School of Energy, Environment and Materials
King Mongkut's University of Technology Thonburi

Committed to Searching for Knowledge

Maintaining the Development of Morally Correct and Proficient Graduates

Determined to be at the Forefront of Technology and Research

New Building Energy Code & Government Policies of Thailand

Pattana Rakkwamsuk
School of Energy, Environment and Materials

Transition towards Low Carbon Society in Thailand and Asia

Pullman Hotel, Bangkok, 18 November 2010

Thailand's Building Energy Code Gazetted in 1995

The Energy Conservation Promotion Act B.E. 2535 (1992)
Given on the 2nd day of April B.E. 2535

The Royal Decree on Designated Building B.E. 2538 (1995)
Given on the 17th day of July B.E. 2538

A set of Ministerial Regulations
B.E. 2538 (1995)

Features of the New Building Energy Code

New and Retrofitting Buildings only

System Performance Requirements

Differentiation of Building Types based on time of use

Whole Building Energy Compliance

Promote the use of Renewable Energy

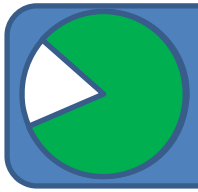
> 2000 sq.m

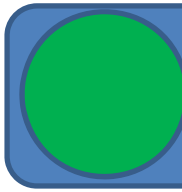
Envelope

Lighting

Air-conditioning


Office & Academic Institution


Super store


Hotel & Hospital


Daylighting


Photovoltaic

- ✓ **New set of Minimum Requirements**
- ✓ **Requirements for new equipment**

$$OTTV_i = (U_w)(1\text{-}WWR)(TD_{eq}) + (U_f)(WWR)(\Delta T) + (WWR)(SHGC)(SC)(ESR)$$

Overall Thermal Transfer Value: Yearly average cooling load of a building.

Minimum requirements for envelope

	Wall	Roof
 Office & Academic Institution	*50* W/m^2	*15* W/m^2
 Super store	*40* W/m^2	*12* W/m^2
 Hotel & Hospital	*30* W/m^2	*10* W/m^2

