The University of Tokyo－Imperial College London Joint Symposium on innovation in Energy Systems
Imperial College London， 31January－1February 2008

Building energy monitoring system

Bumpei Magori, Tomonari Yashiro
bumpei@m.email.ne.jp
magori@iis.u-tokyo.ac.jp
Institute of Industrial Science, University of Tokyo

INDEX

Introduction

- Why energy monitoring? Need and problems to be solved.

Outline of presentation

- Monitoring system.
  - Web based
  - Module framework
  - By open source (protocol , database and web etc)

- Development stage 1
  - Provision of information to stakeholders
  - Well informed decision making
  - “Mieruka (visualization)”

- Development stage 2
  - Statistics analysis
  - Prediction / Simulation model
  - Re-systemization & Control
  - Building energy AI system.
  - Achievements

Introduction

- Why energy monitoring?

Introduction

●Why energy monitoring?

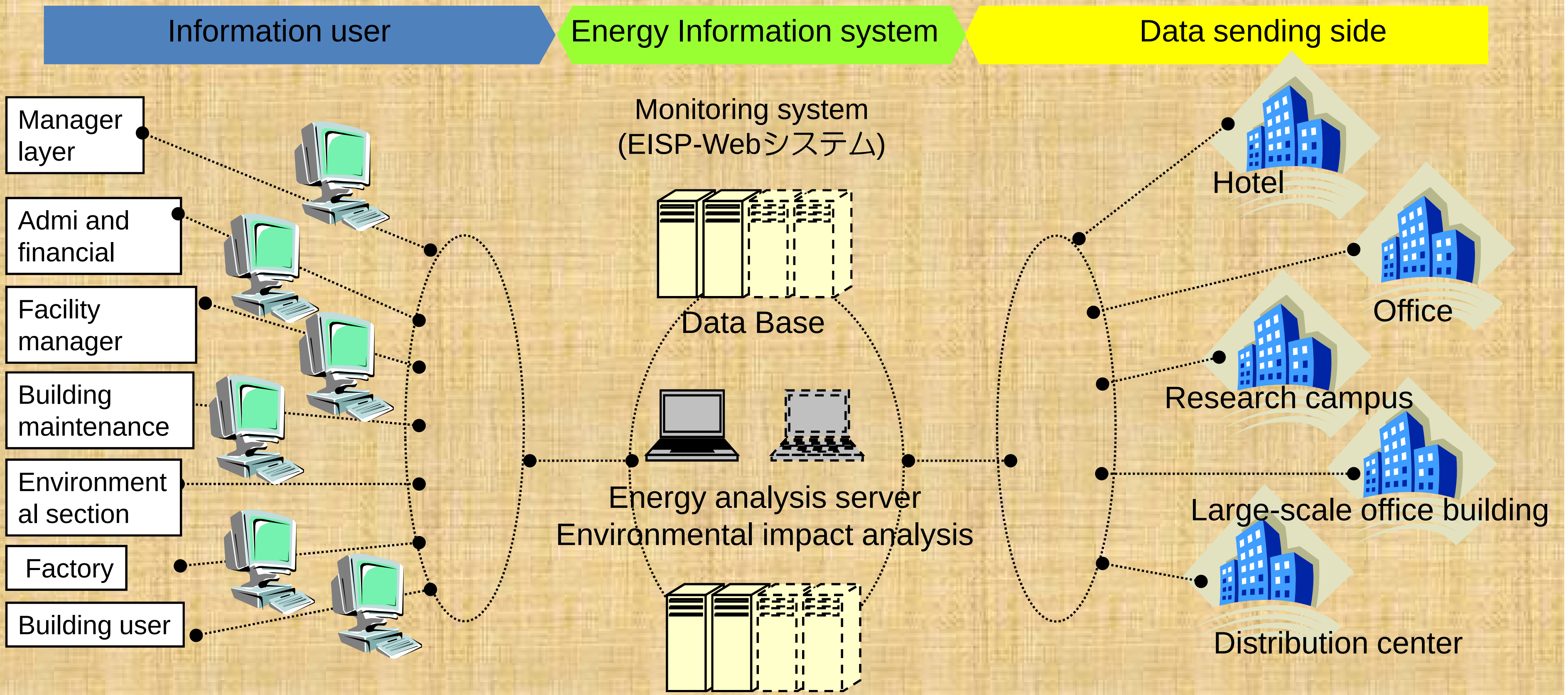
Needs and Problems to be solved for building energy conservation.

1. No one knows real time energy demand with the real time use at the same time.
2. Small and middle size buildings(under 5000㎡) don't have energy manager.
3. Not to be able to compared at the same time the energy use in two or more, similar buildings.
4. There are many stakeholders to achieve building energy conservation, so it will take a long time to decision making process of renewal and improvement.
5. Most building owner and user informally need only less facility cost, not less CO_2.
   ⇒Therefore we have to develop easy installed technology, and the combined methodology of economics and environment.
6. Easy data stock methodology of building energy
   ⇒Cheaper and more convenience database
   ⇒Easy data analysis
   ⇒Automatically energy conservation control

● Monitoring system(1)

- Web based
- Module framework
- By open source (protocol , database and web etc)

Framework of energy monitoring



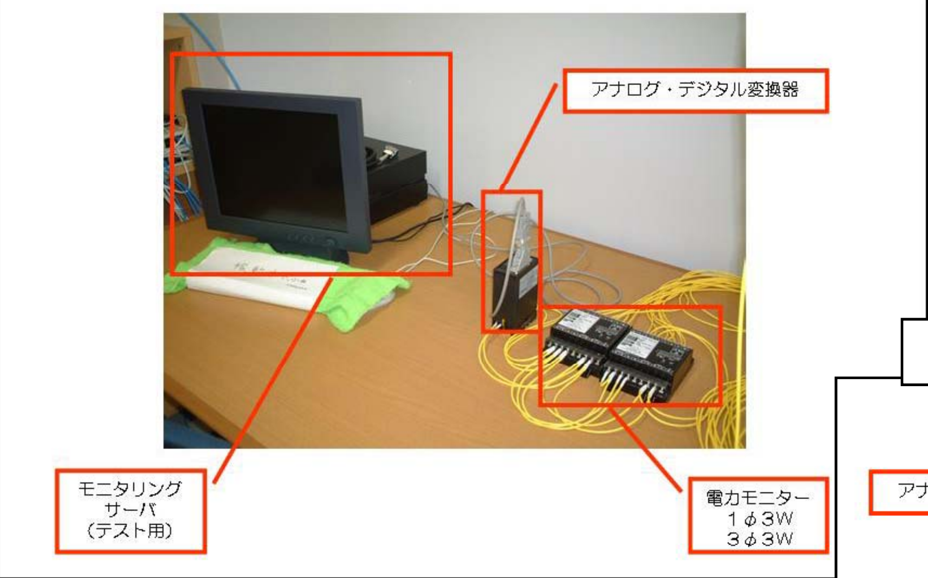
Output of the system

Low carbonization promotion of buildings
Energy conservation and saving resource
High Management efficiency

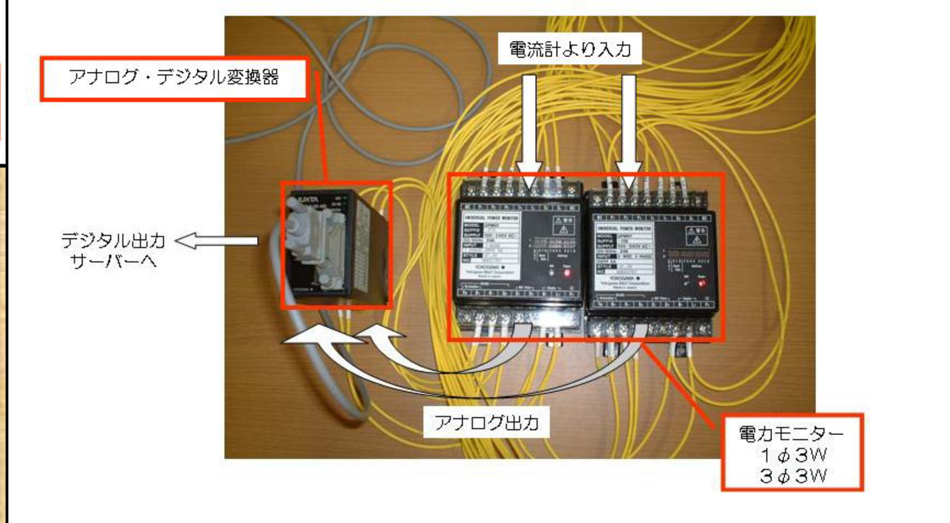
Monitoring system(2)

Prototype

Prototype testing



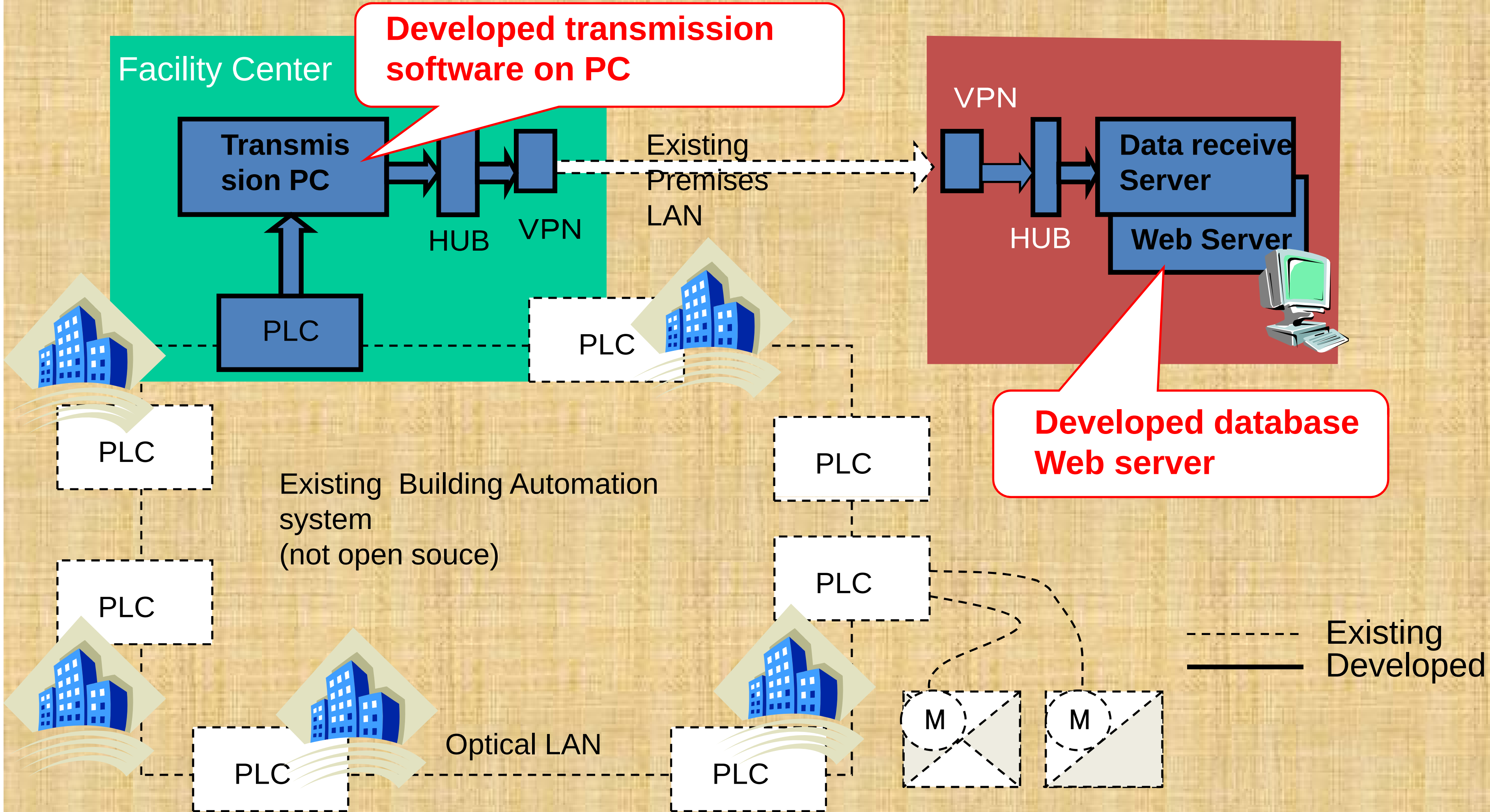
Original electric data transform to open source



Monitoring system(3)

Outline of the first trial

- **Institute of industrial science, The University of Tokyo**
- **1200 points monitoring**



PLC : program-able logic controller (Sequencer)
VPN : Virtual Private Network

Monitoring system(4)

Map Institute of industrial science, The University of Tokyo

Address
〒153-8904
東京都目黒区駒場4-6-1

Lot area 97,943m2
Floor area 50,149m2

Komaba Research campus
≒1200 points Monitoring Wattmeter

- **Development stage 1**
  - **Provision of information to stakeholders**
  - **Well informed decision making**
  - **Mieruka (visualization)**
  - **Mieruka (visualization) and valification**

●Development stage 1

➢Provision of information to stakeholders

The past stakeholders

- Building owners
- Renter
- Facility Manager (Energy Manager)
- Electric power supply company
GAS supply company
Energy supply

(Only claim data)

[dashed box] No facility and energy manager in small and middle size building

more information →

Present and the future stakeholders

- Building owners
- Admi and Financial
- Top manager
- Building Users
- Facility Manager (Energy Manager)
- Electric power supply company
GAS supply company
Energy supply
- ESCO
Energy service company
- Maker and Building service
- Asset management company
- Property management company
- Architect & Construction engineer

(Energy and CO2 data)

FigD1-1 Building Energy information user (stakeholders)

●Development stage 1

➢Well informed decision making

TableD1-1 The relation about decision making and information of energy monitoring data use

Stakeholders	Interested information	Energy data and data analysis	Energy conservation effects
Building owners CEO	●lifecycle cost ●Asset and property value	●Changing ratio of energy use and facility date predict future investment.	●Lifecycle cost and environmental load will be minimum.
Administrator and Financial	●Annual operation cost ●Annual maintenance and energy cost		
Facility Manager Energy Manager	●Monthly maintenance cost ●Monthly energy cost ●Daily safety operation ●Monthly repair cost	●Daily energy data ●Peak time energy data ●Emergency energy data	●High efficiency management ●Verification of cost ●Creation of a plan document
Building users Tenant user	●Amenity and convenience information	●Indoor temp and humidity data ●Lighting luminance data ●Indoor Air Quality data	●Commissioning operation ●Re-setting indoor air quality temp and humidity control
Energy supply company	●Monthly energy cost ●Peak energy use ●Seasons energy use	●Monthly energy cost data	●Adoptable energy select ion to the future
ESCO	●Repair to increase in efficiency ●To change high efficiency devices	●M & E device consumption data ●Base line data	●To improve high efficiency device ● investment
M &E device maker	●M &E device energy consumption and past maintenance number	●M & E device consumption data ●Emergency and broken number	
Building Management company	●Information about operational report of Monthly, Annual energy use and repair.	●Monthly energy data ●Annual energy data ●Repair information	●High efficiency management ●Good operation for energy conservation
Architect, contractor and engineer	●Design information ●Engineering information ●Improvement need	●Real operation data ●Original energy use and load	●Grasp and a report of the reduction effect ●Arrangement for reduction effectiveness

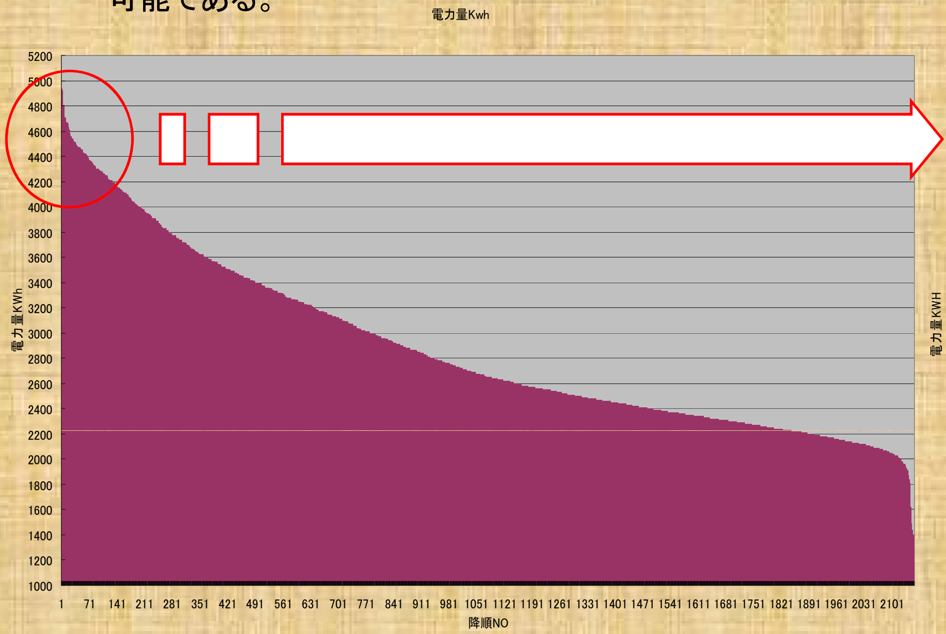
●Development stage 1
➢"Mieruka (visualization)"

