Effects of Distributed Generation on Existing and Future Grid

NEITF DGS Technical Advisory Group
April 14, 2016

Jessica Scott
Regional Director, Interior West
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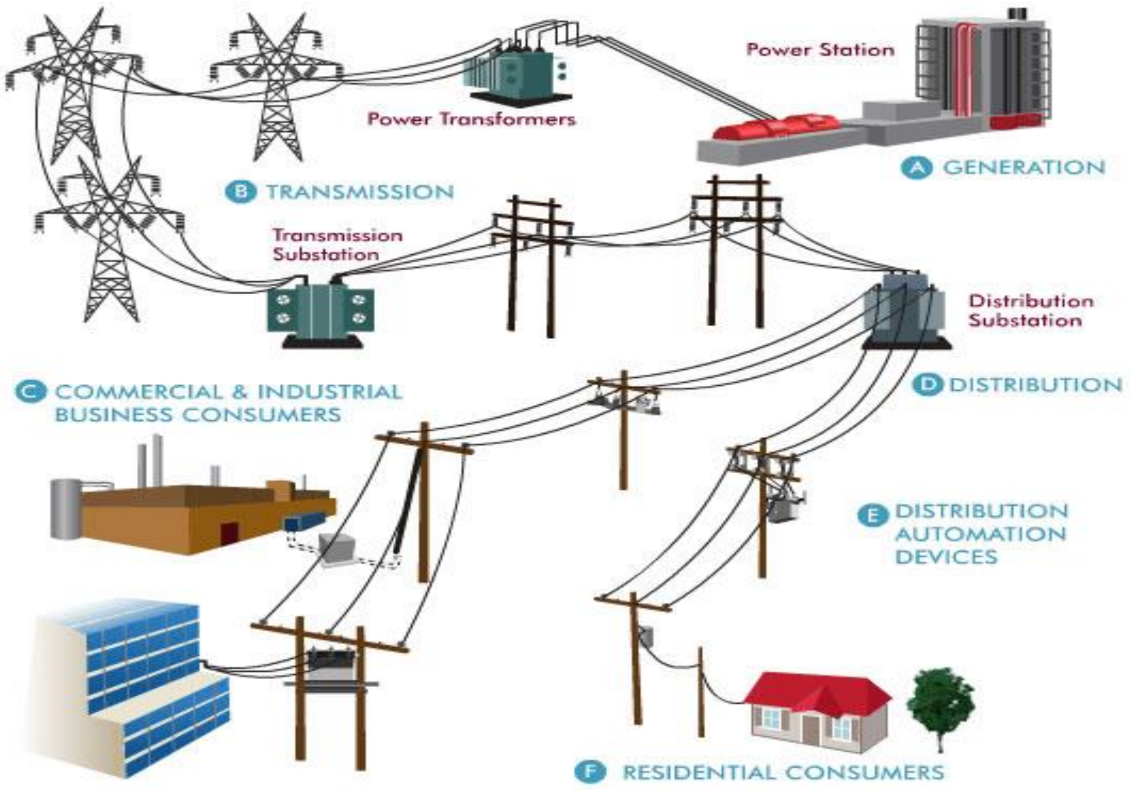
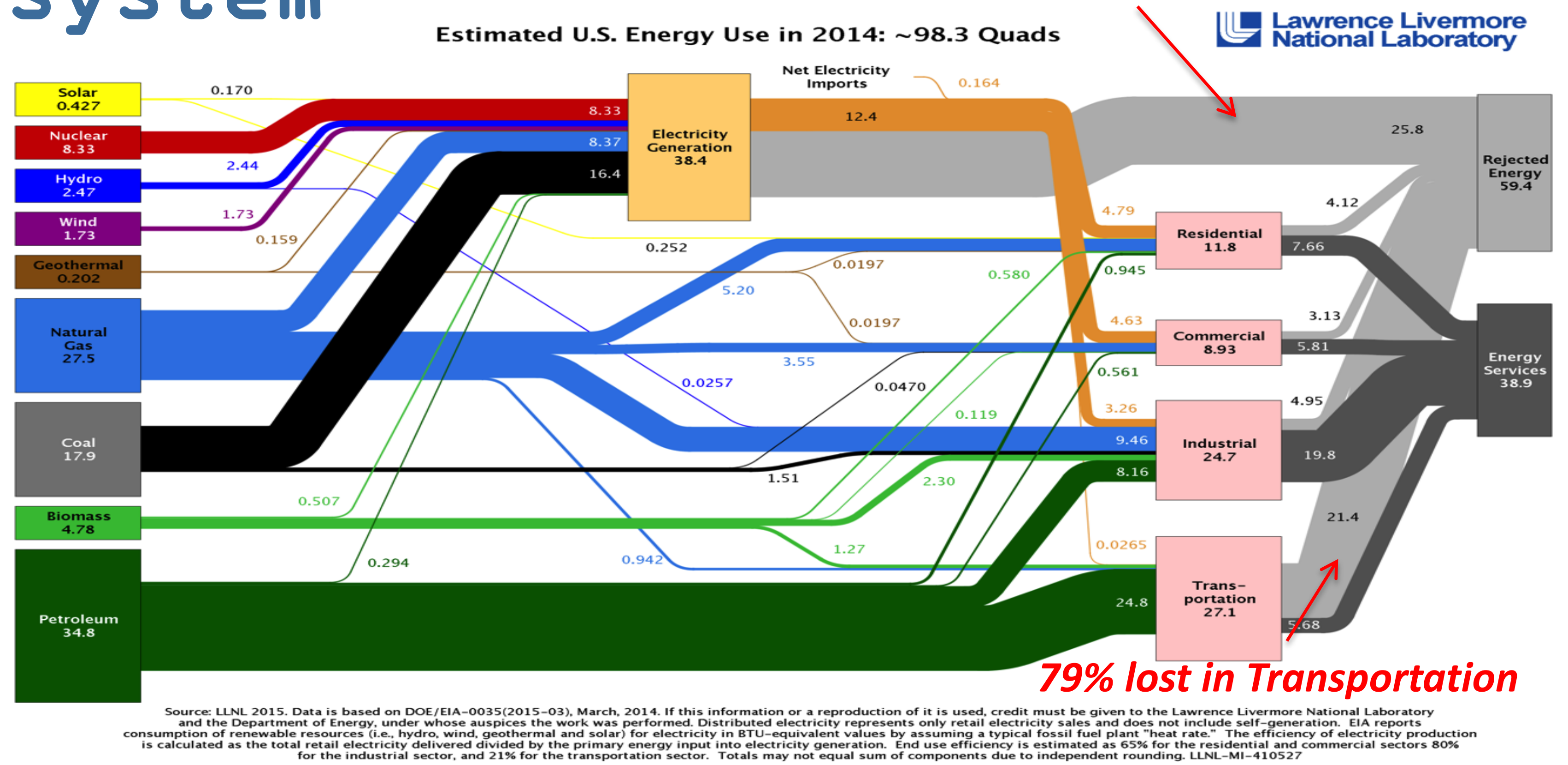
Today's electricity system