Energy performance requirements for lighting

Allowable rated power

14 W/m^2

18 W/m^2

12 W/m^2

$$LPD_a = \frac{\sum_{i=1}^{n}(A_i)(LPD_i)}{\sum_{i=1}^{n} A_i}$$

Energy performance requirements for Air-conditioning

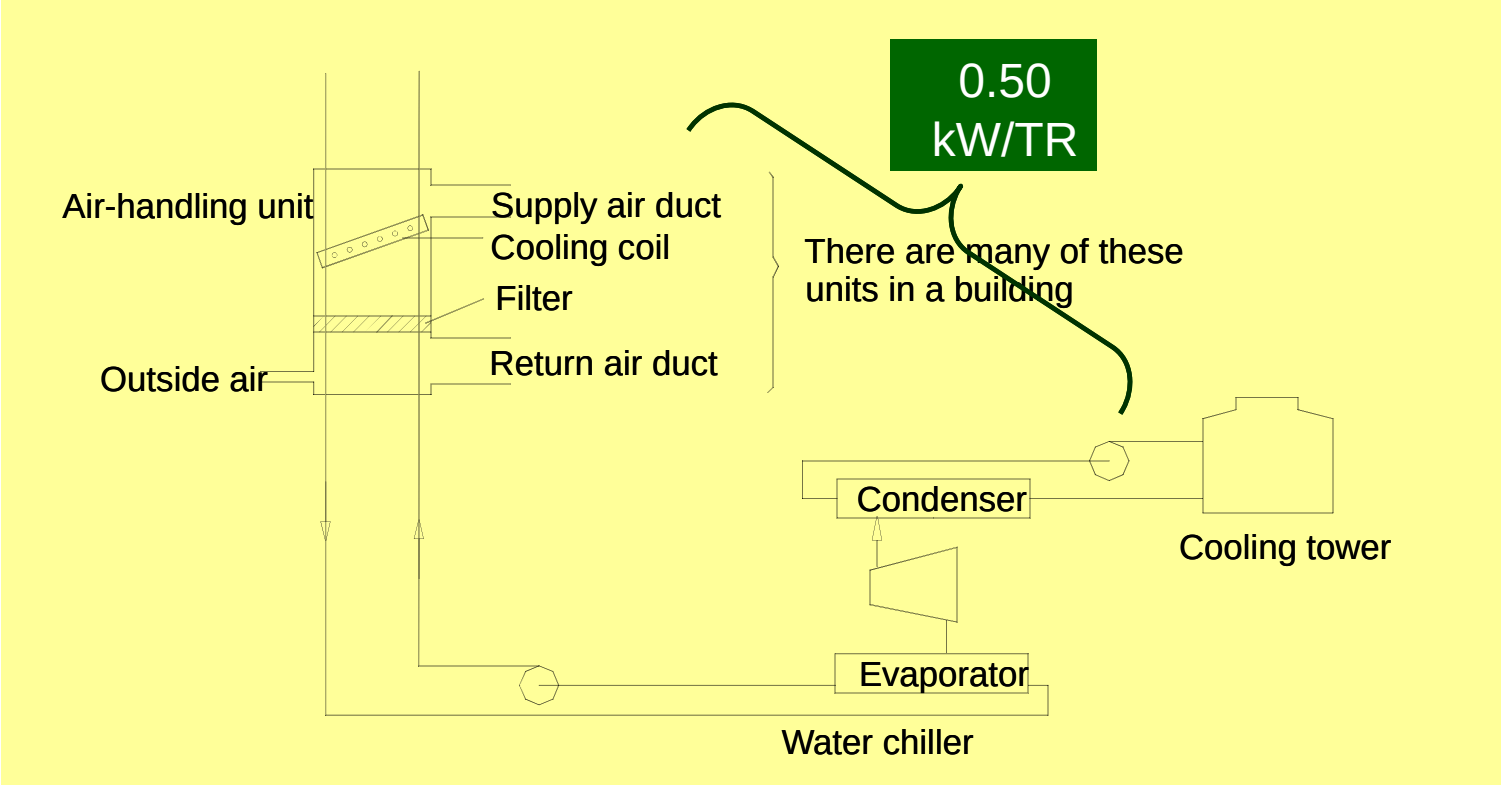
TYPE & SIZE

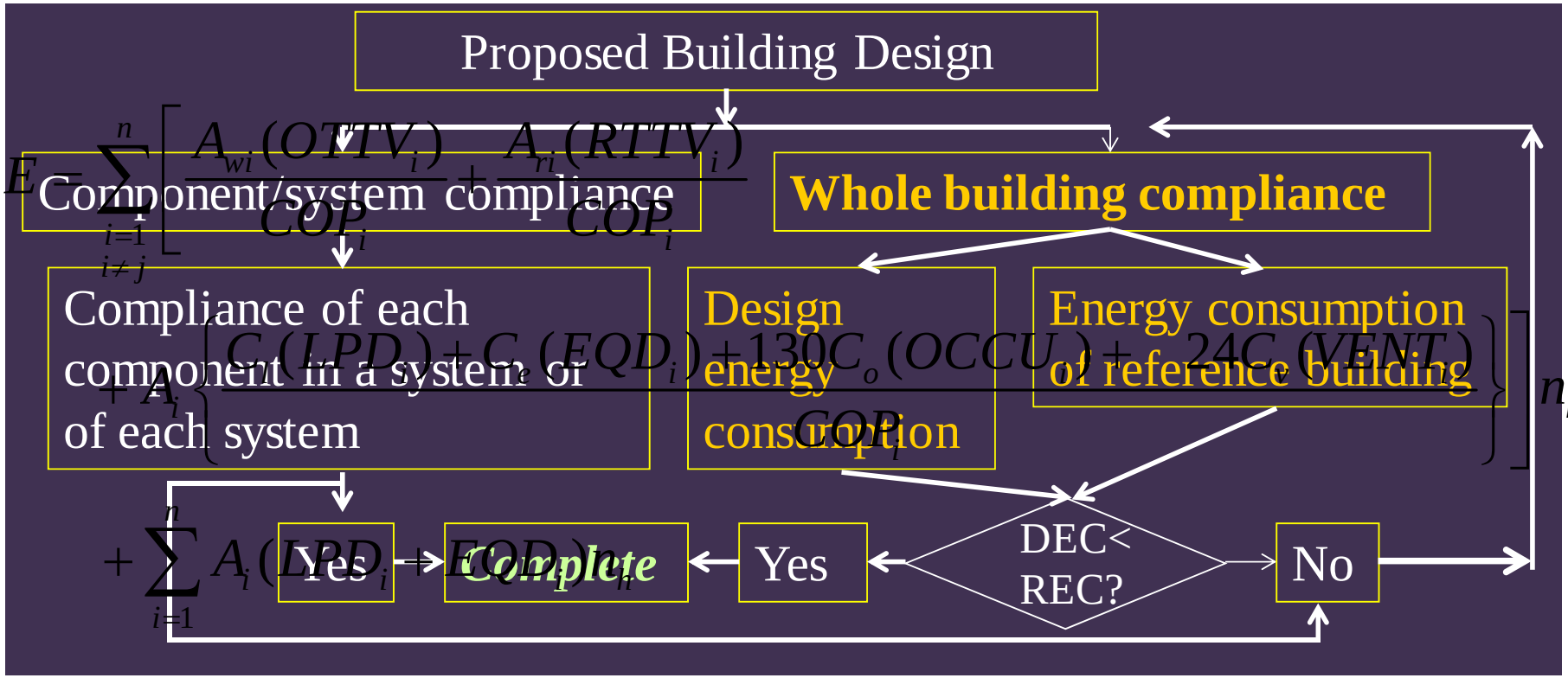
Type and Size	COP (EER)
Air cooled systems (split type and package type)	
Less than 3,500 watts (0.995 RFT)	2.82 (9.62)
Between 3,500 watts and 17,600 วัตต์ (5.00 RFT)	2.82 (9.62)
Greater than 17,600 watts (5.00 RFT)	2.56 (8.74)
Water-cooled systems	
All size	3.99 (13.62)