CASE1

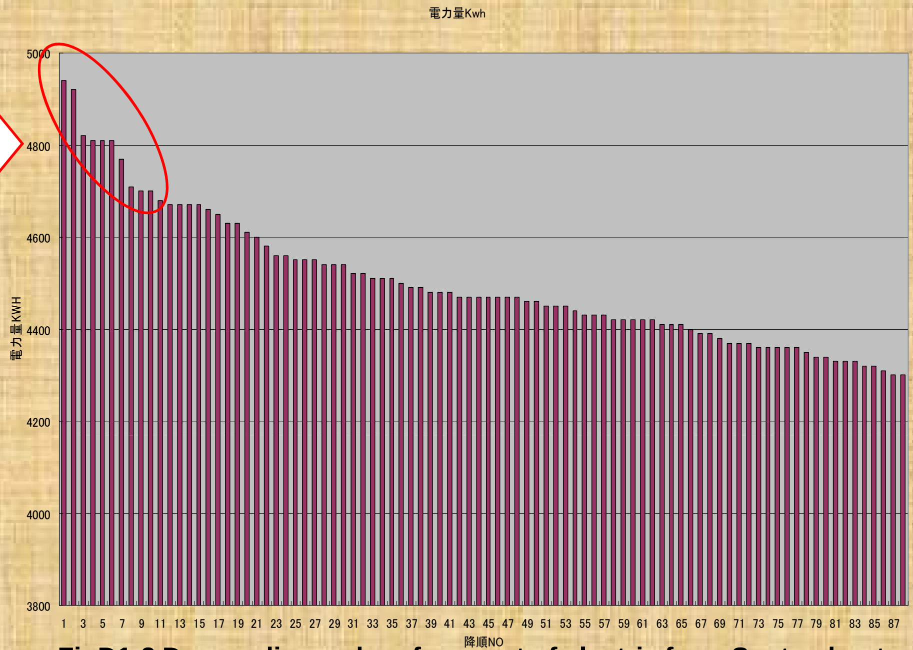
Example
Analyzed maximum electrical peak demand of all campus in summer
Operation improvement was needed

Komaba Research Campus. From July to September, 2003.

- 受電電力量の大きい順に並べ替えたものである。
- 最大受電電力は、4848Kwであり、以下のグラフからもわかるように、上位1%(トップから88hr分)の時間ピークを抑制できれば、4300KWhまで抑制でき、上位10Hrを抑制しただけで4700KWhまで契約電力を下げることも可能であり、△148Kwhの削減が可能である。



FigD1-2 Descending order of electric demand from September to July , 2003.
図 2003年7～9月特高電力量降順グラフ



FigD1-2 Descending order of amount of electric from September to July , 2003.(High rank 1%)
図 2003年7～9月特高電力量降順グラフ(上位1%)

●**Development stage 1**

➢**"Mieruka (visualization)"**

CASE1

Example

Analyzed maximum peak of electrical power in summer

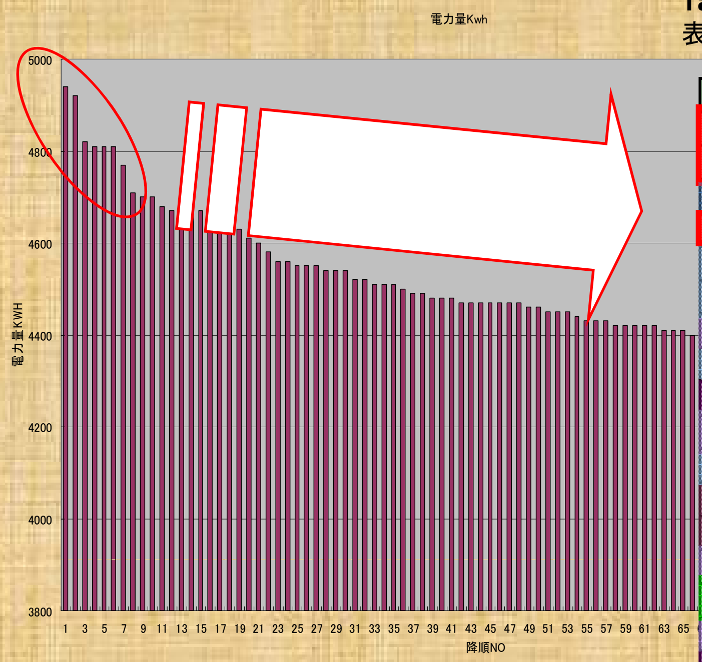
Operation improvement was needed

Komaba Research Campus. From July to September, 2003

電力ピークの特性を把握する。

上位10時間の内訳は以下
- 9月11日　3時間
- 9月12日　4時間
- 8月25日　2時間
- 8月7日　　1時間
- （計4日間）

上位20時間の内訳は以下
- 9月11日　6時間
- 9月12日　5時間
- 8月25日　4時間
- 8月7日　　2時間
- 8月22日　2時間
- 9月10日　1時間
- （計5日間）



FigD1-3 Top 10 th of electric power use

図　2003年7～9月特高電力量降順グラフ（上位10時間）

Table Top 10 th of electric power use

表　2003年7～9月特高電力量降順グラフ（上位10時間）

日時	曜日	順位	電力量Kwh
2003/9/11 0:00	木	1	4940
2003/9/11 0:00	木	2	4920
2003/9/12 0:00	金	3	4820
2003/9/11 0:00	木	4	4810
2003/9/12 0:00	金	5	4810
2003/9/12 0:00	金	6	4810
2003/8/25 0:00	月	7	4770
2003/9/12 0:00	金	8	4710
2003/8/7 0:00	木	9	4700
2003/8/25 0:00	月	10	4700
2003/9/12 0:00	金	11	4680
2003/8/22 0:00	金	12	4670
2003/8/22 0:00	金	13	4670
2003/8/25 0:00	月	14	4670
2003/9/10 0:00	水	15	4670
2003/8/25 0:00	月	16	4660
2003/8/7 0:00	木	17	4650
2003/9/11 0:00	木	18	4630
2003/9/11 0:00	木	19	4630
2003/9/11 0:00	木	20	4610

http://221.249.224.10/ut/graph1.htm

●Development stage 1

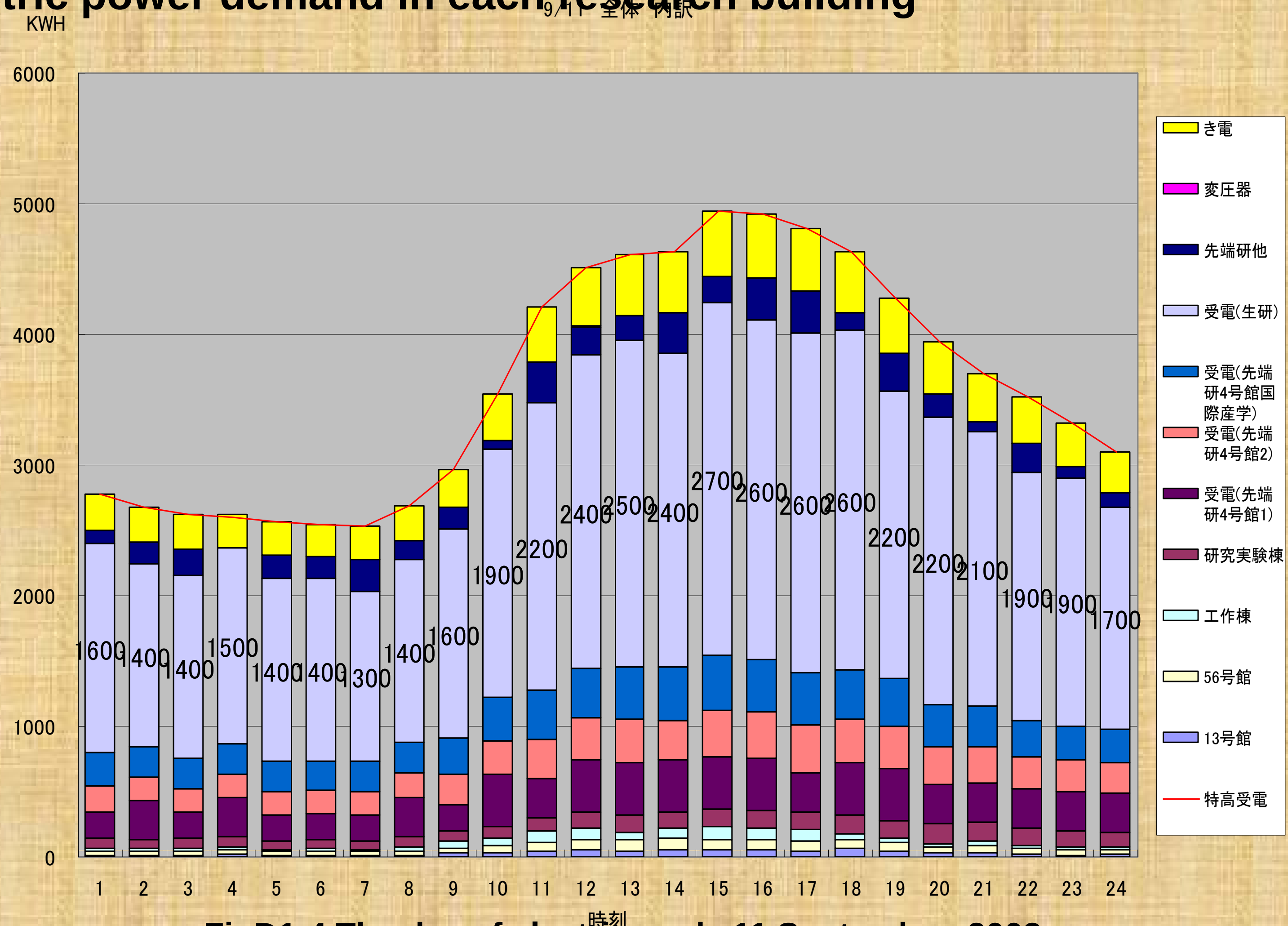
➢"Mieruka (visualization)"

CASE1

Example
Ratio of electric power demand in each research building

夜間の不在時でも2530KW～2780KWの電力負荷がある。実験および共用部の負荷と想定できる。

ピーク時に生産研2700KWhの電力を利用している。



FigD1-4 The day of electric peak, 11 September, 2003

図　電力ピーク日(9/11)の各棟の毎時電力使用量(KWh)

●Development stage 1

➢"Mieruka (visualization)"

CASE1

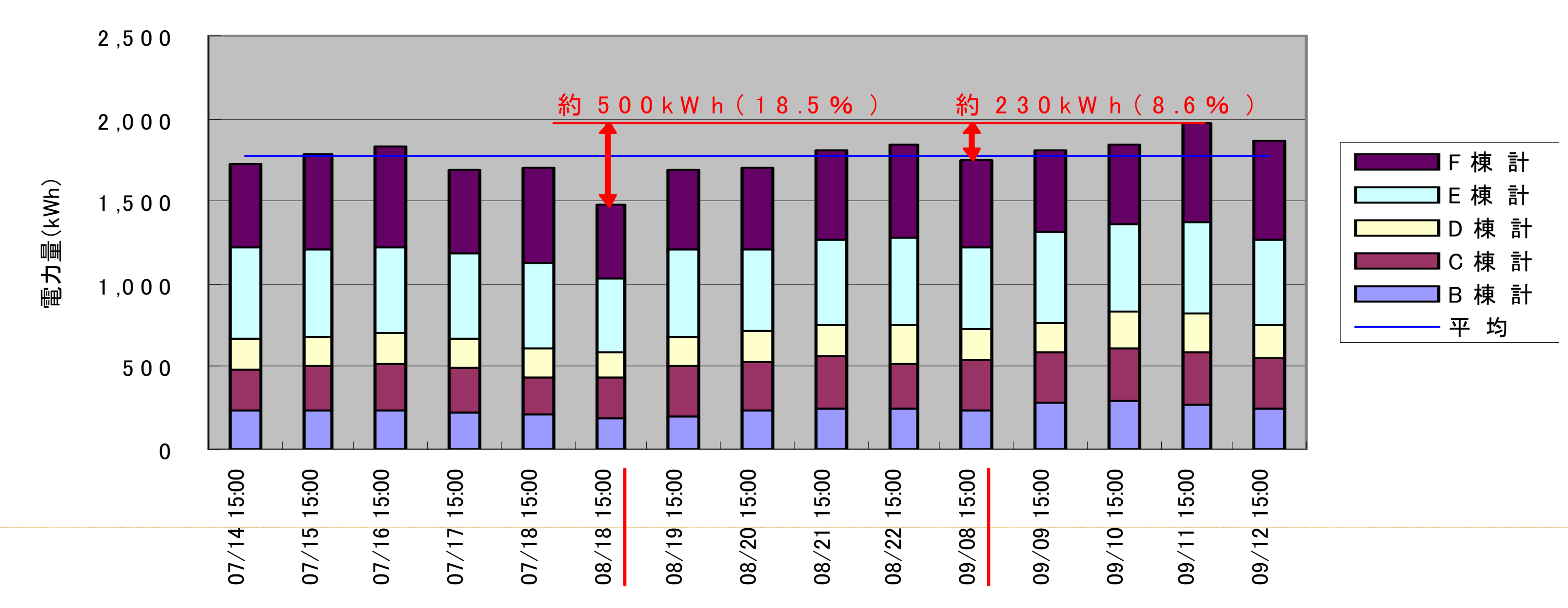
Example

Evaluate the closed room effectiveness of each laboratory for electric peak demand control

Amount of theory peak demand reduction 49%（△1300KWH） 生研の理論削減量

Improvement operation: Summer close room effect

Analyzed data of September,2003. Predictable 8.6%less than non effect（△230KWH）



FigD1-5 Close room effectiveness

尚、8月のお盆の時期のデータでは、18.5%削減（△500KWH）

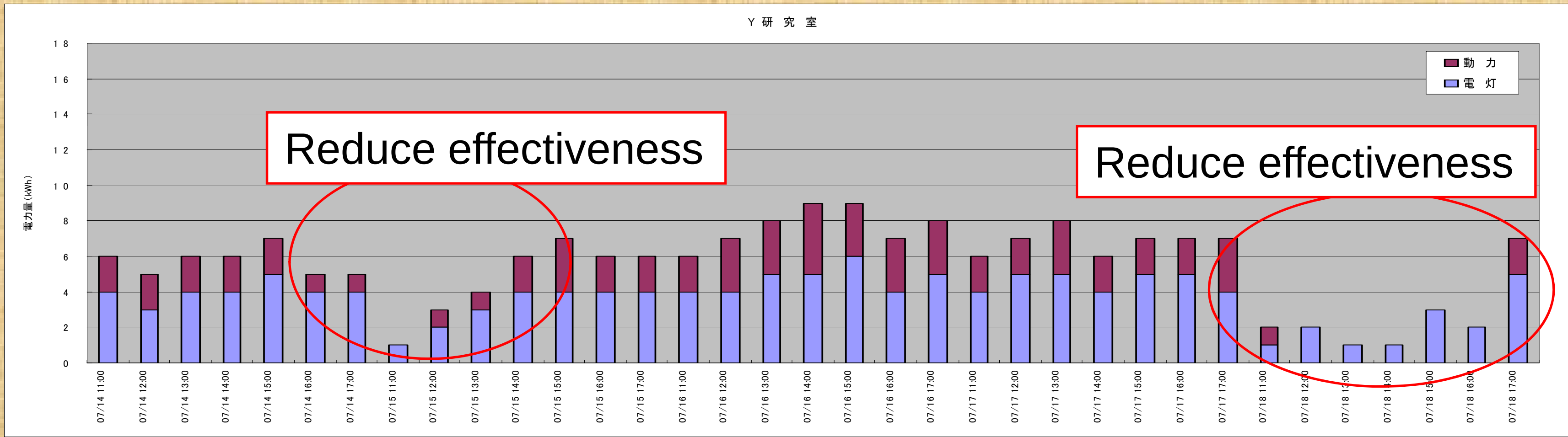
●Development stage 1

➢"Mieruka (visualization)"

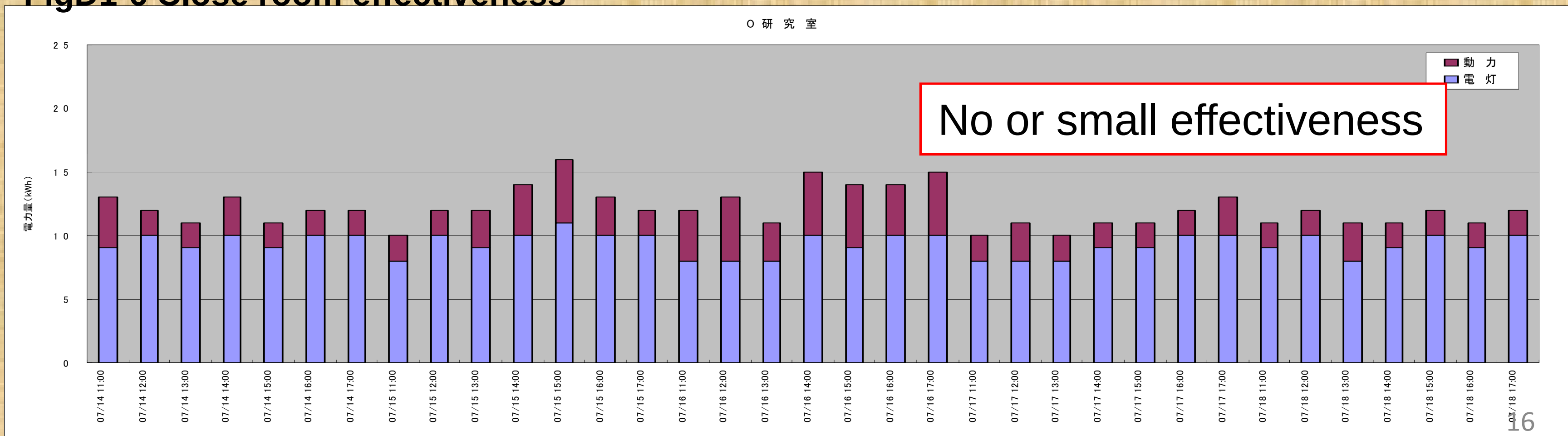
CASE1

Example

Evaluate the closed room effectiveness of each laboratory at peak electric power demand.



