RAP Energy solutions for a changing world

A Look Ahead to Proliferating Customer Generation

Presentation to the New Hampshire Energy Efficiency and Sustainable Energy Board

Presented by Richard Sedano

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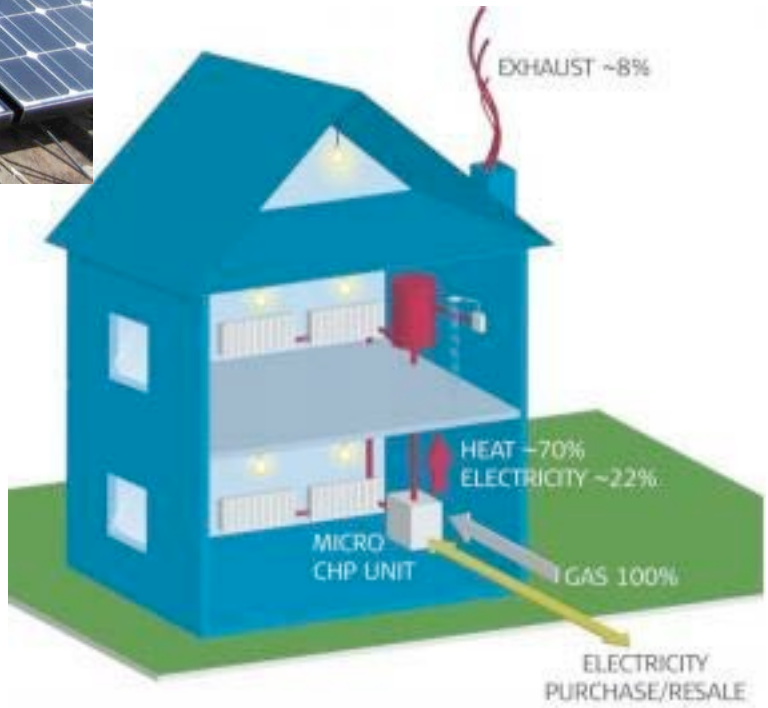
Introducing RAP and Rich

- RAP is a non-profit organization providing technical and educational assistance to government officials on energy and environmental issues. RAP staff have extensive utility regulatory experience. RAP technical assistance to states is supported by US DOE and foundations.
  - Richard Sedano directs RAP's US Program. He was commissioner of the Vermont Department of Public Service from 1991-2001 and is an engineer.

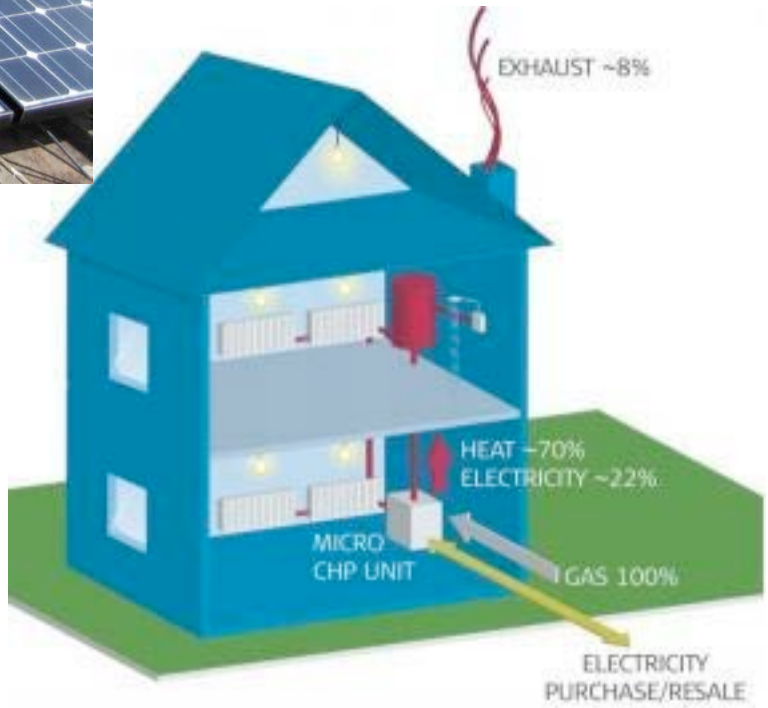
Focus: Solar PV and Combined Heat and Power (CHP)



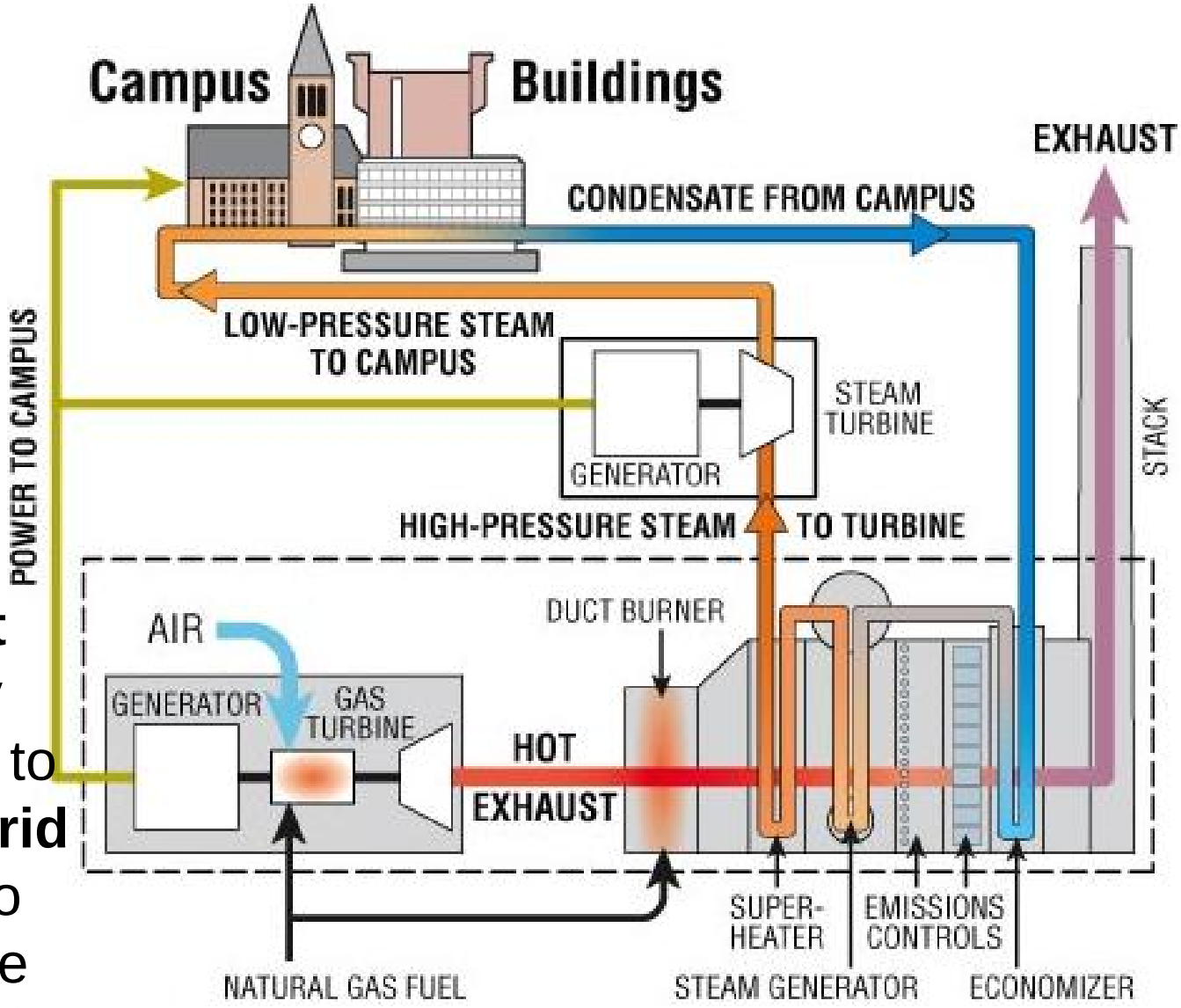
Before we start: Underlying Trend

- More technology to differentiate the customer experience (EE, DR, DG, services)
  - With supporting automation, information
  - Accessible to customers who seem interested
    - With or without utility assistance
- Monetizing value of these assets and services is not mature
  - PUC (retail), RTO (wholesale) actions needed
- Effects on utility and regulation are likely to be profound