Source: Texas Electricity Alliance

Our inefficient energy system

67% lost in electricity supply and delivery



79% lost in Transportation

The water-energy

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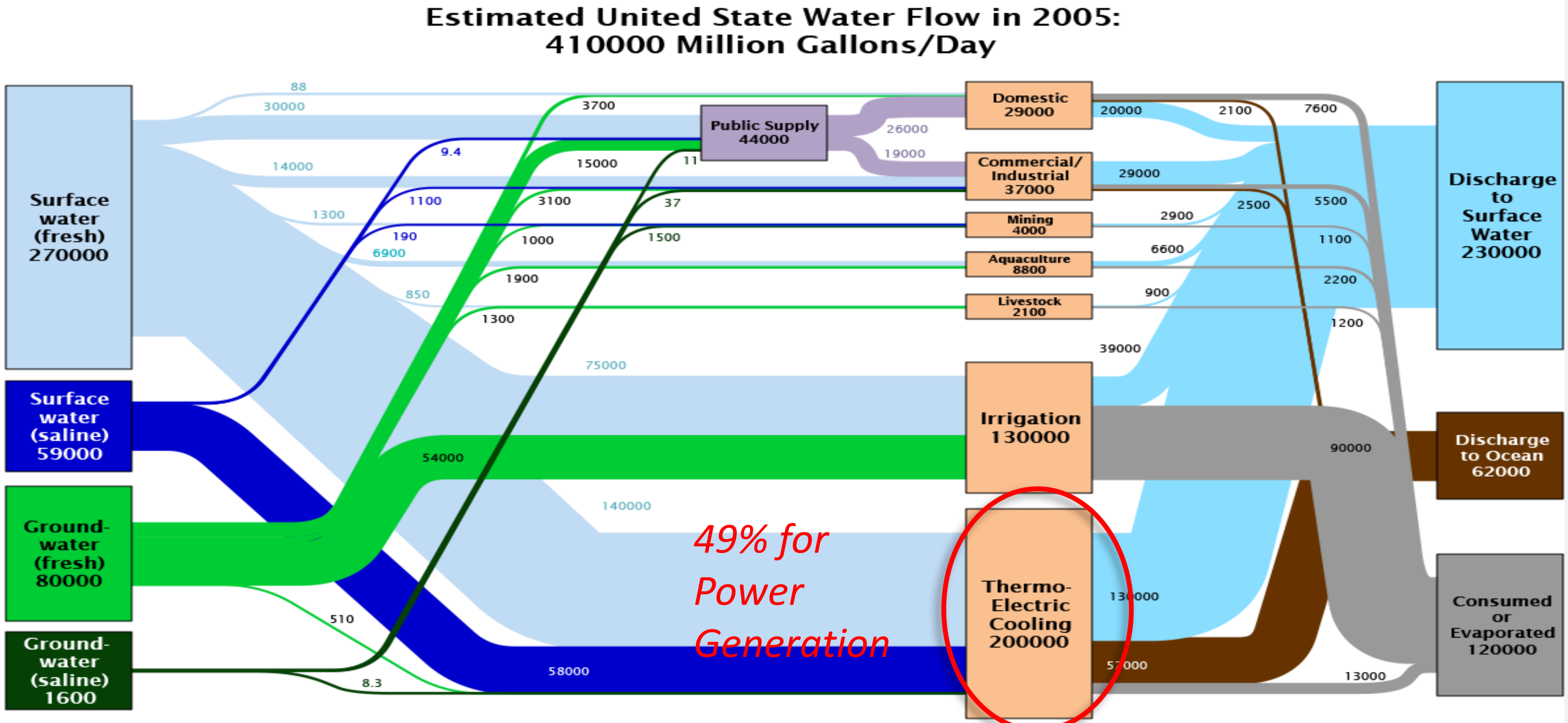
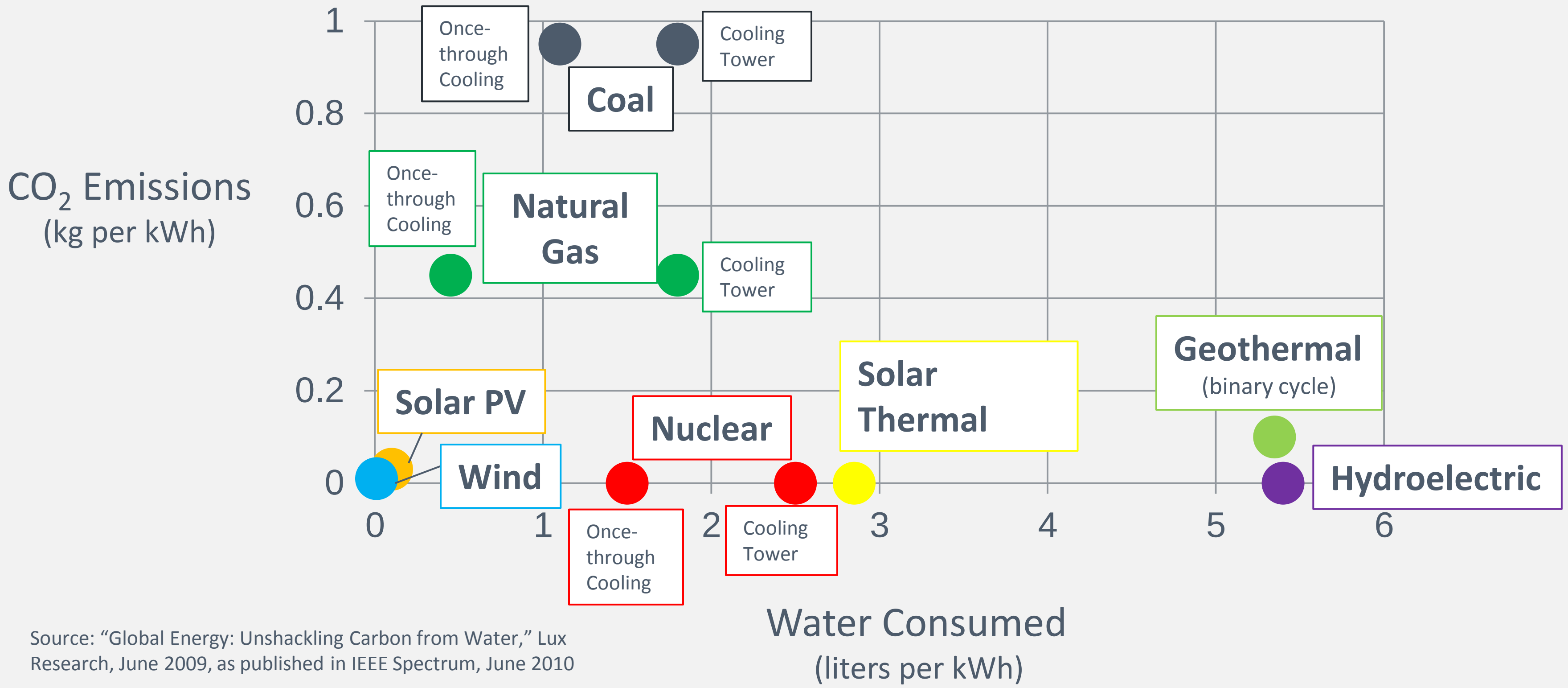


