths taken by several ARPA-E performers as they learned to secure funding and manage the risks of scale-up.

- *Moderator: Dr. Cheryl Martin, ARPA-E Acting Director*
- *Phil Giudice, Ambri*
- *Dr. Joel Moxley, Foro Energy*
- *Frank van Mierlo, 1366 Technologies*

10:00-10:50 a.m.
Change the World with an ARPA-E Award.....Potomac 5

ARPA-E has a unique funding model. Panelists explain how the ARPA-E model works: from Funding Opportunity Announcement (FOA) determination, to selection, to contract negotiation, and ongoing project management.

- *Dr. Dane Boysen, ARPA-E Program Director*
- *Dr. Eric Rohlfing, ARPA-E Deputy Director for Technology*

Continued to next page >>

MONDAY (CONTINUED)

11:00 - 11:05 a.m.
Summit Kickoff ..... **Potomac A**

11:05-11:25 a.m.
Opening Keynote ..... **Potomac A**

- *Dr. Sylvia A. Earle, Explorer in Residence of the National Geographic Society and Founder, Mission Blue*

11:25-11:30 a.m.
ARPA-E Awardee Spotlight Video ..... **Potomac A**

11:30 a.m. -12:10 p.m.
Fireside Chat - Innovation: Investment and Commitment ..... **Potomac A**

- *Moderator: Steve Clemons, Washington Editor at Large, The Atlantic*
- *Dr. Stefan Blank, Managing Director and Chief Executive Officer, BASF New Business GmbH*
- *William Caesar, President, WM Recycle America and WM Organic Growth, Waste Management Inc.*

12:10-12:15 p.m.
Welcoming Comments ..... **Potomac A**

- *Joseph M. Rigby, Chairman of the Board, President and Chief Executive Officer, Pepco Holdings, Inc.*

12:15-2:15 p.m.
GOVERNMENT AGENCY NETWORKING PROGRAM AND LUNCH ..... **PRINCE GEORGE'S HALL A-B**

Connect with leaders and program directors from federal government agencies. See page 45 for a listing of participating government agencies.

Continued to next page >>

2013 Energy Innovation Summit

MONDAY (CONTINUED)

2:15-3:15 p.m.

PANEL SESSIONS

Re-envisioning the Grid from the Ground Up..... Potomac A

Increasing penetrations of wind and solar generation, aging infrastructure, electricity consumption changes, and other factors are increasing pressure on electric power grids. These challenges are creating an era of unprecedented innovation in grid technologies. Panelists explore "starting from scratch" and how to modernize existing and future grid infrastructures.

- *Moderator: Katherine Tweed, Greentech Media*
- *Clark W. Gellings, Electric Power Research Institute (EPRI)*
- *John D. Hewa, Pedernales Electric Cooperative*
- *Dr. Marija D. Ilić, Carnegie Mellon University*
- *Dr. Lawrence Jones, Alstom Grid Inc.*

Carbon Capture Technologies: Comparing State-of-the-Art to Reality..... Potomac C

Panelists discuss the status of developing transformative, economically viable carbon capture technologies, as well as what other innovative strategies should be explored to make carbon capture investments more economically attractive.

- *Moderator: Dr. Mark Hartney, SLAC National Accelerator Laboratory*
- *Michael Matuszewski, National Energy Technology Laboratory (NETL)*
- *Jim Spiers, Tri-State Generation and Transmission Association*
- *Pamela Tomski, Global Carbon Capture and Storage (CCS) Institute*

Will Big Data Mean Big Energy for the 21st Century?..... Potomac 5

Big data has the potential to revolutionize nearly every part of our economy, but will the power of information assist in curbing energy use for future generations? Panelists explore if big data means big energy for the 21st century.

- *Moderator: Katie Fehrenbacher, GigaOM*
- *David Douglas, Applied Minds*
- *Dr. Eric Masanet, Northwestern University*
- *Dr. Nicole Peill-Moelter, Akamai Technologies, Inc.*

Beyond Washington: How States are Taking Charge on Energy..... National Harbor 3

Many states have established new funding and partnership models to move energy technologies to scale and drive both energy goals and economic development. Panelists discuss new programs and how best to partner with states for technology development.

- *Moderator: Stephen Stromberg, The Washington Post*
- *Alicia Barton, Massachusetts Clean Energy Center*
- *Richard Kauffman, State of New York*
- *Dr. Robert Weisenmiller, California Energy Commission (CEC)*

3:15-3:30 p.m.

Networking Break..... Potomac Foyer

Continued to next page >>

MONDAY (CONTINUED)

3:30-4:30 p.m.

TECHNOLOGY DISCUSSIONS WITH ARPA-E PROGRAM DIRECTORS

Capturing America's Natural Gas..... Potomac A

New technology has dramatically expanded natural gas production in the U.S. Learn how ARPA-E is helping to develop beneficial new applications for natural gas and working to reduce the impacts of increased natural gas production.

- *Dr. Dane Boysen, ARPA-E Program Director*
- *Dr. Ramon Gonzalez, ARPA-E Program Director*
- *Dr. Ashwin Salvi, ARPA-E Fellow*
- *Dr. Bryan Willson, ARPA-E Program Director*

Doing More with Less: Opportunities for Increased Energy Efficiency ..... Potomac C

Inefficiencies in the flow of energy result in over 60% of domestic energy being wasted. Panelists discuss new initiatives ARPA-E has targeted and other potential emerging opportunities to significantly impact energy efficiency.

- *Dr. Tim Heidel, ARPA-E Program Diretor*
- *Dr. James Klausner, ARPA-E Program Director*
- *Dr. Amul Tevar, ARPA-E Fellow*
- *Dr. Bradley Zamft, ARPA-E Fellow*

Going Places: Prospects for Transportation Alternatives .....Potomac 5

ARPA-E is working to increase the number of viable transportation alternatives, through development of alternative fuels and electrified drive trains. Panelists explore the opportunities and technological challenges in design and implementation.

- *Dr. Jonathan Burbaum, ARPA-E Program Director*
- *Dr. Ilan Gur, ARPA-E Program Director*
- *Dr. Ping Liu, ARPA-E Program Director*
- *Dr. Elizabeth Santori, ARPA-E Fellow*

Generation for the Next Generation..... National Harbor 3

The electric power sector accounts for 40% of U.S. energy use, and 39% of U.S. energy-related CO_2 emissions. Panelists discuss new technologies ARPA-E is creating and ways ARPA-E is helping to bridge the U.S. to a low-carbon future for electricity.

- *Dr. Howard Branz, ARPA-E Program Director*
- *Dr. John Lemmon, ARPA-E Program Director*
- *Dr. Patrick McGrath, ARPA-E Program Director*
- *Dr. William Regan, ARPA-E Fellow*

Continued to next page >>

MONDAY (CONTINUED)

4:30-6:30 p.m.
NETWORKING RECEPTION

4:30-6:30 p.m.

Opening Networking Reception ..... Potomac Foyer

Evening Networking Reception open to all Summit attendees.

4:30-5:30 p.m.

Small Group Networking *(Optional)* **..... See Below for Locations**

During the Monday evening networking event, Summit attendees have the opportunity to meet in the following sub-groups:

- U.S. State & Global Energy Networking – Potomac Foyer
- Natural Gas – Potomac A Foyer
- Efficiency – Potomac C
- Transportation – Potomac 5 Foyer
- Generation – National Harbor Foyer

5:30-8:00pm
FUTURE ENERGY PITCHING SESSION

5:30-7:30 p.m.

Future Energy Pitching Session ..... Potomac A

This event features eight early-stage energy technology startups presenting to a panel of venture capital investors. Investors provide feedback and actionable advice to the startups. All Summit attendees are invited to attend and vote for their favorite startups. The startups that get the most votes will be acknowledged as winners. See pages 46-49 for details.

7:30-8:00 p.m.

Coffee and Dessert ..... Potomac Foyer

2013 Energy Innovation Summit

Please see pages 50-51 for the Student Program Agenda.

TUESDAY, FEBRUARY 25

7:00 a.m.-6:00 p.m.
Registration and Information Desk Hours ..... **Potomac Foyer**

7:00-9:00 a.m.
Technology Showcase and Continental Breakfast ..... **Technology Showcase**

7:30 - 8:30am
Special Networking Event: National Venture Capital Association ..... **Technology Showcase**

Investors and Technology Showcase exhibitors are invited to network and discuss potential commercialization opportunities at a special networking event hosted by the National Venture Capital Association. Meet in the Technology Showcase Partner Pavilion, far right side.

9:00-9:05 a.m.
Opening Remarks ..... **Potomac A**

9:05-9:25 a.m.
ARPA-E Director Fireside Chat ..... **Potomac A**

- *Moderator: Bart Gordon, Partner, K&L Gates*
- *Dr. Cheryl Martin, Acting Director, ARPA-E*

9:25-10:10 a.m.
Main-Stage Panel Discussion: Energy Innovation View from the Hill ..... **Potomac A**

- *Moderator: Coral Davenport, The New York Times*

10:10-10:25 a.m.
Networking Break ..... **Potomac Foyer**

10:25-10:30 a.m.
ARPA-E Awardee Spotlight Video ..... **Potomac A**

10:30-11:10 a.m.
Fireside Chat - Innovation: Creating Tomorrow's Utility ..... **Potomac A**

- *Moderator: Marc Gunther, Editor-at-large, Guardian Sustainable Business U.S.*
- *David Crane, President and Chief Executive Officer, NRG Energy*
- *Professor Richard Lester, Japan Steel Industry Professor and Head of the Department of Nuclear Science and Engineering, Massachusetts Institute of Technology (MIT)*

11:10-11:45 a.m.
Fireside Chat ..... **Potomac A**

- *Dr. Ernest Moniz, Secretary, U.S. Department of Energy*
- *Mr. John Podesta, Counselor to the President, The White House*

Continued to next page >>

TUESDAY (CONTINUED)

11:45 a.m.-1:45 p.m.

Technology Showcase and Lunch ..... Technology Showcase

1:45-2:45 p.m.

PANEL SESSIONS

Microgrids—Why Are They Tough and Will They Matter? ..... Potomac A

The term 'microgrid' has become a popular buzzword. Yet the applications, motivations and requirements for microgrids are often very different. Panelists explore the challenges associated with different types of microgrids.

- *Moderator: Daniel C. Esty, Connecticut Department of Energy and Environmental Protection*
- *Robyn Beavers, NRG Energy*
- *Sumit Bose, GE Global Research*
- *Dr. James Galvin, U.S. Department of Defense*
- *Haresh Kamath, Electric Power Research Institute (EPRI)*

Back to the Future: Advances in Personal Transportation..... Potomac C

Recent innovations in technology have transformed automobiles such that they are no longer just a means of transportation. The automotive industry now faces accelerating demand for future enhancements and technologies. This dynamic provides opportunities and challenges for present business models in the automobile manufacturing and transportation industries. Innovations are being developed both by startups and by established companies.

- *Moderator: David Biello, Environment & Energy, Scientific American*
- *Gretchen Effgen, Zipcar*
- *Cliff Fietzek, BMW of North America, LLC*
- *Scott Kubly, Chicago Department of Transportation*
- *Rick Schuman, INRIX*

Driving Deployment: A Global Perspective on Emerging Clean Energy Policy Drivers.....Potomac 5

Panelists discuss the best practices, challenges and interrelationships of international energy policy tools in accelerating energy technology innovations, demonstrations, and deployment, and resulting opportunities.

Solar at a Crossroads? ..... National Harbor 3

Solar electricity has become a $100 billion global industry. Panelists debate opposing views regarding possible futures for solar electricity and discuss the likely impact on the photovoltaic industry and the traditional utility business model.

- *Moderator: Ucilia Wang, Forbes*
- *Jeffrey Ball, Stanford University*
- *Dr. Tom Bialek, San Diego Gas and Electric*
- *Dr. Tom Starrs, SunPower Corporation*

Continued to next page >>

Summit Agenda: TUESDAY

TUESDAY (CONTINUED)

2:45-3:00 p.m.
Networking Break..... Potomac Foyer

3:00 – 3:05 p.m.
Congressional Comment..... Potomac A

3:05 – 3:25 p.m.
Keynote Presentation – The Entrepreneurial State: Rethinking Risks and Rewards in Innovation

- *Professor Mariana Mazzucato, Professor of Economics and RM Phillips Chair in Science and Technology Policy, University of Sussex*

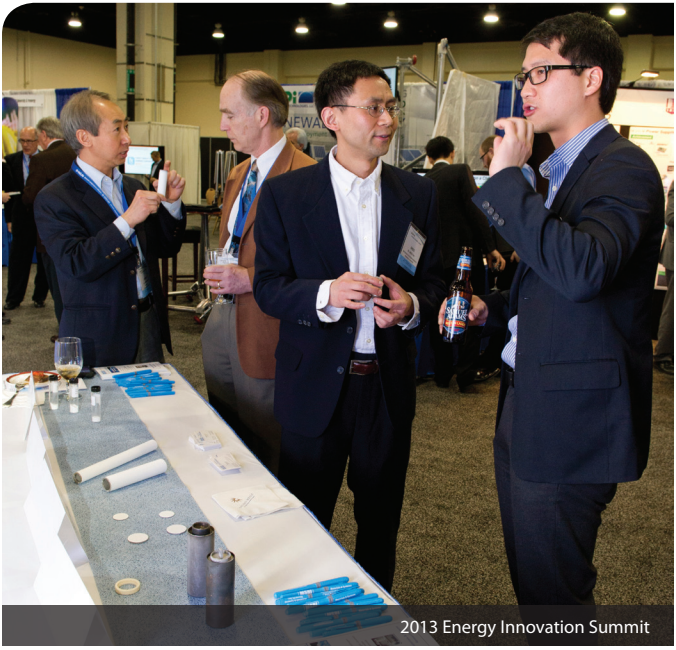
3:25 – 3:30 p.m.
ARPA-E Awardee Spotlight Video..... Potomac A

3:30 – 4:00 p.m.
Fireside Chat - Energy and Security ..... Potomac A

- *Moderator: Steve Clemons, Washington Editor at Large, The Atlantic*
- *Vice Admiral Michelle Howard, Deputy Chief of Naval Operations for Operations, Plans, and Strategy, U.S. Navy*

4:00 – 4:20 p.m.
Keynote Presentation..... Potomac A

4:30-7:30 p.m.
Technology Showcase and Reception .....Technology Showcase



2013 Energy Innovation Summit

Summit Agenda: WEDNESDAY

Please see pages 50-51 for the Student Program Agenda.

WEDNESDAY, FEBRUARY 26

7:00 a.m.-3:00 p.m.
Registration and Information Desk Hours ..... Potomac Foyer

7:00-9:30 a.m.
Technology Showcase and Continental Breakfast ..... Technology Showcase

7:30-9:00 a.m.
Special Networking Event: Women in the Energy Sector ..... ARPA-E Booth 629 in Technology Showcase

9:30-9:35 a.m.
Opening Remarks ..... Potomac A

9:35-9:50 a.m.
Keynote Presentation ..... Potomac A
- *Dr. Ernest Moniz, Secretary, U.S. Department of Energy*

9:50-10:00 a.m.
ARPA-E Awardee Spotlight Video ..... Potomac A

10:00-10:40 a.m.
Fireside Chat - Innovation: Education and Entrepreneurship ..... Potomac A
- *Moderator: Amy Schatz, Senior Editor, Tech Policy, Re/code*
- *Carmichael Roberts, General Partner, North Bridge Venture Partners*
- *Barbara R. Snyder, President, Case Western Reserve University*

10:40-10:50 a.m.
Congressional Comment ..... Potomac A

10:50-11:15 a.m.
Keynote Presentation ..... Potomac A

11:15 a.m.-1:30 p.m.
Technology Showcase and Lunch ..... Technology Showcase

Continued to next page >>

2013 Energy Innovation Summit

WEDNESDAY (CONTINUED)

1:30-2:30 p.m.

PANEL SESSIONS

Lab 2.0: New Models for Breakthrough Energy R&D ..... Potomac A

Along with breakthrough technology innovation, perhaps institutional innovation is needed to meet the urgency and magnitude of the energy problem. Panelists evaluate and explore a number of new models for unleashing game-changing energy research.

- *Moderator: Jon Gertner, Fast Company*
- *Danielle Fong, LightSail Energy*
- *Dr. Saul Griffith, Otherlab*
- *Dr. Delia J. Milliron, University of Texas at Austin*

Combinatorial Discovery in Energy: The Quest for the Next Big Hit ..... Potomac C

Combinatorial, high-throughput methods have been triumphed for their potential to increase the efficiency of research and development, and to facilitate big discoveries in materials for energy applications. Panelists address the hype and explore key successes.

- *Moderator: Kevin Bullis, MIT Technology Review*
- *Dr. Steven Kaye, Wildcat Discovery Technologies*
- *Dr. Terry Leib, GE Global Research*
- *Dr. Howard Turner, Kinestral Technologies, Inc.*

Opportunities Abroad: The Role of International Markets in U.S. Energy Innovation ..... Potomac 5

Clean energy investment has quadrupled over the past decade. Panelists discuss the range of financing options available from early stage to deployment and highlight best practices to put together partnerships for success.

- *Moderator: Matthew L. Wald, The New York Times*
- *Marcene D. Broadwater, International Finance Corporation*
- *Spencer Mahony, United Kingdom Trade & Investment*
- *John E. Morton, Overseas Private Investment Corporation*

Your Technology Will Change the World, but Can it Power a Laptop at my Forward Operating Base? ..... National Harbor 3

The Department of Defense faces many challenges in assuring the availability of energy in the field, and deploying emerging technologies to address those challenges is difficult. Panelists demonstrate how DoD adopts and fields innovations in the energy arena.

- *Moderator: Ben Geman, National Journal*
- *Sharon Beerman-Curtin, Office of Naval Research*
- *Bob Lewis, Cummins Power Generation*
- *The Honorable Heidi Shyu, U.S. Army*
- *Chief Master Sergeant Alan T. Yoshida, U.S. Special Operations Command*

2:30-3:30 p.m.

Closing Networking Reception ..... Potomac Foyer

All attendees are encouraged to participate.
The Summit concludes at 3:30 p.m.

SECTION 3

SESSION DESCRIPTIONS

"This unique forum will help facilitate the partnerships necessary to bring game-changing technologies to market quickly, which is critical to securing America's global technology leadership and creating new jobs."

—Steven Chu, Former Secretary, U.S. Department of Energy

Pre-Summit Technical Sessions

Lessons Learned in Technology Development: Pivoting to Avoid Pitfalls

Monday | 9:00-9:50 a.m. | Potomac C

Panel Description:

In order to have R&D grounded in commercial relevance, ARPA-E's unique model requires each ARPA-E project to include a Technology-to-Market set of tasks. The in-depth exploration of customer needs and cost-benefit trade-offs within technology development often leads to surprising discoveries that require a re-think in direction. Panelists discuss examples of ARPA-E projects that have successfully moved toward market relevance and impact. As new information was obtained, how was a flexible research approach maintained? What level of customer analysis was necessary for them to gain insight into the market and how did they gather that information? What constitutes a "robust" and useful techno-economic model?

Panelists:

MODERATOR

JEFF MCAULAY
Senior Manager of Strategic Partnerships, EnerNOC

DR. VENKAT SRINIVASAN,
Department Head, Energy Storage and Distributed Resources, Lawrence Berkeley National Lab (LBNL)

DR. JOANNA AIZENBERG
Professor of Materials Science, Harvard University

T.J. WAINERDI
Energy Research Business Director, University of Houston

Pre-Summit Technical Sessions

Have You Ever Thought of Working at ARPA-E?

Monday | 9:00-9:50 a.m. | Potomac 5

Panel Description:

There are a variety of limited term positions at ARPA-E from Program Directors to Technology to Market Advisors to Fellows. Each one is unique in how it contributes to the overall mission of ARPA-E. Join this conversation to learn more about each of these positions and ask questions of those currently holding them.

Panelists:

MODERATOR

DR. ERIC ROHLFING
Deputy Director for Technology, Advanced Research Projects Agency–Energy (ARPA-E)

DR. ILAN GUR
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

JOSH GOULD
Technology-to-Market Advisor, Advanced Research Projects Agency-Energy (ARPA-E)

DR. ELIZABETH SANTORI
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

Pre-Summit Technical Sessions

Lessons Learned in Technology Scaling-Up: Transitioning Science into Production

Monday | 10:00-10:50 a.m. | Potomac C

Panel Description:

Once technology has been validated, the entrepreneur must meet the next great challenge of successfully scaling up their innovations. The potential for extraordinatry value cannot be captured without the build-out of a broader based team which expands into skills outside of those responsible for the initial success. This panel explores the paths taken by several ARPA-E performers as they learned to secure high quality follow-on funding and manage the risks of scale-up. How did they choose the initial markets and secure commitments and funding? How did they develop useful advisor relationships and leverage those into effective strategy and traction in the market? How did they manage supply chain and balance internal manufacturing versus external contracting? How can the instincts that got them to this point work as an advantage rather than a disadvantage?

Panelists:

MODERATOR

DR. CHERYL MARTIN
Acting Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. JOEL MOXLEY
Founder, Foro Energy

PHIL GIUDICE
Chief Executive Officer, Ambri

Frank van Mierlo
Chief Executive Officer, 1366 Technologies

Pre-Summit Technical Sessions

Change the World with an ARPA-E Award

Monday | 10:00-10:50 a.m. | Potomac 5

Panel Description:

ARPA-E has a unique funding model. Panelists explain how the ARPA-E model works: from Funding Opportunity Announcement (FOA) determination to selection to contract negotiation and ongoing project management.

Panelists:

DR. DANE BOYSEN
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. ERIC ROHLFING
Deputy Director for Technology, Advanced Research Projects Agency–Energy (ARPA-E)

Re-envisioning the Grid from the Ground Up

Monday | 2:15-3:15 p.m. | Potomac A

Panel Description:

Increasing penetrations of wind and solar generation, aging infrastructure, electricity consumption changes, and many other factors are increasing the demand on electric power grids. These emerging challenges have given rise to an era of unprecedented technical innovation in grid technologies. However, all of the advances currently under development are being designed to operate with our existing grid infrastructure. This may constrain the range of solutions one might consider and may also require the use of old, antiquated assumptions about how grids operate The panel discussion begins with stepping away from the practical limitations and asking the following questions: If you could start from scratch, given today's technical capabilities, how would you design the grid? If given infinite resources, what are the three things you would do to address the growing challenges related to the transmission and delivery of electric power? Finally, we explore how the answers to those initial questions might be best applied toward the modernization of our existing grid infrastructure and how they could be used to direct the development of future grid-related technologies.

Panelists:

MODERATOR
KATHERINE TWEED
Writer, Greentech Media

DR. MARIJA D. ILIĆ
Professor, Electrical & Computer Engineering and Engineering & Public Policy, Carnegie Mellon University

CLARK W. GELLINGS
Fellow, Electric Power Research Institute (EPRI)

DR. LAWRENCE JONES
Vice President, Utility Innovations & Infrastructure Resilience, Alstom Grid Inc.

JOHN D. HEWA
Chief Executive Officer, Pedernales Electric Cooperative

Carbon Capture Technologies: Comparing State-of-the-Art to Reality

Monday | 2:15-3:15 p.m | Potomac C

Panel Description:

Today, there are two external forces surrounding the carbon capture debate: the regulatory dynamic for new and existing coal plants and the influx of low natural gas prices. In light of this, this panel explores to what extent carbon capture technologies will play a role, aiming to answer the tough questions: Where are we with developing transformative, economically viable carbon capture technologies? What is the current dynamic between carbon dioxide utilization versus sequestration? Technology development aside, what other innovative strategies should be explored to make carbon capture investments more economically attractive?

Panelists:

MODERATOR

DR. MARK HARTNEY
Director, Strategic Planning and Program Development, SLAC National Accelerator Laboratory

JIM SPIERS
Senior Vice President, Business Strategy and Chief Technology Officer, Tri-State Generation and Transmission Association

MICHAEL MATUSZEWSKI
Carbon Capture Technology Manager, U.S. Department of Energy, National Energy Technology Laboratory (NETL)

PAMELA TOMSKI
Senior Advisor, Policy and Regulatory - The Americas, Global Carbon Capture and Storage (CCS) Institute

Will Big Data Mean Big Energy for the 21st Century?

Monday | 2:15-3:15 p.m. | Potomac 5

Panel Description:

Researchers and policy makers have struggled for decades with the concept that improvements in device efficiency may ultimately lead to a net rise in energy use when technologies create new energy services. The emergence of big data analytics, ubiquitous computing, and automation brings a whole new dimension to this struggle. Big data has the potential to revolutionize nearly every part of our economy, offering high efficiency and optimization to existing industries, while enabling transformative new approaches like autonomous vehicles, internet-connected appliances, and individualized drone-based deliveries. But will the power of information serve to curb energy use for future generations, or will big data mean big energy for the 21st century?

Panelists:

MODERATOR

KATIE FEHRENBACHER
Senior Writer, GigaOM

DR. ERIC MASANET
Associate Professor, McCormick School of Engineering, Northwestern University

DAVID DOUGLAS
Vice President, Applied Minds

DR. NICOLE PEILL-MOELTER
Director of Environmental Sustainability, Akamai Technologies, Inc.

Beyond Washington: How States are Taking Charge on Energy

Monday | 2:15-3:15 p.m. | National Harbor 3

Panel Description:

Many states have established new funding and partnership models to move energy technologies to scale and drive both energy goals and economic development. The panel focuses on new programs and models to share best practices and to help technologists better understand how to partner with states for technology development.

Panelists:

MODERATOR
STEPHEN STROMBERG
Editorial Writer, The Washington Post

RICHARD KAUFFMAN
Chairman, Energy and Finance, State of New York

ALICIA BARTON
Chief Executive Officer, Massachusetts Clean Energy Center

DR. ROBERT WEISENMILLER
Chairman, California Energy Commission (CEC)

Technology Discussions with ARPA-E Program Directors

Capturing America's Natural Gas

Monday | 3:30 - 4:30 p.m. | Potomac A

Panel Description:

New technology has dramatically expanded natural gas production in the U.S. How is ARPA-E helping to develop beneficial new applications for natural gas and working to reduce the impacts of increased natural gas production?

Panelists:

DR. DANE BOYSEN
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. ASHWIN SALVI
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

DR. RAMON GONZALEZ
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. BRYAN WILLSON
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

Technology Discussions with ARPA-E Program Directors

Doing More with Less: Opportunities for Increased Energy Efficiency

Monday | 3:30 - 4:30 p.m. | Potomac C

Panel Description:

Inefficiencies in the flow of energy result in over 60% of domestic energy being wasted. Efficiency improvements along energy pathways will allow for a significant reduction in total energy expended for work, industrial processing, and climate control. ARPA-E has targeted and is currently supporting advances in several high impact inefficiencies, including those associated with power electronics (the ADEPT and SWITCHES programs) and light metal production (METALS). This panel discusses these initiatives, as well as other potential emerging opportunities to significantly impact energy efficiency across broad sectors in order to better utilize energy and material resources more efficiently.

Panelists:

DR. TIM HEIDEL
Program Diretor, Advanced Research Projects Agency-Energy (ARPA-E)

DR. AMUL TEVAR
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

DR. JAMES KLAUSNER
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. BRADLEY ZAMFT
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

Technology Discussions with ARPA-E Program Directors

Going Places: Prospects for Transportation Alternatives

Monday | 3:30 - 4:30 p.m. | Potomac 5

Panel Description:

For over a century personal transportation has been dominated by internal combustion engines fueled by non-renewable resources. Today, ARPA-E is working to increase the number of viable transportation alternatives through development of alternative fuels and electrified drive trains. Due to recent technological innovations, transportation technologies must fit into a different world. Electric vehicles need the electric grid, and alternative fuels need "drop-in" flexibility. This constraint also provides an opportunity for positive techno-economic synergies, such as vehicle-to-grid and combined food-fuel agriculture. This panel explores opportunities and technological challenges in the design and implementation of these approaches.

Panelists:

DR. JONATHAN BURBAUM
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. PING LIU
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. ILAN GUR
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. ELIZABETH SANTORI
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

Technology Discussions with ARPA-E Program Directors

Generation for the Next Generation

Monday | 3:30 - 4:30 p.m. | National Harbor 3

Panel Description:

The electric power sector accounts for 40% of U.S. energy use, and 39% of U.S. energy-related CO_2 emissions. What technologies is ARPA-E creating for low- or zero-emissions generation of electricity, and how will ARPA-E help increase penetration of these technologies into the grid to bridge the U.S. to a low-carbon future for electricity?

Panelists:

DR. HOWARD BRANZ
Program Diretor, Advanced Research Projects Agency-Energy (ARPA-E)

DR. PATRICK MCGRATH
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. JOHN LEMMON
Program Director, Advanced Research Projects Agency-Energy (ARPA-E)

DR. WILLIAM REGAN
Fellow, Advanced Research Projects Agency-Energy (ARPA-E)

Microgrids - Why Are They Tough and Will They Matter?

Tuesday | 1:45-2:45 p.m. | Potomac A

Panel Description:

The term "microgrid" has become a popular buzzword. Yet the applications, motivations and requirements for microgrids are often very different. This panel explores the enablers and challenges of different types of microgrids. What are the important ways in which individual microgrids are different - from performance requirements, size, and regulatory requirements? How do technologies get sourced and incorporated into microgrids? Can a key technology(ies) or regulatory development usher in a tipping point in microgrid adoption?

Panelists:

MODERATOR

DANIEL C. ESTY
Commissioner, Connecticut Department of Energy and Environmental Protection

DR. JAMES GALVIN
Program Manager, Energy and Water, Environmental Security Technology Certification Program (ESTCP), U.S. Department of Defense

ROBYN BEAVERS
Founder, Station A Group and Senior Vice President of Innovation, NRG Energy

HARESH KAMATH
Program Manager, Energy Storage, Electric Power Research Institute (EPRI)

SUMIT BOSE
Senior Electrical Engineer, GE Global Research

Back to the Future: Advances in Personal Transportation

Tuesday | 1:45-2:45 p.m. | Potomac C

Panel Description:

The private automobile has long been woven into the American fabric, providing manufacturing jobs and enabling the extension of cities into suburbs. Today's cars, as well as the role they play in society, are expanding from simply a means of transport, to "car as networked computer", "car as the extended home", or "car as a community property". Both lifestyles and work habits are adapting to this expansion, accelerating demand and setting expectations for future automobile technologies. This dynamic provides opportunities and challenges for present business models in the automobile manufacturing and transportation industries. Innovations such as adaptive headlights, smart braking systems, network-enabled navigation, and adaptive traffic control are being developed by both startups and established companies. This panel shares views from diverse players in this rapidly evolving field.

Panelists:

MODERATOR

DAVID BIELLO
Editor, Environment & Energy, Scientific American

SCOTT KUBLY
Commissioner, Chicago Department of Transportation

GRETCHEN EFFGEN
Vice President, Strategy & Corporate Development, Zipcar

RICK SCHUMAN
Vice President and General Manager, Public Sector, INRIX

CLIFF FIETZEK
Manager, Connected eMobility, BMW of North America, LLC

Driving Deployment: A Global Perspective on Emerging Clean Energy Policy Drivers

Tuesday | 1:45-2:45 p.m. | Potomac 5

Panel Description:

Energy policies, including feed-in tariffs, tax incentives, rebates, trade and quota, Renewable Portfolio Standards, RECs, and tendering, have been adopted by countries around the globe with varying degrees of success to spur the development of specific energy technologies. This discussion focuses on the best practices, challenges and interrelationships of international energy policy tools in accelerating energy technology innovations, demonstrations, and deployment, and resulting opportunities.

Solar at a Crossroads?

Tuesday | 1:45-2:45 p.m. | National Harbor 3

Panel Description:

The dramatic drop in photovoltaic costs in combination with the advent of new financing mechanisms has made solar electricity a $100 billion global industry. An explosion of distributed residential electricity producers that compete with centralized solar plants makes utilities squirm and sometimes push back. How serious are these skirmishes and is there an end in sight? What new technical approaches have the ability to fundamentally alter the current trajectory? Today's panel debates opposing possible futures for solar electricity and discusses the likely impact on the photovoltaic industry and the traditional utility business model.

Panelists:

MODERATOR

UCILIA WANG
Contributing Writer, GigaOm, Forbes

DR. TOM BIALEK
Chief Engineer, Smart Grid, San Diego Gas and Electric

JEFFREY BALL
Writer and Scholar-in-Residence, Steyer-Taylor Center for Energy Policy and Finance, Stanford University

DR. TOM STARRS
Vice President, Market Strategy and Policy, SunPower Corporation

Lab 2.0: New Models for Breakthrough Energy R&D

Wednesday | 1:30 -2:30 p.m. | Potomac A

Panel Description:

Bell Labs is often touted as the birthplace of the modern technological age, responsible for the most notable scientific and technological breakthroughs underlying advanced telecommunications and computing. Since its breakup, many wonder whether the age of game-changing institutional research has ended. One can argue that the venture-backed startup emerged as an effective and efficient alternative for forging disruptive research into commercial impact; however, the decline of venture funding in the energy space highlights a breakdown in areas with high development costs, long adoption times, and commodity economics. Along with breakthrough technology innovation, perhaps we also need breakthrough institutional innovation to meet the urgency and magnitude of the energy problem. This panel evaluates gaps in the current energy innovation ecosystem, and explores a number of new models for unleashing game-changing energy research.

Panelists:

MODERATOR

JON GERTNER
Editor-at-large, Fast Company and Author, The Idea Factory: Bell Labs and the Great Age of American Innovation

DR. SAUL GRIFFITH
Chief Executive Officer, Otherlab

DANIELLE FONG
Chief Scientist, LightSail Energy

DR. DELIA J. MILLIRON
Associate Professor, University of Texas at Austin

Combinatorial Discovery in Energy: The Quest for the Next Big Hit

Wednesday | 1:30 -2:30 p.m. | Potomac C

Panel Description:

Combinatorial, high-throughput methods have been triumphed for their potential to increase the efficiency of research and development, and to facilitate big discoveries in materials for energy applications. This panel touches on key successes across several energy areas and highlights ongoing work in metallurgical alloys, battery chemistry, catalysis, and adsorbants for gas storage and carbon capture. Panelists address whether combinatorial, high-throughput R&D has lived up to the hype, keys for success when using such methods, and strategies to remove bottlenecks in synthesis, testing, and informatics to accelerate the pace of discovery.