Focus: Solar PV and Combined Heat and Power (CHP)



District Energy leading to **Microgrid** can also be in the picture



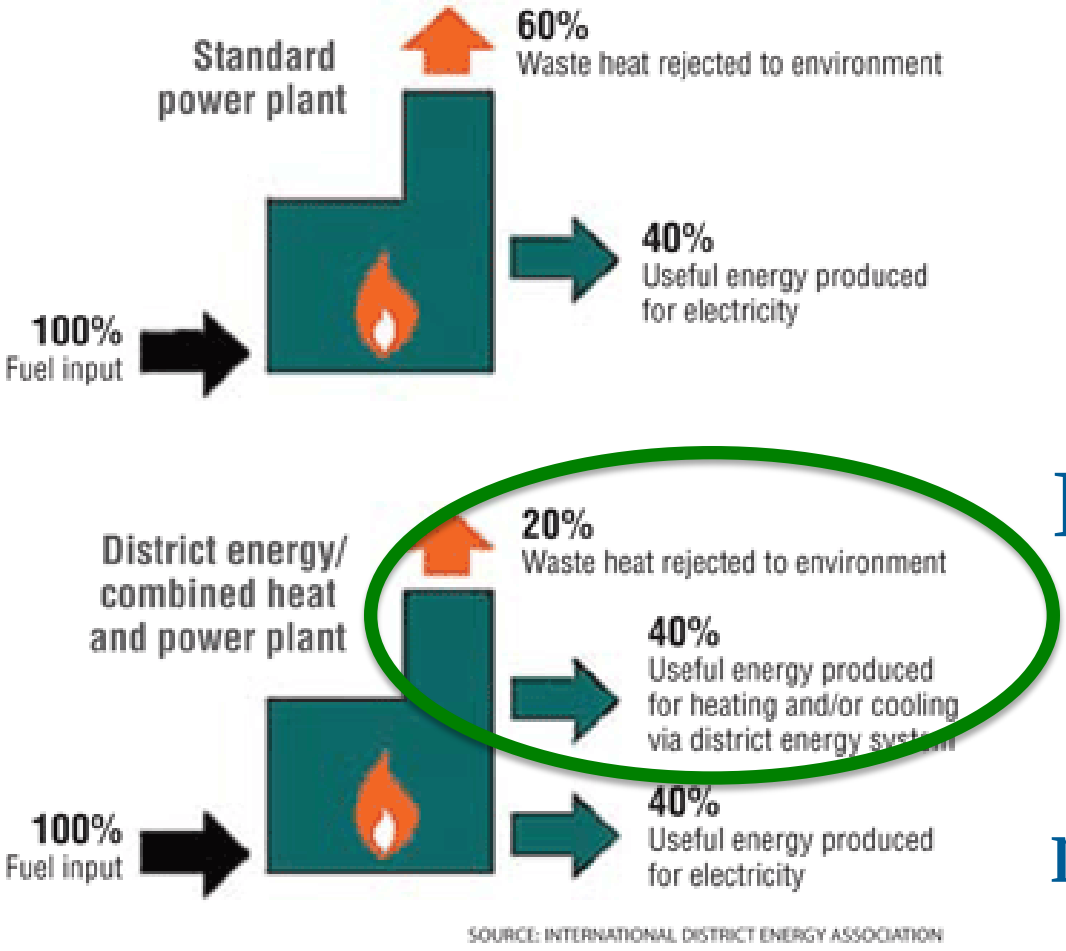
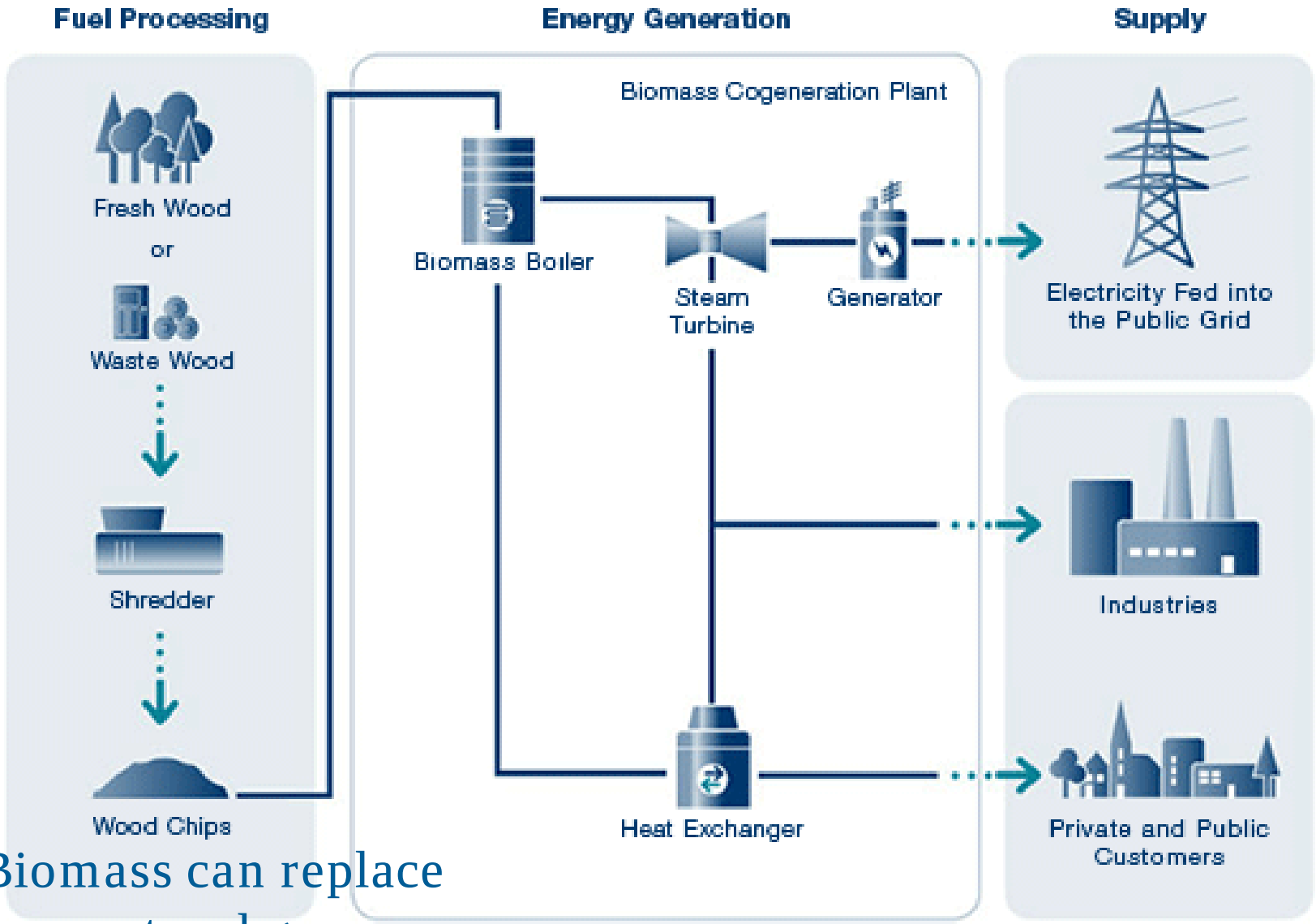
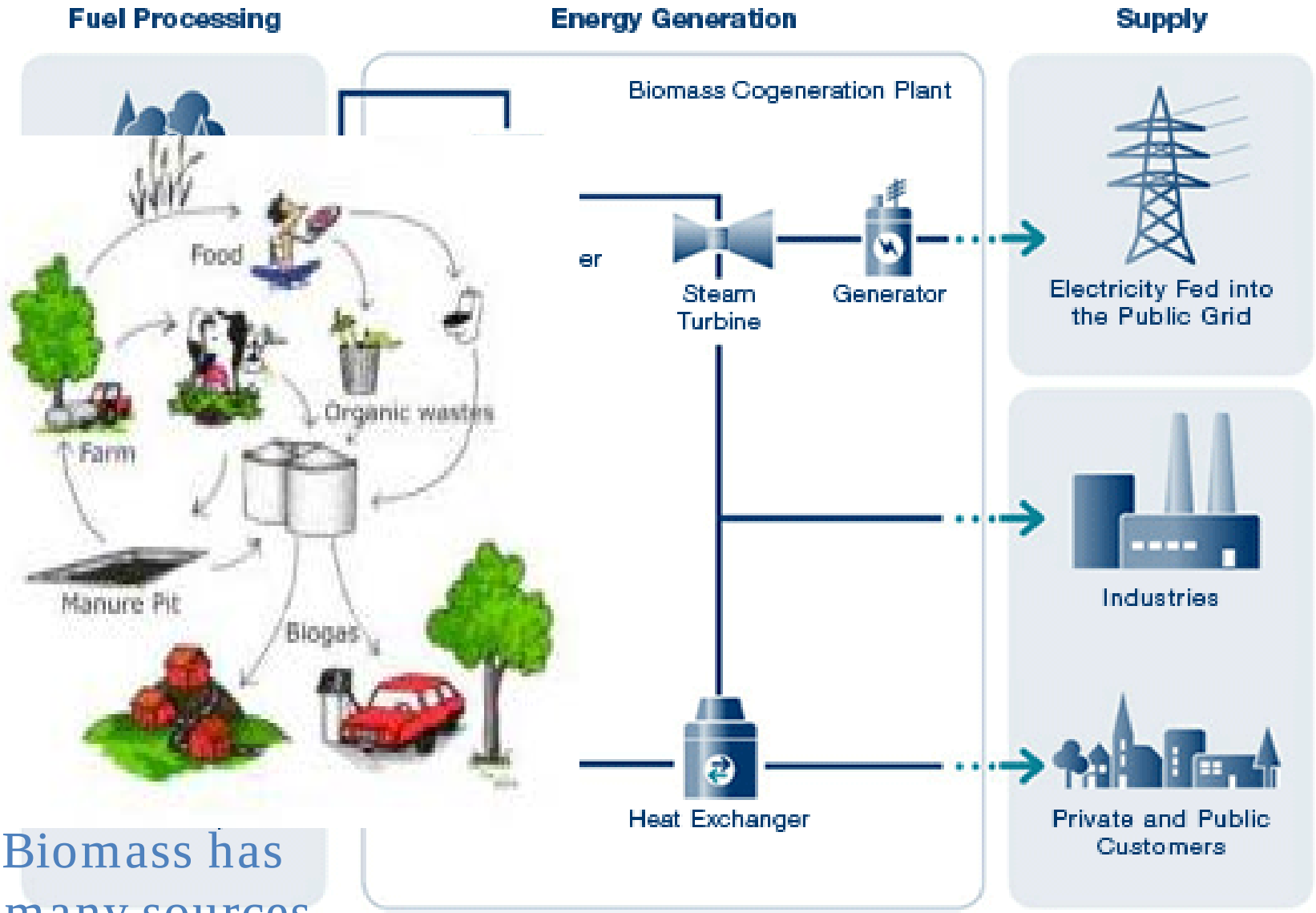