Source: LLNL 2011. Data is based on USGS Circular 1344, October 2009. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. All quantities are rounded to 2 significant digits and annual flows of less than 0.05 MGal/day are not included. Totals may not equal sum of flows due to independent rounding. Further detail on how all flows are calculated can be found at http://flowcharts.llnl.gov. LLNL-TR-475772

Carbon- and water-intensity of power generation



Source: "Global Energy: Unshackling Carbon from Water," Lux Research, June 2009, as published in IEEE Spectrum, June 2010

The Distributed Energy Future

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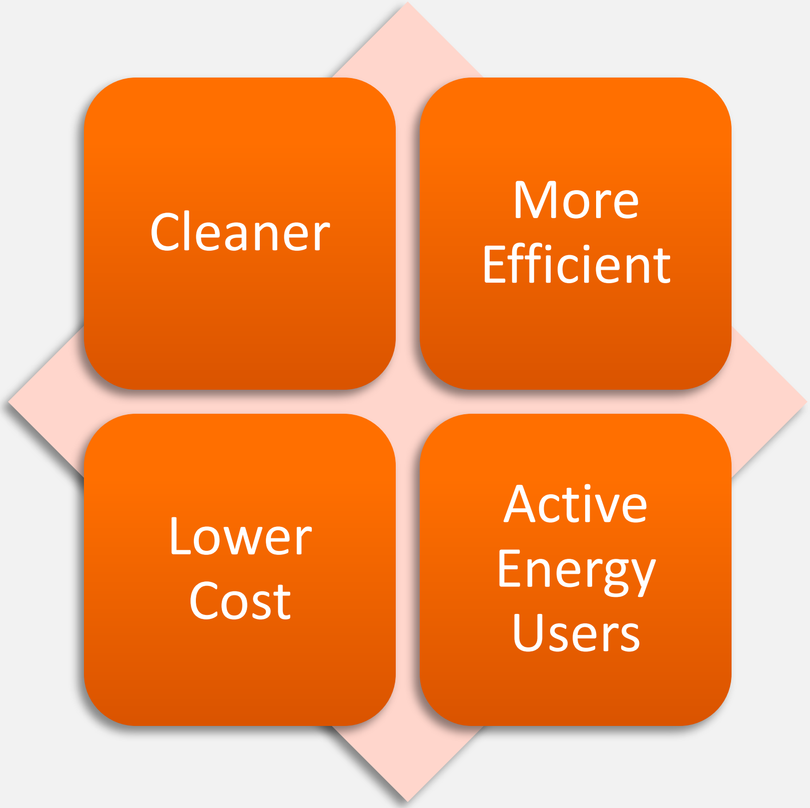

- Technology enables a new grid paradigm
- Attracts private capital to contribute to the public good
- Provides immense opportunity for policymakers to lead