FigD1-6 Close room effectiveness



FigD1-7 Close room effectiveness

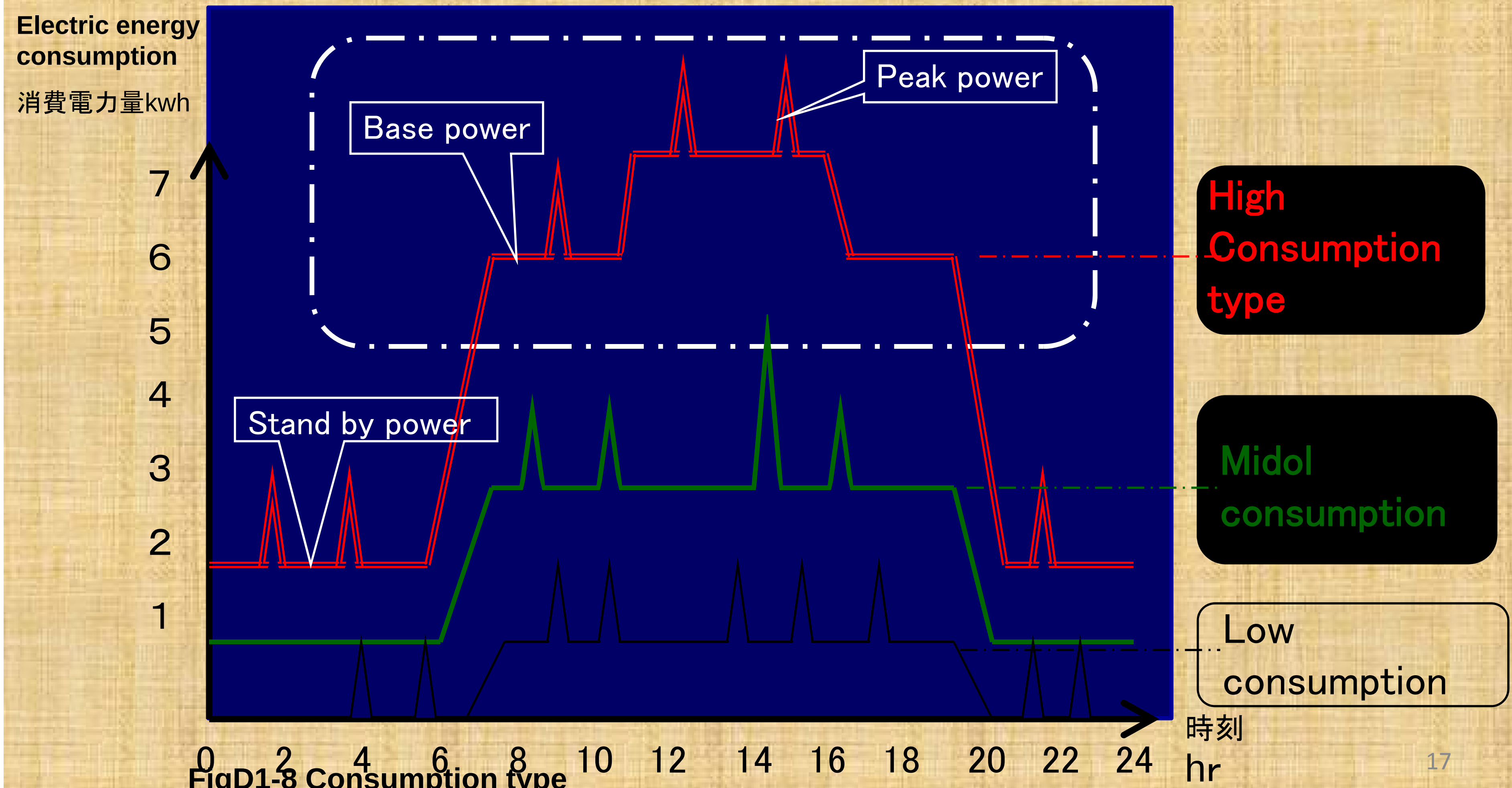
●Development stage 1

➢"Mieruka (visualization)"

CASE1

Example

Mieruka (visualization) of "High energy consumption type laboratory"



FigD1-8 Consumption type

●Development stage 1

➢"Mieruka (visualization)"

CASE1

Example of solutions

Energy conservation about high consumption type laboratory.

- ➢Energy conservation diagnosis was needed
- ➢Making plan of energy conservation was needed
- ➢To reduce the base power demand
  - ✓Indoor Air condition setting temperature 28℃
  - ✓Use air to air heat exchanger
  - ✓ Lighting and Air-conditioning are off at lunch time and at the absence
  - ✓ Display the sticker about temperature setting everywhere in campus
- ➢To reduce the peak power demand
  - ✓To shift the peak of using time of experiment equipment.
- ➢Information service of conservation plan for researcher of high consumption type laboratory.

●Development stage 1

➢“Mieruka (visualization)” and verification

CASE2

Example
Web information for general user (Cyber pavilion)
EXPO 2005 AICHI JAPAN (Japan government pavilion)
愛知万博日本館

●The effect of the adopted technology of energy conservation is expressed by the numerical value.

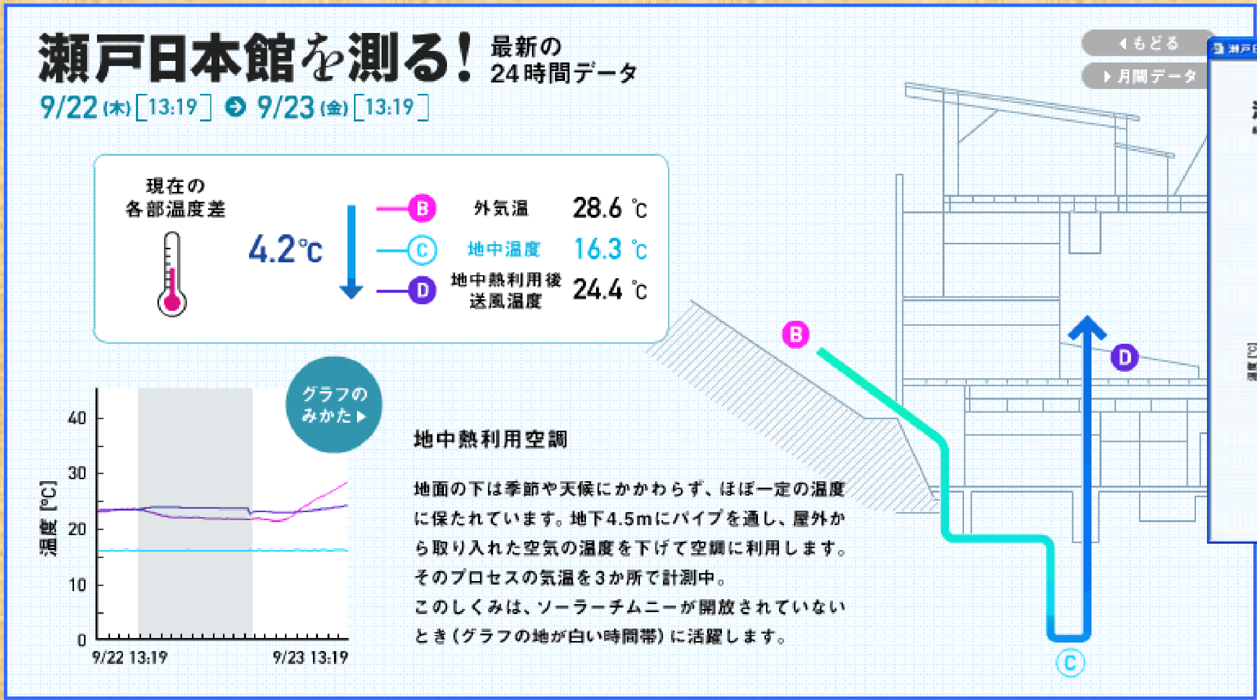
●PR of environment friendly construction.

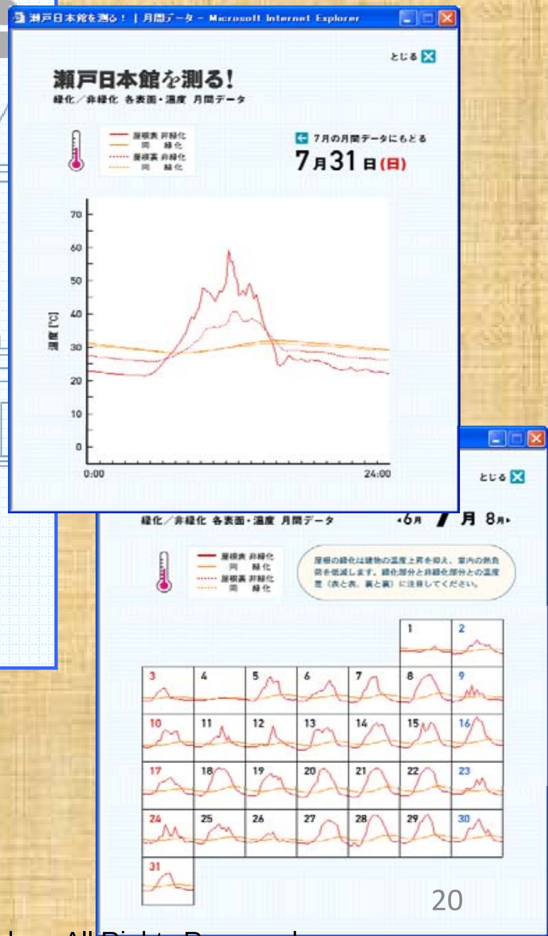
採用された省エネ配慮技術の
効果を数値で表現し,
環境にやさしい建築をPR

●Development stage 1
➢"Mieruka (visualization)" and verification

CASE2

Example of verification
Web information for general user (Cyber pavilion)
EXPO 2005 AICHI JAPAN (Japan Government Pavilion)





●The effect of the adopted technology of energy conservation is expressed by the numerical value.
●PR of environment friendly construction.
採用された省エネ配慮技術の効果を数値で表現し環境にやさしい建築をPR

●Development stage 1

➢"Mieruka (visualization)" and verification

CASE2

EXPO 2005 AICHI JAPAN

2005年日本国際博覧会政府出展事業実施制作業務

「平成17年度エネルギーモニタリング報告書作成業務」より

●Development stage 1
➢"Mieruka (visualization)" and verification

CASE2

Example
EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

長久手日本館・西堰堤の外観

竹ケージ外観（出口廻り）

Example
EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

館全体を覆う竹ケージと、壁面緑化の様子

出口付近の壁面緑化

南壁面の壁面緑化（正面竹扉は機械室）

Example
EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

壁面緑化（南壁・出口）　　　同左　　　（※雨天）

Example
EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

壁面緑化（南） ※閉扉時　　　　同左

EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

Spring shower for roof system 屋上・鋼板屋根（北側）の打ち水装置と、小屋裏排熱扉

散水栓

散水シャワー（鋼板屋根にタイマーで打ち水）

EXPO 2005 AICHI JAPAN
Energy conservation method of Nagakute pavilion
Passive solar, spring water for the roof, bamboo gage and roof wool planter
（パッシブソーラ、鋼板屋根打ち水効果、竹ケージ日陰効果、コクマザサ壁面緑化など）

Natural ventilation combined smoke existing 小屋裏排熱口

小屋裏の熱気を排気する跳上窓と、
屋根を覆う竹ケージの日陰効果

排煙窓を兼ねる開閉用ダンパー

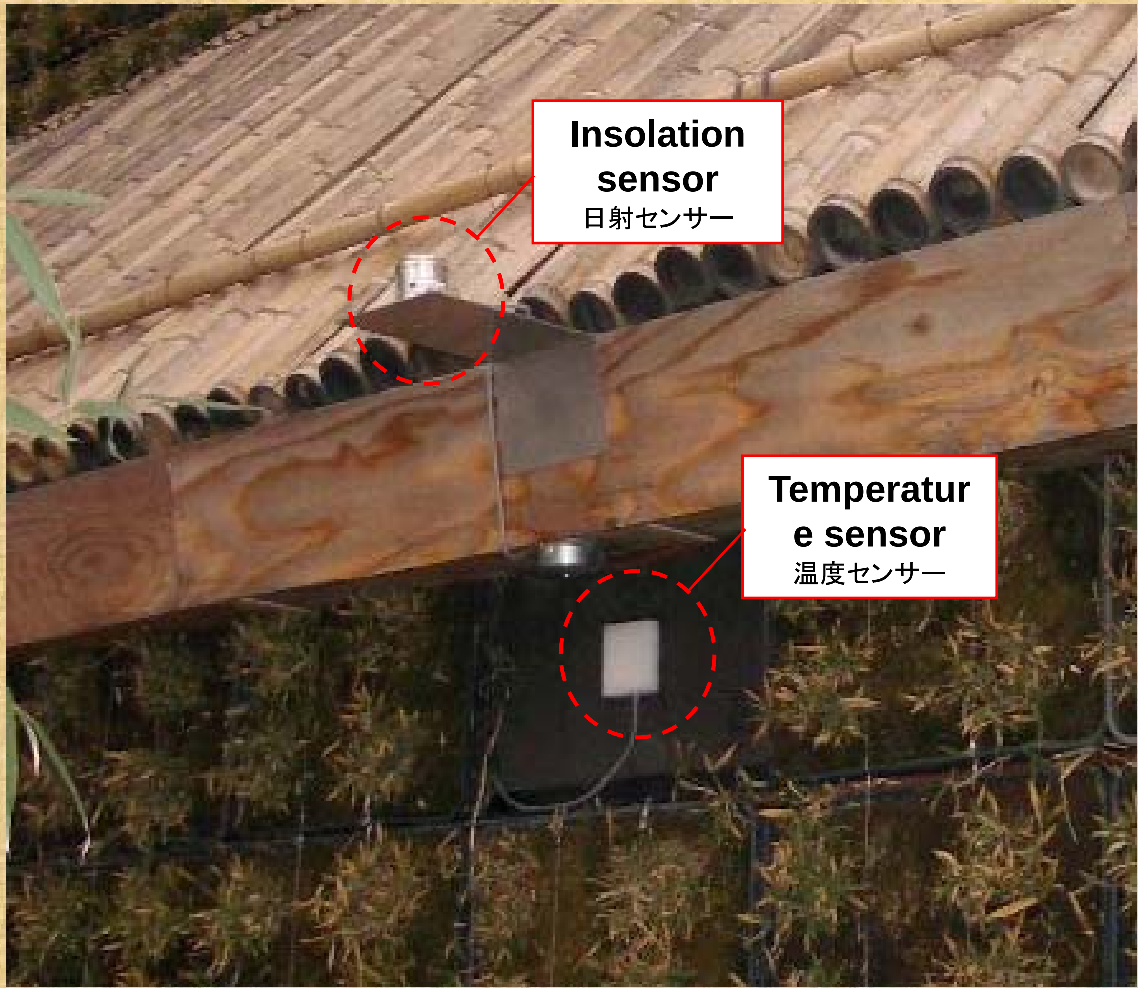


図2.1.1　センサー設置状況（日射センサー、温度センサー）

Indoor temp sensor
室内側温度センサー

Sunlight sensor and wall temp sensor
外壁の温度センサー、日照計

Display in the pavilion
ゾーン3「パビリオンの試み」コーナー展示状況

Display in the pavilion

ゾーン3「パビリオンの試み」コーナー展示状況

パビリオンの各種試みを解説する液晶モニター（左：壁面緑化、右：省エネルギー）

- Development stage 2
  - Statistics analysis
  - Prediction / Simulation model
  - Re-systemization & Control
  - Developed Energy AI system
  - Achievements

