“How To Promote A New Energy Network”

Area Energy Network is the entrance to a Smart Society

November 7, 2013
Shimizu Corporation
Kazuyoshi Nasuhara, Director of ecoBCP Business Promotion Office
Promote area energy network from a single facility and improve energy efficiency

\[
\text{CO}_2 \text{ Emission} = \frac{\text{CO}_2 \text{ Emission}}{\text{Energy consumption}} \times \frac{\text{Energy consumption}}{\text{GDP}} \times \frac{\text{GDP}}{\text{Population}} \times \text{Population}
\]

\[
\text{CO}_2 \text{ Emission} = \frac{(C)}{(E)} \times \frac{(E)}{(E)} \times \frac{(E)}{(E)} \times \text{Building floor area m}^2 \times \frac{\text{Building floor area m}^2}{\text{GDP}} \times \frac{\text{GDP}}{\text{GDP}}
\]

<table>
<thead>
<tr>
<th>Automobile</th>
<th>3 elements to deliver performance</th>
<th>Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental performance of the automobile itself</td>
<td>Product</td>
<td>Environmental performance of the architectural structure itself, energy creation</td>
</tr>
<tr>
<td>Driver skill, ethic</td>
<td>Operation</td>
<td>FM, PM (BEMS, Tuning)</td>
</tr>
<tr>
<td>Road network, standard, upgrading convenience facilities such as gas stations</td>
<td>Environment</td>
<td>Network performance, Area Energy Network (legal system, operation)</td>
</tr>
</tbody>
</table>
From a single facility to Area Energy Network 1

1. Our company’s Technical Research Institute: Cooperative control of a total of 12 buildings with a micro grid

- Automatic control of multiple distributed batteries and storage batteries, and optimal delivery of power and heat to multiple facilities
- 36% reduction at peak time, 30% reduction in usage
  - Energy saving in block assuming urban area (12 experimental facilities at the Shimizu Corporation Institute of Technology in 2011)
- Energy independence: Already verified 72 consecutive hours of self-reliant operation
- Alleviate impact of renewable energy on power grid

![Diagram of integrated control system and energy flow](image)

- **Integrated control system**
  - Gas engine: 350 kW, 90 kW
  - Nickel hydride: 100 kW, 80 kWh
  - Lithium ion: 100 kW, 60 kWh
  - Electricity double layer capacitor: ± 2 sec, 100 kW × 2
  - Photovoltaics: 10 kW
  - Power purchase: 10 kW

- **Exhaust heat use**
  - Heat recovery style absorption chilled/warm water generator

- **Heat storage**
  - Heat storage tank

- **Heat pump chiller**

- **Experimental buildings**
  - Supply power and heat to 12 experimental facilities

---

[Institute of Technology, Shimizu Corporation]
2. Chubu University: Stepwise energy control of 7 faculty facilities

- Operating since July 2012
- Power and energy saving over the entire campus, emergency response
- Changed to “Smart” on a faculty basis, expanded stepwise
- Energy control of facilities with Smart BEMS
  - Introduction of cogeneration, photovoltaics, storage batteries
  - Peak cut on a faculty basis, energy saving

**Step 1** Attained 25% power saving, 30% energy saving (last summer)

**Step 2** 

**Step 3** 

Gradually changed to “Smart” on a faculty basis

- Chubu University: Stepwise energy control of 7 faculty facilities
From a single facility to Area Energy Network

Create Area Energy Network through certification of one building

- New facilities mainly accommodate neighboring facilities with combined heat and power
- Control multiple facilities with Smart BEMS
- Peak reduction of area energy demand, improvement of BCP function
  - Introduction of distributed energy (cogeneration, PV, storage battery, etc.)
- Reduction in electricity purchased, peak shift, peak cut
- Self-reliant operation during emergency

Diagram showing the integration of new and existing buildings with Smart BEMS for energy management.
Facility level
- eco during normal period
- Secure energy for emergency

Facility block, urban area level
- Constitutes block of multiple facilities
- Power and heat interchange in urban area

Area level
- Energy self-reliance through disaster-prevention facility
- Energy interchange within area

Area energy networks

- [Power, Heat, Information] networks are important

- eco
- BC (Business Continuity)
- overall eco
- DC (District Continuity)
- Strong, Smart City
- CC (Community Continuity)
Overall interchange leads to a new dimension!