Panelists:

MODERATOR
KEVIN BULLIS
Senior Editor, Energy, MIT Technology Review

DR. TERRY LEIB
Global Technology Director, GE Global Research

DR. STEVEN KAYE
Chief Scientific Officer, Wildcat Discovery Technologies

DR. HOWARD TURNER
Co-Founder and Chief Technology Officer, Kinestral Technologies, Inc.

Opportunities Abroad: The Role of International Markets in U.S. Energy Innovation

Wednesday | 1:30 -2:30 p.m. | Potomac 5

Panel Description:

Clean energy investment has quadrupled over the past decade, with the total 2012 investments of $244 billion being the second-highest ever. This growth has been largely stimulated by a surge in global investments both in early stage technology development as well as demonstration and project deployment. These efforts have often been driven by strategic alliances between companies, international development institutions and international development banks, and individual country partners. This panel discusses the range of financing options available from early stage to deployment and highlights best practices to put together partnerships to succeed.

Panelists:

MODERATOR

MATTHEW L. WALD
Reporter, New York Times

SPENCER MAHONY
HM Consul and Regional Director (East), United Kingdom Trade & Investment

MARCENE D. BROADWATER
Global Head, Climate Strategy and Business Development, International Finance Corporation

JOHN E. MORTON
Chief of Staff, Overseas Private Investment Corporation

Your Technology Will Change the World, but Can it Power a Laptop at my Forward Operating Base?

Wednesday | 1:30 -2:30 p.m. | National Harbor 3

Panel Description:

The Department of Defense faces acute challenges in assuring the availability of energy in the field, but deploying emerging technologies to address those challenges is difficult. For example, unique DoD needs for ruggedness, reliability, maintainability, and interoperability are common hurdles. This conversation draws on the extensive experience of the panelists in technology development, defense acquisitions, and field operations to illustrate by example, how DoD adopts and fields innovations in the energy space. Participants gain valuable insight for positioning new technologies to enable DoD missions.

Panelists:

MODERATOR

BEN GEMAN
Energy and Environment Correspondent, National Journal

THE HONORABLE HEIDI SHYU
Assistant Secretary of Acquisition, Logistics and Technology, U.S. Army

SHARON BEERMAN-CURTIN
Power and Energy Technical Lead, Office of Naval Research

CHIEF MASTER SERGEANT ALAN T. YOSHIDA
Special Operation Research Development Acquisitions Center SOF Warrior (SORDAC- SW) Chief, U.S. Special Operations Command

BOB LEWIS
Military Marketing Programs Manager, Cummins Power Generation

Government Agency Networking Program

Monday | 12:15 - 2:15 p.m. | Prince George's Hall A-B

Connect with leadership and program directors from the nation's top federal agencies focused on energy innovation. Representatives from federal government agencies are available in an open, reception-style forum to discuss their research interests, services, and funding opportunities.

Listed below are the participating government agencies. See pages 77-82 to learn their focus areas.

U.S. DEPARTMENT OF DEFENSE AGENCIES

Air Force

Army

Marine Corps

Navy Energy and Environmental Readiness Programs (OPNAV N45)

Office of Naval Research (ONR)

Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs (OASD/OEPP)

Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP)

Special Operations Command (USSOCOM)

U.S. DEPARTMENT OF ENERGY AGENCIES

Office of Electricity Delivery and Energy Reliability

Office of Energy Efficiency and Renewable Energy (EERE)

Office of Fossil Energy

Office of Nuclear Energy

Office of Science

Energy Information Administration (EIA)

OTHER U.S. FEDERAL AGENCIES

Department of Agriculture (USDA)

Department of Transportation (DOT)

National Aeronautics and Space Administration (NASA)

National Institute of Standards and Technology (NIST)

National Science Foundation (NSF)

Future Energy Pitching Session

Monday | 5:30 p.m. – 7:30 p.m. | Potomac A
Coffee and Dessert | 7:30 p.m. – 8:00 p.m. | Potomac Foyer

Attend the Future Energy Pitching Session and vote for your favorite startup.

Future Energy is a community for entrepreneurs, researchers, and investors in the energy and cleantech industries to commercialize radical solutions to the world's energy challenges. The Future Energy community collaborates through in-person startup pitch events in key innovation centers across the U.S. and accompanying online communities for national and international participation.

Monday night's Future Energy Pitching Session features eight early-stage energy technology startups presenting to a panel of top venture capital investors. Investors provide feedback and actionable advice to the presenters, and the audience members vote for their favorite startup.

After the Pitching Session, please stay for coffee and dessert in the Potomac Foyer.

2014 Moderators:

ALEXANDRA ADLER
Cleantech Open Northeast

Alexandra (Ali) Adler is a skilled manager, organizer and connector who lives and breathes energy, environment and sustainability. She is passionate about addressing the world's energy and environmental challenges through entrepreneurship, and her drive to connect people to key resources and contacts to help them succeed has led her to numerous roles supporting the development of clean technology companies. She is currently developing and overseeing a variety of cleantech innovation and entrepreneurship initiatives across the northeast region, including acting as Co-Chair of Cleantech Open Northeast, the region's premier cleantech start-up accelerator program.

GRAHAM LAWLOR
Ultra Light Startups

Graham Lawlor is the founder of Ultra Light Startups, which helps Fortune 100 companies and government institutions connect with startups based on their strategic and financial objectives. Ultra Light is the largest monthly startup-investor pitch event community in both New York and Boston, and has also held events in Toronto, London, Cleveland and Austin. Since 2008, over 700 startups have pitched at Ultra Light Startups events. Graham is a frequent guest speaker, moderator, interviewer, and press source on startups and online business.

2014 Investor Panelists:

WILL COLEMAN
OnRamp Capital

Will Coleman is the Managing Director of OnRamp Capital, an early stage innovation partnership for corporates. Will has spent his career working with and investing in early stage companies in energy, technology, and media, and focuses on helping entrepreneurs build and scale their ideas. He is on the Advisory Board for the National Renewable Energy Laboratory (NREL) and the Advisory Committee for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. Will received his AB from Harvard University, and also holds a MBA from the Haas School of Business and a MS in Energy & Resources from UC Berkeley where he founded the Berkeley Energy & Resources Collaborative (BERC) and the Center for Energy & Environmental Innovation (CEEI).

NEAL M. DIKEMAN
Shell Technology Ventures

Neal M. Dikeman is a Senior Venture Principal at Shell Technology Ventures. Prior to working at Shell, he was founding partner of cleantech merchant bank Jane Capital Partners, where he served as advisor on corporate venture and alternative energy to a number of multinationals and R&D labs, including Meridian Energy, Ltd, ConocoPhillips, and Macquarie Bank. At Jane Capital he also cofounded, and led the launch of a number of energy tech startups in smart grid, power, alternative energy, and IT. He holds a BA from Texas A&M and currently serves on the board of American Electric Technologies, Inc, a provider of power delivery solutions to the petrochemical sector, is Chairman of Greenhome LLC and CleanTech.org, and is chief blogger of Cleantechblog.com.

ANDREW R. GARMAN
New Venture Partners, LLC

Andrew R. Garman is Managing Partner at New Venture Partners, an early stage venture capital firm with over $700M under management, focused on technology spinouts from corporations and major institutional labs. Previously he was a Vice President at Lucent Technologies; the Managing Director of BT Ventures at Bankers Trust Company; and Vice President of Strategy and Business Development for Xerox's New Enterprise Group. His current focus is on investments in energy technology, with board positions at Novinda, ICRtec, BrisMat, and Blinq. He began his career doing research and development in alternative energy systems, combustion and air pollution, and authoring or co-authoring 23 technical publications.

Continued to next page >>

Future Energy Pitching Session

ZACK SCHILDHORN
Lux Capital

Zack Schildhorn is a Vice President and Director of Operations with Lux Capital, based in the Firm's New York headquarters. Zack has been working with Lux since 2006, focusing on marketing, operations, and investments within energy, novel materials, and technologies at the intersection of the digital and physical worlds. Zack led Lux's investment in Shapeways and has worked extensively with a number of Lux portfolio companies including Transphorm, Kurion, and Siluria. Before joining Lux, Zack worked as an expedition photographer on the Colorado Plateau. He created his own curriculum at Cornell University to study materials science and business entrepreneurship, graduating in 5 years with a BS in engineering and an MBA. Zack is a regular contributing editor for Forbes and has been an invited speaker and guest lecturer at Cornell University, Drexel University, NYU, and the University of Pennsylvania.

STEVE TAUB
GE Ventures

Steve Taub is currently Senior Director at GE Ventures. Prior to joining GE, he was with Cambridge Energy Research Associates (CERA), where he was engaged in research and strategic consulting on energy technology and electric power for a wide range of clients worldwide. He also has worked for the U.S. Department of Energy office of Environmental Management and office of New Production Reactors. Steve earned his master's degrees in Mechanical Engineering and Technology and Policy from the Massachusetts Institute of Technology and a bachelor's degree in Mechanical Engineering from Columbia University. He also completed a U.S. DOE engineering training program at Virginia Polytechnic Institute and State University and class work in corporate finance at Harvard.

2013 Energy Innovation Summit's Future Energy Pitching Session Winner, Russ Wilcox with Transatomic Power, pitching his program/project.

Future Energy Pitching Session

Participating Companies (in alpha order):

Agira Energy

Project: 50-100X, non-tracking waveguide solar concentrator for $0.4.W PV modules.

Presenter: Bal Mukund Dhar

ChemVoltaics

Project: Smart-Grid demand control software and energy storage systems for grid frequency regulation.

Presenter: Adrian Hightower

CrowdComfort

Project: A smart device app that provides facilities managers the ability to manage crowd comfort.

Presenter: Eric Graham

Helion Energy

Project: Make clean fusion energy a reality today.

Presenter: David Kirtley

Onboard Dynamics, Inc.

Project: Self-fueling natural gas compressors for vehicles.

Presenter: Rita Hansen

Solid Power, Inc.

Project: Safe, low cost, ultra high energy solid-state rechargeable batteries.

Presenter: Douglas Campbell

SynShark, LLC

Project: Tobacco biofuel - a unique approach to photosynthesis, changing science and protecting scarce resources.

Presenter: J.M. Ornstein

Wristify

Project: A bracelet that heats and cools the individual instead of the whole building.

Presenter: David Cohen-Tanugi

FUTURE ENERGY PITCHING SESSION PLATINUM PARTNER

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Student Program

The Student Program at the Energy Innovation Summit is a unique opportunity for student energy leaders to network with each other as well as engage in interactive discussions and create future career opportunities.

Student/Company Networking Lunch Reception

Monday | 12:15-2:15 p.m. | National Harbor 5

An opportunity for graduate students to network with companies looking for new talent and for companies to meet the next generation of energy leaders. List of participating companies:

3M | BASF Corporation North America | DuPont | Electric Power Research Institute | Fraunhofer TechBridge | Gas Technology Institute | Robert Bosch LLC | ThermoLift | United Technologies Research Center

Student Panel - Understanding Transitions between Academia, Government, and the Private Sector

Tuesday | 11:45 a.m.-12:45 p.m. | National Harbor 5

Transitions between jobs are much more fluid today than in the past. Understanding the skill requirements across the energy ecosystem, including academia, government, and the private sector, could be critical to ensuring a bright start to your career. Featuring panelists with experience in multiple of these career areas, the panel empowers graduate students to visualize the entry paths for each career area, and the skills required to transition to the next.

Presenters:

MODERATOR

DR. CYRUS WADIA
Director's Office, Lawrence Berkeley National Laboratory (LBNL)

DR. GAVI BEGTRUP
Chief Executive Officer, Wave Tech LLC

ALLYSON ANDERSON
Senior Advisor to the Director, Bureau of Safety and Environmental Enforcement, U.S. Department of the Interior

From the Lab to the Market: Turning your Bright Idea into the Next Big Thing in Energy

Wednesday | 11:15 a.m.-12:15 p.m.| National Harbor 5

The energy ecosystem is littered with brilliant ideas that came to nothing. Turning "eureka!" moments into market realities is a pivotal challenge for all innovators. This in-depth conversation with experts in many facets of bringing technologies to successful outcomes focuses on how revolutionary concepts become innovative companies and how students might leverage their academic experience to provide value for these companies.

Presenters:

MODERATOR

JEFF ST. JOHN
Senior Editor, Smart Grid, Greentech Media

DAWN LIPPERT
Director, Energy Excelerator

LINDY FISHBURNE
Executive Director, Breakout Labs and Senior Vice President, Thiel Foundation

DR. EMILY REICHERT
Executive Director, Greentown Labs

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Energy is vital to our daily lives. It helps us produce food, fuel transport and power communication channels across the world. Over the coming decades, more people will gain access to energy and enjoy higher standards of living. But these developments could place greater pressure on our world's resources, such as energy, fresh water and food. At the same time, climate change remains a serious concern. At Shell, we use human ingenuity, innovation and technology to unlock the energy our customers need to power their lives in the years ahead, while aiming to limit our impact on the environment.

We are looking for innovative ideas to more affordably, efficiently and cleanly develop and use today's energy resources, or unlock the clean energy resources of tomorrow.

Submit your proposal to Shell GameChanger at www.shell.com/gamechanger

Personal Agenda

Use this page to create your own personal agenda.

MONDAY

TIME	SESSION	LOCATION

TUESDAY

TIME	SESSION	LOCATION

WEDNESDAY

TIME	SESSION	LOCATION

Session Notes

SECTION 4

SUMMIT PARTNERS & TECHNOLOGY SHOWCASE

"The best national networking of any event I attend each year and the speakers and panels help me to get a broader perspective of federal priorities and national trends in the future of energy technology."

— David Kenney, Oregon BEST

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A DOVER COMPANY

Patron Partners

Constellation
An Exelon Company

ESA Energy Storage Association

Case Western Reserve University
Great Lakes Energy Institute

How to
Find the Funding

Great ideas won't make it to market if they don't get funded. Visit **Booth 503** and hear from some of America's top experts on how to find financing for your clean energy innovation.

Join us Tuesday, Feb. 25, at Booth 503

8–8:30 a.m.
Venture capital and private equity explained
Neil Z. Auerbach, CEO, Hudson Clean Energy Partners
Nikhil Garg, vice president, Black Coral Capital

5:30–6 p.m.
Corporate investment in research and innovation
Dr. Carolin Funk, venture technology mgr., Siemens Corp.
Fred H. Walti II, exec. director, LA Cleantech Incubator

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ACEP

Argonne NATIONAL LABORATORY

TECHNOLOGY CENTRE MONGSTAD

EPRI ELECTRIC POWER RESEARCH INSTITUTE

NIST National Institute of Standards and Technology U.S. Department of Commerce

NorTech

NREL NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE National Laboratory

OREGON BEST

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—U.S. Department of Energy Agencies—

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—Other Government Agencies—

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NIST National Institute of Standards and Technology U.S. Department of Commerce

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Collegiate Energy Association

ESA Energy Storage Association

EE Environmental Entrepreneurs

Fuel Cell & Hydrogen Energy Association

Government | University | Industry Research Roundtable

GovEvents Where Government Gathers

ITIF The Information Technology & Innovation Foundation

National Venture Capital Association

NESEA Northeast Sustainable Energy Association

new england clean energy council

Unlimited Possibilities UIDP University-Industry Demonstration Partnership

Affiliate Partners

Advanced Biofuels USA

Alliance to Save Energy

CALSTART

CleanTechIQ

Colorado Cleantech Industries Association (CCIA)

How2Power.com

IAGS Journal of Energy Security

Young Professionals in Energy

environmental control | security

United Technologies Research Center

SIKORSKY

UTC BUILDING & INDUSTRIAL SYSTEMS
- OTIS
- UTC CLIMATE, CONTROLS & SECURITY
  Carrier, AutomatedLogic, NORESCO, Lenel, Onity, Interlogix, Kidde, Marioff, AdvanTE³C

UTC PROPULSION & AEROSPACE SYSTEMS
- PRATT & WHITNEY
- UTC AEROSPACE SYSTEMS

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DuPont.....Booth 206

STUDENT LANYARD PARTNER

www.dupont.com/industries/energy.html

DuPont (NYSE: DD) has been bringing world-class science and engineering to the global marketplace in the form of innovative products, materials, and services since 1802. The company believes that by collaborating with customers, governments, NGOs, and thought leaders we will identify solutions to such global challenges as providing healthy food for people everywhere, decreasing dependence on fossil fuels, and protecting life and the environment.

GOLD PARTNERS

BASF Corporation.....Booth 405

www.basf.us

BASF Corporation, headquartered in Florham Park, New Jersey, is the North American affiliate of BASF SE, Ludwigshafen, Germany. BASF is the world's leading chemical company: The Chemical Company. The product list includes chemicals, plastics, performance and crop protection substances as well as oil and gas, combining economic success, social responsibility and environmental protection. Science and innovation enables our customers to meet the current and future needs of society. Our products and system solutions contribute to conserving resources, ensuring healthy food and nutrition and helping to improve the quality of life. We create chemistry for a sustainable future.

Bosch North America .....Booth 607

www.bosch.us

The Bosch Group is a leading global supplier of technology and services. In fiscal year 2012 approximately 306,000 associates generated sales of $67.5 billion. In the U.S, the Bosch Group manufactures and markets automotive original equipment and aftermarket solutions, industrial drives and control technology, power tools, security and communication systems, packaging technology, thermotechnology, household appliances, healthcare telemedicine and software solutions. Bosch employs nearly 15,200 associates in the region, with consolidated sales of $8.85 billion in fiscal year 2012. In the U.S, the Bosch Group holds 5,769 patents. It offers technology worldwide that is "Invented for life."

Lockheed Martin ..... **Booth 506**

www.lockheedmartin.com

Lockheed Martin delivers mission solutions, information systems and global services when and where they're needed most. We partner closely with our customers, understanding and supporting the needs of citizens and military personnel worldwide. Powered by innovation, guided by integrity; Lockheed Martin helps customers achieve their most challenging goals.

Massachusetts Clean Energy Center ..... **Booth 105**

www.masscec.com

Created by the Massachusetts Green Jobs Act of 2008, the Massachusetts Clean Energy Center (MassCEC) is dedicated to accelerating the success of clean energy technologies, companies and projects in the Commonwealth – while creating high-quality jobs and long-term economic growth for the people of Massachusetts. Since its inception in 2009, MassCEC has helped clean energy companies grow, supported municipal clean energy projects, invested in residential and commercial renewable energy installations to create a robust marketplace for innovative clean technology companies and service providers.

Siemens ..... **Booth 702**

www.siemens.com

Siemens Corporation is a U.S. subsidiary of Siemens AG, a global powerhouse in electronics and electrical engineering, operating in the industry, energy, healthcare, and infrastructure and city sectors. For more than 165 years, Siemens has built a reputation for leading-edge innovation and the quality of its products, services and solutions. With 370,000 employees in 190 countries, Siemens reported worldwide revenue of approximately $102 billion in fiscal year 2012. Siemens in the USA reported revenue of $22 billion and employs approximately 60,000 people throughout all 50 states and Puerto Rico.

The Pew Charitable Trusts ..... **Booth 503**

BAG PARTNER

www.pewtrusts.org/cleanenergy

The Pew Charitable Trusts is a public charity that conducts research and acts as an advocate on key policy issues at the local, federal, and international level. Pew's Clean Energy Program engages policymakers, businesses, and other stakeholders to advance bipartisan policies that unleash the economic, security, and environmental benefits of a clean energy economy while positioning the United States as a global leader in this quickly growing sector.

United Technologies Research Center

United Technologies Research Center ..... Booth 205

www.utrc.utc.com

United Technologies Corporation is a diversified company that provides a broad range of high-technology products and services to the global aerospace and building systems industries. Its commercial business, UTC Building & Industrial Systems, is the world's largest provider of building technologies with elevator, escalator, fire safety, security, heating, ventilation, and air conditioning systems. The company's aerospace businesses include Sikorsky aircraft, Pratt & Whitney engines and UTC Aerospace Systems aerospace products. The company also operates a central research organization, United Technologies Research Center (UTRC) that partners with the businesses to deliver the world's most advanced technologies, innovative thinking and disciplined research.

FUTURE ENERGY PITCHING SESSION PARTNER

Shell GameChanger

Shell ..... Booth 306

www.shell.com

Shell is a global group of energy and petrochemicals companies. With around 90,000 employees in more than 80 countries and territories, Shell helps to meet the world's growing demand for energy in economically, environmentally and socially responsible ways. At Shell we are finding ways to deliver more, cleaner energy and helping find ways to use it more efficiently. Shell GameChanger is looking for people with ideas and supporting expertise to partner with us and redefine the future of energy. We bridge the space between traditional Shell and wildly innovative ideas.

SILVER PARTNERS

Applied Materials, Inc. ..... Booth 711

www.appliedmaterials.com

Applied Materials is the global leader in providing innovative equipment, services and software to enable the manufacture of advanced semiconductor, flat panel display and solar photovoltaic (PV) products. Our technologies help make innovations like smartphones, flat screen TVs and solar panels more affordable and accessible to consumers and businesses around the world.

Chevron

Chevron Technology Ventures

www.chevron.com

Chevron is one of the world's leading integrated energy companies and conducts business worldwide. Our success is driven by our people and their commitment to get results the right way—by operating responsibly, executing with excellence, applying innovative technologies and capturing new opportunities for profitable growth. We are involved in virtually every facet of the energy industry. We explore for, produce and transport crude oil and natural gas; refine, market and distribute transportation fuels and lubricants; manufacture and sell petrochemical products; generate power and produce geothermal energy; provide energy efficiency solutions; and develop the energy resources of the future.

GE Global Research

www.ge.com/research

GE Global Research is the hub of technology development for all of GE's businesses. Our scientists and engineers redefine possibilities, drive growth for our businesses, and find answers to some of the world's toughest problems. We innovate 24 hours a day, with sites in Niskayuna, New York; San Ramon, California; Bangalore, India; Shanghai, China; Munich, Germany; and Rio de Janeiro, Brazil. Visit GE Global Research on the web at www.ge.com/research and our blog, edisonsdesk.com where researchers today discuss the technologies of tomorrow. Visit GE in one of their many Technology Showcase booths.

BRONZE PARTNERS

Bright Capital Management Ltd

www.bright-capital.com

Bright Capital is an independent venture capital firm that invests globally in a wide range of promising companies. The firm works as a merchant venturing entity in a multi-corporate model, building bridges between Silicon Valley, MENA countries, Russia & CIS, southeast Asia. Investments include products in energy and resource efficiency, clean technology and industrial biotech.

Innocentive ..... Booth 309

www.innocentive.com

InnoCentive is the global leader in crowdsourcing innovation problems to the world's innovators who compete to provide ideas and solutions to important business, social, policy, scientific, and technical challenges. For more than a decade, leading commercial, government, and nonprofit organizations have partnered with InnoCentive to rapidly generate innovative new ideas and solve pressing problems. For more information, visit www.innocentive.com.

MDB Capital ..... Booth 207

www.mdb.com

MDB Capital Group is Wall Street's only intellectual property-focused investment bank, with over 15 years of experience launching disruptive technology companies into the public markets. We maximize value disruptive technology companies by optimizing their positioning to attract growth capital, strengthening their IP portfolios to sustain competitive advantage, and connecting them with our base of like-minded, high-quality investors. Our public venture process combined with our deep expertise have grown several of our small and microcap clients to valuations of over $1 billion.

Power flow control for the Grid

swg

Smart Wire Grid, Inc. ..... Booth 511

www.smartwiregrid.com

It's time to convert your legacy transmission lines into Smart Wires with Smart Wire Grid. Smart Wire Grid's Distributed Series Reactor or DSR is the first in a series of distributed power flow controllers by Smart Wire Grid. The DSR is a proven, innovative, and rapidly deployable device to convert your existing transmission line into an intelligent asset. DSRs are quick to ship, easy to install and are redeployable. They begin to improve your system reliability, economics and situational awareness as soon as they are powered up.

USSynthetic

A DOVER COMPANY

US Synthetic ..... Booth 409

www.ussynthetic.com/diamondtechnology

Diamonds have been used in a variety of industries such as energy exploration, aerospace, car manufacturing, mining and many other custom engineering applications. Due to its extreme hardness, wear resistance and thermal conductivity it is an ideal choice for extreme conditions and applications. US Synthetic is 30-year industry veteran and a leader in the development and production of polycrystalline diamond.

PATRON PARTNERS

Constellation

An Exelon Company

Constellation

www.Constellation.com

Constellation, an Exelon company, is a leading competitive supplier of power, natural gas, renewable energy and energy management products and services for homes and businesses across the continental U.S. We provide integrated energy solutions that help customers strategically buy, manage and use their energy. Our customers, including two-thirds of the Fortune 100, rely on our commitment to innovation, reliability, transparency and service. That is the kind of value you and your communities can expect from Constellation.

ESA Energy Storage Association

Energy Storage Association ..... Booth 706

www.energystorage.org

As the national trade association in the U.S., the Energy Storage Association (ESA) is the leading voice for companies that develop and deploy the multitude of energy storage technologies that we rely on every day. Our member companies research, manufacture, distribute, finance, and build energy storage projects domestically and abroad.

Great Lakes Energy Institute @Case Western Reserve University

energy.case.edu

Great Lakes Energy Institute at CWRU facilitates faculty collaboration to create sustainable energy solutions through translational research and education. Since 2008, GLEI has helped catalyze a four-fold increase in energy research, won awards from federal and state agencies, attracted over $10 million in gifts, worked with over 100 industry partners, and encouraged multidisciplinary proposals from throughout the university. At the heart of the effort are over 90 engaged faculty from engineering, arts and sciences, business, and law. GLEI's work supports all types of energy, with particular focus in energy power management, energy generation, and storage and conversion.

TECHNOLOGY DEVELOPMENT PARTNERS

Alaska Center for Energy and Power.....Booth 709

www.uaf.edu/acep

The Alaska Center for Energy and Power (ACEP) is a statewide, university-led, applied research program based at the University of Alaska Fairbanks. ACEP excels at being responsive to immediate and long term needs of residents, industries and agencies and focuses on research related to community and industry-scale power generation, transmission, heating, and transportation fuels. ACEP prioritizes its work on areas where Alaska has specific needs or where the state has a strategic advantage due to resource availability, unique circumstances, or location.

Argonne National Laboratory.....Booth 608

www.anl.gov

Argonne National Laboratory is a leading center of basic and applied research. With more than 1,400 scientists and engineers, Argonne quickly assembles cross-disciplinary teams from many fields to address major national challenges in energy and the environment. Argonne is managed by UChicago Argonne, LLC for the U.S. Department of Energy.

CO2 Technology Centre.....Booth 308

www.tcmda.com

Technology Centre Mongstad (TCM) is the world's largest and most advanced facility for testing and improving CO_2 capture. TCM is a joint venture set up by the Norwegian state (75.12 %), Statoil (20 %), Shell (2.44 %) and and Sasol (2.44 %). The goal is to increase knowledge on carbon capture technologies in order to reduce technical and financial risk, and accelerate the development of qualified technologies capable of wide scale international deployment. The center is comprised of two CO_2 capture plants each with a capacity to capture 80,000 tons of CO_2 from the nearby refinery or 20,000 tons from the power station.

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Electric Power Research Institute (EPRI) ..... Booth 502

www.epri.com

The Electric Power Research Institute (EPRI) conducts research and development for the global electricity sector. An independent, nonprofit organization, EPRI brings together outside experts and its own scientists and engineers to help address challenges in electricity generation, delivery, and use, including health, safety and the environment. EPRI also provides analyses to formulate long-range research and development planning, and supports research in emerging technologies. Representing more than 90% of the electricity generated and delivered in the US, international participation now extends to over 30 countries.

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

National Institute of Standards and Technology (NIST) ... Booth 304

www.nist.gov

Founded in 1901 and now part of the U.S. Department of Commerce, NIST is one of the nation's oldest physical science laboratories. Congress established the agency to remove a major handicap to U.S. industrial competitiveness at the time—a second-rate measurement infrastructure that lagged behind the capabilities of England, Germany, and other economic rivals. Today, NIST measurements support the smallest of technologies—nanoscale devices so tiny that tens of thousands can fit on the end of a single human hair—to the largest and most complex of human-made creations, from earthquake-resistant skyscrapers to wide-body jetliners to global communication networks.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

National Renewable Energy Laboratory (NREL) ..... Booth 408

www.nrel.gov/esi

NREL is exploring a unique system-of-systems concept to energy systems integration. This approach considers the relationships among electricity, thermal, and fuel systems and data and information networks to ensure optimal integration and interoperability across the entire energy system spectrum. Learn more about this new approach to energy systems integration.

NorTech

NorTech ..... Booth 209

www.nortech.org

NorTech is a technology-based economic development organization working towards the revitalization of Northeast Ohio by accelerating the growth of regional innovation clusters in targeted emerging industries. Serving 21 counties in Northeast Ohio, NorTech works as an intermediary to connect small, large and mid-size companies and universities for business, funding and research opportunities that result in job creation and capital attraction. NorTech is currently focused on three industries: advanced energy, flexible electronics and water technologies.

Oak Ridge National Laboratory (ORNL) .....Booth 508

www.ornl.gov

ORNL is the largest science and energy laboratory within DOE. Focusing on materials, neutron science, energy, high-performance computing, systems biology and national security. ORNL partners with the state of Tennessee, universities and industries to solve challenges in energy, advanced materials, manufacturing, security, and physics. ORNL operates nine user facilities drawing thousands of research scientists and visitors each year.

Building Technologies Research and Integration Center | Center for Nanophase Materials Sciences | Center for Structural Molecular Biology | High Flux Isotope Reactor | High Temperature Materials Laboratory | National Center for Computational Sciences | National Transportation Research Center | Shared Research Equipment Collaborative Research Center | Spallation Neutron Source

Oregon BEST.....Booth 509

www.oregonbest.org

Oregon BEST is an independent, nonprofit state signature research center dedicated to transforming clean-tech research discoveries into commercial products. We work in a unique role, exercising a powerful lever outside of, but connected with existing programs and systems along with our public universities and regional national labs to promote the effective expansion of global solutions, creating local jobs and companies. We make targeted, strategic investments in technologies and teams positioned to have maximum impact on the world's biggest problems. Oregon BEST is harnessing the power of new ideas, cutting-edge research and collaboration to create prosperity for Oregon and the region.

Projects Include: Inspired Light | Applied Exergy | M3 Wave APEX

Pacific Northwest National Laboratory (PNNL)..... Booth 1106

www.pnnl.gov

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,900 staff, has an annual budget of nearly $1.1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

Sandia National Laboratories ..... Booth 603

energy.sandia.gov

Sandia National Laboratories carries out research and development in national security, defense, energy, and homeland security. Sandia's mission is enabled through research staff working at the forefront of innovation, collaborative research with companies and universities, and discretionary research projects with significant impact. Our goal is to become the laboratory the nation turns to for innovative, science-based systems engineering solutions to the most challenging problems. We seek collaborative partnerships on emerging technologies that support our mission. Sandia is a government-owned/contractor operated (GOCO) facility managed by Sandia Corporation, a Lockheed Martin company, for the U.S. Department of Energy's National Nuclear Security Administration.

Projects Include: Sandia Cooler | Supercritical CO_2 Brayton for Compact High Efficiency Power Generation | Binder-free pelletization for porous molecular sieves, clays and metal-organic frameworks (MOFs), for applications in gas or ion selectivity

Texas A&M AgriLife Research ..... Booth 708

agriliferesearch.tamu.edu

Texas A&M AgriLife Research is the state's premier research agency in agriculture, natural resources, and the life sciences. We conduct hundreds of projects spanning many scientific disciplines to deliver life-sustaining and industry-changing impacts to citizens throughout Texas and around the world. A member of The Texas A&M University System, AgriLife Research collaborates with the Texas A&M University College of Agriculture and Life Sciences, the Texas A&M AgriLife Extension Service, and many others to help fulfill the A&M System's land-grant mission of teaching, research, extension, and service.

START-UP PARTNER

Motion Battery

Modern Communication Technology ..... Booth 303

www.surfacetensionengine.com

Modern Communication Technology patented the Surface Tension Engine. The Surface Tension Engine converts motion (wind or vehicular) to electric energy to extend the range of electric vehicles and improve the efficiency of wind conversion to electricity.

SHOWCASE SUPPORTER

BMW Group.....Booth 703

www.bmwgroup.com

The BMW Group is the leading premium manufacturer of automobiles and motorcycles in the world with BMW, MINI, and Rolls-Royce Motor Cars brands. As a global company, the BMW Group operates 28 production and assembly facilities in 13 countries and has a sales network in over 140 countries. The success of the BMW Group has always been built on long-term thinking and responsible action. The company has established ecological and social sustainability throughout the value chain, comprehensive product responsibility, and a clear commitment to conserving resources as an integral part of its strategy.

MAGNETS

American Elements

www.americanelements.com

American Elements is the world's manufacturer of engineered and advanced materials with a catalog of over 12,000 materials including rare earth metals, alloys, compounds and nanoparticles; high purity metals, chemicals, semiconductors and minerals; and crystal-grown materials for commercial and research applications including automotive, aerospace, military, medical, electronic, and green/clean technologies. American Elements maintains research and laboratory facilities in the U.S. and manufacturing/warehousing in the U.S., Europe, China and Brazil. The complete catalog of advanced and engineered materials can be found at americanelements.com.

PLATINUM MEDIA PARTNER

The Atlantic

www.theatlantic.com

A brand with unmatched history, The Atlantic has defined and redefined what it means for a magazine to thrive in the digital space, and its award-winning content continues to shine. Penned by the smartest, most-provocative journalists – and attracting the most important readers – in the country, it consistently defines the national conversation. Sparking intellectual debate, encouraging lively discussion, and bringing this rich editorial dialogue to life, AtlanticLIVE convenes high-powered for thought leader roundtables to full-day issue-driven summits and week-long programs gathering the nation's top decision makers and influentials in conversation and dialogue.

MEDIA PARTNERS

Clean Edge

www.cleanedge.com

Clean Edge, Inc. (www.cleanedge.com), founded in 2000, is a leading research and advisory firm devoted to the clean-tech sector. For more than a decade, the firm has delivered timely data, expert analysis, and comprehensive insights to key industry stakeholders including industry firms, investors, governments, and not for profit groups. With full-time staff in the San Francisco Bay Area and Portland, Oregon, the firm offers unique insight and intelligence on emerging and developing clean-tech trends, opportunities, and challenges through its unparalleled suite of indexing, benchmarking, and advisory services.

DOD Power, Energy & Propulsion

www.tacticaldefensemedia.com

DoD Power, Energy & Propulsion covers the latest developments in the military's quest to improve energy security, including news on renewables, generators, and biofuels. From cutting-edge R&D to joint test programs to COTS technology, we take power seriously. Each issue strives to feature stories on powering three crucial echelons: major bases, large bases in theatre, and small units and individual warfighters.

