Proceedings and Summary Report of

APEC Policy Workshop for Energy Efficient Building Envelopes
Venue: Surasak Ballroom, 11th Floor, Eastin Grand Hotel Sathorn, Bangkok, Thailand
22 October 2013

and

APEC Training Workshop for Window Thermal Performance Testing and Rating
Venue: School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi
23-25 October 2013

APEC Energy Working Group

Energy Working Group/Expert Group on Energy Efficiency and Conservation

December 2013

APEC Project: EWG13-2012A

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Proceedings and Summary Report of

APEC Policy Workshop for Energy Efficient Building Envelopes
Venue: Surasak Ballroom, 11th Floor, Eastin Grand Hotel Sathorn, Bangkok, Thailand
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and

APEC Training Workshop for Window Thermal Performance Testing and Rating
Venue: School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi
23-25 October 2013

During October 22-25, 2013, KMUTT hosted the APEC Policy Workshop for Energy Efficient Building Envelopes and Training Workshop Window Thermal Performance Testing and Rating. The workshops are partially sponsored by APEC under cooperation between APEC, US-Department of Energy (US-DOE) and Department of Alternative Energy Development and Efficiency (DEDE) of Thailand. The policy workshop was held at Eastin Grand Hotel Sathorn, Bangkok, Thailand on October 22, 2013 and the training workshop was held at School of Energy Environment and Materials, King Mongkut's University of Technology Thonburi on October 23 – 25, 2013. The agenda of both workshops can be found in Appendix 1. The list of participants from 16 APEC economies can also be found in the Appendix 2.

This workshop brought together the range of public, private and academic sector stakeholders who are involved in developing an advanced building material infrastructure in the APEC region. It aimed at experiences sharing and recommendations for an establishment of needed infrastructure, i.e., testing and certification program of building envelope materials. In addition, the workshops directly support APEC ESCI SB2 goal to develop a pilot regional testing center to support and implement a building energy code and labeling program for use among APEC economies. This effort will educate other APEC economies on how to perform widely accepted energy efficiency practices to ensure implementation and enforcement of building energy codes and labeling.

The main objectives of the project are the followings:

- Develop and initiate the implementation of an APEC economy pilot, regional simulation and test centre that can be replicated throughout APEC economies where building envelope energy saving opportunities will be taught and implemented
- Train APEC participants to perform energy saving window rating thermal simulations
- Enhance energy efficient building practices understanding by developing building envelope component ratings

There were 55 participants from 16 APEC economies joined the policy workshop on October 22, 2013 that was divided into four parts including (1) the session for welcome and keynote addresses, (2) Session 1: building envelope energy efficiency policy in APEC economies, (3) Session 2: building envelope components energy efficiency testing and rating systems and (4) Session 3: industries initiatives towards green economy of building construction materials.

The workshop began with the keynote addresses by Assoc. Prof. Dr. Bundit Fungtammasan, the KMUTT's Vice President for Research, Mr. Dean Matlack, a Foreign Service Officer stationed at the U.S. Embassy in Bangkok, Thailand and Dr.Twarath Sutabutr, Deputy Director-General of Department of Alternative Energy Development and Efficiency, Ministry of Energy of Thailand. Following the keynote address, Session 1 started off with a session's keynote address by Mr. M.L. Soriano, a senior technical advisor of UNDP based in Bangkok

who delivered a presentation entitled Low Carbon Initiatives in the Building Sector in the Asia-Pacific Region. The session was then fully covered by the presentations from Thailand, USA, Mexico and New Zealand.

In Session 2, Professor S.C. Yang delivered a keynote address on Fenestration Energy Efficiency Performance Labeling of China and followed by the presentations from Australia, Korea Russia Singapore, Thailand andUSA.

In Session 3, there were contribution from ASAHI Flat Glass (Thailand) and Guardian Industries Corp. New development of energy efficient glazing was presented.

The materials for the presentation in the workshop were included in Appendix 3. Upon completion, we have evaluated that the workshop successfully met its objectives. We conducted surveys and found that, on the average, the participants rated satisfactory to the workshops at 4.43 on the full score of 5.0.

Key findings
• A network of stakeholders among APEC communities was created. The stakeholder includes policy/regulation makers, academia, engineers/consultants and industries. They have shared their knowledge and experience concerning energy efficient building materials. • Thailand by KMUTT presented a strong commitment to the establishment of the Building Materials Testing and Certification Center (BMTCC). This set-up will be jointed-supported by the Ministry of Energy of Thailand, building materials industry and KMUTT. KMUTT will develop a business plan of BMTCC and will be proactive on seeking strong cooperation with industries.

For the Training Workshop for Window Thermal Performance Testing and Rating, the workshop aimed at capacity building for all participants. There were 32 participants joined the raining (See Appendix 2). It is arranged on October 23 – 25, 2013 at Preeda Wibulswas Room, SEEM, KMUTT. Optics 6, Window 7 and THERM 7, softwares developed by Lawrence Berkeley National Laboratory (LBNL) and adopted by National Fenestration Rating Council (NFRC) to rate glazing and window systems, were brought for the training that was conducted by Mr.Bipin Shah of WinBuild Inc. and Dr.Charlie Curcija from LBNL. Its agenda can be found in Appendix 1.

This simulation training is one of the initial steps towards the establishment of a regional buildings materials testing and certification center (BMTCC) which is an essential activity declared in the Energy Smart Communities Initiative (ESCI). Most building components can be simulated to determine their energy performance characteristics; U-Value, SHGC, visible transmittance, etc. and can then can be used to satisfy building energy codes and product rating systems. At the end of the workshop, workshop certificates were granted to all of participants.

Upon completion, we have evaluated that the training successfully met its objectives. We conducted surveys and found that, on the average, the participants rated satisfactory to the workshops at 4.49 on the full score of 5.0.

Key Findings
• The participants have been trained to use the software including Optics 6, Window 7 and THERM. This set of software was developed by LBNL and adopted by NFRC for determining the energy performance of windows. These tools are

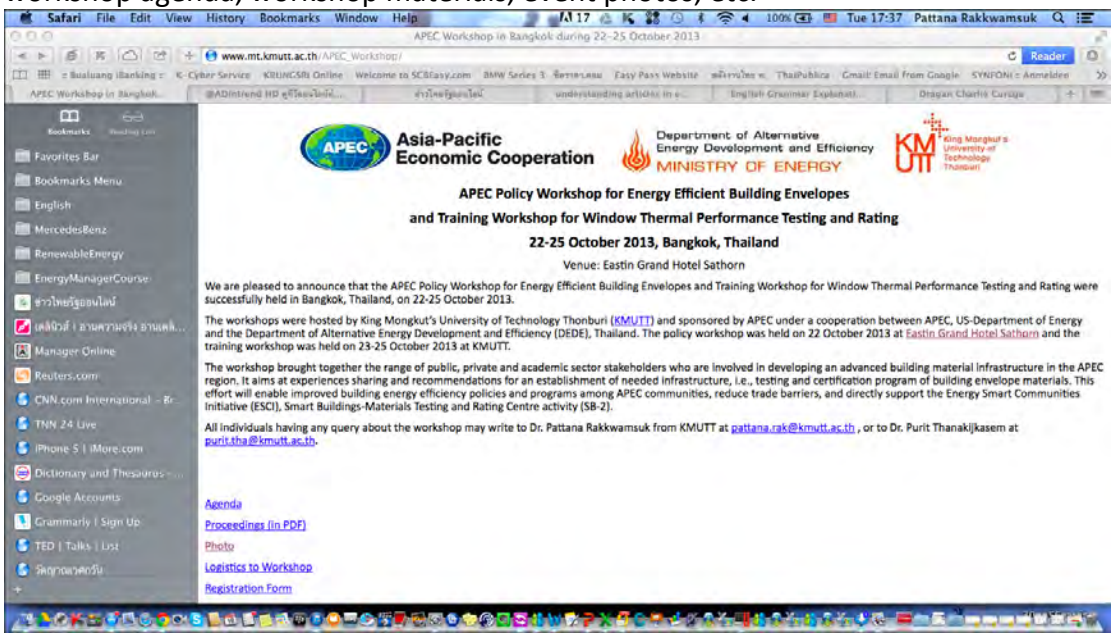
necessary and essential when energy performance in compliance of ISO 9050 and ISO 15099 is required.

- Trainees have been well trained by the experts. Very positive feedback was received from the trainees. Part of the success is due to having very knowledgeable experts to conduct the training.
- Many participants reflected that they can make use of skill built during the training in their jobs they are responsible.

Conclusion and future plans

The workshop fully met its objectives. It can be evidenced by fruitful participations engaged by 16 APEC economies. There were 55 and 32 participants joined the policy and training workshops, respectively. The policy workshop has created a collaborative network of stakeholders involving in energy efficient building envelope. For the training workshop, the success can be found from high satisfaction of the workshop participants. The trainees have high appreciation of the knowledgeable training instructors and facility.

In order to create continuing linkage among participants as well as public, a website at http://www.mt.kmutt.ac.th/APEC_Workshop/ has been created to provide public with information related to the workshop, for example the workshop logistic, workshop agenda, workshop materials, event photos, etc.



KMUTT has planned to pursue an ultimate goal at which the establishment of the testing and rating center is aimed. A two-year plan for its completion starting from 2014 to 2015 has been made. We will report the progress periodically via the website.

In addition, we also have planned to continue on capacity building activities. The feedback received from the participants revealed that they need some other training

programs such as building energy simulation, façade simulation, and lighting simulation, etc.

Appendix 1

Workshop agenda

Workshop Agenda

APEC Policy Workshop for Energy Efficient Building Envelopes

Venue: Surasak Ballroom, 11th Floor, Eastin Grand Hotel Sathorn, Bangkok, Thailand

22 October 2013

08:00 – 08:30	Registration
Opening Ceremony and Welcome Address	
08:30 - 08:40	Welcome address by KMUTT Vice President (Assoc. Prof. Dr. Bundit Fungtammasan)
08:40 – 08:50	Keynote address and workshop declaration by DEDE Deputy Director-General (Dr. Twarath Sutabutr)
08:50 – 09:00	Keynote address by a representative from the US Embassy (D. Matlack)
09:00 – 09:30	Photo session and Coffee Break
Session 1: Building Envelope Energy Efficiency Policy in APEC Economies	
09:30 – 10:00	Keynote speaker – Low Carbon Initiatives in the Buildings Sector in the Asia-Pacific Region (M.L. Soriano – Senior Technical Advisor, UNDP)
10:00 – 10:25	Development & Progress of Energy Efficiency in Thailand (S. Prakobchart – Senior Professional Engineer, DEDE)
10:25 – 10:50	Experiences of Energy Efficiency Policy Development (B. Shah – USA)
10:50 – 11:15	Building Envelope Energy Efficiency Policy in Mexico (J.A. Landa – Mexico)
11:15 – 11:40	Development of a New Zealand Specific, Energy Star Endorsement For Windows and Overview of a Recently Launched Performance-Based Rating System For Buildings In New Zealand (N. Smith – New Zealand)
11:40 – 13:00	Lunch
Session 2: Building Envelope Components Energy Efficiency Testing and Rating Systems	
13:00 – 13:25	Keynote speaker – Fenestration Energy Efficiency Performance Labeling of China (S.C. Yang – China)
13:25 – 13:50	Thailand's Experiences on Testing and Rating Building Materials (P. Rakkwamsuk – Thailand)
13:50 – 14:15	Fenestration System Thermal Performance Rating for Summer Condition (F. Chen – Singapore)
14:15 –	Simulation and Testing Role in Rating Program in the USA (C. Curcija – USA)

14:40	
14:40 – 15:05	Energy Efficiency Code, Testing and Rating Systems for Building Envelope Components in Korea (S.E. Lee – Korea)
15:05 – 15:25	Coffee Break
15:25 – 15:50	Energy Rating Programs & Labeling for Fenestration in Australia (T. Gramlick – Australia)
15:50 – 16:15	Energy Rating Programs & Labeling for Fenestration in Russia (N. Umnyakova – Russia)
Session 3: Industries Initiatives Towards Green Economy of Building Construction Materials	
16:15 – 16:40	Green Buildings Materials (S. Bumpensanti – AGC Flat Glass, Thailand)
16:40 – 17:05	Glass for Tropical Climates (D. Plotnick – Guardian, Hong Kong)
17:05 – 17:30	Discussion
Closing ceremony	
18:00 – 21:00	Evening Reception at Chaophraya Princess Dinner Cruise (RSVP only)

Workshop Agenda

APEC Training Workshop for Window Thermal Performance Testing and Rating

Venue: School of Energy, Environment and Materials, King Mongkut's University of Technology THonburi

23-25 October 2013

Day 1: 23 October 2013	
08:00	Depart from Eastin Grand Hotel, Sathorn, Bangkok
08:30 – 09:20	Registration and morning coffee
09:20 – 09:30	Opening remarks
09:30 – 17:00	Software overview and installation requirements: ▪ WINDOW 7 ▪ THERM 7 ▪ IGDB ▪ CGDB ▪ WINDOW/THERM Simulation Manual ▪ Other software tools o OPTICS o COMFEN *Note:* Software tools will be provided to attendees on USB thumb drive or CD. WINDOW 7: ▪ Program Structure / Libraries ▪ Database Structure – Import and Export between databases ▪ Glass Library – Optics connection, Optics User Database ▪ Gas Library – make new records for gas mixtures ▪ Environmental Conditions Library – Defining Different APEC country Boundary Conditions ▪ Glazing System Library – Thermal Transmittance (U-factor) o Modeling Glazing and Shading systems. ▪ Frame and Divider Library – Importing files from THERM, Condensation Resistance (CR) details, Absorptance ▪ Window Library and Data bases– (Glazing, and Shading devices) o International Glazing Data base library o Complex Glazing Data Base Library o Bi-direction ▪ Assemble a whole fixed window ▪ Review Results. Thermal Transmittance (U-Factor), Solar Heat Gain Coefficient (SHGC), Visible Transmittance (VT),

	Condensation Resistance (CR) and other energy indices. ▪ Introduction to Complex Glazing modeling. o Attachments, (Venetian blinds, roller blinds, etc. o Frit glass, etc. Glazing Exercise for the attendees
17:15	Depart from KMUTT for Eastin Grand Hotel
Day 2: 24 October 2013	
08:00	Depart from Eastin Grand Hotel, Sathorn, Bangkok
08:30 – 09:20	Registration and morning coffee
09:30 – 17:00	THERM 7: ▪ Walk through - Menu / Toolbar / Status Bar ▪ File Properties ▪ Results and Reports ▪ Modeling Aluminum Fix window ▪ Glazing System Import ▪ Frame Cavities – gravity vectors, emissivity, temperatures ▪ Boundary Conditions ▪ U-factor tags ▪ Radiation Enclosures ▪ SHGC tag for SHGC and VT ▪ CR requirements ▪ Obtain all indices value, U-factor, SHGC, VT for Aluminum fix o Reviewing model results and understanding from design concepts.
17:15	Depart from KMUTT for Eastin Grand Hotel
Day 3: 25 October 2013	
08:00	Depart from Eastin Grand Hotel, Sathorn, Bangkok
08:30 – 09:20	Registration and morning coffee
09:30 – 15:30	THERM 7 Continuation: ▪ Dividers ▪ Meeting rail and External/Internal exposed air cavity rules ▪ Resolving geometry problems o Donuts o Bad points o Overlaps o Voids ▪ Resolving WINDOW import problems ▪ Resolving modeling problems o Mesh o convergence THERM Modeling Special Cases (if time allows): ▪ Curtain wall, strip windows modeling ▪ Sloped glazing ▪ Applied Films and Laminates

	▪ Bolts, Skip and debridge Component Modeling Approach Software Tool (CMAST): Commercial Fenestration Modeling and Rating Tool: ▪ Introduction to CMAST ▪ Overview of component libraries o Import of THERM files into frame library o Import of THERM files into spacer library o Creation of glazing systems o Creation of frame assemblies o Creation of spacer assemblies ▪ Whole product assembly o Overview additional capabilities of configurator (complex assemblies), if time permits ▪ Label certificate/Project ▪ Certified component and product directory (web) Discussion and Q&A
15:30 – 15:45	Closing remarks
15:45	Depart from KMUTT for Eastin Grand Hotel

Appendix 2

List of participants

The APEC Policy Workshop for Energy Efficient Building Envelope October 22nd, 2013				
#	**APEC Member Economies**	**Name**	**Affiliation**	**Email Address**
1	Australia	Ms. Tracey Gramlick	Executive Director, Australian Window Association & Australian Fenestration Rating Council	Tracey.Gramlick@awa.org.au
2	China	Ms. Jie Wu	Deputy Manager of Glass Test & Certification Dept, China Building Materials Academy	wj@ctc.ac.cn
3	China	Ms. Zhou Quan	Director of Division of Green Building , Guangdong Provincial Academy of Building Research	86681608@qq.com
4	China	Mr. Shi Chao Yang	Vice-President of Guangdong Academy	Ysc8865@21cn.net
5	Hong kong, China	Mr. Dan Plotnick	Architectural Sales and Marketing Director, Guardian	dplotnick@guardian.com
6	Indonesia	Mr. Totok Sulistiyanto Wardoyo	President of ASHARAE Indonesia Chapter	totok.sulis@cbn.net.id
7	Indonesia	Mr. Jimmy Siswanto Juwana	Advisor to the Rector of Sustainable Construction Sector and Local Wisdom at Trisakti University	jimmy28112000@yahoo.com
8	Japan	Dr. Tetsuya Hiramatsu	Manager, AGC Japan/Asia	tetsuya-hiramatu@agc.com
9	Japan	Mr. Hideki Shioi	President, AGC Flat Glass	
10	Japan	Mr. Masahiro Tsuchiya	Executive Director, AGC Flat Glass	
11	Korea	Dr. Seung-eon Lee;	Korean Institute of Construction Technology	selee2@kict.re.kr
12	Mexico	Dr. Jesús Arce Landa	The National Center for Research and Technological Development (CENIDET)	jesuso@cenidet.edu.mx
13	Mexico	Mr. Iván Hernández	The National Center for Research and Technological Development (CENIDET)	ivanalejandrohp@hotmail.com
14	New Zealand	Mr. Nicolas David Smith	Energy Efficiency and Conservation Authority	Nick.Smith@eeca.govt.nz
15	Peru	Mr. Roberto PRIETO	Architech, Ministry of Housing, Construction and Sanitation	rprieto@vivienda.gob.pe
16	Philippines	Mr. Emelito Cabrera Punsalan	Vice President, Philippine Green Building Initiative, LR Punsalan & Associates	archmelp@gmail.com
17	Philippines	Ms. Angelina Margaret F. Tajon	Senior Trade and Industry Development Specialist, Construction Industry Authority of the Philipines	angtajon@yahoo.com

The APEC Policy Workshop for Energy Efficient Building Envelope October 22nd, 2013				
#	**APEC Member Economies**	**Name**	**Affiliation**	**Email Address**
18	Russia	Ms. Kristina ANDREYTSEVA	Postgraduate Student; Research Institute for Building Physics	9259988800@mail.ru
19	Russia	Mr. Lyubim SHUBIN	Commercial Director of VELKO2000	9201808@mail.ru
20	Singapore	Dr. Fangzhi Chen	Research Scientist; Solar Energy Research Institute of Singapore (SERIS)	chen.fz@nus.edu.sg
21	Singapore	Mr. Seah Amos	Technoform Bautec Asia Pacific	amos.seah@technoform.sg
22	Thailand	Dr. Bundit Fungtammasan	Vice President, KMUTT	bundit_f@jgsee.kmutt.ac.th
23	Thailand	Dr. Kuskana Kubaha	Assistant Professor, KMUTT	kuskana.kub@kmutt.ac.th
24	Thailand	Dr. Nuchthana Poolthong	Assistant Professor, KMUTT	nuchthana.poo@kmutt.ac.th
25	Thailand	Dr. Pattana Rakkwamsuk	Dean, SEEM, KMUTT	pattana.rak@kmutt.ac.th
26	Thailand	Dr. Pongpan Vorasayan	DEDE	pongpan_v@dede.go.th
27	Thailand	Dr. Prasert Sinsukprasert	Executive Director, International Energy Cooperation Bureau	prasert.sinsukprasert@gmail.com
28	Thailand	Dr. Purit Thanakijkasem	Associate Professor, KMUTT	purit.tha@kmutt.ac.th
29	Thailand	Dr. Sarat Prakobchart	Senior Professional Engineer, DEDE	sarat_p@dede.go.th
30	Thailand	Dr. Tippaban Palathai	Assistant Professor, KMUTT	tippaban.sud@kmutt.ac.th
31	Thailand	Dr. Twarath Sutabutr	Deputy Director-General, DEDE	twarath@dede.go.th
32	Thailand	Mr. Asawin Asawutmangkul	Senior Engineer, DEDE	
33	Thailand	Mr. Booranin Kamponpan	Senior Engineer, Windsor	
34	Thailand	Mr. Chatchawin Nuchanong	Technical Engineer, 3M	cnuchanong@mmm.com
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38	Thailand	Mr. Panya Tantisuwichwong	Deputy General Manager, AGC Flat Glass	
39	Thailand	Mr. Ratchapol Kulchaisiri	Sales and Marketing Manager, BASF (Thai) Ltd.	ratchapol.kulchaisiri@basf.com
40	Thailand	Mr. Songpol Bumpensanti	Assistant to Executive Director, AGC	songpol.bumpensanti@agc.com
41	Thailand	Mr. Sutti Klovuttivat	Sales Director, Guardian Industries Corp	sklovuttivat@guardian.com
42	Thailand	Ms. Katunyoo Kamollakorn	Government Affairs Manager-Thailand, Guardian Industries Corp	kkamollakorn@guardian.com
43	Thailand	Ms. NualAnong Methapipatkul	Architectural Sales Manager, Guardian Industries Rayong	nmethapipatkul@guardian.com

The APEC Policy Workshop for Energy Efficient Building Envelope October 22nd, 2013				
#	**APEC Member Economies**	**Name**	**Affiliation**	**Email Address**
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45	Thailand	Ms. Ticha Sayaves	Engineer, Windsor	
46	Thailand	Ms. Vinuchada Talangsri	Plan and Policy Analyst, DEDE	vinuchada_t@dede.go.th
47	UNDP	Mr. Manuel L. Soriano	Senior Technical Advisor, UNDP	manuel.soriano@undp.org
48	USA	Mr. Brian Bogard	Regional Government Affairs Manager, Guardian Industries Corp	bbogard@guardian.com
49	USA	Mr. Bipin Shah	President, WinBuild	winbuild.usa@gmail.com
50	USA	Dr. Charlie Curcija	Scientist, Lawrence Berkeley National Laboratory	dccurcija@lbl.gov
51	USA	Mr. Dean Matlack	Commercial Officer, U.S. Embassy Bangkok	Dean.Matlack@trade.gov
52	Vietnam	Mr. Nguyen Huy Thang	Secretary General (VieGlass)	thangnguyenfm@gmail.com
53	Vietnam	Dr. Kieu Le Hai	Director of Technical Consulting Center (VieGlass)	klhaido@yahoo.com
54	Vietnam	Mr. Tran Quoc Thai	Adviser of Association Executive Committee	thai920@gmail.com