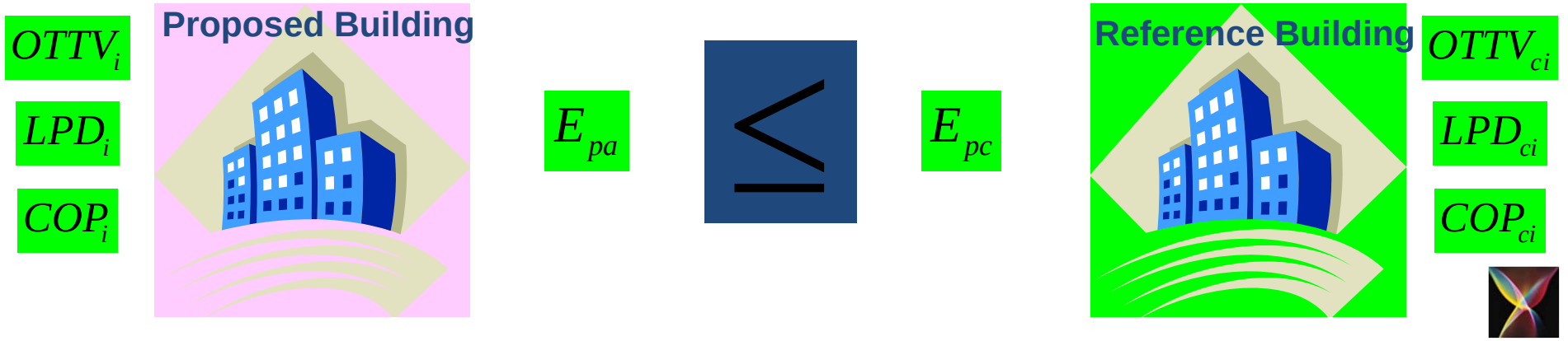
Type and Size	COP (kW/TR)
Centrifugal: Air-cooled systems	
Less than 351.7 kilowatts (100 RFT)	2.70 (1.30)
Greater than 351.7 kilowatts (100 RFT)	2.93 (1.20)
Centrifugal: Water-cooled systems	
Less than 527.5 kilowatts (150 RFT)	3.91 (0.90)
527.5 - 703.3 kilowatts (200 RFT)	4.69 (0.75)
703.3 - 879.2 kilowatts (250 RFT)	5.25 (0.67)
879.2 - 1,758.3 kilowatts (500 RFT)	5.40 (0.65)
Greater than 1,758.3 kilowatts (500 RFT)	5.67 (0.62)