- Shimizu Corporation Headquarters (Super environment-conscious office with state-of-the-art technology)

  Challenge to zero carbon
  When designed (2009): CO₂ -50%
  When completed (2012): CO₂ -62%
  After operation (2015): CO₂ -70%
  + renewable energy

Task & ambient AC

- Hybrid radiant panel (perimeter)
- Radiant ceiling panel
- Personal floor outlet
- Humidity adjusted air from desiccant AC
- Cooling water supply from DHC system

Task & ambient lighting

- Sensor control of ambient lighting
  Intensity depending on daylight
- Utilizing daylight
- Lighting on
- Ambient lighting
- Task lighting
- Graduated blind
- Office
- Ambient lighting
- Task lighting

Comfort control of temperature, humidity, air current
(approx. 50% energy saving)

Optimize use of solar light (approx. 90% energy saving)
Overall interchange leads to a new dimension!

- Efficient use of urban exhaust heat in collaboration with area DHC system (Shimizu Corporation Headquarters)
- (*a) Comprehensive energy efficiency, 1.39, Japan’s highest figure; (*b) National average. 0.823

(*a) August 2012 – July actual
(*b) Area heat supply system after 1997
Source: METI
How to promote city development and Area Energy Network

Promote “Smart City Regeneration”

Energy independence in case of disaster, new buildings, enhanced continuity function, and area energy interchange

- Disaster prevention facility (government building, public facility, Hospital, etc.)
- Large redevelopment type
- Sequential development type → Key point of “Smart City Regeneration”

Promote Area Energy Network for sequential development

Promote as a special area with three adjacent neighbor-type emergency collaboration/arrangement, introduction of distributed energy (cogeneration)

Advantage 1: Improve self-reliant BCP readiness by utilizing Area Energy Network in emergency, etc.
Advantage 2: Speeding up the wide use of area energy network, and large increase in the number of cases applicable

Promotion structure prepared with “Eco City Act,” etc.

High applicability

1. Enhanced energy independency when a building is new or renovated
2. Energy interchange to neighboring buildings
3. Implementation of Area Energy Management
How to promote town development and Area Energy Network

**Normal**
- Natural Energy Area Network
- Overall power and heat interchange, CO₂ reduction
- Entire area peak cut

**Emergency**
- Life and business continuity, secure medical services
- Secure energy independence in area
- Accept commuters who have difficulty getting home
<table>
<thead>
<tr>
<th>Policy area</th>
<th>Issues</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant public benefit to supply</td>
<td>Installation of <strong>power grids</strong> on public roads</td>
<td>Area energy interchange for power will ease if electricity generated by cogeneration and solar and wind power are approved for transmission by public roads.</td>
</tr>
<tr>
<td>route</td>
<td>Permission for occupancy of roads to <strong>heat conduit pipe</strong></td>
<td>Positioning of heat conduit pipes except for the DHC conduit pipe through city planning decision (heat source water pipe, pipe for seawater/river water, steam pipe from waste treatment plant, etc.) is not determined; desirable that permission for occupancy of roads is also granted to these heat conduit pipes, as is the case with other infrastructure</td>
</tr>
<tr>
<td></td>
<td><strong>Area energy (utility)</strong></td>
<td></td>
</tr>
<tr>
<td>Policy for efficiency in block</td>
<td><strong>System in city block, infrastructure’s flexible use</strong></td>
<td>In terms of license of specified electricity business, it is stipulated that “the commencement of the electricity business corresponds to demand at the service point.” This is interpreted as a requirement to install a full-capacity power generation facility that corresponds to demand. However, installing a full-capacity power generation facility for the service area imposes a large economic burden on electricity utilities. Therefore, it is considered that it will become easier to launch the specified electricity business by authorizing concurrent power receipt from a power generation facility and commercial electricity.</td>
</tr>
<tr>
<td>use of heat and power</td>
<td><strong>Concurrent power receipt from specified electricity utility</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Easing to 50% → diversification</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Easing of regulations and interchange between city blocks</strong></td>
<td>When developing a city block with low carbon through Area Energy Network, a city block that contributes area continuity (including multiple blocks) will be promoted by granting incentives, such as easing of restrictions for building height, diagonal line, cubic volume, open-space ratio, etc., and interchange between city blocks. (Assuming specific city block, comprehensive design, district planning, etc.)</td>
</tr>
<tr>
<td></td>
<td><strong>Easing of DHC terms and conditions</strong></td>
<td>In DHC business, supply heat media (chilled water, warm water, steam, etc.) and supply terms (temperature, pressure) are fixed, so it is difficult to conduct flexible and efficient operation according to seasonal load changes. In western district heating, common knowledge is to seasonally adjust the temperature of warm water supplied. It is a desire that our country will address this.</td>
</tr>
<tr>
<td></td>
<td><strong>Special treatment to small-scale interchange</strong></td>
<td>Although there is an advantage to a building providing a machinery room for a DHC plant through exclusion of the cubic volume of the machinery room, the incentive is not sufficient to expand area energy interchange with only this advantage. Further favorable treatments are advisable, such as exclusion of cubic volume of the utility consumer reception facility, and addition of the cubic volume used for environmental contribution.</td>
</tr>
<tr>
<td></td>
<td><strong>DHC plant space</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grant incentives to a building providing space</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Expansion policy of DHC</strong></td>
<td></td>
</tr>
<tr>
<td>Expansion of unharnessed energy</td>
<td><strong>Simplify procedures to use river water, seawater, sewage, etc.</strong></td>
<td>Since it requires a long time to obtain approval and authorization for facility improvement related to the use of river water, seawater, or sewage after obtaining understandings from river administrators, port authority, etc., it is difficult to expand unharnessed energy use.</td>
</tr>
<tr>
<td>use</td>
<td><strong>Area energy (utility)</strong></td>
<td></td>
</tr>
</tbody>
</table>
Issues in town development and Area Energy Network