The APEC Training Workshop for Window Thermal Performance Testing and Rating October 23rd - 25th, 2013				
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1	China	Ms. Jie Wu	Deputy Manager of Glass Test & Certification Dept, China Building Materials Academy	wj@ctc.ac.cn
2	China	Ms. Zhou Quan	Director of Division of Green Building , Guangdong Provincial Academy of Building Research	86681608@qq.com
3	Indonesia	Mr. Totok Sulistiyanto Wardoyo	President of ASHARAE Indonesia Chapter	totok.sulis@cbn.net.id
4	Indonesia	Mr. Jimmy Siswanto Juwana	Advisor to the Rector of Sustainable Construction Sector and Local Wisdom at Trisakti University	jimmy28112000@yahoo.com
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6	Mexico	Mr. Iván Hernández	The National Center for Research and Technological Development (CENIDET)	ivanalejandrohp@hotmail.com
7	New	Mr. Nicolas David Smith	Energy Efficiency and	Nick.Smith@eeca.govt.nz

The APEC Training Workshop for Window Thermal Performance Testing and Rating October 23rd - 25th, 2013				
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10	Philippines	Ms. Angelina Margaret F. Tajon	Senior Trade and Industry Development Specialist, Construction Industry Authority of the Philipines	angtajon@yahoo.com
11	Russia	Ms. Kristina ANDREYTSEVA	Postgraduate Student; Research Institute for Building Physics	9259988800@mail.ru
12	Russia	Mr. Lyubim SHUBIN	Commercial Director of VELKO2000	9201808@mail.ru
13	Singapore	Dr. Fangzhi Chen	Research Scientist; Solar Energy Research Institute of Singapore (SERIS)	chen.fz@nus.edu.sg
14	Singapore	Mr. Seah Amos	Technoform Bautec Asia Pacific	amos.seah@technoform.sg
15	Thailand	Dr. Purit Thanakijkasem	Associate Professor, KMUTT	purit.tha@kmutt.ac.th
16	Thailand	Mr. Boonyarit Phuethisarikorn	Technical Services Staff, Thai-German Specialty Glass	boonyarit.tgsg@gmail.com
17	Thailand	Mr. Chatchawin Nuchanong	Technical Engineer, 3M	cnuchanong@mmm.com
18	Thailand	Mr. Joenel B Tajonara	Engineering Manager, Kaskal	joenel.t@kaskalthai.com
19	Thailand	Mr. Kitipat Chinkarun	Sale Engineer, 3M	kchinkarun@mmm.com
20	Thailand	Mr. Krisanatas Sumdangrit	Engineer, DEDE	
21	Thailand	Mr. PhaiChayon Lumlert	AGC Flat Glass	
22	Thailand	Mr. Poonlarp Sumitmoh	AGC Flat Glass	
23	Thailand	Mr. Prakob Eamsa-Ard	Senior Engineer, DEDE	
24	Thailand	Mr. Ronnakorn Junma	Silpakorn University	naphat_ple@hotmail.com
25	Thailand	Ms. NualAnong Methapipatkul	Architectural Sales Manager, Guardian Industries Rayong	nmethapipatkul@guardian.com
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3	Thailand	Ms. Hanan Sareh	KMUTT	be_bear3103@hotmail.com
4	Thailand	Mr. Trin Buapakham	KMUTT	t_bpk@hotmail.com
5	Thailand	Ms. Chittaworanan Itsarhatrakoon	KMUTT	chittaworanan@hotmail.com
6	Thailand	Mr. Teerasak	KMUTT	ban1150@hotmail.com

The APEC Training Workshop for Window Thermal Performance Testing and Rating October 23rd - 25th, 2013				
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27	USA	Mr. Bipin Shah	President, WinBuild	winbuild.usa@gmail.com
28	USA	Dr. Charlie Curcija	Scientist, Lawrence Berkeley National Laboratory	dccurcija@lbl.gov
29	Vietnam	Mr. Nguyen Huy Thang	Secretary General (VieGlass)	thangnguyenfm@gmail.com
30	Vietnam	Dr. Kieu Le Hai	Director of Technical Consulting Center (VieGlass)	klhaido@yahoo.com

Appendix 3

Materials presented in the workshop

Asia-Pacific Economic Cooperation

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

King Mongkut's University of Technology Thonburi

APEC *Policy* workshop

for Energy Efficient Building Envelopes

Eastin Grand Hotel
Sathorn, Bangkok, Thailand

– 22 October 2013 –

Co-Sponsored by

AGC กระจกไทยอาซาฮี AGC FLAT GLASS (THAILAND)

GUARDIAN Glass - Automotive - Building Products

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PMK DIAMOND GLASS

WIN BUILD

Preface

The Asia-Pacific Economic Cooperation (APEC) Policy Workshop for Energy Efficient Building Envelopes and Training Workshop for Window Thermal Performance Testing and Rating, hosted by King Mongkut's University of Technology Thonburi (KMUTT) and sponsored by APEC under a cooperation between APEC, US-Department of Energy and Thai-Department of Alternative Energy Development and Efficiency (DEDE), was held at Eastin Grand Hotel Sathorn in Bangkok, the capital city of the Kingdom of Thailand, during 22-25 October 2013.

The workshop has provided an opportunity for the range of public, private and academic sector stakeholders who are involved in developing an advanced building material infrastructure in the APEC region to exchange their views and experience on energy efficient building envelopes and window thermal performance testing and rating of their economies. It aims at experiences sharing and recommendations for an establishment of needed infrastructure, i.e., testing and certification program of building envelope materials. This effort will enable improved building energy efficiency policies and programs among APEC communities, reduce trade barriers, and directly support the Energy Smart Communities Initiative (ESCI), Smart Buildings-Materials Testing and Rating Centre activity (SB-2).

The workshop was able to gather representatives from almost every APEC member economies; namely Australia, China, Indonesia, Japan, Korea, Mexico, New Zealand, Peru, Philippines, Russia, Singapore, Thailand, USA and Vietnam. In addition, there is participation from a UNDP representative to discuss low carbon initiatives in the building sectors. There are 14 talks in the policy workshop to cover building envelope energy efficiency policy in APEC economies, building envelope components energy efficiency testing and rating systems and industries initiatives towards green economy of building construction materials. And there will be 3 days of training on window thermal performance testing and rating.

I expect that the future of energy efficient building envelopes and window thermal performance testing and rating will play a vital role to make our world grow sustainably through our future generation. I appreciate the main supports from APEC, DEDE and KMUTT. My appreciation also goes to major sponsorship including AGC Flat Glass Thailand PLC., and Guardian Industries Corporation Ltd. Lastly, I am grateful to the courtesy of Thai-German Specialty Glass, Co. Ltd., 3M, PMK Diamond Glass Co. Ltd., and WinBuild Consultant.

I do hope KMUTT would have a chance to bring a fruitful collaboration like this event in the future.

On behalf of the organizing committee

Pattana Rakkwamsuk, Ph.D.

Chair

Dean of School of Energy, Environment and Materials

King Mongkut's University of Technology Thonburi

Workshop Agenda

APEC Policy Workshop for Energy Efficient Building Envelopes

Venue: Surasak Ballroom, 11th Floor, Eastin Grand Hotel Sathorn, Bangkok, Thailand

22 October 2013

08:00 – 08:30	Registration
Opening Ceremony and Welcome Address	
08:30 - 08:40	Welcome address by KMUTT Vice President (Assoc. Prof. Dr. Bundit Fungtammasan)
08:40 – 08:50	Keynote address and workshop declaration by DEDE Deputy Director-General (Dr. Twarath Sutabutr)
08:50 – 09:00	Keynote address by a representative from the US Embassy (D. Matlack)
09:00 – 09:30	Photo session and Coffee Break
Session 1: Building Envelope Energy Efficiency Policy in APEC Economies	
09:30 – 10:00	Keynote speaker – Low Carbon Initiatives in the Buildings Sector in the Asia-Pacific Region (M.L. Soriano – Senior Technical Advisor, UNDP)
10:00 – 10:25	Development & Progress of Energy Efficiency in Thailand (S. Prakobchart – Senior Professional Engineer, DEDE)
10:25 – 10:50	Experiences of Energy Efficiency Policy Development (B. Shah – USA)
10:50 – 11:15	Building Envelope Energy Efficiency Policy in Mexico (J.A. Landa – Mexico)
11:15 – 11:40	Development of a New Zealand Specific, Energy Star Endorsement For Windows and Overview of a Recently Launched Performance-Based Rating System For Buildings In New Zealand (N. Smith – New Zealand)
11:40 – 13:00	Lunch
Session 2: Building Envelope Components Energy Efficiency Testing and Rating Systems	
13:00 – 13:25	Keynote speaker – Fenestration Energy Efficiency Performance Labeling of China (S.C. Yang – China)
13:25 – 13:50	Thailand's Experiences on Testing and Rating Building Materials (P. Rakkwamsuk – Thailand)
13:50 – 14:15	Fenestration System Thermal Performance Rating for Summer Condition (F. Chen – Singapore)
14:15 – 14:40	Simulation and Testing Role in Rating Program in the USA (C. Curcija – USA)
14:40 – 15:05	Energy Efficiency Code, Testing and Rating Systems for Building Envelope Components in Korea (S.E. Lee – Korea)
15:05 – 15:25	Coffee Break
15:25 – 15:50	Energy Rating Programs & Labeling for Fenestration in Australia (T. Gramlick – Australia)
15:50 – 16:15	Energy Rating Programs & Labeling for Fenestration in Russia (N. Umnyakova – Russia)
Session 3: Industries Initiatives Towards Green Economy of Building Construction Materials	
16:15 – 16:40	Green Buildings Materials (S. Bumpensanti – AGC Flat Glass, Thailand)
16:40 – 17:05	Glass for Tropical Climates (D. Plotnick – Guardian, Hong Kong)
17:05 – 17:30	Discussion
Closing ceremony	
18:00 – 21:00	Evening Reception at Chaophraya Princess Dinner Cruise (RSVP only)

Workshop Agenda

APEC Training Workshop for Window Thermal Performance Testing and Rating

Instructor: Mr. Bipin Shah, WinBuild, Inc., USA

Dr. Charlie Curcija, LBNL, USA

Venue: King Mongkut's University of Technology Thonburi, Bangkok, Thailand

23 – 25 October 2013

Day 1: 23 October 2013	
08:00 am	Depart from Eastin Grand Hotel, Sathorn, Bangkok
08:30 – 09:20	Registration and morning coffee
09:20 – 09:30	Opening remarks
09:30 – 17:00	Software overview and installation requirements: ▪ WINDOW 7 ▪ THERM 7 ▪ IGDB ▪ CGDB ▪ WINDOW/THERM Simulation Manual ▪ Other software tools ○ OPTICS ○ COMFEN *Note:* Software tools will be provided to attendees on USB thumb drive or CD. WINDOW 7: ▪ Program Structure / Libraries ▪ Database Structure – Import and Export between databases ▪ Glass Library – Optics connection, Optics User Database ▪ Gas Library – make new records for gas mixtures ▪ Environmental Conditions Library – Defining Different APEC country Boundary Conditions ▪ Glazing System Library – Thermal Transmittance (U-factor) ○ Modeling Glazing and Shading systems. ▪ Frame and Divider Library – Importing files from THERM, Condensation Resistance (CR) details, Absorptance

	▪ Window Library and Data bases– (Glazing, and Shading devices) ○ International Glazing Data base library ○ Complex Glazing Data Base Library ○ Bi-direction ▪ Assemble a whole fixed window ▪ Review Results. Thermal Transmittance (U-Factor), Solar Heat Gain Coefficient (SHGC), Visible Transmittance (VT), Condensation Resistance (CR) and other energy indices. ▪ Introduction to Complex Glazing modeling. ○ Attachments, (Venetian blinds, roller blinds, etc. ○ Frit glass, etc. Glazing Exercise for the attendees
17:15	Depart from KMUTT for Eastin Grand Hotel
Day 2: 24 October 2013	
08:30 am	Depart from Eastin Grand Hotel, Sathorn, Bangkok
09:00 – 09:30	Registration and morning coffee
09:30 – 17:00	THERM 7: ▪ Walk through - Menu / Toolbar / Status Bar ▪ File Properties ▪ Results and Reports ▪ Modeling Aluminum Fix window ▪ Glazing System Import ▪ Frame Cavities – gravity vectors, emissivity, temperatures ▪ Boundary Conditions ▪ U-factor tags ▪ Radiation Enclosures ▪ SHGC tag for SHGC and VT ▪ CR requirements ▪ Obtain all indices value, U-factor, SHGC, VT for Aluminum fix ○ Reviewing model results and understanding from design concepts.
17:15	Depart from KMUTT for Eastin Grand Hotel
Day 3: 25 October 2013	
08:30 am	Depart from Eastin Grand Hotel, Sathorn, Bangkok
09:00 – 09:30	Registration and morning coffee
09:30 – 15:30	THERM 7 Continuation: ▪ Dividers ▪ Meeting rail and External/Internal exposed air cavity rules ▪ Resolving geometry problems ○ Donuts ○ Bad points

	○ Overlaps ○ Voids ▪ Resolving WINDOW import problems ▪ Resolving modeling problems ○ Mesh ○ convergence THERM Modeling Special Cases (if time allows): ▪ Curtain wall, strip windows modeling ▪ Sloped glazing ▪ Applied Films and Laminates ▪ Bolts, Skip and debridge Component Modeling Approach Software Tool (CMAST): Commercial Fenestration Modeling and Rating Tool: ▪ Introduction to CMAST ▪ Overview of component libraries ○ Import of THERM files into frame library ○ Import of THERM files into spacer library ○ Creation of glazing systems ○ Creation of frame assemblies ○ Creation of spacer assemblies ▪ Whole product assembly ○ Overview additional capabilities of configurator (complex assemblies), if time permits ▪ Label certificate/Project ▪ Certified component and product directory (web) Discussion and Q&A
15:30 – 15:45	Closing remarks
15:45	Depart from KMUTT for Eastin Grand Hotel

APEC Policy Workshop on 22 October 2013

#	APEC Member Economies	Name	Affiliation
1	Australia	Ms. Tracey Gramlick	Executive Director, Australian Window Association & Australian Fenestration Rating Council
2	China	Ms. Jie Wu	Deputy Manager of Glass Test & Certification Dept, China Building Materials Academy
3	China	Ms. Zhou Quan	Guangdong Provincial Academy of Building Research
4	China	Mr. Shi Chao Yang	Vice-President of Guangdong Academy
5	Hongkong	Mr. Dan Plotnick	Architectural Sales and Marketing Director, Guardian
6	Indonesia	Mr. Jimmy Siswanto Juwana	Construction Sector and Local Wisdom at Trisakti University
7	Indonesia	Mr. Totok Sulistiyanto Wardoyo	President of ASHARAE Indonesia Chapter
8	Japan	Mr. Masahiro Tsuchiya	Executive Director, AGC Flat Glass
9	Japan	Dr. Tetsuya Hiramatsu	Manager, AGC Japan/Asia
10	Japan	Mr. Hideki Shioi	President, AGC Flat Glass
11	Korea	Dr. Seung-eon Lee;	Korean Institute of Construction Technology
12	Mexico	Dr. Jesús Arce Landa	The National Center for Research and Technological Development (CENIDET)
13	Mexico	Mr. Iván Hernández	The National Center for Research and Technological Development (CENIDET)
14	New Zealand	Mr. Nicolas David Smith	Energy Efficiency and Conservation Authority
15	Peru	Mr. Roberto PRIETO	Architech, Ministry of Housing, Construction and Sanitation
16	Philippines	Ms. Angelina Margaret F. Tajon	Specialist, Construction Industry Authority of the Philipines
17	Philippines	Mr. Emelito Cabrera Punsalan	Vice President, Philippine Green Building Initiative, LR Punsalan & Associates
18	Russia	Mr. Lyubim SHUBIN	Commercial Director of VELKO2000
20	Russia	Ms. Kristina ANDREYTSEVA	Postgraduate Student; Research Institute for Building Physics
21	Singapore	Dr. Fangzhi Chen	Research Scientist; Solar Energy Research Institute of Singapore (SERIS)
22	Singapore	Mr. Seah Amos	Technoform Bautec Asia Pacific
23	Thailand	Dr. Bundit Fungtammasan	Vice President, KMUTT
24	Thailand	Dr. Kuskana Kubaha	Assistant Professor, KMUTT
25	Thailand	Dr. Nuchthana Poolthong	Assistant Professor, KMUTT
26	Thailand	Dr. Paritud Bhandhubanyong	Panyapiwat Institute of Management
27	Thailand	Dr. Pattana Rakkwamsuk	Dean, SEEM, KMUTT
28	Thailand	Dr. Pongpan Vorasayan	DEDE

APEC Policy Workshop on 22 October 2013

#	APEC Member Economies	Name	Affiliation
29	Thailand	Dr. Prasert Sinsukprasert	Executive Director, International Energy Cooperation Bureau
30	Thailand	Dr. Purit Thanakijkasem	Associate Professor, KMUTT
31	Thailand	Dr. Sarat Prakobchart	Senior Professional Engineer, DEDE
32	Thailand	Dr. Tippaban Palathai	Assistant Professor, KMUTT
33	Thailand	Dr. Twarath Sutabutr	Deputy Director-General, DEDE
34	Thailand	Mr. Asawin Asawutmangkul	Senior Engineer, DEDE
35	Thailand	Mr. Booranin Kamponpan	Senior Engineer, Windsor
36	Thailand	Mr. Chatchawin Nuchanong	Technical Engineer, 3M
37	Thailand	Mr. Kitipat Chinkarun	Sale Engineer, 3M
38	Thailand	Mr. Lal C Silva	Technical Director, Kaskal
39	Thailand	Mr. Maiti Bibekananda	Asia Facific Sales Director, Guardian Industries Corp
40	Thailand	Mr. Panya Tantisuwichwong	Deputy General Manager, AGC Flat Glass
41	Thailand	Mr. Ratchapol Kulchaisiri	Ltd.
42	Thailand	Mr. Songpol Bumpensanti	Assistant to Executive Director, AGC
43	Thailand	Mr. Sutti Klovuttivat	Sales Director, Guardian Industries Corp
44	Thailand	Ms. Katunyoo Kamollakorn	Government Affairs Manager-Thailand, Guardian Industries Corp
45	Thailand	Ms. NualAnong Methapipatkul	Architectural Sales Manager, Guardian Industries Rayong
46	Thailand	Ms. Sothida Ngamwiwatsawang	Project Sales Manager, Thai-German Specialty Glass
47	Thailand	Ms. Ticha Sayaves	Engineer, Windsor
48	Thailand	Ms. Vinuchada Talangsri	Plan and Policy Analyst, DEDE
49	UNDP	Mr. Manuel L. Soriano	Senior Technical Advisor, UNDP
50	USA	Dr. Charlie Curcija	Laboratory
51	USA	Mr. Bipin Shah	President, WinBuild
52	USA	Mr. Brian Bogard	Regional Government Affairs Manager, Guardian Industries Corp
53	USA	Mr. Dean Matlack	Commercial Officer, U.S. Embassy Bangkok
54	Vietnam	Mr. Tran Quoc Thai	Adviser of Association Executive Committee
55	Vietnam	Dr. Kieu Le Hai	(VieGlass)
56	Vietnam	Mr. Nguyen Huy Thang	Secretary General (VieGlass)

Staff

1	Thailand	Mr. Teerasak Likhitlertlam	KMUTT
2	Thailand	Mr. Trin Buapakham	KMUTT
3	Thailand	Ms. Chittaworanan Itsarhatrakoo	KMUTT
4	Thailand	Ms. Chutimon Worachetbancha	KMUTT
5	Thailand	Ms. Hanan Sareh	KMUTT
6	Thailand	Ms. Thamolwan Kiawpan	KMUTT

APEC Training Workshop on 23-25 October 2013

#	APEC Member Economies	Name	Affiliation
1	China	Ms. Jie Wu	Certification Dept, China Building Materials Academy
2	China	Ms. Zhou Quan	Director of Division of Green Building , Guangdong Provincial Academy of Building Research
3	Indonesia	Mr. Jimmy Siswanto Juwana	Advisor to the Rector of Sustainable Construction Sector and Local Wisdom at Trisakti University
4	Indonesia	Wardoyo	President of ASHARAE Indonesia Chapter
5	Mexico	Dr. Jesús Arce Landa	The National Center for Research and Technological Development (CENIDET)
6	Mexico	Mr. Iván Hernández	The National Center for Research and Technological Development (CENIDET)
7	New Zealand	Mr. Nicolas David Smith	Authority
8	Peru	Mr. Roberto PRIETO	Architech, Ministry of Housing, Construction and Sanitation
9	Philippines	Ms. Angelina Margaret F. Tajon	Senior Trade and Industry Development Specialist, Construction Industry Authority of the Philipines
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12	Russia	Ms. Kristina ANDREYTSEVA	Postgraduate Student; Research Institute for Building Physics
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14	Singapore	Mr. Seah Amos	Technoform Bautec Asia Pacific
15	Thailand	Dr. Purit Thanakijkasem	Associate Professor, KMUTT
16	Thailand	Mr. Boonyarit Phuethisarikorn	Technical Services Staff, Thai-German Specialty Glass
17	Thailand	Mr. Chatchawin Nuchanong	Technical Engineer, 3M
18	Thailand	Mr. Joenel B Tajonara	Engineering Manager, Kaskal
19	Thailand	Mr. Kitipat Chinkarun	Sale Engineer, 3M
20	Thailand	Mr. Krisanatas Sumdangrit	Engineer, DEDE
21	Thailand	Mr. PhaiChayon Lumlert	AGC Flat Glass
22	Thailand	Mr. Poonlarp Sumitmoh	AGC Flat Glass
23	Thailand	Mr. Prakob Eamsa-Ard	Senior Engineer, DEDE
24	Thailand	Mr. Ronnakorn Junma	Silpakorn University
25	Thailand	Ms. NualAnong Methapipatkul	Architectural Sales Manager, Guardian Industries Rayong
26	Thailand	Ms. Vichuda Mettanant	Silpakorn University
27	USA	Mr. Bipin Shah	President, WinBuild

APEC Training Workshop on 23-25 October 2013

#	APEC Member Economies	Name	Affiliation
28	USA	Dr. Charlie Curcija	Scientist, Lawrence Berkeley National Laboratory
29	Vietnam	Dr. Kieu Le Hai	Director of Technical Consulting Center (VieGlass)
30	Vietnam	Mr. Nguyen Huy Thang	Secretary General (VieGlass)

Staff

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2	Thailand	Mr. Trin Buapakham	KMUTT
3	Thailand	Ms. Chittaworanan Itsarhatrakoo	KMUTT
4	Thailand	Ms. Chutimon Worachetbancha	KMUTT
5	Thailand	Ms. Hanan Sareh	KMUTT
6	Thailand	Ms. Thamolwan Kiawpan	KMUTT

Sustainable Development

Low Carbon Initiatives in the Buildings Sector in the Asia-Pacific Region

Manuel L. Soriano, Senior Technical Advisor
Energy, Infrastructure, Transport & Technology Group
UNDP Asia-Pacific Regional Centre

Sustainable Development

Low Carbon Development

- Climate change mitigation measures or Low Carbon Initiatives need to be looked at in a "development context".
- **UNDP Goal**: Alignment of development and low carbon initiatives by promoting activities that do not slow down, but rather accelerate socio-economic progress. **Low Carbon & Climate Resilient Development**
- Addressing climate change and achieving the MDGs requires a new development paradigm that puts climate change into national strategies and plans, and that links policy-setting with the financing of solutions.
- **Energy Efficiency & Renewable Energy Projects:** Assisting countries in moving to a low-carbon development path through market transformation of; and investment in environmentally sound, climate-friendly technologies.