Framing the Value Discussion

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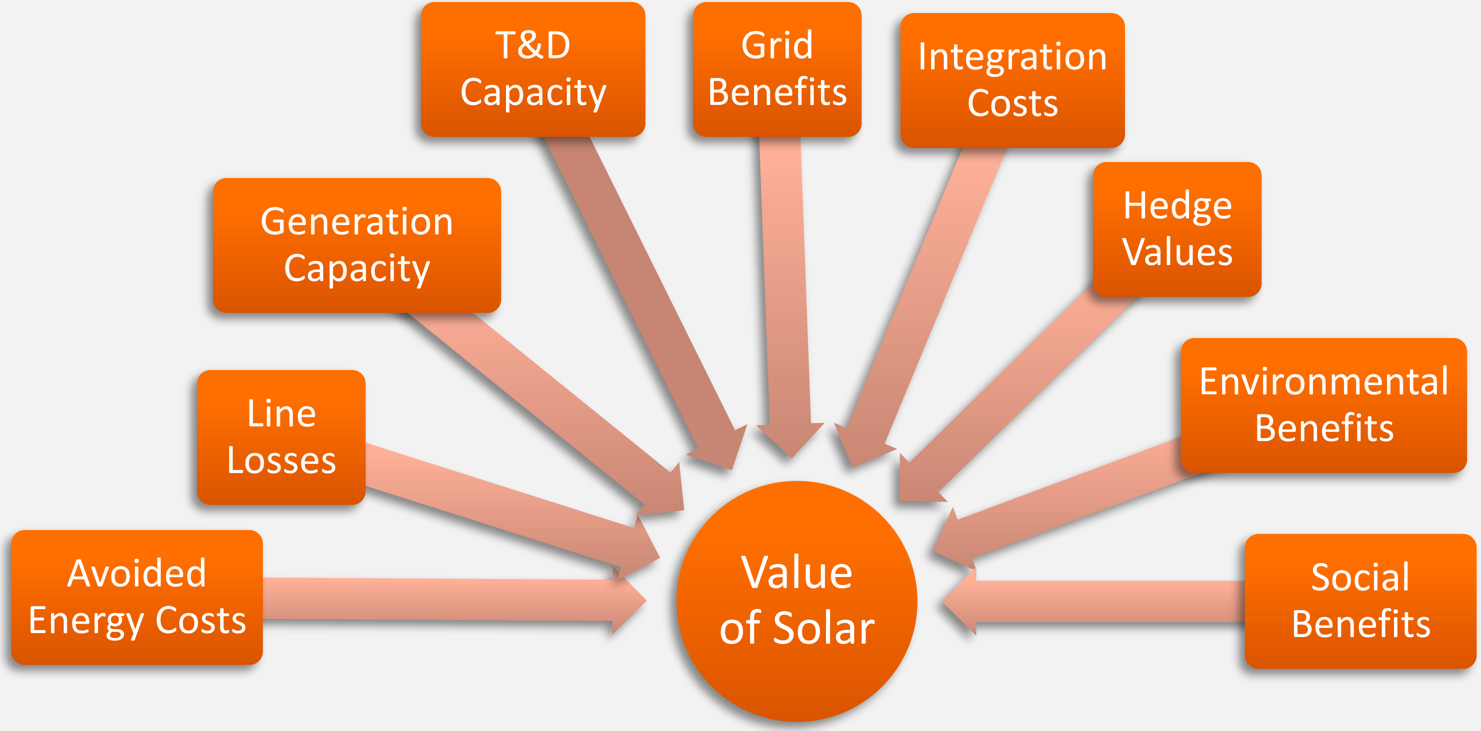
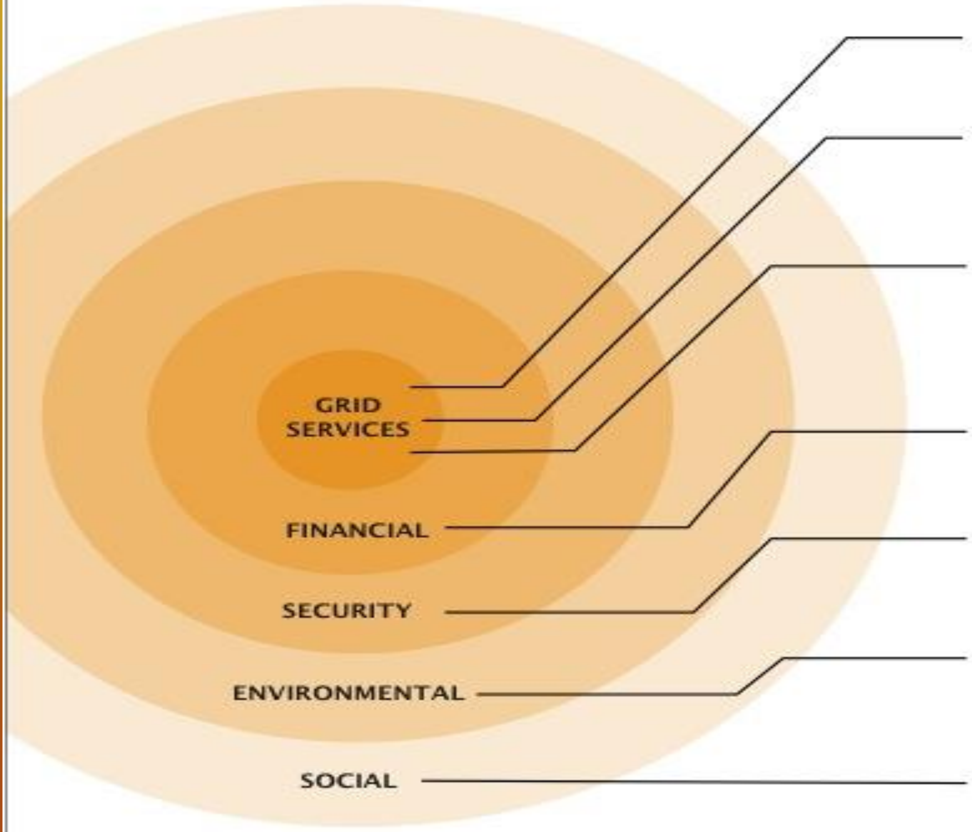