Other parts of the air-conditioning system

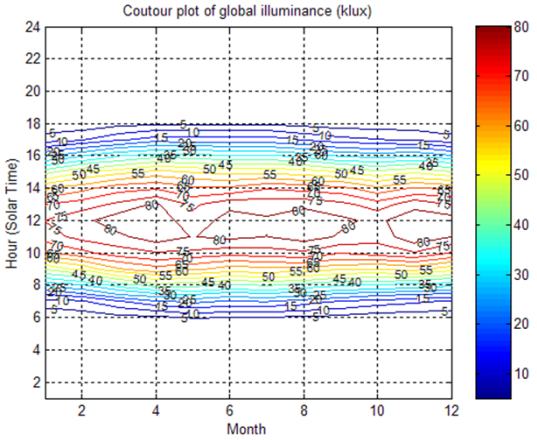
The air-handling system, condenser water cooling system, and chilled water transport system shall be considered to comply with the requirement if taken together has a rated coefficient of performance of 7.03 (0.5 kW/TR).

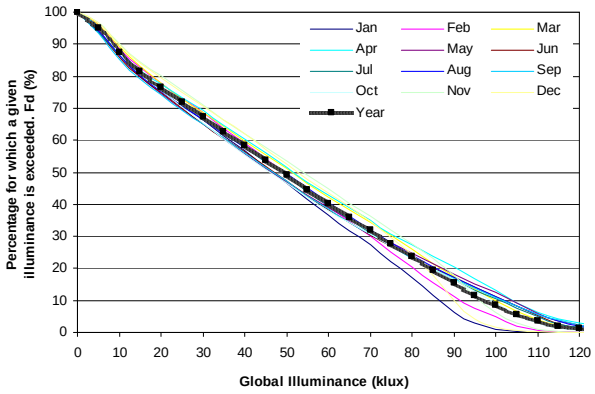



Proposed Building Design
Component/system compliance
Whole building compliance
Compliance of each component in a system or of each system
Design energy consumption
Energy consumption of reference building
Yes
Complete
DEC < REC?
No


Proposed Building
Reference Building

DAYLIGHTING CREDIT





- ✓ Dedicated lighting control switches for luminaries covering area within 1.5 times height of window.
- ✓ Effective Visible Light Transmittance (EVLT) ≥ 0.3.
- ✓ Light to Solar Gain ≥ 1.0.

Accreditation for Renewable Energy: PV Electrification

Calculation of yearly average electricity produced by photovoltaic electrification system, PVE)

$$PVE = \frac{9 \times 365 \times A_{\mathrm{mod}} \times \eta_{sys} \times ESR_{PV}}{1000}$$

A_{mod} : Total area of installed PV modules [m²]

η_{sys} : Overall system efficiency

ESR_{PV} : Effective solar radiation

Electricity produced by PVs can accredited through Whole Building Energy Compliance

Minimum performance for Absorption chillers

Types and Size	COP
Single effect absorption chiller	0.65
Double effect absorption chiller	1.1

Minimum performance for Heat Pumps

Rated conditions	Minimum COP
Inlet water temperature: 30°C, Outlet water temperature: 60°C, and Ambient temperature: 30°C	3.0
Inlet water temperature: 30°C, Outlet water temperature: 50°C, and Ambient temperature: 30°C	3.5

Minimum performance of instantaneous water heater:

Minimum performance is not specified.