Sustainable Development

UNDP Approach to Low Carbon Development

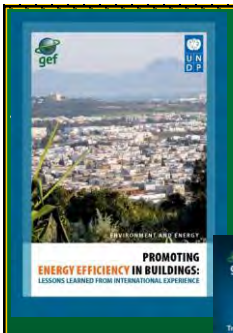
UNDP –GEF Climate Change Mitigation Projects:

- Provide grants to realize the global environmental benefits (GHG emission reduction) from energy efficiency & renewable energy measures
- Aim at "market transformation", i.e., creation of new or expansion or transformation of market(s) for EE & RE technologies/applications
- Purpose of market transformation is to 'unlock' commercial, governmental financing for EE/RE by:
  - *improving profitability, and/or*
  - *covering or reallocating various market / project related risks to market players who are best able to manage the risks.*

Shift from UNDP/GEF-funded technical demonstrations to the UNDP/GEF-capitalized/supported financial mechanisms

Sustainable Development

UNDP Low Carbon Development Initiatives



Transformational Change

- ✓Markets (e.g., buildings, on-grid renewable energy systems)
- ✓Entire supply and value chains (e.g., RACs, EE Lighting systems, SWHs, improved cook stoves)
- ✓Economic sectors (e.g., select industries)
- ✓At the level of spatial/geographic units (e.g. urban centers – cities; entire (small) countries, like SIDS)

Common Principles:

- ✓Make most cost-effective use of scarce public resources to maximize private sector finance leverage
- ✓Interventions must lead to scale-up
- ✓Explore untested, innovative approaches

Sustainable Development

Carbon Footprint of the Buildings Sector

Buildings use about 40% of global energy, 25% of global water, 40% of global resources, and emit about 1/3 of GHG emissions.

The building sector is estimated to be worth 10% of global GDP (USD7.5 trillion) and employs 111 million people.

Residential and commercial buildings consume approximately 60% of the world's electricity.

Source: UNEP Sustainable Buildings and Climate Initiative

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Low Carbon Initiatives in the Buildings Sector

Findings	Priority Targets	Instruments
High rate of building construction	New Buildings	Energy Building Codes, Labeling of Buildings, Training of designers and Builders
Short building lifespan	New Buildings	Energy Building Codes, Labeling of Buildings, Training of designers and Builders
Old deteriorated building stock	Existing Buildings	Energy Audits, Energy Information Centers, Utility Programs, Energy Standards and Labels, Soft Loans, Tax Incentives
Rising service sector	Service Sector, Hotels	Energy Audits, EE Demonstration Programs, Tax Incentives

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Low Carbon Initiatives in the Buildings Sector

	1 Energy sufficiency	2 Energy efficiency	3 Renewable energy
Energy strategy	Reduce energy needs	Reduce energy consumption	Reduce CO_2 emissions by using renewable energy
Policy instrument	Land-use policies Building energy codes	Building energy codes S&L policies	Land-use policies Building energy codes S&L policies for equipment
Policy measure	Bioclimatic design principles Use of passive solutions	Mandatory S&L for: overall building energy performance building elements and equipment	Mandatory share of supply from renewable energy sources Mandatory S&L for equipment

Sustainable Development

Low Carbon Initiatives in the Buildings Sector

Design and Application of Energy Efficient Building Systems

Sustainable Development

Low Carbon Initiatives in the Buildings Sector

Building Integrated Photovoltaic Technology Application – *Malaysia Green Tech Corporation*

Application of Renewable Energy Technology in Buildings

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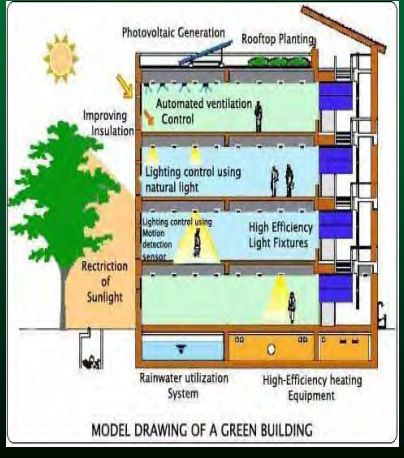
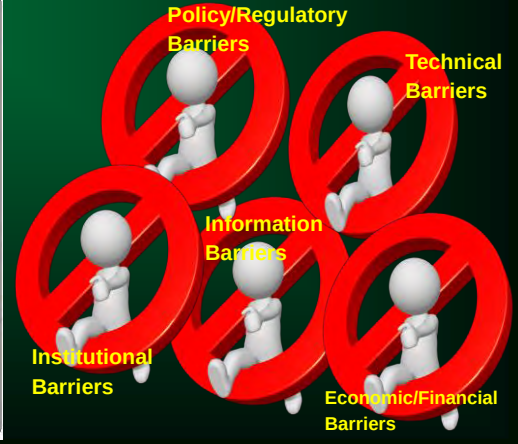
Barriers to Implementation of Building EE Initiatives



MODEL DRAWING OF A GREEN BUILDING



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Low Carbon Initiatives in the Buildings Sector

Expected Outcome: Removal of Barriers to Low Carbon Initiatives

- Creation of enabling legal and regulatory environment supportive of EE/RE initiatives in the buildings sector
- Enhanced confidence on techno-economic viability of EE/RE technology application projects in buildings
- Availability and affordability of financing assistance for EE/RE projects in buildings
- Enhanced capacity in accessing financing for building EE/RE projects

Brokering Sources of Capital for Low Carbon Projects

- Development Banks
- Private Sector/Banks
- Government Funds

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Removing Barriers

Barrier-removal measures require a different mix of the following activities:

- **Targeted Research** (e.g., determination of local building material U-values, local weather data)
- **Capacity Building** (e.g., operation and maintenance of EE/RET systems, conduct of building energy audit)
- **Institutional Strengthening** (e.g., regulatory framework, establishment of a building energy code enforcement agency, establishment of a building industry association)
- **Investments** (e.g., pilot/demonstration of building EE technology application, establishment of EE fund for building EE projects)
- **Training** (e.g., Building energy performance modeling/simulation, building EE technology design and application, monitoring, reporting & verification).

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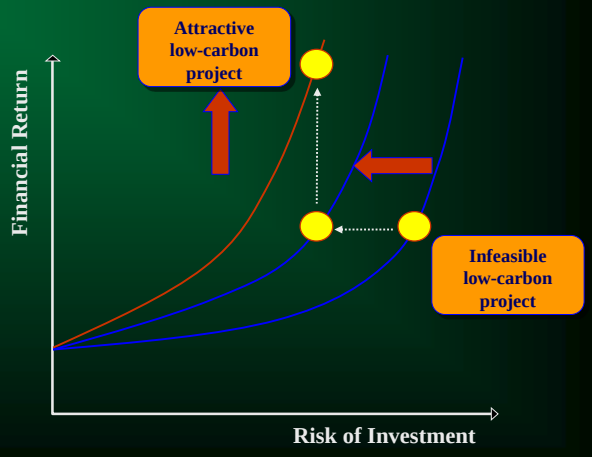
Facilitating Low Carbon Initiatives

Linking policy-setting, institutional capacity building with financing of solutions at national and local level

Access, combine and absorb new sources of environmental finance (donor grants, carbon finance, loans, equity) to implement these strategies



Sustainable Development

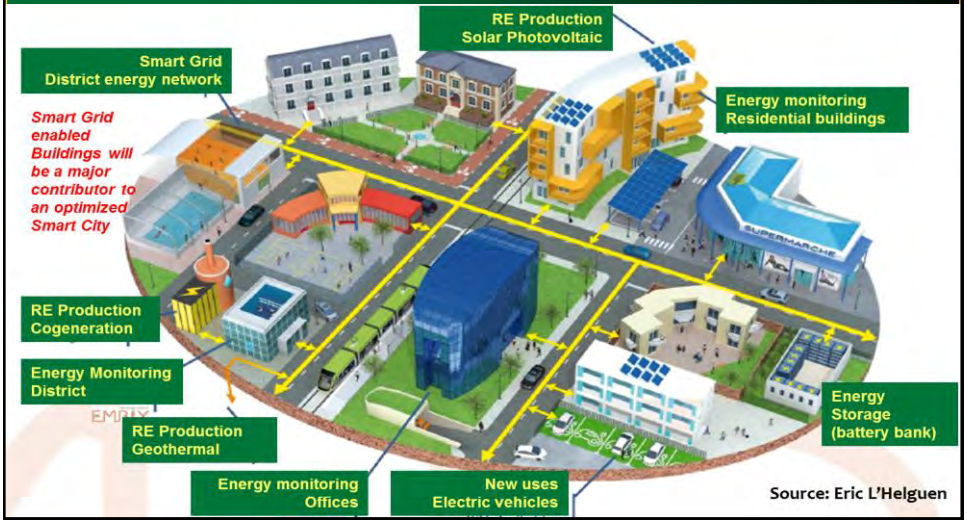
Low Carbon Initiatives in the Buildings Sector

Associated with Low Carbon Urban Development

- Energy efficient and climate resilient urban systems and infrastructures (e.g., all types of buildings)
- Design and implementation of sustainable urban policies and programs integrating EE, RE, water and other sectors
- Sustainable production and consumption, resources efficiency, waste management practices
- Sustainable transport infrastructure and systems

Sustainable Development

EE Urban Systems: Smart City & Smart Buildings

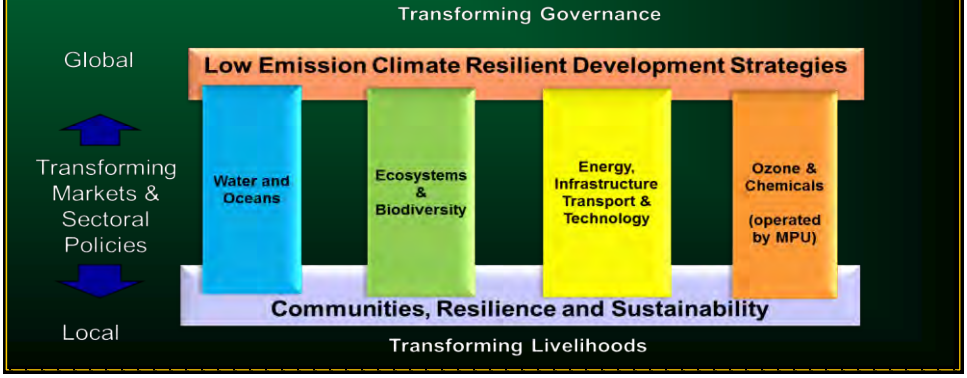


Sustainable Development

UNDP Support to Low Carbon Development

Mission

Assist developing countries to transition to green, inclusive, low emission and climate resilient development



Sustainable Development

UNDP Support to Low Carbon Development

1 Access to clean and affordable energy

- 1.1 Access to electricity (on- and off-grid)
- 1.2 Access to clean fuel for heating and cooking
- 1.3 Access to mechanical power

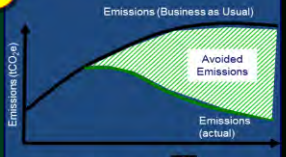
- CleanStart; charcoal; cook stoves
- Mini-grids (small hydro)
- On-grid RE power systems

2 Low emission urban and transport infrastructure

- 2.1 Energy efficiency and conservation
- 2.2 Sustainable urban and transport systems:

- EE Buildings projects (enforcement and market transformation)
- Green & smart cities with incr. climate resilience

3 Access to new financing mechanisms



- NAMA type projects
- Sector Wide Approaches in Civil Aviation and Maritime shipping
- Standardized Baselines for CDM (and NAMAs)

Sustainable Development

Empowered lives.
Resilient nations.

Thank You

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Tel: +66-2-3049100 Ext 2720

Development & Progress of Energy Efficiency in Thailand

Sarat Prakobchat

Department of Alternative Energy Development and Efficiency (DEDE)

22 October 2013,
Eastin Grand Hotel, Bangkok

กระทรวงพลังงาน
MINISTRY OF ENERGY

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Outline

1. Thailand's Energy Situation
2. 20 years Energy Efficiency Development Plan
3. Building Energy Code
4. MEP & HEP
5. Government supports in EE financing
6. Conclusions

1. Thailand's Energy Situation

3

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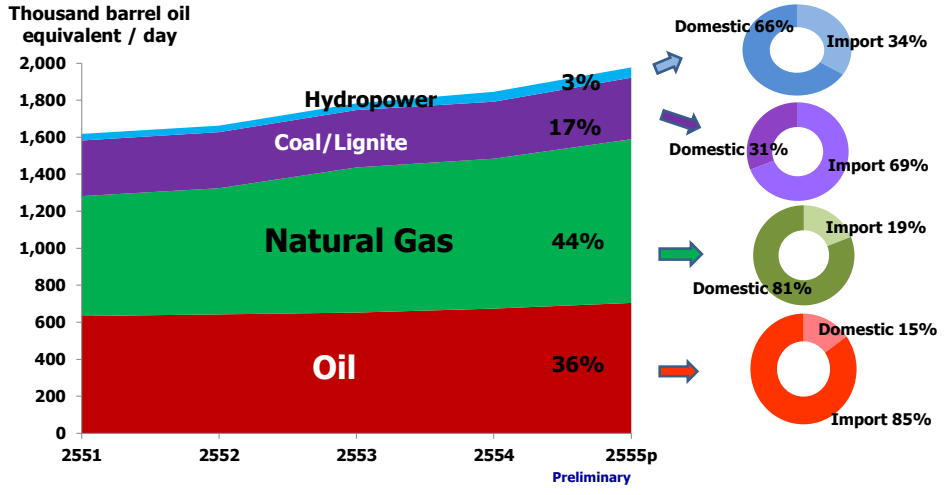
MINISTRY OF ENERGY

Final Energy Consumption



Consumption	Oil	Natural gas	Coal/Lignite	Electricity	Total
Growth (%)	4.7	9.2	5.0	3.4	6.7

4

Source : DEDE Energy Statistics 2012

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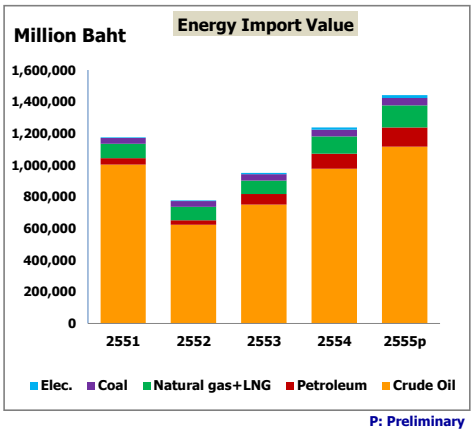
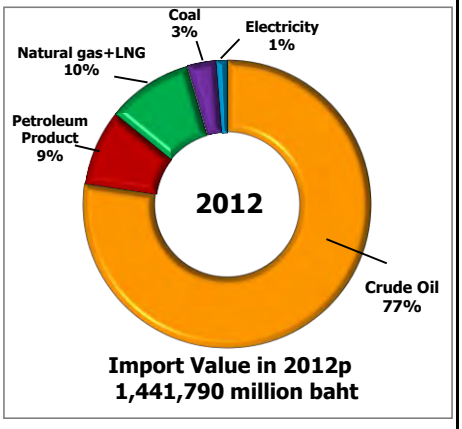
MINISTRY OF ENERGY

Energy Imported Value





P: Preliminary

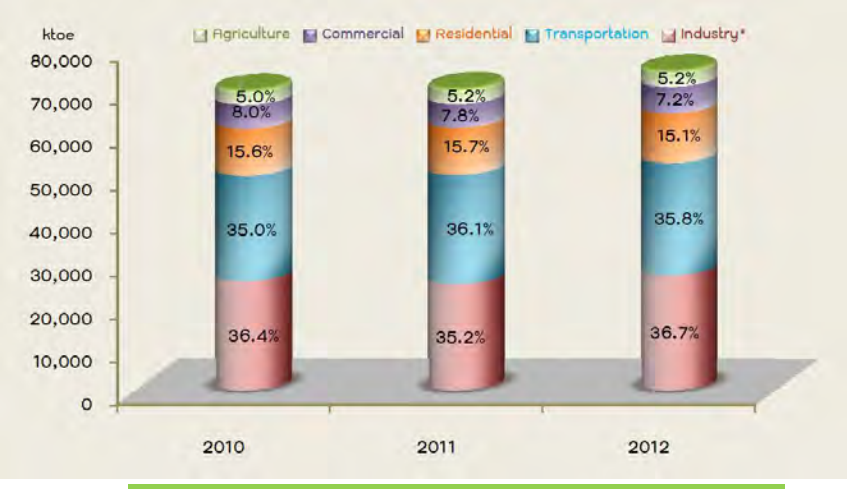
2012	Crude oil	Petroleum Product	Natural gas+LNG	Coal	Electricity	Total
Import value (million baht)	1,115,366	122,634	138,952	46,770	18,069	1,441,790
Growth (%)	14.1	30.1	23.8	10.5	30.4	16.5

Source : DEDE Energy Statistics 2012

5

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Consumption by Economic Sector



- Total consumption in 2012 is 73,316 ktoe
- 3.9% growth from 2011
- Industry & Transport are the main consumers

Source : DEDE Energy Statistics 2012

6

2. 20 years Energy Efficiency Development Plan

7

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

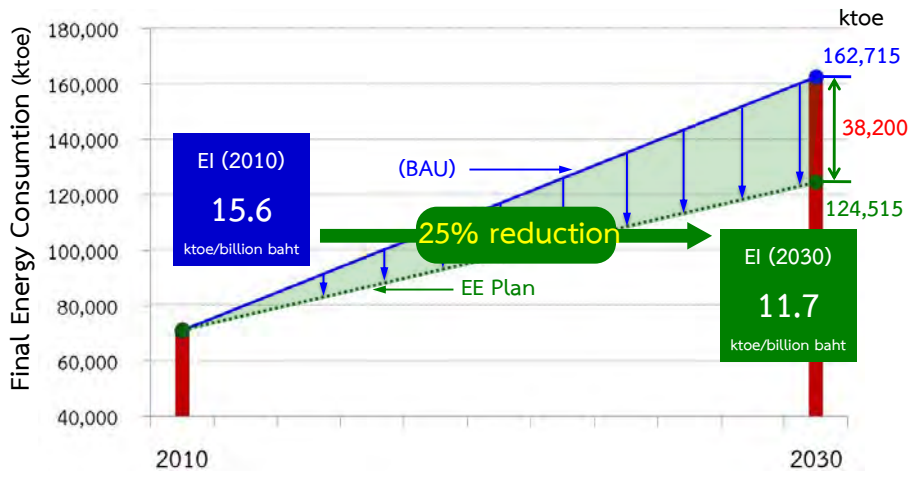
Highlight of EEDP Plan

- Being a long term plan to promote EE in Thailand (20 years from 2011 -2030)
- Master Plan was approved by National Energy Policy Committee in April 2011
- Target to reduce Energy Intensity by 25% in 2030 (based on 2010)
- Action Plan has been approved by the Cabinet in March 2013 for full implementation
- Result from EEDP will contribute to;
  - 38,200 ktoe energy reduction from BAU in 2030
  - Saving energy expense up to 707 billion Baht
  - Reduce CO_2 emission around 130 million ton

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

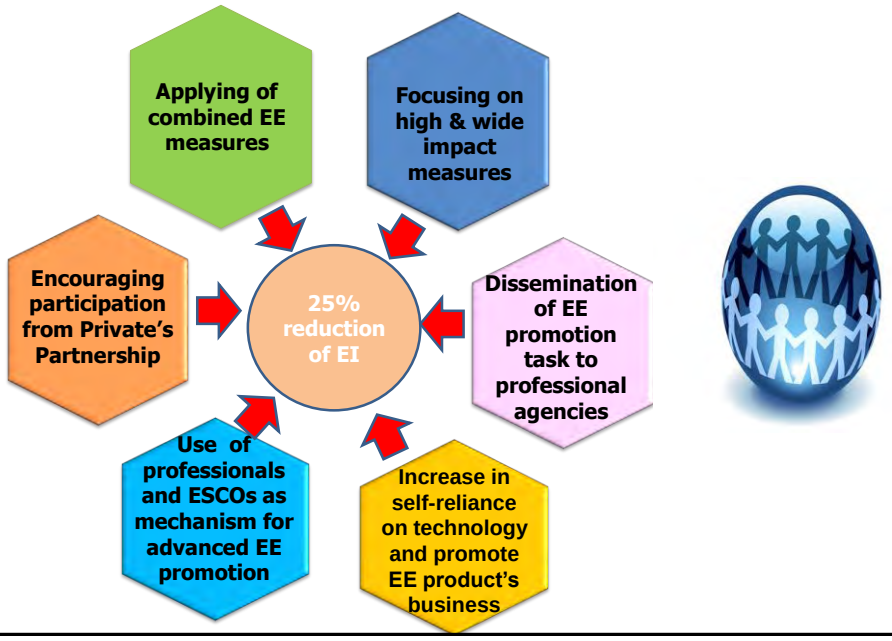
EE Plan and Target

Thailand 20-Year Energy Efficiency Development Plan (2011 - 2030)



Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Strategies for EEDP : Vision to Action



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Actions to be taken under EEDP

Short term approach

2011 ⇨ 2016

Target : Accumulated energy saving 7,980 ktoe

Target group: existing sectors
- ✓ existing buildings & houses
- ✓ Low EE factories
- ✓ Transport (Efficiency)
- ✓ Public service (Street lights, Ads. Boards)

Main approaches

- Continual on successful measures i.e. ESCO, DSM bidding
- Promotion on EE proven technologies through incentive scheme (tax & subsidy)
- More Emphasis on mandatory program for designated buildings and factories
- Promotion on Voluntary Agreement Program
- Develop & Promote efficient energy management system
- Promote EE logistics
- Increase in capacity building & Awareness for energy consumers

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Actions to be taken under EEDP

Mid Term approach

2017 ⇨ 2022

Target : Accumulated energy saving 21,058 ktoe

Target group: High energy saving potential sectors
- ✓ New & Retrofitted buildings
- ✓ Factories
- ✓ Transport

Main approaches

- Develop & Promote EE indicators ; Specific Energy Consumption (SEC) based on energy footprint
- Promote EE for new buildings (Green building & Zero energy Building)
- Promotion on process improvement through high EE technologies
- Increase efficiency in power transmission & energy transporting (pipeline system)
- Improve efficiency of power plants and promotion on smart grid system

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Actions to be taken under EEDP

Long term approach

2023 ⇨ 2030

Target : Accumulated energy saving 38,200 ktoe

Target group: all energy - related sectors
- ✓ Energy production
- ✓ Energy transmission
- ✓ Energy consumption

Main approaches

- Structure change of Industry with balancing between energy and economics
- Integrating & Changing of mode of transport for high EE
- Targeting for low carbon society

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3. Building Energy Code

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Legal Framework to promote EE

Energy Conservation and Promotion Act. B.E. 2535 (revision B.E. 2550) 2007

1992

Decree on designated building

Effective from 12/12/1995

Decree on designated factory

Effective from 17/07/1997

Ministerial Regulations

Energy Management in designated buildings and factories

Effective from 20/11/2009

Persons Responsible for Energy (PRE)

