Creating Energy Security for Communities

- Brian Levite, CDM, Senior Manager
  Hitachi Consulting
- David Ager, AIA, LEED AP ND, IEA, Principal
  Townscape Design LLC

1. Energy Future
2. Energy Security
3. Unique Opportunities
4. Community Concepts
5. Challenges
6. Urban Planning Considerations
7. Energy Planning Considerations
8. Energy Independence Planning
9. Q & A / Workshop
1. Change

The amount of new technical information is doubling every 2 years... now 11 months!

In 1950 it took 10 years...
In 1750 it took 250 years...
2. Demand

**Electric Gen. Waste:**

26%

National Energy Use: 98 Quadrillion Btus

3. Supply

- Coal: 42.90%
- Natural Gas: 12.90%
- Oil: 0.40%
- Wind: 0.94%
- Solid Waste: 0.64%
- Inlet: 0.04%
- System Mix: 3.60%
- Nuclear: 32.60%
- Hydroelectric: 2.70%
- Blast Furnace Gas: 0.12%
- Black Liquor: 1.44%
- Captured Methane: 0.79%

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4. Dependency

PJM Interconnection

5. Price Instability

6. Regulation

PJM Cap: 164,561.2 MW
EPA/MATS: -14,500 MW (9%)
Add: +6,076 MW

- Efficiency: 922 MW
- Wind: 796 MW
- Solar: 56 MW
- Purchase: 4,302 MW
7. System Age

• D- from ASCE
• Demand up 25%, T+D Const. down 30% since 1990
• $1.5 to $2 Trillion by 2030
• 50%+ is more than 30 years old, 70%+ for T+D
• Bottlenecks = Blackouts
• Our region is one of the most congested in U.S.

8. Vulnerability

July 2, 2012
More than 2.5 million customers still in the dark.
Numbers are down slightly from the more than 4 million customers out overnight, but will likely continue for several days.

June 29, 2012
The East Coast Derecho Strikes

Maryland / DC (3,452,842)

3,264,842 – Baltimore Gas & Electric
299,980 – Pepco

Ohio (4,564,408)

4,014,159 – AEP Ohio
474,318 – Union Electric Power & Light
23,469 – Duke Energy
15,237 – South Central Power

Virginia (5,627,311)

4,509,799 – Dominion Virginia Power
152,436 – Appalachian Power
26,689 – Appalachian Electric Coop
13,236 – Shenandoah Valley Electric Coop
2,235 – Southside Electric Coop

West Virginia (1,391,098)

2,984 – Appalachian Power
2,135 – iOptima
1,076 – AEP Ohio

Indiana (5,440,975)

7,752 – Indiana & Michigan Power
9. Gaps

<table>
<thead>
<tr>
<th>Region</th>
<th>SEMINAL CAPSULES BY REGION</th>
<th>2006-2025</th>
<th>2026-2045</th>
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<tr>
<td>Tissue</td>
<td>16.6</td>
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<tr>
<td>Floridas</td>
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<tr>
<td>World</td>
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<tr>
<td>U.S. Total</td>
<td>213.0</td>
<td>793.0</td>
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</tbody>
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*Source: National Economic Development Administration (NEDA)*

10. Security

- Food and Agriculture
- Commercial facilities
- Finance
- Energy
- Information Technology
- Transportation
- Critical Manufacturing
- Chemical
- Communications
- Government facilities
- Health care
- National Monuments
- Nuclear Reactors
- Materials & Waste
- Water

Homeland Security: 18 Critical Sectors

Water

- 410 Billion Gallons a Day
- 205 Billion Gallons a Day
- 84 Billion Gallons a Day
- 8 Billion Gallons a Day

100 Billion Consumed
What Is “Local” Energy Independence?

- Reduced demand from outside sources for power
- Strategy to reduce the impact of external energy forces on your community
- For the foreseeable future – a mixture of:
  - Urban planning to reduce energy intensity of the community
  - Energy efficiency to reduce total demand
  - Load shifting to reduce peak demand
  - Local fossil fuel combustion to provide baseload power (level of independence also depends on sourcing of fuels)
  - Combined heat and power to reduce combustion waste
  - Renewable energy to generate clean, local energy

Continuum of Energy Independence

- Energy independence is a continuum
- Different levels are possible for different entities
- The maximum possible independence is not necessarily practical or desirable.