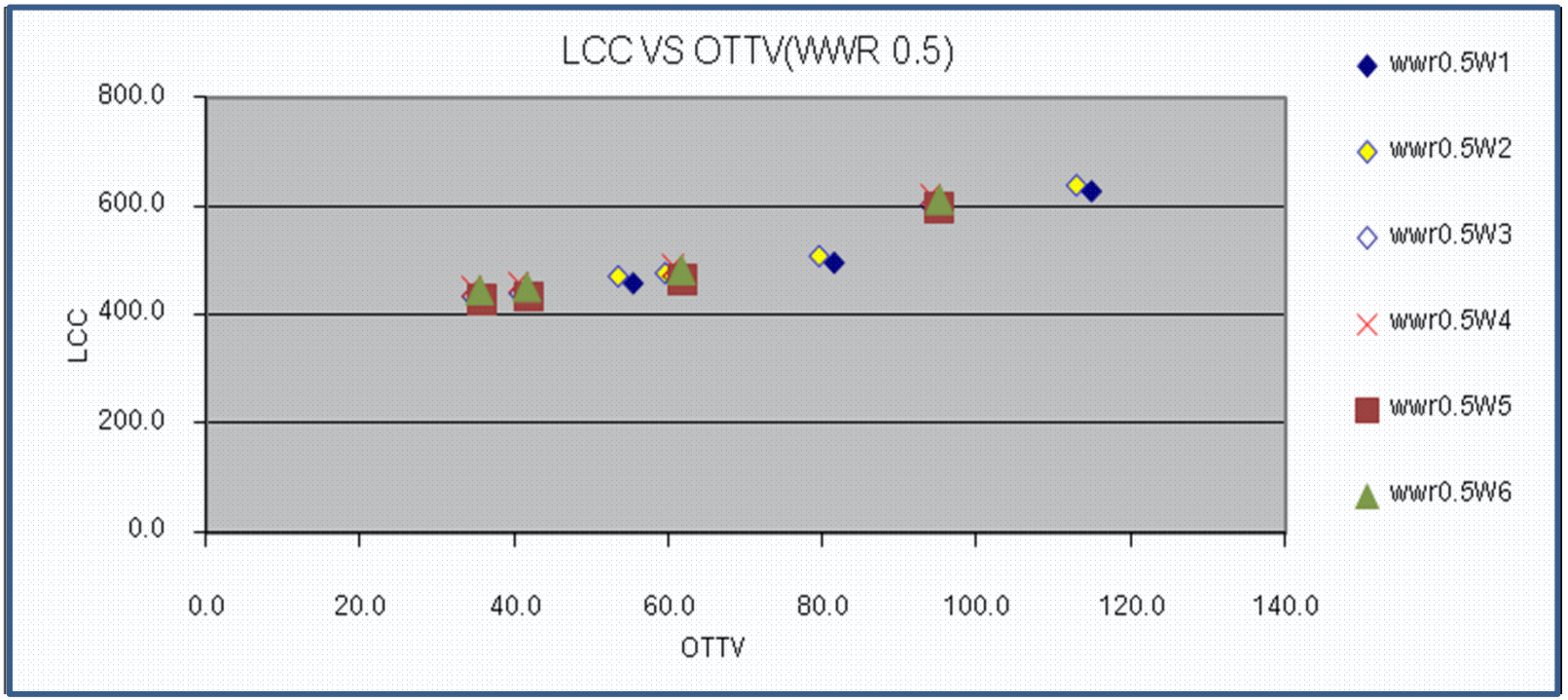
Minimum performance for Boilers

ประเภท	ประสิทธิภาพขั้นต่ำ (%)
Oil fired steam boiler	85
Oil fired hot water boiler	80
Gas fired steam boiler	80
Gas fired hot water boiler	80

HINTS FOR ENERGY EFFICIENT DESIGN

- Heat gain through fenestration is extremely sensitive to cooling load in a building. Thus,
  - ✓ WWR $\leq$ 30%
  - ✓ Energy-efficient glazing is a good choice.
- Besides EE lighting equipment, Daylight Design is truly promising.
- Good choice of energy efficient A/C.
- Wall insulation.

LCC vs OTTV: Office with WWR = 0.5



Alternative choices of opaque walls: Regular brick, Lightweight concrete with Insulation 50mm and 25 mm.