Effective from 31/07/2009

Energy Management Auditors*

Effective from 11/05/2012

Building Energy Code

Effective from 20/06/2009

High Energy Efficiency Standard for Equipments and Machinery

Effective from 08/04/2009

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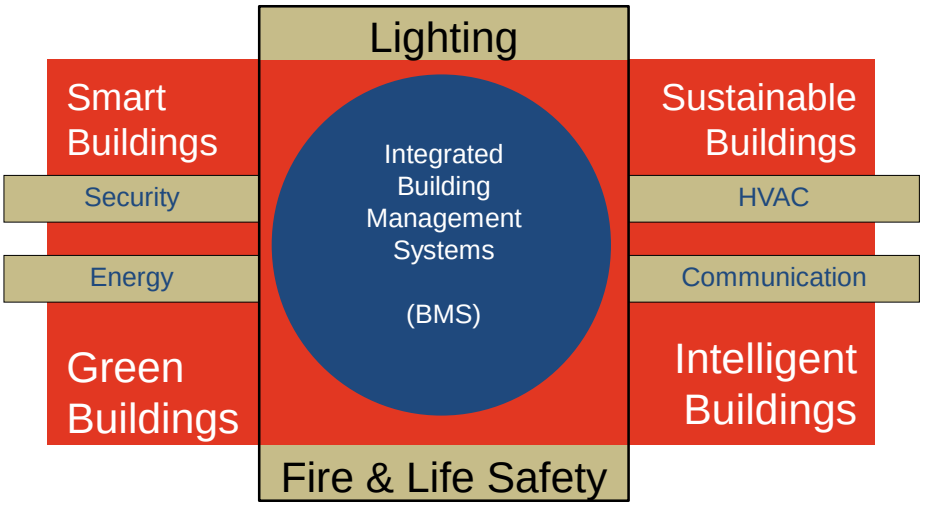
Building Trends

Total Building Management



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Building Energy Code

"New or retrofitted building with total area in all storeys in the same building ≥ 2,000 m² must be designed to comply with Building Energy Code"

Type of targeted building

Building Code components

1. Building Envelope
2. Lighting system
3. Air-conditioning system
4. Hot water generating system
5. Renewable energy utilization
6. Whole building performance

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Building Energy Code

Building Envelope

Maximum OTTV/RTTV value

	Wall	Roof
Office & Academic Institution	50 w/m²	15 w/m²
Super store	40 w/m²	12 w/m²
Hotel & Hospital	30 w/m²	10 w/m²

Lighting System

Allowable rated power

Office & Academic Institution	≤ 14 w/m²
Super store	≤ 18 w/m²
Hotel & Hospital	≤ 12 w/m²

Building Design Coordination Center

Program

Handbook

www.2e-building.com

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* OTTV = Overall Thermal Transfer Value ** RTTV = Roof Thermal Transfer Value

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EEDP in Building Sector

YEAR =>	2012	2015	2018	2021	2024	2027	2030
LEVEL	BEC	BEC+	HEPS	HEPS+	LEB	LEB+	ZEB
OTTV, $W.m^{-2}$	50	45	40	35	30	25	20
LPD, $W.m^{-2}$	14	12	10	8	6	4	2
A/C, $kW.RFT^{-1}$	1.12	0.95	0.8	0.7	0.6	0.5	0.4
Building, %	80	70	60	50	40	30	20

BEC = building energy code, HEPS = higher performance standards, LEB = low energy building, ZEB = zero energy building
OTTV = overall thermal transfer, LPD = lighting power density, A/C = air-conditioning

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4. MEPS/HEPS

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Standard & Labeling

Framework of EES&L Measures

MEPS: Minimum Energy Performance Standards

- Both voluntary and mandatory program
- Collaboration between DEDE and TISI
- Standards are set up by DEDE, but they are regulated by TISI.

voluntary certification mark

mandatory certification mark

HEPS: High Energy Performance Standard

- Voluntary program
- Collaboration between DEDE and EGAT
- Standards are set up by DEDE, and labeling programs are responsible by DEDE and EGAT

Electric Labelling **Non-Electric Labelling**

TISI: Thailand Industrial Standard Institute, EGAT: Electricity Generating Authority of Thailand

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EE Labeling by EGAT

Standby Power for TV	Standby Power for Computer Monitor	Electric Pots
Refrigerators	Air Condition	Low Loss Magnetic Ballasts
T5 Electronic Ballast	T5 Fluorescent Lamps	Electric Fan
Oscilating Fan	Compact Fluorescent Lamps	Electric Rice Cooker
Oscilating Fan	Brown Rice	T5 Luminaires
Eletric Water Heater	Ventilation Fan	Iron
Washing Machine	LED	T5 Set

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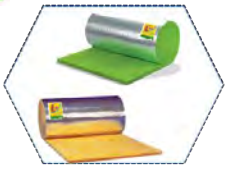
EE Labeling by DEDE

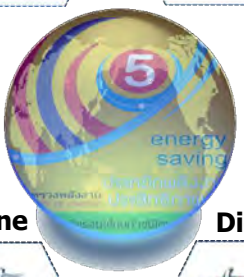
VSD

Stove

Insulator



Windows



Gasoline Engine

New Products!

Diesel Engine

New Products!

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EE Labeling by DEDE

Windows

- a space or an area of glass in the wall of a building or vehicle that lets in light
- Testing Standard: ISO 9050 and ISO 10292
- U-Value ≤ 0.55 (ค่าสัมประสิทธิ์การส่งผ่านความร้อน)
- Light-to-Solar Gain Ratio ≥ 1.20 (ค่าการส่องผ่านของแสงต่อค่าสัมประสิทธิ์การส่งผ่านความร้อน)

5. Government supports in EE financing

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Financial Incentives

Direct Subsidy
- 20% subsidy for EE proj. to privates (max. 3 mill.Baht)
- Subsidy for Gov. buildings for EE equipment

ESCO Fund
- Co-investing with privates through benefit sharing
- Run by selected fund managers (E for E, ECTF)

DEDE's efforts

Financing

Cooperation with others

Tax Incentive
- Privilege on buying EE products
- Privilege on doing EE business

EE Loans
- Encouraging banks to offer loans for EE proj. based on the success from RF program
- DEDE provide technical assistance & Info.

Welcome for new initiatives

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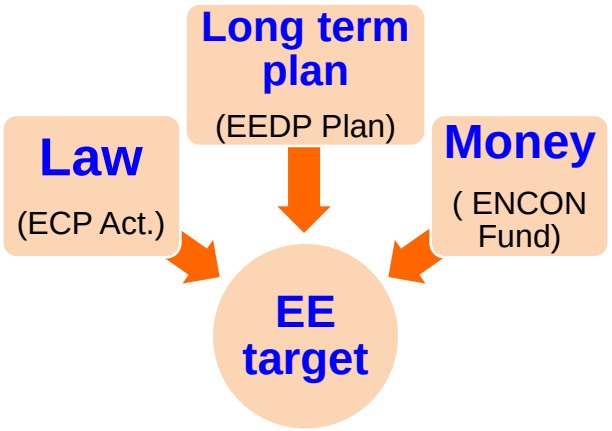
Conclusion for Success in EE Promotion



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www.dede.go.th

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MINISTRY OF ENERGY

Development of Ratings, Infrastructure and Policies to Achieve Energy Efficiency Targets and Energy Goals



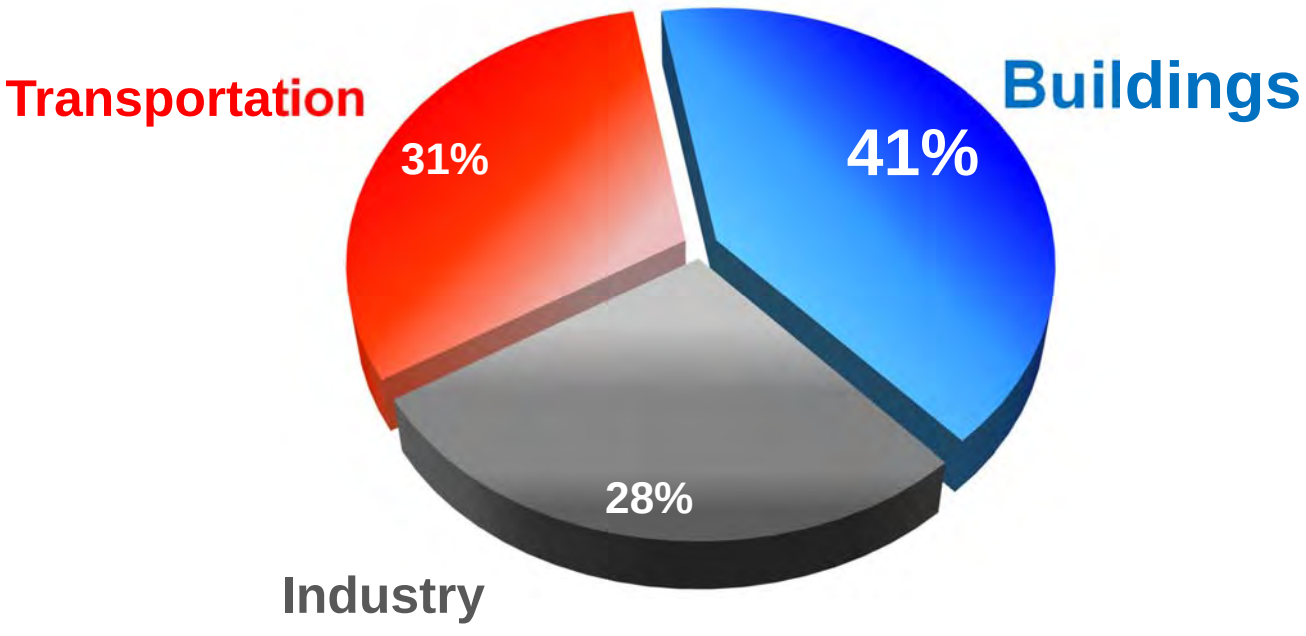

Bipin Shah

President WinBuild Inc.

US DOE International Consultant

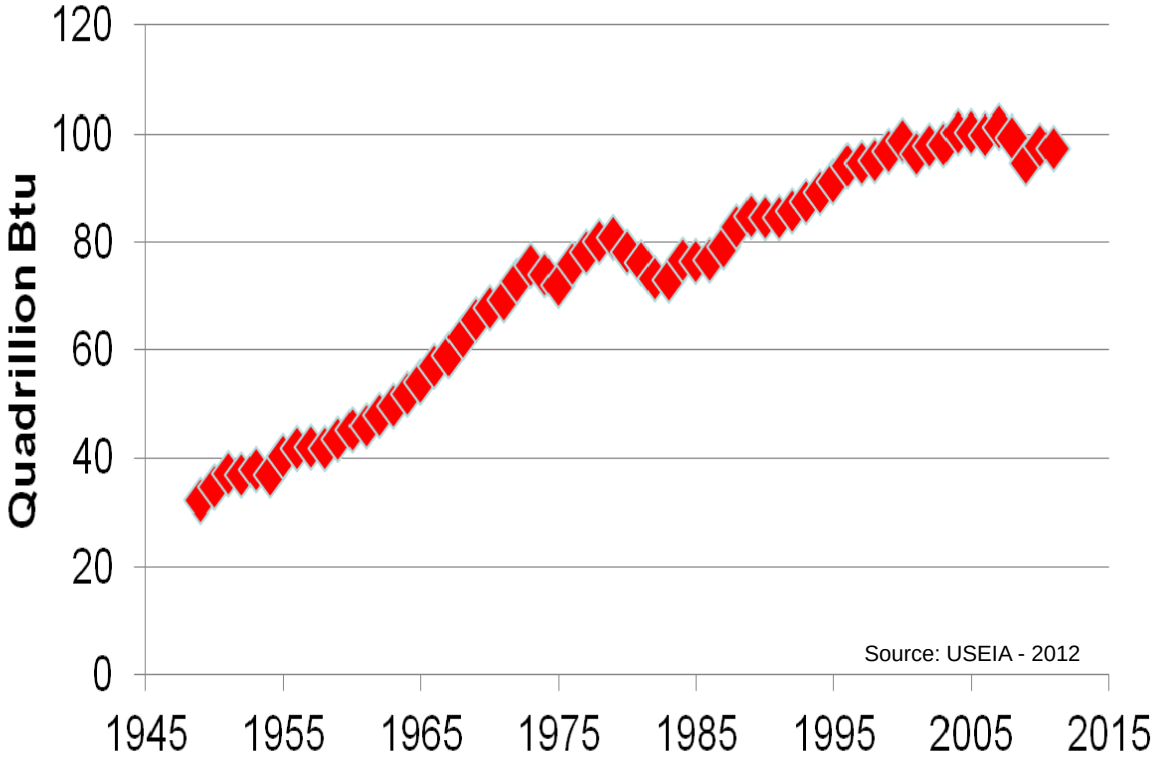
National Fenestration Rating Council International Coordinator

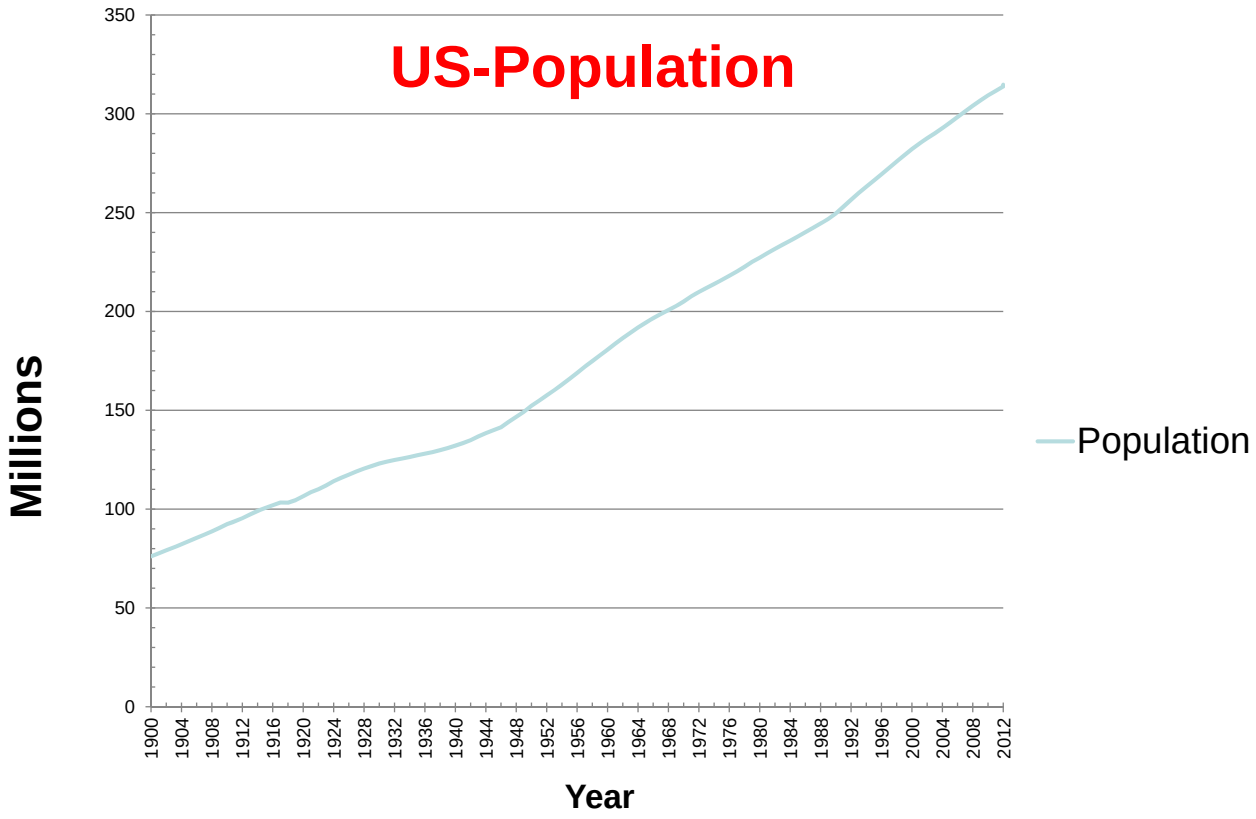
Buildings Matter: US Energy Use



Source: USEIA - 2012

U.S. Energy Consumption





US Census Bureau

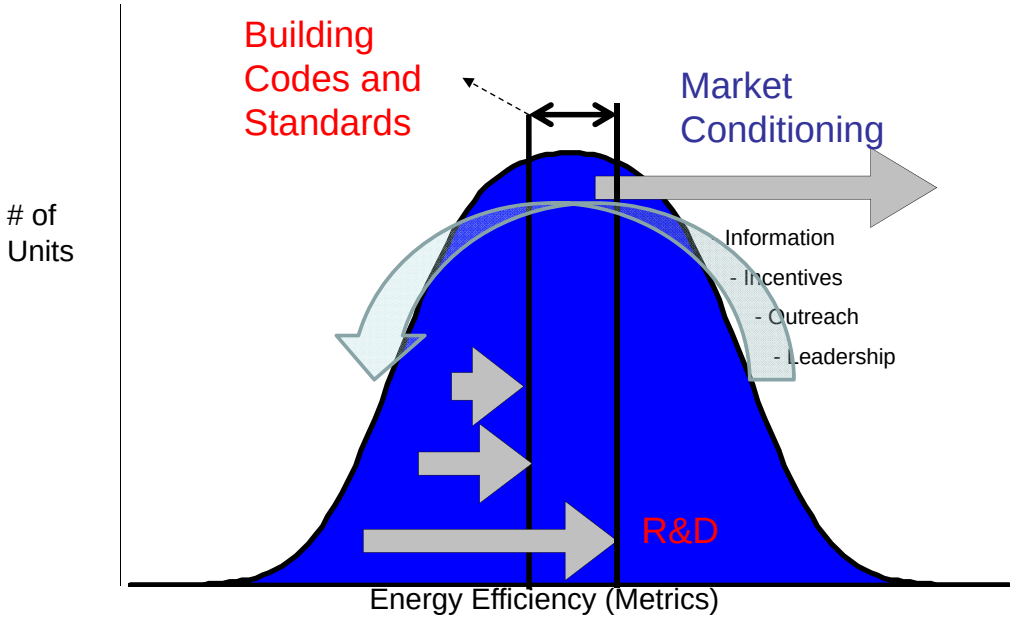
WHY Energy Policy

- Address Increasing demand
- Address Fuel Supply challenges
- Industrial Growth
- National security
- Economic security

Energy is a low hanging fruit

Transforming the Market

Moving Product Performance Forward with Energy Efficiency Policies



Why Ratings are Important

Consumer Interest

- Provides performance comparison
- Provides a base line for developments and product improvement
- Promotes energy efficiency
- Help consumer to make informed decision
- Help meet the code requirements
- International Harmonization

Manufacturer

- Barrier for cheap inferior competition
- Codes helps push the performing product in marketplace
- Demand helps develop more energy efficient products
- Provides means to market products & recognition
- Select providers in large market place = profit
- Harmonization helps less duplication of certification and testing

Rating and Certification

- **Label helps Verify the Compliance**
- **Helps consumer to distinguish products**

Requirements of a Successful Rating System

- Fair, accurate and unbiased
- Based on Science
- Provide Verifiable, Repeatable and Consistent Results
- Evaluation Based on Fixed Conditions
- Cost Effective for Adoption
- Industry buy-in

Key Elements are Interrelated and Work to Achieve Results

Code Development

- Sends a strong message to economy
- Sets goals to strive for

Infrastructure

- Needed to assess key building components
- Likely starting point, but hard to get interest w/o codes

Enforcement

-Key issue to achieve results, but often not investigated deep enough

-Core problems include lack of product ratings, product availability, lack of knowledge

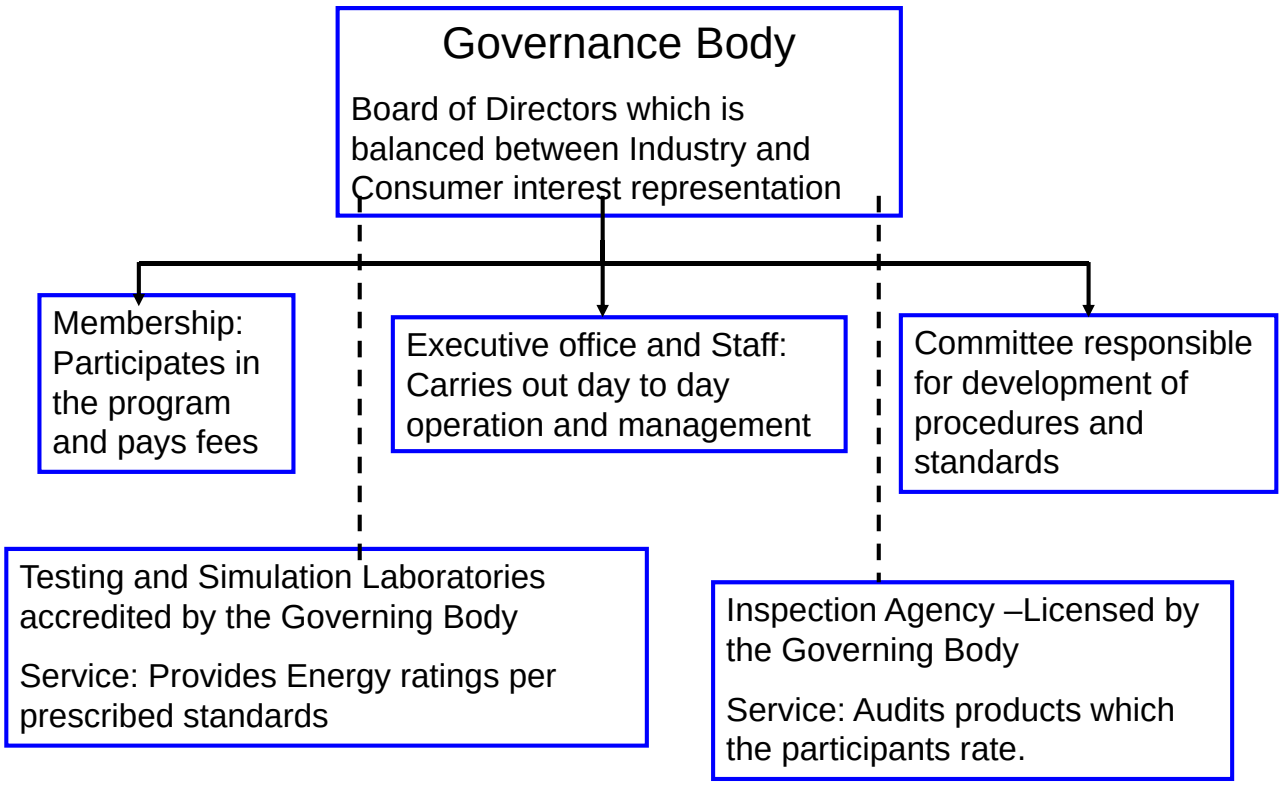
Establishment Process Infrastructure

- Governance Institution
  - day to day Management, policies, funding
  - Standards, procedure and education
  - Promotion of ratings through codes, policies and incentive programs
  - Accreditation of Testing and Simulation laboratories, Quality control and Education
- Testing and Simulation laboratories
- Inspection agenceies

Establishment Process

- Technical - Simulation and Test Standards
  - Glass and Frame properties, Optical and Material (e.g. NFRC 300, 301, 101)
  - Over product Energy Indices, (e.g. NFRC 102, 201)
- Technical - Procedure document
  - Specify size, environmental conditions and rules, (e.g. NFRC 100, 200)
- Program document
  - Manufacturers Guideline (e.g. NFRC 700)
  - Laboratory Guideline (e.g. NFRC 701)
  - Inspection agency (e.g. 702)
- Challenge and Appeals Procedures