BENEFIT & COST CATEGORIES

For the purposes of this report, **value is defined as net value, i.e. benefits minus costs.** Depending upon the size of the benefit and the size of the cost, value can be positive or negative. A variety of categories of benefits or costs of DPV have been considered or acknowledged in evaluating the value of DPV. Broadly, these categories are:



ENERGY
- energy
- energy losses

CAPACITY
- generation capacity
- transmission & distribution capacity
- DPV installed capacity

GRID SUPPORT SERVICES
- reactive supply & voltage control
- regulation & frequency response
- energy & generator imbalance
- synchronized & supplemental operating reserves
- scheduling, forecasting, and system control & dispatch

FINANCIAL RISK
- fuel price hedge
- market price response

SECURITY RISK
- reliability & resilience

ENVIRONMENTAL
- carbon emissions
- criteria air pollutants (SOx, NOx, PM10)
- water
- land

SOCIAL
- Economic development (jobs and tax revenues)

Nevada is not the only state grappling with this

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» New York Reforming the Energy Vision (REV)

Reforming the Energy Vision (NY REV)

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» **Overview**

> Reforming the Energy Vision (REV) is a set of sweeping regulatory reforms and state initiatives designed to spur clean energy innovation, improve consumer choice and affordability, and increase grid efficiency and resiliency with an emphasis on distributed energy resources.

» **Initiatives**

> Market and regulatory reform

> Incentive programs

> Improving financing

The impact of PV + storage

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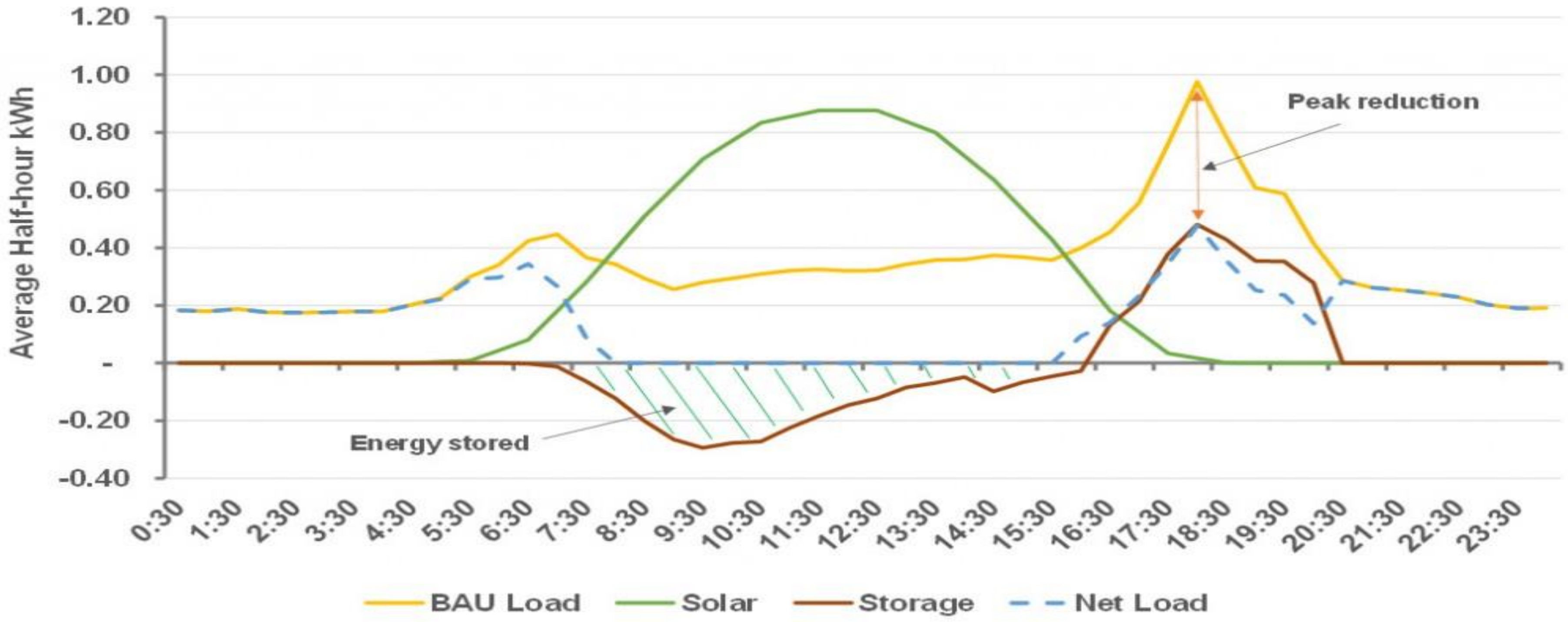

Source: http://www.marchmenthill.com/qsi-online/2015-07-21/why-isnt-there-more-talk-about-network-storage-as-a-service/