FIGURE 3. Energy-efficiency comparisons of a standard power plant and a district energy combined-heat-and-power plant.

Illustrative primer on CHP: Use more input energy

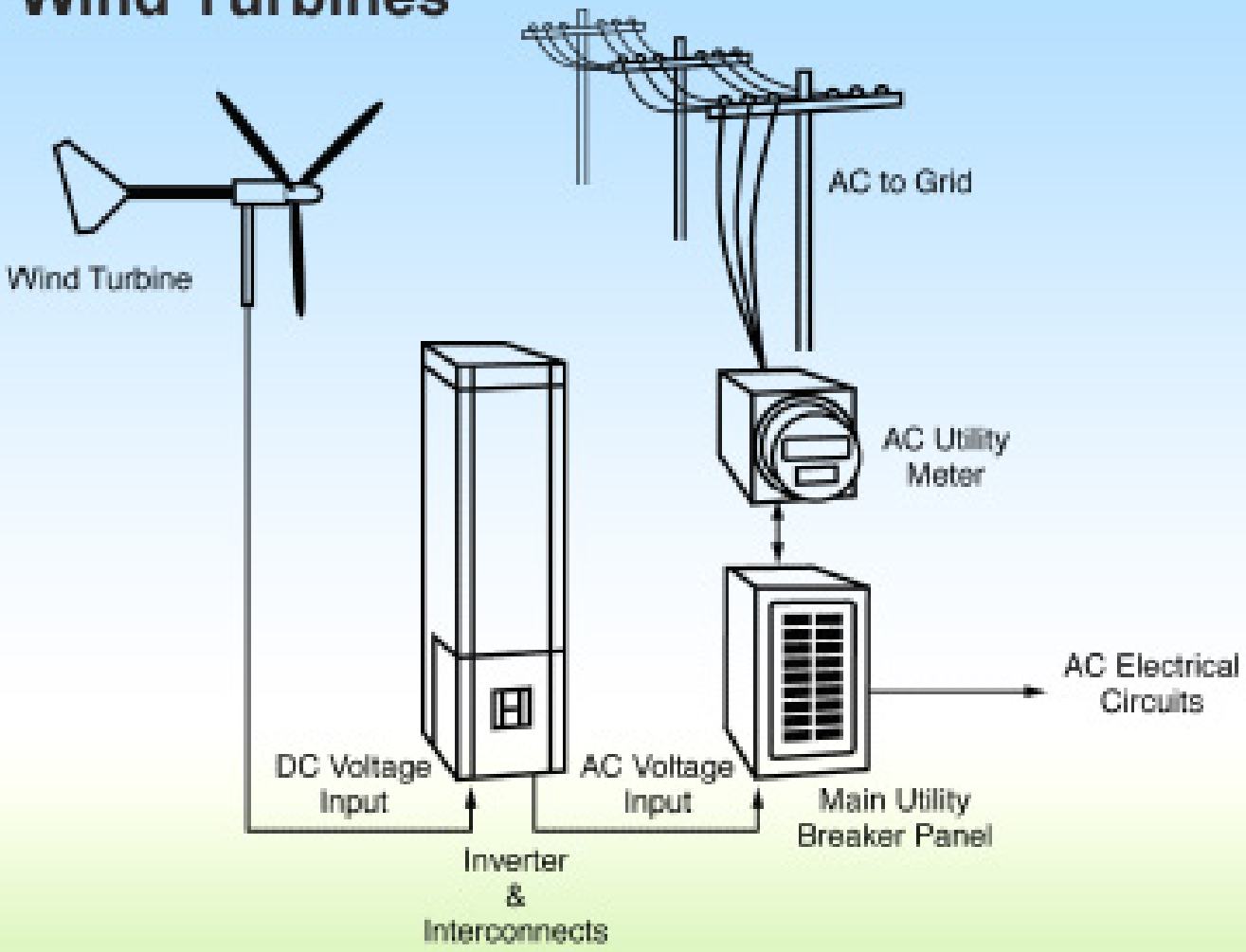


Biomass can replace natural gas

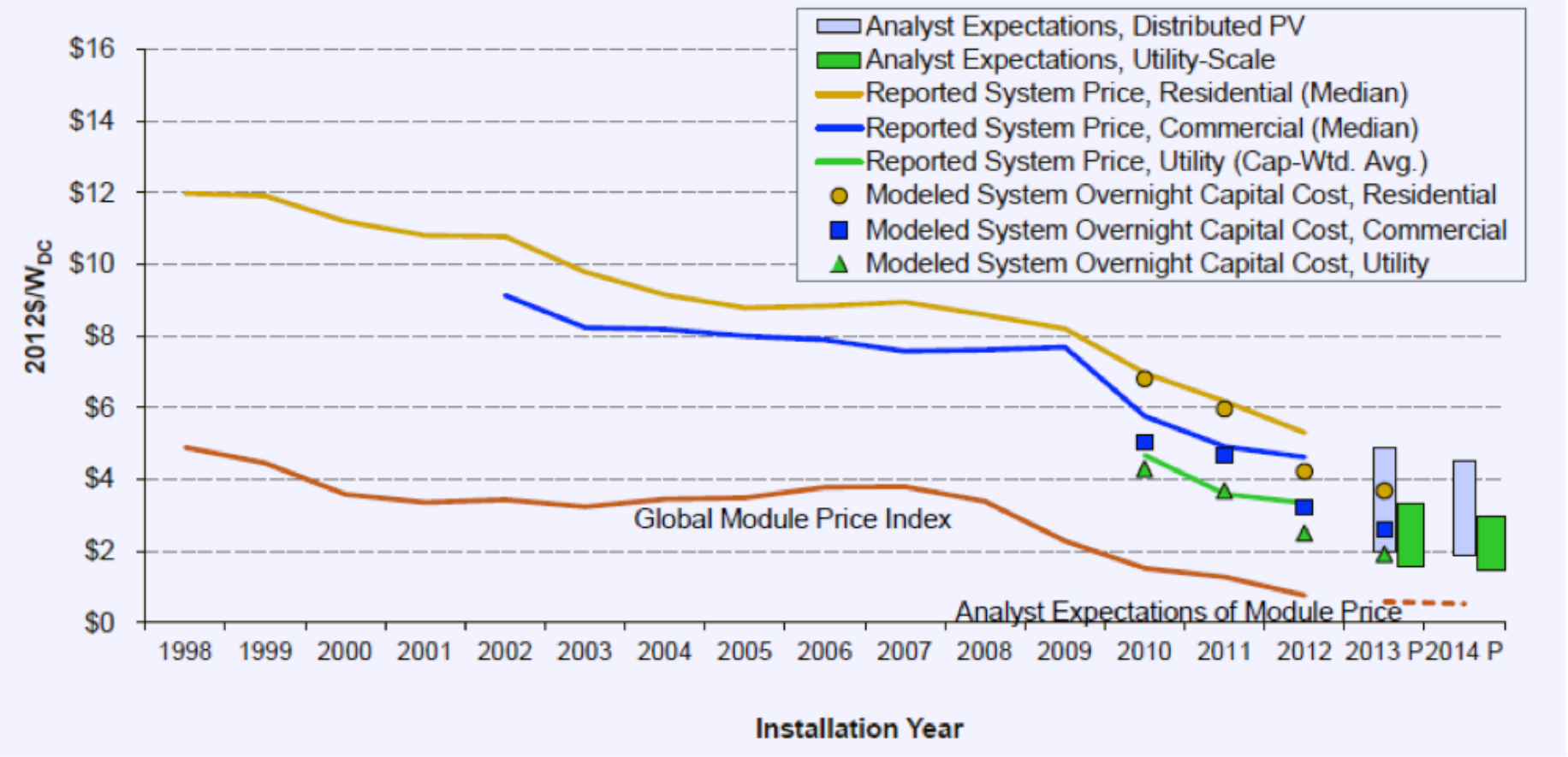


Biomass has many sources

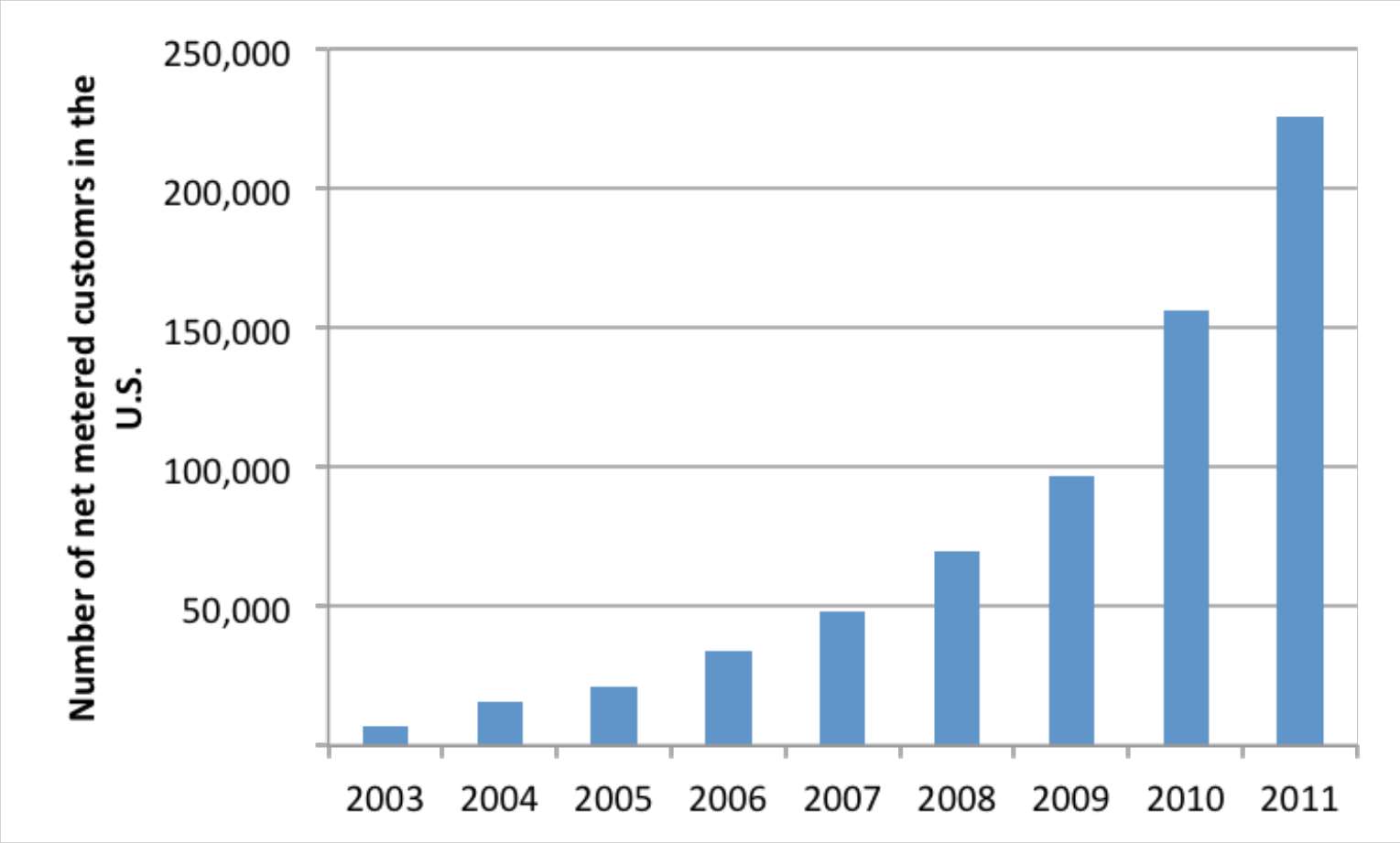
Wind Turbines



Reported, bottom-up, and analyst-projected average U.S. PV system price over time.



Number of net metered customers in the United States.



Solar PV in the US

- Exponential growth
- Net metering (nearly national)
  - Feed in tariffs where used (CA, VT)
- Federal tax/other support sweetens deal
- EE, Solar leasing reduce cost to enter
- Hard costs decline with (technology)
- Soft costs also a bit (government)
  - But remain much higher than in Europe
  - 3rd party leasing and aggregation important

Net Metering

- Simple
  - Offset usage
  - Usually not for maximizing onsite production
- Rough value ~ tail block retail rate
  - Predictable, stable
- Suited for infant industry and customers with other things to do
  - Nurture growth
- Other energy forms qualify, not just PV