Greentech Media

www.greentechmedia.com

Greentech Media (GTM) produces industry-leading news, research, and conferences in the business-to-business greentech market. Our coverage areas include solar, grid modernization, energy efficiency, wind, and other non-incumbent energy markets. GTM Research, the research arm of the company, produces competitive intelligence reports and data subscriptions. Using our extensive network and in-depth analysis, GTM hosts conferences for in-person networking and deal-making, with operations in Boston, New York, and San Francisco. For more information, visit: greentechmedia.com, follow us on Twitter: @greentechmedia, or like us on Facebook: facebook.com/greentechmedia.

MIT Technology Review

www.technologyreview.com

MIT Technology Review is leading the global conversation about technologies that matter. An independent media company owned by the Massachusetts Institute of Technology (MIT),the company produces publications read by millions of business leaders, innovators, thought leaders, and early adopters around the globe in six languages and on a variety of digital and print platforms. We publish MIT Technology Review magazine, the world's oldest technology magazine (established 1899); daily news, analysis, opinion, and video; and Business Reports, which explains how new technologies are transforming companies, disrupting markets, or creating entirely new industries.

Tactical Defense Media.....Booth 805

www.tacticaldefensemedia.com

Tactical Defense Media's focus is centered on collecting expert opinion regarding best practices and lessons learned through the eyes of military and civilian subject-matter experts, warfighters, and law enforcement. Our goal is to produce the most interesting, relevant, and accurate trade publications for defense and homeland security professionals.

SUPPORTING PARTNERS

ACORE

www.acore.org

ACORE, a 501©(3) non-profit membership organization, is dedicated to building a secure and prosperous America with clean, renewable energy. ACORE seeks to advance renewable energy through finance, policy, technology, and market development and is concentrating its member focus in 2013 on National Defense & Security, Power Generation & Infrastructure, and Transportation. Additional information is available at www.acore.org.

Advanced Energy Economy (AEE)

www.aee.net

Advanced Energy Economy (AEE) is an association of business leaders who are making the global energy system more secure, clean, and affordable. Advanced energy encompasses a broad range of products and services that constitute the best available commercial technologies for meeting energy needs today and tomorrow. AEE's mission is to influence public policy, foster advanced energy innovation and business growth, and provide a unified voice for a strong U.S. advanced energy industry. Our members include companies involved in technology development, component and product manufacturing, project and infrastructure development, equipment installation, and engineering, finance and advisory services.

BIO .....Booth 807

www.bio.org

BIO represents more than 1,100 biotechnology companies, academic institutions, state biotechnology centers and related organizations across the United States and in more than 30 other nations. BIO members are involved in the research and development of innovative healthcare, agricultural, industrial and environmental biotechnology products. BIO also produces the BIO International Convention, the world's largest gathering of the biotechnology industry, along with industry-leading investor and partnering meetings held around the world. BIO produces BIOtechNOW, an online portal and monthly newsletter chronicling "innovations transforming our world."

Collegiate Energy Association (CEA)

www.collegeenergy.org

The Collegiate Energy Association (CEA) is a global community of approximately 100 university-based energy clubs, each of which provides a forum for students to learn about energy. With undergraduate, graduate, and professional student organizations across Asia, North America, and Europe, the CEA empowers energy club leaders to connect, collaborate, and learn from one another.

Energy Storage Association .....Booth 706

www.energystorage.org

As the national trade association in the U.S., the Energy Storage Association (ESA) is the leading voice for companies that develop and deploy the multitude of energy storage technologies that we rely on every day. Our member companies research, manufacture, distribute, finance, and build energy storage projects domestically and abroad.

Environmental Entrepreneurs (E2)

www.e2.org

Environmental Entrepreneurs (E2) is a national community of business leaders who promote sound environmental policy that builds economic prosperity. E2 is the independent business voice for the environment. We provide a non-partisan resource for understanding the business perspective on environmental issues. Working with our public and private partners, E2 shapes state and national policy for the economy and for the environment.

Fuel Cell and Hydrogen Energy Association (FCHEA)

www.fchea.org

The Fuel Cell and Hydrogen Energy Association (FCHEA) is the trade association for the fuel cell and hydrogen energy industry, and is dedicated to the commercialization of fuel cells and hydrogen energy technologies. Fuel cells and hydrogen energy technologies deliver clean, reliable power to leading edge corporate, academic and public sector users, and FCHEA members are helping to transform the our energy future. FCHEA represents the full global supply chain, including universities, government laboratories and agencies, trade associations, fuel cell materials, components and systems manufacturers, hydrogen producers and fuel distributors, utilities and other end users.

Government-University-Industry Research Roundtable (GUIRR)

www.nas.edu/guirr

The Government-University-Industry Research Roundtable (GUIRR) is a joint body of the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine that brings together the senior-most representatives from government, universities, and industry to define and explore critical cross-cutting issues related to the national and global science and technology agenda. This forum is designed to facilitate candid dialogue among participants, to foster self-implementing activities, and, where appropriate, to carry awareness of consequences to the wider public.

GovEvents.com

www.govevents.com

GovEvents is the fastest and easiest way to find government and military events happening all over the world. Find events by date, location, keyword, focus and more! You'll find government and military-related conferences, trade shows, expos, training sessions, and webcasts—all in one place! Join today. Subscribe: www.govevents.com/register.php

Information Technology and Innovation Foundation (ITIF)

www.itif.org

The Information Technology and Innovation Foundation (ITIF) is a Washington, D.C.-based non-partisan think tank whose mission is to formulate and promote public policies to advance technological innovation and productivity internationally, in Washington, and in the states.

National Venture Capital Association (NVCA)

www.nvca.org

As the voice of the U.S. venture capital community, the National Venture Capital Association (NVCA) empowers its members and the entrepreneurs they fund by advocating for policies that encourage innovation and reward long-term investment. As the venture community's preeminent trade association, NVCA serves as the definitive resource for venture capital data and unites nearly 400 members through a full range of professional services. Investors and Technology Showcase exhibitors are invited to network and discuss potential commercialization opportunities and special networking breakfast on Tuesday from 7:30 - 8:30 a.m. hosted by the National Venture Capital Association in the Technology Showcase.

NESEA

www.nesea.org

The Northeast Sustainable Energy Association connects sustainability professionals to ideas, and to each other.

New England Clean Energy Council

www.cleanenergycouncil.org

The New England Clean Energy Council's mission is to accelerate New England's clean energy economy to global leadership by building an active community of stakeholders and a world-class cluster of clean energy companies. The Council represents nearly 400 member and affiliate member organizations, including clean energy companies, venture investors, major financial institutions, universities, industry associations, utilities, labor and large commercial end-users. The Council's ranks now include clean energy CEOs, representatives from many of the region's top 10 law firms, and partners from most of the top New England venture capital firms (with a total of over $8 billion under management).

University-Industry Demonstration Partnership (UIDP)

www.uidp.org

The University-Industry Demonstration Partnership (UIDP) is an organization of universities and companies that seek to build a stronger relationship between these parties. UIDP provides a unique forum for university and industry representatives to meet and discuss operational and strategic issues such as contracting, intellectual property, and compliance matters. These conversations might otherwise never take place, and they serve to help university representatives better understand the culture and constraints of their industry counterparts, and vice versa. This initiative is supported by the National Academies' Government-University-Industry Research Roundtable (GUIRR).

GOVERNMENT AGENCY PARTNERS

Visit the following U.S. Government Agencies staffing an exhibit in the Technology Showcase.

★ U.S. Department of Defense Agencies ★

Air Force .....Booth 731

www.safie.hq.af.mil/energy

The Office of the Deputy Assistant Secretary for Energy (SAF/IEN) develops energy policy for the Air Force; providing direction, advocacy, oversight, and coordination of all energy programs in concert with federal laws, goals, and mandates related to energy and the environment. SAF/IEN is also responsible for Energy Governance which provides energy policy and guides investment for the entire Air Force enterprise, including facilities, operations, and acquisition. SAF/IEN coordinates and collaborates across HAF/SAF offices on energy-related issues, while overseeing Air Force actions to achieve federal, Department of Defense (DoD), and Air Force energy goals and mandates.

Army.....Booth 733

Dr. Ed Shaffer
edward.c.shaffer.civ@mail.mil

www.army.mil

The Army's ability to accomplish our mission on a global scale depends on secure, uninterrupted access to power and energy. The Army is aggressively pursuing power and energy advancements in an effort to enhance mission effectiveness and maintain operational readiness at all times. Energy efforts are focused on Soldier Power, the energy and associated systems required for a dismounted Soldier; Basing Power, the fuel, water, and energy needed at our installations and base camps; and Vehicle Power, the energy associated with our air-ground-tactical and non-tactical vehicles.

Marine Corps .....Booth 727

www.usmc.mil

One of the most significant challenges facing the Marine Corps is reducing the need for fuel, water, and battery resupply on the battlefield. Energy efficient wearable power management and light-weight portable power solutions have the potential to simplify power distribution and reduce the quantity of batteries dismounted Marines carry by integrating all power and communication into a single system. In addition, enabling Marines to produce clean drinking water without resupply in austere environments increases combat effectiveness.

Navy Energy and Environmental Readiness Program.....Booth 830

greenfleet.dodlive.mil/energy/task-force-energy

The Navy is deeply committed to reducing energy use, integrating alternative fuels into our systems, and adopting energy efficiency as a means of increasing combat capability. We work with industry, academia, and federal agencies to incorporate advanced, drop-in replacements for petroleum and expand renewable energy use recognizing energy as a strategic resource, critical to our mission. Through an aggressive strategy, the Navy ensures energy independence for the long haul-which protects sailors and Marines, making us more effective in defending our nation and allies, and enable sustainable use of the world's precious resources for future generations.

Office of Naval Research.....Booth 832

Dr. Richard T. Carlin
rich.carlin1@navy.mil

www.onr.navy.mil/en.aspx

The Office of Naval Research (ONR) invests in energy research covering the full spectrum of Navy and Marine Corps power systems for ships, aircraft, expeditionary platforms, unmanned vehicles, and facilities. ONR S&T is concurrently investing in three key areas of the alternative energy community: education and training; technology development and evaluation; and successful product development, especially in small businesses. These three areas are interlinked within two ONR programs: the Energy Excelerator (EEx) helping seed-and growth-stage startup companies address energy challenges in Hawaii and across the Asia-Pacific region; and the Energy Systems Evaluation Program (ESTEP) evaluating nascent commercial technologies at naval facilities using naval personnel and veteran interns to carry-out all projects, thus providing them with real-world training for workforce growth and career development. Both EEx and ESTEP are competitively run programs that offer valuable opportunities for ARPA-E supported companies to mature technologies toward commercial products; develop successful business approaches, especially for Asia-Pacific markets; and put products into the hands of the current and future naval energy workforce.

Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs

www.energy.defense.gov

Office of the Assistant Secretary of Defense for Operational Energy Plans and Program (OASD/OEPP) The Department of Defense is the single largest consumer of energy in the U.S., and seventy-five percent of this energy is "operational energy" used to power vehicles, ships, aircraft, and tactical power generation systems. The Department's Operational Energy Strategy and supporting Implementation Plan identify how to achieve energy security for the warfighter by assuring that U.S. forces have a reliable supply of energy for 21st century military missions. First, the Department will reduce demand for energy in military operations by increasing the efficiency of energy use. Second, the Department will expand and secure energy supplies for military operations by diversifying its energy sources. Finally, the Department will build energy security into the future force by integrating operational energy considerations into the full range of planning and force development activities.

Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP).....Booth 828

www.serdp-estcp.org

SERDP and ESTCP are the Department of Defense's (DoD) environmental research and installation energy test bed programs. The programs harness the latest science and technology to develop and demonstrate innovative, cost-effective, and sustainable solutions. SERDP and ESTCP's Energy and Water program area supports the demonstration of innovative technologies to reduce DoD's installation energy consumption and carbon footprint, improve energy security, and facilitate water conservation. The 90+ energy and water projects funded by ESTCP address technologies such as building energy efficiency, energy management systems, smart microgrids, and distributed energy generation.

United States Special Operations Command.....Booth 729

www.socom.mil

The Department of Defense (DoD) activated U.S. Special Operations Command (USSOCOM) April 16, 1987, at MacDill Air Force Base, Fla. DoD created the new unified command in response to congressional action in the Goldwater-Nichols Defense Reorganization Act of 1986 and the Nunn-Cohen Amendment to the National Defense Authorization Act of 1987. Congress mandated a new four-star command be activated to prepare Special Operations Forces (SOF) to carry out assigned missions and, if directed by the president or secretary of defense (SECDEF), to plan for and conduct special operations.

★ U.S. Department of Energy Agencies ★

ARPA-E.....Booth 629

www.arpa-e.energy.gov

The U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) has hosted the Energy Innovation Summit since 2010. The Summit brings together the nation's most innovative minds to collaborate on potential breakthroughs in energy technologies. ARPA-E invests in transformational energy technology projects that could create entirely new ways to generate, store, and use energy. The Agency's unique approach combines world-class Program Directors with multi-disciplinary teams to identify promising solutions to the nation's most critical energy problems. Byleveraging the best practices of academia, business, and government, ARPA-E can fast-track new innovative technologies toward the marketplace.

Loan Programs Office.....Booth 932

lpo.energy.gov

The mission of LPO is to accelerate the domestic commercial deployment of innovative and advanced clean energy technologies at a scale sufficient to contribute meaningfully to the achievement of our national clean energy objectives—including job creation; reducing dependency on foreign oil; improving our environmental legacy; and enhancing American competitiveness in the global economy of the 21st century.

Office of Electricity Delivery & Energy Reliability .....Booth 829

oe.energy.gov

DOE's Office of Electricity Delivery & Energy Reliability (OE) drives electric grid modernization and resiliency in the energy infrastructure. OE recognizes that our Nation's sustained economic prosperity, quality of life, and global competitiveness depend on access to an abundance of secure, reliable, and affordable energy resources. Through a mix of technology and policy solutions, OE addresses the changing dynamics and uncertainties in which the electric system operates. OE leverages effective partnerships, solid research, and best practices to address diverse interests in achieving economic, societal, and environmental objectives.

Office of Energy Efficiency and Renewable Energy.....Booth 928

www.eere.energy.gov

The Office of Energy Efficiency and Renewable Energy (EERE) accelerates development and facilitates deployment of energy efficiency and renewable energy technologies and market-based solutions that strengthen U.S. energy security, environmental quality, and economic vitality. EERE drives energy innovation through strong private and public sector relationships with researchers, industries, businesses, universities, and laboratories. We envision a prosperous future where energy use and generation are efficient, secure, clean, and affordable.

Office of Fossil Energy.....Booth 825

www.fossil.energy.gov

Ensuring that we can continue to rely on clean, affordable energy from our traditional fuel resources is the primary mission of DOE's Office of Fossil Energy. The Office of Fossil Energy is responsible for several high-priority initiatives including implementation of the Clean Coal Power Initiative to develop a new generation of environmentally sound clean coal technologies, the Fossil Energy elements of the American Recovery and Reinvestment Act of 2009, and the Nation's Strategic Petroleum Reserve and Northeast Home Heating Oil Reserve, both key emergency response tools available to the President to protect Americans from energy supply disruptions.

Office of Nuclear Energy .....Booth 827

www.ne.doe.gov

The Office of Nuclear Energy (NE) promotes nuclear power as a resource capable of meeting the Nation's energy, environmental and national security needs by resolving technical and regulatory barriers through research, development and demonstration.

Office of Science ..... Booth 924

science.energy.gov

The Department of Energy's (DOE's) Office of Science is an indispensable pillar of America's leadership in science and technology. We are the nation's largest supporter of basic research in the physical sciences, the steward of ten national laboratories, and the lead federal agency supporting fundamental research for energy. Our researchers have won 115 Nobel Prizes and over 800 R&D 100 Awards over the past six decades. We support over 29,000 researchers – scientists, engineers and students – at national laboratories and in more than 300 universities and institutions of higher learning in all 50 States and the District of Columbia.

U.S. Energy Information Administration ..... Booth 831

www.eia.gov

The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA conducts a comprehensive data collection program that covers the full spectrum of energy sources, end uses, and energy flows. EIA also prepares informative energy analyses, monthly short-term forecasts of energy market trends, and long-term U.S. and international energy outlooks.

★ Other U.S. Federal Agencies ★

Department of Agriculture..... Booth 833

www.usda.gov/wps/portal/usda/usdahome?navid=ENERGY

The U.S. Department of Agriculture (USDA) works in every way to encourage and support the development, production, and delivery of clean, renewable, domestically produced energy. Our efforts cover the entire renewable energy supply chain: research and development activities; financial assistance to agriculture and forest producers for raising and harvesting energy crops; financing biorefineries that produce renewable sources of fuel and power; and providing technical and financial assistance to agricultural producers and rural small business to assist them in becoming more energy efficient. We are working to lead the way for a clean energy future for our country.

Department of Transportation

www.volpe.dot.gov

Part of the U.S. Department of Transportation's Research and Innovative Technology Administration, Volpe, The National Transportation Systems Center, is a critical resource for innovation in transportation. Our mission is to improve the nation's transportation system by anticipating emerging transportation issues and to serve as a center of excellence for informed decision making.

National Aeronautics and Space Administration .....Booth 727

www.nasa.gov

Energy and sustainability are key elements of NASA's efforts to pioneer and prove new flight technologies that improve our ability to explore with practical applications on Earth, focus on International Space Station (ISS) operations and human exploration beyond low Earth orbit, and explore the Earth, solar system and universe beyond, chart the best route of discovery, and reap the benefits of Earth and space exploration for society.

National Institute of Standards and Technology (NIST) ...Booth 304

www.nist.gov

Founded in 1901 and now part of the U.S. Department of Commerce, NIST is one of the nation's oldest physical science laboratories. Congress established the agency to remove a major handicap to U.S. industrial competitiveness at the time—a second-rate measurement infrastructure that lagged behind the capabilities of England, Germany, and other economic rivals. Today, NIST measurements support the smallest of technologies—nanoscale devices so tiny that tens of thousands can fit on the end of a single human hair—to the largest and most complex of human-made creations, from earthquake-resistant skyscrapers to wide-body jetliners to global communication networks.

National Science Foundation .....Booth 826

Cecile Gonzalez
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www.nsf.gov

Since its creation over 60 years ago, the National Science Foundation (NSF) has profoundly impacted U.S. innovation by funding transformative, fundamental research in academia and ground-breaking, translational research in high-tech small businesses. NSF investments have led to advances ranging from nanotechnologies and chemical processes to sensor technologies and complex systems theory. NSF's commitment to support a wide range of fields and disciplines -- including those advancing sustainable, reliable energy -- helps secure long-term U.S. competitiveness and economic growth. Similarly, NSF's strong support for science, technology, engineering, and mathematics (STEM) education provides the nation with a globally competitive workforce.

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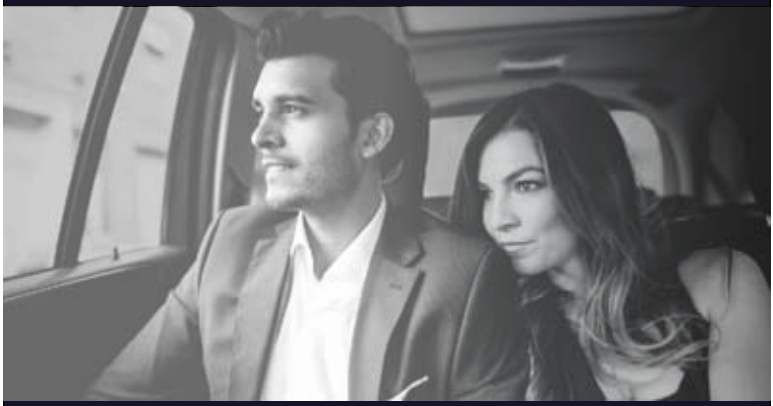

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SHOWCASE PARTICIPANTS

ABB Inc. — ARPA-E AWARDEE — Booth 615

Le Tang
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Superconducting Magnet Energy Storage System with Direct Power Electronics Interface

ABB, Inc. is developing an advanced superconducting magnet energy storage system (SMES) will be developed that stores significantly more energy than current SMES at a fraction of the cost. The SMES will use an advanced second generation high temperature superconducting wire. A 2.5 MJ SMES with a modular, scalable power electronics converter will be demonstrated.

Abengoa Solar — ARPA-E AWARDEE — Booth 1218

Drake Tilley
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www.abengoasolar.com

Conversion Tower for Dispatchable Solar Power

Abengoa Solar is developing a high-efficiency solar-electric conversion tower to enable low-cost, fully dispatchable solar energy generation. Abengoa's conversion tower utilizes new system architecture and a two-phase thermal energy storage media with an efficient supercritical carbon dioxide (CO_2) power cycle. The company is using a high-temperature heat-transfer fluid with a phase change in between its hot and cold operating temperature. The fluid serves as a heat storage material and is cheaper and more efficient than conventional heat-storage materials, like molten salt. It also allows the use of a high heat flux solar receiver and advanced high thermal energy density storage.

ADI Solar Corporation — Booth 1140

Wayne Bliesner
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alternativedesignsinc.com

Environmentally integrated low cost 100% thermo-chemical pathways for extraction of titanium metal operating as continuous process

ADI Solar has been working on a new process for lowering the manufacturing cost of titanium production using thermo-chemical hydride processing technology. ADI has developed a unique liquid salt slurry system to separate the titanium hydride in a continous process further lowering the cost for production. Integration with solar energy for the thermal load requirements will show how the complete process is environmentally friendly.

ADMA Products, Inc. — ARPA-E AWARDEE — Booth 532

Vladimir Duz
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Membrane Dehumidifier

ADMA Products is developing a foil-like membrane for air conditioners that efficiently removes moisture from humid air. The metal foil-like membrane consists of a paper-thin, porous metal sheet coated with a layer of water-loving molecules. This new membrane allows water vapor to permeate across the membrane at high fluxes, at the same time blocking air penetration and resulting in high selectivity. The high selectivity translates to less energy use, while the high permeation fluxes result in a more compact device. The new materials and the flat foil-like nature of the membrane facilitate mass production of a low-cost compact dehumidification device.

AEROJET ROCKETDYNE

Aerojet-Rocketdyne ..... ARPA-E AWARDEE **Booth 514**

Kenneth M. Sprouse; PE, Esq.
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www.rocket.com/heritage-rocketdyne

Turbo-POx & Regen SCOTT for Ultra Low Cost Gasoline and High Efficiency Electrical Power

Aerojet-Rocketdyne (AR) is developing regeneratively cooled turbines that cool and recover the heat loss from the expander's blades as high pressure saturated steam or high temperature supercritical carbon dioxide. Such turbines are capable of significantly increasing overall process thermal efficiencies over those using film cooled turbines since the recycled coolant is recycled as a reactant into the upstream combustor/gasifier. For the natural gas to gasoline Turbo-POx process, regen cooled turbines allow for the production of gasoline at the refinery gate of $1.30/gal. For electric power generation, the SCOT process allows electricity to be produced at 8 cents/kWh with CO_2 sequestration.

AEROJET ROCKETDYNE

Aerojet Rocketdyne ..... ARPA-E AWARDEE **Booth 516**

Scott Claflin
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www.rocket.com

Continuous Detonation Combustor for Natural Gas Turbine

Continuous detonation (or rotating detonation) is a form of pressure gain combustion that is thermodynamically more efficient than the constant-pressure Brayton cycle used in gas turbines. This project has two overall objectives: (1) for the first time, to demonstrate rotating detonation under the pressure and temperature conditions typically experienced by combustors in power generation gas turbines, and (2) to measure the resultant emissions. Test hardware has been designed and fabricated, and build up of the test facility has initiated. Testing is scheduled for April and May of 2014.

Agrivida

Agrivida, Inc. ..... ARPA-E AWARDEE **Booth 923**

David Agneta
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www.agrivida.com

Conditionally activated enzymes expressed in cellulosic energy crops

Agrivida is commercializing novel technologies that dramatically improve the performance of animal feed, industrial enzymes, and bio-based fuels and chemicals processes, by precision engineering of regulated enzymes. The company's patented technologies enable integrated solutions for applications in agriculture and industry where enzyme control is critical. Current programs include highly digestible animal feed, regulated detergent enzymes, and self-processing cellulosic feedstocks.

Alcoa Inc ..... ARPA-E AWARDEE **Booth 1041**

Douglas Ramsey
Doug.Ramsey@alcoa.com
www.Alcoa.com

Energy Efficient, High Productivity Aluminum Electrolytic Cell with Integrated Power Modulation and Heat Recovery

Alcoa is designing a new, electrolytic cell that could significantly improve the efficiency and price point of aluminum production. Conventional cells tend to reject a great deal of waste heat, are difficult to adjust to electricity price changes, and emit significant levels of CO_2. Alcoa is addressing these problems by improving electrode design and integrating a heat exchanger into the wall of the cell. Typically, the positive and negative electrodes—or anode and cathode, respectively—within a smelting cell are horizontal. Alcoa will angle their cathode, increasing the surface area of the cell and shortening the distance between anode and cathode.

Allylix, Inc. ..... ARPA-E AWARDEE **Booth 1225**

Seth Goldblum
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www.Allylix.com

Platform for Production of Sesquiterpene Aviation Fuels and Fuel Additives from Renewable Feedstocks

Allylix aims to synthesize, field test, and advance, integrate and optimize production processes and scale-up of renewable cyclic sesquiterpenes as disruptive, high performance aviation fuels and fuel additives. Cyclic sesquiterpenes are well suited for use as high performance fuels because their multi-cyclic structure provides a high degree of ring strain, resulting in high heats of combustion. In addition, they have a high density compared with plant oil-based fuels and linear petroleum-based hydrocarbons, resulting in high volumetric net heats of combustion (NHOC).

Alveo Energy ..... ARPA-E AWARDEE **Booth 720**

Colin Wessells
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www.alveoenergy.com

Prussian Blue Batteries

Alveo is developing a grid-scale storage battery using Prussian Blue dye as the active material within the battery. Prussian Blue is most commonly known for its application in blueprint documents, but it can also hold electric charge. Though it provides only modest energy density, Prussian Blue is so readily available and inexpensive that it could provide a cost-effective and sustainable storage solution for years to come. Alveo repurposes this inexpensive dye for a new battery that is far cheaper and less sensitive to temperature, air, and other external factors than comparable systems. This facilitates the adoption and deployment of renewable energy technology. Alveo's Prussian Blue dye-based grid-scale storage batteries are safe and reliable, have long operational lifetime, and are cheaper to produce than any existing battery technology.

Ames Laboratory ..... ARPA-E AWARDEE Booth 1130

R. William McCallum
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www.ameslab.gov

Novel high energy permanent magnet without critical elements

This project will develop Cerium transition-metal (Ce–TM) based permanent magnets. The abundance of Ce is three times that of Nd and Pr combined. The RE 4f electrons play a key role in RE permanent magnets. Unfortunately, in many compounds with Fe and Co, Ce atoms lose their 4f electrons, significantly decreasing the Curie temperature and the saturation magnetization. This project will avoid such effects by controlling the intrinsic ferromagnetic properties through intelligent materials design. The project is a combined theoretical and experimental effort to study the potential of Ce intermetallic compounds for use in permanent magnets.

Antropy Inc/Demaray LLC & Univ. of California Santa Cruz..... ARPA-E AWARDEE Booth 948

Dr. Demest Demaray
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Efficient Collection and Transport of Concentrated Solar Energy, Sun2Fiber Coupler

UC Santa Cruz is developing a "Sun 2 Fiber Coupler"(S2FC) in collaboration with Antropy Inc. The S2FC couples concentrated sunlight at the focus of a tracking mirror efficiently into a high power optical fiber for PV conversion or transport to thermal storage as light without emissive losses of conventional thermal absorption and transport. The UCSC/Antropy approach leverages unique optical quality and high index thin-films, processes and structures licensed from Demaray LLC. The S2FC is designed to achieve more than ~ 90% efficiency and enable an LCOE less than $.06/kW-hr and enable wavelength specific applications of concentrated sunlight.

Applied Materials, Inc ..... ARPA-E AWARDEE Booth 711

James Gee
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www.appliedmaterials.com

Kerfless Crystalline-Silicon PV: Gas to Modules

At present, silicon wafers represent the single largest cost associated with the manufacture of crystalline silicon (c-Si) solar photovoltaic modules. The current wafer supply chain consists of production of polysilicon, solidification into ingots and wafering. The costs associated with these processes are expensive, especially due to the loss of silicon material from wafering, called "kerf-loss". This project aims to improve the utilization of silicon material by manufacturing solar modules through a "kerf-less" wafer approach. This approach will employ a fully-integrated value chain, from "gas to module", to produce high-efficiency, low-cost solar modules from thin epitaxial crystalline silicon films.

Architectural Applications.....Booth 841

John Breshears
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www.architecturalapplications.com

AirFlow Panels: an integrated solution to low-energy, high performance buildings

AirFlow PanelsTM integrate heat and humidity removal into a building enclosure product. A membrane exchanger embedded into a wall panel produces ultra-efficient moisture exchange (90%) at 1/3 of the pressure penalty of conventional systems while simultaneously improving the insulation value of the building envelope, the indoor air quality, and leasable floor area. While envelope and heat/humidity control systems are typically considered separately, AirFlow PanelsTM integrates these functions into a hybrid product to create new and retrofit buildings with low energy and high performance. Architectural Applications proved the concept with LBNL and is currently demonstrating the product in multiple locations.

Argonne National Laboratory..... ARPA-E AWARDEE Booth 1018

Richard Brotzman
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www.anl.gov

Nanocomposite Exchange-Spring Magnets for Motor and Generator Applications

Argonne's approach is to combine the attributes of "hard magnets" (high Hc) with "soft magnets" (high Msat) to create novel exchange-spring (ES) magnets. The magnetic phases in E-S magnets interact through an "exchange-coupling" mechanism and are projected to have an energy product higher than today's state-of-the-art Nd-Fe-B magnets. In addition, the E-S magnet will retain magnetization at temperatures well above those of current state-of-the-art Nd-Fe-B magnets.

Argonne E-S magnets have these attributes:

- No supply-critical RE content
- Large maximum energy product – enables lightweighting
- Significantly higher operating temperatures

Arizona State University..... ARPA-E AWARDEE Poster 18

www.asu.edu

An ACTIVE Program to Revolutionalize EV Adoption - Advanced Cells for Transportation via Integrated Vehicle Energy (ACTIVE)

Arizona State University is developing Advanced Cells for Transportation via Integrated Vehicle Energy (ACTIVE) which constitutes a transformational approach to motive energy storage in electrified vehicles, enabling a paradigm shift in cost, safety, weight and manufacturability.

ASU Arizona State University

Arizona State University..... ARPA-E AWARDEE **Poster 21**

Robert Nemanich
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www.asu.edu

Diamond Power Transistors Enabled by Phosphorus Doped Diamond

Arizona State University (ASU) will develop a method to produce low-cost, vertical diamond semiconductor devices for use in high-power electronics. Diamond is an excellent conductor of electricity when boron or phosphorus are added, or doped, into its crystal structures. In fact, diamond can withstand much higher temperatures with higher performance levels than silicon, which is widely used in today's semiconductors. However, growing uniformly doped diamond crystals is expensive, and it is difficult to grow them in multiple layers while maintaining the structure necessary for semiconductor devices. ASU's innovative diamond-growing process could create greater doping uniformity, enable improved electrical contacts, and help lower the cost of diamond semiconductors.

ASU Arizona State University

Arizona State University..... ARPA-E AWARDEE **Booth 517**

Dan Buttry
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chemistry.asu.edu/faculty/D_Buttry.asp

Electrochemical Carbon Capture

ASU is developing an innovative electrochemical technology for capturing the CO_2 released by coal-fired power plants. ASU's technology aims to cut both the energy requirements and cost of CO_2 capture technology in half compared to today's best methods. Presently, the only proven commercially viable technology for capturing CO_2 from coal plants uses a significant amount of energy, consuming roughly 40% of total power plant output. If installed today, this technology would increase the cost of electricity production by 85%. ASU is advancing a fundamentally new paradigm for CO_2 capture using novel electrochemical reactants to separate and capture CO_2. This process could be easily scaled and integrated in conventional fossil fuel power generation facilities.

Arkansas Power Electronics International, Inc./Toyota..... ARPA-E AWARDEE **Booth 318, 215**

Ty McNutt
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Low-Cost, Highly-Integrated Silicon Carbide (SiC) Multichip Power Modules (MCPMs) for Plug-In Hybrid Electric Vehicles (PHEVs)

A prototype PHEV plug-in charger utilizing SiC integrated gate drivers and 1200V MOSFETs was developed. The project culminated in testing a >5kW SiC PHEV battery charger on a modified Toyota vehicle, demonstrating a >10× size and weight reduction over state-of-the-art systems with >95% efficiency, >5kW/kg, >100W/in3.

Arzeda ..... ARPA-E AWARDEE Booth 1121

Eric Althoff
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www.arzeda.com

Design of Metalloenzymes for Methane Activation

Arzeda will leverage its proprietary computational enzyme design algorithms to engineer proteins for the creation of new synthetic enzymes to activate methane, which is the first step in producing a liquid fuel from natural gas. These completely new enzymes transform the way methane is activated and will be more efficient than current chemical and biological approaches. Furthermore, the activated methane intermediate is directly coupled to central metabolism in a fermentation host. If successful, Arzeda's technology could efficiently activate methane for cost-effective fuel production, and could also be applied in a variety of other fermentation and bioprocesses for fuels and chemicals.

Astronautics Corporation ..... ARPA-E AWARDEE Booth 938

Steven Jacobs
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www.astronautics.com

An Efficient, Green Compact Cooling System Using Magnetic Refrigeration

Astronautics has designed and constructed a magnetic refrigeration system for air conditioning applications which will provide 3.5 kW of cooling power with COP = 4. Magnetic refrigeration technology offers a number of advantages over vapor compression. In particular, it uses no greenhouse or ozone-depleting gases. Instead, it uses a solid-state refrigerant with water as a heat transfer fluid. Because of the absence of gases, leaks are much less likely to occur, and much easier to detect and repair if they should occur. These advantages will be highlighted in the Astronautics prototype.

ATK ..... Booth 1046

George Papadopoulos
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www.atk.com

A High Efficiency Inertial CO_2 Extraction System -- ICES

The Inertial Carbon-dioxide Extraction System (ICES) de-sublimates CO_2 from the flue gas of pulverized coal power plants via rapid expansion through a converging-diverging nozzle, then inertially separates the CO_2 ice, which subsequently vaporizes to pipeline pressures for transport and storage.