High Energy Exposure

- All energy secured from outside the community
- High energy intensity of infrastructure
- Energy performance improvements have begun

Low Energy Exposure

- All energy generated inside the community (with external fuel support)
- Energy efficient conventional buildings – plans to incorporate low energy concepts into future facilities
- All energy secured from inside the community
- Low energy intensity of infrastructure using passive solar design
Driving Factors for Energy Independence

- Access to capital for large, long-term infrastructure projects
- Long timeline for institutional planning
- Renewable energy resources (wind, geothermal, solar radiation, biomass)
- Proximity to sources of fossil fuel (coal, oil, gas, biofuel refineries)
- Unified community commitment to the effort
- Central control of all planning decisions
- Control of decisions around buildings – technology, management, siting, etc.
- Access to available land for new projects (buildings, energy projects)

Unique Opportunities For Communities

- **Being smaller than a state or the entire nation**
  - Typically less large, energy-intensive energy users like industrial manufacturing parks
  - A greater ability to forecast where energy use will be increasing or decreasing over the next 20 years
  - Fewer stakeholder groups that need to be coordinated

- **Being larger than a campus or base environment**
  - A wider variety space types and usage providing more flexible opportunities for saving energy and creating generation
  - More and more varied land on which to install new generation
  - Ability to connect economic development to the value proposition
  - More leverage to get local utilities to engage in this effort

- **Being government rather than a private entity**
  - Able to engage multiple types of businesses and residents to address opportunities and leverage skill/resources
  - Can leverage planning and zoning to effect changes in efficiency
  - More leverage to get local utilities to engage in this effort

HOK’s 9 Elements of Community

Berkeley County Comprehensive Planning

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APA Regional Conference October 19, 2012

Townscape Design
Energy Mapping

- Identify local energy opportunities in development areas
- Inform growth options and help prioritize investment
- Exclude inappropriate areas (low density; rural)
- Classify unique energy character areas

Complete Town Planning Tool Kit Menu

System
- Power
- Heating
- Cooling
- Air Movement
- Air Quality
- Demand Reduction

Scale
- Neighborhood
- Block
- Site
- Building

Process
- Buildings
- Town Building Tools
- Tactics

Techniques
- Active Air Movement
- Humidity Control
- Temperature Control
- Passive Street and Block Orientation
- Width and Shading
- Activity and Use
- Surface Material
- Color
- Connectivity
- Amenities
- Green Islands
- Landform Alterations
- Vegetative Solutions
- Natural Ventilation
South North

Locate wider sidewalks and solar control on the north side of east-west streets.

1. Use the transect on south facing and south-west facing slopes and increase building heights generally from south to north to provide uninterupted solar access.

2. Use wide, tree-lined boulevards and avenues to connect high and low points within a town. These routes will facilitate valley winds: cool air rising during the day and falling during the night. The designs for Washington and Annapolis are examples of this technique.

3. Wider green streets should run east-west to accommodate summer breezes and allow for needed solar radiation in winter.

4. Classic diurnal temperature variation from Vienna, Austria in August 1931.
Interconnection is

Decentralization is

Smart Growth is integrated with a new Smart Grid

(Smart Substations and Integrated Local Power Production)
PLACEMENT

Tactic: TOD/Focused Growth

SCALE: Corridor

SYSTEM: Energy

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Townscape Design

IMAGE: Google Earth

PATTERN

Tactic: Greenway Islands/Green Streets

SCALE: Neighborhood

SYSTEM: Energy

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Townscape Design

SOURCE: Urban Advantage

DESIGN: Dover-Kohl Architects

POWER

Tactic: Commercial Roof PV

SCALE: Corridor/Redevelopment

SYSTEM: Energy

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Townscape Design

• Existing conditions
• Attached urban buildings and street trees
• Green roof on parking structure
• Solar PV on flat roof

Illustration, copyright AEI/Affiliated Engineers, Inc.
Underground network of pipes "combines" heating and cooling requirements of multiple buildings.