●Development stage 2
➢Statistics analysis

CASE1

Komaba campus

●**Outside temperature analysis during peak time**

●**Study of relation about electric power demand and outside temperature**

●**Prediction of 2003 summer demand by 2001 and 2002 data**
- ✓**2003's summer was colder than another year in Tokyo**
- ✓**prediction of electric power demand**
- ✓**Planning energy conservation by the prediction**

2003年の夏は、例年より冷夏であった。そこで昨年・一昨年の夏期の外気温度データを活用し、平均的な外気温度だった場合の電力使用量を予測した。

●Development stage 2
➢Statistics analysis

CASE1

Komaba campus

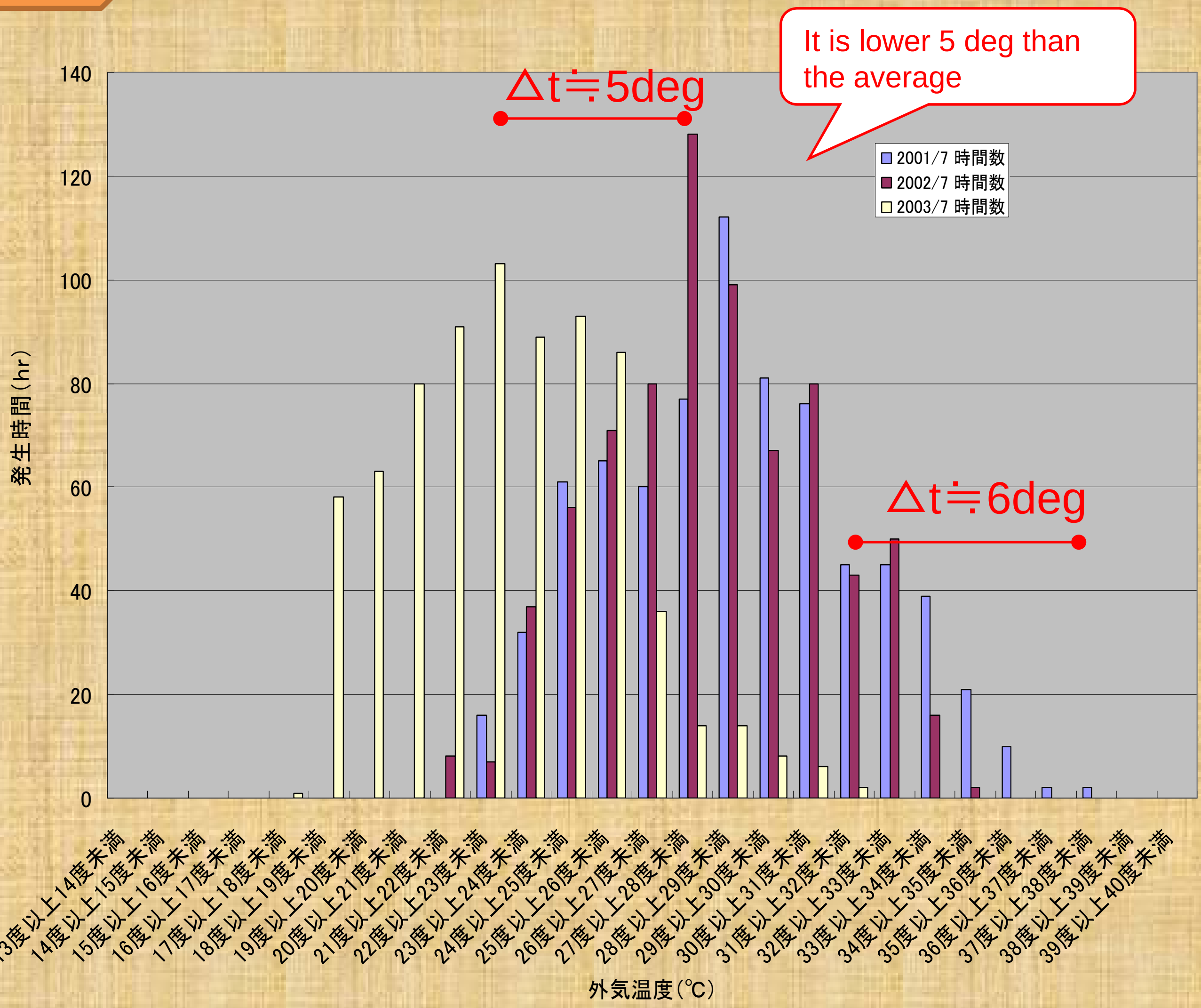
測定結果及び考察（各年の7月外気温度について）

2001～2003年7月の外気温データを示す。

今年は冷夏であったため以下の違いが読み取れる。

中央値：約△5度差
最大値：約△6度差

外気温は、気象庁東京気象台データを採用。



FigD2-1 Outside temperature analysis of July 2001, 2002, 2003

●Development stage 2
➢Statistics analysis

CASE1

駒場リサーチキャンパス

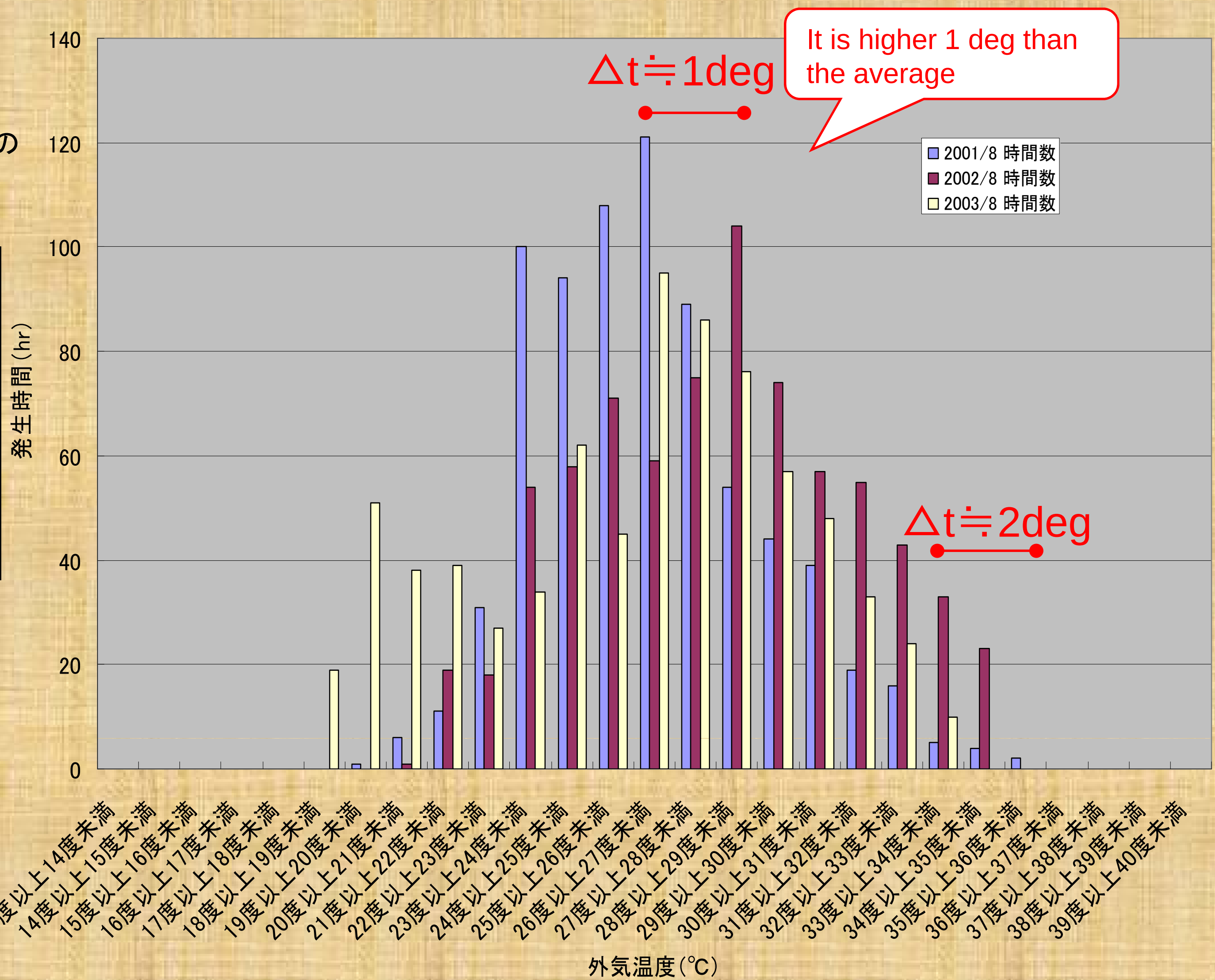
測定結果及び考察(各年の8月外気温度について)

2001～2003年8月の外気温データを示す。

今年は冷夏であったため以下の違いが読み取れる。

中央値:約△1度差
最大値:約△2度差

外気温は、気象庁東京気象台データを採用。



FigD2-2 Outside Temperature analysis of August 2001, 2002, 2003

●Development stage 2
➢Statistics analysis

CASE1

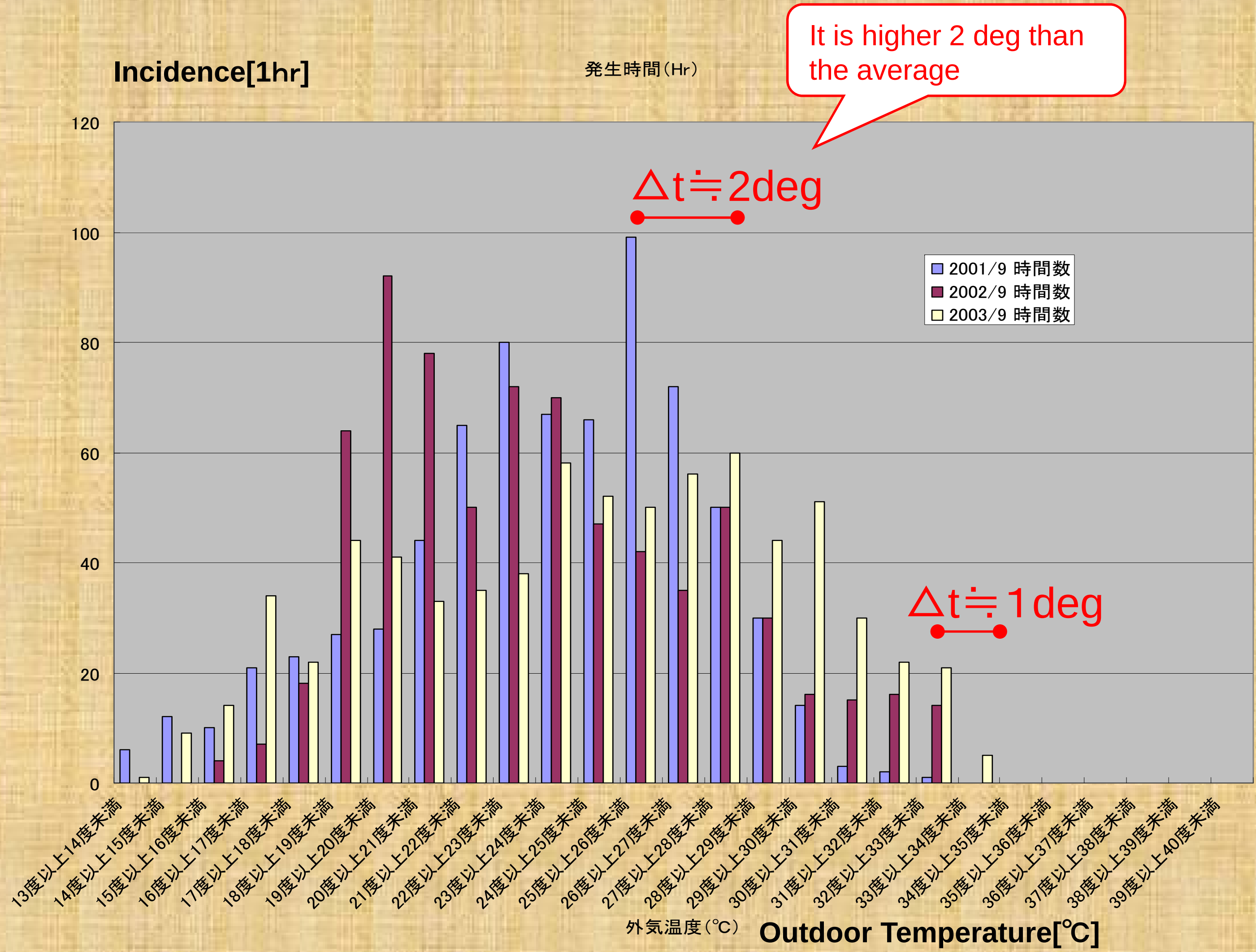
Komaba campus

測定結果及び考察（各年の9月外気温度について）

2001～2003年9月の外気温データを示す。

中央値：約△2度差
最大値：約△1度差

外気温は、気象庁東京気象台データを採用。



FigD2-3 Outside Temperature analysis of September 2001, 2002, 2003

●Development stage 2

➢Statistics analysis > Prediction/Simulation model

CASE1

Komaba campus

測定結果及び考察(2001年7月の外気温度分布と工学的推定による電力需要との関係)

2001年7月の外気温データに本年の電力使用量から想定した電力使用量予測を重ねた。

契約電力4848KWを超過する可能性のある時間は外気温32℃以上の時間は1ヶ月間に119hr。

発生する可能性16.0%、平日で14日間程度

最大5153KWHの可能性が想定される。
（超過305KWh）

電力使用量予測には以下の相関を既往データより採用
傾き111.03
切片934.33
相関係数0.93
外気温は、気象庁東京気象台データを採用。

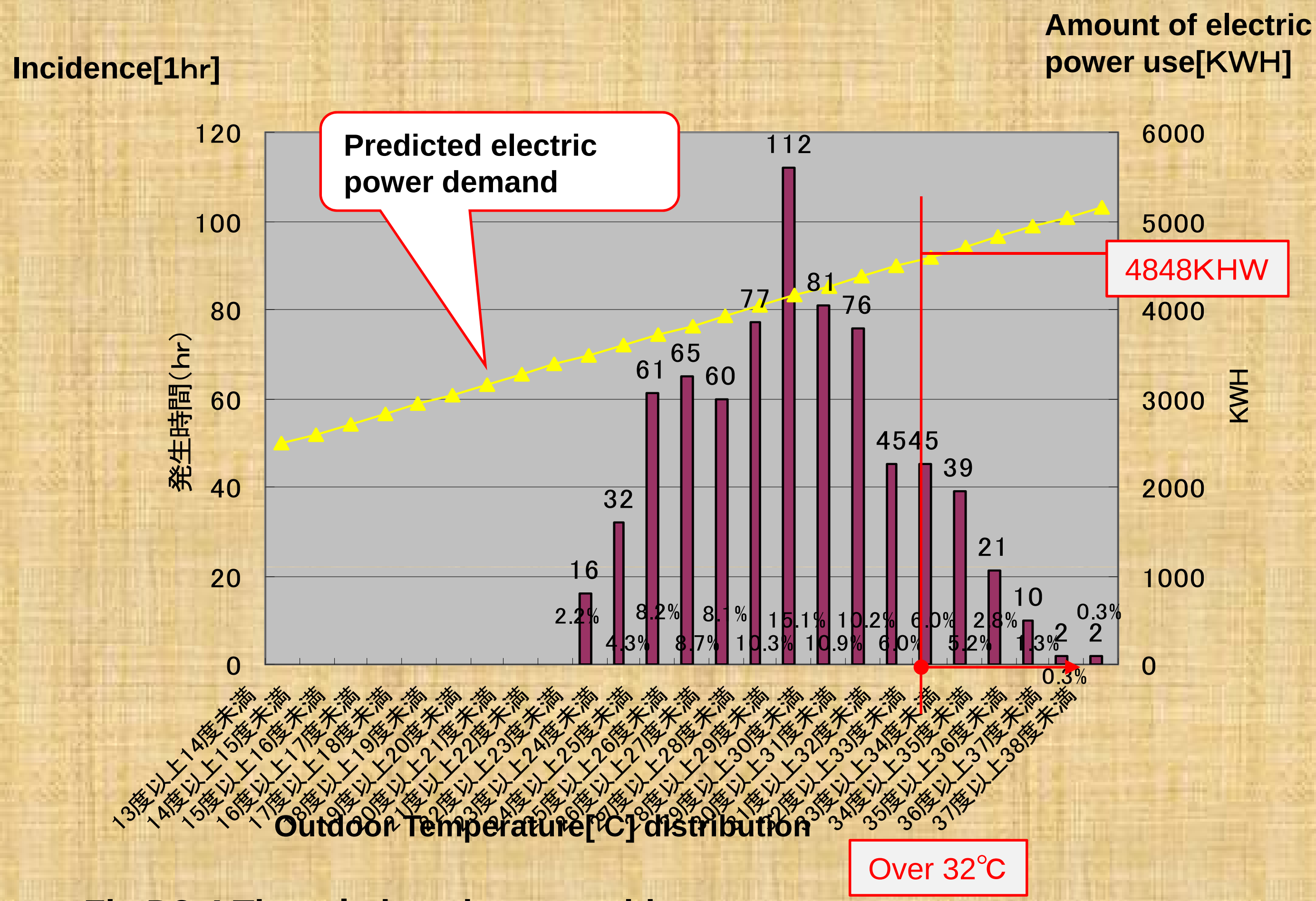


Fig D2-4 The relation about outside temperature, Incidence, and electric power demand analysis in July 2003.