Energy Storage

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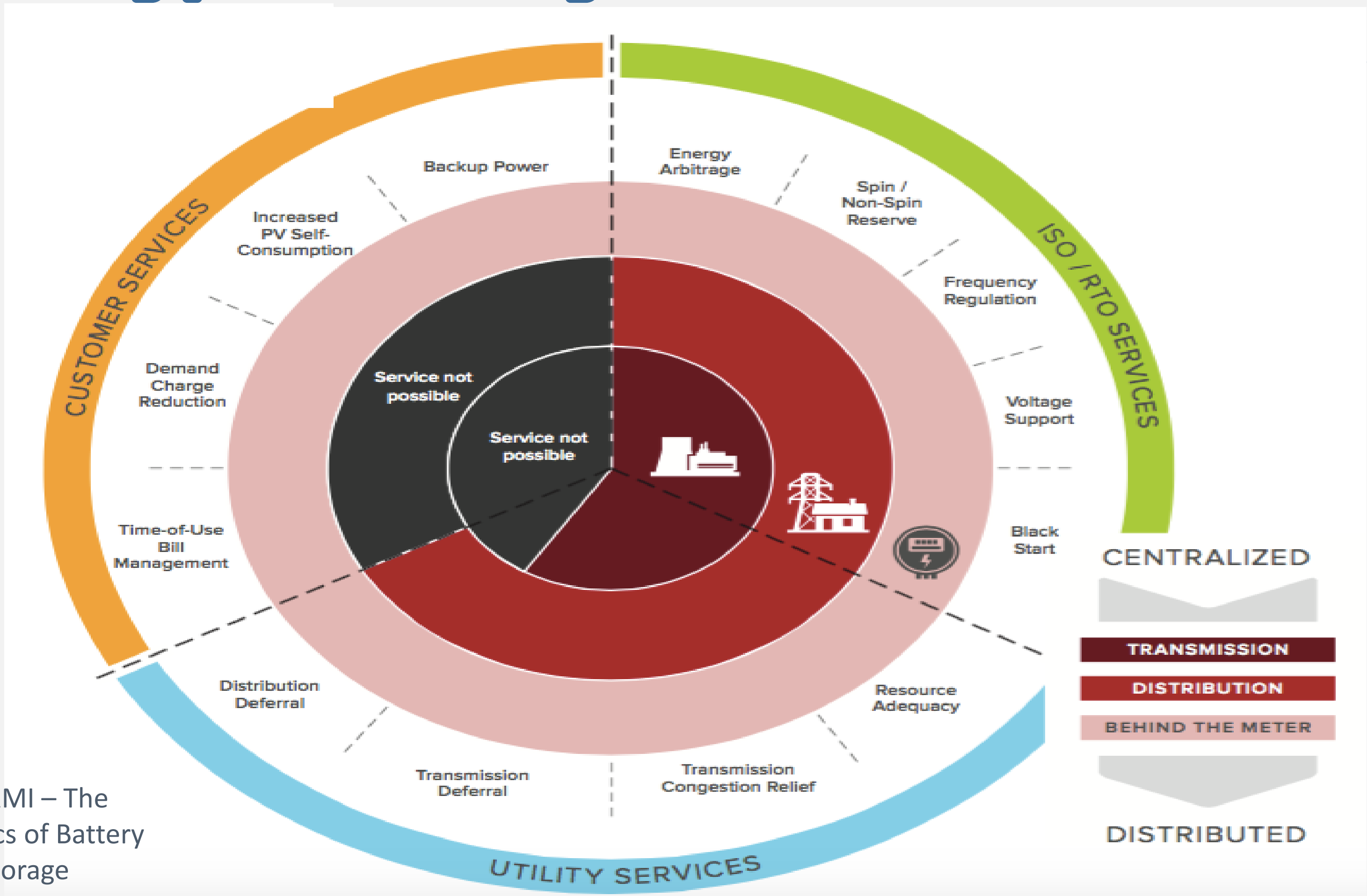


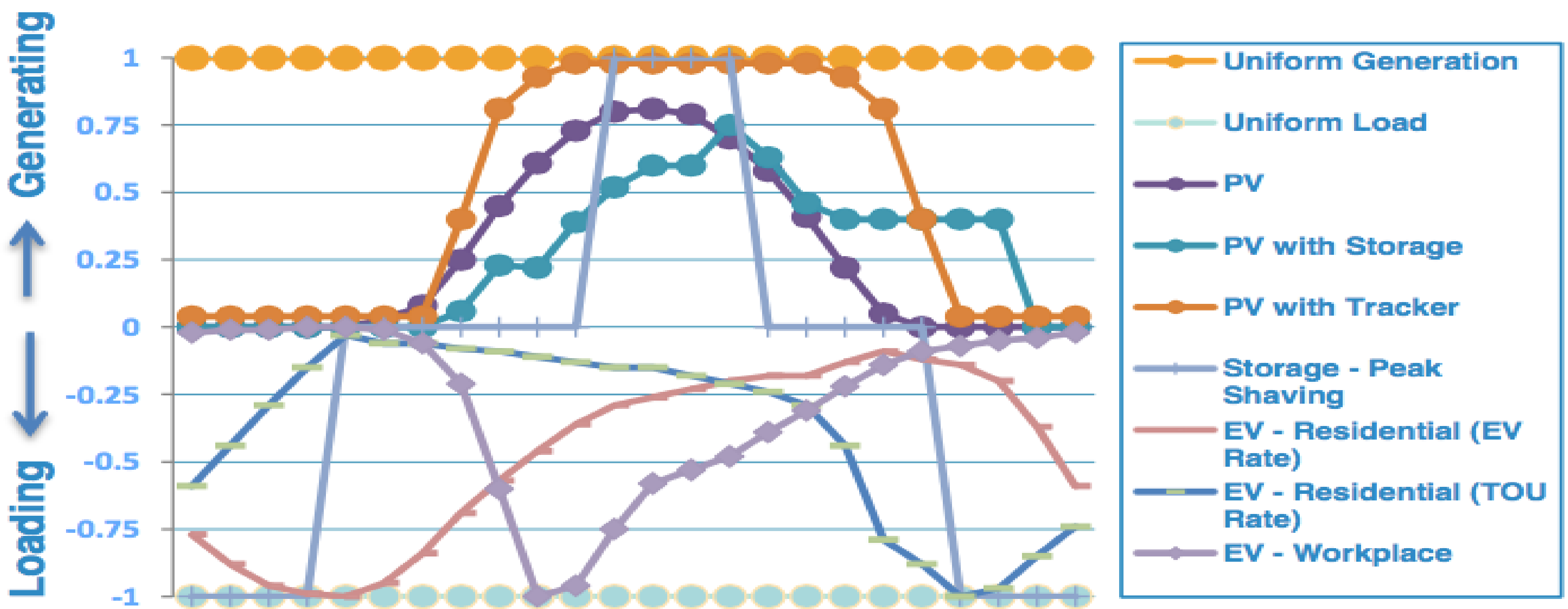
Source: RMI – The Economics of Battery Energy Storage