- Creates a "market" for valuable thermal energy.
- Aggregated thermal loads creates scale to apply fuels, technologies not feasible on single-building basis.
- Fuel flexibility improves energy security, local economy.

Net Zero Homes... designed to produce as much energy as they consume.

- EV Charging
- Linked LED Lighting
- Green Walls
- Rainwater Harvesting
- Living Landscape
- Gray Water Recycling
- Integrated Micro-bioretention

14 x 32 footprint 3-bed town w/ 1.5 Car Garage / Studio
Interior Strategies
- Motorized Shades
- Building Integrated PV Windows
- Daylighting and Window Treatments

HE Water Utilization
HE Appliances
Lighting Controls
Security Systems
Smart Home Monitors
High Efficiency Envelope

14 x 32 footprint 3 bed town w/ 1.5 Car Garage / Studio

Tactic: Neighborhood Power

System: Energy
Scale: Block / Lot
Tactic: Neighborhood Power

50 du/ac (16 du/.33 ac)
1.1 ps/du
0.9 ev/du

- Demand: 60,000 kWh
- Supply: 120,000 kWh
- Net: 200%

8 Towns plus 8 Garage-Studios plus 14 EV Chargers

DG Supply

1.06 FAR

<table>
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<tr>
<th>DG SUPPLY</th>
<th>kW</th>
<th>kW/sq ft</th>
<th>kW/ps</th>
<th>kW/ev</th>
<th>kW/du</th>
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<tbody>
<tr>
<td>Description</td>
<td>150</td>
<td>45</td>
<td>500</td>
<td>1.06</td>
<td>0.9</td>
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Demand

380%
Zoning Incentives

Montgomery County is providing a unique incentive to developers willing to explore on-site renewable energy.

Montgomery County CR Zone (Division 59 – 15.8)
59-C-15.8c6 (b) Energy Conservation and Generation:

"Up to 15 points for constructing buildings that exceed the energy-efficiency standards for the building type by 17.5% for new buildings or 10% for existing buildings. At least 15 points for providing renewable energy generation facilities on site or within ½ mile of the site for a minimum of 2.5% of the projected energy requirement for the development."

Clean Energy Town Plans

Buffer or urban agriculture
1.2 MW solar array on 1% adjacent farmland
Downtown with civic space and transit opportunity
5 minute walk to downtown
1.5 MW solar array on 1% adjacent farmland

4 Four 5-minute walkable neighborhoods surrounding a small downtown with transit opportunity

6 Five minute walk to downtown

100 Potential power continuity substation

Industrial district and corridor

1000,000 Net Annual Supply: 90,000 mWh

Demand:
- 4,000 Residential: 44,000 mWh
- 15,000 Commercial/Office: 10,000 mWh
- 50,000 SF Industrial: 20,000 mWh
- Institutional: 10,000 mWh
- Government & Infrastructure: 8,000 mWh

Total Est. Annual Demand: 90,000 mWh

Supply:
- General Passive Design Eff.: 10,000 mWh
- 1.8 MW Solar Farms: 15,000 mWh
- 0.5 MW Commercial Roofs: 6,000 mWh
- 500 50kW Comm. Arrays (26m/20): 2,500 mWh
- 100 70kWe Block Power-grids: 2,500 mWh
- 10kW exterior lighting: 4,000 mWh
- 1,000 net-zero homes: 1,000 mWh
- 1,000 passive homes: 7,400 mWh
- 1,000 EnergyStar homes: 2,000 mWh
- 1,000 Residential Fuel Cells: 2,000 mWh
- 1,000 Mobile Residential Arrays: 1,000 mWh
- 1,000 Off-grid Arrays: 24,000 mWh

Total Est. Annual Supply: 90,000 mWh
The Plan is Shaped by The Drivers

Energy Security
- Focus on baseload generation and energy infrastructure
- Reduce peak loads

Cost Savings
- Focus on energy efficiency of existing infrastructure
- Use smart urban planning to reduce community energy intensity

Economic Development
- Focus on new energy projects
- Focus on creating energy skills and technologies within the community