Aurora Solar ..... Booth 1138

Christopher Hopper
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www.aurorsolar.com

Aurora - An Integrated Solar PV Design and Optimization Platform

Aurora is a cloud-based platform that enables sophisticated solar PV engineering design, supports operations and facilitates customer acquisition for solar installers, financiers and utilities of any scale.

AutoGrid ..... ARPA-E AWARDEE Booth 814

Sandra Kwak
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www.auto-grid.com

Highly Dispatchable and Distributed Demand Response for the Integration of Distributed Generation

AutoGrid has developed a highly scalable, cloud-based platform that brings the power of Big Data, predictive analytics and automated demand response to the grid. Serving utilities, grid operators, electricity retailers, ESCOs, and end-users, AutoGrid's tools analyze data generated by smart meters, voltage regulators, building management systems and other equipment along with historical and prospective usage patterns so suppliers and consumers can precisely monitor or change power consumption in real time safely, quickly and securely.

Avogy Inc. ..... ARPA-E AWARDEE Poster 73

Isik C. Kizilyalli
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www.avogy.com

Vertical GaN transistors on bulk GaN substrates

In this project GaN vertical power transistors epitaxially grown on bulk GaN substrates with blocking voltages exceeding 1200V and a drain current of 100A are developed. Specific RDSON of 2mΩ-cm2 is targeted. These devices will feature vertical current flow, high reliability through avalanche ruggedness, and a wide range for temperature of operation. The improved performance metrics for GaN devices is a consequence of the wide band-gap (EG=3.4eV) between the valence and the conduction bands in GaN. The target specific on-resistance for the transistor is much lower than best-in-class Si MOSFETs and its switching frequency 10x faster than state-of-the art IGBT.

Baldor Electric Company..... ARPA-E AWARDEE Booth 613

www.baldor.com

Rare-Earth-Free Traction Motor

Baldor is developing a new type of traction motor with the potential to efficiently power future generations of EVs. Unlike today's large, bulky EV motors which use expensive, imported rare-earth-based magnets, Baldor's motor is light, compact, contains no rare earth materials, and has the potential to deliver more torque at a substantially lower cost. Key innovations in this project include the use of a unique motor design, incorporation of an improved cooling system, and the development of advanced materials manufacturing techniques. These innovations could significantly reduce the cost of an electric motor.

BASF Corporation..... ARPA-E AWARDEE Booth 405

Dr. Kwo Young
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www.basf.com

High Preformance NiMH Alloy For Next Generation Batteries

BASF's object for this program is to increase the range and reduce the cost of the NiMH battery in the EV application by substituting the current rare-earth metal containing anode material with low-cost alloys with ultra-high storage capacity. To demonstrate the performance 100 Ah prismatic cell will be built specially designed to fully utilize potential of the newly developed alloy.

Battelle
The Business of Innovation

Battelle Memorial Institute..... ARPA-E AWARDEE Booth 518

www.battelle.org

Optical Fault Sensors for Lithium-Ion Batteries

Battelle is developing an optical sensor to monitor the internal environment of lithium-ion (Li-ion) batteries in real-time. Over time, crystalline structures known as dendrites can form within batteries and cause a short circuiting of the battery's electrodes. Because faults can originate in even the tiniest places within a battery, they are hard to detect with traditional sensors. Battelle is exploring a new, transformational method for continuous monitoring of operating Li-ion batteries. Their optical sensors detect internal faults well before they can lead to battery failures or safety problems. The Battelle team will modify a conventional battery component to scan the cell's interior, watching for internal faults to develop and alerting the battery management system to take corrective action before a hazardous condition occurs.

Beacon POWER.

Beacon Power LLC..... ARPA-E AWARDEE Booth 818

Richard Hockney
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www.beaconpower.com

Next-Generation Flywheel Energy Storage

Beacon Power is developing a flywheel energy storage system that costs substantially less than existing flywheel technologies. Flywheels store the energy created by turning an internal rotor at high speeds-slowing the rotor releases the energy back to the grid when needed. Beacon Power is redesigning the heart of the flywheel, eliminating the cumbersome hub and shaft typically found at its center. The improved design resembles a flying ring that relies on new magnetic bearings to levitate, freeing it to rotate faster and deliver 400% as much energy as today's flywheels. Beacon Power's flywheels can be linked together to provide storage capacity for balancing the approximately 10% of U.S. electricity that comes from renewable sources each year.

Bettergy Corp. ..... ARPA-E AWARDEE Booth 918

Lin-Feng Li
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www.bettergy.com

Low Cost Solid State Battery for EV Applications

Widespread adoption of electric vehicles (EVs) can substantially reduce the oil import and greenhouse gas emissions. However, due to the high battery cost ($800/kWh) and the range limitation (~200 miles) of EVs, the market penetration of EVs is well limited. Currently, next generation lithium battery development is at the forefront of the research efforts around the world. Since flammable electrolyte and highly energetic redox couples are still employed in these batteries, cell level specific energy improvement are largely offset by additional safety protections required on both pack and vehicle level.

Bio2Electric, LLC ..... ARPA-E AWARDEE Booth 942

John A Sofranko
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Electrogenerative System for Co-Production of Green Liquid Fuels and Electricity from Methane

This "electrogenerative" technology will yield economically viable gas-to-liquids (GTL) facilities at small scale (≤1,000 BL/D). This breakthrough was achieved through advancements in state-of-the-art oxidative coupling of methane (OCM) catalysis, mixed and ionic conductive material design, and their application in commercial solid oxide fuel cell (SOFC) manufacturing systems. Low manufacturing costs for small scale units will be achieved by piggybacking onto the existing SOFC manufacturing infrastructure. The intensified electrogenerative system effectively reduces the process exothermicity by electricity co-production. Process models indicate a potential to improve the efficiency over state-of-the-art GTL by 20% with >50% reductions in life cycle CO_2 emissions.

BlazeTech Corp. ..... ARPA-E AWARDEE Booth 1232

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www.blazetech.com

Hyperspectral Imaging for the Identification of Light Metals

BlazeTech is developing an innovative hyperspectral imaging technology to identify metals (especially light metals, alloy families, and alloy numbers) and plastics in recycled waste. The technology consists of illuminating the specimen on a moving belt with a multi-wavelength light source and capturing the resulting reflectance spectra data with a hyperspectral camera. The reflectance spectra are then matched against a library of target material signatures for material identification. This technology can be integrated into sense-and sort recycling separation equipment. Successful development of the technology will represent a breakthrough in light metal identification that can be used throughout the scrap recycling industry.

Boston University (BU) ..... ARPA-E AWARDEE Booth 432

www.bu.edu

Decision-Support Software for Grid Operators

The BU team is developing control technology to help grid operators more actively manage power flows and integrate renewables by optimally turning entire power lines on and off in coordination with traditional control of generation and load resources. The control technology being developed would provide grid operators with tools to help manage transmission congestion by identifying the facilities whose on/off status must change to lower generation costs, increase utilization of renewable resources and improve system reliability. The technology is based on fast optimization algorithms for the near to real-time change in the on/off status of transmission facilities and their software implementation.

Brookhaven National Laboratory ..... ARPA-E AWARDEE Booth 936

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Superconducting Wires for Direct-Drive Wind Generators

The high performance superconducting wires will enable superconducting motors and generators with significant performance and cost advantage over the permanent magnet technology, and reduce the use of rare-earth materials by over 1000 times.

Brown University ..... ARPA-E AWARDEE Booth 416

Shreyas Mandre
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Customized Tidal Power Conversion Devices

Brown University is developing a power conversion device to maximize power production and reduce costs to capture energy from flowing water in rivers and tidal basins. Conventional methods to harness energy from these resources face a number of challenges, including the costs of developing customized turbine technology to a specific site. Additionally, sites with sufficient energy exist near coastal habitats which depend on the natural water flow to transport nutrients. The tidal power conversion devices continuously customize themselves using an onboard computer and control software to respond to real-time measurements, which increases tidal power conversion efficiency. This technology will allow for inexpensive installation and software upgrades and optimized layout of tidal power generators to maximize power generation and mitigate environmental impacts.

California Institute of Technology ..... ARPA-E AWARDEE Booth 419

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www.caltech.edu

Scalable Distributed Automation System

Caltech is developing a distributed automation system that allows distributed generators-solar panels, wind farms, thermal co-generation systems-to effectively manage their own power. To date, the main stumbling block for distributed automation systems has been the inability to develop software that can handle more than 100,000 distributed generators and be implemented in real time. Caltech's software could allow millions of generators to self-manage through local sensing, computation, and communication. Taken together, localized algorithms can support certain global objectives, such as maintaining the balance of energy supply and demand, regulating voltage and frequency, and minimizing cost. An automated, grid-wide power control system would ease the integration of renewable energy sources like solar power into the grid by quickly transmitting power when it is created, eliminating the energy loss associated with the lack of renewable energy storage capacity of the grid.

California Institute of Technology ..... ARPA-E AWARDEE Booth 528

Harry Atwater
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Full spectrum, ultrahigh efficiency solar energy conversion

Caltech is developing a solar module that splits sunlight into individual spectral bands to enable ultrahigh efficiency (>40%) solar electricity generation. This increase in efficiency provides a path to lower power generation costs. Most conventional photovoltaic modules provide 15-20% energy conversion efficiency because single-junction solar cells are ideal converters for a narrow band of the solar spectrum. Caltech's solar module includes several different, independently connected III-V compound semiconductor subcells matched to the different spectral bands.

Calysta Energy, Inc. ..... ARPA-E AWARDEE Booth 1025

Luan Nguyen
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www.calystaenergy.com

Novel Bioreactor Designs Based on High Mass Transfer Chemical Reactors for Methanotroph Fermentation

The objective of this project is to develop key bioreactor technology to enable efficient methane-to-biofuel fermentation processes. Although sugar-based fermentation is well-established with a variety of off-the-shelf reactor technologies available, relatively little effort has been expended to address unique challenges in gas-fed fermentations, such as low rates of mass/heat transfer and accumulation of explosive gas mixtures. By utilizing the project team's unique expertise in reactor design in the chemical industry and in methanotrophic fermentation, we plan to develop specialized reactors that can serve as the basis for the production of a variety of fuels and chemicals via bioconversion of methane.

Carnegie Mellon University (CMU)..... ARPA-E AWARDEE Booth 449

Alex Leary
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www.cmu.edu

Magnet Technology for Power Converters

CMU is developing a new nanoscale magnetic material that will reduce the size, weight, and cost of utility-scale PV solar power conversion systems that connect directly to the grid. Power converters are required to turn the energy that solar power systems create into useable energy for the grid. The power conversion systems made with CMU's nanoscale magnetic material have the potential to be 150 times lighter and significantly smaller than conventional power conversion systems that produce similar amounts of power.

Case Western Reserve University ..... ARPA-E AWARDEE Poster 16

Rohan Akolkar
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Novel Titanium Electrowinning Process Using Specialized Segmented Diaphragms

Case Western Reserve University is developing a single-step process to produce titanium from titanium salts using a multi-membrane electrochemical reactor. The thin, non-polar membrane technology prevents undesirable chemical reactions, enabling simpler conversion of titanium salts to titanium powder. Conventional titanium production methods are costly and energy intensive, limiting the widespread use of titanium, a versatile and durable structural metal. If successful, Case Western's single-step titanium production process will require one-third of the energy at a fraction of the cost, compared to conventional production methods.

Case Western Reserve Univeristy ..... ARPA-E AWARDEE Booth 738

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High Energy Storage Capacity Low Cost Iron Flow Battery

- The all-Iron flow battery energy uses abundant, low cost, safe, and non-toxic materials to provide energy storage
- Development of a slurry electrode for the negative half-cell will decouple the amount of energy stored from the power delivered, driving down cost and expanding applications

Case Western Reserve University ..... ARPA-E AWARDEE Booth 939

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engineering.case.edu/arpa-e-magnets

Transformation Enabled Nitride Magnets Absent Rare Earths

This proof-of-concept project focuses on a component-level technology innovation that will eliminate rare earth elements in permanent magnet materials for wind turbine generators and electric vehicle motors. Specifically, we propose to fabricate bulk powder of fully transformed a"-Fe16N2 using a novel process for enhancing nitrogen solubility in Fe-base alloys. Feasibility for this work stems from the 1972 discovery of a 'giant' magnetic saturation in a"-Fe16N2 as well as the 1994 announcement of the highest magnetic saturation value for any magnetic material ever reported (3.2T at 5K, 2.9T at 298K).

Case Western Reserve University .....Booth 947

Roger French
engineering.case.edu/centers/sdle

Lifetime & Degradation Science - A Pioneering Approach to Reliability Testing

The Solar Durability and Lifetime Extension (SDLE) Center at Case Western Reserve University (CWRU) is a world-class research center dedicated to lifetime and degradation science. Established in 2011 by Professor Roger French, the SDLE Center focuses on the durability and degradation of solar photovoltaic (PV) materials, and other environmentally exposed, long lived technologies.

Center for Electromechanics - University of Texas at Austin ..... ARPA-E AWARDEE **Booth 718**

Michael Lewis
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www.utexas.edu/research/cem

Free Piston Natural Gas Compressor

The Center for Electromechanics at UT Austin, in partnership with Gas Technology Institute and Argonne National Labs, is developing a low cost solution for at-home refueling of natural gas vehicles. The technology uses a single piston compressor driven by a directly coupled linear motor, which eliminates many of the moving components associated with typical reciprocating compressors, resulting in less friction and wear and increased durability.

Center for Power Electronics Systems (CPES) Virginia Tech ..... ARPA-E AWARDEE **Booth 1039**

Fred C. Lee
fclee@vt.edu
www.cpes.vt.edu

Power Supplies on a Chip (PSOC)

This project is focused on a high-voltage, high-current integrated circuit to power future generations of microprocessors, graphic cards and memory devices. The chip-scale power supply uses new high-voltage transistors using gallium nitride on silicon integrated with new magnetic components.

Ceramatec, Inc. ..... ARPA-E AWARDEE **Booth 329**

Feng Zhao
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www.ceramatec.com

Advanced Hybrid, Planar Lithium/Sulfur Batteries

Ceramatec will develop a non-porous, high-conductivity ceramic membrane for lithium-sulfur batteries to minimize self-discharge, provide mechanical integrity, and extend battery life. Current porous separators contain liquids that negatively impact cycle life and have a low abuse tolerance. Ceramatec will demonstrate its innovative, low-cost, non- porous membrane with a prototype lithium-sulfur battery that also contains advanced electrolytes developed for this system.

Ceramatec Inc. ..... ARPA-E AWARDEE **Booth 431**

Anthony Nickens
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www.ceramatec.com

Direct Natural Gas to Chemicals

Ceramatec is developing a small-scale reactor to convert natural gas into benzene—a feedstock for industrial chemicals or liquid fuels. Natural gas as a byproduct is highly abundant, readily available, and inexpensive. Ceramatec's reactor will use a one-step chemical conversion process to convert natural gas into benzene. This one-step process is highly efficient and prevents the build-up of solid residue that can occur when gas is processed. The benzene that is produced can be used as a starting material for nylons, polycarbonates, polystyrene, epoxy resins, and as a component of gasoline.

Ceramatec Inc. ..... ARPA-E AWARDEE **Booth 433**

Anthony Nickens
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www.ceramatec.com

Mid-Temperature Fuel Cells for Vehicles

Ceramatec is developing a solid-state fuel cell that operates in an intermediate temperature range that could overcome persistent challenges faced by both high temperature and low temperature fuel cells. The advantages compared to higher temperature fuel cells are less expensive seals and interconnects as well as longer lifetime. The advantages compared to low temperature fuel cells are reduced platinum requirements and the ability to run on fuels other than hydrogen, such as natural gas or methanol. Ceramatec's design would use a new electrolyte material to transport protons within the cell and advanced electrode layers.

Chromatin Inc. ..... ARPA-E AWARDEE **Booth 921**

Ramesh Nair
rnair@chromatininc.com
www.chromatininc.com

Biofuels from Sorghum

Chromatin will engineer sorghum-a plant that naturally produces large quantities of biomass and requires little water-to accumulate the fuel precursor farnesene, a molecule that can be blended into diesel fuel. Chromatin's proprietary technology enables the introduction of a completely novel biosynthetic process into the plant to produce farnesene, enabling sorghum to accumulate up to 20% of its weight as fuel. Chromatin will also introduce a trait to improve biomass yields in sorghum. The farnesene will accumulate in the sorghum plants-similar to the way in which it currently stores sugar-and can be extracted and converted into a type of diesel.

CIEE/LBNL/PSL ..... ARPA-E AWARDEE **Booth 331**

uc-ciee.org

Measuring Phase Angle Change in Power Lines

UC Berkeley is developing a device to monitor and measure electric power data from the grid's distribution system. The new instrument-known as a micro-phasor measurement unit (PMU)-is designed to measure critical parameters such as voltage and phase angle at different locations, and correlate them in time via extremely precise GPS clocks. The amount of phase angle difference provides information about the stability and direction of power flow. Data collected from a network of these PMUs would facilitate better monitoring and control of grid power flow-a critical element for integrating intermittent and renewable resources, such as rooftop solar and wind energy, and other technologies such as electric vehicles and distributed storage.

Clean Energy Research Center ..... ARPA-E AWARDEE Booth 237

Yogi Goswami
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Efficient Phase-Change Materials

USF is developing low-cost, high-temperature phase-change materials (PCMs) for use in thermal energy storage systems. Heat storage materials are critical to the energy storage process. In solar thermal storage systems, heat can be stored in these materials during the day and released at night-when the sun is not out-to drive a turbine and produce electricity. In nuclear storage systems, heat can be stored in these materials at night and released to produce electricity during daytime peak-demand hours. Most PCMs do not conduct heat very well and by using an innovative, electroless encapsulation technique, USF is enhancing the heat transfer capability.

CLOTEAM, LLC ..... ARPA-E AWARDEE Poster 31

Per Onnerud
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Novel Low Cost and Safe Li ion Battery

Colorado State University..... ARPA-E AWARDEE Booth 1116

wp.natsci.colostate.edu/medfordlab

SYNTHETIC GENE CIRCUITS TO ENHANCE PRODUCTION OF TRANSGENIC BIOENERGY CROPS

We are developing technology to rapidly introduce new synthetic genetic traits into crops that currently cannot be readily engineered. Currently, only a limited number of crops can be engineered to optimize biofuel production, and expanding this number could substantially improve the efficiency and geographic range of biofuel production. Our approach utilizes synthetic biology tools to enable easy genetic modification of bioenergy crops. This technology will not only enable simple and efficient engineering of a broad range of bioenergy crops, but could also be applied to improve agricultural productivity.

Columbia University/IBM/MIT/Veeco ..... ARPA-E AWARDEE Poster 15

Kenneth Shepard
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www.columbia.edu

Vertical GaN power transistors using controlled spalling for substrate heterogeneity

We are developing a new low-cost vertical GaN power transistor technology based on homo-epitaxy on free-standing GaN substrates that supports voltages up to 1200 V and currents as high as 100 A for such applications as industrial motors and automotive applications. We exploit spalling to achieve this goal, a technique that we have recently developed that allows entire devices, in fact, entire working circuits, to be "exfoliated" and transferred to any desired alternate substrate. We use it here to spall entire fabricated transistors from GaN wafers and transfer these to silicon substrates.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

Columbia University ..... ARPA-E AWARDEE Booth 426

Scott Banta
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www.columbia.edu

Biofuels from Bacteria, Electricity, and CO_2

Columbia University is using carbon dioxide (CO_2) from ambient air and electricity to produce biofuels. This is accomplished using iron-oxidizing bacteria that naturally utilize CO_2 and they have been genetically altered to use the CO_2 to make chemicals and fuels. The cells obtain energy by oxidizing iron, and the oxidized iron is reduced in an electrochemical reactor so that the iron is recycled between reactors in the process. The overall process is flexible and scalable.

Cornell University ..... ARPA-E AWARDEE Booth 424

www.cs.cornell.edu/Projects/Gridcontrol

Cloud Computing for the Grid

Cornell is creating a new software platform for grid operators called GridControl that will utilize cloud computing to more efficiently control the grid. In a cloud computing system, there are minimal hardware and software demands on users. The user can tap into a network of computers that is housed elsewhere (the cloud) and the network runs computer applications for the user. The user only needs interface software to access all of the cloud's data resources, which can be as simple as a web browser. Cloud computing can reduce costs, facilitate innovation through sharing, empower users, and improve the overall reliability of a dispersed system. Cornell's GridControl will focus on 4 elements: delivering the state of the grid to users quickly and reliably; building networked, scalable grid-control software; tailoring services to emerging smart grid uses; and simulating smart grid behavior under various conditions.

Cornell University ..... ARPA-E AWARDEE Booth 1019

David Erickson
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nano.mae.cornell.edu

High density photobiorefineries with optimized light/CO_2 delivery and product extraction

Cornell is developing a new photobioreactor to produce algae-based fuels that are more efficient than conventional bioreactors. Existing reactor systems for photosynthetic based bioconversion have a series of well-known weaknesses including poor distribution of light, low microbe concentrations, large amounts of water and energy consumption, and inefficiencies associated with harvesting and post-processing of the microbes. Our system exploits new light guiding and hollow fiber carbon delivery and fuel extraction techniques which dramatically reduce operational costs that have limited the commercial exploitation of algae based biofuels.

Coskata, Inc. ..... ARPA-E AWARDEE **Booth 740**

Loula Merkel
lmerkel@coskata.com
www.coskata.com

Activated Methane to Butanol

Coskata will construct strains of Clostridium species with the ability to efficiently convert activated methane to butanol under anaerobic conditions. This process will involve molecular genetics and fermentation optimization of constructed strains. Successful achievement of the targeted performance metrics for this proof-of-concept will represent a significant advancement in the efficiency of biological synthesis of liquid fuels. This is in line with ARPA-E's program goals of transforming our country's ability to convert methane into liquid fuels.

CPS Technologies ..... **Booth 340**

Mark Occhionero
marko@alsic.com
www.alsic.com

Aluminum Silicon Carbide (AlSiC) Heat Spreaders with Embedded Dielectric Ceramic for High Voltage IGBT Module Assembly

CPS is developing an AlSiC baseplate or cooler with an embedded dielectric substrate with metallization that is equivalent to the DBC (Direct Bond Copper) substrates provided today. By embedding the dielectric in the AlSiC composite during our NetShape casting process, CPS can eliminate the traditional solder layer between the baseplate and ceramic thus reducing the thermal path by one layer in an IGBT assembly. This should lead to improved thermal performance for the overall IGBT assembly.

Cree, Inc. ..... ARPA-E AWARDEE **Booth 321**

Dr. David Grider
david_grider@cree.com
www.cree.com

15 kV SiC IGBT For Grid Scale Power Conversion

This program is developing high voltage 15 kV SiC IGBT power electronics technology which will be used to demonstrate a 100 kVA Transformerless Intelligent Power Substation (TIPS) for grid-scale power conversion. This SiC IGBT technology offers critical advantages for grid-scale power conversion systems such as TIPS including higher efficiency power conversion up to 98%, replacement of heavy (8000 lb) 60 Hz transformer s with much smaller (100 lb) 50 kHz transformers, as well as over 50% reduction in power converter weight, size, and cooling requirements. This transformative SiC IGBT technology will enable a broad range of grid-scale power conversion systems.

CUNY Energy Institute, Columbia University and University of California at Berkeley ..... ARPA-E AWARDEE Booth 640

metacapacitor.com

Metacapacitors: Power Electronics for LED Lighting

The Metacapacitors team is developing next-generation technology for LED power supplies and DC-DC converters using switched-capacitor circuits paired with a new class of high-frequency power handling capacitors. In a Metacapacitors DC-DC converter, control and power switching are combined in a single integrated circuit, while energy storage is provided by an inexpensive network of printed capacitors developed using proprietary technology.

CUNY Energy Institute ..... ARPA-E AWARDEE Booth 646

Sanjoy Banerjee
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www.cuny.edu/energy

Low-Cost Grid-Scale Electrical Storage Using a Flow-Assisted Rechargeable Zinc-Manganese Dioxide Battery

The CUNY Energy Institute is developing zinc-manganese dioxide batteries for grid-scale storage applications. Zinc (Zn) and manganese dioxide (MnO2) batteries are non-toxic, abundant, and inexpensive. The challenge is to make a Zn-MnO2 battery that is rechargeable for thousands of cycles. We are examining a 35Ah modules that perform for 3,000 cycles at cost of less than $100/kWh. In addition, ARPA-E provided a grant extension (a "Plus-Up") to develop and test improvements to the anode in it's zinc / manganese rechargeable battery technology. This project will be conducted through the end of 2014 and generate a performance database for baseline design.

Dais Analytic ..... ARPA-E AWARDEE Booth 512

Brian Johnson
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www.daisanalytic.com

Membrane Dehumidification Enabling Alternative Cooling Strategies in Humid Environments

Dais' patented nanostructured membrane allows direct dehumidification of a humid airstream with minimal temperature change. This dry air stream can then be cooled by one of several alternative strategies that do not employ a traditional vapor compression cycle. This combination will extend the applicability of energy efficient, zero-GWP cooling mechanisms to humid regions that are currently not viable possibilities.

Danforth Plant Science Center ..... ARPA-E AWARDEE Booth 539

www.danforthcenter.org

Improved Light Utilization in Camelina

The Danforth Center will optimize light utilization in Camelina, a drought-resistant, cold-tolerant oilseed crop. The team is modifying how Camelina collects sunlight, engineering its topmost leaves to be lighter in color so sunlight can more easily reflect onto lower parts of the plant. A more uniform distribution of light would improve the efficiency of photosynthesis. Combined with other strategies to produce more oil in the seed, Camelina would yield more oil per plant. The team is also working to allow Camelina to absorb carbon dioxide (CO_2) more efficiently, providing more carbon input for oil production. The goal is to improve light utilization and oil production to the point where Camelina produces enough fuel precursors per acre to compete with other fuels.

Delphi Automotive Systems, LLC ..... Booth 225

Gregory L. Grant
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Delphi.com

Gallium Nitride Advanced Power Semiconductor & Packaging

This project will create a 600-Volt Gallium Nitride (GaN)-on-Silicon (Si) device packaged with sintered interconnects and double-side cooling to reduce power semiconductor device size, cost and energy losses for automotive and renewable energy applications by at least 50% compared to today's commercial Si IGBTs. The project's final deliverable is a GaN-on-Si based, electrically-stable, packaged 600V depletion-mode, high electron mobility transistor (HEMT) power device with a second chip providing anti-parallel diode and normally-off behavior. The functionality of this advanced GaN-on-Si power package will be demonstrated in an inverter designed for an electric drive traction motor.

Dioxide Materials ..... ARPA-E AWARDEE Booth 521

Megan Atchley
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www.dioxidematerials.com

Converting CO_2 into Fuel and Chemicals

Dioxide Materials is developing technology to produce carbon monoxide, or synthesis gas electrochemically from CO_2 emitted by power plants. Synthesis gas can be used as a feedstock for the production of industrial chemicals and liquid fuels. The current state-of-the-art process for capturing and removing CO_2 from the flue gas of power plants is expensive and energy intensive, and therefore faces significant hurdles towards widespread implementation. The technologies being developed by Dioxide Materials aim to convert CO_2 into something useful in an economical and practical way. The technology has the potential to create an entirely new industry where waste CO_2-rather than oil-is used to produce gasoline, diesel fuel, jet fuel, and industrial chemicals.

DNV ..... ARPA-E AWARDEE Booth 1015

Davion M Hill
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www.dnv.com

Gas-Based Battery Monitoring System

DNV KEMA is testing a new gas monitoring system developed by NexTech Materials to provide early warning signals that a battery is operating under stressful conditions and at risk of premature failure. As batteries degrade, they emit low level quantities of gas that can be measured over the course of a battery's life-time. DNV KEMA is working with NexTech to develop technology to accurately measure these gas emissions. By taking accurate stock of gas emissions within the battery pack, the monitoring method could help battery management systems predict when a battery is likely to fail. Advanced prediction models could work alongside more traditional models to optimize the performance of electrical energy storage systems going forward. In the final phase of the project, DNV KEMA will build a demonstration in a community energy storage system with Beckett Energy Systems.

EaglePicher Technologies, LLC ..... Booth 1239

Dave Lucero
dave.lucero@eaglepicher.com
www.eaglepicher.com

Sodium β″-alumina batteries

EaglePicher Technologies, Inc. is teaming with Pacific Northwest National Laboratory to develop the next-generation sodium β″-alumina batteries for the nation's large-scale energy storage needs. The outcome will have direct impact on establishing U.S. leadership in stationary storage, and will demonstrate a competitive path to cost effective electrical energy storage.

Eaton Corporation ..... ARPA-E AWARDEE Booth 614

Clark Fortune
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www.eaton.com

Liquid-Piston Isothermal Home Natural Gas Compressor

Eaton is developing a natural gas refueling system that relies on a liquid piston to compress natural gas. A traditional compressor uses an electric motor to rotate a crankshaft, which is tied to several metal pistons that pump to compress gas. Traditional compressor systems can be inefficient and their complex components make them expensive to manufacture, difficult to maintain, and short-lived. Eaton's system replaces traditional pistons with a liquid that comes into direct contact with the natural gas without the need for the costly high-pressure piston seals that are used in conventional gas compression.

Eaton Corporation ..... ARPA-E AWARDEE Booth 616

Chinmaya Patil
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www.eaton.com

Advanced Battery Management for Hybrid Vehicles

Eaton is developing advanced battery and vehicle systems models that will enable fast, accurate estimation of battery health and remaining life. The batteries used in hybrid vehicles are highly complex and require advanced management systems to maximize their performance. Eaton's battery models will be coupled with hybrid powertrain control and power management systems of the vehicle enabling a broader, more comprehensive vehicle management system for better optimization of battery life and fuel economy. Their design would reduce the sticker price of commercial hybrid vehicles, making them cost-competitive with non-hybrid vehicles.

Electron Energy Corporation ..... ARPA-E AWARDEE Booth 1126

Melania Marinescu
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www.electronenergy.com

New Processing Technology for Permanent Magnets

EEC and its team are developing a new processing technology that could transform how permanent magnets found in today's EV motors and renewable power generators are fabricated. This new process, known as friction consolidation extrusion (FC&E), could produce stronger magnets at a lower cost. The advantage of FC&E over today's best processes is that it can be applied to fabricate nanocomposite structures using precursor conventional powders, and could double the magnetic energy density of the permanent magnets. The process could considerably reduce the need for rare earth elements in permanent magnets.

Ener-G-Rotors, Inc. ..... Booth 846

Michael Newell
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www.energrotors.com

A Novel Heat Engine that Changes the Economics of Heat Recovery

Ener-G-Rotors, Inc. sells devices that are a breakthrough in the economic generation of electricity from low temperature heat. We have an exclusive license for a patented technology, called a Trochoidal Gear Engine (TGE™), which is more efficient, cost effective, and durable than existing technologies. We will soon begin commercialization of the GEN4, a 40-60kW system targeted at the industrial waste heat market. Our TGE™ expander, is a relatively simple positive displacement device that is as efficient at small kilowatt sizes as turbines are at megawatt sizes.

Energy & Environmental Research Center .... ARPA-E AWARDEE Booth 715

Christopher Martin
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www.undeerc.org

Novel Dry Cooling Technology for Power Plants

UND-EERC is developing an air-cooling alternative for power plants that helps maintain operating efficiency during electricity production with low environmental impact. The project addresses the shortcomings of conventional dry cooling, including high cost and degraded cooling performance during daytime temperature peaks. UND-EERC's device would use an air-cooled adsorbent liquid that results in more efficient power production with no water consumption. The technology could be applied to a broad range of plants including fossil, nuclear, solar thermal, and geothermal.

Energy Research Company ..... ARPA-E AWARDEE Poster 2

Robert De Saro
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www.er-co.com

An Integrated Minimill for the Aluminum Industry: From Scrap to Product in One Step

AIM will process scrap aluminum and make a finished product, saving considerable energy and emissions and will greatly enhance the competitive position of the US aluminum industry.

Energy Storage Systems, Inc. ..... ARPA-E AWARDEE Booth 714

Craig Evans
Craig.Evans@EnergyStorageSystems.com
www.energystoragesystems.com

Iron Flow Battery

ESS is developing a cost-effective, reliable, and environmentally friendly all-iron hybrid flow battery. A flow battery is an easily rechargeable system that stores its electrolyte-the material that provides energy-as liquid in external tanks. Currently, flow batteries account for less than 1% of the grid-scale energy storage market because of their high system costs. The ESS flow battery technology is distinguished by its cost-effective electrolytes, based on earth-abundant iron, and its innovative battery hardware design that dramatically increases power density and enables a smaller and less costly battery. Creating a high-performing and low-cost storage system would enable broad adoption of distributed energy storage systems and help bring more renewable energy technologies-such as wind and solar-onto the grid.

EnZinc ..... ARPA-E AWARDEE Poster 49

Michael Burz
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www.enzinc.com

A Rechargeable, Dendrite-Free Zinc Anode for a Zinc-Air Battery

Researchers from the US Naval Research Laboratory and engineers from EnZinc are striving to improve battery electrodes made from a very safe, common material: Zinc. The scientists had to completely rethink the electrode structure to operate without the growth of zinc stalactites called dendrites that can short circuit the battery. They designed a Zn "sponge" with features the size of a human hair. The team will test the sponge electrodes up to 500 cycles and evaluate the impact on electric vehicles. The electrodes could double vehicle range, lower costs by half, and eliminate the danger associated with overheating and accidents.

Fairfield Crystal Technology ..... ARPA-E AWARDEE Booth 1031

Andy Timmerman
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www.fairfieldcrystal.com

High-quality, low-cost GaN single crystal substrates for high-power devices

The project will demonstrate a novel technique for producing GaN single-crystal boules that yield GaN wafers and substrates suitable for fabrication of GaN high-power devices. Fairfield Crystal's novel GaN crystal growth technique can achieve a growth rate significantly higher than that can be achieved using any existing GaN crystal growth technique, including a state-of-the-art hydride vapor phase expitaxy (HVPE) technique. As a result, GaN single crystal boules and wafers will be produced at a low cost and at a high throughput.