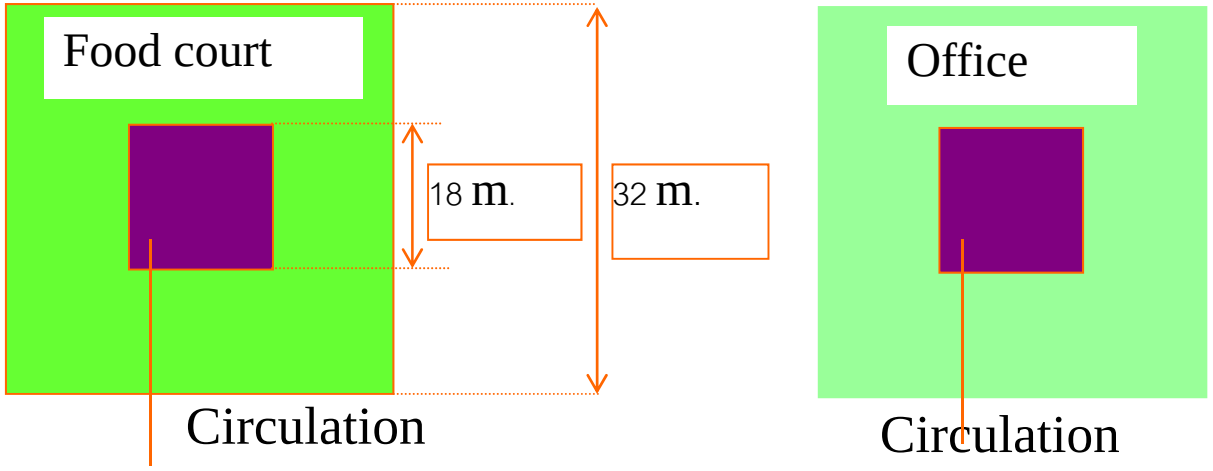
Alternative choices of windows: Single laminated glass and IGU low e glasses.

Energy Performance Requirements on Lighting

Office

The following example illustrates development of the requirement for lighting in office buildings.

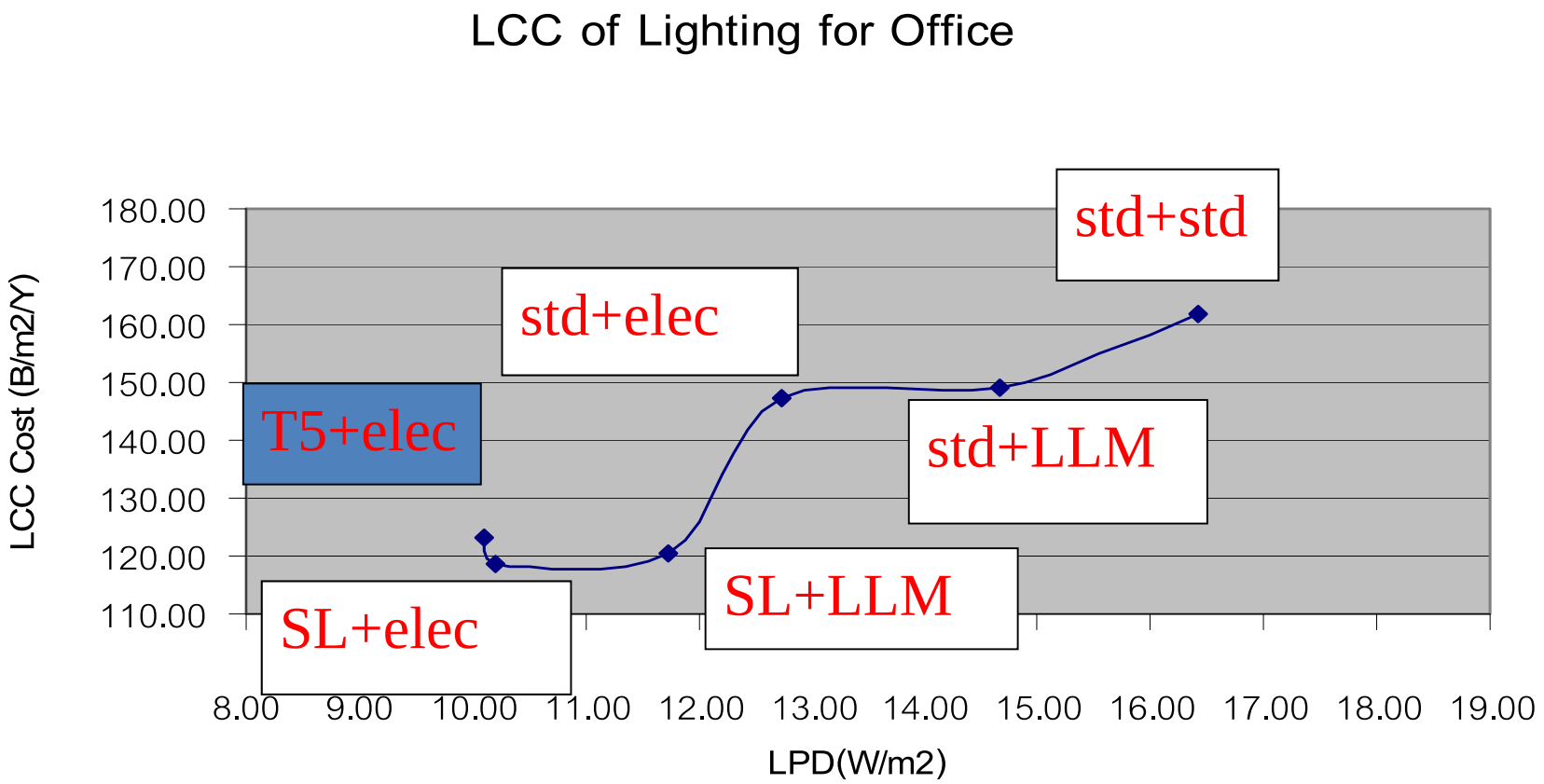
✧Consider a reference office model of square shape that comprises 12 floors as shown in the figure.