Environmental Impact
- Focus on reducing peak load and avoiding usage of high emission sources
- Focus on clean energy generation

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Energy Security Planning
Protection of Critical Infrastructure and Key Resources (CIKR)

1. Vision and Goal Setting
2. Document Regional and Local Energy Profile
3. Identify Assets, Systems, and Networks
4. Gap Analysis
5. Assess Risks Consequences, Vulnerabilities, and Threats
6. Prioritize Infrastructure
7. Develop Protective Programs and Resilience Strategies
8. Implementation
9. Measure Effectiveness and Resilency
10. Continuous Improvement and R&D

Tactics/Technologies to Get There

- **Order is critical (front-load certain efforts)**
  - Energy Efficiency
  - Urban Planning
  - On-site Generation/Combined Heat and Power
  - Renewable Energy
- Incorporate changing energy needs into your planning (growth may require more energy, efficiency efforts may reduce total or peak demand)
- Design programs so that cost savings from one effort can be used to help fund the next
- While you have temporal priorities, a long-term, master plan is critical
- Play to your community's strengths
- Look outside your community for support
Energy Planning Considerations: Energy Intensity / Efficiency

- Where is energy used in your community?
- Where are the financial and environmental impacts most acute? Is it baseload? Peak demand? Power quality?
- What are the barriers keeping residents and businesses from improving energy performance right now?
- What incentives can be leveraged to offset project costs (utility, state, Federal, etc.)?
- What skills do you have in the community to address these issues?

Energy Planning Considerations: Urban Planning

- What have other, similar communities done that has worked or not worked? Why and how do these lessons apply to your community?
- What legacy urban infrastructure issues impact your ability to affect energy independence?
- How can the drivers of your community master plan be aligned with energy independence efforts?

Energy Planning Considerations: Fossil Generation

- How would additional generation (central or distributed) impact your community’s energy independence?
- Are there opportunities to deploy combined heat and power applications?
- Do you have reliable access to fossil fuel sources?
- What is the transportation requirement for those sources?

Energy Planning Considerations: Renewable Energy

- What are the renewable energy sources available within your community?
- What additional incentives exist (utility, state, Federal) to support the financial case for renewables?
- Does your community have logical spaces for installation of renewables?
- Does your state have a net-metering law? (YES!)
- What is the stance of the local utility on renewable integration into their grid?
Energy Planning Considerations: Smart Grid

- To what extent does our community need to invest in smart grid and smart buildings in order to achieve our energy goals?
- What are the initial priorities for smart grid vis-à-vis our long-term plan?
- How can this effort be coordinated across our entire community by the government and electric utility?

Energy Independence Planning

- This effort should be integrated with the economic development plan, sustainability plan, and urban master plan.

Who Needs To Be Involved?

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<tr>
<th>Sector</th>
<th>Areas of Impact</th>
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<td>Utilities – electric &amp; fuel</td>
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Critical First Steps

- Determine if/why your community should be moving along the continuum of energy independence
- Meet with your key stakeholders to determine if planning for energy independence can benefit your community
- Evaluate your opportunities – what resources do you have and what are your challenges?
- Create a vision for your community’s energy independence
- Set priorities for near-term energy independence development
- Engage stakeholders to understand their levels and areas of commitment and determine the most productive tactics to increase energy independence.

4 Point Proposal:

“Our proposal is to simply correlate Smart Growth with the Smart Grid through the deployment of distributed generation of clean, renewable and small scale power production plants linked with power continuity units that will begin to provide risk management and grid security through decentralization, peak load shaving capacity, critical circuit continuity in the event of grid failure, legacy grid resiliency and local power production. This deployment is scalable to differing situations, with quick mobilization potential, but it all starts with a comprehensive energy plan.”

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Energy Integration

4 Point Approach

1. Prepare a state-wide energy plan combined with local Community Energy Planning
2. Local Power Production focused on offsetting regional losses blended with new technologies
3. Integrate new power production facilities with Power Continuity Connection solutions for reliability and security
4. Break down barriers to allow new power production solutions seamlessly integrated into the urban context
Thank you for your time.

We would appreciate your questions.

We would be happy to engage with you after today’s session.