DSIRE™

Database of State Incentives for Renewables & Efficiency

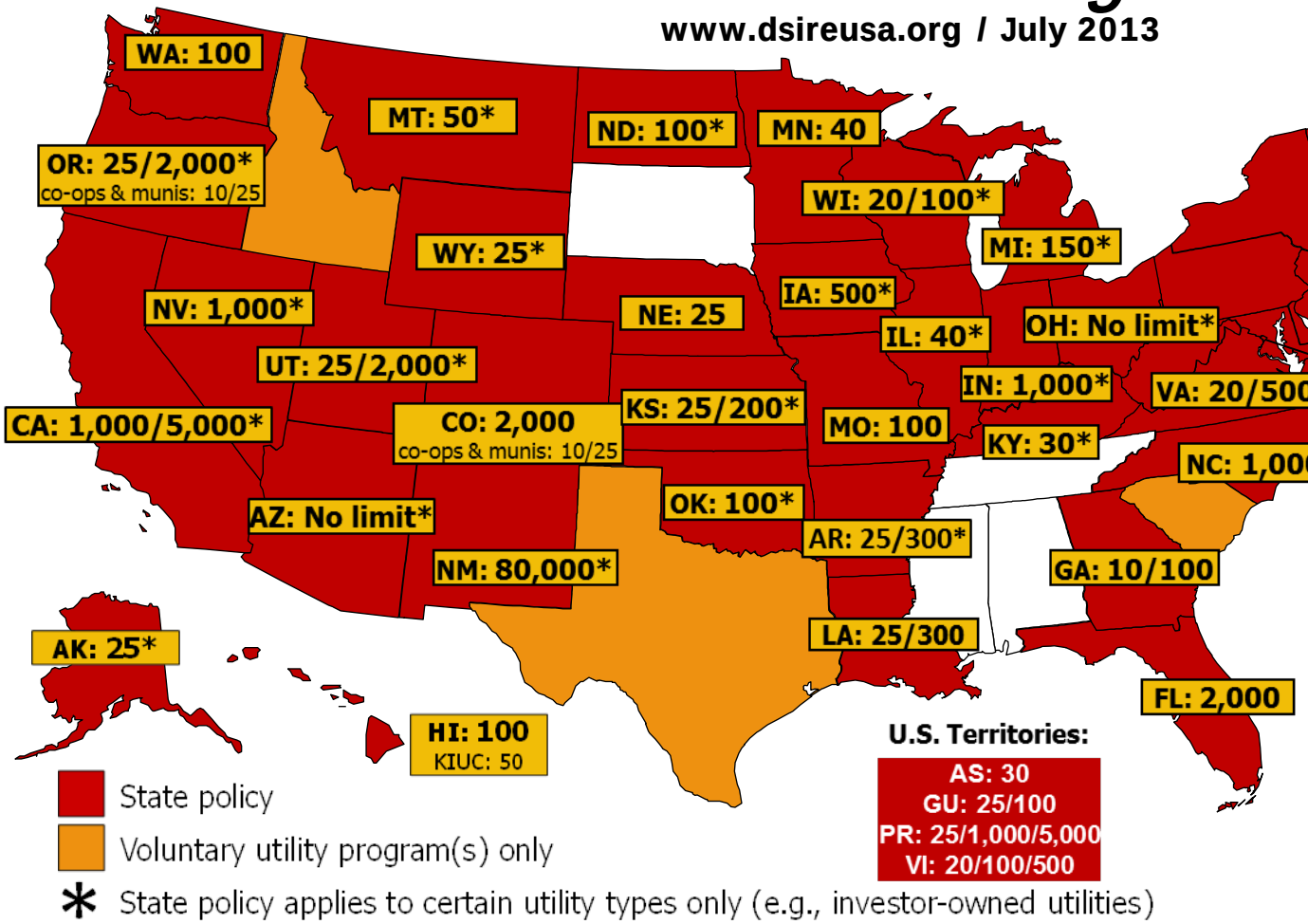
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IREC Interstate Renewable Energy Council

NORTH CAROLINA Solar Center

Net Metering

www.dsireusa.org / July 2013



U.S. Territories:

AS: 30
GU: 25/100
PR: 25/1,000/5,000
VI: 20/100/500

43 states
+ Washington DC & 4 territories have adopted a net metering policy

State policy

Voluntary utility program(s) only

* State policy applies to certain utility types only (e.g., investor-owned utilities)

Note: Numbers indicate individual system capacity limit in kilowatts. Some limits vary by customer type, technology and/or application. Other limits might also apply. This map generally does not address statutory changes until administrative rules have been adopted to implement such changes.

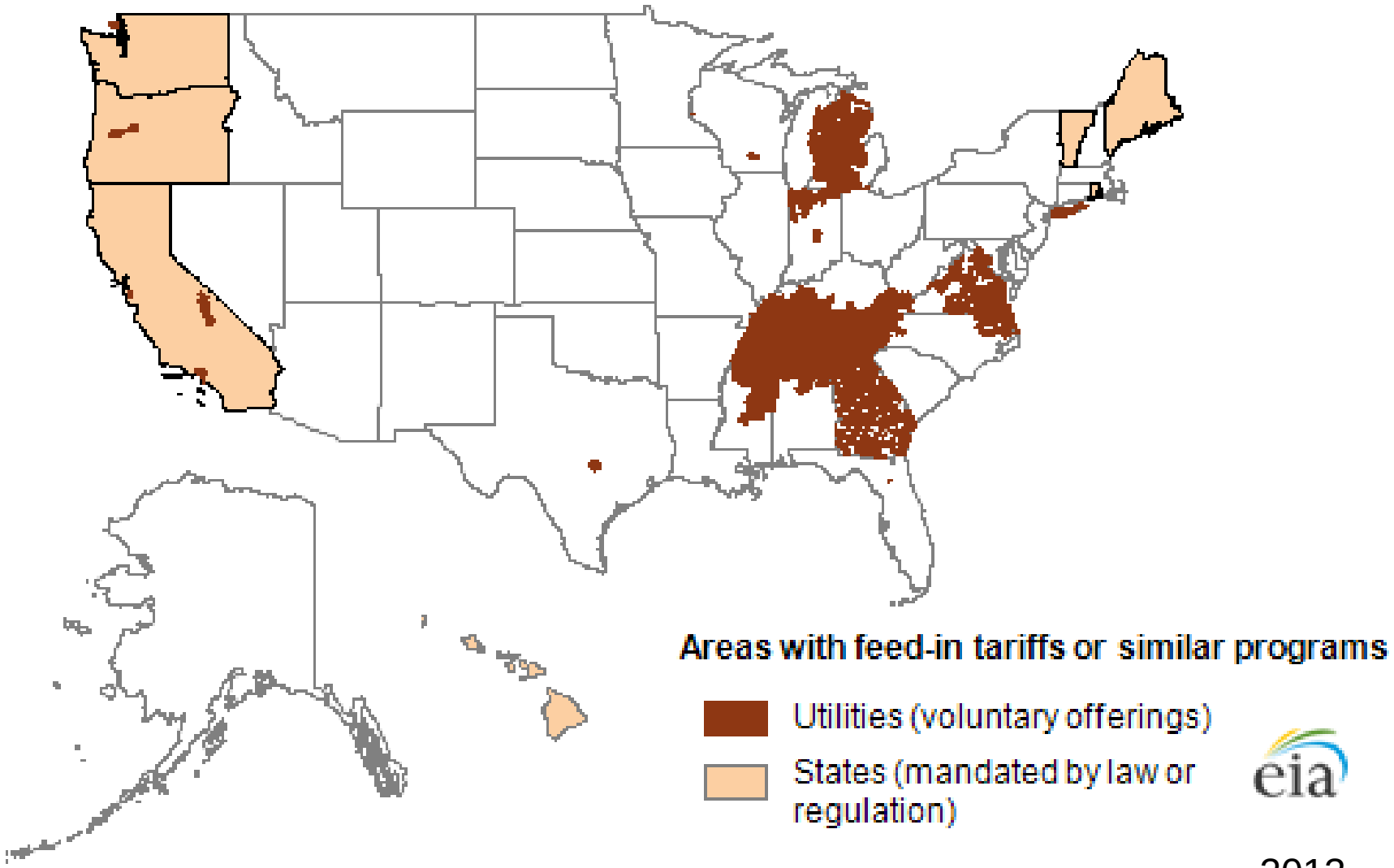
Adaptation

- Group or Community Net Metering
  - A group of consumers can support a single, larger (probably cheaper per kWh) system
  - A remote ground-based system can be credited to an account
  - Utility manages the billing credit
  - Special mention to Massachusetts using community net metering to create access to PV credits for public housing residents

Feed in Tariff

- Administratively set compensation for customer production
  - Lock in a long term sale price
  - Distinct price for distinct technologies
- Based on cost to produce energy, including a profit
  - Volume usually capped (## MW)
- Early versions did not build in competition
  - Can be corrected with reverse auction

U.S. states and utilities with feed-in tariffs or similar programs



- Question of the moment: is net metering in states with lots of PV reaching a point in PV development when it has to change?