Energy Performance Requirements for Lighting

Office

Office Lighting power < 14 Wm^{-2}



Energy conservation potential: Micro-scale

- **Energy Utilization Index (kWh/m^2 yr)**
  - Reference building
  - Case 1: buildings barely complied with BEC
  - Case 2: EE buildings with high economic return

Building types	Extra large buildings			Large & Medium size buildings		
	Ref.Bldg.	Case 1	Case 2	Ref.Bldg.	Case 1	Case 2
Office	146.4	98.7	82.3	147.5	140.9	115.0
Hotel	173.2	117.0	101.7	209.3	194.7	165.7
Hospital	148.8	123.9	112.0	158.8	148.2	139.9
Superstore	556.0	394.3	368.0	270.9	259.0	230.2
Academic institution	94.0	79.3	67.2	65.2	61.2	54.9
Others	139.7	117.2	100.0	117.6	97.9	85.9
Condomenium	118.4	105.3	92.7	146.6	138.5	126.6
	394.7	300.9	248.7	391.0	350.4	315.1

Energy conservation potential: Macro-scale

- Year 2009: start implementing BEC on newly built buildings (floor area > 2,000 Sq.m)
- Assumption: all commercial buildings built in 2009 and thereafter must comply with the BEC.
- 2 Cases were investigated
  - **Case 1 buildings barely complied with BEC**
  - **Case 2 EE buildings with high economic return**

Total of MEA and PEA							
Total Energy Requirement, GWh		209,225					
Total Peak Demand, MW		32,830					
MEA							
Energy Requirement, GWh	56,728						
Peak Demand, MW	9,857						

Savings in year 2015	2,988	GWh
	624	MW
Cumulative savings from 2010	9,916	GWh

Building Type	Very Large Buildings			Large Buildings			Total Savings
	Old, Econ Savings	New, Code Savings	New, Econ Savings	Old, Econ Savings	New, Code Savings	New, Econ Savings	
Office	61.9	109.2	36.7	148.3	157.6	58.5	572.2
Hotel	22.6	42.1	13.4	31.8	34.1	12.5	156.5
Hospital	5.6	9.0	3.3	22.9	18.9	9.0	68.7
Department store	3.6	7.3	2.1	37.6	23.9	14.9	89.4
Education	0.2	0.3	0.1	28.8	21.8	11.4	62.6
Misc	2.1	2.9	1.3	30.9	30.9	12.2	80.3
Condominium	3.5	4.2	2.1	16.3	16.5	6.4	49.1
Hypermart	24.5	37.2	14.5	0.0	0.0	0.0	76.1
Energy Savings, GWh	124.0	212.1	73.4	316.6	303.7	124.9	1,154.8
Peak demand Savings, MW	29.7	50.8	17.6	59.7	57.3	23.6	238.6