FastCAP Systems ..... ARPA-E AWARDEE Booth 339

Jamie Beard
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www.fastcapsystems.com

Low Cost, High Energy and Power Density, Nanotube-Enhanced Ultracapacitors

FastCAP Systems uses nanotechnology to improve an energy storage device called an ultracapacitor (ultracap). After only two years of development under its ARPA-E program, FastCAP achieved four world performance records related to the power and energy density of its cells (including 10X the power and 5-10X the energy of commercially available ultracaps). FastCAP has also achieved automated pilot-scale manufacturing of its core carbon nanotube technology under the program. FastCAP's ultracaps contain no lithium and carry zero risk of thermal runaway explosions, a stark contrast to lithium based chemistries that are prevalent today.

Ford Motor Company..... ARPA-E AWARDEE **Booth 619**

www.ford.com

Low Pressure Material-Based Natural Gas Fuel System

Ford is developing an on-board adsorbed natural gas tank system with a high surface area framework material that would increase the energy density of compressed natural gas at low pressures. Traditional natural gas tanks attempt to compensate for low energy density and limited driving range by storing compressed gas at high pressures, requiring expensive pressure vessels. Ford and their project partners will optimize advanced porous material within a system to reduce the pressure of on-board tanks while delivering the customer expected driving range. This porous material allows more gas to be stored inside a tank by utilizing a surface energy attraction to the natural gas. These materials would be efficiently and cost-effectively integrated into a natural gas vehicle system that will promote and contribute to the widespread use of natural gas vehicles.

Ford Motor Company..... ARPA-E AWARDEE **Booth 621**

Alvaro Masias

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www.ford.com/technology

High Precision Battery Tester

Ford is developing a commercially viable battery tester with measurement precision that is significantly better than today's best battery testers. Improvements in the predictive ability of battery testers would enable significant reductions in the time and expense involved in electric vehicle technology validation. Unfortunately, the instrumental precision required to reliably predict performance of batteries after thousands of charge and discharge cycles does not exist in today's commercial systems. Ford's design would dramatically improve the precision of electric vehicle battery testing equipment, which would reduce the time and expense required in the research, development, and qualification testing of new automobiles.

framergy, Inc......**Booth 233**

J.M.Ornstein

findoutmore@framergy.com

www.framergy.com

framergyTM with Texas A&M University

framergy's internationally-protected property rights strategically bundle ARPA-E funded technology from Dr. Hongcai Zhou's laboratory at Texas A&M University, creating a comprehensive toolbox of enabling materials that support a broad range of energy applications. Metal organic frameworks (MOFs), have emerged as an extensive class of crystalline materials with ultrahigh porosity and enormous surface areas. These properties, together with the extraordinary degree of variability for both the organic and inorganic components of their structures, make MOFs capable of unlocking clean energy. Shortly, framergy MOFs will allow for exponential improvements in gaseous energy storage and low energy gas separations.

GaN Systems Inc ..... Booth 231

Girvan Patterson
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www.gansystems.com

Gallium Nitride Power Transistors

GaN Systems is the first place systems designers go to realize all of the benefits of gallium nitride in their power conversion and control applications. To overcome silicon's limitations in switching speed, temperature, voltage, and current, the Company develops the most complete range of gallium nitride power switching solutions for a variety of markets. Its unique Island Technology™ addresses the cost, performance, and manufacturability-related challenges of gallium nitride resulting in devices that are smaller, more efficient, and lower cost than traditional design approaches.

Gas Technology Institute (GTI) ..... ARPA-E AWARDEE Booth 719

Ted Barnes
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www.gastechnology.org

Engineered Adsorption Materials for Natural Gas Storage

GTI is partnering with Northwestern University, NuMat Technologies, and Westport Fuel Systems to identify materials with the best characteristics for low-pressure natural gas storage. The gas-storing materials, known as metal organic framework (MOF) adsorbents, hold natural gas the way a sponge holds liquids. The project team is developing their computer modeling and screening technique to support the creation of a low-pressure adsorbent material specifically designed for natural gas vehicles. The team will also validate the materials properties in real-world conditions. Adsorbed storage represents significant potential for lowering the cost of NGVs and other gas storage technologies.

Gas Technology Institute (GTI) ..... ARPA-E AWARDEE Booth 721

www.gastechnology.org

Adsorbent Materials for Natural Gas Storage

GTI is developing a natural gas tank for light-duty vehicles that features a thin, tailored shell containing microscopic valves which open and close on demand to manage pressure within the tank. Traditional natural gas storage tanks are thick and heavy, which makes them more expensive to manufacture. GTI's tank design uses unique adsorbent pellets with nano-scale pores surrounded by a coating that functions as valves to help manage the pressure of the gas and facilitate more efficient storage and transportation. GTI's low-pressure tanks would have thinner walls than today's best alternatives, resulting in a lighter, more affordable product with increased storage capacity.

Gas Technology Institute (GTI) ..... ARPA-E AWARDEE **Booth 1036**

Dr. Chinbay Fan
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www.gastechnology.org

Methane to Methanol Fuel: A Low Temperature Process

Gas Technology Institute developed a methane to methanol process with high faradaic efficiency 91.4%. Methane is fed to the anode producing methanol, water, and electrons with the aid of catalytic nickel-based anode material. Methanol is collected as a liquid and separated from the methane, while the electrons are conducted to the cathode where they transform water to H2 and hydroxide ions. The H2 is collected for other uses, while the hydroxide is transferred back to the anode through the electrolyte for regeneration of the anode metal oxide cation catalyst. The process is continuous as long as proper current is applied.

Gas Technology Institute (GTI) ..... ARPA-E AWARDEE **Booth 1036**

Dr. Chinbay Fan
chinbay.fan@gastechnology.org
www.gastechnology.org

Dual Electrolyte Extraction Electro-Refinery (DEEE) for Light Metal Production

GTI is developing a continuously operating cell that produces low-cost aluminum powder using less energy than conventional methods. Conventional aluminum production is done by pumping huge electrical currents into a vat of molten aluminum dissolved in mineral salts at nearly 2000 degrees Fahrenheit. GTI's technology occurs near room temperature using reusable solvents to dissolve the ore. Because GTI's design relies on chemical dissolution rather than heat, its cells can operate at room temperature, meaning it does not suffer from wasteful thermal energy losses associated with conventional systems. GTI's electrochemical cell could also make aluminum production significantly less expensive.

GE Global Research..... ARPA-E AWARDEE **Poster 7**

Grigorii Soloveichik
soloveichik@ge.com
ge.geglobalresearch.com

High Energy Density Flow Battery for EV Storage

General Electric (GE) will develop an innovative high-energy chemistry for a water-based flow battery. Current flow batteries are generally low-energy density and only used for stationary energy storage. If successful, GE's new chemistry could enable the use of flow batteries in electric vehicles and improve driving range, cost, and reliability.

GE Global Research..... ARPA-E AWARDEE **Booth 414**

ge.geglobalresearch.com

Connecting Renewables Directly to the Grid

GE is developing electricity transmission hardware that could connect distributed renewable energy sources such as wind farms directly to the grid, eliminating the need to feed the energy generated through intermediate power conversion stations before they enter the grid. GE is using the advanced semiconductor material silicon carbide (SiC) to conduct electricity through its transmission hardware because SiC can operate at higher voltage levels than semiconductors made out of other materials. This high-voltage capability is important because electricity must be converted to high-voltage levels before it can be sent along the grid's network of transmission lines. Power companies do this because less electricity is lost along the lines when the voltage is high.

GE Global Research..... ARPA-E AWARDEE **Booth 417**

Anna Lis Laursen

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ge.geglobalresearch.com

Chilled Natural Gas for At-Home Refueling

GE is developing a low-cost, at-home natural gas refueling system that reduces fueling time and eliminates compression stages. Traditional compressor-based natural gas refueling systems require removal of water from natural gas through complicated desiccant cycles to avoid damage. GE's design uses a chiller to cool the gas to a temperature below -50degrees C, which would separate water and other contaminants from the natural gas. This design has very few moving parts, will operate quietly, and will be virtually maintenance-free. This simplified, compressor-free design could allow fast refueling at 10% of the cost of today's systems.

GE Global Research..... ARPA-E AWARDEE **Booth 843**

Aaron Knobloch

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ge.geglobalresearch.com

Thin-Film Temperature & Expansion Sensors for Batteries

GE is developing low-cost, thin-film sensors that enable real-time mapping of temperature and expansion for each cell within a battery pack, which could help predict how and when batteries begin to fail. The thermal sensors within today's best battery packs are thick, expensive, and incapable of precisely assessing important factors like temperature and pressure within their cells. In comparison to today's best systems, GE's design would provide temperature and pressure measurements using smaller, more affordable sensors than those used in today's measurement systems. Ultimately, GE's sensors could dramatically improve the thermal mapping and pressure measurement capabilities of battery management systems.

GE Global Research ..... ARPA-E AWARDEE Booth 1231

ge.geglobalresearch.com

Cost-Effective Cable Insulation

GE is developing new, low-cost insulation for high-voltage direct current (HVDC) electricity transmission cables. The current material used to insulate HVDC transmission cables is very expensive and can account for as much as 1/3 of the total cost of a high-voltage transmission system. GE is embedding nanomaterials into specialty rubber to create its insulation. Not only are these materials less expensive than those used in conventional HVDC insulation, but they also will help suppress excess charge accumulation. The excess charge left behind on a cable poses a major challenge for high-voltage insulation-if it is not kept to a low level, it could ultimately lead the insulation to fail. GE's low-cost insulation is compatible with existing U.S. cable manufacturing processes, further enhancing its cost effectiveness.

GE Power & Water ..... ARPA-E AWARDEE Booth 327

Qi (Joyee) Zhu
zhujo@ge.com
www.ge-energy.com/about/power_water.jsp

Tensioned Fabric Wind Blades

The TENSIONED FABRIC WIND BLADES project will transform the way wind blades are designed, manufactured, and installed by employing fabric uniquely wrapped around a space frame blade structure. The main innovation of the tensioned fabric blade is to replace current clam shell of wind blades with selected fabrics. The underlying blade structure will be changed radically to enable an optimal stiffness/weight ratio. The structure would also be designed to enable easier field assembly and possible automated processing. The net result of this technology is a lower cost of electricity by enabling cost effective larger wind blades.

GE Research ..... ARPA-E AWARDEE Booth 219

Timothy Sommerer
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ge.geglobalresearch.com

High-Power Gas Tube Switches

GE is developing a new gas tube switch that could significantly improve and lower the cost of utility-scale power conversion. A switch breaks an electrical circuit by interrupting the current or diverting it from one conductor to another. To date, solid state semiconductor switches have completely replaced gas tube switches in utility-scale power converters because they have provided lower cost, higher efficiency, and greater reliability. GE is using new materials and innovative designs to develop tubes that not only operate well in high-power conversion, but also perform better and cost less than non-tube electrical switches. A single gas tube switch could replace many semiconductor switches, resulting in more cost effective high power converters.

Georgia Institute of Technology ..... ARPA-E AWARDEE **Booth 1042**

Srinivas Garimella
sgarimella@gatech.edu
STSL.gatech.edu

Modular Thermal Hub for Building Cooling, Heating and Water Heating

A thermally activated hub for modular, scalable, distributed cooling and heating in buildings, which uses fluids with zero global warming potential, and can run on energy from combustion, waste heat or solar energy, is being developed. Several-fold enhancements in heat and mass transfer possible in microscale passages remove the primary hurdle to the implementation of thermally activated heat pumps for more than a century. Cooling capacities of 100s of watts to tens of kW are possible through scale-up of components. These mass-producible miniaturized systems can be packaged as monolithic full-system packages or as discrete, distributed components.

Georgia Institute of Technology ..... ARPA-E AWARDEE **Booth 429**

Asegun Henry
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www.gatech.edu

High-Efficiency Solar Fuel Reactor

Georgia Tech is developing a high-efficiency concentrating solar receiver and reactor for the production of solar fuels. The team will develop a system that uses liquid metal to capture and transport heat at much higher temperatures compared to state-of-the-art concentrating solar power facilities. This high temperature system will be combined with the team's novel reactor to produce solar fuels that allow the flexibility to store and transport solar energy for later use or for immediate power production. Higher temperatures should result in much higher efficiencies and therefore lower costs of produced fuel or electricity. Additionally, plant operators would have the flexibility to match electricity or fuel production with the changing market demand to improve the cost effectiveness of the plant.

Georgia Institute of Technology ..... ARPA-E AWARDEE **Booth 931**

sov.gatech.edu

Power Generation Using Solar-Heated Ground Air

Georgia Tech is developing a method to capture energy from wind vortices that form from a thin layer of solar-heated air along the ground. Dust devils are a random and intermittent example of this phenomenon in nature. Naturally, the sun heats the ground creating a thin air layer near the surface that is warmer than the air above, and since hot air rises, this layer of air will naturally want to rise. The Georgia Tech team will use a set of vanes to force the air to rotate as it rises, forming an anchored columnar vortex that draws in additional hot air to sustain itself. Georgia Tech's technology uses a rotor and generator to produce electrical power from this rising, rotating air similar to a conventional wind turbine. This solar-heated air, a renewable energy resource, is broadly available, especially in the southern U.S. Sunbelt, yet has not been utilized to date. This technology could offer more continuous power generation than conventional solar PV or wind. Georgia Tech's technology is a, low-cost, scalable approach to electrical power generation that could create a new class of renewable energy ideally suited for arid low-wind regions.

Georgia Institute of Technology ..... ARPA-E AWARDEE Booth 526

www.gatech.edu

Graphene-Based Supercapacitors

Georgia Tech is developing a supercapacitor using graphene-a two-dimensional sheet of carbon atoms-to substantially store more energy than current technologies. Supercapacitors store energy in a different manner than batteries, which enables them to charge and discharge much more rapidly. The Georgia Tech team approach is to improve the internal structure of graphene sheets with molecular spacers,' in order to store more energy at lower cost. The proposed design could increase the energy density of the supercapacitor by 1015 times over established capacitor technologies, and would serve as a cost-effective and environmentally safe alternative to traditional storage methods.

Georgia Tech MicroSensors & MicroActuators Research Corporation ..... ARPA-E AWARDEE Booth 326

www.mems.gatech.edu/msma/lamination_technologies.html

Highly-laminated, High-saturation-flux-density, Magnetic Cores For On-chip Inductors In Power Converter Applications

The overall goal of this project is to reduce the size, cost and increase the efficiency of power converters for consumer applications. In such systems, the largest components are typically the passive elements such as the inductor. We are currently developing metallic magnetic materials for on-chip cored inductors that will greatly improve compactness and efficiency of the power converters.

Georgia Institute of Technology Research Corporation ..... ARPA-E AWARDEE Booth 620

Masoud

mhnazari@ece.gatech.edu

www.ece.gatech.edu/research/labs/aces/pages/home.html

Autonomous, Decentralized Grid Architecture

Georgia Tech is developing a decentralized, autonomous, internet-like control architecture and control software system for the electric power grid. Georgia Tech's new architecture is based on the emerging concept of electricity prosumers-economically motivated actors that can produce, consume, or store electricity. Under Georgia Tech's architecture, all of the actors in an energy system are empowered to offer associated energy services based on their capabilities. The actors achieve their sustainability, efficiency, reliability, and economic objectives, while contributing to system-wide reliability and efficiency goals. This is in marked contrast to the current one-way, centralized control paradigm.

Glint Photonics, Inc. ..... ARPA-E AWARDEE Booth 816

Peter Kozodoy

peter@glintphotonics.com

www.glintphotonics.com

Self-Tracking Concentrator Photovoltaics

Glint is developing an inexpensive solar concentrating PV (CPV) module that tracks the sun's position over the course of the day to channel sunlight into PV materials more efficiently. Conventional solar concentrator technology requires complex moving parts to track the sun's movements. In contrast, Glint's inexpensive design can be mounted in a stationary configuration and adjusts its properties automatically in response to the solar position. By embedding this automated tracking function within the concentrator, Glint's design enables CPV modules to use traditional mounting technology and techniques, reducing installation complexity and cost.

GMZ Energy, Inc. ..... Booth 439

Xiaowei Wang
xwang@gmzenergy.com
www.gmzenergy.com

Combined Heat and Power Boiler with Thermoelectric Generators

GMZ Energy will develop the world's first cost-effective combined heat and power (CHP) boilers using high-efficiency thermoelectric generators (TEGs). The CHP boiler will not only provide on-site energy generating capabilities at 50% less cost than electricity from the grid, but also provide thermal and electrical energy at times when other alternative energy sources are not available. This is obtainable at an installation cost of 1.5$/W with a payback period of <5 years. Our first–of-a-kind product will significantly increases the value of fuel and enhances the overall facility security by providing a back-up power during inclement weather and natural/artificial disasters.

GreenLight Biosciences ..... ARPA-E AWARDEE Poster 48

Marta Ortega-Valle
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www.glbiosciences.com

Highly Productive Cell-free Bioconversion of Methane

GreenLight Biosciences will develop a cell-free bioreactor that can convert large quantities of methane to liquid fuels in one step. The proposed technology is a radically different approach that combines the benefits of biological catalysts with the principles of chemical processes to achieve economically attractive conversion of natural gas to liquid fuels.

Grid Logic, Inc. ..... ARPA-E AWARDEE Booth 737

George Caravias
caravias@grid-logic.com
www.grid-logic.com

High-Power Superconductors

Grid Logic is developing a new type of electrical superconductor that could significantly improve the performance (in $/kA-m) and lower the cost of high-power energy generation, transmission, and distribution. Grid Logic is using a new manufacturing technique to coat very fine particles of superconducting material with an extremely thin layer-less than 1/1,000 the width of a human hair-of a low-cost metal composite. This new manufacturing process is not only much simpler and more cost effective than the process used to make today's state-of-the-art high-power superconductors, but also it makes superconductive cables easier to handle and improves their electrical properties.

HALOTECHNICS

Halotechnics ..... ARPA-E AWARDEE **Booth 427**

Justin Raade
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www.halotechnics.com

Molten Glass for Thermal Storage

Halotechnics is developing a high-temperature thermal energy storage system using a new thermal-storage and heat-transfer material: earth-abundant and low-melting-point molten glass. Heat storage materials are critical to the energy storage process. In solar thermal storage systems, heat is stored in these materials during the day and released at night--when the sun is not out-to drive a turbine and produce electricity. In nuclear storage systems, heat is stored in these materials at night and released to produce electricity during daytime peak-demand hours. Halotechnics new thermal storage material targets a price that is potentially cheaper than the molten salt used currently.

Harvard School of Engineering and Applied Sciences

Harvard University/ Sustainable Innovations ..... ARPA-E AWARDEE **Booth 1220**

Michael Aziz
maziz@harvard.edu
www.arpa-e.energy.gov/?q=arpa-e-projects/organic-flow-battery-energy-storage

Small Organic Molecule Based Flow Battery

Flow batteries with energy storage in very inexpensive, stable, small organic molecules in aqueous solution enable large cost reductions.

HEXATECH

HexaTech, Inc. ..... ARPA-E AWARDEE **Booth 817**

www.hexatechinc.com

Semiconductors that Improve Electricity Flow

HexaTech is developing new semiconductors for electrical switches that will more efficiently control the flow of electricity across high-voltage electrical lines. A switch helps control electricity: switching it on and off, converting it from one voltage to another, and converting it from an Alternating Current (A/C) to a Direct Current (D/C) and back. Most switches today use silicon or silicon-based semiconductors, which are not able to handle high voltages, fast switching speeds, or high operating temperatures. HexaTech has developed highest quality, single crystalline Aluminum Nitride (AlN) semiconductor wafers. HexaTech AlN wafers are the enabling platform for power converters which can handle 50 times more voltage than silicon, as well as higher switching speeds and operating temperatures.

HRL LABORATORIES

HRL Laboratories, LLC ..... ARPA-E AWARDEE **Booth 315**

Rongming Chu
rchu@hrl.com
www.hrl.com

Low-Cost Gallium Nitride Vertical Transistor Switch

HRL Laboratories will develop a new, high-performance gallium nitride (GaN) vertical transistor that will displace inefficient silicon transistor technologies used in high-power switching applications like electric motor drives. HRL will improve device fabrication and circuit design to enable high-power operation of GaN. This new GaN vertical transistor could have 10 times lower power loss at the same cost as today's widely used silicon transistors.

HRL Laboratories, LLC ..... ARPA-E AWARDEE Booth 315

Dr. Karim Boutros
ksboutros@hrl.com
www.hrl.com

Compact, Interactive Electric Vehicle Charger

HRL Laboratories is using gallium nitride (GaN) semiconductors to create battery chargers for electric vehicles (EVs) that are more compact and efficient than traditional EV chargers. Reducing the size and weight of the battery charger is important because it would help improve the overall performance of the EV. GaN semiconductors process electricity faster than the silicon semiconductors used in most conventional EV battery chargers. These high-speed semiconductors can be paired with lighter-weight electrical circuit components, which helps decrease the overall weight of the EV battery charger. HRL Laboratories is combining the performance advantages of GaN semiconductors with an innovative, interactive battery-to-grid energy distribution design. This design would support 2-way power flow, enabling EV battery chargers to not only draw energy from the power grid, but also store and feed energy back into it.

I-Corps @ ARPA-E ..... Booth 824

Raffaella Montell
arpa-e.energy.gov/?q=arpa-e-site-page/i-corps-arpa-e

I-Corps@ ARPA-E

In 2012, ARPA-E and the National Science Foundation (NSF) partnered to have ARPA-E project teams participate in the "Innovation Corps" (I-Corps) program. I-Corps is an intensive, structured, and curriculum-based program designed to educate early-stage technology developers on business model development and the value of customer discovery. Three member teams to include the principal investigator, a student entrepreneur, and a business/industry mentor, undergo an interview process in order to be selected. NSF has I-Corps programs at the national level, with cohorts happening multiple times a year, along with regional I-Corps nodes, taking place within local ecosystems across the country.

iBeam Materials ..... ARPA-E AWARDEE Booth 1132

Vladimir Matias
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ibeammaterials.com

Epitaxial GaN on flexible metal tapes for low-cost transistor devices

iBeam Materials is developing a new way to manufacture low-cost gallium nitride (GaN) devices for use in large-scale power electronics. iBeam Materials will use crystal-aligned coatings on large-area, flexible, metal foils for deposition of epitaxial GaN films. This low-cost coating technology based on ion-beam induced grain alignment was recently developed to manufacture high-quality, low-cost superconductor wire in long lengths. If successful, iBeam Materials will adapt the coating technology for use in high-performance GaN electronic devices, significantly reducing manufacturing costs.

IDEAL POWER

Ideal Power, Inc. ..... ARPA-E AWARDEE **Booth 325**

Paul Bundschuh
Paul.Bundschuh@idealpower.com
www.idealpower.com

Lightweight PV Inverters

PV inverters convert DC power generated by modules into usable AC power. IPC's initial 30kW 97 lb. PV inverter reduces the weight of comparable 30kW PV inverters by 90%-reducing the cost of materials, manufacturing, shipping, and installation. With ARPA-E support, IPC intends to develop new bi-directional silicon power switches. With these components, IPC will produce 100 kW inverters that weight less than 200lbs., reducing the weight of conventional 3,000lb. 100 kW inverters by more than 90%.

ILLINOIS INSTITUTE OF TECHNOLOGY

Illinois Institute of Technology ..... ARPA-E AWARDEE **Poster 63**

John Katsoudas
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www.phys.iit.edu/~segre

Prototype of Rechargeable Nanoelectorfuel Flow Battery for EVs

Illinois Institute of Technology (IIT) is collaborating with Argonne National Laboratory to develop a rechargeable flow battery for EVs that uses a nanotechnology-based electrochemical liquid fuel that offers over 10 times the energy density of traditional redox electrolytes. Nanoelectrofuel is a liquid electrolyte containing a large portion of redox nanoparticles to carry its charge, which increases its energy density while ensuring stability and low-resistance flow within the battery. Liquid nanoelectrofuels could accelerate adaptation of EVs offering convenience of quick charge refills by pumping and remote fuel charging. This unique battery design could be manufactured domestically using an easily scalable process.

IMETALX

iMetalx ..... ARPA-E AWARDEE **Poster 3**

Nehal Gajjar
info@imetalx.com
www.imetalx.com

Advanced Titanium Electrowinning using Alternative Ores

iMetalx is scaling up an advanced electrochemical process to produce low-cost titanium from domestic ore. While titanium is a versatile and robust structural metal, its widespread adoption for consumer applications has been limited due to the high cost of production. By developing a scalable and stable electrochemical cell, iMetalx could significantly reduce the costs and energy consumption associated with producing titanium.

Infinia Technology Corporation ..... ARPA-E AWARDEE Booth 927

Peter Brehm
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ITCpowersolutions.com

Rugged Innovative Scalable ECU (RISE) & Free-Piston Zero Emission Refrigerator (FREEZER)

ITC has developed a modular, scalable and sustainable, natural refrigerant (synthetic refrigerant-free), distributed refrigeration platform at transformational efficiency and cost on a portfolio of U.S. Government sponsored technology development grants including numerous SBIR awards and two ARPA-E awards. ITC's Core Cooler Platform Technology enables revolutionary cooling and cryocooling with 20% to 200%+ efficiency increases and 50% to 90% cost reductions over incumbent HVAC (heating, ventilation & air conditioning), refrigeration, cooling and cryocooling technologies.

INFINIUM, Inc. ..... ARPA-E AWARDEE Booth 914

Adam Powell
apowell@infiniummetals.com
www.infiniummetals.com

Clean Efficient Aluminum Oxide Electrolysis Production using Pure Oxygen Anodes™

Infinium will develop an electrochemical aluminum-extraction process using Pure Oxygen Anodes™. Infinium's anode technology will eliminate the toxic and corrosive contamination associated with conventional extraction methods, and it will dramatically reduce energy losses compared to conventional extraction processes. If successful, Infinium will deploy low-cost and highly energy-efficient aluminum-production cells in minimills or large plants.

ITN Energy Systems, Inc. ..... ARPA-E AWARDEE Booth 1131

Ashutosh Misra
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www.itnes.com

Advanced Vanadium Redox Flow Battery

ITN is developing a vanadium redox flow battery for residential and small-scale commercial energy storage that would be more efficient and affordable than today's best energy storage systems. In a redox flow battery, chemical reactions occur that allow the battery to absorb or deliver electricity. Unlike conventional batteries, flow batteries use a liquid (also known as an electrolyte) to store energy; the more electrolyte used, the longer the battery can operate. Vanadium electrolyte-based redox flow battery systems are a technology for today's market, but they require expensive ion-exchange membranes. In the past, prices of vanadium have fluctuated, increasing the cost of the electrolyte and posing a major obstacle to more widespread adoption of vanadium redox flow batteries. ITN's design combines a low-cost ion-exchange membrane and a low-cost electrolyte solution to reduce overall system cost, ultimately making a vanadium redox flow battery cost-competitive with more traditional lead-acid batteries.

Jet Propulsion Laboratory ..... ARPA-E AWARDEE Poster 5

Ratnakumar Bugga
ratnakumar.v.bugga@jpl.nasa.gov
www.jpl.nasa.gov

Safe, High Energy and Robust Aqueous Battery for Electric Vehicles

NASA-JPL, in collaboration with Caltech and industry, is proposing to develop low cost and safe aqueous rechargeable metal hydride–air batteries with high specific energy (150 Wh/kg), high energy density (300 Wh/l) and long cycle life (> 1000 cycles) for electric vehicle applications. The proposed metal-hydride-air battery employs high specific capacity metal hydride anodes, long life bi-functional air cathodes with low cost catalysts, and alkaline polymer electrolyte membranes for water and gas management required to enhance cell performance.

Kohana Technologies Inc. ..... ARPA-E AWARDEE Booth 639

Paul Lees
paul@kohanatech.com
www.kohanatech.com

Adaptive Turbine Blades: Blown Wing Technology for Low-Cost Wind Power

Kohana's "Blown Wing Technology" offers the potential to revolutionize the landscape of wind turbine control, and lead to significant reductions in the associated cost of energy. It provides a high bandwidth, high-authority control system that results in vastly reduced peak structural loads. The system is simple, with no moving parts in the outboard of the blade, and few required additions to the wind turbine system, it is truly viable in a real world turbine environment. A step change in wind turbine control.

Kyma Technologies ..... ARPA-E AWARDEE Booth 441

Keith Evans
evans@kymatech.com
www.kymatech.com

Transformational GaN Substrate Technology

Kyma Technologies will develop a cost-effective technique to grow high-quality gallium nitride (GaN) by developing a high growth rate process for creating crystalline GaN boules, which are used as starting material for semiconductor device manufacturing. Currently, growing boules from GaN seeds is slow, expensive, and inconsistent, which negatively affects manufacturing yield and device performance. Kyma will select the highest quality GaN seeds and use their proprietary hydride vapor phase epitaxy growth process to rapidly grow the seeds into boules while maintaining high crystal structural quality and purity. If successful, Kyma will produce low-cost, high-performing boules needed for power semiconductor manufacturing.

LanzaTech Inc. ..... ARPA-E AWARDEE Booth 849

Derek Griffin
derek.griffin@lanzatech.com
www.lanzatech.com

Innovative Bioreactor Designs for Process Intensification in Biological Natural Gas Conversion

LanzaTech will design a gas fermentation system that significantly improves the rate at which methane gas is delivered to a biocatalyst. Current gas fermentation processes and other gas-to-liquid technologies are not cost effective in small-scale production. If successful, LanzaTech's system will process large amounts of remote methane sources at a high rate, reducing the energy inputs and capital costs associated with methane conversion.

Lawrence Berkeley National Laboratory..... ARPA-E AWARDEE Booth 1020

Philip Haves
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www.lbl.gov

Backpack-Mounted Building Efficiency Modeling

LBNL and partners are developing a portable system of sensing and computer hardware to rapidly generate indoor thermal and physical building maps. Using cameras and laser scanners, the team will create a 3D visualization of walls, windows, floors, and other parts of buildings and use a computer model to predict how much energy the building should use. These cameras and scanners are mounted on a backpack, allowing a person to walk through and record the interior of an entire building.

Lawrence Berkeley National Laboratory..... ARPA-E AWARDEE Booth 1021

Christer Jansson
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www.lbl.gov

FOLIUM: Foliar production of hydrocarbon fuels in tobacco leaves.

LBNL is modifying tobacco to enable it to directly produce fuel molecules in its leaves for use as a biofuel. Tobacco is a good crop for biofuels production because it is an outstanding biomass crop, has a long history of cultivation, does not compete with the national food supply, and is highly responsive to genetic manipulation. LBNL will incorporate traits for hydrocarbon biosynthesis from cyanobacteria and algae, and enhance light utilization and carbon uptake in tobacco, improving the efficiency of photosynthesis so more fuel can be produced in the leaves. The tobacco-generated biofuels can be processed for gasoline, jet fuel or diesel alternatives. LBNL is also working to optimize methods for planting, cultivating and harvesting tobacco to increase biomass production several-fold over the level of traditional growing techniques.

Lawrence Berkeley National Laboratory..... ARPA-E AWARDEE Booth 1224

Christer Jansson
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www.lbl.gov

Methylase: Enzyme Engineering for Direct Methane Conversion

We intend to develop a biological system for efficient conversion of methane to liquid transportation fuel. The focus is on engineering a key enzyme for activation of methane, such that a high yield of carbon and energy content of the methane molecule can be directed to metabolic pathways leading to the biosynthesis of high-energy density liquid fuels. The result will be a novel methylase enzyme and methane assimilation cycle generating production a fuel intermediate and regeneration of the methyl acceptor molecule.

Lawrence Berkeley National Laboratory/ Heliotrope Technologies ..... ARPA-E AWARDEE Booth 1013

Guillermo Garcia
memo@heliotropetech.com
www.lbl.gov and www.heliotropetech.com

Low Cost Universal Smart Window Coatings

LBNL is developing low-cost coatings that control how light enters buildings through windows. By individually blocking infrared and visible components of sunlight, LBNL's design would allow building occupants to better control the amount of heat and the brightness of light that enters the structure, saving heating, cooling, and lighting costs. These coatings can be applied to windows using inexpensive techniques similar to spray-painting a car to keep the cost per window low. Windows incorporating these coatings and a simple control system have the potential to dramatically enhance energy efficiency and reduce energy consumption throughout the commercial and residential building sectors.

Lawrence Livermore National Laboratory (LLNL) ..... ARPA-E AWARDEE Booth 245

www.llnl.gov

Wireless Sensor System for Battery Packs

LLNL is developing a wireless sensor system to improve the safety and reliability of lithium-ion (LI-ion) battery systems by monitoring key operating parameters of LI-ion cells and battery packs. This system can be used to control battery operation and provide early indicators of battery failure. LLNL's design will monitor every cell within a large LI-ion battery pack without the need for large bundles of cables to carry sensor signals to the battery management system. This wireless sensor network will dramatically reduce system cost, improve operational performance, and detect battery pack failures in real time, enabling a path to cheaper, better, and safer large-scale batteries.

Lionano Inc. ..... Booth 920

contact@lionanobattery.com
www.lionanobattery.com

Advanced Li-ion battery anode materials with 3x energy capacity, 4x durability, 3x faster charging rate, 40% higher safety and only 20% cost

Lionano Inc. is a Cornellian startup company selling an advanced drop-in replacement anode material for the lithium-ion batteries (LIBs), which increases the capacity (3X), prolongs battery durability (4X) and reduces charging time (1/3), with only 20% cost as compared to the current anode material, with significantly improved safety. This technology has been completely developed and Lionano is ready to launch the product. Considering 300% capacity improvement and 80% cost savings relative to current materials, our technology saves at least $75/kWh. Each EV equipped with a 60 kWh battery would yield savings of about $4500/ vehicle.

Liquid Light, Inc ..... Booth 1215

Kyle Teamey
kteamey@llchemical.com
www.llchemical.com

Process Technology to Make Major Chemicals from Carbon Dioxide

Liquid Light is a chemical technology company that has developed catalysts, reactors, and processes for the efficient conversion of carbon dioxide to chemicals and fuels. The company has further developed a unique co-production process that allows the simultaneous production of chemicals from carbon dioxide and shale gas. Liquid Light offers lower costs of production than existing best available technologies in markets worth more than $250B in processes with low or negative carbon dioxide emissions. Our investors and partners include BP, VantagePoint, Chrysalix, Osage, and Princeton University.

LiquidPiston, Inc. .....Booth 538

Alexander Shkolnik
www.liquidpiston.com

High Efficiency Rotary Diesel Combustion Engine

LiquidPiston, Inc. develops compact, quiet, high-efficiency, low-vibration, multi-fuel capable combustion engines that are scalable from 1 HP to over 1000 HP. LiquidPiston's X Engine is a non-Wankel rotary embodiment of the company's innovative High Efficiency Hybrid Cycle (HEHC).