●Development stage 2

➢Statistics analysis >>> Prediction/Simulation model

CASE1

Komaba Campus

測定結果及び考察
（2002年8月の外気温度分布と工学的推定による電力需要との関係）

2002年8月の外気温データに本年の電力使用量を重ねた。

契約電力4848KW を超過する可能性のある時間は外気温32℃以上の場合は1ヶ月間に99hr

発生する可能性13.3%、平日で11日間程度

最大4820KWHの可能性が想定される。
（最大電力は、超過するかしないぎりぎり）

電力使用量予測には以下の相関を既往データより採用

傾き111.03
切片934.33
相関係数0.93
外気温は、気象庁東京気象台データを採用

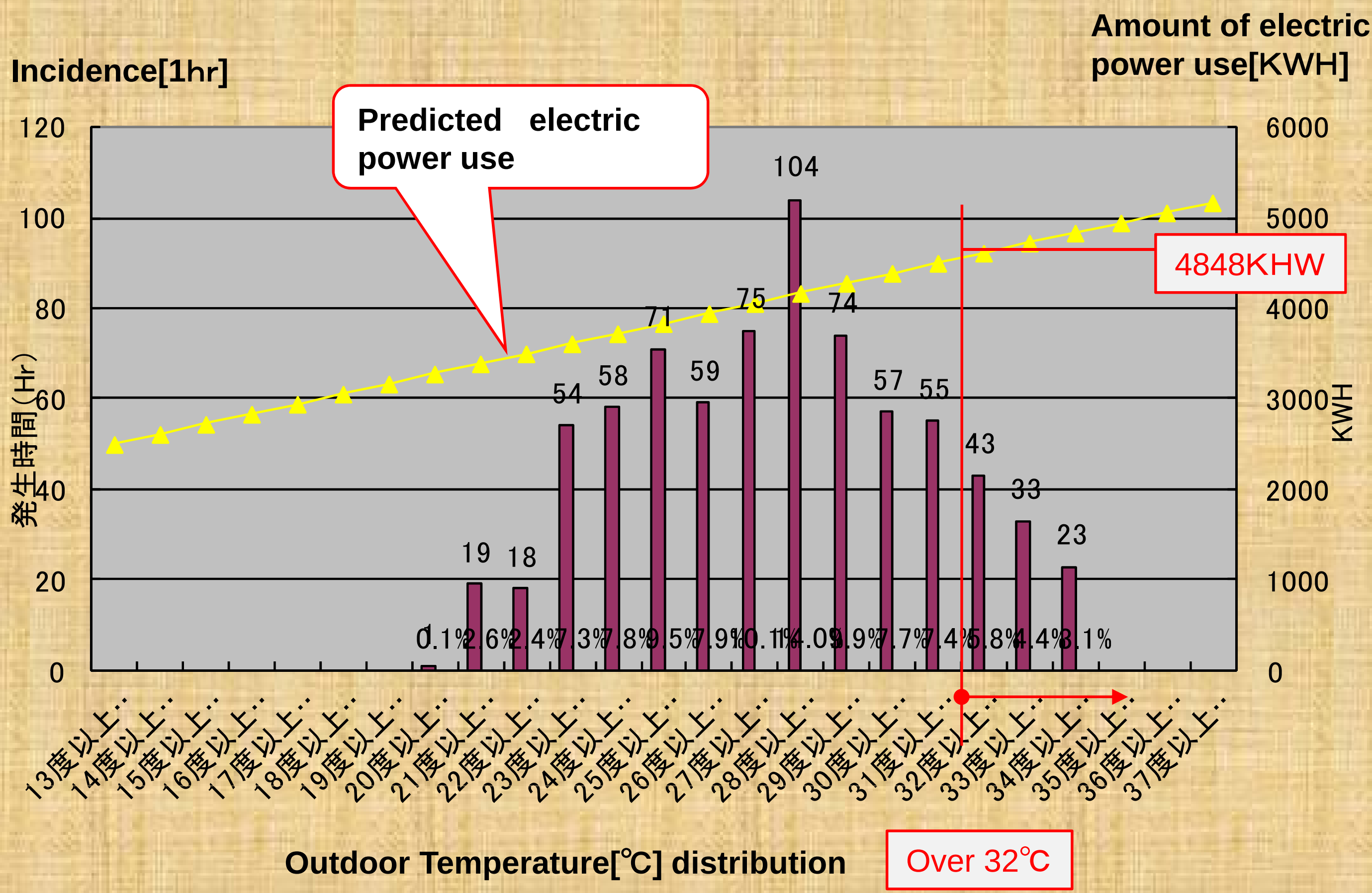


Fig D2-5 The relation about outdoor Temperature temp, Incidence, Amount of electric power use analysis in august 2003.

●Development stage 2

➢Prediction/Simulation model >>>Re-systemization & control

Komaba campus | CASE1

Simulation

If outdoor temperature 32.3℃ will be recorded, the electric power peak demand is occurred one hour after

電力ピークは、最高温度32.3℃を記録してから、約1時間後に発生する。

Solution of energy conservation (Operation improvement)

It is predictable that the outside temperature becomes 32℃ by monitoring morning temperature. Operation control

EX1) load control operation procedure(management of close room schedule)

EX2) ON-OFF control synchronized with temperature

EX3) Insolation control

Engineering approach

The electric power peak is generated by solar radiation

Building being heated by the outside temperature, and air-conditioning load will be increased.

最大日射量及び外気温度により、躯体が熱せられ、空調負荷が増大することにより電力ピークが発生する。

Hardware improvement

Ex 1) Setting film on the windows

Ex 2) Improvement of insulation efficiency about old building and prefab building

Ex 3) Roof, rooftop gardening, and roof watering

Ex 4) High efficient air-conditioning equipment

Ex 5) Improvement of night storage type air-conditioning equipment

Ex 6) Use of fuel cell system for control electric peak demand

Indicator for energy conservation
Case study about energy analysis of amusement park in Kyusyu prefecture.

Looks like Amsterdam!

Indicator for energy conservation
Case study about energy analysis of amusement park in Kyusyu prefecture.

●Development stage 2

CASE2

Making indicator for energy conservation by monitoring Case study about energy analysis of amusement park in Kyusyu prefecture.

エネルギー原単位で経年変化を記録、削減の達成度を評価する。

Table D2-1 Indicator for energy conservation

Average of visitor [person/d]

Daily electric power standard [KWH/d] [KWH/d･m2]

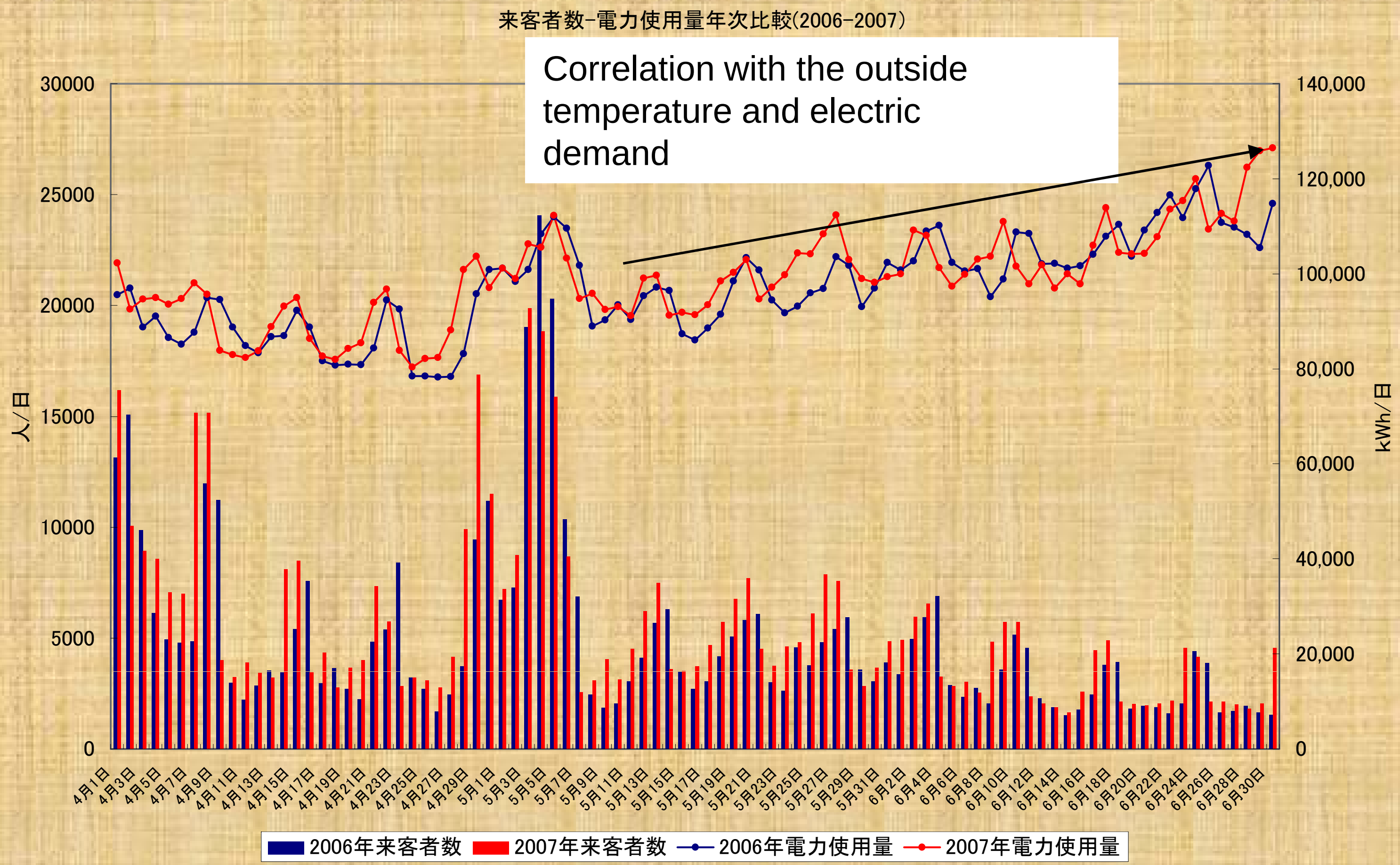
Peak electric demand standard

Nighttime Peak electric demand standard

	2005年夏季	2006年夏季	2005年冬季	2006年冬季	2007年4-7月	
平均入場者数〔平日〕	3,000	4,500	3,000	4,000	3,870	(4-6月)
平均入場者数〔休日〕	9,000	8,500	8,000	9,500	9,100	(4-6月)
日 電力量基準値〔平日〕	120,000	122,000	90,000	68,400	104,230	
日 電力量基準値〔休日〕	135,000	136,000	100,000	81,500	113,100	
日 電力量㎡基準値〔平日〕	0.68	0.69	0.51	0.39	0.59	
日 電力量㎡基準値〔休日〕	0.77	0.77	0.57	0.46	0.64	
ピーク時 電力量基準値〔平日〕	7,500	7,900	5,200	5,300	6,120	
ピーク時 電力量基準値〔休日〕	8,500	8,700	6,000	6,100	6,470	
ピーク時 電力量㎡基準値〔平日〕	0.043	0.045	0.030	0.030	0.035	
ピーク時 電力量㎡基準値〔休日〕	0.048	0.049	0.034	0.035	0.037	
夜間 電力量基準値〔平日〕	2,700	3,100	2,700	2,300	2,832	
夜間 電力量基準値〔休日〕	3,000	3,200	2,400	2,500	2,866	
夜間 電力量㎡基準値〔平日〕	0.015	0.018	0.015	0.013	0.016	
夜間 電力量㎡基準値〔休日〕	0.017	0.018	0.014	0.014	0.016	

●Development stage 2
➢Prediction/Simulation model

CASE2



FigD2-6 Visitor, outside temperature and electric demand

●Development stage 2
➢Prediction/Simulation model

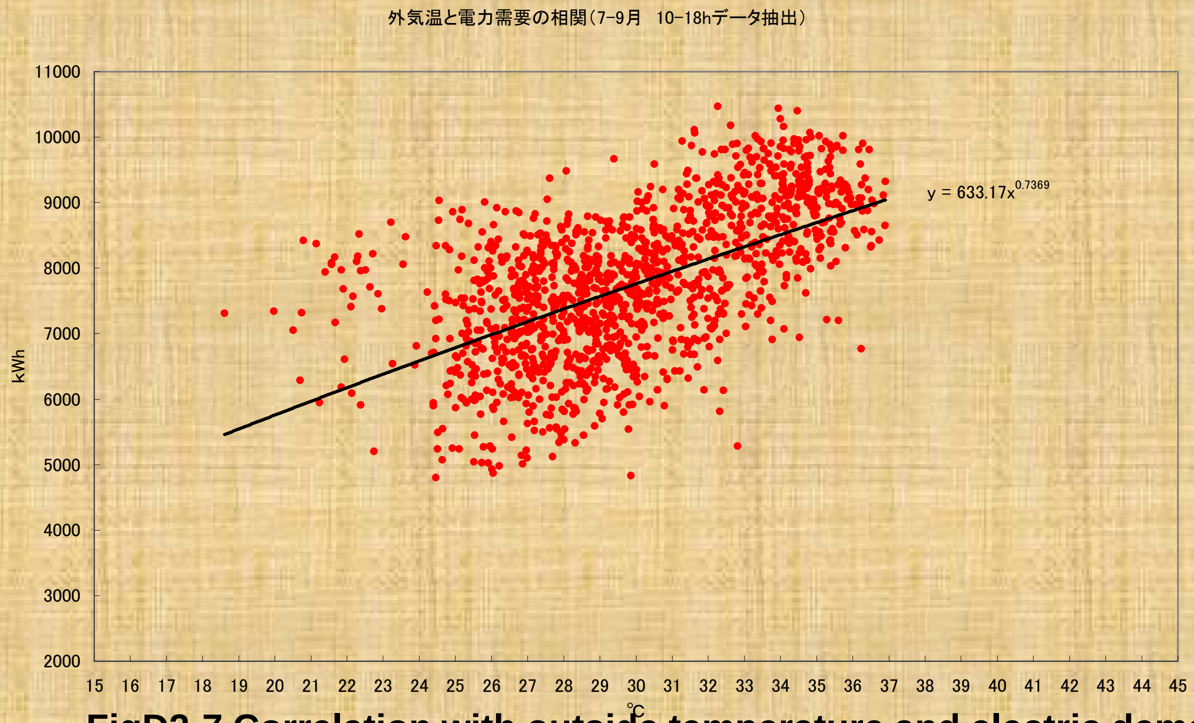
CASE2

外気温と電力使用量の相関から予想電力需要量を推定する

方法：　過去夏場(7−9月)の10−18hにおける外気温と電力需要(受電電力量+コジェネ発電量)の相関を求め、外気温より電力需要の予想をはかる。

相関近似式：　$y = 633.17x^{0.7369}$

y：電力需要量推定値(kWh)
X：外気温(℃)



FigD2-7 Correlation with outside temperature and electric demand And prediction demand