EV Charging


TESLA


TESLA
SUPERCHARGING STATION
EXCEPT FOR ELECTRIC VEHICLE CHARGING

DER load profiles



Source: PG&E's Distribution Resources Plan Webinar, August, 2015

States Find Benefits of Solar Exceed Costs

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» Review of studies sponsored by independent state entities reveals net benefits

State	Date	Sponsor	Resulting Value (Levelized)
Maine	March 2015	Legislature	33.7¢/kWh
Vermont	Nov 2014	Dept. of Public. Serv.	25.7¢/kWh
Mississippi	Sept 2014	PSC	17.0¢/kWh
Nevada	July 2014	PUC	18.5¢/kWh
Minnesota	Jan 2014	Dept. of Commerce	14.5¢/kWh

Value and Cost of Solar

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- Comprehensive costs and benefits need to be considered
- Cost of service studies look only at single year but benefits accrue over time
- Discussion should not be limited to residential class
- Policy makers should weigh assessment of long-term solar benefits and policy goals with cost of service findings

New planning paradigms

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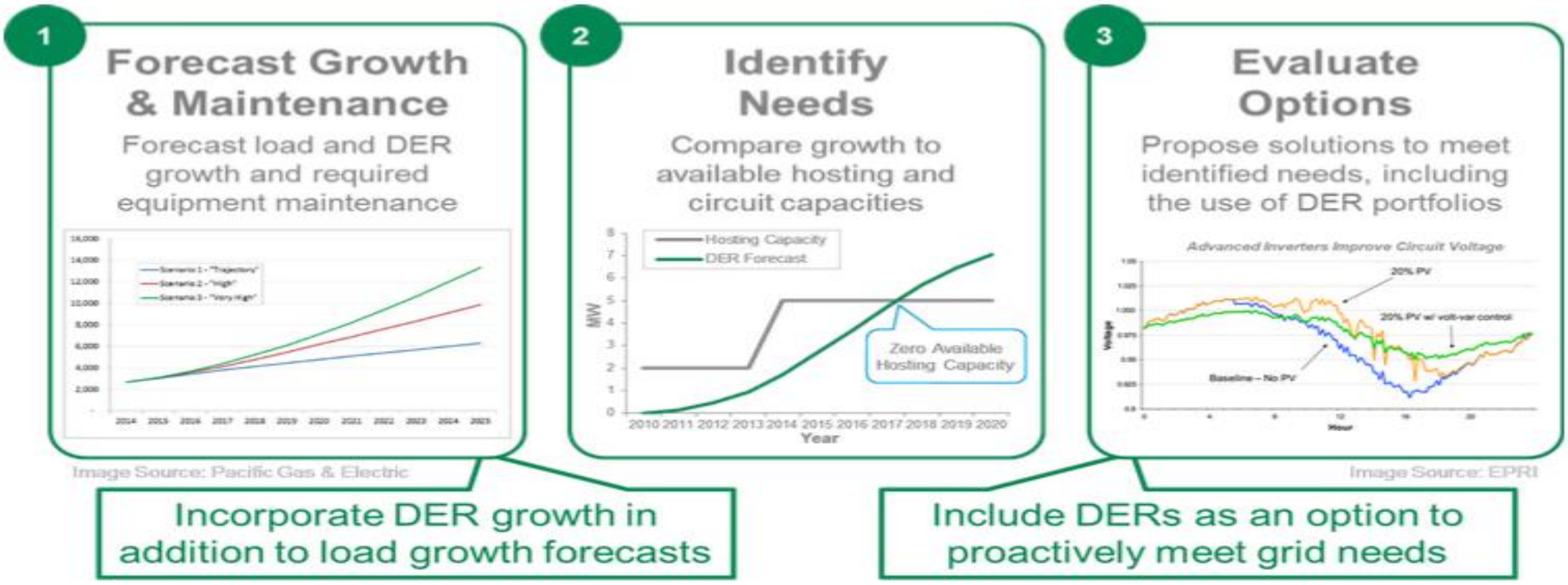

Source: SolarCity

Nevada at the Crossroads

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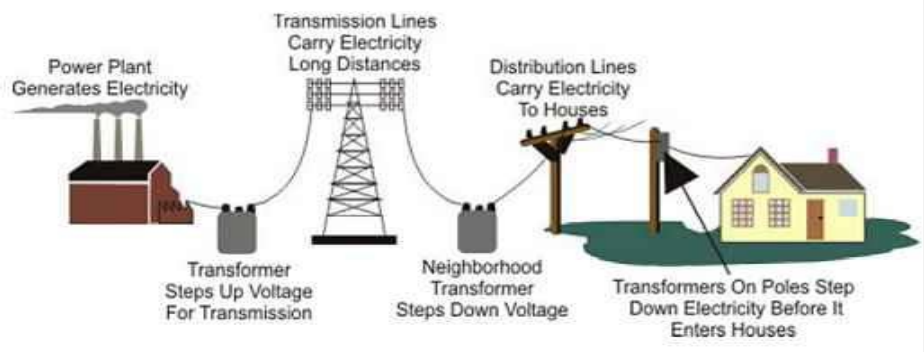
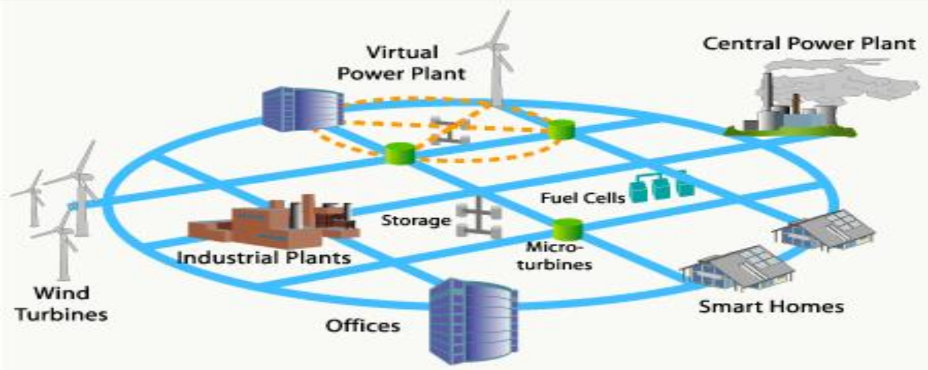
» Benefits of DG and storage will not be fully realized without proactive planning for distributed energy future