Benefits:

- Lightweight and compact (high power density of up to 2 HP/Lb) (5-10x smaller/lighter than comparable diesel engines)
- Quiet (no poppet valves) (exhaust turbulence minimized by over-expansion)
- High-efficiency (75% theoretical thermal cycle efficiency of HEHC, LiquidPiston's patented cycle) (57% expected realized peak brake efficiency)
- Low-vibration (only two primary moving parts, optimally balanced)
- Multi-fuel capable (diesel, natural gas, gasoline, JP-8, etc.)

Massachusetts Institute of Technology ..... ARPA-E AWARDEE Booth 337

Dr. Jongyoon Han
jyhan@mit.edu

Water Purification Technology for Energy Industry

In this project, we will develop several key technologies to address serious water challenges in energy industry, including produced water and high concentration brine. A novel electrical desalination technique (ICP desalination) will be developed and optimized for this particular application. In addition, a hybrid technology of electrocoagulation (EC) and ICP desalination will be demonstrated, for removing suspended solids and extracting desalted water. Advanced chemical coatings will be explored to address serious fouling challenges in the desalination systems.

Massachusetts Institute of Technology ..... ARPA-E AWARDEE **Booth 530**

Dr. Leslie Bromberg
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www.psfc.mit.edu

Compact Inexpensive Reformers for Natural Gas

MIT is leveraging existing engine technology to develop a compact reformer for natural gas conversion. Reformers produce synthesis gas-the first step in the commercial process of converting natural gas to liquid fuels. As a major component of any gas-to-liquid plant, the reformer represents a substantial cost. MIT's re-designed reformer would be compact, inexpensive, and easily integrated with small-scale chemical reactors. MIT's technology allows for significant cost savings by harnessing equipment that is already manufactured and readily available. Unlike other systems that are too large to be deployed remotely, MIT's reformer could be used for small, remote sources of gas.

Massachusetts Institute of Technology ..... ARPA-E AWARDEE **Booth 736**

Evelyn Wang
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drl.mit.edu/research.cgi?p=storage

Advanced Thermo-Adsorptive Battery

MIT is developing a low-cost, compact, high-capacity, advanced thermo-adsorptive battery (ATB) for effective climate control of EVs. The ATB provides both heating and cooling by taking advantage of the materials' ability to adsorb a significant amount of water. This efficient battery system design could offer up as much as a 30% increase in driving range compared to current EV climate control technology. The ATB provides high-capacity thermal storage with little-to-no electrical power consumption. MIT is also planning to explore the possibility of shifting peak electricity loads for cooling and heating in a variety of other applications, including commercial and residential buildings, data centers, and telecom facilities.

Massachusetts Institute of Technology ..... ARPA-E AWARDEE **Booth 815**

John McGann
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www.mit.edu

Solar Thermal Energy Storage Device

MIT is developing a thermal energy storage device that captures energy from the sun which can be stored and released at a later time when it is needed most. Within the device, the absorption of sunlight causes the solar thermal fuel's photoactive molecules to change shape, which allows energy to be stored within their chemical bonds. A trigger is applied to release the stored energy as heat, where it can be converted into electricity or used directly as heat. The molecules would then revert to their original shape, and can be recharged using sunlight to begin the process anew. MIT's technology would be 100% renewable, rechargeable like a battery, and emissions-free. Devices using these solar thermal fuels-called HybriSol-can also be used without a grid infrastructure for applications such as de-icing, heating, cooking, and water purification.

Massachusettes Institute of Technology, NanoEngineering Group ..... ARPA-E AWARDEE Booth 919

Dr. James Loomis
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Efficient Heat Storage Materials

The NanoEngineering Group is part of the Mechanical Engineering Department at MIT with research focused on nanoscale energy transport, conversion, and storage. There are fundamental differences between transport processes at the nanoscale and the macroscale due to quantum and classical size effects. For example, both classical diffusion laws and Planck's law for blackbody radiation break down in nanostructures. We explore these effects for improving energy conversion efficiency and storage density, and thermal energy transport. Examples include development of nanostructured thermoelectric materials, use of nanotechnology to advance solar thermal and photovoltaic devices, and fundamental investigation of phonon transport.

Massachusetts Institute of Technology ..... ARPA-E AWARDEE Booth 1027

Adrian Fay
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Natural Oil Production from Microorganisms

MIT is using carbon dioxide (CO_2) and hydrogen generated from electricity to produce natural oils that can be upgraded to hydrocarbon fuels. MIT has designed a 2-stage biofuel production system. In the first stage, hydrogen and CO_2 are fed to a microorganism capable of converting these feedstocks to a 2-carbon compound called acetate. In the second stage, acetate is delivered to a different microorganism that uses the acetate to grow and produce oil. The oil can be removed from the reactor tank and chemically converted to various hydrocarbons. The electricity for the process could be supplied from novel means currently in development, or more proven methods such as the combustion of municipal waste, which would also generate the required CO_2 and enhance the overall efficiency of MIT's biofuel-production system.

Massachusetts Institute of Technology ..... ARPA-E AWARDEE Booth 1027

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Bio-GTL: Direct and Indirect Paths of Methane Activation and Conversion to Biofuels

Massachusetts Institute of Technology ..... ARPA-E AWARDEE Booth 1032

Gary DesGroseilliers
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Advanced Technologies for integrated Power Electronics

This research will improve the size, integration and performance of power electronics enabling a reduction in electrical energy consumption. We focus on co-optimizing advanced GaN semiconductor devices, microfabricated magnetics, and high-frequency circuit architectures to improve the interface between electric grid sources and loads. This work will address power electronics bottlenecks in the application of high-efficiency solid-state lighting.

Materials & Systems Research, Inc. ..... ARPA-E AWARDEE Booth 813

Joonho Koh
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Advanced Sodium Battery

MSRI is developing a high-strength, low-cost solid-state electrolyte membrane structure for use in advanced grid-scale sodium batteries. The electrolyte, a separator between the positive and negative electrodes, carries charged materials called ions. In the solid electrolyte sodium batteries, sodium ions move through the solid-state ceramic electrolyte. This electrolyte is normally brittle, expensive, and difficult to produce because it is formed over the course of hours in high-temperature furnaces. With MSRI's design, this ceramic electrolyte will be produced cheaply within minutes by single-step coating technologies onto high-strength support materials. The high-strength support material provides excellent structural integrity, much superior to the conventional cell design which depends solely on the brittle ceramic material for its strength. The resultant stronger, cheaper sodium battery design will enable a new generation of low-cost, safe, and reliable batteries for grid-scale energy storage applications.

Medical University of South Carolina..... ARPA-E AWARDEE Booth 941

Harold May
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Electroalcoholgenesis: Bioelectrochemical Reduction of CO_2 to Butanol

Electrofuel & Electrochemical Synthesis. MUSC has discovered a bioelectrochemical system capable of producing up to 2.6 kg of hydrogen and 3.1 kg of acetate per m^3 of catholyte volume per day. The system consists of a highly developed electrosynthetic microbial community, graphite electrodes, and a cation exchange membrane, without rare earth, noble elements or expensive catalysts. In its present state the system produces a kg of hydrogen (1 gallon of gasoline equivalent) with $5.36 to $13.40 of electricity ($0.02 to $0.05 per kWh) and potentially may be modified for liquid fuel production.

Michigan State University..... ARPA-E AWARDEE Poster 29

Timothy Grotjohn
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www.egr.msu.edu/~grotjohn/DiamondElectronics

Diamond Diode and Transistor Devices

High-voltage diamond semiconductor devices are being built for high-power electronics. Diamond has properties that include an exceptional thermal conductivity and a high electric field breakdown strength that exceeds other semiconductor materials. Diamond is also an excellent conductor of electricity when boron or phosphorus are added, or doped, into the crystal structure. Diamond can withstand much higher temperatures with higher performance levels than silicon, which is widely used in today's semiconductors. Project objectives are to grow diamond layers with different doping levels and elements and then to fabricate electronic diamond devices capable of conducting enough electricity for high-power electronics.

MICHIGAN STATE UNIVERSITY

Michigan State University ..... ARPA-E AWARDEE **Booth 819**

Fang Zheng Peng
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Power Flow Controller for Renewables

MSU is developing a power flow controller to improve the routing of electricity from renewable sources through existing power lines. The fast, innovative, and lightweight circuitry that MSU is incorporating into its controller will eliminate the need for a separate heavy and expensive transformer, as well as the construction of new transmission lines. MSU's controller is better suited to control power flows from distributed and intermittent wind and solar power systems than traditional transformer-based controllers are, so it will help to integrate more renewable energy into the grid. MSU's power flow controller can be installed anywhere in the existing grid to optimize energy transmission and help reduce transmission congestion.

MicroLink Devices, Inc.

MicroLink Devices ..... ARPA-E AWARDEE **Booth 717**

David McCallum
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High-Power Vertical-Junction Field-Effect Transistors Fabricated on Low-Dislocation-Density GaN by Epitaxial Lift-Off

MicroLink Devices plans to reduce the cost of high power transistors by developing a method of removing the transistor structure from the gallium nitride deposition wafer without damaging either the transistor or the wafer so that the wafer can be reused many times. This method involves growing a release layer under the transistor structure. The composition of the release layer means that it dissolves many times faster than the surrounding material when exposed to the correct combination of chemicals and light. This allows the transistor structure to be lifted off the gallium nitride wafer.

MicroLink Devices, Inc.

MicroLink Devices ..... ARPA-E AWARDEE **Booth 717**

David McCallum
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www.mldevices.com

High Efficiency, Lattice-Matched Solar Cells Using Epitaxial Lift-Off

MicroLink Devices are developing a novel, high-efficiency, all-lattice-matched solar cell that can achieve much higher power conversion efficiency than is possible with current CPV technologies. We use a triple-junction InAlAsSb/InGaAsP/InGaAs cell lattice-matched to InP. With the inclusion of strain-balanced quantum well layers in the bottom subcell, this structure has a subcell bandgap combination with the potential to achieve power conversion efficiency >50% under 500x AM1.5D illumination. The wide band-gap, InAlAsSb top-junction is a novel solar cell material and is the key enabling technology for this project. The cost of the InP substrate will be mitigated using our epitaxial lift-off (ELO) process.

MOgene

MOgene Green Chemicals..... ARPA-E AWARDEE Poster 20

Abhay
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Biotransformation of Methane into n-butanol by a Methanotrophic Cyanobacterium

MOgene Green Chemicals technology will utilize a phototrophic organism for cost-effective conversion of methane into liquid transportation fuel. A methanotrophic and phototrophic biocatalyst will derive its entire energy requirement from sunlight. It will naturally provide oxygen (produced from water) for activation of methane, and CO_2 released during biotransformation process would also be captured by the native carbon fixation pathways. These attributes will significantly minimize the energy- and economic inputs, while lowering the carbon footprint of methane biotransformation into energy-dense liquid transformation fuels.

MONOLITH SEMICONDUCTOR INC.

Monolith Semiconductor Inc..... ARPA-E AWARDEE Booth 227

Kevin Matocha
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Advanced Manufacturing and Performance Enhancements for Reduced-cost Silicon Carbide MOSFETs (AMPERES)

Monolith Semiconductor will utilize advanced device designs and existing low-cost, high-volume manufacturing processes to create high-performance silicon carbide (SiC) diodes and switches for power conversion. SiC devices provide much better performance and efficiency than current silicon devices, however they currently cost significantly more. Monolith is developing a high-volume SiC production process that utilizes existing silicon manufacturing facilities to minimize capital costs and increase the affordability of advanced Silicon Carbide power semiconductor devices.

MTPV

MTPV Power Corporation ..... Booth 1233

David Mather
www.mtpv.com

MTPV (Micron-gap Thermal Photovoltaic) makes semiconductor chips that convert heat directly into electricity

MTPV (Micron-gap Thermal Photovoltaic) makes semiconductor chips that convert heat directly into electricity. Much like a solar panel that converts sunlight into electricity, MTPV solutions are able to convert any source of heat into electricity with several significant advantages when compared to other chip based solutions. MTPV chips are able to generate 10x to 50x more power, with 45% less heat/temperature than competitive technologies and are capable of generating 1-50 watts/cm^2 at efficiencies between 10%-60%. MTPV solutions are solid-state, scalable, and create 100% green energy when converting waste heat to electricity.

National Renewable Energy Laboratory..... ARPA-E AWARDEE Poster 76

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High Energy, Long Life Organic Battery with Quick Charge Capability

Sales of battery electric vehicles (BEVs) are limited by range, cost, and safety. Charge time, resource availability, and disposal concerns also impede BEV adoption. The National Renewable Energy Laboratory (NREL) has proposed a battery design that addresses all of these issues by decoupling requirements for energy density, safety, service life, and charge time with a liquid phase system that uses renewable, low cost, organic materials. In this 2014 project, NREL, EIC Laboratories, and Chemtura Corporation will assess the feasibility of this technology by tuning process chemistry, testing a prototype cell, and evaluating performance and cost.

National Renewable Energy Laboratory..... ARPA-E AWARDEE Booth 842

David Ginley
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www.nrel.gov

Solar Thermoelectric Generator

NREL is developing a solar thermoelectric generator to directly convert heat from concentrated sunlight to electricity. Thermoelectric devices can directly convert heat to electricity, yet due to cost and efficiency limitations they have not been viewed as a viable large-scale energy conversion technology. However, new thermoelectric materials have dramatically increased the efficiency of direct heat-to-electricity conversion. NREL is using these innovative materials to develop a new solar thermoelectric generator. This device will concentrate sunlight onto an absorbing surface on top of a thermoelectric stage and the resulting temperature difference between the top and bottom of the device will drive the generator to produce electricity at 3 times the efficiency of current systems. NREL's solar thermoelectric generator could reduce the cost associated with converting large amounts of solar energy into electricity through a much simpler and scalable process which does not rely upon moving parts and transfer fluids.

North Carolina State University..... ARPA-E AWARDEE Booth 542

Heike Sederoff
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Jet Fuel From Camelina Sativa: A Systems Approach

NC State has genetically engineered the oil-crop plant Camelina sativa to produce high seed yield, high quantities of both modified oils and terpenes. These components are optimized for thermocatalytic conversion into energy-dense drop-in transportation fuels. The genetically engineered Camelina capture more carbon than current varieties and have higher oil yields. These Camelina plants are more tolerant to drought and heat, which makes them suitable for farming in warmer and drier climate zones in the US. The increased productivity of NC State's enhanced Camelina and the development of energy-effective harvesting, extraction, and conversion technology provides an alternative non-petrochemical source.

North Carolina State University/ University of Georgia ..... ARPA-E AWARDEE Booth 229

Robert Kelly
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Hydrogen-Dependent Conversion of Carbon Dioxide to Liquid Electrofuels By Extremely Thermophilic Archaea

This project combines enzymes from a novel CO_2 fixation cycle discovered in an extremely thermoacidophilic microorganism (Metallosphaera sedula) that grows optimally near 75°C/pH 2 with enzymes recruited from other high temperature organisms to construct a metabolically engineered strain of Pyrococcus furiosus (grows optimally at 100°C). This strain uses hydrogen gas to convert CO_2 into C-2 and C-4 intermediates that are converted to biofuels, such as ethanol and butanol. Key advantage are microbiological function at high temperatures, where product recovery processes operate, and the use of temperature as a driving mechanism for gene regulation.

Northwestern University..... ARPA-E AWARDEE Poster 34

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Engineering Enzymes for Methane C-H Activation

Methane monooxygenase (MMO) enzymes are the only biological systems known to activate the methane C-H bond, but their commercial viability is limited due to poor efficiency and complexity. Northwestern University in collaboration with the California Institute of Technology and Protabit, will engineer single peptide MMO-like enzymes that activate methane efficiently and can be expressed in model organisms. This technology will transform well-established chemistry found in nature into commercially accessible chemistry for methane C-H activation.

Oak Ridge National Laboratory ..... ARPA-E AWARDEE Booth 347

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SAFIRE a Safe Impact Resistant Electrolyte

We are focused on liquid electrolytes which under go a liquid-to-solid phase transformation upon application of a mechanical force, like an impact. The resulting solid will prevent electrical shorts and reduce the risk of fires in battery packs.

Oak Ridge National Laboratory ..... ARPA-E AWARDEE Booth 446

www.ornl.gov

Magnetic Amplifier for Power Flow Control

ORNL is developing an electromagnet-based, amplifier-like device that will allow for complete control over the flow of power within the electric grid. To date, complete control of power flow within the grid has been prohibitively expensive. ORNL's controller could provide a reliable, cost-effective solution to this problem. The team is combining two types of pre-existing technologies to assist in flow control, culminating in a prototype iron-based magnetic amplifier. Ordinarily, such a device would require expensive superconductive wire, but the magnetic iron core of ORNL's device could serve as a low-cost alternative that is equally adept at regulating power flow.

Oak Ridge National Laboratory ..... ARPA-E AWARDEE Booth 741

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Temperature-Regulated Batteries

ORNL is developing an innovative battery design to more effectively regulate temperature within a battery during use. Today's batteries are not fully equipped to monitor and regulate internal temperatures, which can negatively impact battery performance, lifetime, and safety. ORNL's design and electrochemical-based model would integrate efficient temperature control at single-layer level inside large format lithium ion cells. In addition to monitoring temperatures, the design would provide active cooling and temperature control deep within the cell, which would represent a dramatic improvement over today's systems. Prototype cells with side thermal tabs have shown expected improvement in cell temperature control.

Ohio State University ..... ARPA-E AWARDEE Booth 442

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Syngas into Fuel

Ohio State has developed an iron-based material and process for converting syngas-a synthetic gas mixture-into electricity, H2, and/or liquid fuel with zero CO_2 emissions. Traditional carbon capture methods use chemical solvents or special membranes to separate CO_2 from the gas exhaust from coal-fired power plants. Ohio State's technology uses an iron-based oxygen carrier to generate CO_2 and H2 from syngas in separate, pure product streams by means of a circulating bed reactor configuration.

Ohio State University ..... ARPA-E AWARDEE Booth 1129

www.osu.edu

Fuel From Bacteria

Ohio State is genetically modifying bacteria to efficiently convert carbon dioxide directly into butanol, an alcohol that can be used directly as a fuel blend or converted to a hydrocarbon, which closely resembles gasoline. Bacteria are typically capable of producing a certain amount of butanol before it becomes too toxic for the bacteria to survive. Ohio State is engineering a new strain of the bacteria that could produce up to 50% more butanol before it becomes too toxic for the bacteria to survive. Finding a way to produce more butanol more efficiently would significantly cut down on biofuel production costs and help make butanol cost competitive with gasoline. Ohio State is also engineering large tanks, or bioreactors, to grow the biofuel-producing bacteria in, and developing ways to efficiently recover biofuel from the tanks.

Oregon State University ..... ARPA-E AWARDEE Poster 32

Bio-Lamina-Plates Bioreactor for Enhanced Mass and Heat Transfer

Oregon State University ..... ARPA-E AWARDEE Booth 821

Chris Hagen
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www.osucascades.edu/energy-systems-lab

Gas-Compressing Engine

OSU is modifying a passenger vehicle to allow its internal combustion engine to be used to compress natural gas for storage on board the vehicle. Ordinarily, filling a compressed natural gas vehicle with natural gas would involve driving to a natural gas refueling station or buying an expensive stand-alone station for home use. OSU's design would allow natural gas compression to take place in a single cylinder of the engine itself, allowing the car to behave like a natural gas refueling station. Ultimately, the engine would then have the ability both to power the vehicle and to compress natural gas so it can be stored efficiently for future use. The design would cost approximately $400 and pay for itself with fuel savings in less than 6 months.

Otherlab ..... ARPA-E AWARDEE Booth 618

Tucker Gilman
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www.otherlab.com

Safe, Dense, Conformal, Gas Intestine Storage

Otherlab has developed a conformable pressure vessel that greatly increases volumetric efficiency over current technology while also offering additional capacity and decreased manufacturing cost.

Otherlab ..... ARPA-E AWARDEE Booth 618

Leila Madrone
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www.otherlab.com

Small Mirrors for Solar Power Tower Plants

Otherlab is developing an inexpensive small mirror system with an innovative drive system to reflect sunlight onto concentrating solar power towers at greatly reduced cost. This system is an alternative to expensive and bulky 20-30 foot tall mirrors and expensive sun-tracking drives used in today's concentrating solar power plants. In order for solar power tower plants to compete with conventional electricity generation, these plants need dramatic component cost reductions and lower maintenance and operational expenses. Otherlab's approach uses a smaller modular mirror design that reduces handling difficulty, suffers less from high winds, and allows the use of mass manufacturing processes.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1112

Pete McGrail
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Genset Heat Recovery Adsorption Chiller for Military Forward Operating Bases

This project will leverage the superhydrophilic properties of a metal-organic framework sorbent developed under the BEETIT program to design, manufacture, and test a ¾ ton adsorption chiller that is substantially smaller, lighter, and far exceeds the operating performance requirements specified by the Navy for forward operations base deployments while meeting cost targets as well. An advanced adsorption module and system design will be utilized to minimize overall size and weight of the chiller and provide rapid heat transfer and efficient internal heat recuperation.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1112

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Catalyzed Organo-Metathetical (COMET) Process for Magnesium Production from Seawater

Producing magnesium is energy intensive and expensive because its concentration in seawater is low and significant energy is used to evaporate off water. Further, conventional technologies require heating the salt to 900°C and electric current to break the chemical bond between magnesium and chlorine. PNNL's new process combines a low-temperature, low-energy dehydration process with a new catalyst-assisted process to generate an organometallic reactant directly from magnesium chloride. The organometallic is decomposed to magnesium metal via a proprietary process at temperatures less than 300°C, thus eliminating electrolysis of magnesium chloride salt completely and cutting overall energy use by 50%.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1114

Ewa Ronnebro
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Reversible Metal Hydride Thermal Storage for High Temperature Power Generation Systems

Pacific Northwest National Laboratory (PNNL) is developing a thermal energy storage system based on a Reversible Metal Hydride Thermochemical (RMHT) system, which uses metal hydride as a heat storage material with high efficiencies. In solar thermal storage systems, heat can be stored in these materials during the day and released at night to produce electricity. PNNL's metal hydride material can reversibly store large amounts of heat as hydrogen cycles in and out of the material, operating at 650°C under ambient pressures. The low-cost material and simplicity of PNNL's thermal energy storage system is expected to keep costs down.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1124

Kevin Simmons
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Ultra-Light Conformable Natural Gas Tank

PNNL is developing a low-cost, conformable natural gas tank for light-duty vehicles based on metal forming techniques that have been used to fabricate high-strength, hollow structures such as cruise missile fins. Traditional compressed natural gas (CNG) tanks are composite cylinders filament wound over a metal or plastic liner. But cylinders have limited conformability to efficiently fill vehicle spaces. The manufacturing process for PNNL's tank designs incorporate high-strength internal strut technology which allows for shapes that efficiently fit into a vehicle, thereby offering expanded volume usage and increased CNG capacity.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1128

Jun Cui
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Manganese-Based Permanent Magnet with 40 MGOe at 200 °C

PNNL is working on MnBi magnets that could serve as an inexpensive alternative to rare earths. The manganese composite, made from low-cost and abundant materials, could challenge the magnetic strength of magnets relative to today's most powerful commercial magnets at 200 C. Members of PNNL's research team will leverage high-performance supercomputer modeling and conduct synthesis experiments of various metal composites that do not contain rare earths.

Pacific Northwest National Lab..... ARPA-E AWARDEE Booth 1226

Wei Liu
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Novel Membrane Dehumidifier-enabled Air Cooling

Novel thin-sheet zeolite membranes are developed by growing a dense zeolite layer on a 50μm-thick robust porous metal support sheet. The metal foil-like membrane sheet provides unique molecular-sieving separation functions possessed by a zeolite membrane which enables the zeolite membrane to be manufactured at competitive costs in a way similar to other planar commodity products. With a water-selective zeolite membrane as an example, the membrane shows exceptionally high moisture permeance and selectivity over other molecules. Such membranes enable development of compact membrane dehumidifiers and new evaporative air cooling units that are highly efficient and do not produce environmental emissions.

Pacific Northwest National Laboratory ..... ARPA-E AWARDEE Booth 1243

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Non-Wire Methods for Transmission Congestion Management through Predictive Simulation and Optimization

The team proposes a non-wire solution to relieving the transmission congestion problem, which will improve the transient and voltage stability simulation 20 times faster, enable path rating studies to be performed at intervals of 5-10 minutes, and utilize existing transmission assets 30% more efficiently. This will save billions of dollars every year in reducing generation costs, minimizing congestion costs and deferring transmission investment. The outcome would fundamentally transform how the grid is operated to maximize the value of national transmission assets, as well as facilitate integration of renewable energy and smart loads.

Pacific Northwest National Laboratory and Quanta Technology ..... ARPA-E AWARDEE Booth 1245

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Non-wire Methods for Transmission Congestion Management through Predictive Simulation and Optimization

The team proposes a non-wire solution to relieving the transmission congestion problem, which will improve the transient and voltage stability simulation 20 times faster, enable path rating studies to be performed at intervals of 5-10 minutes, and utilize existing transmission assets 30% more efficiently. This will save billions of dollars every year in reducing generation costs, minimizing congestion costs and deferring transmission investment. The outcome would fundamentally transform how the grid is operated to maximize the value of national transmission assets, as well as facilitate integration of renewable energy and smart loads.

PARC, a Xerox company ..... ARPA-E AWARDEE **Booth 1117**

Eric Shrader
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Innovative Manufacturing Process for Li-ion Batteries

PARC is developing a new way to manufacture Li-ion batteries that reduces manufacturing costs and improves overall battery performance. Traditionally, Li-ion manufacturers make each layer of the battery separately and then integrate the layers together. PARC is working to manufacture a Li-ion battery by printing each layer simultaneously into an integrated battery, thereby streamlining the manufacturing process. Additionally, the battery structure includes narrow stripes inside the layers that increase the battery's overall energy storage. Together, these innovations should allow the production of higher capacity batteries at dramatically lower manufacturing costs compared to today's Li-ion batteries.

PARC, a Xerox company ..... ARPA-E AWARDEE **Booth 1115**

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Probing Alloys for Rapid Sorting Electrochemically (PARSE)

PARC is developing a new electrochemical diagnostic probe that identifies the composition of light metal scrap for efficient sorting. Current sorting technologies for light metals are costly and inefficient because they cannot distinguish between different metals. While the PARSE technology is capable of identifying a range of metals and alloys, the application focus of the project will be to scan through Aluminum/Magnesium scrap aggregates at great speed and distinguish high-value alloy compositions from low-value ones with high accuracy. Currently no commercial automated method capable of rapid and high-precision identification of such alloys exists.

PARC, a Xerox company ..... ARPA-E AWARDEE **Booth 1119**

Ajay Raghavan
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Embedded Fiber Optic Sensing System for Battery Packs

PARC and LG Chem Power (LGCPI) are developing an embedded fiber-optic sensing system prototype targeting batteries for electric vehicles (EVs) The system will use PARC's compact wavelength-shift detection technology and intelligent algorithms expertise to enable effective real-time performance management and optimized battery design. Capabilities will range from inferring state and health information to predicting remaining life, and the resulting commercial EV-grade battery module with embedded fiber-optic sensors and readout unit will undergo industry-standard validation at LGCPI's facilities. Promising initial results have been shown using this technology toward improving performance and reducing costs and oversizing in next-generation energy storage technologies.

Penn State University..... ARPA-E AWARDEE **Poster 19**

www.psu.edu

Engineering a Methane-to-Acetate Pathway for Producing Liquid Biofuels

The goal of this project is reversal of the acetate-to-methane pathway to provide a platform for converting methane to liquid fuels. Reversal will be accomplished by engineering Methanosarcina acetivorans to bypass membrane-bound complexes and introduce enzymes genetically modified to optimize reversal of key reactions. Modifications will be facilitated by computational design. Regulation of gene expression will be optimized through identification of regulatory proteins and engineering promoter sequences. Evaluation of the reversed pathway will be enabled by co-culturing M. acetivorans with an acetate-utilizing species. Optimization of the reversed pathway will be facilitated by genome-scale modeling.

Penn State University..... ARPA-E AWARDEE **Poster 71**

Chris Rahn

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PowerPanels: Multifunctional Composites with Li-Ion Battery Cores

This RANGE seedling project develops sandwich panels with Li-Ion battery cores for electric vehicles. High performance battery materials are integrated into the core of a sandwich panel. The PowerPanel design allows the battery materials to carry structural loads without impacting electrochemical performance. PowerPanels combine the structural and energy storage functions of an electric vehicle in the same volume, increasing the energy density of the vehicle. The large surface area to volume ratio of the PowerPanel design limits temperature excursions, increasing vehicle safety.

Penn State University..... ARPA-E AWARDEE **Booth 1142**

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Reconfigurable Battery Packs

Penn State is developing an innovative, reconfigurable design for electric vehicle battery packs that can re-route power in real time between individual cells. Much like how most cars carry a spare tire in the event of a blowout, today's battery packs contain extra capacity to continue supplying power, managing current, and maintaining capacity as cells age and degrade. Some batteries carry more than 4 times the capacity needed to maintain operation. Penn State is developing innovative reconfigurable pack management and diagnostics technologies to manage long-term pack health more effectively, thereby reducing the need for overdesign.

Penn State Applied Research Lab ..... ARPA-E AWARDEE Booth 1214

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Trillium: A Helium-Based Sonic Chiller - Tons of Freezing with 0 GWP Refrigerants

A leader in the development and commercialization of thermoacoustic technology, the team at Penn State's Applied Research Lab is prototyping a new design for a thermoacoustic freezer called Trillium that has improved efficiency and significantly reduced Total Environmental Warming Impact (TEWI) compared to the state-of-the-shelf. The goal of the project is to work with potential sub-system manufacturers to establish processes and competence so that an integrator will be ready to build Trillium-based machines by the end of the project.

Phinix, LLC ..... ARPA-E AWARDEE Poster 1

Dr. Subodh Das
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Production of Primary Quality Magnesium and Al-Mg Alloys from Secondary Aluminum Scraps

The objective of this proprietary process is to develop proof of concept for an electrorefining process to produce primary-quality Mg and Al-Mg alloys using secondary Al-alloy melts as domestic scrap feedstock.The chemical composition of both the Al scrap feedstock as well as the Al-Mg alloy product could be variable, depending on supply, demand and cost. The process would be controlled to the desired Al-Mg alloy composition by diluting it with primary-grade Al. The products could be pure Mg and/or controlled Al-Mg alloys. This process is also capable of producing primary-quality alloys with other reactive alloying elements such.

Plant Sensory Systems..... ARPA-E AWARDEE Booth 1022

Frank Turano
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www.plantsensorysystems.com

Development of High-Output, Low-Input Energy Beets

Plant Sensory Systems is developing an enhanced energy (sugar) beet, optimized for biofuel production. The newly engineered beets will contain a gene construct that is expected to produce larger beets which use fertilizer and water more efficiently and produce higher levels of fermentable sugars compared to current feedstocks. The new beet crop will have lower production costs and increased yield for biofuels without competing against food-grade sugar. Other benefits include decreased energy requirements and pollution emissions. The proposed technology could easily be transferred into other feedstocks (sweet sorghum, sugar cane) with expected similar results.

PolyPlus ..... ARPA-E AWARDEE Booth 916

Dr. Tommy Conry
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www.polyplus.com

Low-Cost, High-Performance Lithium-Sulfur Batteries

PolyPlus is developing an innovative, water-based Lithium-Sulfur (Li-S) battery. Today, Li-S battery technology offers the lightest high-energy batteries that are completely self-contained. New features in these water-based batteries make PolyPlus' lightweight battery ideal for a variety of military and consumer applications. The design could achieve energy densities between 400-600 Wh/kg, a substantial improvement from today's state-of-the-art Li-ion batteries that can hold only 150 Wh/kg. PolyPlus' technology-with applications for vehicle transportation as well as grid storage-would be able to transition to a widespread commercial and military market.

Princeton University ..... ARPA-E AWARDEE Booth 642

Dan Steingart
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Fast Aqueous Multiple Electron Ubiquitous Systems

The Fast Aqueous Multiple Electron Ubiquitous Systems project is creating a range extending battery for electric vehicles and a potential replacement for existing NiCd/ NiMH secondary battery. In this project we plan to combine the cost and energy density of a primary alkaline battery with the cycle life and safety features of a secondary alkaline battery.

Proton OnSite ..... ARPA-E AWARDEE Booth 1241

Katherine Ayers
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www.protononsite.com

Transformative Renewable Energy Storage Devices Based on Neutral Water

Hydrogen via membrane-based water electrolysis is a promising technology for renewable energy capture because it can not only provide ancillary services to the grid such as frequency regulation and load shifting, but also enables high dispatchability via multiple chemical processes. Europe in particular has been committed to these pathways and making heavy investment in this area. Commercial products based on acidic membranes are cost competitive in the industrial hydrogen market, but do not meet the more challenging targets for energy applications. This project shows the feasibility of using basic membranes to eliminate the highest cost components of the cell.

Purdue University ..... ARPA-E AWARDEE Booth 1125

Wayne Chen
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www.purdue.edu

Crash Safety of Batteries for Passenger Vehicle

Purdue's EV battery pack is designed to absorb the shock from an accident, prevents battery failure, and mitigates the risk of personal injury. Batteries housed in protective units are arranged in an interlocking configuration to create an impact energy dissipation device. Should a collision occur, the assemblies of the encased battery units rub against each other, thereby absorbing impact energy. Purdue will build a prototype protective casing, create a battery array of several battery units using this design, and study the dynamic behavior of battery assemblies under impact mechanical loading in order to develop a novel EV battery pack.

QM POWER

QM Power ..... ARPA-E AWARDEE **Booth 1213**

PJ Piper
pjpiper@qmpower.com
www.qmpower.com

Efficient, High-Torque Electric Vehicle Motor

QM Power will develop a new type of electric motor with the potential to efficiently power future generations of EVs without the use of rare-earth-based magnets. Many of today's EV motors use rare earth magnets to efficiently provide torque to the wheels. QM Power's motors would contain magnets that use no rare earth minerals, are light and compact, and can deliver more power with greater efficiency and at reduced cost. Key innovations in this project include a new motor design with iron-based magnetic materials, a new motor control technique, and advanced manufacturing techniques that substantially reduce the cost of the motor. The ultimate goal is to create a cost-effective EV motor that offers the rough peak equivalent of 270 horsepower.