A Rating Organization Structure in the USA



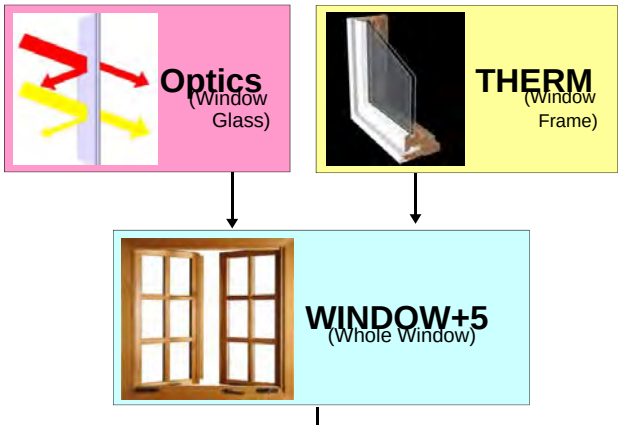
Applicable ISO Standards

- **ISO 9050 -** Glass in building-Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors
- **ISO – 15099** -Thermal Performance of Windows, Doors and Shading Devices — Detailed Calculations
- **ISO 12567**: Thermal performance of windows and doors -Determination of thermal transmittance by hot box method —
  - Part 1: Complete windows and doors and
  - Part II: Roof windows and other projecting windows
- **ASTM C1199:** Standard Test Method for
- Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods

Available Simulation Tools

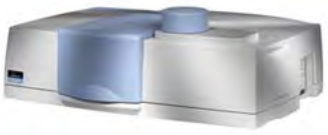
Simulations – Provides Repeatability Consistency and Reliability – Beside being Cost Effective

- WINDOW
- THERM
- OPTICS



Computer Programs are ISO-15099 & 9050 compliant

Minimum Needs for a Regional Building envelope Energy Testing Center



Spectrophotometer

Fenestration:

- Simulation of U-factor, Solar Heat Gain Factor and Visible transmittance - ISO 15099, NFRC 100
- U-factor testing - ASTM C 1363, C1199, NFRC 102
- Solar Heat Gain Testing – NFRC 201
- Spectral Optical Property – ISO 9050, ASTM E903, NFRC 300,
- Emissivity – ASTM E1371, NFRC 301
- Thickness – ASTM D 1005, D 7091
- Air Leakage – ASTM E283, NFRC 400

Hot Box

Wall Insulation Conductivity

- ASTM C 518, C 177

Solar Calorimeter

Wall System

- ASTM C1363, ASTM C1155

Air Leakage

Testing Used for Windows, Roofs and Walls Product Certification

Solar Reflectance

- Reflectometer (ASTM C1549)
- Spectrometer (ASTM E903)
- CRRC-1 Test Method 1
- Pyranometer (ASTM E1918 and E1918A)

Thermal Emittance

- Emissometer (ASTM 1371)

USA - Window Energy Rating Process – Pre Fabricated

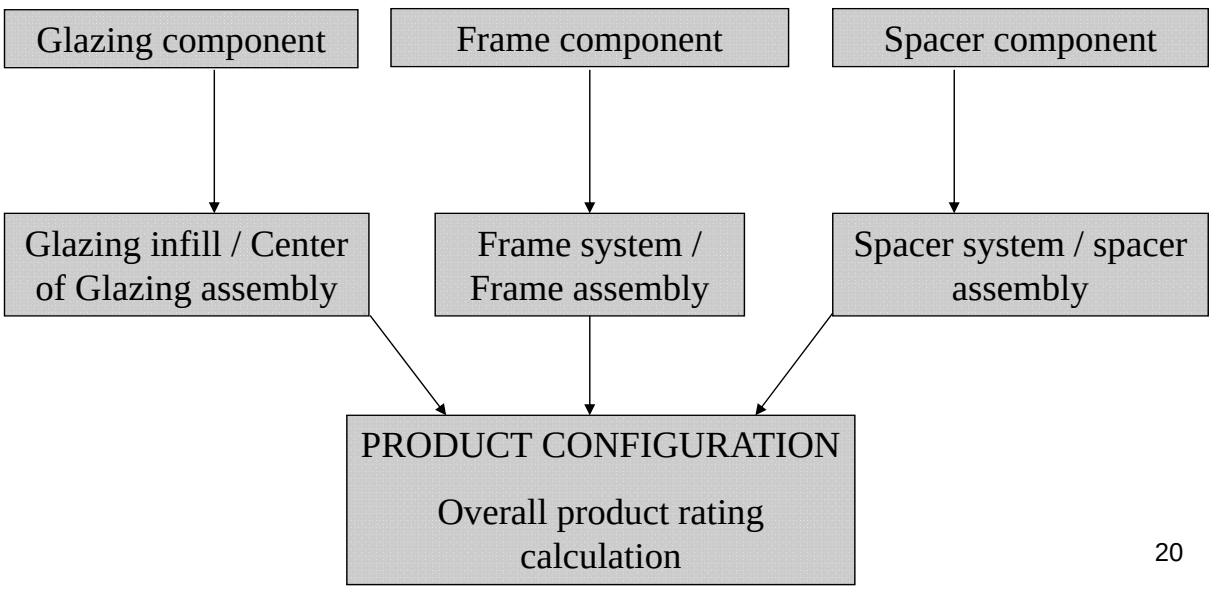
Rating of Products
Pre Fabricated Fenestration

- Temporary (Displayed for Verification removed after installation and inspection)

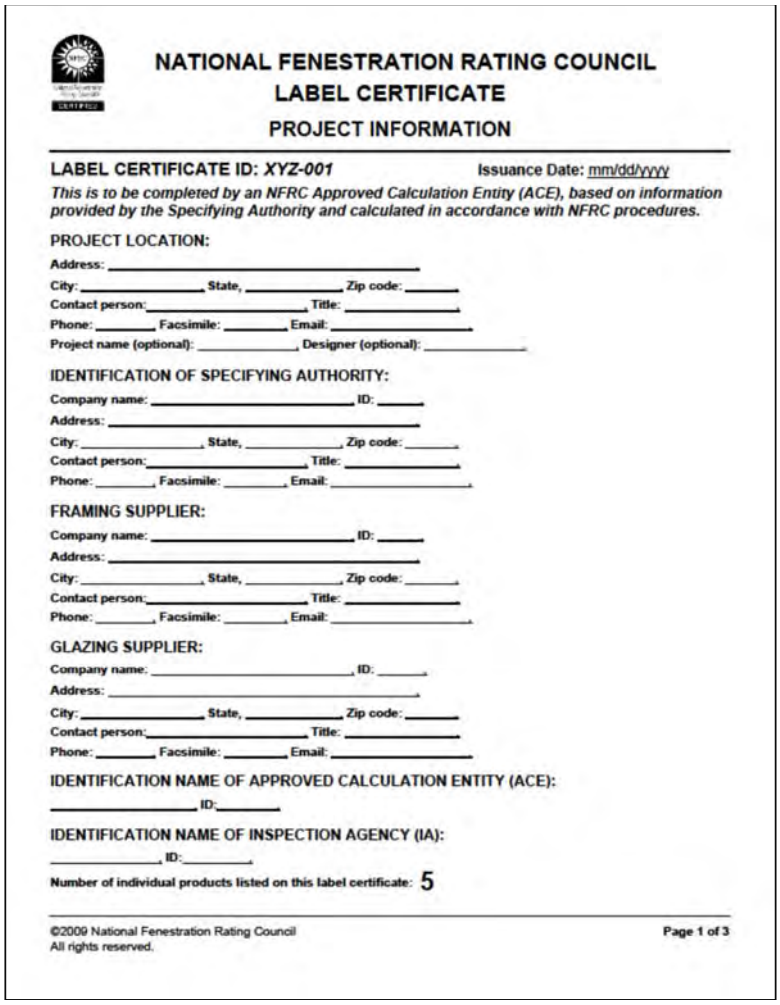
- Permanent: (Part of the window, used for replacement of components to preserve performance)

USA - Rating Process for
Post Fabricated Fenestration

Component Modeling Approach - CMA



Sample Label for Post Fabricated Product



NATIONAL FENESTRATION RATING COUNCIL
LABEL CERTIFICATE
PROJECT INFORMATION

LABEL CERTIFICATE ID: *XYZ-001* Issuance Date: mm/dd/yyyy

This is to be completed by an NFRC Approved Calculation Entity (ACE), based on information provided by the Specifying Authority and calculated in accordance with NFRC procedures.

PROJECT LOCATION:

Address: _____
City: _____, State, _____, Zip code: _____
Contact person: _____, Title: _____
Phone: _____, Facsimile: _____, Email: _____
Project name (optional): _____, Designer (optional): _____

IDENTIFICATION OF SPECIFYING AUTHORITY:

Company name: _____, ID: _____
Address: _____
City: _____, State, _____, Zip code: _____
Contact person: _____, Title: _____
Phone: _____, Facsimile: _____, Email: _____

FRAMING SUPPLIER:

Company name: _____, ID: _____
Address: _____
City: _____, State, _____, Zip code: _____
Contact person: _____, Title: _____
Phone: _____, Facsimile: _____, Email: _____

GLAZING SUPPLIER:

Company name: _____, ID: _____
Address: _____
City: _____, State, _____, Zip code: _____
Contact person: _____, Title: _____
Phone: _____, Facsimile: _____, Email: _____

IDENTIFICATION NAME OF APPROVED CALCULATION ENTITY (ACE):

_____, ID: _____

IDENTIFICATION NAME OF INSPECTION AGENCY (IA):

_____, ID: _____

Number of individual products listed on this label certificate: 5

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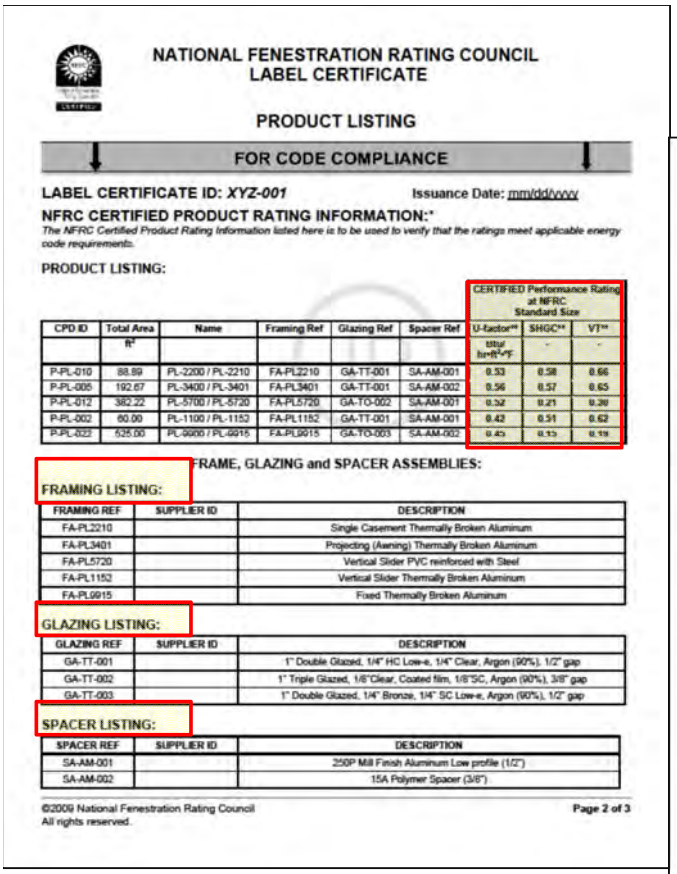

NATIONAL FENESTRATION RATING COUNCIL
LABEL CERTIFICATE
PRODUCT LISTING
FOR CODE COMPLIANCE

LABEL CERTIFICATE ID: *XYZ-001* Issuance Date: mm/dd/yyyy

NFRC CERTIFIED PRODUCT RATING INFORMATION:*

The NFRC Certified Product Rating Information listed here is to be used to verify that the ratings meet applicable energy code requirements.

PRODUCT LISTING:

CPD ID	Total Area ft²	Name	Framing Ref	Glazing Ref	Spacer Ref	CERTIFIED Performance Rating at NFRC Standard Size U-factor** Btu/hr-ft²-°F	SHGC** -	VT** -
P-PL-010	88.89	PL-2200 / PL-2210	FA-PL2210	GA-TT-001	SA-AM-001	0.53	0.58	0.66
P-PL-005	192.67	PL-3400 / PL-3401	FA-PL3401	GA-TT-001	SA-AM-002	0.56	0.57	0.65
P-PL-012	382.22	PL-5700 / PL-5720	FA-PL5720	GA-TO-002	SA-AM-001	0.32	0.21	0.30
P-PL-002	60.00	PL-1100 / PL-1152	FA-PL1152	GA-TT-001	SA-AM-001	0.42	0.51	0.62
P-PL-022	525.00	PL-9900 / PL-9915	FA-PL9915	GA-TO-003	SA-AM-002	0.45	0.33	0.19

FRAME, GLAZING and SPACER ASSEMBLIES:

FRAMING LISTING:

FRAMING REF	SUPPLIER ID	DESCRIPTION
FA-PL2210		Single Casement Thermally Broken Aluminum
FA-PL3401		Projecting (Awning) Thermally Broken Aluminum
FA-PL5720		Vertical Slider PVC reinforced with Steel
FA-PL1152		Vertical Slider Thermally Broken Aluminum
FA-PL9915		Fixed Thermally Broken Aluminum

GLAZING LISTING:

GLAZING REF	SUPPLIER ID	DESCRIPTION
GA-TT-001		1" Double Glazed, 1/4" HC Low-e, 1/4" Clear, Argon (90%), 1/2" gap
GA-TT-002		1" Triple Glazed, 1/8"Clear, Coated film, 1/8"SC, Argon (90%), 3/8" gap
GA-TT-003		1" Double Glazed, 1/4" Bronze, 1/4" SC Low-e, Argon (90%), 1/2" gap

SPACER LISTING:

SPACER REF	SUPPLIER ID	DESCRIPTION
SA-AM-001		250P Mill Finish Aluminum Low profile (1/2")
SA-AM-002		15A Polymer Spacer (3/8")

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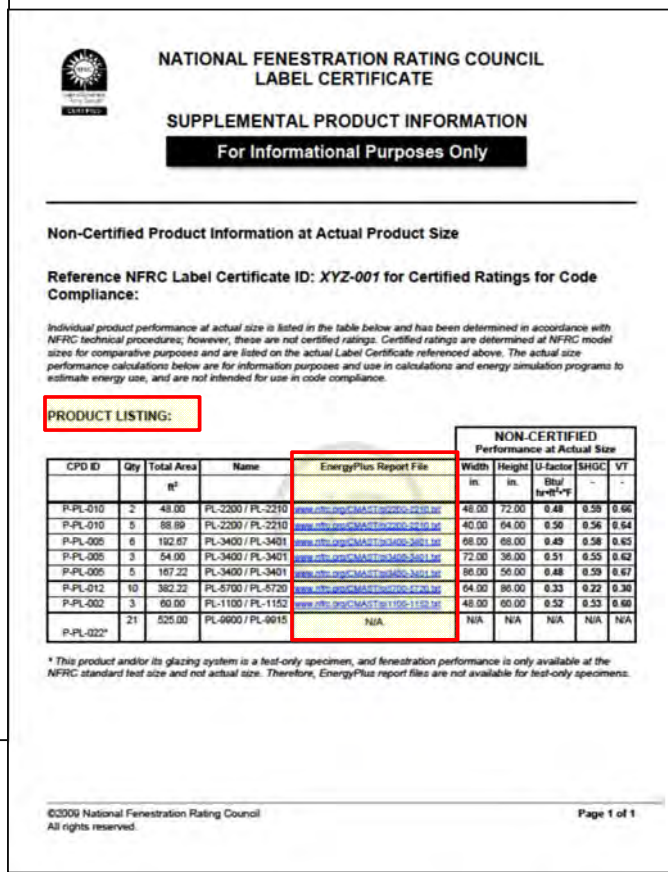

NATIONAL FENESTRATION RATING COUNCIL
LABEL CERTIFICATE
SUPPLEMENTAL PRODUCT INFORMATION
For Informational Purposes Only

Non-Certified Product Information at Actual Product Size

Reference NFRC Label Certificate ID: *XYZ-001* for Certified Ratings for Code Compliance:

Individual product performance at actual size is listed in the table below and has been determined in accordance with NFRC technical procedures; however, these are not certified ratings. Certified ratings are determined at NFRC model sizes for comparative purposes and are listed on the actual Label Certificate referenced above. The actual size performance calculations below are for information purposes and use in calculations and energy simulation programs to estimate energy use, and are not intended for use in code compliance.

PRODUCT LISTING:

CPD ID	Qty	Total Area ft²	Name	EnergyPlus Report File	NON-CERTIFIED Performance at Actual Size Width in.	Height in.	U-factor Btu/hr-ft²-°F	SHGC -	VT -
P-PL-010	2	48.00	PL-2200 / PL-2210	www.nfrc.org/CMAST/ts0200-2210.txt	48.00	72.00	0.48	0.59	0.66
P-PL-010	5	88.89	PL-2200 / PL-2210	www.nfrc.org/CMAST/ts0400-2210.txt	40.00	64.00	0.50	0.56	0.64
P-PL-005	6	192.67	PL-3400 / PL-3401	www.nfrc.org/CMAST/ts3400-3401.txt	68.00	68.00	0.49	0.58	0.65
P-PL-005	3	54.00	PL-3400 / PL-3401	www.nfrc.org/CMAST/ts3400-3401.txt	72.00	36.00	0.51	0.55	0.62
P-PL-005	5	167.22	PL-3400 / PL-3401	www.nfrc.org/CMAST/ts3400-3401.txt	86.00	56.00	0.48	0.59	0.67
P-PL-012	10	382.22	PL-5700 / PL-5720	www.nfrc.org/CMAST/ts0700-5720.txt	64.00	86.00	0.33	0.22	0.30
P-PL-002	3	60.00	PL-1100 / PL-1152	www.nfrc.org/CMAST/ts1100-1152.txt	48.00	60.00	0.52	0.53	0.60
P-PL-022*	21	525.00	PL-9900 / PL-9915	N/A	N/A	N/A	N/A	N/A	N/A

** This product and/or its glazing system is a test-only specimen, and fenestration performance is only available at the NFRC standard test size and not actual size. Therefore, EnergyPlus report files are not available for test-only specimens.*

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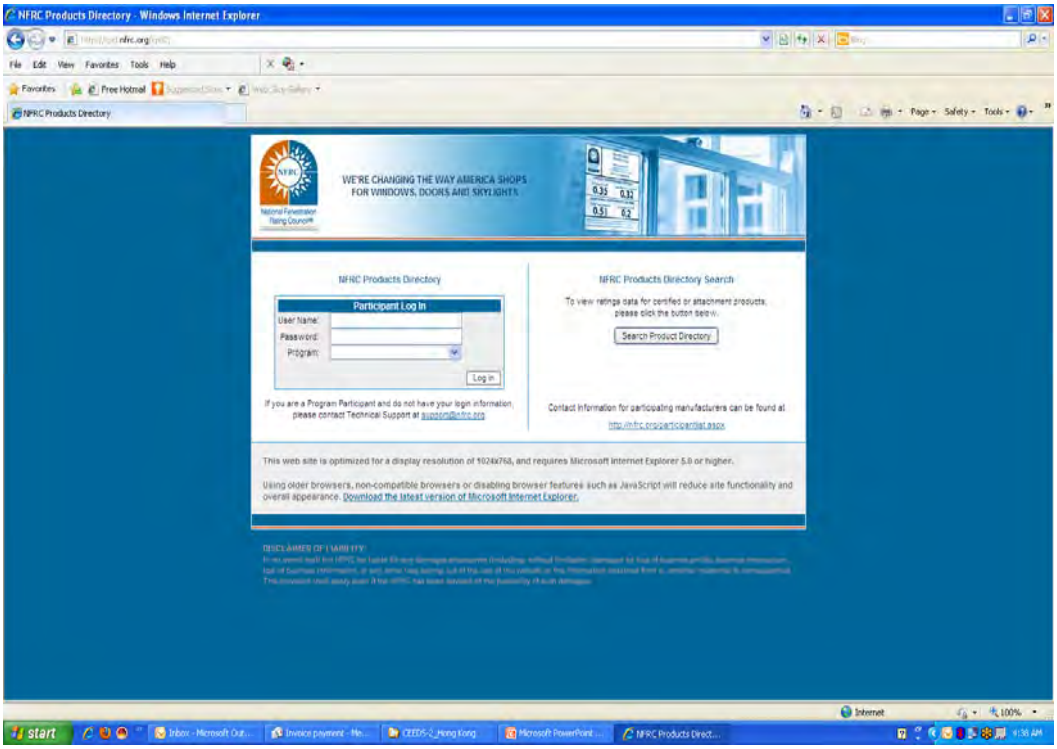
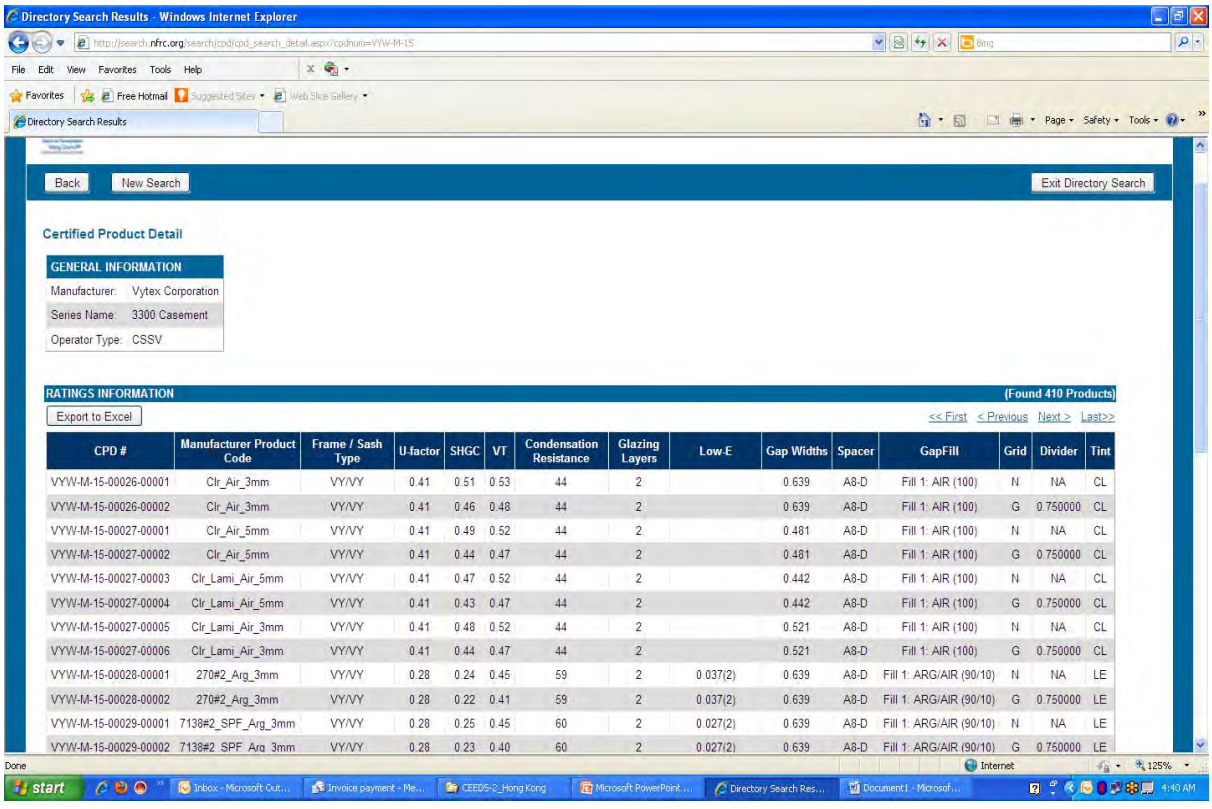
NFRC – Certified Product Database