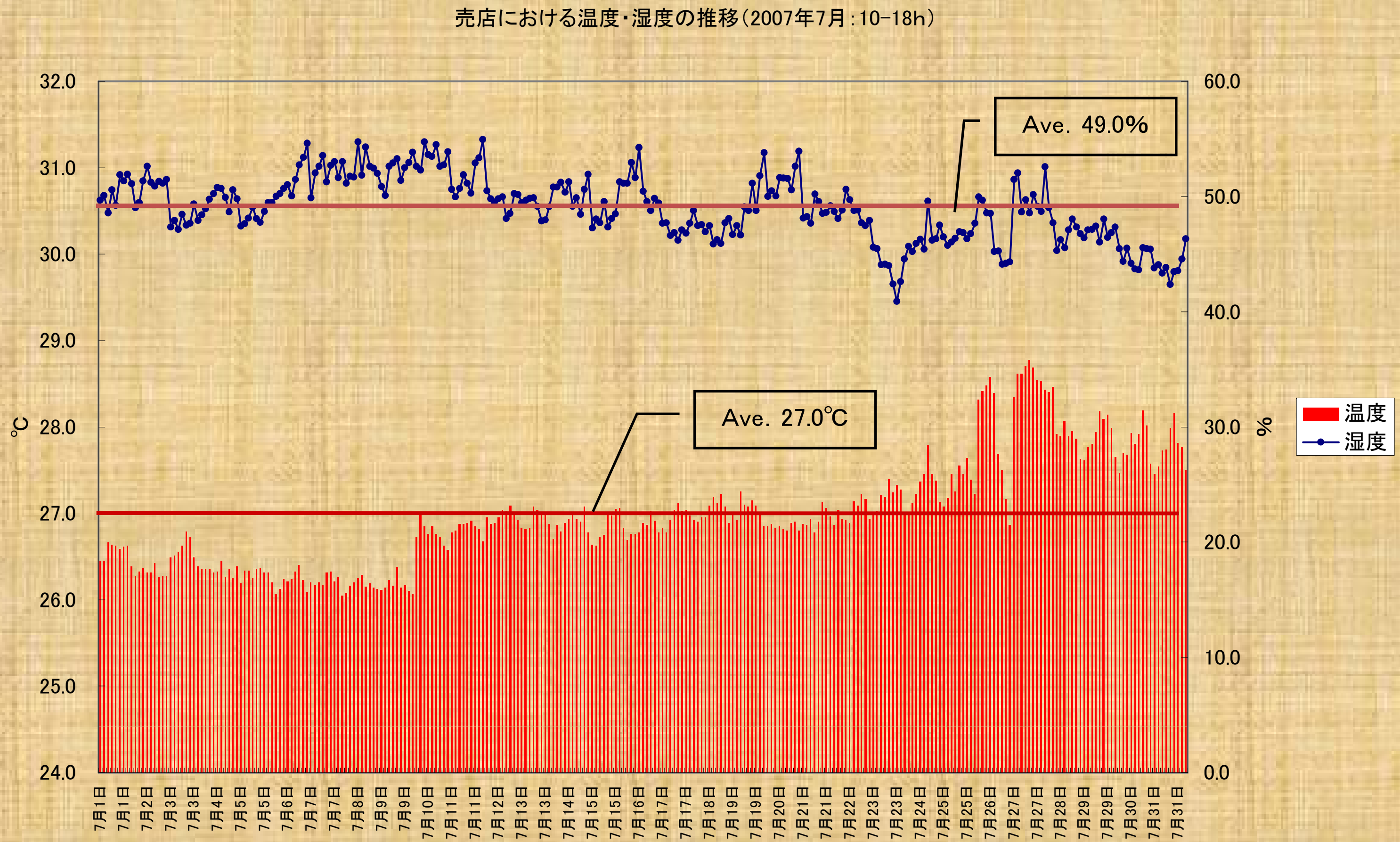
Prediction demand By analysis

外気温(℃)	電力需要予想(kWh)
20.0	5758
21.0	5968
22.0	6177
23.0	6382
24.0	6586
25.0	6787
26.0	6986
27.0	7183
28.0	7378
29.0	7571
30.0	7763
31.0	7953
32.0	8141
33.0	8327
34.0	8513
35.0	8696
36.0	8879
37.0	9060
38.0	9240
39.0	9418
40.0	9596

●Development stage 2
➢Monitoring and Operation control >>> Commissioning

CASE2

In the commercial building



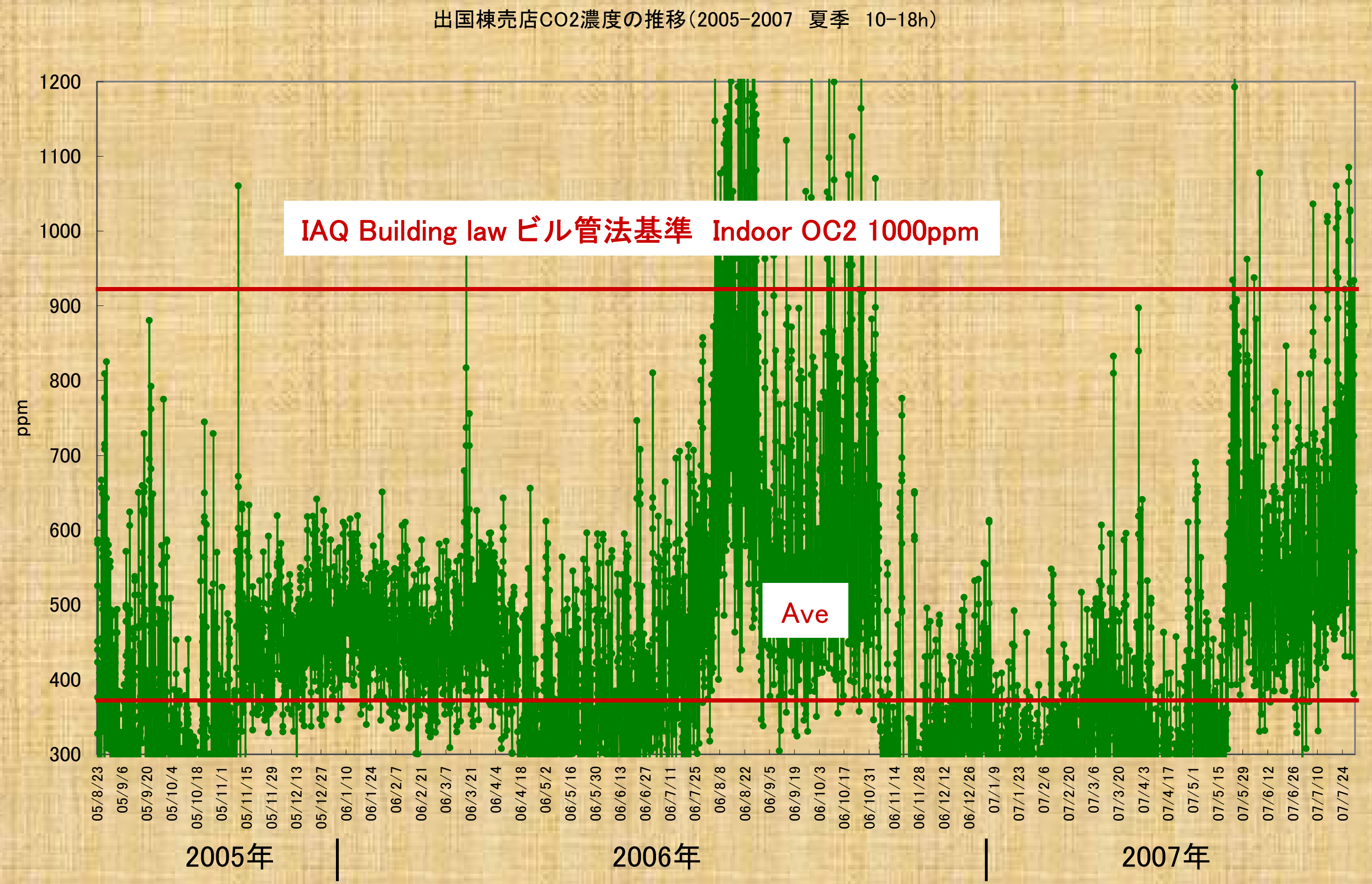
FigD2-8 Indoor temperature and humidity – Operation control before / after

●Development stage 2

➢Re-systemization & control >>> Commissioning

CASE2

In the commercial building



FigD2-9 Indoor Air Quality– Operation ventilation control before / after

●Development stage 2

➢Developed Energy AI system (Artificial intelligence)

人口知能R03 TM

TM & Powered by Woodnote Corporation http://www.woodnote-co.com/

Target
①CO2 reduction
②Energy & resource cost reduction
③Management cost reduction

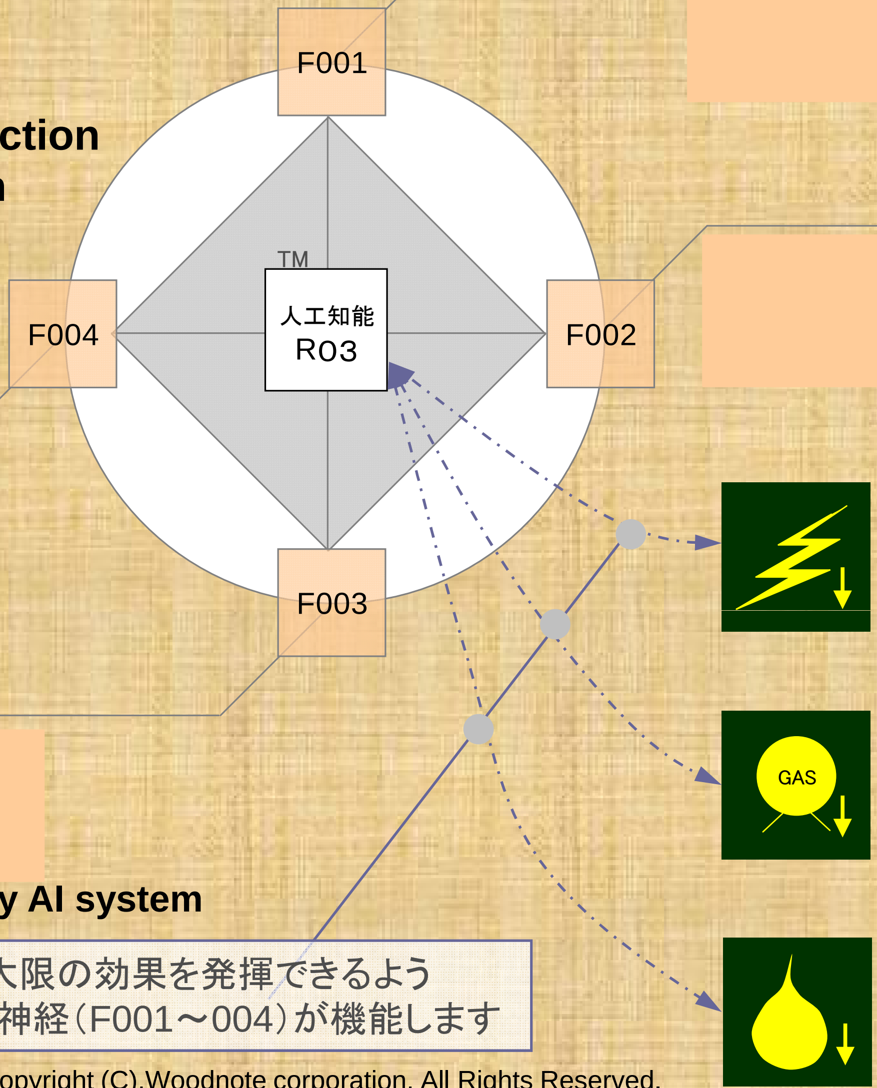
省エネ／省資源のための中枢神経です。
各種削減システムに付加して導入する
ことにより、以下の効果を最大にします。

Monitoring

Self-Learning

WEB Informing

Feed-Forward Controlling



Electric power reduction system
電力削減システム

GAS power reduction system
ガス削減システム

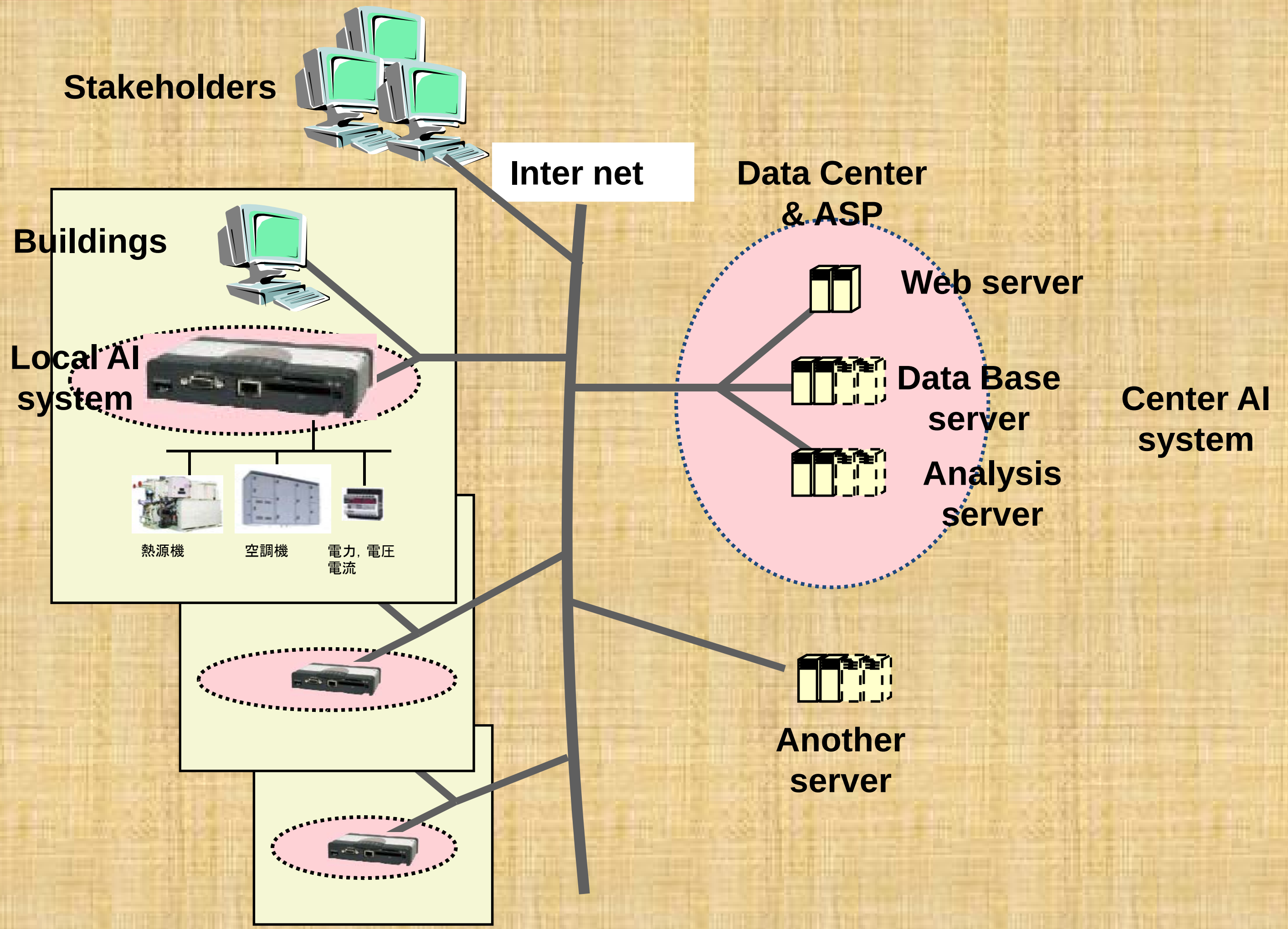
Water reduction system
水削減システム

FigD2-10 function of Energy AI system

省エネ／省資源システムが最大限の効果を発揮できるよう
人工知能R03 TM の4つの中枢神経（F001～004）が機能します

●Development stage 2
●Re-systemization & AI Control

TM & Powered by Woodnote Corporation http://www.woodnote-co.com/



●Development stage 2

➢AI energy system's functions

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/

Local AI unit Functions

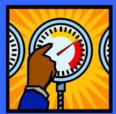
- PMV (Predicted Mean Vote) control
  Indoor temperature / Radiation temperature / Relative humidity / velocity / Amount of clothes
- Optimized ventilation control
- Outdoor air cooling control
- Warming-up control
- Heat source efficiency management
- Heat source efficiency control
- Demand control
- Schedule control
- IAQ monitoring
- Emergency data storage
- Feed-forward control

Center AI unit Functions

- Web based automatic making graph and data indicate function
- Auto simulation
- Auto verification of after control
- Correlation analysis
- Reduce check
- Auto reporting function

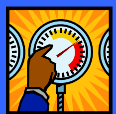
●Development stage 2
●Offline activities for using monitoring and AI system

