# Development of web-based scheduling tool of facility operation for energy system of a microgrid by using open source software

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## Why and What for do we develop this tool?

・Various tariff menus of electricity including economic program of demand response

○What are benefits for customers?

To reduce their energy cost by optimizing the operation pattern of their facilities

○Proposed Solution

- ✓ Support for optimal operation of consumers' energy system and their facilities consuming electricity
- ✓ Support of choice of optimal tariff menus

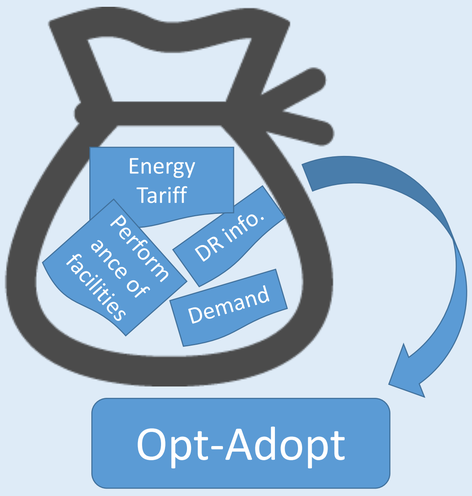


Fig.1 Benefit Opt-adopt supplies

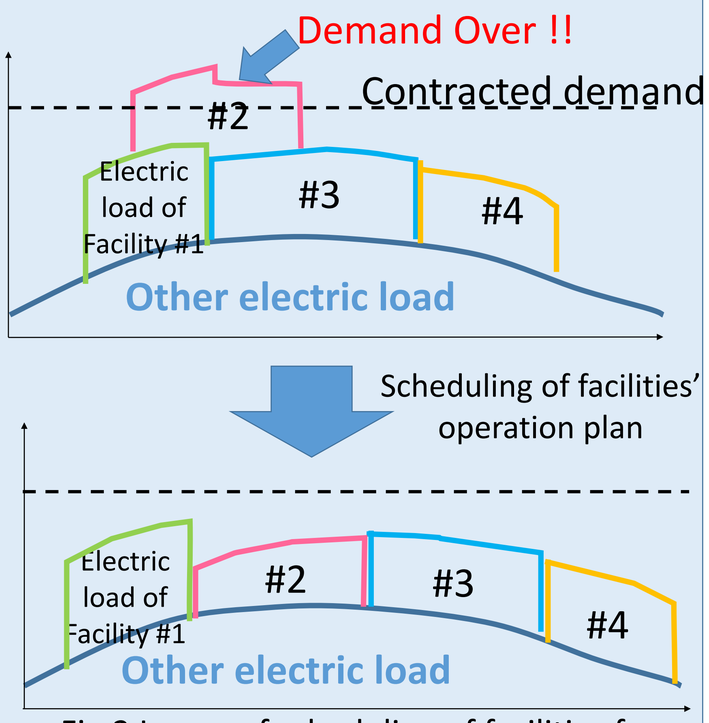


Fig.2 Image of scheduling of facilities for consumer production

## Function of OPT-ADOPT

- Target of OPT-ADOPT
  - ✓ Consumers who have multiple facilities which consume large electric power and can shift their operation time
  - ✓ Consumers who have their Combined Heat & Power (CHP), air conditioners using exhausted heat from CHP, and electric refrigerators
- Function
  - ✓ Supply daily and annual solution about optimal operation planning of energy system and facilities
  - ✓ Annual operation planning enables users (consumers) to remind seasonal characteristics of their energy demand.
    ⇒Supply information of making a decision when reviewing energy tariff menu, and designing replacement of an energy supply facility
  - ✓ Supply annual gas consumption planning for the consumers who contract a discount menu that a constant amount of gas consumption

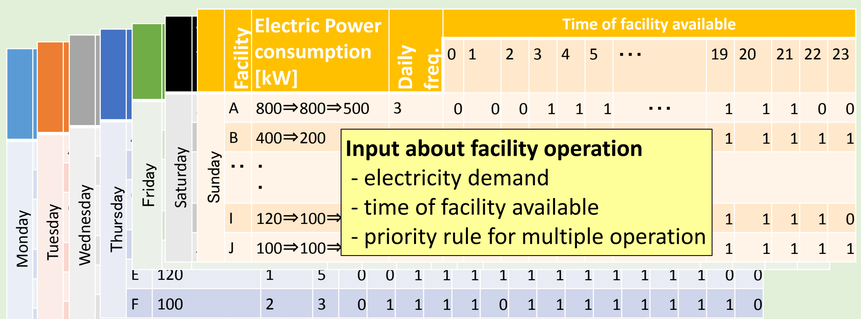


Fig.3 Input/Output example of OPT-ADOPT

## Web-based tool eases users to get solution regardless of their computer's performance

- Web-based tool enables users to calculate heavy task, i.e. annual operation planning, regardless of computer's performance.
- Users don't need to update executable file.