Considerations

- Value is a two way street
- Defining value and cost is important
- Subsidies can go in any direction
- Trending: Transactive relationships
  - Active (often automated) customers
  - In the meantime (and especially for smaller customers) Net Metering seems to work well

Further Considerations

- Valuation aligned with public interest
- Fair value paid for DG output and for grid services
- Tail block set to long run marginal cost
  - Avoided consumption ~ avoided cost
  - Set other rates accordingly
- Simplicity is valuable
- Consider throughput and performance solutions separately to tariff design

Elements of Value

- Benefits
  - Energy cost
    - Fuel price hedge
  - Line loss saving
  - Assets (G&T&D)
  - Risk reduction
  - Environment
  - Grid reliability
  - Customer benefits
- Costs
  - Direct
  - Administrative
  - Interconnection
  - Integration
  - Risk addition

Customer – Utility Tariffs Signal Value

- Attention to rate design and price of marginal consumption
  - Customers have most influence on the margin
- Classes of service – what is the customer buying?
  - All requirements throughput (energy and capacity)
  - Connection service – static
  - Integration service – transactive, dynamic
  - Back up or stand by service

Emergent Ideas

- Zero Net Energy
  - Buildings
  - Campuses
  - Communities
  - Enterprises
- Two way grid
  - DG a resource, not incidental, not negative load
  - Customers integrated into grid operations
  - Capital, new operations practices emergent

Notable Recent State Actions

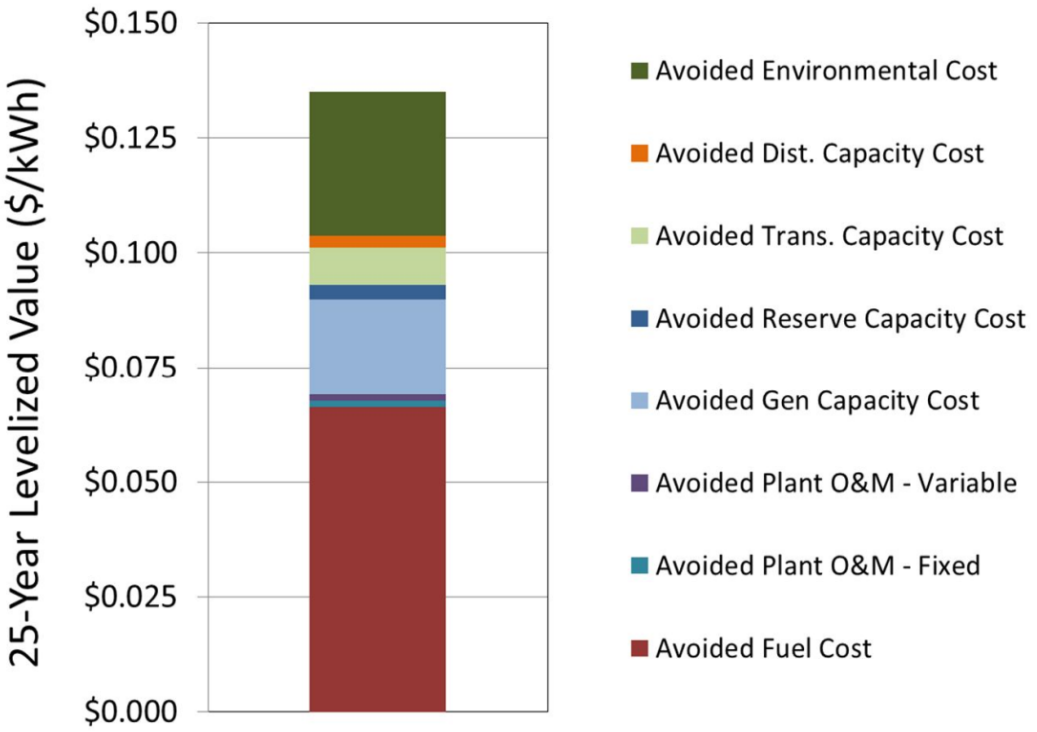
Arizona: A connection charge

- A per month charge for PV connected customers
  - Attempts to value the **connection service**
  - Commission decided this result is good enough

Minnesota: A two way rate

- Value of Solar Tariff approved
  - Thorough assessment of value
  - Not equal to retail tail block rate
  - Usage and production billed

Figure 4. (EXAMPLE) Levelized value components.



Note about AZ and MN Results

- Both were 3-2 votes

Meanwhile, in Hawaii and Georgia

- Hawaii legislature is resetting DG plans
  - Fast growth leads to integration problem sooner than they were ready to solve it
  - 9% of Oahu electricity today is from solar PV
- Georgia has equated enabling solar power with civil liberties
  - Regulation, perceived as barrier, adapts
  - Georgia Power is ramping up over 500 MW

Compensation for customer DG

- Individual interconnection agreements
- Net metering
- Feed in tariff
- Two way rates
  - Value of solar tariff
  - Unbundled rate elements
- New tariff models, customer classes