REL

REL, Inc...... ARPA-E AWARDEE **Booth 636**

Dr. Adam Loukus
adam@relinc.net
www.relinc.net

Conformable Core Gas Tank

REL is developing a low-cost, conformable natural gas tank for CNG vehicles, which contains an internal structural cellular core. Traditional natural gas storage tanks are cylindrical and rigid. REL is exploring various materials that could be used to design a gas tank's internal structure and allow the tank to be any shape. The REL team has developed a cast aluminum prototype that withstood 3800psi, and is now targeting the burst pressure of 6500psi. REL's conformable tank uses 50% of the space, at a comparable cost, to the current carbon fiber-based tanks.

Rensselaer

Rensselaer Polytechnic Institute..... ARPA-E AWARDEE **Booth 330**

T. Paul Chow
chowt@rpi.edu
www.rpi.edu

High-Power Transistor Switch

RPI is working to develop and demonstrate a new bi-directional transistor switch that would significantly simplify the power conversion process for high-voltage, high-power electronics systems. A transistor switch helps control electricity, converting it from one voltage to another or from an Alternating Current (A/C) to a Direct Current (D/C). High-power systems, including solar and wind plants, usually require multiple switches to convert energy into electricity that can be transmitted through the grid. These multi-level switch configurations are costly and complex, which drives down their overall efficiency and reliability. RPI's new switch would require fewer components than conventional high-power switches. This simple design would in turn simplify the overall power conversion process and enable renewable energy sources to more easily connect to the grid.

BOSCH
Invented for life

Research and Technology Center, Robert Bosch LLC ..... ARPA-E AWARDEE Booth 536

Nalin Chaturvedi
Nalin.Chaturvedi@us.bosch.com
www.bosch.us

Battery Management and Control Software

Bosch is developing battery monitoring and control software to improve the capacity, safety, and charge rate of electric vehicle batteries. Conventional methods for preventing premature aging and failures in electric vehicle batteries involve expensive and heavy overdesign of the battery and tend to result in inefficient use of available battery capacity. Bosch would increase usable capacity and enhance charging rates by improving the ability to estimate battery health in real-time, to predict and manage the impact of charge and discharge cycles on battery health, and to minimize battery degradation.

RTI INTERNATIONAL
turning knowledge into practice

RTI International ..... ARPA-E AWARDEE Booth 415

Luke Coleman
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www.rti.org/page.cfm/Energy_Research

High Operating Temperature Transfer And Storage (HOTTS) System For Light Metal Production

RTI is developing a solar thermal energy transport and storage system for use in light metals manufacturing. A challenge with integrating renewable energy into light metals manufacturing has been the need for large quantities of very high temperature heat. RTI's technology overcomes this with a specialized particulate heat transfer fluid that can be heated to 1,100°C, some 200°C higher than conventional solutions. The heat transfer fluid can store thermal energy allowing continuous operation even when the sun is not shining. RTI will also develop advanced materials that protect the system's components from accelerated degradation experienced at high operating temperatures.

Sandia National Laboratories

Sandia National Laboratories ..... ARPA-E AWARDEE Booth 421

Jean-Paul Watson
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www.sandia.gov

Stochastic Unit Commitment for Improved Day-Ahead Grid Operations

Sandia National Laboratories is working with several commercial and university partners to develop software for market management systems (MMSs) that enable greater use of renewable energy sources throughout the grid. MMSs are used to securely and optimally determine which energy resources should be used to service energy demand across the country. Contributions of electricity to the grid from renewable energy sources such as wind and solar are intermittent, introducing complications for MMSs, which have trouble accommodating the multiple sources of price and supply uncertainties associated with bringing these new types of energy into the grid.

Sea Engineering, Inc. ..... ARPA-E AWARDEE **Booth 820**

Ken Israel
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www.seaengineering.com

Measuring Real-Time Wave Data with Ocean Wave Buoy

Sea Engineering is developing a cost-effective ocean wave buoy system that will accurately measure its own movements as it follows the surface wave motions of the ocean and relay this real-time wave data. Conventional real-time wave measurement buoys are expensive, which limits the ability to deploy large networks of buoys. Data from Sea Engineering's buoys can be used as input to control strategies of wave energy conversion (WEC) devices and allow these controlled WECs to capture significantly more energy than systems that do not employ control strategies.

Sharp Laboratories of America ..... ARPA-E AWARDEE **Booth 520**

JJ Lee
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www.sharplabs.com

Sodium-Based Energy Storage

Sharp Labs and their partners at the University of Texas and Oregon State University are developing a sodium-based battery that could dramatically increase battery cycle life at a low cost while maintaining a high energy capacity. Current storage approaches use either massive pumped reservoirs of water or underground compressed air storage, which carry serious infrastructure requirements and are not feasible beyond specific site limitations. Therefore, there is a critical need for a scalable, adaptable battery technology to enable widespread deployment of renewable power. Sodium ion batteries have the potential to perform as well as today's best lithium-based designs.

Sheetak, Inc. ..... ARPA-E AWARDEE **Booth 436**

www.sheetak.com

High-Efficiency Solid State Heating Cooling and Power Generation Technologies

Sheetak is developing a thermoelectric-based solid state system to replace typical vapor compressors for cooling or heat pumping applications. Sheetak has demonstrated very high efficiency thermoelectric heat pumps for water heating, process heating, chemical distillation and desalination processes.

Sheetak, Inc. ..... ARPA-E AWARDEE **Booth 436**

www.sheetak.com

High Energy Density Thermal Batteries

Sheetak is developing a new HVAC system to store the energy required for heating and cooling in EVs. This system will replace the traditional refrigerant-based vapor compressors and inefficient heaters used in today's EVs with efficient, light, and rechargeable hot-and-cold thermal batteries. The high energy density thermal battery-which does not use any hazardous substances-can be recharged by an integrated solid-state thermoelectric energy converter while the vehicle is parked and its electrical battery is being charged. Sheetak's converters can also run on the electric battery if needed and provide the required cooling and heating to the passengers-eliminating the space constraint and reducing the weight of EVs that use more traditional compressors and heaters.

Sila Nanotechnologies Inc ..... ARPA-E AWARDEE Booth 1237

Gene Berdichevsky
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www.silanano.com

Double Energy Density Anodes for Lithium Ion Batteries

Sila is developing a high-throughput technology for scalable synthesis of high-capacity nanostructured materials for Li-Ion EV batteries. Succesful implementation of this technology will allow improvements in energy storage capacity of today's best batteries at half the cost. In contrast to other high-capacity material synthesis technologies, Sila's materials show minimal volume changes during the battery operation, which is a key challenge of next-generation battery anode materials. In addition, Sila's technology may allow for the dramatic enhancements of the batteries' cycle life, structural stability, safety, and charging rate.

Silicon Power Corporation ..... ARPA-E AWARDEE Booth 443

David Syracuse
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www.siliconpower.com

Optical Switches for High-Power Systems

Silicon Power is developing a semiconducting device that switches high-power and high-voltage electricity using optical signals as triggers for the switches, instead of conventional signals carried through wires. A switch helps control electricity, converting it from one voltage or current to another. High-power systems generally require multiple switches to convert energy into electricity that can be transmitted through the grid. These multi-level switch configurations use many switches which may be costly and inefficient. Additionally, most switching mechanisms use silicon, which cannot handle the high switching frequencies or voltages that high-power systems demand. Silicon Power is using light to trigger its switching mechanisms, which could greatly simplify the overall power conversion process. Silicon Power's switching device is made of silicon carbide instead of straight silicon, which is more efficient and allows it to handle higher frequencies and voltages.conversion process. Additionally, Silicon Power's switching device is made of silicon carbide instead of straight silicon, which is more efficient and allows it to handle higher frequencies and voltages.

SixPoint Materials, Inc. ..... ARPA-E AWARDEE Poster 74

Tadao Hashimoto
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www.spmaterials.com

GaN homoepitaxial wafers for vertical high-power devices grown by vapor phase epitaxy on low-cost, high-quality ammonothermal GaN substrates

SixPoint Materials Inc. is the leading company in "ammonothermal" technology. Ammonothermal growth is a highly scalable process and can produce true bulk single crystals of GaN, which yields many slices of higher quality GaN substrates at lower cost. SixPoint will combine this innovative ammonothermal technology with the conventional hydride vapor epitaxy to realize high-breakdown voltage GaN homoepitaxial wafers, which are needed to realize high-performance vertical GaN power transistors. In addition to a performance improvement, the developed homoepitaxial wafers will reduce production cost of vertical power devices by reducing epitaxial growth time.

SLAC National Accelerator Laboratory ..... Booth 840

Mark Hartney
slac.stanford.edu

SLAC's Energy Research and Materials Characterization Tools

SLAC is a DOE laboratory conducting reserach on new materials for energy generation, storage, and efficiency. We also operate synchrotron and x-ray laser facilities utilized by many ARPA-E awardees in their program research.

Smart Wire Grid, Inc. ..... ARPA-E AWARDEE Booth 1033

Julie Couillard
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www.smartwiregrid.com

Distributed Power Flow Control

Smart Wire Grid is developing a solution for controlling power flow within the electric grid to better manage unused and overall transmission capacity. The 300,000 miles of high-voltage transmission line in the U.S. today are congested and inefficient, with only around 50% of all transmission capacity utilized at any given time. Increased consumer demand should be met in part with a more efficient and economical power flow. Smart Wire Grid's devices clamp onto existing transmission lines and control the flow of power within-much like the way internet routers help allocate bandwidth throughout the web. Smart wires could support greater use of renewable energy by providing more consistent control over how that energy is routed within the grid on a real-time basis. This would lessen the concerns surrounding the grid's inability to effectively store intermittent energy from renewables for later use.

SolarBridge Technologies, Inc. ..... ARPA-E AWARDEE Booth 317

Patrick Chapman
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www.solarbridgetech.com

Scalable Submodule Power Conversion Methods for Power Density, Efficiency, Performance, and Protection Leaps in Utility-scale Photovoltaics

SolarBridge is developing a new power conversion technique to improve the energy output of PV power plants. This new technique is specifically aimed at large plants where many solar panels are connected together. SolarBridge is correcting for the inefficiencies that occur when two solar panels that encounter different amounts of sun are connected together. SolarBridge's technique only requires processing of the difference in power, rather than the sum of the power, of two adjacent modules. As such, it should have inherently lower cost.

Solid Power ..... ARPA-E AWARDEE Poster 72

Douglas Campbell
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www.solidpowerbattery.com

An Ultra High Energy, Safe and Low Cost All Solid-State Rechargeable Battery for Electric Vehicles

Ultra high energy, safe all solid-state rechargeable batteries.

SORAA
Simply Perfect.

Soraa, Inc. ARPA-E AWARDEE **Booth 221**

Mark P. D'Evelyn
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www.soraa.com

Large Area, Low Cost Bulk GaN Substrates for Power Electronics

Soraa will develop a cost-effective technique to manufacture high-quality, high-performance gallium nitride (GaN) crystal substrates that are better than today's GaN crystal substrates, which are expensive and prone to defects. Soraa will also develop pathways to large-area GaN substrates that can handle power switch applications. Substrates are thin wafers of semiconducting material needed for power devices such as transistors and integrated circuits. If successful, Soraa will produce GaN crystal substrates that have 100 times fewer defects than conventional GaN substrates, cost eight times less, and are three to four times larger in diameter.

SORAA
Simply Perfect.

Soraa, Inc. ARPA-E AWARDEE **Booth 221**

Mark P. D'Evelyn
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www.soraa.com

Ammonothermal Bulk GaN Crystal Growth for Energy Efficient Lighting and Power Electronics

A new, scalable method has been developed for cost-effective manufacturing of bulk gallium nitride (GaN) substrates. We have demonstrated 2-inch crack-free GaN crystals and 100x lower defect densities than conventional bulk GaN substrates. The new substrates, once commercialized, will enable significant cost reductions in GaN-on-GaNTM light-emitting diodes (LEDs) and new generations of high performance power electronics and laser diodes for full-color displays. These applications represent markets of more than $50 billion per year and have the potential to reduce electricity consumption in the United States by 30% or more.

SOUTHWEST RESEARCH INSTITUTE

Southwest Research Institute ARPA-E AWARDEE **Booth 836**

Jeff Xu
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www.swri.com

Sensor Technology for Lithium-Ion Batteries

SwRI is developing a battery management system to track the performance characteristics of lithium-ion batteries during cycles to help analyze battery capacity and health. There are no two battery cells alike, and they differ over their life-times in terms of charge and discharge rates, capacity, and temperature characteristics. In SwRI's design, a number of strain gauges would be strategically placed on the cells to monitor the state of charges and overall health during operation. This could help reduce the risk of battery malfunction or failure during extreme conditions. This novel sensing technique should allow the battery to be operated in an effective window.

SRI International

SRI International ..... ARPA-E AWARDEE **Poster 77**

Jordi Perez
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www.sri.com

Direct Low-cost Production of Titanium Alloys

SRI International (SRI) is proposing a transformative new technology to directly produce Ti alloy granules at a cost similar to stainless steel. This process eliminates costly, energy-intensive steps to produce sponge and ingot, as well as the waste associated with machining operations. SRI's process will also enable production of alloys that cannot be produced with conventional technology. SRI proposed process produces Ti pellets by reduction of titanium tetrachloride in a multi-arc fluidized bed reactor (MAFBR).

SRI International

SRI International ..... ARPA-E AWARDEE **Booth 524**

Barbara Heydorn
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www.sri.com

Low-Pressure, Conformable Natural Gas Tank

SRI International has built and tested a proof-of-concept adsorbed natural gas (ANG) storage system that matches the performance of compressed natural gas tanks, but at low pressure. Using a high-strength, monolithic carbon sorbent manufactured by ATMI and coated with a thin polymer film, the ANG tanks can be made in virtually any shape and safely store natural gas without a conventional external tank. Coolant can be placed in direct contact with the high thermal conductivity sorbent, providing rapid charge/discharge. The tank enables home refueling and allows ANG tanks to be placed in unused vehicle spaces, similar to conventional gasoline tanks.

Stanford | Energy Behavior Initiative

Stanford University ..... ARPA-E AWARDEE **Booth 940**

Carrie Armel
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Large-Scale Energy Reductions through Sensors, Feedback, & Information Technology

The goal of this initiative is to develop a comprehensive human-centered solution that leverages the widespread diffusion of energy sensors to significantly reduce and shift energy use. Our initiative has four parts: (1) analytics and a technology platform that enables behavioral programs to be implemented at scale; (2) behavioral interventions to reduce and shift energy use; (3) data evaluation and modeling to assess program effectiveness; and (4) an extensible energy communication network to enable future innovation. The behavioral interventions include media (e.g., Facebook applications), policy (behavioral economic incentive programs), and community (e.g., Girl Scout curriculum).

Stanford University ..... ARPA-E AWARDEE Booth 1228

Aaswath Raman
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fan.group.stanford.edu

Photonic Structures for High-Efficiency Daytime Radiative Cooling

We are developing an entirely passive, electricity-free, way of cooling buildings during the hottest hours of the day. In this technique, known as daytime radiative cooling, a carefully designed surface exposed to the sky on the roof of a building, can in fact, cool to temperatures well below the ambient air temperature even under direct sunlight. Using state of the art nano-photonics techniques, we design and implement a photonic structure that simultaneously reflects sunlight and emits thermal radiation to outer space. In doing so it has the potential to provide up to 100 W/m2 of passive cooling power.

SACL

Stanford University ..... ARPA-E AWARDEE Booth 1043

David Wang
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structure.stanford.edu

Robust Multifunctional Battery Chassis Systems for Automotive Applications

Stanford's new battery design for electric vehicles (EV) would improve upon existing technologies in four areas: 1) structural capabilities, 2) damage and state sensing systems, 3) novel battery management and thermal regulation, and 4) high-capacity battery cells. Stanford's research will result in a multifunctional battery chassis system that is safe and achieves high efficiency in terms of energy storage at low production cost. The integration of such a battery system would result in decreased overall weight of the combined vehicle and battery, for greater EV range.

Sun Catalytix

Sun Catalytix Corporation ..... Booth 747

Thomas D. Jarvi
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www.suncatalytix.com

Coordination Chemistry Flow Battery

Cost effective storage of electrical energy is a key need to enable more resilient electricity grid systems especially as renewable energy sources proliferate. A flow-battery architecture separates power and energy and can deliver cost effective storage of large amounts of electrical energy. Sun Catalytix is developing a flow battery based on metal-ligand coordination compounds. The Sun Catalytix system achieves the full benefit of a flow battery architecture due to clean separation of power and energy and inexpensive electrolytes.

SES

Sustainable Energy Solutions (SES) ..... ARPA-E AWARDEE Booth 413

www.sustainablees.com

Capturing CO_2 from Exhaust Gas

SES is developing a process to capture CO_2 from the exhaust gas of coal-fired power plants by desublimation-the conversion of a gas to a solid. Capturing CO_2 as a solid and delivering it as a liquid avoids the large energy cost of CO_2 gas compression. SES' capture technology facilitates the prudent use of available energy resources; coal is our most abundant energy resource and is an excellent fuel for baseline power production. SES capture technology enables the capture of 99% of the CO_2 emissions in addition to a wide range of other pollutants more efficiently and at lower costs than existing capture technologies. SES' capture technology can be readily added to our existing energy infrastructure.

Teknatool USA Inc. ..... Booth 1040

Joel Latimer
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dvr-motor.com

DVR Integration the future of variable speed Motors

Teknatool USA Inc. introduces an innovative product solution that facilitates the growing global demand for intelligent and energy efficient motors. The company has a traditional market background in DIY/woodworking but is working to become a global technology solutions provider having developed a "next generation" computerized green electric motor with its Digital Variable Reluctance (DVR)® Motor Technology. While standard motors hog energy, the DVR technology improves energy efficiency by at least 50% - feeding real-time data into the smart grid. The DVR motor can be incorporated into a wide range of applications to transform traditional equipment use.

terrafore

Terrafore Technologies .....Booth 838

Anoop Mathur
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www.terrafore.com

Encapsulated Phase Change Thermal Energy Storage for Concentrated Solar Power

Terrafore has successfully demonstrated and optimized the manufacturing of capsules containing phase-changing inorganic salts. The phase-change is used to store thermal energy collected from a concentrating solar-power plant as latent heat. This latent heat, in addition to sensible heat increased the energy density by over 50%, thus requiring 40% less salt and over 60% less container as compared to conventional two-tank, sensible-only storage systems. Costs associated with poor heat-transfer in phase change materials (PCM) were also eliminated. Therefore, the cost to store thermal energy is reduced by almost 40%, and expected to achieve the SunShot goal of $15 per kWht.

RATC

Texas A&M Engineering Experiment Station ARPA-E AWARDEE **Booth 430**

Dr. Dean Schneider
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Robust Adaptive Topology Control

The RATC research team is using topology control as a mechanism to improve system operations and manage disruptions within the electric grid. The grid is subject to interruption from cascading faults caused by extreme operating conditions, malicious external attacks, and intermittent electricity generation from renewable energy sources. The RATC system is capable of detecting, classifying, and responding to grid disturbances by reconfiguring the grid in order to maintain economically efficient operations while guaranteeing reliability. The RATC system would help prevent future power outages, which account for roughly $80 billion in losses for businesses and consumers each year. Minimizing the time it takes for the grid to respond to expensive interruptions will also make it easier to integrate intermittent renewable energy sources into the grid.

Texas A&M University ..... ARPA-E AWARDEE Booth 333

Hong-Cai Joe Zhou
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Highly Adsorbent Materials for Natural Gas Storage

Texas A&M University is developing a highly adsorbent material for use in on-board natural gas storage tanks that could drastically increase the volumetric energy density of methane, which makes up 95% of natural gas. Today's best tanks do not optimize natural gas storage capacity and add too much to the sticker price of natural gas vehicles to make them viable options for most consumers. Texas A&M University will synthesize low-cost materials that adsorb high volumes of natural gas and increase the storage capacity of the tanks. This design could result in a natural gas storage tank that maximizes its ability to store methane and can be manufactured at a low cost, side-stepping two major obstacles associated with the use of natural gas vehicles.

Texas A&M University ..... ARPA-E AWARDEE Booth 1030

tees.tamu.edu

Electricity from Low-Temperature Waste Heat

TEES is developing a system to generate electricity from low-temperature waste heat streams. Conventional waste heat recovery technology is proficient at harnessing energy from waste heat streams that are at a much higher temperature than ambient air. However, existing technology has not been developed to address lower temperature differences. The proposed system cycles between heating and cooling a metal hydride to produce a flow of pressurized hydrogen. This hydrogen flow is then used to generate electricity via a turbine generator. TEES' system has the potential to be more efficient than conventional waste heat recovery technologies.

Texas A&M/SynShark ..... ARPA-E AWARDEE Booth 716

Joshua S. Yuan
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www.jmornstein.com/portfolio-synshark.htm

Synthetic Crop for Direct Biofuel Production through Re-routing the Photosynthesis Intermediates and Engineering Terpenoid Pathways

A set of novel technologies have been developed to engineer plant to produce record level of terpenoid hydrocarbon. The platform can be broadly used to produced fuels, chemicals, and high value products, and is currently commercialized by the start-up company SynShark.

ThermoLift, Inc. ..... Booth 1038

Paul Schwartz
pschwartz@tm-lift.com
www.tm-lift.com

ThermoLift - The Ultimate Heat Pump

ThermoLift, Inc. is developing a novel fuel-agnostic, thermally-driven, compressor-less heat pump and air conditioner technology that will provide a 30-50% reduction in fuel consumption. The device provides superior performance for hot and cold weather climates, including heating, air conditioning and hot water (HAC-HW) in one device. ThermoLift has been awarded two separate grants from the New York State Energy and Research Development Authority and from the US Department of Energy. ThermoLift has a multi-disciplinary technical team and is based out of the Advanced Energy Research and Technology Center (AERTC) located on Stony Brook University campus.

TIMET ..... ARPA-E AWARDEE **Booth 548**

Eliana Fu
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www.timet.com

A Vision of an Electrochemical Cell to Produce Clean Titanium

TIMET is developing an electrochemical process for producing pure titanium powder. Incumbent titanium production processes require the importation of high grade titanium ores. TIMET's ground-breaking design will enable the use of abundant, low-cost, domestic ore to produce titanium powder electrolytically. By totally revolutionizing the electrolysis process, TIMET can fully optimize the process more effectively using a unique approach. TIMET's electrochemical methods could produce higher quality titanium powder at lower cost and reduced energy consumption compared to the conventional established Kroll process.

transphorm

Transphorm, Inc..... ARPA-E AWARDEE **Booth 324**

Rakesh K Lal
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Efficient Switches for Solar Power Conversion

Transphorm is developing power switches for new types of inverters that improve the efficiency and reliability of converting energy from solar panels into useable electricity for the grid. Semiconductor switches can control electrical energy that flows in an electrical circuit and hence are used to make inverters to convert DC from solar panels into AC for use in a home. Transphorm's low loss gallium nitride switches enable a single semiconductor device to switch electrical current in both directions at high voltage and frequencies, making inverters more efficient, compact and reliable. This creates value not possible with conventional silicon switches.

TVN Systems, Inc.

TVN Systems ..... ARPA-E AWARDEE **Booth 943**

Guangyu Lin
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www.tvnsystems.com

Hydrogen Bromine Battery

TVN is developing an advanced hydrogen-bromine flow battery that incorporates a low-cost membrane and durable catalyst materials. A flow battery's membrane separates its active materials and keeps them from mixing, while the catalyst serves to speed up the chemical reactions that generate electricity. Today's hydrogen-bromine batteries use very expensive membrane material and catalysts that can degrade as the battery is used. TVN is exploring new catalysts that will last longer than today's catalysts, and developing new membranes at a fraction of the cost of those currently used. Demonstrating long-lasting, cost-competitive storage systems could enable deployment of renewable energy technologies.

TYRC ..... ARPA-E AWARDEE **Booth 837**

Christopher Rey
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www.tai-yang.com

High-Power, Low-Cost Superconducting Cable

TYRC is developing a superconducting cable, which is a key enabling component for a grid-scale magnetic energy storage device. Superconducting magnetic energy storage systems have not established a commercial foothold because of relatively low energy density and the high cost of the superconducting material. TYRC is coating their cable in yttrium barium copper oxide (YBCO) to increase energy density. This unique, proprietary cable could be manufactured at low cost because it requires less superconducting material to produce the same level of energy storage as today's best cables.

UHV Technologies, Inc. ..... ARPA-E AWARDEE **Booth 1230**

Nalin Kumar
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www.nanoRANCH.com

Low Cost High Throughput In-Line XRF Scrap Metal Sorter

The overall goal of this project is to develop the IL-XRF technology and demonstrate its applicability for commercial scale aluminum scrap sorting with a target of sorting 4 tons/hr at a cost less than $0.04/kg. This roughly corresponds to identification and sorting of more than 10 pieces per second (100 ms per piece or ~100 million pieces per year).

United Technologies Research Center (UTRC) ..... ARPA-E AWARDEE **Booth 328**

Catherine Thibaud-Erkey
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www.utrc.utc.com

Hybrid Vapor Compression Adsorption System

UTRC is developing a new climate-control system for EVs that uses a hybrid vapor compression adsorption system with thermal energy storage. The targeted, closed system will use energy during the battery-charging step to recharge the thermal storage, and minimal power to provide cooling or heating to the cabin during a drive cycle. The team will use a unique approach of absorbing a refrigerant on a metal salt, which will create a lightweight, high-energy-density refrigerant. This unique working pair can operate indefinitely as a traditional vapor compression heat pump using electrical energy, if desired. The project will deliver a hot-and-cold battery that provides comfort to the passengers using minimal power, substantially extending the driving range of EVs.

United Technologies Research Center

United Technologies Research Center (UTRC) ..... ARPA-E AWARDEE Booth 332

Paul Croteau
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www.utrc.utc.com

Low Cost Conformable CNG Tank

UTRC is developing a conformable modular storage tank that could integrate easily into the tight spaces in the undercarriage of natural gas-powered vehicles. Traditional steel and carbon fiber natural gas storage tanks are rigid, bulky, and expensive, which adds to the overall cost of the vehicle and discourages broad use of natural gas vehicles. UTRC is designing modular natural gas storage units that can be assembled to form a wide range of shapes and fit a wide range of undercarriages. UTRC's modular tank could substantially improve upon the conformability level of existing technologies at a cost of approximately $1500, considerably less than today's tanks.

United Technologies Research Center

United Technologies Research Center (UTRC) ..... ARPA-E AWARDEE Booth 336

www.utrc.utc.com

Additive Manufacturing for Electric Vehicle Motors

UTRC is using additive manufacturing techniques to develop an ultra-high-efficiency electric motor for automobiles. The process and design does not rely on rare earth materials and sidesteps any associated supply concerns. Additive manufacturing uses a laser to deposit copper and insulation, layer-by-layer, instead of winding wires. EV motors rely heavily on permanent magnets, which are expensive given the high concentrations of rare earth material required to deliver the performance required in today's market. UTRC's efficient manufacturing method would produce motors that reduce electricity use and require less rare earth material. This project will also examine the application of additive manufacturing more widely for other energy systems, such as renewable power generators.

United Technologies Research Center

United Technologies Research Center (UTRC) ..... ARPA-E AWARDEE Booth 344

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Nano-Engineered Porous Hollow Fiber Membrane-Based Air Conditioning System

UTRC is developing a membrane-based liquid desiccant with a vapor compression cycle (VCC) air conditioner. At both warm and humid conditions the system will be at least 50% more efficient than conventional vapor compression cycle air conditioning systems. This goal will be achieved by a novel integration of a VCC system with a liquid desiccant (LD) system utilizing porous polymeric membrane contactors as mass and heat exchangers (both sensible and latent loads). This is a transformational technology that can improve energy efficiency, reduce energy-related emissions, and decrease dependence on energy imports.

University of California at Santa Barbara, University of Oregon, and Oregon State University ..... ARPA-E AWARDEE Booth 748

www.ucsb.edu

Boosted Capacitors

UCSB is developing an energy storage device for HEVs that combines the properties of capacitors and batteries in one technology. Capacitors enjoy shorter charging times, better durability, and higher power than batteries, but offer less than 5% of their energy density. By integrating the two technologies, UCSB's design would offer a much reduced charge time with a product lifetime that matches or surpasses that of typical EV batteries. Additionally, the technology would deliver significantly higher power density than any current battery. This feature would extend EV driving range and provide a longer life expectancy than today's best EV batteries.

University of California, Berkeley ..... ARPA-E AWARDEE Booth 1216

alchemy.cchem.berkeley.edu

Developing Metal-Organic Frameworks as Adsorbents for Industrial Carbon Capture Applications

High-throughput synthesis and screening technology is employed to generate metal-organic frameworks (MOFs) for the efficient capture of CO_2 from flue gas. MOFs represent a new class of porous materials holding great promise as solid sorbents capable of selectively binding CO_2 with a minimal energy penalty for regeneration. The program pursues ways to identify, synthesize at large scale, and test the most promising adsorbents for CO_2 capture.

UCDAVIS
DEPARTMENT OF CHEMISTRY

University of California, Davis..... ARPA-E AWARDEE Booth 1037

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Biosynthetic Conversion of Ethylene to Butanol

This technology integrates synthetic biology and protein engineering to develop a novel and efficient pathway for the conversion of ethylene to n-butanol. We will engineer an ethylene assimilation pathway into the industrial host Escherichia coli to convert ethylene into acetyl-CoA. The ethylene assimilation pathway will be combined with well-established n-butanol biosynthesis pathway.

UCLA

University of California, Los Angeles..... ARPA-E AWARDEE Poster 33

Safe Aqueous Based High-Performance Electrochemical Energy Storage

The University of California, Los Angeles (UCLA) is developing a new high-power, long-life, acid-based battery that addresses the cycle life issues associated with lead-acid batteries today. Lead-acid batteries are used extensively in gasoline-powered vehicles and even modern electric vehicles for initial ignition, but inevitably wear out after a limited number of complete discharge cycles. To solve this problem, UCLA will incorporate novel, newly-discovered material that allows the battery to store a greater electrical charge using a conventional battery design. This new battery would provide up to 500 times more charge and discharge cycles and up to 10 times the power of existing lead-acid batteries. UCLA's batteries will be compatible with comparable manufacturing processes for current lead-acid batteries, allowing for rapid, low-cost commercialization.

University of California, Los Angeles (UCLA) ..... ARPA-E AWARDEE Booth 1017

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Thermal Energy Storage With Supercritical Fluids

UCLA and JPL are creating cost-effective solar thermal energy storage systems using new materials and designs. Cost-effective thermal storage technology is necessary for the widespread use of solar thermal energy. State-of-the-art molten salt systems cost well in excess of DOE's $20/kWh thermal energy storage cost goal, which is required for long-term investment viability. UCLA and JPL are developing a supercritical fluid-based thermal energy storage system that employs low-cost fluids that can meet DOE's cost goal. The team's design also uses a novel modular tank design and is more reliable and scalable for a large range of thermal storage applications.

University of California, Los Angeles (UCLA)-Chemical and Biomolecular Engineering ..... ARPA-E AWARDEE Booth 637

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Genetic Engineering of Photosynthetic Pathway to Improve Food and Fuel Production in Crops

UCLA is redesigning the carbon fixation pathway in plants to make them more energy efficient. Carbon fixation is a fundamental process in plants that converts solar energy into chemical energy. UCLA is addressing the inefficiency of this process through an alternative biochemical pathway that uses 50% less energy than the pathway used by all land plants. These high efficiency photosynthetic crop could become an ideal host for our bioenergy needs.

University of California, Los Angeles (UCLA) and Easel Biotechnologies ..... ARPA-E AWARDEE Booth 649

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Electro-Autotrophic Synthesis of Higher Alcohols

One of the major challenges in using electrical energy is the efficiency in its storage. UCLA and Easel Biotechnologies developed a method to store electrical energy as chemical energy in higher alcohols, which can be used as liquid transportation fuels. We genetically engineered a lithoautotrophic microorganism, Ralstonia eutropha, to produce higher alcohols in an electro-bioreactor using CO_2 or formate as the sole carbon source and electricity as the sole energy input. The process integrates electrochemical formate production and biological CO_2 fixation and higher alcohol synthesis, opening the possibility of electricity-driven bioconversion of CO_2 to transportation fuels or other commercial chemicals.

UCLA
University of California, Los Angeles - Chemical and Biomolecular Engineering Department..... ARPA-E AWARDEE Booth 638

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High Efficiency Methanol Condensation Cycle (MC2)

Our team is developing a novel synthetic pathway, termed MC2 that can convert methanol to n-butanol(or higher alcohols) with 100% carbon yield and 96% energy yield. Unlike other approaches, this new technology rearranges metabolic pathways that avoid carbon dioxide generating reactions (decarboxylating). High-throughput screening technology will be used to improve enzyme activity of potential bottleneck steps and implement the pathway in two platform microorganisms, Escherichia coli and a methanotroph. If successful, MC2 can radically alter the marketplace towards bioconversion of methanol to fuel and opens a new frontier for methane utilization.

UC RIVERSIDE
University of California, Riverside .....Booth 547

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Integrating Photovoltaics, Energy Storage, and a Local Utility for Electric Transportation

The "New Grid" demonstration project integrates solar energy production, distributed battery storage, and electric vehicle charging. This innovative program will point the way toward accommodating large numbers of electric vehicles – which reduce air pollution and emissions of greenhouse gases – without stressing the electric grid or triggering additional power plant operations. The project opened in January 2014 and during the Technology Showcase the University of California, Riverside, will share preliminary data and discuss a comprehensive research and demonstration strategy with interested prospective partners.

UC San Diego
University of California, San Diego ..... ARPA-E AWARDEE Poster 17

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Developing Low-Cost, Robust, and Multifunctional Battery System for Electric Vehicles: A Non-Chemical Approach

Novel, robust, and multifunctional battery electrodes, cells, and modules are being developed for electric vehicles (EV). The goal is to increase the drive range to 250-300 miles and keep the cost comparable with that of conventional cars. The batteries will be thermal-run-away free; that is, they would not catch fire even under most adverse mechanical abuse situations, which saves cost and weight from auto frame, and, more importantly, enables the use of relatively-low-energy-density while relatively-cost-efficient battery systems.

University of California, Santa Barbara ..... ARPA-E AWARDEE Poster 4

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Ultimate Switches (US)

The University of California, Santa Barbara (UCSB) will develop several new vertical gallium nitride (GaN) semiconductor technologies that will enhance the performance and reduce the cost of high-power electronics. The team's current aperture vertical electron transistor devices could reduce power losses and reach beyond the performance of lateral GaN devices when switching and converting power. If successful, UCSB's devices will enable high-power conversion at low cost in motor drives, electric vehicles, and power grid applications.