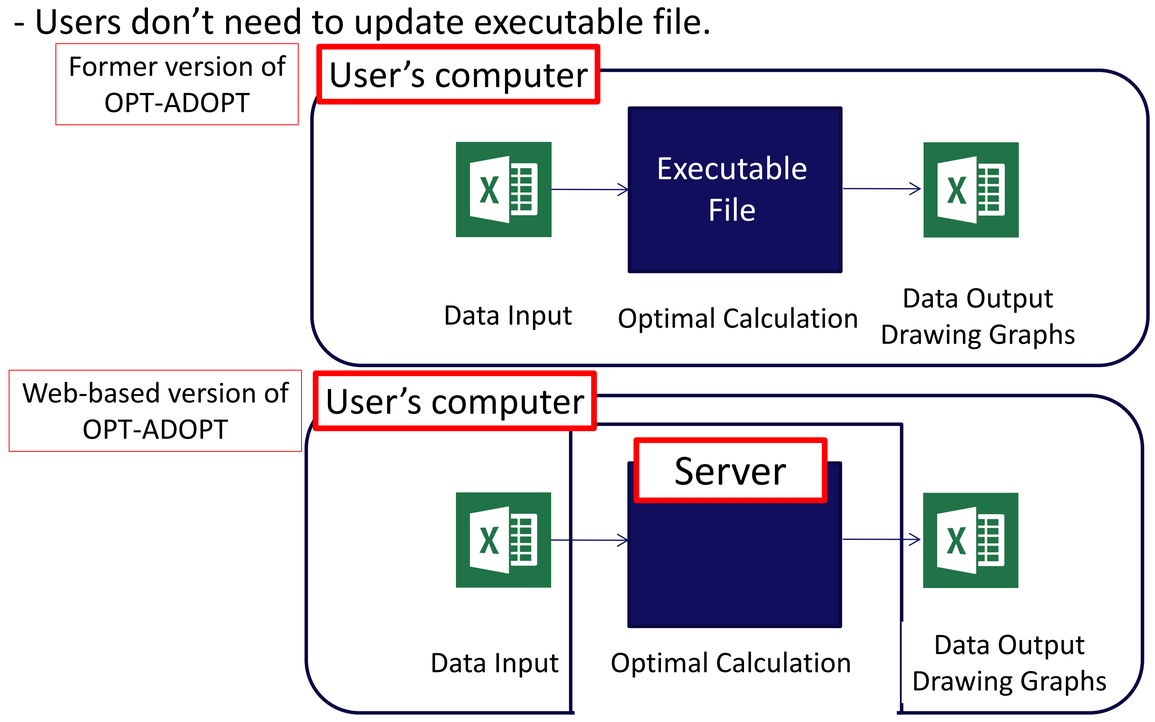


Fig.4 Configuration Difference between User-Based Tool Web-Based Tool

## Open-source software reduces developing cost for developers and install cost for users

It is difficult for users to know cost-benefit effect of this tool before purchasing, because they cannot generally predict how they can reduce their energy cost by using this tool. We applied an open source optimization solver (CBC) for optimizing calculation in order to suppress the development cost and install cost for users.

## An example of using OPT-ADOPT

Table 1 Energy facilities in an office building

| Energy Facility | Rated Power |
|---|---|
| Combined Heat & Power | 900kW |
| Turbo-refrigerator | 1,723kW |
| Absorption Chiller #1 | 779kW(hot water)<br>985kW(cool water) |
| Absorption Chiller #2 | 779kW(hot water)<br>985kW(cool water) |
| Absorption Refrigerator driven by gas/hot water | 1,177kW(hot water)<br>1,758kW(cool water) |
| Heat Exchanger | 900kW |

Table 2 Characteristic of Office Building

| | |
|---|---|
| Contracted Demand | 1,500kW |
| Floor Area | 55,000m$^2$ |
| Sector of building | Office |
| Area | Tokyo |

Table 3 COP setting of Turbo -refrigerator for replacement

| | Load factor | | | |
|---|---|---|---|---|
| | 25% | 50% | 75% | 100% |
| Type-α | 6.3 | 7.5 | 7.5 | 6.5 |
| Type-β | 12.8 | 11.0 | 9.0 | 7.5 |

○Example of replacement planning of old turbo-refrigerator

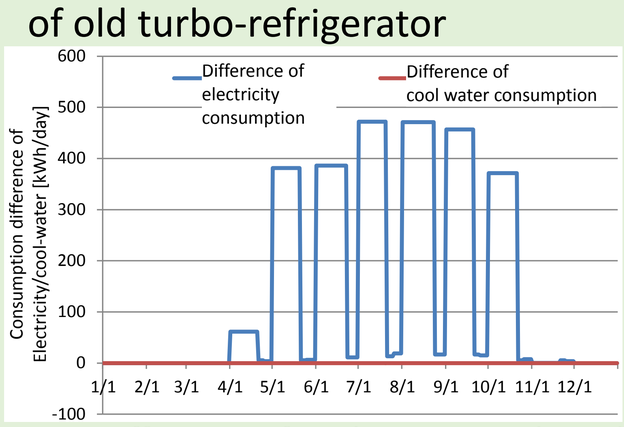


Fig. 6 Difference of cool water supply and electricity consumption between 2 cases

How much does the efficiency difference of replaced facility candidates affect annual operation cost?

- Type α: 112.5 million USD/y
- Type β: 111.5 million USD/y

⇒Users can compare to difference of annual fixed costs of two facility candidates.

## Concluded remarks

○Web-based scheduling tool for electric demand management of small scale industrial, commercial customers and a microgrid is developed.

○ The tool can calculate daily and annual optimal operation planning of energy system including CHP and thermal supply systems.

○ The function of annual planning is expected to give the customers or an operator of the microgrid suggestions of renewal plans of their energy system and re-examinations of energy tariff menus of gas and electric power utility company.

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