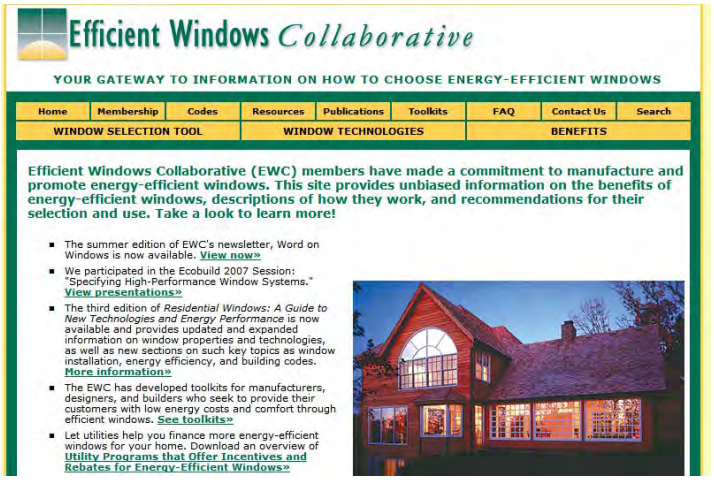
NFRC – Certified Product Database



CPD #	Manufacturer Product Code	Frame / Sash Type	U-factor	SHGC	VT	Condensation Resistance	Glazing Layers	Low-E	Gap Widths	Spacer	GapFill	Grid	Divider	Tint
VYW-M-15-00026-00001	Clr_Air_3mm	VY/VY	0.41	0.51	0.53	44	2		0.639	A8-D	Fill 1: AIR (100)	N	NA	CL
VYW-M-15-00026-00002	Clr_Air_3mm	VY/VY	0.41	0.46	0.48	44	2		0.639	A8-D	Fill 1: AIR (100)	G	0.750000	CL
VYW-M-15-00027-00001	Clr_Air_5mm	VY/VY	0.41	0.49	0.52	44	2		0.481	A8-D	Fill 1: AIR (100)	N	NA	CL
VYW-M-15-00027-00002	Clr_Air_5mm	VY/VY	0.41	0.44	0.47	44	2		0.481	A8-D	Fill 1: AIR (100)	G	0.750000	CL
VYW-M-15-00027-00003	Clr_Lami_Air_5mm	VY/VY	0.41	0.47	0.52	44	2		0.442	A8-D	Fill 1: AIR (100)	N	NA	CL
VYW-M-15-00027-00004	Clr_Lami_Air_5mm	VY/VY	0.41	0.43	0.47	44	2		0.442	A8-D	Fill 1: AIR (100)	G	0.750000	CL
VYW-M-15-00027-00005	Clr_Lami_Air_3mm	VY/VY	0.41	0.48	0.52	44	2		0.521	A8-D	Fill 1: AIR (100)	N	NA	CL
VYW-M-15-00027-00006	Clr_Lami_Air_3mm	VY/VY	0.41	0.44	0.47	44	2		0.521	A8-D	Fill 1: AIR (100)	G	0.750000	CL
VYW-M-15-00028-00001	270#2_Arg_3mm	VY/VY	0.28	0.24	0.45	59	2	0.037(2)	0.639	A8-D	Fill 1: ARG/AIR (90/10)	N	NA	LE
VYW-M-15-00028-00002	270#2_Arg_3mm	VY/VY	0.28	0.22	0.41	59	2	0.037(2)	0.639	A8-D	Fill 1: ARG/AIR (90/10)	G	0.750000	LE
VYW-M-15-00029-00001	7138#2_SPF_Arg_3mm	VY/VY	0.28	0.25	0.45	60	2	0.027(2)	0.639	A8-D	Fill 1: ARG/AIR (90/10)	N	NA	LE
VYW-M-15-00029-00002	7138#2_SPF_Arg_3mm	VY/VY	0.28	0.23	0.40	60	2	0.027(2)	0.639	A8-D	Fill 1: ARG/AIR (90/10)	G	0.750000	LE

Education

- Website to Help educate consumer and stake holders



http://www.efficientwindows.org/index.cfm

Implementation of Successful Rating System

- Referenced by Codes and Regulations
- Promotional Programs like Energy Star
- Financial Incentives

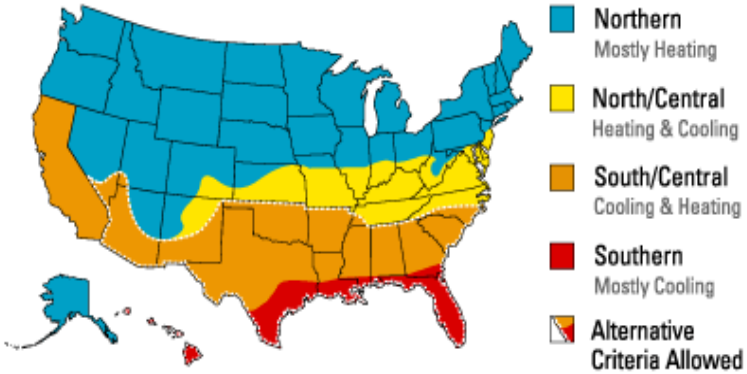
Fenestration & Code

- **IECC & IBC** International (Energy Conservation Code & International Building Code)
  - IECC and IBC's Energy Code require rating for Residential and Non-Residential and specify NFRC certification for compliance.

- **ASHRAE** (American Society of Heating, Refrigeration & Air Conditioning Engineers)
  - ASHRAE 90.1: *Energy Standard for Buildings* Except Low-Rise Residential Buildings require U-factor and Solar Heat Gain and specify NFRC certification for compliance.

- **ASHRAE** (American Society of Heating, Refrigeration & Air Conditioning Engineers)
  - ASHRAE 90.2: *Energy Standard for* Low-Rise Residential Buildings require U-factor and Solar Heat Gain and specify NFRC certification for compliance.

Energy Policy Act 2005 & Energy Star Program



Windows & Doors

Climate Zone	U-Factor[1]	SHGC[2]	
Northern	≤ 0.35	Any	
North/Central	≤ 0.40	≤ 0.55	
South/Central	≤ 0.40	≤ 0.40	Prescriptive
	≤ 0.41	≤ 0.36	Equivalent Performance *(Excluding CA)*
	≤ 0.42	≤ 0.31	
	≤ 0.43	≤ 0.24	*Products meeting these criteria also qualify in the Southern zone.*
Southern	≤ 0.65	≤ 0.40	Prescriptive
	≤ 0.66	≤ 0.39	Equivalent Performance
	≤ 0.67		
	≤ 0.68	≤ 0.38	
	≤ 0.69	≤ 0.37	
	≤ 0.70		
	≤ 0.71	≤ 0.36	
	≤ 0.72	≤ 0.35	
	≤ 0.73		
	≤ 0.74	≤ 0.34	
	≤ 0.75	≤ 0.33	

Skylights

Climate Zone	U-Factor[1] 2001 NFRC rated at 20°[3]	U-Factor[1] RES97 rated at 90°[4]	SHGC[2]
Northern	≤ 0.60	≤ 0.45	Any
North/Central	≤ 0.60	≤ 0.45	≤ 0.40
South/Central	≤ 0.60	≤ 0.45	≤ 0.40
Southern	≤ 0.75	≤ 0.75	≤ 0.40

[1] *Btu/h.ft².°F*

[2] *Fraction of incident solar radiation.*

[3] *U-Factor qualification criteria based on 2001 NFRC simulation and certification procedures that rate skylights at a 20-degree angle. Although reported U-Factor is higher than RES97 rated products, energy performance at the ENERGY STAR minimum qualifying level is equivalent.*

[4] *NFRC certification using the 1997 NFRC procedures for residential windows (RES 97) that rated skylights at a 90-degree angle. Skylights rated under this procedure may be present in the marketplace until March 31, 2008. NFRC labels for products using this procedure state: "RES97 rated at 90 degrees."*

Incentive Program

Table 1.
State Windows Programs

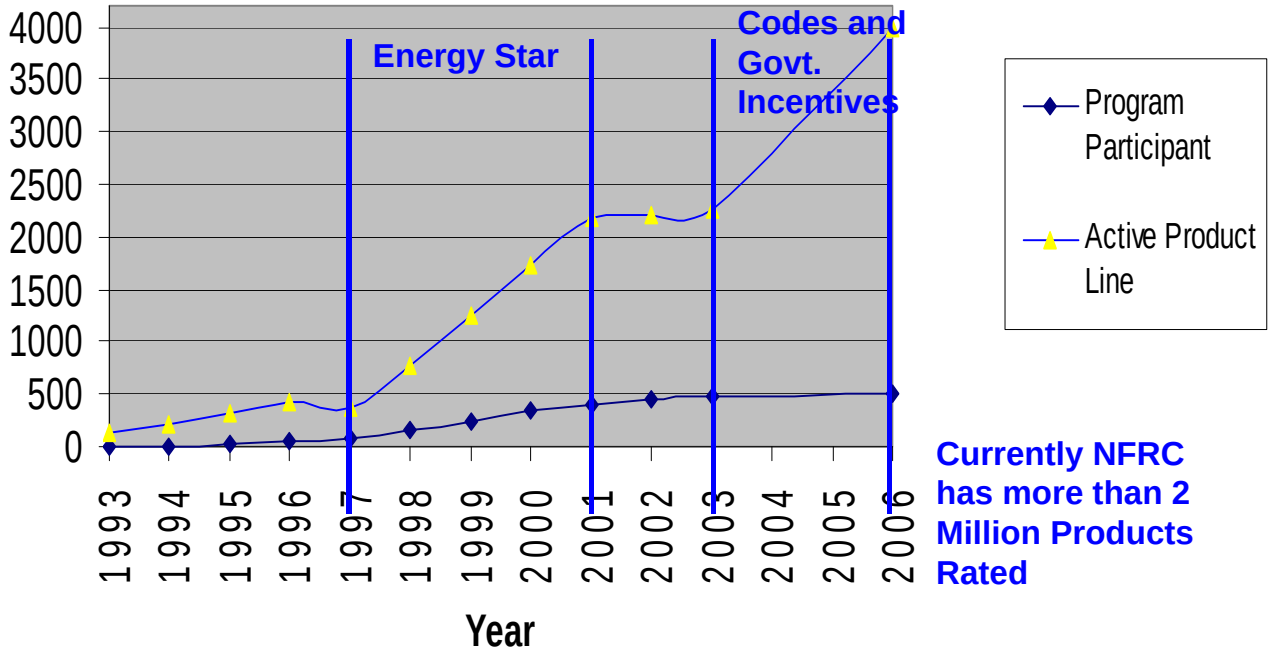
STATE	PROGRAMS
California	13
Colorado	1
Idaho	3
Iowa	3
Massachusetts	3
Montana	2
New Hampshire	1
New Jersey	1
New York	1
Oregon	27
Washington	19
Wisconsin	1
Wyoming	1

Tax Credit

- the IRS has provided a “special rule” (on page 7 of the IRS notice 2006-26) for claiming the residential tax credits with **Energy Star** windows:

- **.03 Special Rule for Energy Star Windows and Skylights. A taxpayer may treat an exterior window or skylight that bears an Energy Star label and is installed in the region identified on the label as an Eligible Building Envelope Component and may rely on such Energy Star label, rather than on a manufacturer’s certification statement, in claiming the § 25C credit.**

NFRC Program Growth Resulting in more use of Energy Efficient Products in Market Place



Impact Rating Can Have in The Market Place

The impact of successful NFRC rating program, in the year 2003 in the USA, 41% of all conventional residential windows were energy rated and were classified as Energy Star® Windows; which would not have been possible without NFRC ratings. As a result, NFRC was active in saving over 7 billion BTU's (and 2 million kW's peak load) in just one year (2003).

Key Conclusions

- Cannot effectively implement building codes without robust product rating and certification.
- Energy Demand in a building should be first minimized for renewable and clean source energy to be cost effective and be successfully implemented.
- Product rating and certification help build consumer confidence.
- Collaborative research and development program to expediently develop newer technologies is essential to achieve building energy efficiency goals
- Product Longevity (life expectancy), and cost effectiveness.

?

Thank You

winbuild.usa@gmail.com

Building Envelope Energy Efficiency Policy in Mexico

Jesús Arce Landa
Iván Hernández Pérez

National Center for Research and Technology Development (***cenidet***)

Mechanical Engineering Department: Thermal Systems

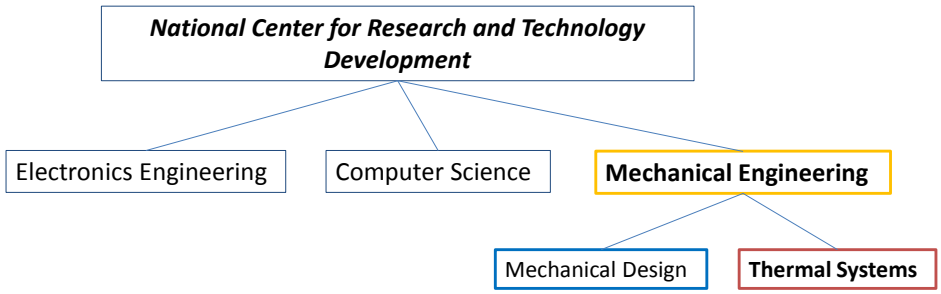
Bangkok, Thailand, October 22, 2013

1

Cuernavaca, Morelos, México

2

Research areas at Cenidet-Mexico



3

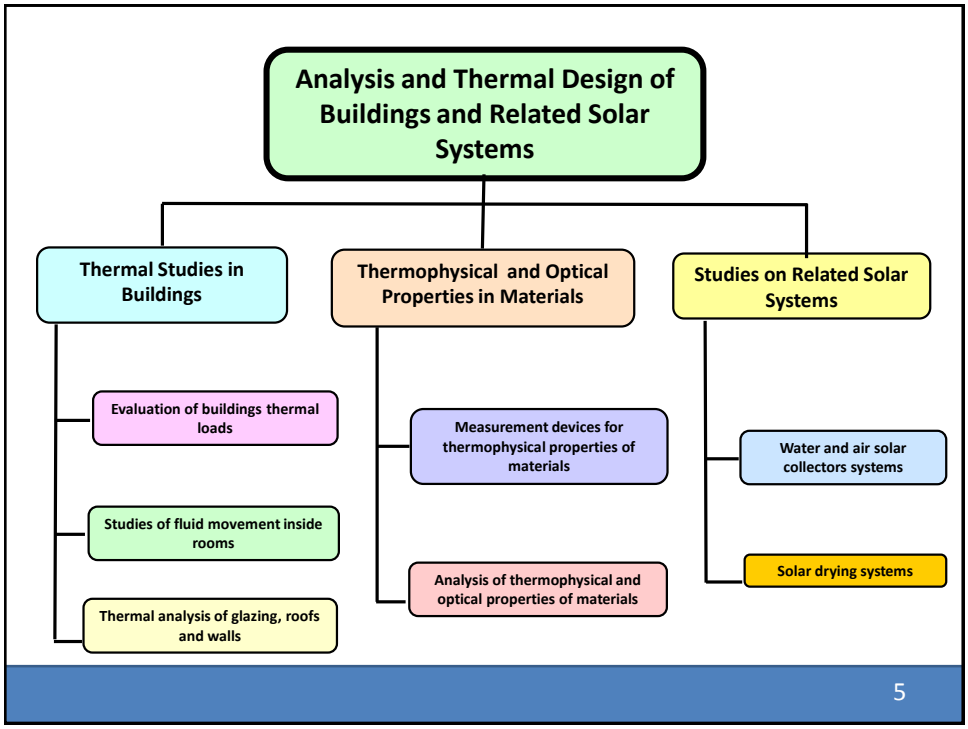
Thermal Systems Research Group

1. Gabriela Álvarez García
2. Yvonne Chávez Chena
3. Jesús Arce Landa
4. Jesús Perfecto Xamán Villaseñor
5. José Jassón Flores Prieto





4



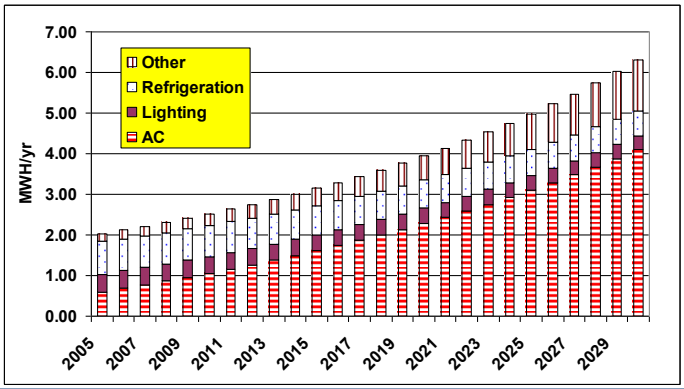
Introduction

Buildings energy consumption in Mexico is expected to increase in the next years

In Mexico, the electricity consumption in 2004 was (Energy Secretariat, 2005):

Commercial: 46,449X10^6 MJ

Residential: 146,639x10^6 MJ



There are three typical types of windows for buildings with frames of four main materials

Aluminum

Steel

Wood

PVC

Casement

Fixed

Horizontal slider

7

Current State of Norms for Mexican Buildings

• **NOM-008-ENER-2009.** Energy Efficiency in Buildings.- Envelope of buildings for non-residential use.

• **NOM-020-ENER-2011.** Energy Efficiency in Buildings.- Envelope of buildings for residential use.

• **NOM-024-ENER-2012.** Thermal and Optical Characteristics of Glass and Glazing systems for Buildings. Labeling and Test Methods.

• **NMX-C-460-ONNCCE-2009. "**R" Value for Envelopes of Dwellings for each Thermal Zone in Mexico.

• **PROY-NMX-AA-164-2012.** Sustainable buildings: Criteria and Minimum environmental requirements.

NOM = Mexican Mandatory Norm (standard)
NMX = Mexican Voluntary Norm (standard)
PROY = Norm project (under development stage)

8

NOM-008-ENER-2009. Energy Efficiency in Buildings.- Envelope of buildings for non-residential use.

It was made up by collaboration of 23 organism either public or private, e.g. :

- ASHRAE
- General Direction of Norms (Secofi)
- National Organism of Normalization and Certification of Construction and Edification, S.C., etc.

Its objective is to minimize the heat gain of buildings through its envelope in order to rationalize the use of energy in cooling systems.

The energetic evaluation consists of five steps:

1. To specify the location of the building to be constructed as well as the data of the Verification Unity .
2. To obtain the values of heat gain through the envelope.
3. To calculate the global heat transfer coefficient (*U*) of each envelope component.
4. To compare the heat gain of the building to be constructed against the reference building.
5. To verify if the building complies with the norm.

9

NOM-020-ENER-2011. Energy Efficiency in Buildings.- Envelope of buildings for residential use.

It was made up by collaboration of 21 organism either public or private, e.g. :

- Company association for energy saving in buildings A.C.
- National commision of dwellings.
- National Organism of Normalization and Certification of Construction and Edification, S.C., etc.

Its objective is to minimize the heat gain of buildings through its envelope in order to rationalize the use of energy in cooling systems.

The energetic evaluation consists of five steps:

1. To specify the location of the building to be constructed as well as the data of the Verification Unity .
2. To obtain the values of heat gain through the envelope.
3. To calculate the global heat transfer coefficient (*U*) of each envelope component.
4. To compare the heat gain of the building to be constructed against the reference building.
5. To verify if the building complies with the norm.

10

NOM-024-ENER-2012. Thermal and Optical Characteristics of Glass and Glazing systems for Buildings. Labeling and Test Methods.

It was made up by collaboration of 14 organism either public or private, e.g. :

- ***Cenidet, Mexico.***
- National Organism of Normalization and Certification of Construction and Edification, S.C., etc.
- Saint-Gobain Glass Mexico.

This norm establishes the commitment to certify the optical and thermal characteristics of glazing and glazing systems as well as the test methods for its verification.

The next main characteristics are evaluated, among others:

1. Visible transmittance.
2. Exterior visible reflectance.
3. Solar transmittance.
4. Solar reflectance.
5. Solar heat gain coefficient (*SHGC*).
6. Global heat transfer coefficient (*U*)

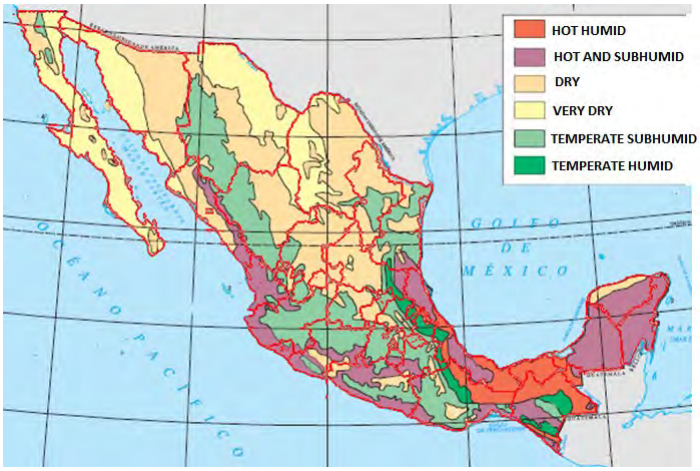
11

Previous studies to NOM-024-ENER-2012.

The next studies have contributed to the development of the NOM024 and they were performed by ***cenidet***

12

Climate regions in Mexico

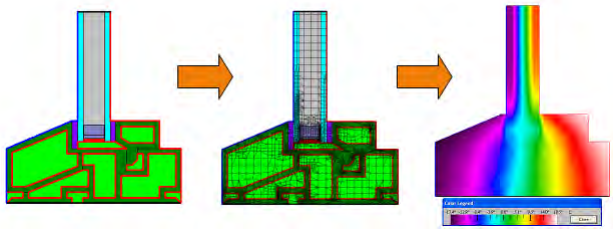


13

Previous studies to NOM-024-ENER-2012.

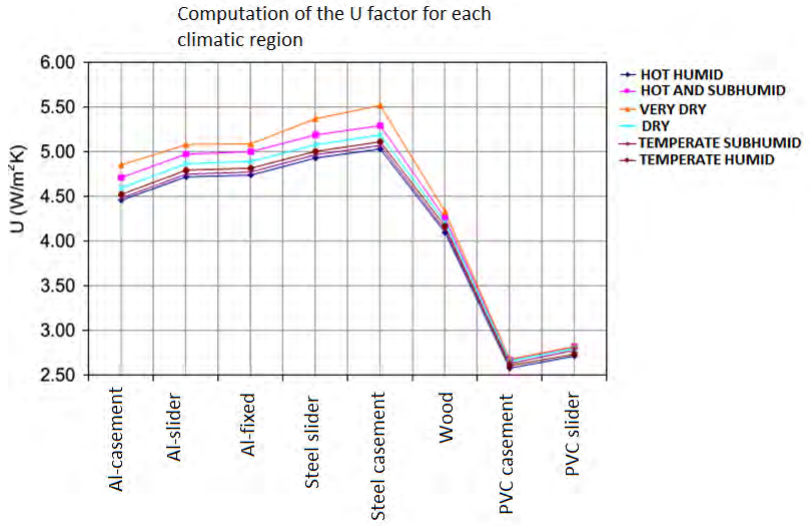
Simulations of windows by using Software WINDOW/THERM were developed to study the Global Heat Transfer Coefficient (*U*) in different locations of México.