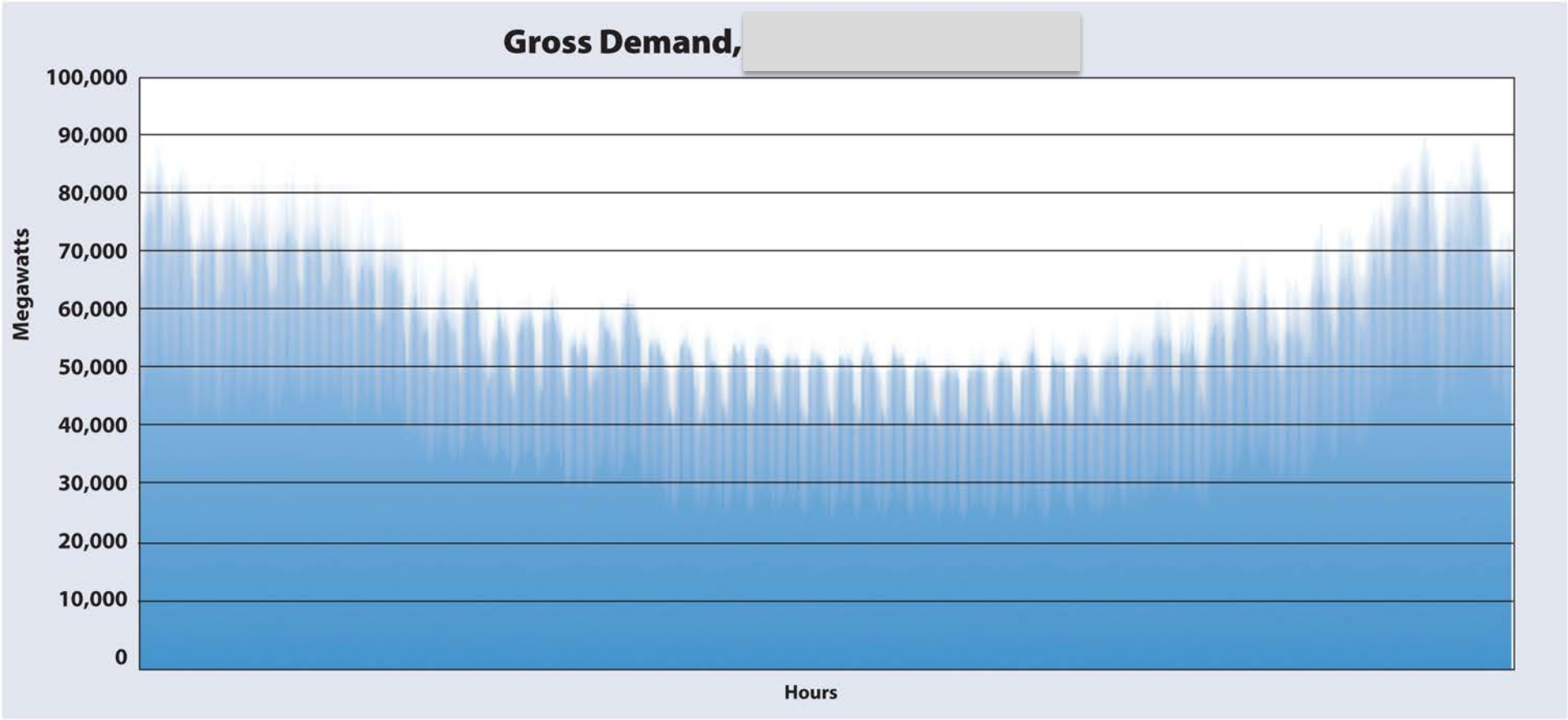
Integrating DG in the Grid

- Skipping for presentation
- Fair game for discussion

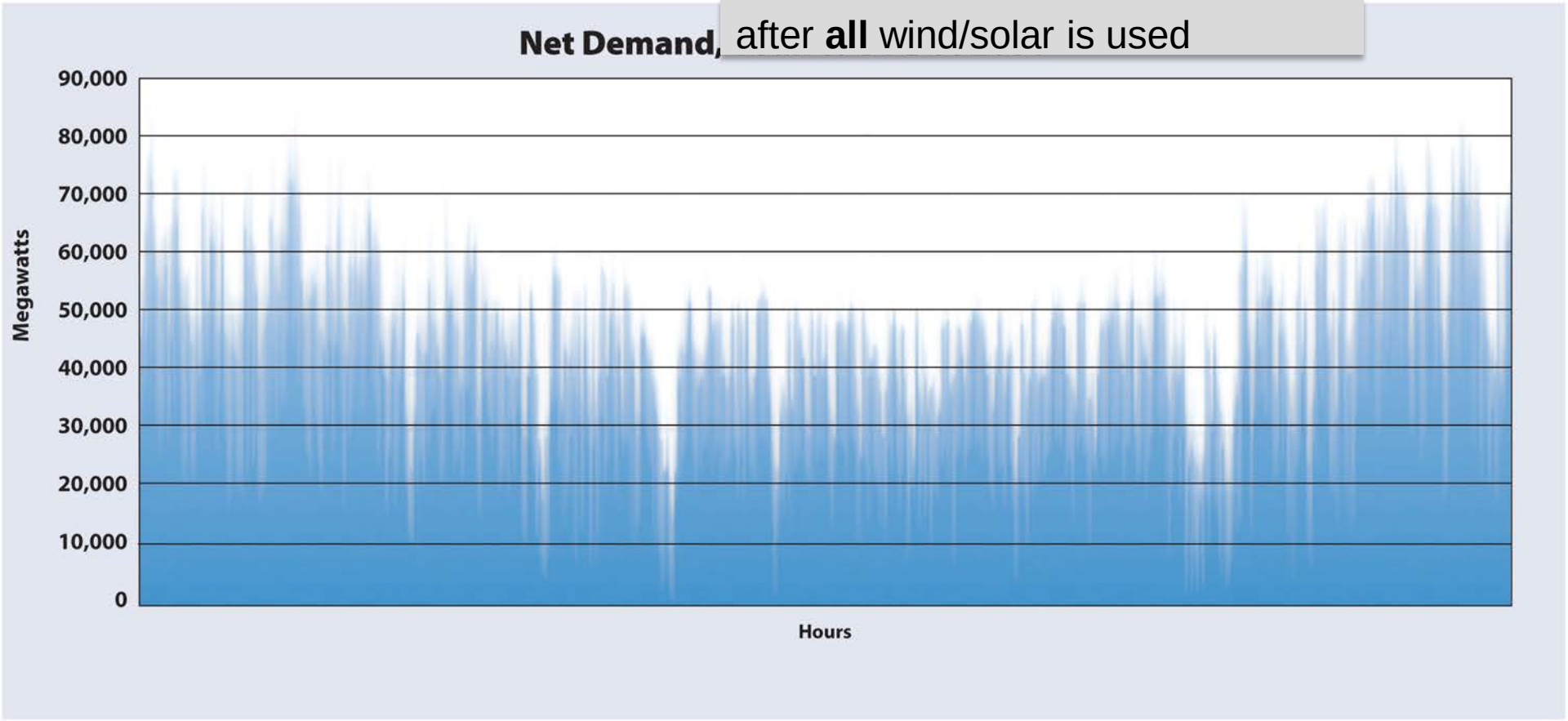
Integration of DG Power into Grid

- Distribution (utility, circuit scale)
  - Significant existing capacity to absorb DG
  - Hawaii curtailment indicates limits
    - Most places far away from limits at present
  - Integration Costs needed sometime to realize high penetrations of DG
- Transmission (RTO, inter-RTO scale)
  - Responsive resources (supply and demand)
  - Address ramping and cycling

Resource Adequacy Objective

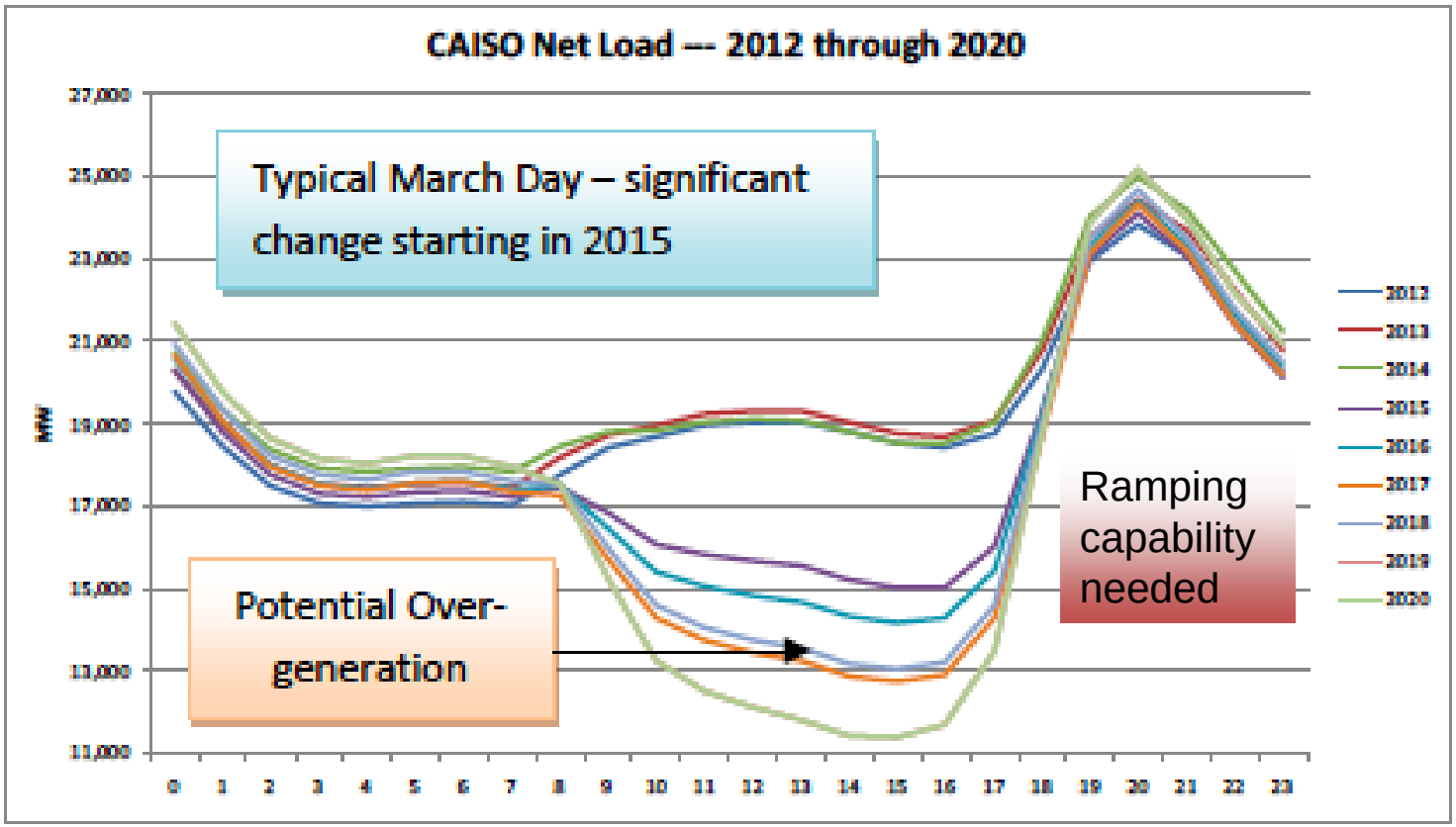


Operating Objective with High Flexible Resources



Ramping and cycling value is revealed by accepting all variable resources

Challenges from success on PV deployment in California



Some Strategies to Reduce Ramping Challenge

- **EE** at time of ramping
- **Orient** PV to the west
- **Storage** (thermal, battery)
- Use electric H2O heaters for **DR**
- Retire inflexible generation
- Demand charges in ramping hours
- **Geo-Target** energy storage
- Use/**target DR** programs
- Inter-RTO transfers