The energy system of the future

From centralized supply …



… to DER



Source: www.powergenasia.com

- One-way power flow
- Inefficient (65-70% losses)
- Water- and carbon-intensive
- Old, vulnerable and fragile
- Low penetration of renewables
- Supply follows demand
- Not so smart
- Strong barriers to entry

- Multi-directional power flow
- Efficient
- Less water- and carbon-intensive
- Resilient and highly reliable
- High penetration of renewables
- Demand follows supply
- Smarter
- Opportunities for new market entrants

Bright Path to the Future

Resources

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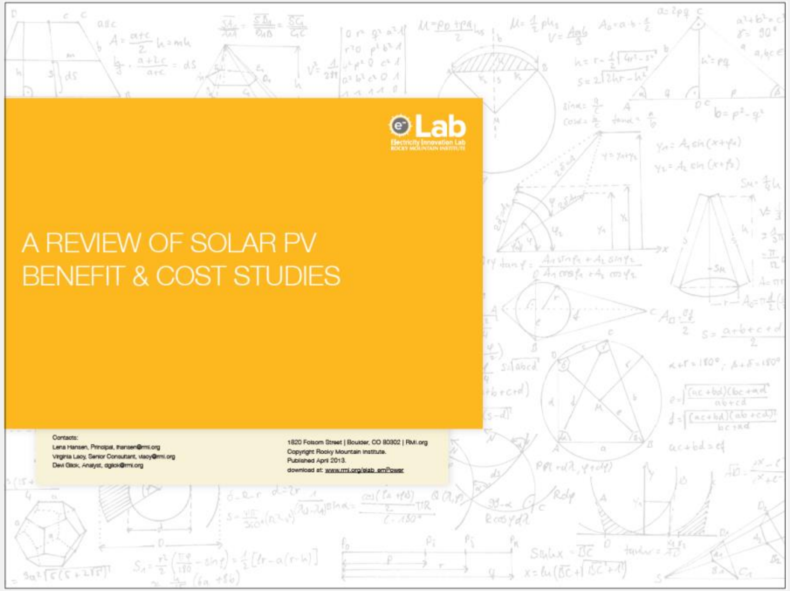

e⁻ Lab
Electricity Innovation Lab
Rocky Mountain Institute
A REVIEW OF SOLAR PV
BENEFIT & COST STUDIES
Contacts:
Lena Hansen, Principal, lhansen@rmi.org
Virginia Lacy, Senior Consultant, vlacy@rmi.org
Devi Glick, Analyst, dglick@rmi.org
1820 Folsom Street | Boulder, CO 80302 | RMI.org
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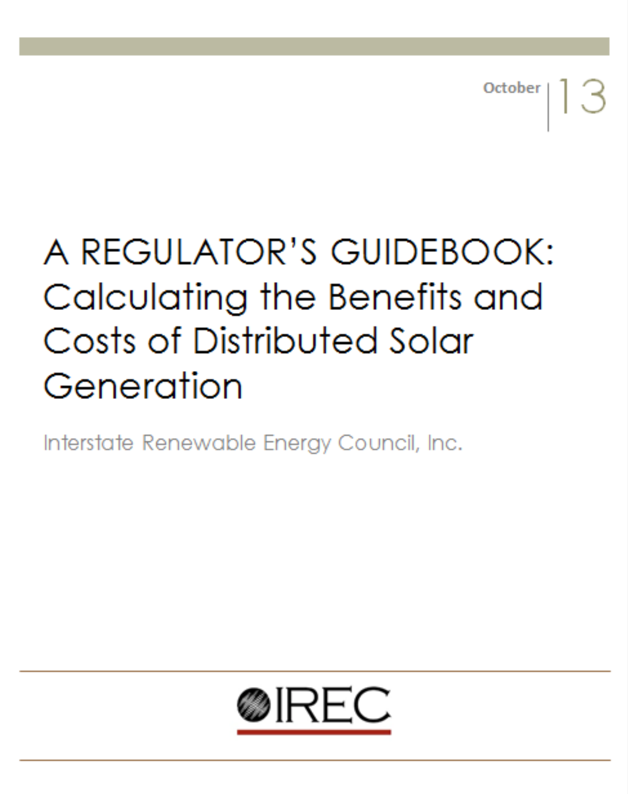
download at: www.rmi.org/elab_emPower



October | 13
A REGULATOR'S GUIDEBOOK:
Calculating the Benefits and
Costs of Distributed Solar
Generation
Interstate Renewable Energy Council, Inc.
IREC

Thank you

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Jessica Scott
Regional Director, Interior West

jessica@votesolar.org

www.votesolar.org
Facebook/votesolar
Twitter: @votesolar