THERM is a two dimensional heat conduction program based on Finite Element Method for computation of U factor of window frames



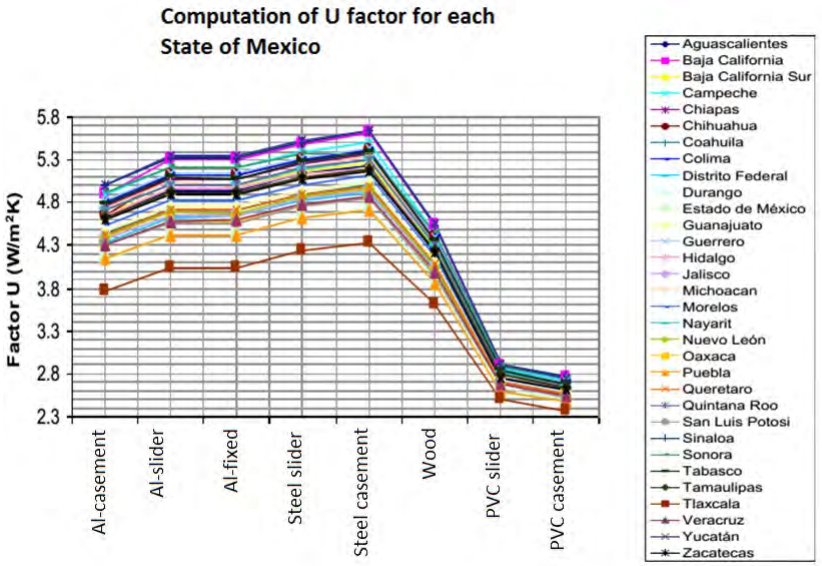
14

Previous studies to NOM-024-ENER-2012.



15

Previous studies to NOM-024-ENER-2012.

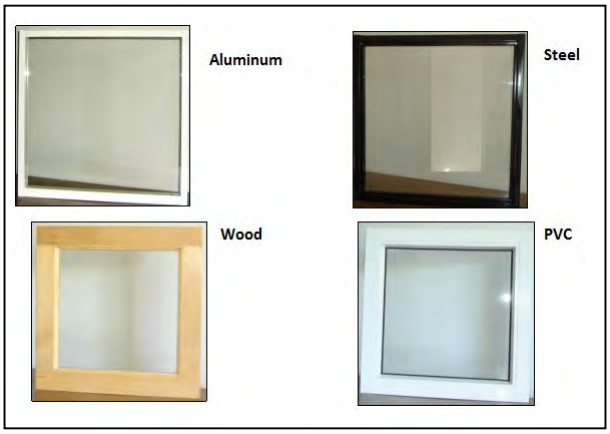


16

Previous studies to NOM-024-ENER-2012.

Experimental

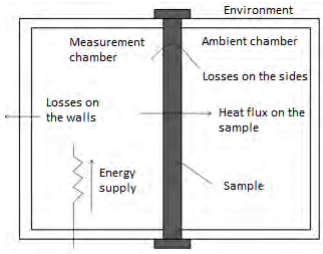
Window utilized for the tests

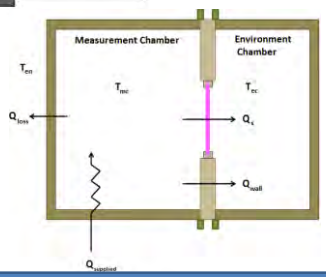


17

Previous studies to NOM-024-ENER-2012.

Hot Box Apparatus

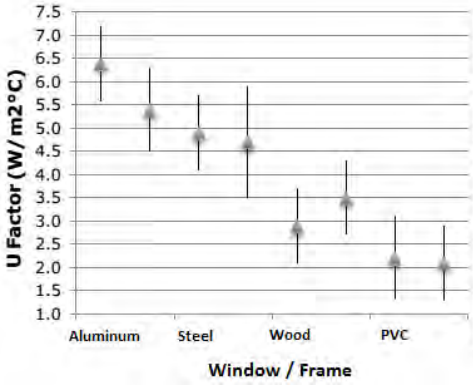




18

Previous studies to NOM-024-ENER-2012.

- *U Factor measured*
- *Two tests*



Window/ Frame	U (W/m²°C)		U_{prom} Factor (W/m²°C)
	First test	Second test	
Aluminum	6.4	5.4	5.9±0.9
Steel	4.9	4.7	4.8±1.0
Wood	2.9	3.5	3.2±0.8
PVC	2.2	2.1	2.2±0.9

19

Previous studies to NOM-024-ENER-2012.

Some comments

- The contribution of the *U* factor on the total *U* window was 15% for the wood frame and 27% for the frame of steel for swing windows.
- If the frame of the window has the U factor greater than the glass, the gains or losses of heat can represent more than 30% of the total heat transfer
- The internal cavities of the frames represent one of the components with greater impact on the heat transfer.
- When evaluating the windows with aluminum, wood and PVC frames, among them, it was observed a big difference on the heat transfer.
- The measured and the calculated results fall in the range of uncertainty of the measurements, hence THERM can be used for Mexican frames.
- Choosing the right frame depending on the climate can contribute to the energy savings

20

Previous studies for roofs

21

The roof is the element most exposed to the solar radiation

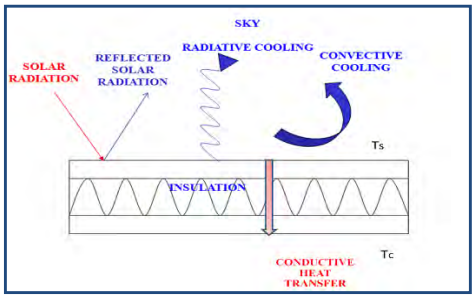
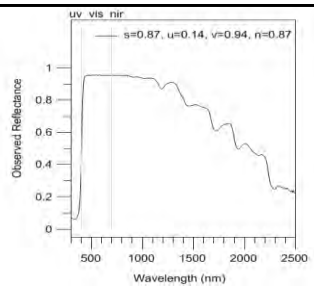
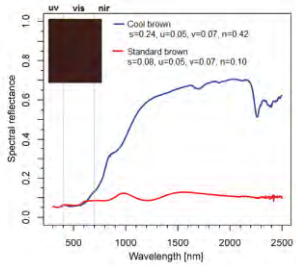


Figure. Heat transfer mechanisms in a roof



Spectral reflectance of a white reflective coating , Levinson et al. (2005)



Spectral reflectance of cool brown and standard brown coatings, Levinson (2009).

22

Theoretical study of a concrete roof with and without solar reflective coating under different climatic conditions of Mexico

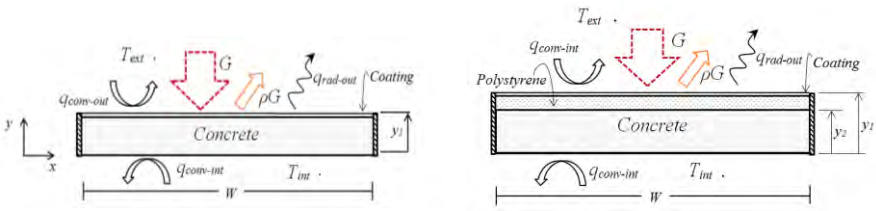


Table. Thermal conductivity of the materials.

Materials	Thermal conductivity, *k* (W/mK)
Concrete	1.7
Polystyrene	0.035

Table. Solar reflectance of the surfaces.

Surface	Solar reflectance, *ρ*
Concrete (gray)	0.328
Reflective coating (white)	0.859

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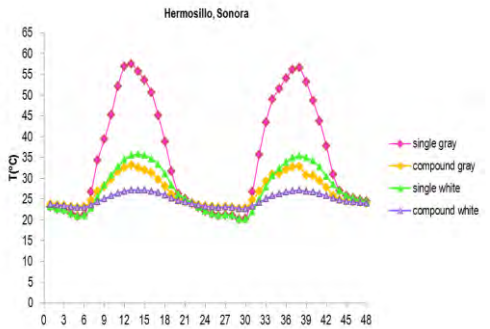
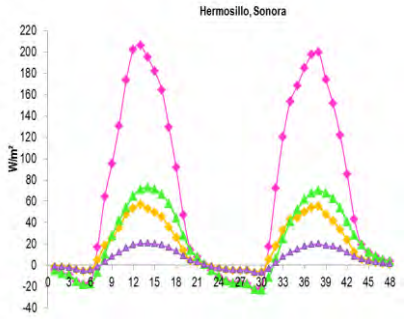


(a) Inside surface temperature



(b) Inward heat flux

Table. Maximum values of interior surface temperature and heat flux during the two day reached by the cases of study.

	Single gray (s.g.)	Single white (s.w.)	Differences between s.g. and s.w.	Compound gray (c.g.)	Compound white (c.w.)	Differences between c.g. and c.w.
	T_{max} (° C)		ΔT_{max}	T_{max} (° C)		ΔT_{max}
Hermosillo	57	36	21 (37 %)	33	27	6 (18 %)
Mérida	62	34	28 (45 %)	32	27	5 (15 %)
	Heat flux max (W/m²)		ΔHF_{max}	Heat flux (W/m²)		ΔHF_{max}
Hermosillo	206	73	105 (64 %)	57	20	37 (65 %)
Mérida	178	67	111 (62 %)	48	18	30 (62 %)

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Conclusions

- The single white roof configuration was able to reduce the interior surface temperature up to 28 °C at midday in comparison to a roof with the original gray color of concrete.
- In hot climates like Hermosillo and Merida, the application of the white reflective coating in a single roof can lead similar results of those reached by the gray roof with insulation with respect to the inward heat flux
- Painting the roof may be a less expensive way to reduce the large heat gains in summer for these cities.
- Currently a norm that takes into account the optical properties of opaque components is under development (**PROY-NMX-AA-164-2012.**)

25

Asia-Pacific Economic Cooperation

26

EECA
Energy Efficiency and Conservation Authority
Te Tari Tiaki Pūngao

New Zealand Government

New Zealand Energy Efficiency Rating Schemes

ENERGY STAR

NABERS NZ

Energy Star® for Windows and NABERSNZ™

October 2013

Presented by: **Nick Smith**

EECA BUSINESS.

EECA energywise.

EECA energywise
THE POWER TO CHOOSE

New Zealand's Most Energy Efficient Products

ENERGY STAR® for Windows in New Zealand

New Zealand Government

EECA Energy Efficiency and Conservation Authority Te Tari Tiaki Pūngao

Why we need to make a difference

Space heating accounts for 34% of all household energy end-use in New Zealand. Much of this energy is lost through the building envelope.

The Energy Star programme intends to promote higher performing product that delivers a lasting investment in energy efficiency and comfort for the consumer.

*HEEP Year 10 Report

What is ENERGY STAR and where does it fit in?

ENERGY STAR is the leading international label of product energy efficiency and performance.

It is an easy consumer identifier that simply means...Best in Class! and is applied to approximately the top 25% of most energy efficient products within a category.

ENERGY STAR

ENERGY STAR PARTNER

ENERGY STAR

New Zealand's Most Energy Efficient Products

The New Zealand ENERGY STAR programme continues to grow…

21 product categories with over 1,800 models from 74 Partner Suppliers

Why promote ENERGY STAR?

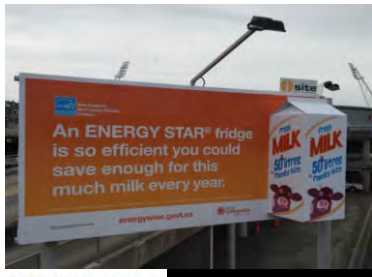
Because it provides consumers with very clear messaging around energy efficiency… particularly for those who are ambivalent or not technically minded…

ENERGY STAR

84%
Current Consumer awareness around this label

Introducing this label has affected a consumer product purchasing behavioural change.

Reinforced messaging



The Power of ENERGY STAR Labels

When ENERGY STAR **is added** to a product that has an energy rating label, consumers are more likely to buy that product

New Zealand Window Market

The New Zealand window market differs to many countries due to;

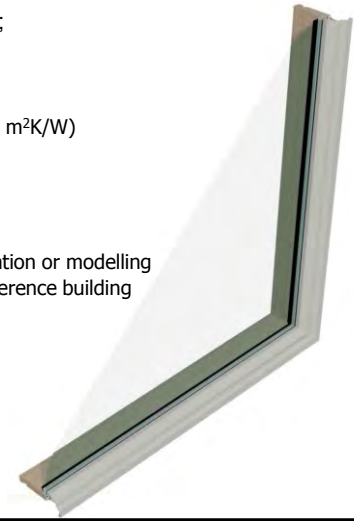
- Temperate climate
- Building code requirements
- Previously dominated by aluminium framed, single glazing
  - Non-thermally Broken Aluminium Frames
  - Older timber frames
- Bespoke – No standard sizes, typically larger windows
- Frame manufacturers & glazing manufacturers provide product to Window Fabricators
- Uses R-Values (1/U-Value)

Below: map of climate zones

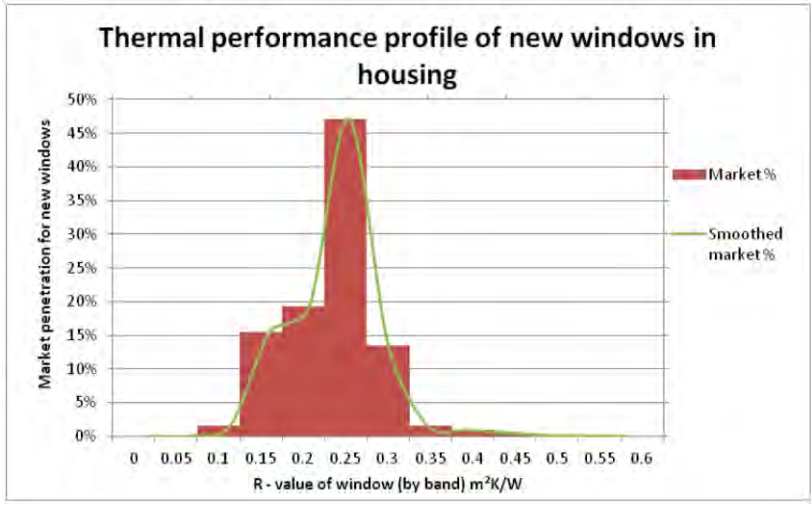
Current Window Requirements

Set by the New Zealand Building Code (NZBC);

- For new builds. In effect from 2008
- Schedule method requires R-0.26 W/m^{2}K (U-3.85 m^{2}K/W)
- Achieved by 'generic' clear double glazed 4-12-4 non thermally broken aluminium frames
- Lower window R-values can be used if the calculation or modelling method can show that it performs better than the reference building (heat loss is prevented elsewhere in the envelope)



Current Market Share



NZ Window Consumers

Current barriers to the adoption of energy efficient windows;

- Capital cost – around 19% - 100% more expensive
- Consumers now have a good understanding of double glazing but little to no understanding of frame performance or low-E glazing
- Lack of voluntary or regulatory incentives/requirements
- Landlords / developers choosing on cost and not having to pay subsequent energy bills

Previous Rating Schemes

Window Efficiency Rating System;

- Adopted from Australian WERS scheme
- Did not obtain significant market uptake
- No regulatory or voluntary drivers in NZ
- Complex
- Manufacturers didn't like the 'standard' sized frame being used as a comparison

Energy Star for Windows

Intent;

- Increase the uptake of energy efficient window technologies in NZ
- Warmer, drier, healthier homes
- Potential lead to Energy Star programme for building products or;
- Energy labelling for windows and/or building products

ENERGY STAR New Zealand's Most Energy Efficient Products

Technical Details

Scope;

- Windows and doors (referred to as windows) in the scope of NZS4218:2004 – Small building envelope.

Exclusions;

- Complex framing systems such as curtain walling
- Window systems that extend over more than one floor, or include spandrel panels
- Any window system that cannot be accurately modelled with the verification software and modelling instructions
- Horizontal glazing systems and skylights

Technical Details

Size;

- Industry does not want a standard size and type of window
- Energy Star for individual windows
  and a 'houselot' of windows

Technical Details

Performance Requirements;

- R-0.32 W/m²K (U-3.13 m²K/W)
- Across New Zealand
- No SHGC requirement
- Must use an IGU
- Other NZBC requirements

Standards

Standards: Coefficients and modelling;

- Environmental Conditions (Recently updated by industry - NZ Specific)
  - Surface coefficients from EN ISO 10077

Glazing Surface Coefficients			
Name	**Outdoor coefficient**	**Indoor coefficient**	**Total surface coefficient**
Glazing surface coefficients for use in NZ	0.04 m²K/W (h_o = 25 W/m²K)	0.13 m²K/W (h_i = 7.7 W/m²K)	0.17 (m²K/W) (h = 5.88 W/m²K)

  - SHGC coefficients from NFRC 200-2010

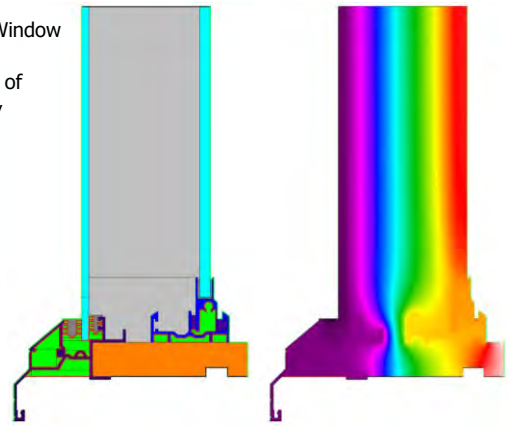
SHGC calculation				
Name	**T_{inside}**	**$T_{outside}$**	**V**	**I_{solar}**
SHGC coefficients for use in NZ	24°C	32°C	2.75 m/s	783 W/m²

- Modelled to EN ISO 10077-2 (With some variations for NZ construction methods)

Window Energy Rating Scheme

Modelling Software;

- Large amount of work done to looking at comparability between software packages
- Looking to use Flixo or Therm & Window
- Proposal to have quick calculation of assemblies built into common industry quoting software



Next Step

Verification, Compliance and Launch;

- Developing verification, certification and compliance processes
- Planned Launch Date: March 2014

NABERSNZ™

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS

What is NABERSNZ?

- Office building rating system
- Voluntary, performance based
- Rates a building's energy performance relative to it's peers

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS

NABERSNZ is based on Australia's NABERS

NABERS

- National Australian Built Environment Rating System
- Launched in 1998 in Australia
- 2011 scale extended to 6 stars
- 2011 became mandatory for selling or leasing office buildings >2000m^2 Net Lettable Area
- Owned and administered in Australia by the New South Wales State Government through the Office of Environment and Heritage (OEH)

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS

NABERS Success in Australia

- Adds Value
  - Research in 2011 found that a 5-star NABERS™ rating delivered a 9% premium in property value, while 3–4.5-star ratings delivered a 2-3% premium in value.
- Encourages energy savings
  - Office buildings that have been re-rated with NABERS energy have demonstrated on average a 0.6 star improvement. This represents an average 9% CO2 saving and energy savings of 23kWh/m2.

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS

NABERSNZ

- Publically launched in New Zealand in June 2013
- Government-backed rating scheme
- Voluntary in NZ
- Developed in close consultation with industry
- Adapted from NABERS to meet New Zealand needs and conditions

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

NABERSNZ Key Differences

- Energy use only. Water use coming soon for whole building ratings.
- Designed for the New Zealand climate, method for determining floor area

- Adapted from NABERS to meet New Zealand needs and conditions by Energy Management Association of New Zealand (EMANZ), working with Exergy in Australia.
- Used research from BEES (Building Energy End-use Study)

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

What does NABERSNZ rate?

Existing commercial offices

Tenancy
(Energy)

Base Building
(Energy)

Whole Building

The NABERSNZ Philosophy is:

- to compare apples with apples
- make allowances for core service delivery functions
- Strict adherence to detailed set of rules.

NABERSNZ star rating

Ratings range from 1 to 6 stars

- 2.5 to 3 stars is the market average in New Zealand

0	Very Poor
★	Poor
★ ★	Below average
★ ★ ★	Market average
★ ★ ★ ★	Very good
★ ★ ★ ★ ★	Market leading
★ ★ ★ ★ ★ ★	Aspirational

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

Two approaches to NABERSNZ ratings

1) Self Assessment

2) Certified Rating

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

NABERSNZ ratings options

Self Assessment

(www.nabersnz.govt.nz)

- It's free
- Only a rough guide
- Results can be saved and revisited in future
- The results can't be promoted !

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

NABERSNZ ratings options

Certified Rating

- Completed by a certified assessor
- Valid for one year

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND

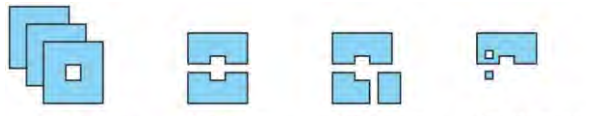
Key Components

1. Rated area
2. Rated hours
3. Counting computers and occupants
4. Energy Consumption

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS.

Rated Area

- The size of the tenancy or building being rated
- Used to adjust energy consumption for fair comparison
- Standard measurement: rentable area
  - ❖ PCNZ standard and lease agreements used



If the Rentable Area has multiple floors, divide it into separate floors

If any floor has multiple tenancies, divide it into separate tenancies

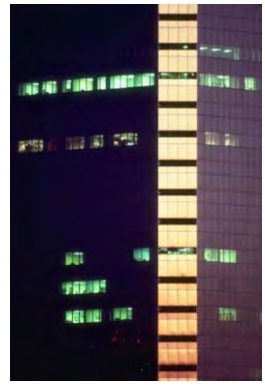
If any tenancy has areas with different periods of occupation or different operating hours, divide them into separate Functional Spaces

If any floor, tenancy or operational area includes a computer server room, make it a separate Functional space

ADMINISTRATOR LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS.