TM & Powered by Woodnote Corporation http://www.woodnote-co.com/

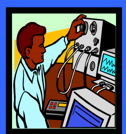


Monitoring
モニタリング

Prescription
プレスクリプション



Monitoring
モニタリング



AI control
AIコントロール

Preliminary survey
事前調査

- Preliminary survey 事前調査
- Extraction of a problem 問題点抽出
- Grasp and analysis of the amount of consumption 消費量の現状把握・分析
- Check of the contents of a contract of public utilities 公益事業の契約内容確認

Planning
削減化計画

- Arrangement for reduction 削減項目の整理
- Verification of cost effectiveness 費用対効果の検証
- Creation of a plan document 削減計画書の作成

Increase in efficiency
高効率化・省資源化

- Reexamination of a setup 各種設定の見直し
- Reexamination of a contract of public utilities 公益事業の契約見直し
- Operation improvement 運転改善
- Repair to increase in efficiency 高効率機器への改修
- Repair to saving-resources 省資源設備への改修

Optimal control
最適制御

- Control suitable for a use situation 使用状況との連動制御
- Remote operation management 遠隔運転管理
- Grasp and a report of the reduction effect 削減効果の把握・報告

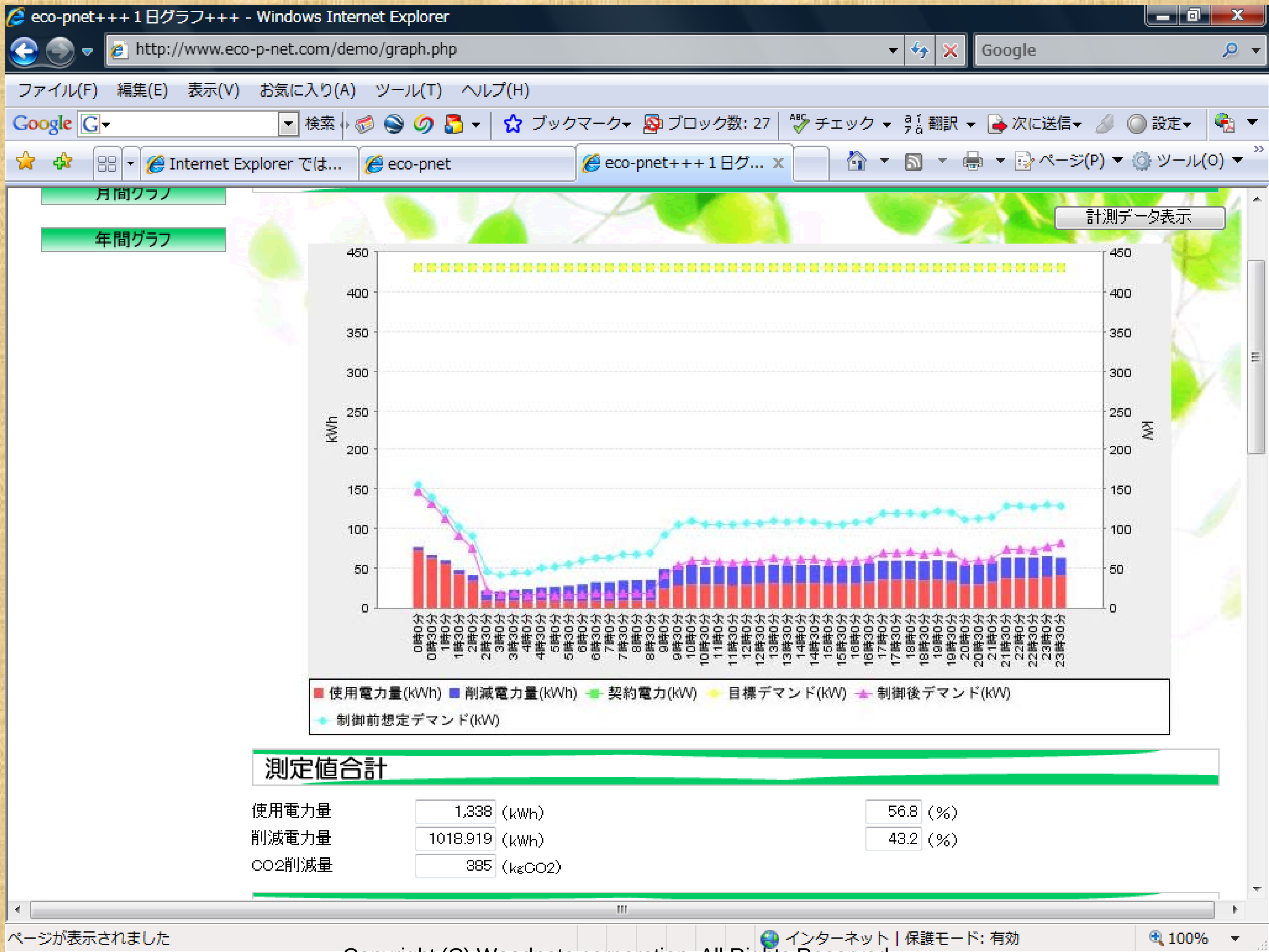
Carbon dioxide reduction
Reduction of light-and-heat water expense

光熱水費の削減化

●Development stage 2

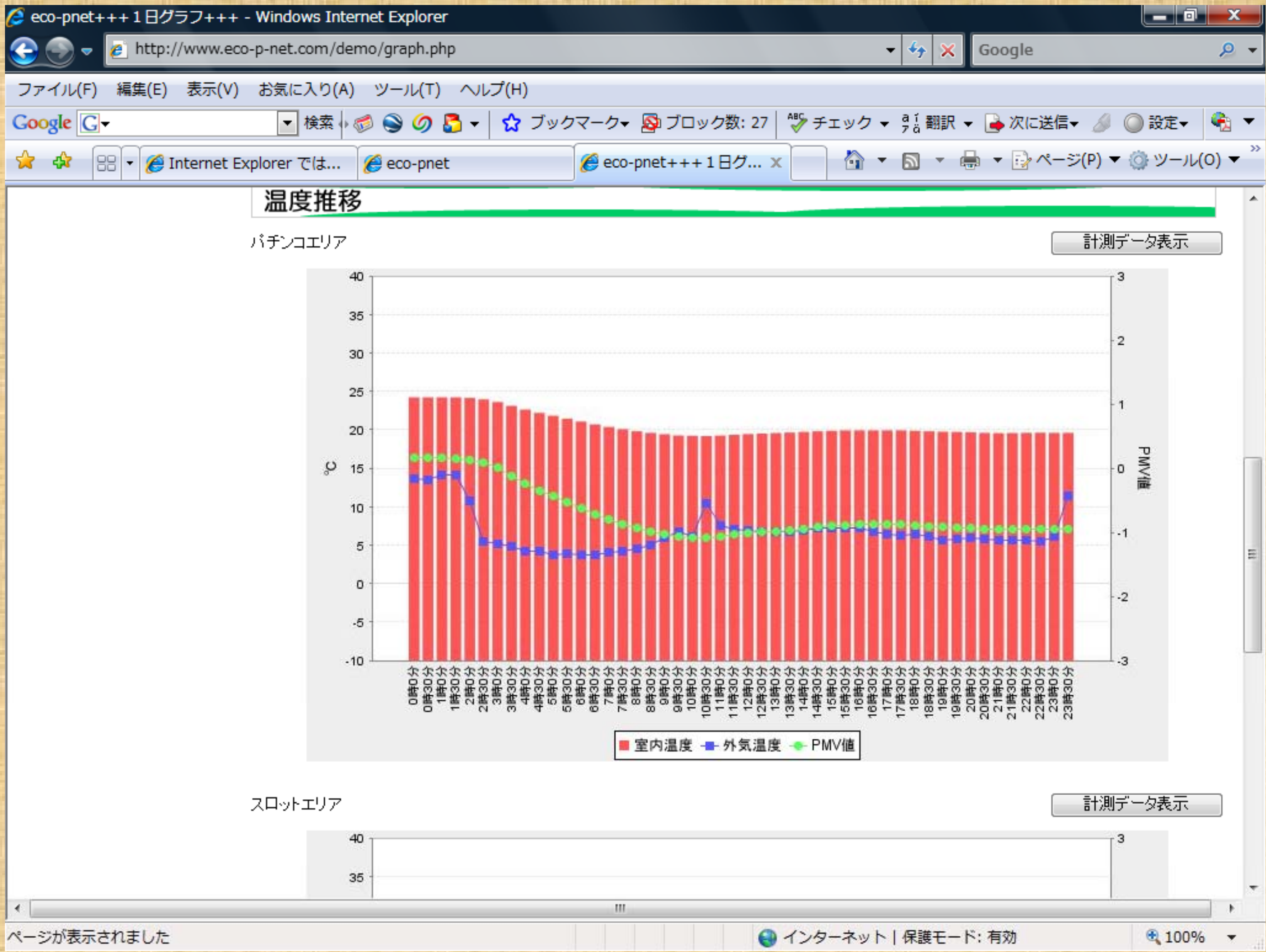
➢Website of Energy AI system (1)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



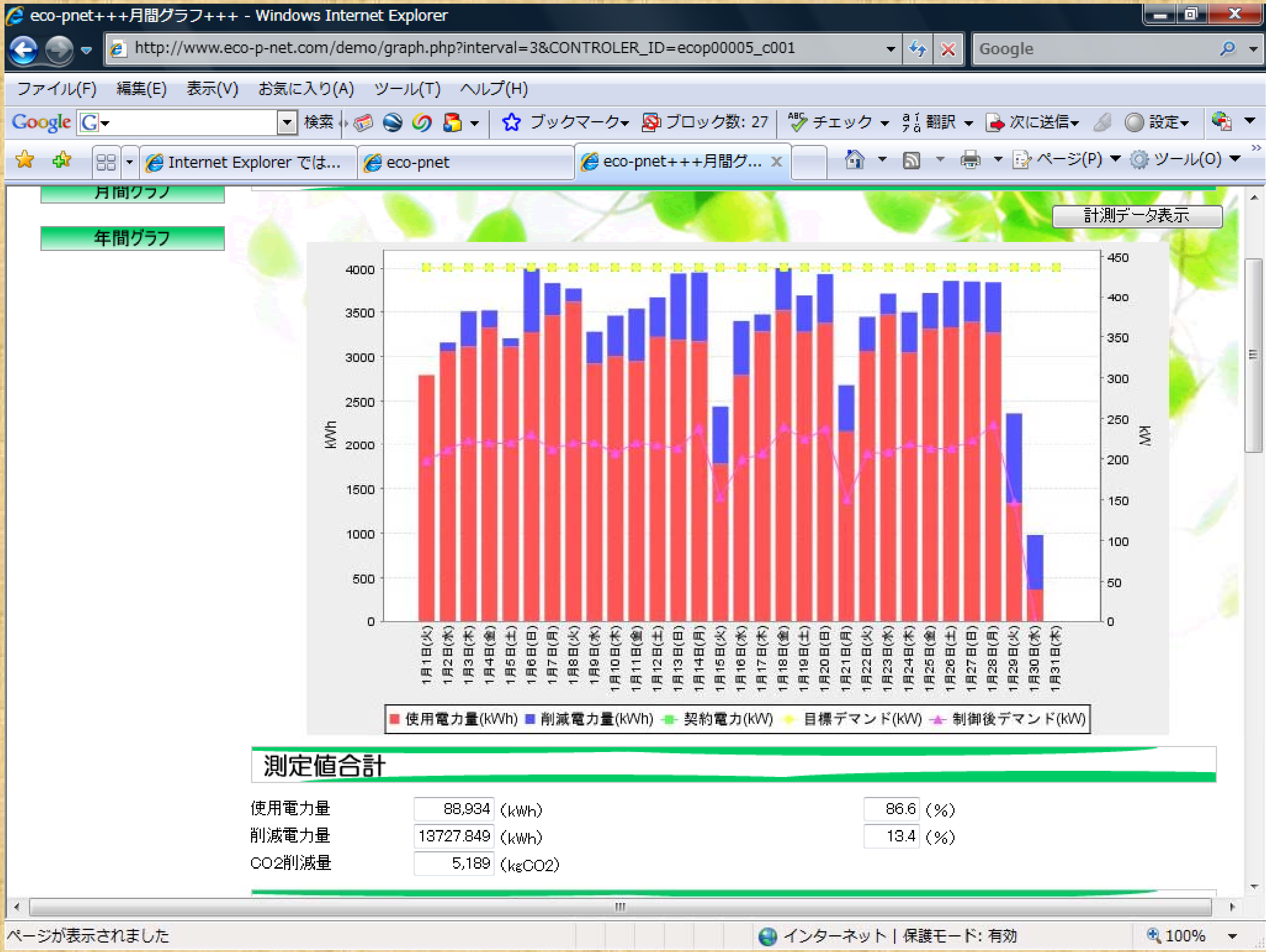
●Development stage 2
➢Website of Energy AI system (2)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



●Development stage 2
➢Website of Energy AI system (3)

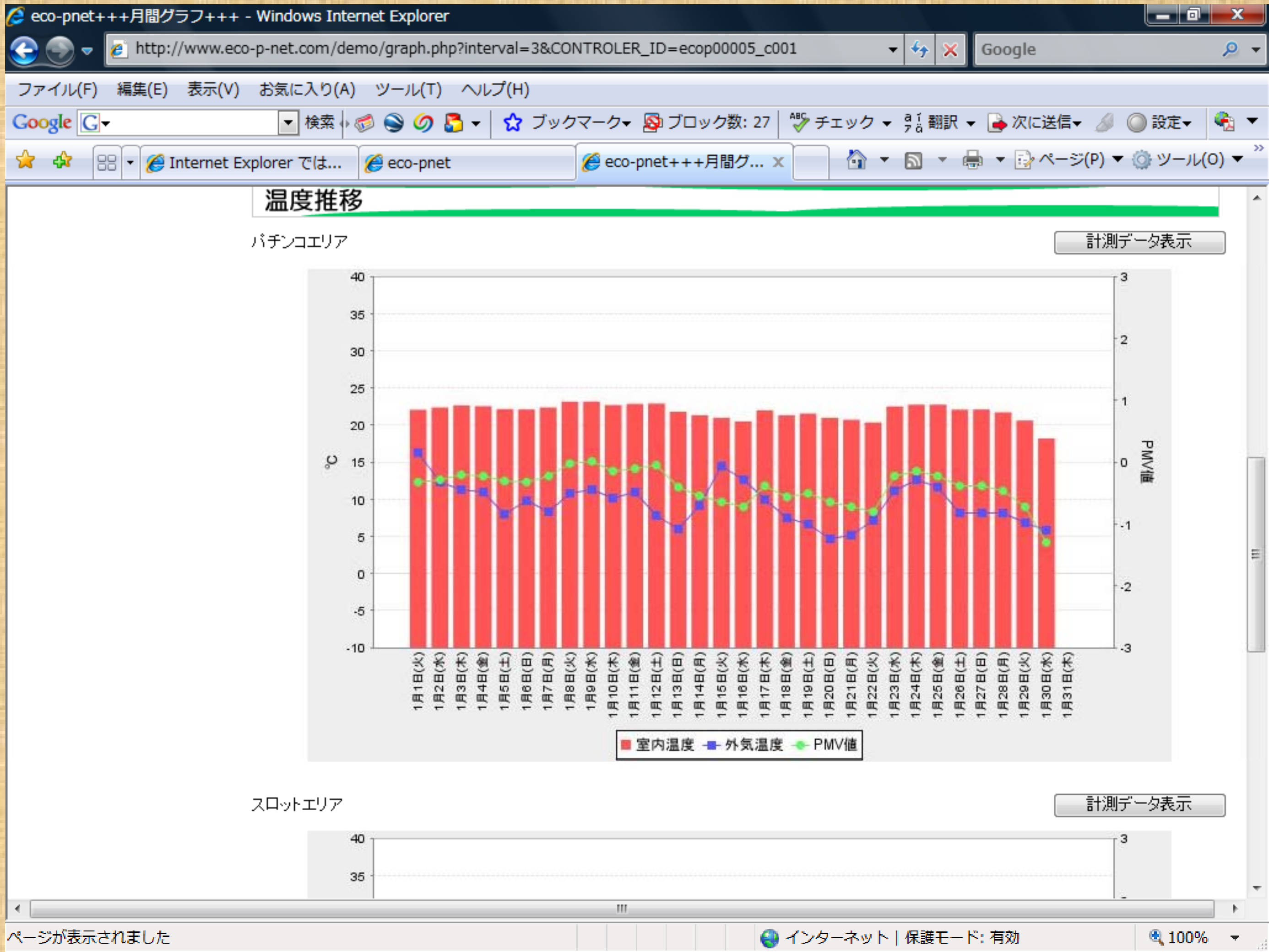
TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