- **Issues at the planning and design stage**
  - It is difficult at the design stage of a single facility to address consensus-building on Area Energy Network.
    
    (Area energy business decision cannot be made unless there is a certain range of consensus-building)
  - It is necessary to consider the policy of the entire-area heat energy supply and demand, and promote consensus-building from the planning stage of a facility with a high heat demand, such as a hospital or hotel, in order to promote energy high efficiency through Area Energy Network.
  - It is effective to consider and introduce a system that is integrated with urban development and improvement.

- **Issues in promoting commercialization**
  - Large initial investment cost such as heat source facility, heat conduits.
  - Cost increase by introducing cogeneration system, etc.
  - Consider Area Energy Network (interchange) in city and town development/make connection mandatory.
  - The key to stable fund procurement is consumers’ small dropout risk.
  - Must have a tax system and structure, which enables NEB, that brought by an area’s efforts for low carbonization and BCP improvement, to be returned and redistributed in the area.
  - Overseas, public-installed, private-managed style exists. (Paris, Copenhagen, etc.)
Recommendation

Promote gradual upgrading of network and attain improvement of energy efficiency and self-reliant BCP

Large-scale redevelopment style

1) Install One-Stop Service window
   - Simplify application procedures, unify consultation contact

2) Clarify approval conditions for special district
   - Energy efficiency (energy saving ratio 30% improvement, etc.)
   - Smart coordination with top grid, including BCP
   - Structure of data collection and upgrading follow-up system
   - Labeling system with above stated rating index

3) Preferential treatment, easing of regulations
   - Easing of installation standards for legally controlled overall interchange buried piping and wiring (Road Act)
   - Diversified supply energy, easing of supply conditions (Heat Supply Business Act)
   - Permit for combined supply of heat and power
   - Need to have a structure that works horizontally among multiple government agencies and related organizations when using unharnessed energy. (River Act, Coast Act, Ports and Harbors Act)
   - Establish preferential treatment in tax breaks, easing of floor area ratio, technical development support, etc.

Stepwise development style

[Urban regeneration that starts from one building’s certification]
(Connect adjacent land with shared facility, and make a new “block”)

1) – 3) on the left are common

4) Additional preferential treatment, easing of regulations
   - Interchange of heat and power
     Interchange heat among private cogeneration sites.
     Interchange power between individual power receiving buildings (system, independent cable)
     Power joint contract for Area Energy Network buildings, etc.

   - Preferential treatment for “connecting.” Granting incentives to cut peak
     Granting incentives to BCP functions

   - Preferential treatment for “distributed energy, overall BEM installation”
     Incentives for burden of easement
Creation of Smart City

- Arch shelter®
- Photovoltaic Business
- Green mound®
- Smart urban area
- Smart eco-campus®
- Wave-dissipation type
- Floating style
- Wind-generated power business
- Implantation style
- Evacuation type
- ecoBCP Buildings
- ecoLCP complex housing
- Smart eco hospital®
- ZEB (Zero energy buildings)