University of Colorado Boulder ..... ARPA-E AWARDEE Booth 1219

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Carbothermal Reduction Process For Producing Magnesium Metal Using A Reduced Pressure Hybrid Solar/Electric Reactor

The overall objective of the work is to develop solar energy-assisted carbothermal reduction (CTR) technology for magnesium metal (Mg) production that will substantially lower energy usage, cost and Greenhouse Gas Emissions (GHGs) relative to the current electrolytic process practiced in the U.S. We will demonstrate reaction at 1500oC and reduced pressure with hybrid solar/electrical heating and will collect product Mg by condensing Mg vapor. A novel hybrid solar/electric reactor will operate 24/7 taking advantage of sunlight while on-sun and using off-peak electricity at night.

University of Colorado Boulder ..... ARPA-E AWARDEE Booth 320

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Integrated Solar Power Converters

CU-Boulder is developing advanced power conversion components that can be integrated into individual solar panels to improve energy yields. The solar energy that is absorbed and collected by a solar panel is converted into useable energy for the grid through an electronic component called an inverter. Many large, conventional solar energy systems use one central inverter to convert energy. CU-Boulder is integrating smaller, microconverters into individual solar panels to improve the efficiency of energy collection. The university's microconverters rely on electrical components that direct energy at high speeds and ensure that minimal energy is lost during the conversion process.

University of Colorado Boulder ..... ARPA-E AWARDEE Booth 1221

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Small-Scale Reactors for Natural Gas Conversion

CU-Boulder is using nanotechnology to improve the structure of natural gas-to-liquids catalysts. The greatest difficulty in industrial-scale catalyst activity is temperature control, which can only be solved by improving reactor design. CU-Boulder's newly structured catalyst creates a small-scale reactor for converting natural gas to liquid fuels that can operate at moderate temperatures. Additionally, CU's small-scale reactors could be located near remote, isolated sources of natural gas, further enabling their use as domestic fuel sources.

University of Delaware ..... ARPA-E AWARDEE Booth 239

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Synthetic Methylotrophy to Liquid Fuel

The University of Delaware has designed synthetic biology approaches for creating platform technologies based on biological processes that enable the use of methane and/or methanol to produce fuel molecules and other chemicals while at the same time capturing CO_2 released from some of the biological steps. The technology employs a modular design with step by step optimization of the overall synthetic-cell design.

University of Delaware ..... ARPA-E AWARDEE Booth 1028

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Affordable Hydrogen Fuel Cell Vehicles

The University of Delaware is developing a new fuel cell membrane for vehicles that relies on cheaper and more abundant materials than those used in current fuel cells. Conventional fuel cells are very acidic, so they require acid-resistant metals such as platinum to generate electricity. The University of Delaware is developing an alkaline fuel cell membrane that can operate in a non-acidic environment where cheaper materials such as nickel and silver, instead of platinum, can be used. In addition to enabling the use of cheaper metals, the University of Delaware's membrane is 500 times less expensive than other polymer membranes.

University of Delaware ..... ARPA-E AWARDEE Booth 1026

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High-Storage Double-Membrane Flow Battery

The University of Delaware is developing a low-cost flow battery that uses membrane technology to increase voltage and energy storage capacity. Flow batteries store chemical energy in external tanks instead of in electrode, which allows for cost-effective scalability. However, traditional flow batteries have limited power and low energy density. The University of Delaware is addressing this limitation by adding an additional membrane within the electrolyte material of the battery, creating 3 separate compartments of electrolytes. Separating the electrolytes in this manner allows freedom for the battery to implement new possible redox pairs and improves the voltage of the system.

UF UNIVERSITY of FLORIDA
The Foundation for The Gator Nation

University of Florida ..... ARPA-E AWARDEE **Booth 343**

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Membrane-Based Absorption Refrigeration Systems

Absorption/desorption cycles can use thermal energy to remove moisture from an air stream or pump a refrigerant between low and high pressures. These cycles, in different configurations, can be utilized for space and water cooling/heating and de-humidification. The University of Florida is developing a robust low-cost absorption/desorption cycle. Unlike in the existing absorption cycles that use large shell-and-tube heat exchangers, membrane-based absorption and desorption processes are utilized to decrease the heat exchangers size and weight by an order of magnitude. The new technology has enabled building more compact and cheaper absorption cycles.

UF IFAS
UNIVERSITY of FLORIDA

University of Florida ..... ARPA-E AWARDEE **Booth 437**

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Tappable Pine Trees

The University of Florida is working to increase the amount of turpentine in harvested pine from 4% to 20% of its dry weight. While enhanced feedstocks for biofuels have generally focused on fuel production from leafy plants and grasses, the University of Florida is experimenting with enhancing fuel production in a species of pine that is currently used in the paper pulping industry. Pine trees naturally produce around 3-5% terpene content in the wood-terpenes are the energy-dense fuel molecules that are the predominant components of turpentine. The team plans to increase the terpene storage potential and production capacity while improving the terpene composition to a point at which the trees could be tapped while alive, as are sugar maples. Growth and production from these trees will take years, but this pioneering technology could have significant impact in making available an economical and domestic source of aviation and diesel biofuels.

UF UNIVERSITY of FLORIDA
The Foundation for The Gator Nation

University of Florida & Solar Fuel Corp. ..... ARPA-E AWARDEE **Booth 1133**

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Solar Thermochemical Fuel Production

The University of Florida is developing a windowless high-temperature chemical reactor that converts concentrated solar thermal energy to syngas, which can be used to produce gasoline. The overarching project goal is lowering the cost of the solar thermochemical production of syngas for clean and synthetic hydrocarbon fuels like petroleum. The team will develop processes that rely on water and recycled CO_2 as the sole feed-stock, and concentrated solar radiation as the sole energy source, to power the reactor to produce fuel efficiently. Successful large-scale deployment of this solar thermochemical fuel production could substantially improve our national and economic security by replacing imported oil with domestically produced solar fuels.

UNIVERSITY of HOUSTON

University of Houston ..... ARPA-E AWARDEE **Booth 1029**

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Advanced Aqueous Lithium-Ion Batteries

The University of Houston (UH) will develop a battery using a novel water-based, lithium-ion chemistry that makes use of sustainable, low-cost, high-energy, organic materials. UH's new batteries will meet today's performance standards, while minimizing the potential impact of battery failure, thus offering manufacturers greater flexibility with regard to vehicle design.

UNIVERSITY of HOUSTON

University of Houston ..... ARPA-E AWARDEE **Booth 1136**

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Low-Cost Superconducting Wire for Wind Generators

The University of Houston will develop a low-cost, high-current superconducting wire that could be used in high-power wind generators. Superconducting wire currently transports 600 times more electric current than a similarly sized copper wire, but is significantly more expensive. The University of Houston's innovation is based on engineering nanoscale defects in the superconducting film. This could quadruple the current relative to today's superconducting wires, supporting the same amount of current using 25% of the material. This would make wind generators lighter, more powerful and more efficient. The design could result in a several-fold reduction in wire costs and enable the commercial viability of high-power wind generators for use in offshore applications.

ILLINOIS

University of Illinois at Urbana-Champaign..... ARPA-E AWARDEE **Booth 418**

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Cyber-Physical Security Analytics for a Resilient Grid

UIUC is developing scalable grid modeling, monitoring, and analysis tools that would improve its resiliency to system failures as well as cyber attacks, which can significantly improve the reliability of grid operations. Power system operators today lack the ability to assess the grid's reliability with respect to potential cyber failures and attacks. UIUC is using theoretical and practical techniques from both the cyber security and power engineering domains to develop new algorithms and software tools capable of analyzing real-world threats against power grid critical infrastructures including cyber components (e.g. communication networks), physical components (e.g. power lines), and interdependencies between the two in its models and simulations.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

University of Illinois at Urbana-Champaign..... ARPA-E AWARDEE **Booth 712**

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Genetically Enhanced Sorghum and Sugarcane

UIUC along with partners (UFL, UNL, BNL) are working to convert sugarcane and sorghum—already two of the most productive crops in the world—into dedicated bio-oil crop systems. Three components will be engineered to produce new crops that have a 50% higher yield, produce easily extractable oils, and have a wider growing range across the U.S. This will be achieved by modifying the crop canopy to better distribute sunlight and increase its cold tolerance. By directly producing oil in the shoots of these plants, these biofuels could be easily extracted with the conventional crushing techniques used today to extract sugar.

UNIVERSITY OF MARYLAND

University of Maryland ..... ARPA-E AWARDEE Booth 1118

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Hybridized Mg2+/H+ Aqueous Battery for Vehicle Electrification

The University of Maryland (UMD) will use water-based magnesium and hydrogen chemistries to improve the energy density and reduce the cost of an electric vehicle battery. Current water-based batteries have greater volume and weight compared to lithium-ion batteries, making them unsuitable for use in electric vehicles. If successful, UMD's water-based battery would achieve the performance standards of lithium-ion batteries, but would be smaller, lighter, and less expensive.

UNIVERSITY OF MARYLAND

University of Maryland ..... ARPA-E AWARDEE Booth 1127

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Compressive Thermoelastic Cooling

UMD is developing an energy-efficient cooling system that eliminates the need for synthetic refrigerants that harm the environment. More than 90% of the cooling and refrigeration systems in the U.S. today use vapor compression systems which rely on liquid to vapor phase transformation of synthetic refrigerants to absorb or release heat. Thermoelastic cooling systems, however, use a solid-state material-an elastic shape memory metal alloy-as a refrigerant and a solid to solid phase transformation to absorb or release heat. UMD is developing and testing shape memory alloys and a cooling device that alternately absorbs or creates heat in much the same way as a vapor compression system, but with significantly less energy and a smaller operational footprint.

UNIVERSITY OF MARYLAND
Energy Research Center

University of Maryland Energy Research Center ..... ARPA-E AWARDEE Booth 1120

Eric Wachsman
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Safe, Low-Cost, High-Energy-Density, Solid-State Li-Ion Batteries

University of Maryland is developing safe, robust, low-cost, high-energy-density all-solid-state Li-ion batteries (SSLiBs), integrating high conductivity garnet-type solid Li ion electrolytes and high voltage cathodes in tailored micro/nano-structures, fabricated by low-cost supported thin-film ceramic techniques. Highly stable garnet electrolytes allows use of high voltage cathodes without stability or flammability concerns. Solid oxide fuel cell fabrication techniques are used to form electrode supported thin-film electrolytes, resulting in low area specific resistance. These scale-able multilayer ceramic fabrication techniques provide for dramatically reduced manufacturing costs and the micro/nano-structured electrode scaffold increases interfacial area, overcoming high impedance typical of planar geometry SSLiBs.

University of Massachusetts ..... ARPA-E AWARDEE Booth 742

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Electrofuels via Direct Electron Transfer from Electrodes to Microbes

This project focuses on microbial electrosynthesis, a process in which electrical energy is used to directly feed microorganisms electrons. The electrons drive the reduction of carbon dioxide to desired organic products, which are then excreted from the cell. Advantages of microbial electrosynthesis include: 1) high efficiency of conversion of carbon dioxide to desired products; 2) retention of the microbial catalysts in a biofilm, permitting continuous operation, eliminating reactor down time; 3) "proton neutrality", avoiding costly pH adjustment; and 4) direct electrode to microbe electron transfer which avoids the use of hydrogen gas, enhancing safety and scalability.

University *of* Massachusetts Amherst

University of Massachusetts Amherst ..... ARPA-E AWARDEE Booth 537

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Development of a Dedicated, High-Value Biofuels Crop

University of Massachusetts Amherst is developing an enhanced, biofuels-producing variant of Camelina, a drought-resistant, cold-tolerant oilseed crop that can be grown in many places other plants cannot. The team is working to incorporate several genetic traits into Camelina that increases its natural ability to produce oils and add the production of energy-dense terpene molecules that can be easily converted into liquid fuels. UMass is also experimenting with translating a component common in algae to Camelina that should allow the plants to absorb higher levels of CO_2, which aids in enhancing photosynthesis and fuel conversion.

University of Michigan..... ARPA-E AWARDEE Poster 35

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Anaerobic Bioconversion of Methane to Methanol

This Technology Development Project plans to develop technology for the biological conversion of methane to methanol. The current state-of-the-art process for methane conversion to liquid fuels utilizes Fischer-Tropsch chemistry, which is limited by high capital costs and low conversion efficiencies. Large amounts (0.3 billion tons per year) of methane are oxidized in marine sediments by microbial communities consisting of methanotrophic archaea (ANME-1, ANME-2 or ANME-3) and sulfate- or nitrate reducing bacteria. We will genetically engineer a metabolic pathway to convert methane to methanol and optimize this process by metabolic flux and molecular modeling and by engineering the enzymatic catalysts.

UNIVERSITY OF MINNESOTA

University of Minnesota ..... ARPA-E AWARDEE Booth 739

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researchumn.com/2013/03/13/miracle-magnetic-materials-jian-ping-wang

Synthesis and Phase Stabilization of Body Center Tetragonal (BCT) Metastable Fe-N Anisotropic Nanocomposite Magnet- A Path to Fabricate Rare Earth Free Magnet

Since the advent of high-flux density permanent magnets based on rare earth elements such as neodymium(Nd) or samarium(Sm) in the 1980's, permanent magnet-based electric machines are preferred over induction machines (when considering weight, size, noise and maintenance). However, less availability and increased cost of rare earth elements, have created a need for a new magnet with more abundant and less strategically important elements. α˝-Fe16N2 is the most promising candidate. Prof.Jian-Ping Wang's group has made breakthroughs in the fabrication of this mystery material.

UNIVERSITY OF MINNESOTA

University of Minnesota, California Institute of Technology ..... ARPA-E AWARDEE Booth 933

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Solar Thermochemical Fuels Production

The University of Minnesota and California Institute of Techology team is developing a solar thermochemical reactor to efficiently split water and carbon dioxide from sunlight by using partial redox cycles and ceria-based reactive materials. The team will achieve unprecedented continuous solar-to-fuel conversion efficiencies of more than 5% (where current state-of-the-art efficiency is 1%) by combined efforts and innovations in material development, and reactor design and demonstration. This new technology will allow for the effective use of vast domestic solar resources to produce precursors to synthetic fuels.

UNIVERSITY OF MINNESOTA

University of Minnesota, Chemical Engineering and Materials Science ..... ARPA-E AWARDEE Booth 342

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Ultra-Thin Membranes for Biofuels, Chemicals and Fuels Production

UMN is developing an ultra-thin separation membrane to decrease the cost of producing biofuels, plastics, and other industrial materials. Nearly 6% of total U.S. energy consumption comes from the energy used in separation and purification processes. Today's separation methods used in the chemical and petrochemical industry are not only energy intensive, but also very expensive. UMN is developing a revolutionary membrane technology based on a recently discovered class of ultra-thin (2-dimensional) porous materials (Zeolite Nanosheets) that will enable energy efficient purification of chemicals and fuels produced from fossil and renewable sources and the production of clean water.

UNLV

University of Nevada Las Vegas ..... ARPA-E AWARDEE **Booth 929**

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Fire-Resistant Solid Electrolytes

UNLV is developing a solid-state, non-flammable electrolyte to make today's Li-Ion vehicle batteries safer. Today's Li-Ion batteries use a flammable liquid electrolyte-the material responsible for shuttling Li-Ions back and forth across the battery-that can catch fire when overheated or overcharged. UNLV will replace this flammable electrolyte with a fire-resistant material called lithium-rich anti-perovskite. This new electrolyte material would help make vehicle batteries safer in an accident while also increasing battery performance by extending vehicle range and acceleration.

University of Notre Dame ..... ARPA-E AWARDEE **Booth 338**

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PolarJFET a novel vertical GaN power transistor concept

An integrated team of researchers from the University of Notre Dame, IQE, TriQuint Semiconductor and United Technologies Research Center will mature their PolarJFETs - miniaturized high-efficiency power switches - to high volume manufacturing cost-effective devices that require substantially lower energy than the state-of-the-art silicon counterparts.

University of Pittsburgh

University of Pittsburgh ..... ARPA-E AWARDEE **Booth 519**

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CO_2 Thickeners for Enhanced Oil and Gas Recovery

Pitt and GE Global Research are developing a compound to increase the viscosity of high pressure carbon dioxide (CO_2). This thickened CO_2 would improve the performance of CO_2 enhanced oil recovery from layers of porous rock. Although CO_2 is an excellent oil solvent, its low viscosity does not allow it to uniformly sweep the oil from the formation and toward the production well. Three types of small molecule CO_2 thickeners are being designed. Our goal is to increase the viscosity of CO_2 to the same value as the oil in the formation.

USC
UNIVERSITY OF SOUTHERN CALIFORNIA

University of Southern California ..... ARPA-E AWARDEE **Booth 641**

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Inexpensive, Metal-free, Organic Flow Battery

USC is developing a water-based, metal-free, grid-scale flow battery that will be cheaper and more rapidly produced than other batteries. Flow batteries store chemical energy in external tanks instead of within the battery container. This allows for cost-effective scalability because adding storage capacity is as simple as expanding the tank. Batteries for grid-scale energy storage must be inexpensive, robust, and sustainable-many of today's mature battery technologies do not meet all these requirements. Using innovative designs and extremely low-cost organic materials, USC's new flow battery has the potential to reduce cost, increase durability, and store increased amounts of excess energy, thereby promoting greater renewable energy deployment.

University of Southern California Information Sciences Institute ..... Booth 438

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Building Level Energy Management System (BLEMS)

The Building Level Energy Management System (BLEMS), is a cost-effective non-intrusive energy management system that optimizes energy consumption while simultaneously meeting the needs of occupants. Employing machine-learning techniques, BLEMS uses ambient sensors to build a room-level occupancy modeling solution and operates the HVAC system based on the actual demand. Occupants communicate (via a Smartphone app) heating/cooling preferences. A fuzzy rule based algorithm extracts the underlying patterns in the data and BLEMS calculates operating parameters to meet these preferences. We were able to show a greater than 25% reduction in HVAC power consumption in a 40,000 sq. ft. test bed building.

University of Tennessee ..... ARPA-E AWARDEE Booth 540

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High Throughput Bioengineering of Switchgrass

The University of Tennessee has developed a transformational switchgrass liquid cell culture system that is a substantial advancement of the system developed previously (Mazarei et al. 2011). The system has now been made simpler (between 1 to 20 cells per cluster—median is 7), transformable at a high frequency (approximately 50% of clusters are transformed) and regenerable. The system has enabled rapid analysis of cell wall traits. We envisage it as being foundational for high throughput genome editing and synthetic biology to enable transformational genetic engineering of bioenegy feedstocks and agricultural crops.

University of Texas at Austin ..... ARPA-E AWARDEE Booth 319

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Thermal Batteries for Electric Vehicles

UT Austin will demonstrate a high-energy density and low-cost thermal storage system that provides efficient cabin heating and cooling for EVs. Compared to existing HVAC systems powered by electric batteries in EVs, the innovative hot-and-cold thermal batteries-based technology is expected to decrease the manufacturing cost and increase the driving range of next-generation EVs. These thermal batteries can be charged with off-peak electric power together with the electric batteries.

University of Texas at Dallas ..... ARPA-E AWARDEE Booth 617

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Double-Stator Motor Design

UT Dallas is developing a unique electric motor with the potential to efficiently power future classes of EVs and renewable power generators. Unlike many of today's best electric motors-which contain permanent magnets that use expensive, imported rare earths-UT Dallas' motor completely eliminates the use of rare earth materials. Additionally, the motor contains two stators. The stator is the stationary part of the motor that uses electromagnetism to help its rotor spin and generate power. The double-stator design has the potential to generate very high power densities at substantially lower cost than existing motors. In addition, this design can operate under higher temperatures and in more rugged environments. This project will focus on manufacturing and testing of a 100 kW motor with emphasis on low cost manufacturing for future use in EVs and renewable power generators.

University of Utah ..... ARPA-E AWARDEE Booth 241

Swomitra Mohanty
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Electrodynamic Sorting of Light Metals and Alloys

The objective of this 3-year R&D project is to fully develop and test an Alpha-Prototype (100 kg/h) and design a commercial Beta-Prototype (TRL=6, 4 ton/h) for the efficient separation of light metal/alloys ("Twitch") as well as heavy metal/alloys ("Zebra") from the "Zorba" fraction in recycling shredded streams. This novel device is called a High Frequency Eddy Current Sorter (HFECS). The particles are allowed to fall freely through an alternating magnetic field. Such a field produces eddy currents on the surface of the particles, which in turn produce the so-called Lorentz Force which repels particles based on conductivity.

University of Utah ..... ARPA-E AWARDEE Booth 541

Peng Fan
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A Novel Chemical Pathway for Ti Production to Drastically Reduce Cost

The University of Utah will develop a new process to produce titanium from titanium slag, an intermediate raw material for current titanium metal extraction processes. The process is based on direct reduction of titanium slag using magnesium hydride, forming titanium hydride, which is subsequently separated from other impurities by a series of chemical leaching steps. If successful, the process will drastically reduce energy consumption and cost of titanium production.

University of Utah ..... ARPA-E AWARDEE Booth 543

Zak Fang
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Advanced Metal-Hydrides-Based Thermal Battery

The University of Utah is developing a compact hot-and-cold thermal battery using advanced metal hydrides that could offer efficient climate control system for EVs. The team's innovative designs of heating and cooling systems for EVs with high energy density, low-cost thermal batteries could significantly reduce the weight and eliminate the space constraint in automobiles. The thermal battery can be charged by plugging it into an electrical outlet while charging the electric battery and it produces heat and cold through a heat exchanger when discharging. The ultimate goal of the project is a climate-controlling thermal battery that can last up to 5,000 charge and discharge cycles while substantially increasing the driving range of EVs, thus reducing the drain on electric batteries.

University of Washington (UW) ..... ARPA-E AWARDEE Booth 428

Mary
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www.washington.edu

Microbe-Based Methane to Diesel Conversion

UW is developing technologies for microbes to convert methane found in natural gas into liquid diesel fuel. Specifically, the project seeks to significantly increase the amount of lipids produced by the microbe, and to develop novel catalytic technology to directly convert these lipids to liquid fuel. These engineered microbes could enable small-scale methane-to-liquid conversion at lower cost than conventional methods. Small-scale, microbe-based conversion would leverage abundant, domestic natural gas resources and reduce U.S. dependence on foreign oil.

University of Washington & University of Michigan..... ARPA-E AWARDEE Booth 420

Dr. Hrvoje Pandzic
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Energy Positioning: Control and Economics

The University of Washington and the University of Michigan are developing an integrated system to match well-positioned energy storage facilities with precise control technologies so the electric grid can more easily include energy from renewable power sources like wind and solar. Because renewable energy sources provide intermittent power, it is difficult for the grid to efficiently allocate those resources without developing solutions to store their energy for later use. The two universities are working with utilities, regulators, and the private sector to position renewable energy storage facilities in locations that optimize their ability to provide and transmit electricity where and when it is needed most. Expanding the network of transmission lines is prohibitively expensive, so combining well-placed storage facilities with robust control systems to efficiently route power will save consumers money and enable the widespread use of safe, renewable sources of power.

Utah State University ..... ARPA-E AWARDEE Booth 743

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Dynamic Cell-Level Control for Battery Packs

The USU team, including USU, CU-Boulder, UCCS, NREL and Ford, is developing electronic hardware and control software to create an advanced battery management system that actively maximizes the performance of each cell in a battery pack. No two battery cells are alike-they differ over their lifetimes in terms of charge and discharge rates, capacity, and temperature characteristics, among other things. Traditionally, cell-to-cell variability has been dealt with through costly batching of cells and over-design of battery packs. The team solution uses physics-based models, dynamic cell-level control, and a low-cost flexible hardware architecture to increase lifetime and decrease pack cost.

Valparaiso University ..... ARPA-E AWARDEE Poster 6

Robert Palumbo
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www.valpo.edu/engineering/facilities/solar/

Solar Thermal Electrolytic Production of Mg From MgO

The goal of this project is to develop solar thermal electrolysis reactor technology for the production of Mg from MgO in molten salt electrolytes. The reactor-cell system will be developed so that electrolysis occurs with high current efficiency at an industrially acceptable current density using an electrical input as close to the thermodynamic limit as molecular mass transport processes allow. The remainder of the required reaction energy will be supplied by concentrated solar energy.

Varentec ..... ARPA-E AWARDEE Booth 425

www.varentec.com

Dynamic Power Flow Controller

Varentec is developing compact, low-cost transmission power controllers with fractional power rating for controlling power flow on transmission networks. The technology will enhance grid operations through improved use of current assets and by dramatically reducing the number of transmission lines that have to be built to meet increasing contributions of renewable energy sources like wind and solar. The proposed transmission controllers would allow for the dynamic control of voltage and power flow, improving the grid's ability to dispatch power in real time to the places where it is most needed. The controllers would work as fail-safe devices whereby the grid would be restored to its present operating state in the event of a controller malfunction instead of failing outright. The ability to affordably and dynamically control power flow with adequate fail-safe switchgear could open up new competitive energy markets which are not possible under the current regulatory structure and technology base.

Vorbeck Materials ..... ARPA-E AWARDEE Booth 515

Emely Johanson
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www.vorbeck.com

High-Performance, Low-Cost Lithium-Sulfur Batteries

Vorbeck is developing a low-cost, fast-charging storage battery for hybrid vehicles. The battery cells are based on lithium-sulfur (Li-S) chemistries, which have a greater energy density compared to today's Li-Ion batteries. Vorbeck's approach involves developing a Li-S battery with radically different design for both cathode and anode. The technology has the potential to capture more energy, increasing the efficiency of hybrid vehicles by up to 20% while reducing cost and greenhouse gas emissions.

Washington University in St. Louis ..... ARPA-E AWARDEE Booth 912

Venkat Subramanian
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www.wustl.edu

Optimal Battery Management System

Washington University in St. Louis is developing a predictive battery management system that uses innovative modeling software to manage how batteries are charged and discharged, helping to optimize battery use. A significant problem with today's battery packs is their lack of internal monitoring capabilities, which interferes with our ability to identify and manage performance issues as they arise. Washington University's system would predict the physical states internal to batteries quickly and accurately enough for the data to be used to make decisions about how to control the battery to optimize its output and efficiency in real time.

Wyss Institute ..... ARPA-E AWARDEE Booth 937

Robert Cunningham
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www.wyss.harvard.edu

Slippery Coatings to Reduce Friction and Energy Loss

Harvard developed a portfolio of slippery coatings useful for many industrial applications including marine shipping vessels, wastewater treatment systems, refrigeration equipment, and other energy-relevant applications. Contamination, build-up of microorganisms, and corrosion of untreated surfaces cause inefficiencies that result in energy penalties. Harvard's liquid-based coating is tailored to adhere uniformly to metal, glass, polymers or textile surfaces to form a microscopically smooth surface that inhibits organic and inorganic fouling as well as ice adhesion. Since it is liquid-based, it self-levels to repair itself if scratched and can be easily replenished to extend the working life of the surface coating.

Xilectric ..... ARPA-E AWARDEE Booth 341

Steve Weiss
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www.xilectric.com

Reinventing the Edison Battery

Xilectric is developing a totally new class of low-cost rechargeable batteries with a chemistry analogous to the the original nickel-iron Edison battery. At the turn of the 20th century, Thomas Edison experimented with low-cost, durable nickel-iron aqueous batteries for use in EVs. Given their inability to operate in cold weather and at higher cost than lead-acid batteries, Edison's batteries were eventually dismissed for automotive applications. Xilectric is reviving and re-engineering the basic chemistry of the Edison battery, using domestically abundant, environmentally friendly, and low-cost metals, such as aluminum and magnesium as its active components. Xilectric's design would be easy to manufacture and demonstrate longer life span than today's best Li-ion batteries, enabling more widespread use of EVs.

Yale University ..... ARPA-E AWARDEE Booth 643

Menachem Elimelech
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www.yale.edu/env/elimelech/research_group.htm

Closed-Loop System Using Waste Heat for Electricity

Yale is developing a system to generate electricity using low-temperature waste heat from power plants, industrial facilities, and geothermal wells. In Yale's closed-loop system, waste heat separates an input salt water stream into two output streams, one with high salt concentration and one with low salt concentration. After separation, the two streams are recombined and the energy released upon mixing is captured. The mixed saltwater stream is then sent back to the waste heat source, allowing the process to begin again. Yale's system for generating electricity from low-temperature heat could considerably increase the efficiency of power generation systems.

Showcase Notes

Showcase Index by Type

ASSOCIATION

AWARDEES

Showcase Index by Type

Showcase Index by Type

PARTNERS

SELECTED SHOWCASE PARTICIPANTS

GOVERNMENT AGENCY PARTICIPANTS

★ U.S. Department of Defense Agencies ★

★ U.S. Department of Energy Agencies ★

★ Other U.S. Federal Agencies ★

Showcase Index by Technology Order

ADVANCED FUELS

BUILDING EFFICIENCY

CARBON CAPTURE & UTILIZATION

CONTROL SYSTEMS

ELECTRICITY TRANSMISSION & DISTRIBUTION

ENERGY STORAGE, PORTABLE

ENERGY STORAGE, STATIONARY

Showcase Index by Technology Order

INDUSTRIAL EFFICIENCY

RENEWABLE POWER GENERATION

THERMAL ENERGY UTILIZATION

TRADITIONAL POWER GENERATION

VEHICLE TECHNOLOGIES

WATER

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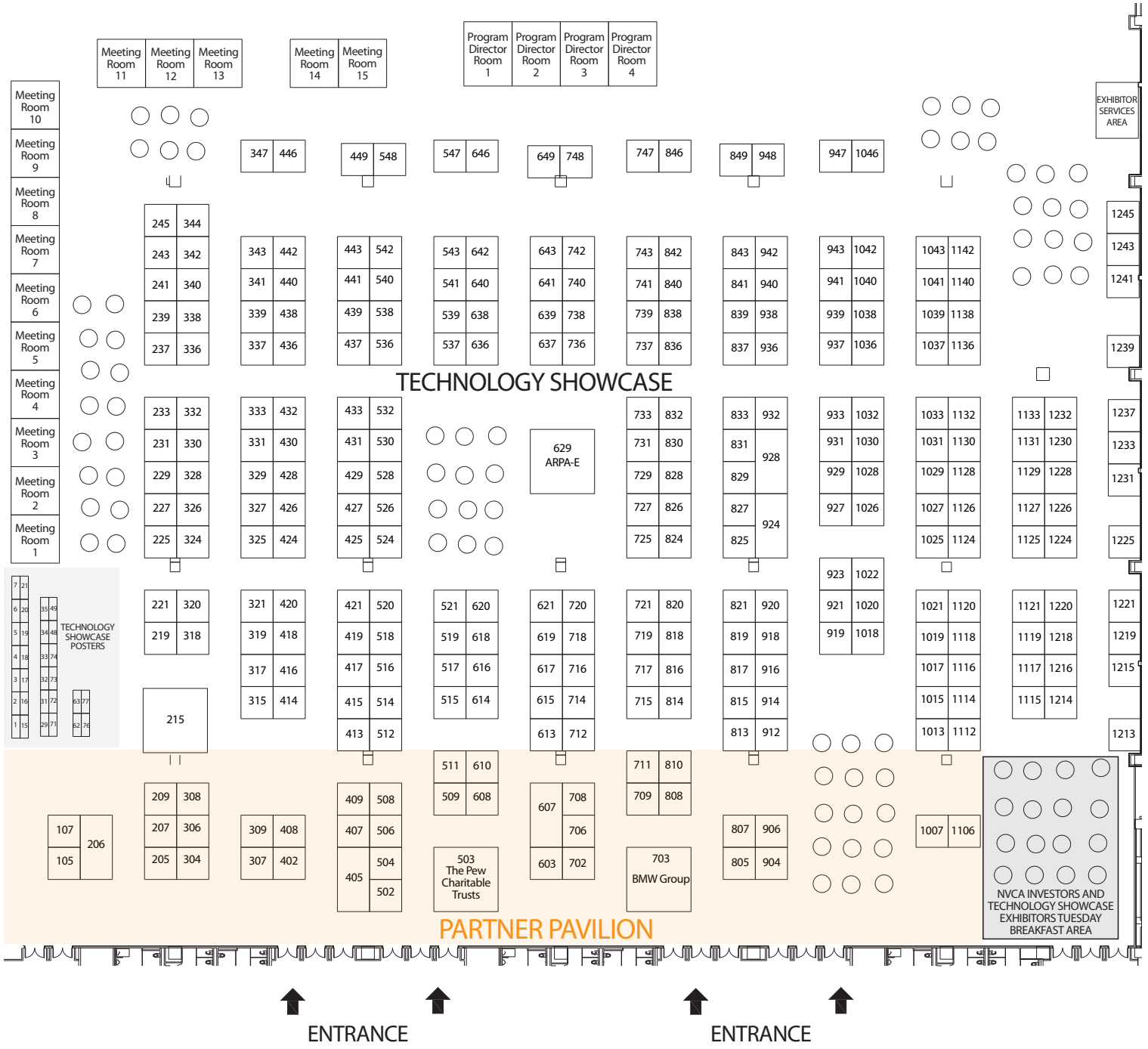
Showcase Floorplan

MEETING ROOMS

#1 DuPont
#2 BASF
#3 Constellation
#4 General Electric
#5 Great Lakes Energy Institute
#6 Lockheed Martin
#7 Massachusetts Clean Energy
#8 Robert Bosch, LLC
#9 Siemens
#10 The Pew Charitable Trusts
#11 United Technologies Research Center
#12 Reserved for CAP
#13 Reserved for CAP
#14 Reserved for CAP
#15 Reserved for CAP



Showcase Hours & Special Events

Technology Showcase Hours of Operation

TUESDAY

Continental Breakfast	7:00 a.m. – 9:00 a.m.
Lunch	11:45 a.m. - 1:45 p.m.
Reception	4:30 p.m. – 7:30 p.m.

WEDNESDAY

Continental Breakfast	7:00 a.m. – 9:30 a.m.
Lunch & Closing	11:15 a.m. – 1:30 p.m.

National Venture Capital Association Networking Event

TUESDAY 7:30-8:30 a.m.

Investors and Technology Showcase exhibitors are invited to network and discuss potential commercialization opportunities. Meet in the Technology Showcase Partner Pavilion on the far right side.

Women in the Energy Sector

WEDNESDAY 7:30-9:00 a.m.

Join ARPA-E Acting Director Dr. Cheryl Martin at the ARPA-E booth in the Technology Showcase for a special networking event with women in the energy sector.

"This unique forum will help facilitate the partnerships necessary to bring game-changing technologies to market quickly, which is critical to securing America's global technology leadership and creating new jobs."

—Steven Chu, Former Secretary, U.S. Department of Energy

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