Total of MEA and PEA							
Total Energy Requirement, GWh		293489	Savings in year 2021			7,715	GWh
Total Peak Demand, MW		45,990				1,641	MW
			Cumulative savings from 2010			78,346	GWh
MEA							
Energy Requirement, GWh	70,355						
Peak Demand, MW	12,240						

Building Type	Very Large Buildings			Large Buildings			Total Savings
	Old, Econ Savings	New, Code Savings	New, Econ Savings	Old, Econ Savings	New, Code Savings	New, Econ Savings	
Office	154.8	140.1	188.1	395.3	222.3	270.1	1370.7
Hotel	56.5	53.9	68.6	84.8	48.1	57.9	369.9
Hospital	14.0	11.5	17.0	61.0	26.6	41.7	171.8
Department store	8.9	9.3	10.9	100.4	33.7	68.6	231.8
Education	0.5	0.3	0.6	76.8	30.7	52.5	161.5
Misc	5.4	3.7	6.5	82.4	43.6	56.3	197.9
Condominium	8.8	5.4	10.7	43.5	23.3	29.7	121.5
Hypermart	61.2	47.7	74.3	0.0	0.0	0.0	183.1
Energy Savings, GWh	310.1	272.0	376.6	844.2	428.4	576.7	2808.1
Peak demand Savings, MW	74.2	65.1	90.1	202.0	102.5	138.0	672.0

Promotion Towards Energy Efficiency in Thailand

- Both government and non-government organizations have put strong efforts towards energy efficiency.

กรมพัฒนาพลังงานทดแทน
และอนุรักษ์พลังงาน
กระทรวงพลังงาน

สำนักงานนโยบาย
และแผนพลังงาน
กระทรวงพลังงาน

มูลนิธิพลังงานเพื่อสิ่งแวดล้อม
Energy for Environment Foundation

- Energy Conservation Fund: a big pool of resource for driving several successfully promotional projects.
- DEDE plays a significant role in promoting such projects. Several mechanisms have been established to escalate energy conservation.

Revolving Fund Project for Energy Conservation (Low interest loan)

- To stimulate and promote energy conservation
- To establish the confidence and familiarity to financial institutions in financing energy conservation projects

Criteria

- Loan amount : Up to 50 Mbaht per project
- Period : Up to 7 years
- Interest : Less than 4% per year
- Loan channel : Through 11 financial institutions
- Only energy conservation and renewable energy projects

From 2003 to 2009, more than 5,650 Mbaht was loaned!

ESCO Fund

- Promote and provide financial support for ESCO business.
- Energy Conservation Fund is a source of money. 500 Mbhat for the first phase in 2009 and 3,000 Mbaht in 3 years between 2010 – 2012.
- Fund is managed by Energy for Environment Foundation and Thailand Energy Conservation Foundation.
- Funding strategies:
  - Invest in equity fund in a period from 3 to 7 years and then return the share to an investor.
  - Invest in ESCO venture capital (not more than 30% of total capital)
  - Equipment leasing
  - Credit guarantee facility

Tax Incentive Measure

- Performance based tax privilege.

Privilege

- 100% of energy saving can be used for tax exemption.
- Maximum support of 2 MBaht per institution.
- Amount of tax support = Energy saving in tax fiscal year X tax rate

Eligible projects

- Promising energy saving.
- Environmentally friendly.
- Proven energy saving not less than 100,000 Baht per project per year.

Various outstanding activities

Building Labeling

Energy Labeling

Thank you for your attention ...

Q & A...

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Options For High Economic Return

Envenlope	Insulated walls, Highly EE glazing
Lighting Sytem	Superlux FL, T5 with e-Ballast
AC System	* Large chiller: 0.5 kW/RFT * Small unitary air-conditioner: EER > 12 (Btu/hr/watt)

End of presentation.....

Thank you for your attention.....

Questions and Answers.....