Business Models

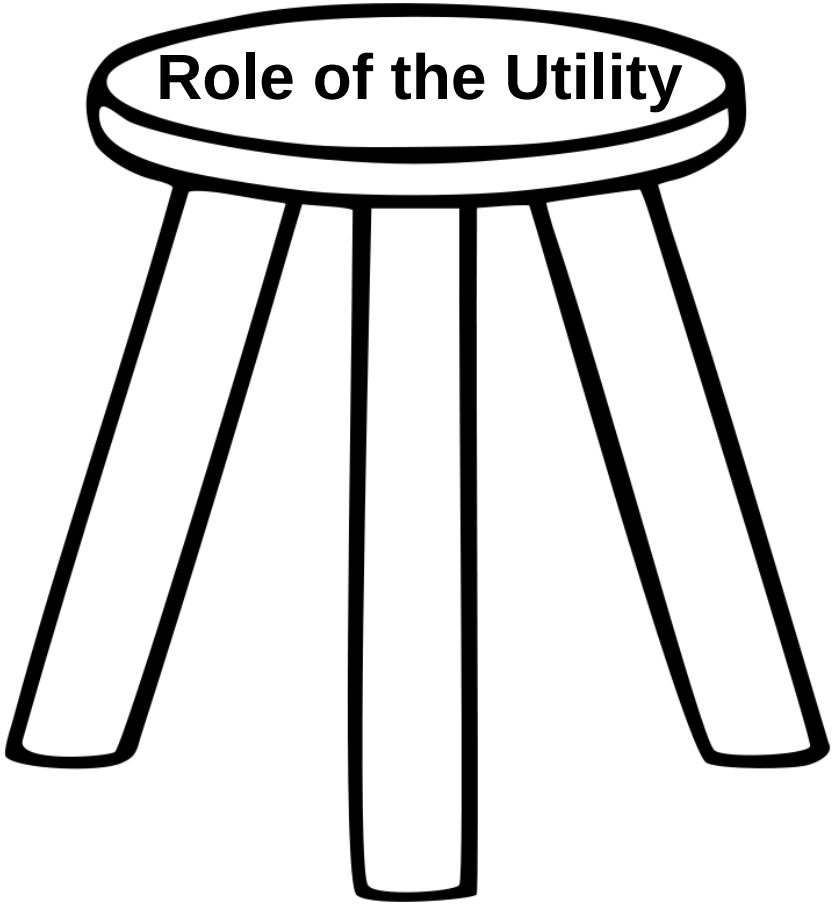
- Utility
- Distributed Generation Businesses

DG Business Models

- Customer buys the system, owns the output, offsets utility purchase
- Customer buys the system, leases the system to a company (aggregator) buys kWh from company and/or utility
- *Customer leases the system, solar/DG company maintains ownership, customer buys output or all requirements from the leasing company*

Utility Business Model Concerns

The Role of the Regulator



Addressing the throughput incentive

Performance Incentives for achievements in public policy

Cost Recovery

Revenue Erosion

- Energy efficiency: slow, offset growth
- Small PV: faster, starts to bend the curve
- Large PV and CHP: much faster

- Anxiety about revenue to cover embedded costs necessary to serve present system
  - Future cost reductions to reflect declining sales are possible, but not quickly

Decoupling

- Focuses on revenue requirement, not rate
  - Periodic reconciliation of rate to achieve target revenue
- Most robust solution to throughput incentive
  - There are other options and all options have pros and cons, which we can discuss

Challenge from proliferating DG

- Revenue erosion from a lot of DG quickly
  - Simple math, fewer kWh sold, embedded costs, rates must rise
- No mechanism can shield customers
  - Decoupling is a way to manage it
  - Rate case is another way to manage it
- A high monthly customer charge to all addresses one problem and raises others

Reminder: DG is helping society
Regulation is navigating an adaptation path

- Benefits
  - Energy cost
    - Fuel price hedge
  - Line loss saving
  - Assets (G&T&D)
  - Risk reduction
  - Environment
  - Grid reliability
  - Customer benefits
- Costs
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Transactional Power System

- Customers making choices on services (not just commodity) (retail choice 2.0)
  - Actively providing resources
  - What is the role of the utility?
    - Changes inevitable
    - Competitor?
    - Enabler?
  - Who decides?
    - Prediction: states will differ

What does “enabler” look like?

- Role of the utility focuses on monopoly services
  - Utility delivers, gets paid for that
  - Utility enables others (innovators, service providers) to connect to customers, gets paid for that
    - This is fairly new of electricity
    - Opens big data to maximize value, with controls
    - Important to have clear public policy framework

What does “competitor” look like?

- More complex for regulator
  - Regulator control over market efficiency is greater because of potential power of utility in any market it enters
    - Traditional affiliate rules including ring fencing and codes of conduct

Combined Heat Power

- Competitiveness for industry, others
  - Also sustainability goals
  - Campuses
- Why has CHP not taken off?
  - Value is more important in these large investments with businesses
  - Grid values from CHP are hard to monetize
    - Ancillary services (voltage support)
    - Stand by rates are tend to be conservative
  - Many other barriers to get decision attention

Recent Motivations for CHP

- Recovery Act channeled significant funds into district energy and CHP
- States have incentive programs
- Sept 2013 Presidential Executive Order is channeling more resources to industrial energy systems
  - New paper from RAP on stand by rate reform

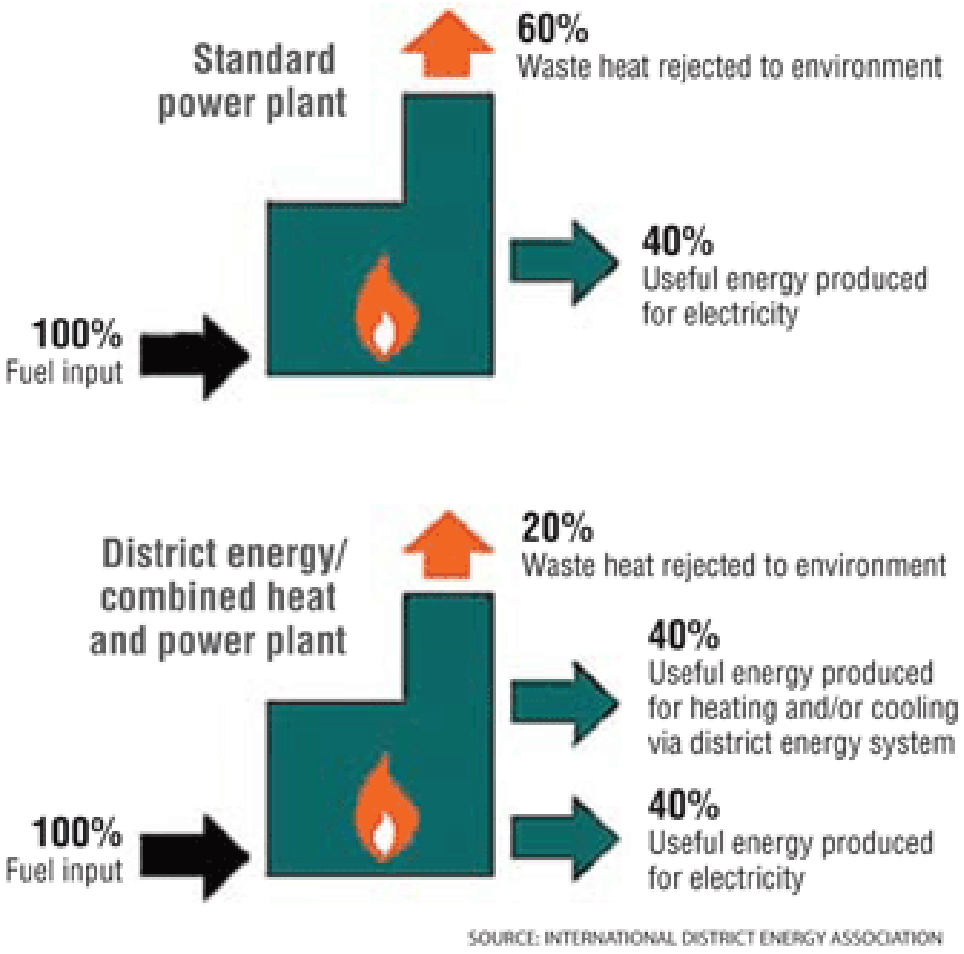

FIGURE 3. Energy-efficiency comparisons of a standard power plant and a district energy combined-heat-and-power plant.

Illustrative primer on CHP

Whew!

- The power sector in the next ten years will be more interesting and challenging than the power sector in the last ten years
- Heretofore accepted inefficiencies in regulation will be harder to tolerate
  - Because **customers** will want more services and they will get most value in places where prices reflect underlying costs and where regulation avoids unnecessary hurdles

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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