●Development stage 2

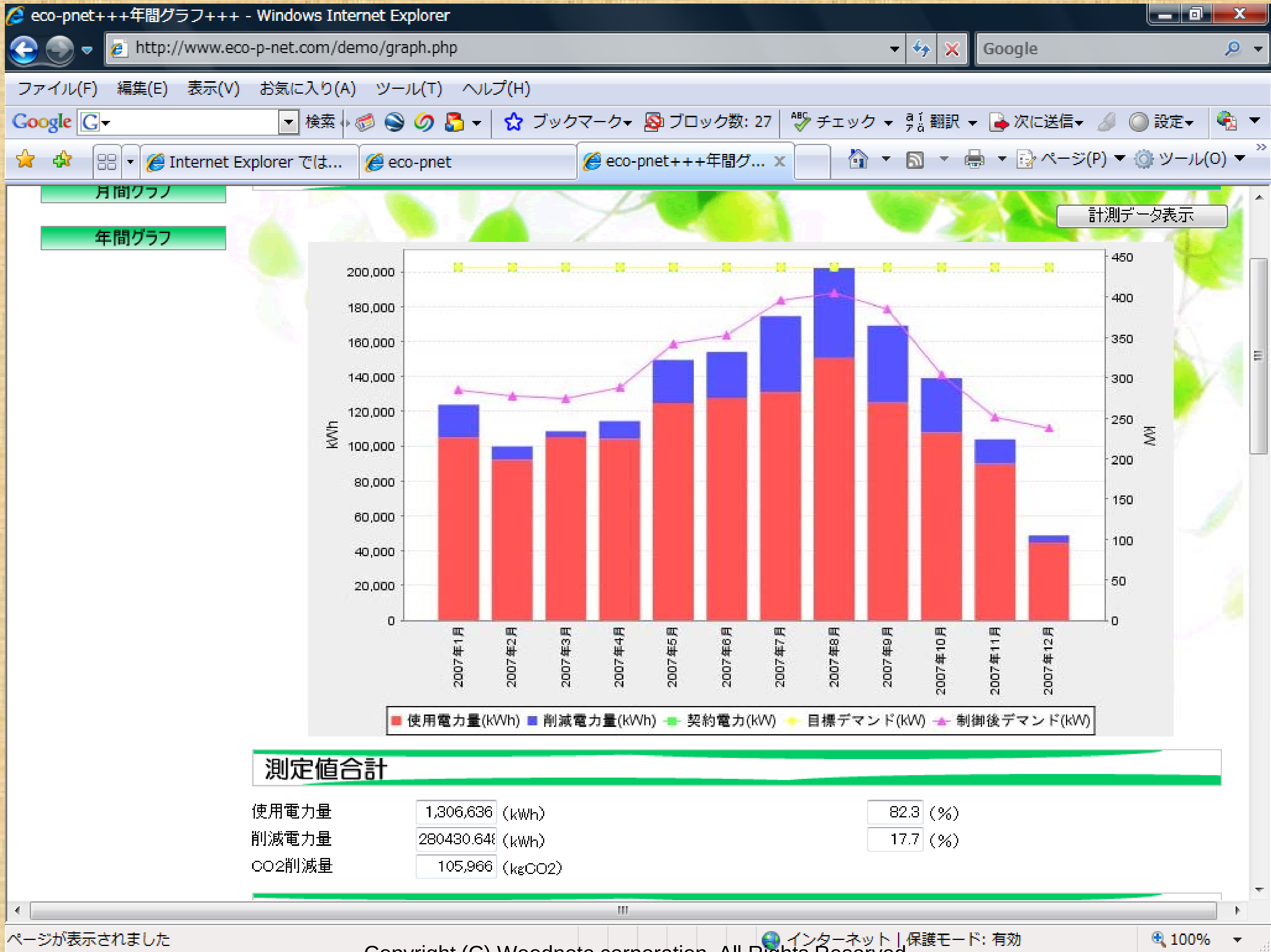
➢Website of Energy AI system (4)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



●Case study stage 2
➢Achievements(4)

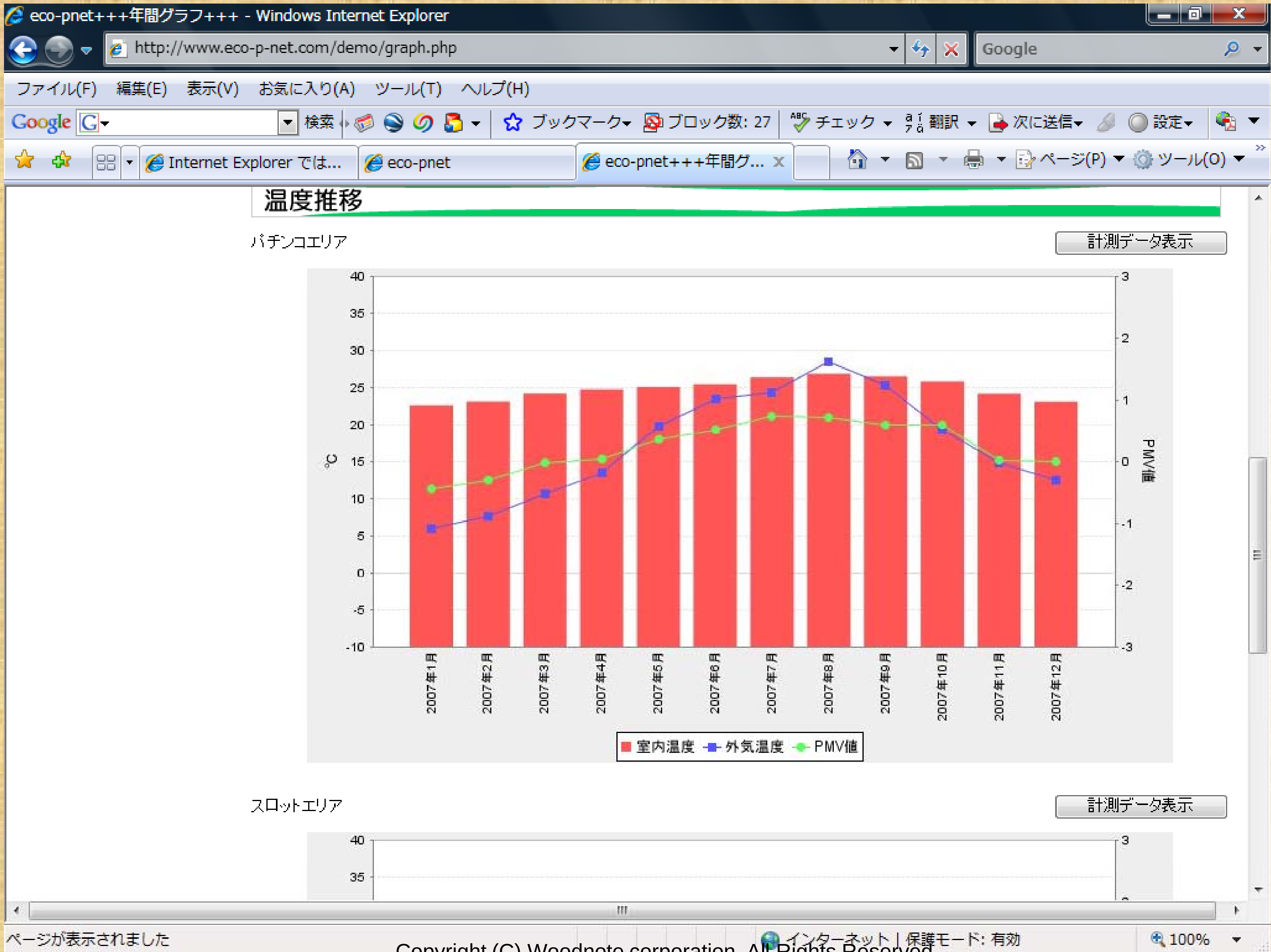
TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



●Development stage 2

➢Website of Energy AI system (5)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/



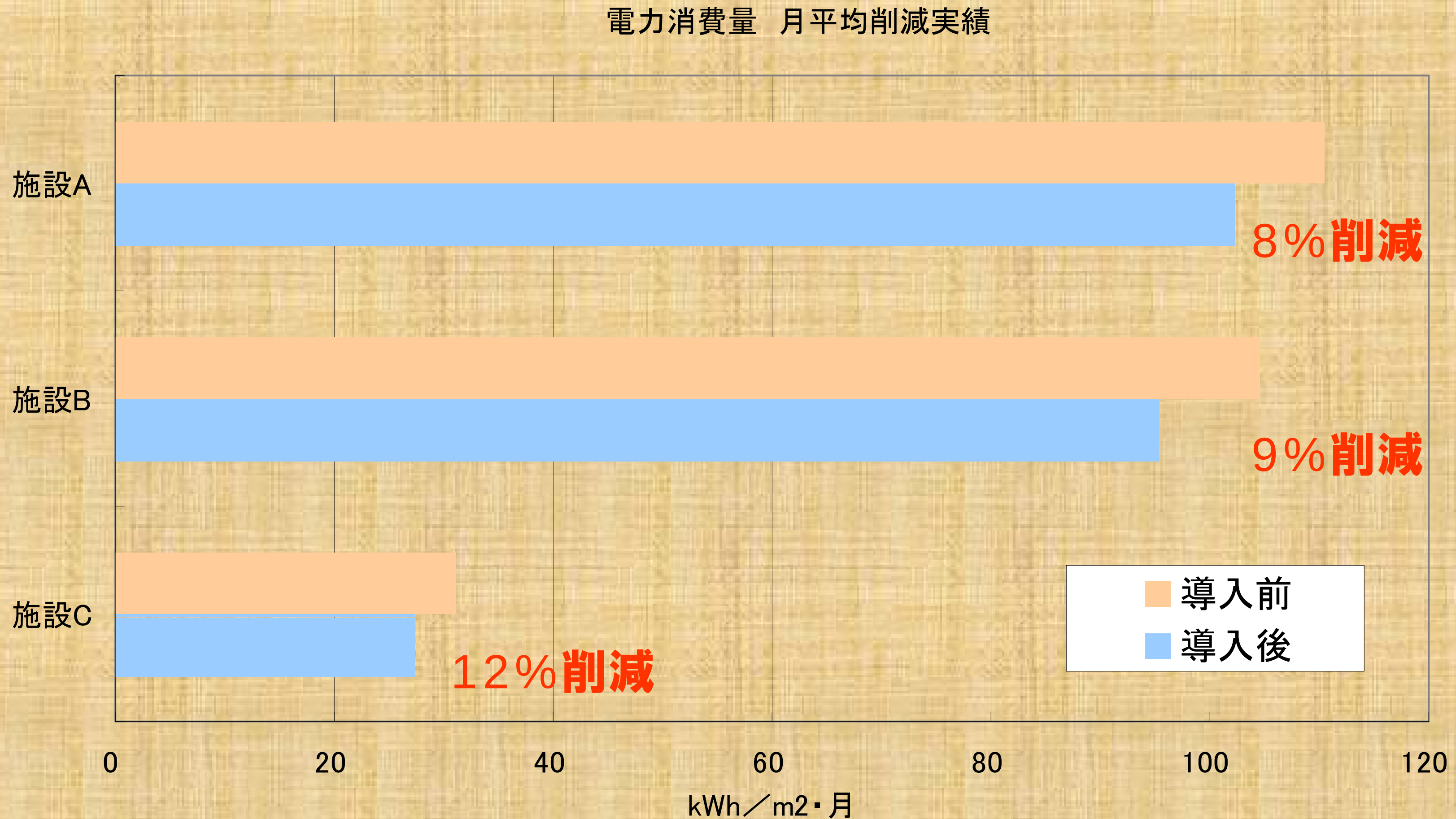
●Development stage 2
➢Website of Energy AI system (1)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/

CASE3

Carbon dioxide reduction by ventilation control only

換気制御のみで約10%の電力消費量を削減



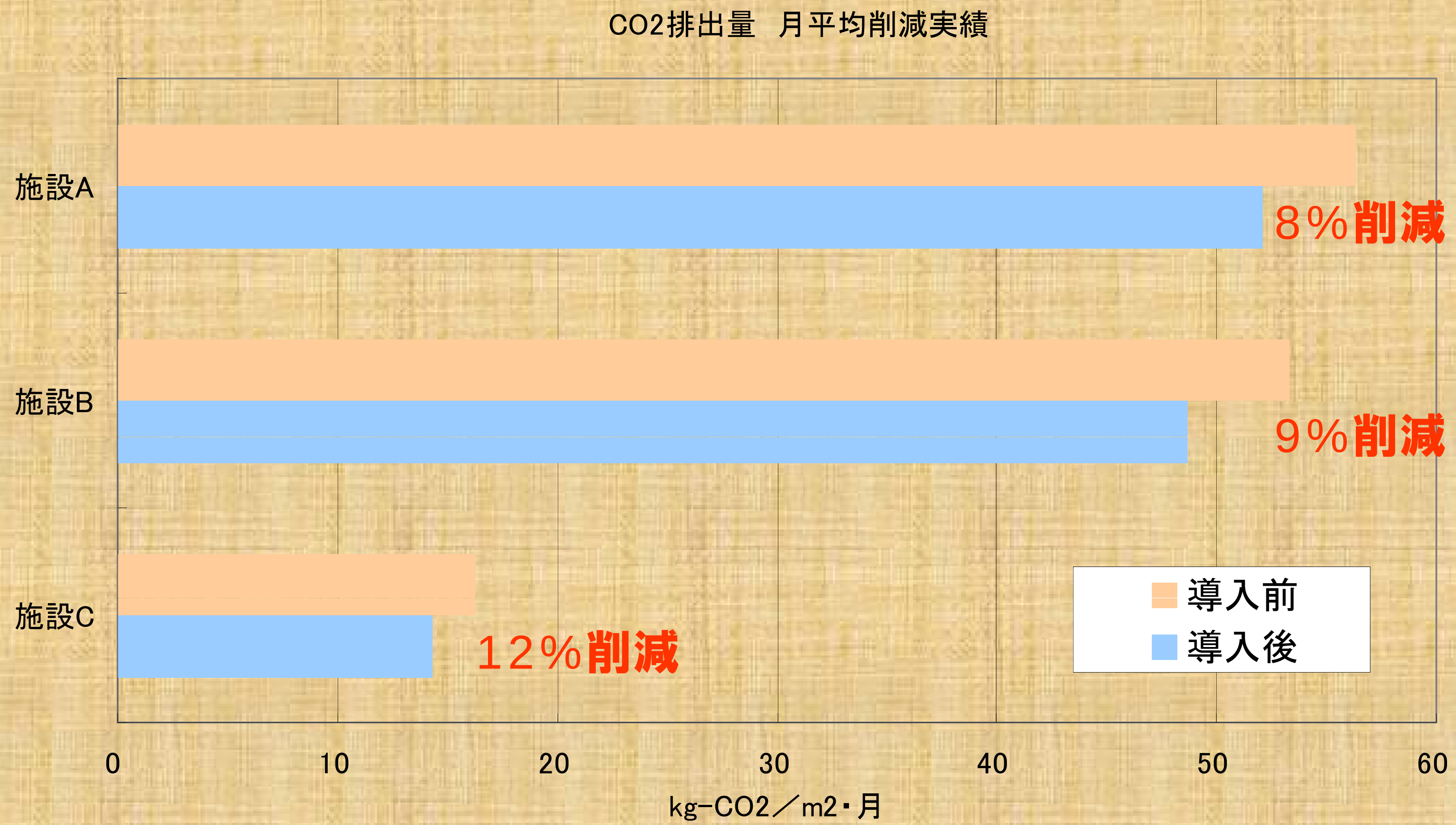
FigD2-11 Results of Energy AI system(1)

●Development stage 2
➢Website of Energy AI system (2)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/

CASE3

Carbon dioxide reduction by ventilation control only



●Development stage 2
➢Website of Energy AI system (1)

TM & Powered by Woodnote Corporation
http://www.woodnote-co.com/

CASE3

制御事例　削減実績

1施設1年間あたり横浜スタジアム数個～10数個分の森林を創造するのと同等の環境貢献

●Carbon dioxide reduction
●Forest conversion

年間CO2削減実績
森林面積換算

FigD2-11 Results of Energy AI system(1)

●Conclusion

Result

- **●Monitor date and using the information are effective to energy conservation**
- **●Well-informed decision making is important for energy conservation**
- **●Energy AI system reduce energy and carbon dioxide**

R & D in the future

- **●Energy AI system have to improved**
  - **✓Making more analysis Patterns**
  - **✓Check adoption of many kind of building types**
  - **✓Making more control software**
  - **✓Automatic simulation**
  - **✓Making website for each stakeholder**

- **●Opening framework for each stakeholder**
  - **✓Making Information Service**

- **● More complex analysis and simulations to be simplified**