Rated Hours

- The hours of occupation of a tenancy or building being rated
- Used to adjust energy consumption for fair comparison
- Different methodology for base building and tenancy/whole building ratings



Number of Computers

- Whole building and tenancy ratings only
- The number of computers in the rated space in regular use
- Statistical method available for large buildings

Energy Consumption End Use

Tenancy

- Tenant lighting & power
- Tenant-controlled supplementary air conditioning
- tenant-installed signage within or on the building
- Generator fuel (tenant usage)

Whole Building:

- Combination of both

Base Building

- Common-area lighting & power
- Lifts and escalators
- A/C and ventilation
- Exterior signage
- Generator fuel (central services)
- Car park ventilation & lighting (for tenant use)
- Exterior lighting

3.5 Star (typical)

Façade

- Fully glazed all orientations
- Single glazed, tinted
- No external shading

HVAC

- Constant volume or VAV

Maintenance

- Has not been re-commissioned or tuned

Lighting

- T8 Fluorescents, 15-20W/m2, zoning by floor

4.5 Star (typical)

Façade

- Glazing and spandrel panels to improve window to wall ratio
- Single glazed, tinted
- Fixed external shading

HVAC

- VAV or low temperature VAV
- Well tuned and re-commissioned

Lighting

- T5 fluorescents, 10-15W/m2, zoned lighting controls

Renewable Energy

- May have some on site renewables

5.5 Star (typical)

Façade

- Orientation-sensitive window to wall ratio
- Double glazed / double skin, tinted
- Fixed/ active external shading

HVAC

- Low temperature VAV or Passive chilled beams
- Fully retro-commissioned and well tuned

Lighting

- T5 fluorescents and LEDS, 5-10W/m2, zoned lighting (core and perimeter, presence detection and photocell control)

Renewable Energy

- Solar thermal, PV or tri generation

Meridian Building

ADMINISTRATOR NZGBC | LICENSEE OF NABERS IN NEW ZEALAND EECA BUSINESS

SPEAKER'S BIO

杨仕超 Shichao Yang

- Master of building environment physics, graduated from Zhejiang University in December, 1988
- Vice-president of Guangdong Provincial Academy of Building Research
- Professor of building environment physics engineering
- Member of Energy Efficiency Experts Committee of MOHURD (The Ministry of Housing Urban Rural Development of the People's Republic of China)
- Member of Green Building Experts Committee of MOHURD
- Member of Fenestration Energy Efficiency Performance Labeling Experts Committee of MOHURD

Fenestration Energy Efficiency Performance Labeling of China

Shichao Yang

Guangdong Provincial Academy of Building Research

Fenestration Energy Efficiency Performance Labeling of China

- ◆1 Research History
- ◆2 Implementation Process
- ◆3 Labeling Labs in China and Their Responsibility and Requirements
- ◆4 Relevant Standards
- ◆5 Dedicated Software
- ◆6 Current Situation
- ◆7 Next Step

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2002

- The MOHURD started the research of Fenestration Energy Efficiency Performance Labeling according to the NFRC system, supported by the Energy Foundation.

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2004

- The technical standard , Calculation Specification for Thermal Performance of Windows, Doors and Glass Curtain-walls (JGJ/T 151-2008), began to draft , based on ISO 15099 and unified Chinese boundary conditions, fulfilled in 2008.
- The Chinese Glass Database and the Optics CC Software began to establish , which was preliminarily fulfilled in 2006.
- The Management Regulation began to draft， including implementation process, Labeling Labs management , etc.
- The working group was established, which is the predecessor of the Experts Committee .
- The first batch of 11 Labeling Labs started to establish.

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2006

- The MOHURD issued the Fenestration Energy Efficiency Performance Labeling Pilot Management Regulation （Jian Ke[2006]No. 319），which marked the labeling system was formally implemented.

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2007

- The MOHURD released three works specification, Fenestration Energy Efficiency Performance Labeling Pilot Specification, Fenestration Energy Efficiency Performance Labeling Labs Management Specification, and Fenestration Energy Efficiency Performance Labeling Experts Committee Regulation.
- The first batch of 11 labeling labs was approved to formally carry out the evaluation work.

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2009

- The calculation software of fenestration thermal performance was finished, applied in evaluation work on 1st January, 2011. In 2012, the management software, MOC-I, was developed to realize information and automation.

1 History of Research on Fenestration Energy Efficiency Performance Labeling of China

In 2010

- The MOHURD issued The Notice on Further Strengthen the Fenestration Energy Efficiency Performance Labeling Work , to speed up its popularization.
- Guideline for Fenestration Energy Efficiency Performance Labeling began to draft， which was issued in May 2012.

Now

- Until the end of 2012, 1372 fenestration products from 146 companies have been granted the Fenestration Energy Efficiency Performance Labeling, including aluminum, plastic, wood, aluminum-wood, aluminum-plastic, fiberglass fenestration. And 25 labeling labs have been approved to carry out the evaluation work.

2 Implementation Process of Fenestration Energy Efficiency Performance Labeling

- （1）Requirements of companies applying the labeling
  - The Corporate Business License or Agency Registration Certificate granted by the government.
  - Necessary production equipment.
  - Enough production capacity, product testing equipment, and area of production place.
  - Products should comply with relevant national standards and should be certificated through type test.
  - Reliable quality assurance system, and normal production assurance.

2 Implementation Process of Fenestration Energy Efficiency Performance Labeling

- （2）Application and implementation process of the labeling
  - ① The company apply to one of the labs.
  - ② The lab audit the application documents.
  - ③ The company sign the evaluation agreement with the lab.
  - ④ The lab carry out the evaluation work, including production site inspection, product sampling and testing, and product thermal performance simulation.
  - ⑤ The company submit the relevant documents to the RISN (Research Institute of Standard and Norm, a department of the MOHURD), to apply the labeling.
  - ⑥ The RISN organize specialist team to carry out the examination by letter.
  - ⑦ The RISN organize the checking, publicity and certification issue.

3 Labeling Labs in China and Their Responsibility and Requirements

- （1） Responsibility of the labeling labs：
  - In charge of the production place and conditions inspection
  - In charge of the sampling of the standard size product
  - In charge of the testing and simulation of thermal performance of the specimen , issuing the evaluation report.
  - In charge of other relevant work in the agreement.

3 Labeling Labs in China and Their Responsibility and Requirements

- （2） Requirements of labeling labs：
  - An independent legal entity.
  - Work place, testing equipments and other necessary condition should be enough, and the qualified scope for testing should be granted by government.
  - The lab should have undertaken researches of building energy efficiency or taken part in drafting relevant standards, and should work on fenestration testing.
  - The lab should have staff with relevant professional backgrounds, such as building environment physics、 building material、 mechanical technology .
  - The lab should have perfect laboratory management system, equipment management specification.
  - Staffs should be in knowledge with relevant standards, building fenestration industry status and production process .
  - The lab should not be engaged in building fenestration production, sales, or supervision, etc.

3 Labeling Labs in China and Their Responsibility and Requirements

- （3） Labeling Labs layout ：
  - In October 2007, the first batch, 11 labeling labs was approved.
  - In November 2011, the second batch, 10 labeling labs was approved.
  - November 2012, the third batch, 4 labeling labs was approved.

blue block means those provinces, which has established labeling lab.

4 Relevant Standards of Fenestration Energy Efficiency Performance Labeling

- Calculation specification for thermal performance of windows, doors and glass curtain-walls , JGJ/T 151-2008；
- Graduations and test methods of air permeability, water tightness, wind load resistance performance for building external windows and doors, GB/T 7106-2008；
- Graduation and test method for thermal insulating properties of doors and windows, GB/T 8484-2008；
- Glass in building — determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors , ISO 9050:2003 。
- Guideline for Fenestration Energy Efficiency Performance Labeling, RISN-TG013-2012

4 Relevant Standards of Fenestration Energy Efficiency Performance Labeling

- To regulate and unified the evaluation work , Guideline for Fenestration Energy Efficiency Performance Labeling was started to draft in 2010， then issued in May 2012.

4 Relevant Standards of Fenestration Energy Efficiency Performance Labeling

Contents of Guideline

- Part 1 Fenestration labeling management
- Chapter1 Fenestration labeling introduction
- Chapter2 Fenestration labeling application
- Chapter3 Application and supervision of fenestration labeling
- Chapter4 Replacement, modification and extension of certificate
- Chapter5 Extension product application
- Part2 Technical regulation of the evaluation work
- Chapter1 Basic requirements
- Chapter2 Production place and capacities inspection
- Chapter3 Fenestration specimen testing
- Chapter4 Simulation of thermal performance
- Chapter5 The evaluation report
- Chapter6 Labeling information application

5 Software of Fenestration Energy Efficiency Performance Labeling

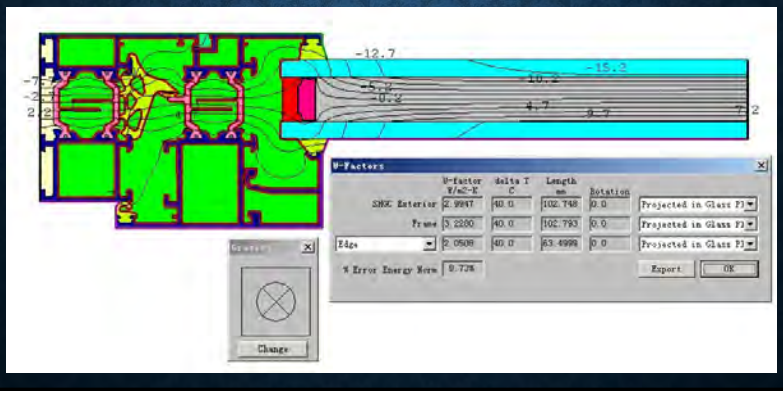
- The Fenestration Labeling Software was developed by Guangdong Provincial Academy of Building Research. It is designed to realize multiple functionalities, including glazing system optics thermal performance analysis, 2D thermal transmission finite element analysis of fenestration frame, fenestration thermal performance calculation, automatic generating simulation report, automatic uploading the evaluation report and so forth.
- The software realizes the standardization, uniformity, intellectualized，and significantly improves the working efficiency of the labeling.

（1） Fenestration Energy Efficiency Performance Labeling **Management**

（1） Fenestration Energy Efficiency Performance Labeling **Management**

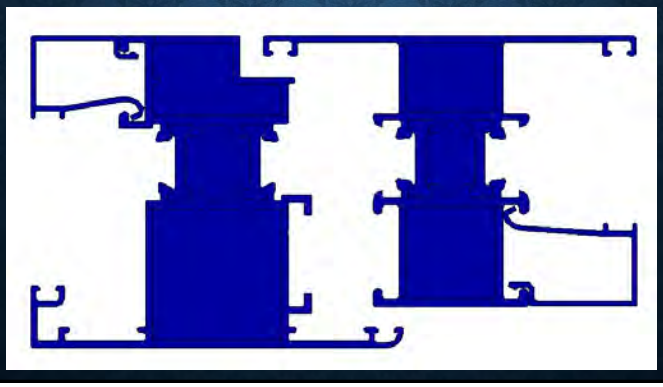
（2） Fenestration thermal performance **calculation**

- The software is able to utilize its calculation core to calculate the glazing system optics thermal performance, 2D finite element analysis of fenestration frame, fenestration thermal performance , and it can generate various kinds of reports based on the results of the calculation. The methodology of calculation which the software deploys is in line with the standard JGJ/T 151-2008.



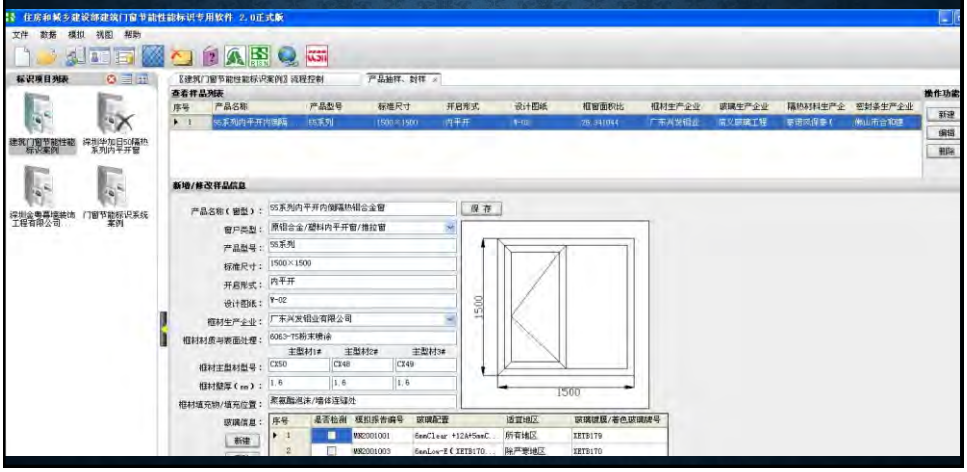
（3）**High efficiently intelligential modeling function**

- 2D finite element calculation of fenestration frame, makes use of the triangle grid to segment the frame area, which makes the calculation precise, fast, and have more calculation capacity.
- It is able to convert DXF file automatically by just loading the DXF file into the software to realize the graphic conversions.



（4） support thermal calculation of all types of fenestration frame

- The software supports all types of fenestration specification, breakthrough the limitations of graphic modeling, supports irregular window, including triangle, trapezoid, circle. The molding is realized by loading the DXF file into the software.



6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （1）The establishment and application of glass database of China
- In 2004, we began to establish the precise format and management methods of glass database.
- In 2005, China Architectural and Industrial Glass Association issued ‘The Management of Glass Database of China (Temporary)’, which was revised in 2010 and 2013.
- The current database includes the recourses coming from 25 glass enterprises, has over 500 types of glasses. The labeling software can access the database or load the global recourses or Chinese data recourses of glasses properties into the database, realize the update online.
- The glass database of China is recognized by fenestration energy efficiency performance labeling of China, which can be directory used and do not have to be tested repeatedly.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- The glass database of China also developed the query software.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （2）The establishment of the plastic fenestration frame database of China

•In 2010,China began to establish the plastic fenestration frame database, which is developed by Labeling Experts Committee, making the management method and technical guideline, and conducting the technical training for the associated doors and windows enterprises.
•The plastic fenestration frame database is based on the standard of JGJ/T 151-2008. It can realize the doors and windows frame's thermal calculations with 21 types of typical of glass system thermal properties.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （2）The establishment of the plastic fenestration frame database of China

•Fenestration energy efficiency performance labeling can directly make use of the completed molding node to do the simulation calculations, the labeling lab does not have to do molding repeatedly.
•In 2012, total 11 enterprises and 7 labeling labs participated in the validation tasks. 12 enterprises with 35 series of products submitted the data and files into the database.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

The plastic fenestration frame database of China

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （3）The construction of Fenestration Energy Efficiency Performance labeling website
- In 2010, the MOHURD began to design the Fenestration Energy Efficiency Performance labeling website, and the website was officially released in 2010.
- The labeling website can combine with the labeling dedicated software, together to realize the functionalities.
- The enterprise user can fill up the enterprise information and the product information on the labeling website, and also apply for the labeling consignation. The information filled up on the labeling website will be transferred to the labeling software through the internet, and then the labeling lab will transfer the corresponding evaluation document back to the website. The website can automatically generate the product and enterprise information access for the user.
- Website: http://www.windowlabel.cn

The Fenestration Energy Efficiency Performance labeling website

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

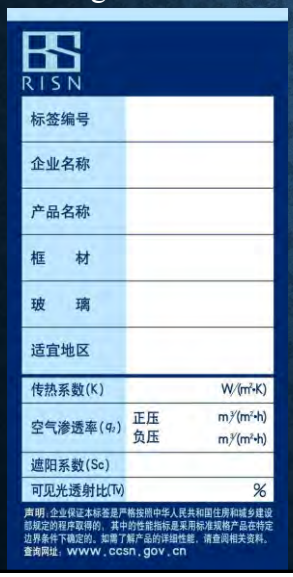
- （3）The construction of Fenestration Energy Efficiency Performance labeling website
- 1)Home page: user guideline and associated information of labeling
- 2)Labeling policy: Introductions labeling policy and associated rudiments.
- 3) Labeling application and its procedurals: Introductions of labeling application and its procedurals, guideline of enterprise application labeling.
- 4)Labeling lab: Introduction of the approved labeling lab's descriptions and its contact way, and associated documents.
- 5)Labeling products: the inquiry for the products and enterprises which have got labeling certificate is available. The inquiry information include: product type, product series, frame material, the way of opening, climate area, the range of heat transfer coefficients, the range of shading coefficients, so forth.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （3）The construction of Fenestration Energy Efficiency Performance labeling website
  - 6)Local situation: Introduction of local provinces and cities' policies and measures for labeling
  - 7)Policies and regulations: Introduction of the law, policies and regulations and administrative documents associated with labeling in China.
  - 8)Standard specification: Introduction of the standard specification associated with labeling.
  - 9)Dedicated area for downloading: It can download the list of labeling evaluation consignation materials, the list of labeling application .materials, table template, to guide the user to apply for the labeling application, and help the labeling lab staff finish the evaluation work.
  - 10)Service area: Introduction of the fundamental and specialized .knowledge of labeling as well as the specialized knowledge of doors and windows processing design.

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- Labeling label and certificate


RISN

标签编号		
企业名称		
产品名称		
框　材		
玻　璃		
适宜地区		
传热系数(K)		W/(m²·K)
空气渗透率(q_1)	正压	m³/(m²·h)
	负压	m³/(m²·h)
遮阳系数(Sc)		
可见光透射比(Tv)		%

声明：企业保证本标签是严格按照中华人民共和国住房和城乡建设部规定的程序取得的，其中的性能指标是采用标准规格产品在特定边界条件下确定的。如需了解产品的详细性能，请查阅相关资料。
查询网址：www.ccsn.gov.cn


NO.

产品名称
Product Name

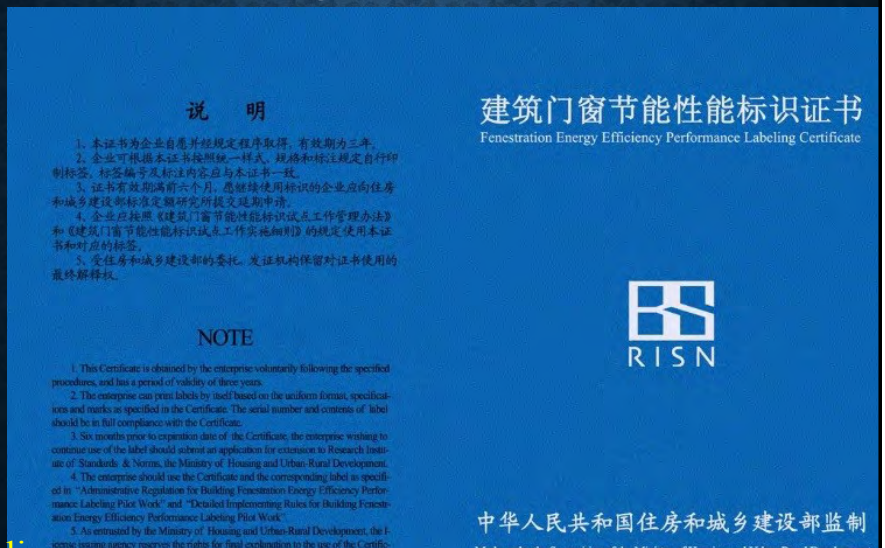
企业名称
Enterprise Name

有效期至
Valid Until

发证机构：
Issuing Agency:

发证日期：
Date of Issue：

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China



说　明

1、本证书为企业自愿并经规定程序取得，有效期为三年。
2、企业可根据本证书按照统一样式、规格和标注规定自行印制标签，标签编号及标注内容应与本证书一致。
3、证书有效期满前六个月，愿继续使用标识的企业应向住房和城乡建设部标准定额研究所提交延期申请。
4、企业应按照《建筑门窗节能性能标识试点工作管理办法》和《建筑门窗节能性能标识试点工作实施细则》的规定使用本证书和对应的标签。
5、受住房和城乡建设部的委托，发证机构保留对证书使用的最终解释权。

NOTE

1. This Certificate is obtained by the enterprise voluntarily following the specified procedures, and has a period of validity of three years.
2. The enterprise can print labels by itself based on the uniform format, specifications and marks as specified in the Certificate. The serial number and contents of label should be in full compliance with the Certificate.
3. Six months prior to expiration date of the Certificate, the enterprise wishing to continue use of the label should submit an application for extension to Research Institute of Standards & Norms, the Ministry of Housing and Urban-Rural Development.
4. The enterprise should use the Certificate and the corresponding label as specified in "Administrative Regulation for Building Fenestration Energy Efficiency Performance Labeling Pilot Work" and "Detailed Implementing Rules for Building Fenestration Energy Efficiency Performance Labeling Pilot Work".
5. As entrusted by the Ministry of Housing and Urban-Rural Development, the license issuing agency reserves the rights for final explanation to the use of the Certific-

建筑门窗节能性能标识证书
Fenestration Energy Efficiency Performance Labeling Certificate

RISN

中华人民共和国住房和城乡建设部监制
Made under the Supervision of the Ministry of Housing and Urban-Rural Development, the People's Republic of China

Labeling certificate

6 Current Situation of Fenestration Energy Efficiency Performance Labeling of China

- （4）The labeling certificate granting situation
- In the end of 2012, there are 146 enterprises with 1327 building doors and windows products have been granted labeling certificate .
- It is mainly distributed in Beijing Jiangsu Zhejiang and Shanghai.
- Beijing has 41 enterprises with 143 products.
- Zhejiang province has 29 enterprises with 125 products.
- Shanghai has 15 enterprises with 36 products.
- Jiangsu province has 23 enterprises with 66 products.
- Sichuan province has 11 enterprises with 23 products.
- Fujian province has 4 enterprises with 12 products.
- Guangdong province has 8 enterprises with 12 products.

7 Next Step

- （1）The labeling will be the evaluation requirement for the acceptance of work
  - The national standard 'The Standard of the Acceptance for Building Energy Efficiency Projects Quality' , GB50411-2007, is revised. New provisions will be incorporated in the standard as the requirement of the acceptance, in order to improve the motility for applying for labeling.
  - For the product which has been certificated, should be checked to see if its features are in line with the labeling. The Thermal transmittance and air leakage should be checked mainly, and should check if the frame section of doors and windows are the same as that in simulation report.

7 Next Step

- （2）The energy efficiency demonstration projects and government invested building projects using labeling products
  - The energy efficiency demonstration projects, energy efficiency modification projects, the building projects invested by government should be using the labeling products and the security housing invested by government should be using the products with the labeling. Associated working requirements should be made.
  - During the "Twelfth Five Year" period, about 35000 thousands security houses and shanty town houses were planed to be built。
  - In 2011, 10000 thousands houses began to be built. In 2012, 7810 thousands houses began to be built， about 6010 out of 7810 thousands houses have been finished the modifications. In 2013, 6000 thousands houses started the modifications, about 4600 out of 6000 thousands houses have been finished the modifications. The construction project of affordable housing is tremendous， by using the products with the label, the development of labeling will be significant.

7 Next Step

- （3） Enhance the glass database

- Current glass database of China includes over 500 types of glass products. However, it is still not comparable with the international glass database (IGDB) in terms of the data size of the glass types, and it is also not able to meet the requirement of labeling. The glass database of China will be enhanced in order to attract more glass enterprises to offer their glasses information. It is estimated that the data size of the glass database of China will be increased to over 1500, to meet the requirement of labeling in 1~2 years.

7 Next Step

- （4） Establish and enhance the doors and windows products database

- The current plastic fenestration frame database just have the data coming from 11 enterprises with over 30 types of products. The database will be enhanced in order to attract more enterprises, and in the meantime to use the data in labeling.
- Establish the fenestration labeling products database. Beside the website inquiry， it also support other ways of inquiry.
- Establish more fenestration labeling products database, such as shading device database and other fenestration material database.

7 Next Step

- （5）The software for application of the fenestration labeling products
- Establish Guangdong province's database based on the fenestration labeling products, and develop the application software which can be installed and run on android and windows 8 for mobile phone. The app is free for download, and it can update automatically.
- The app is able to simulate standard house in different climate area based on fenestration labeling database. It enable the user to conveniently choose the energy efficiency fenestration. It can be installed and run on android and windows 8 for mobile phone. The app is free for download, and it can update automatically.

Thank You !

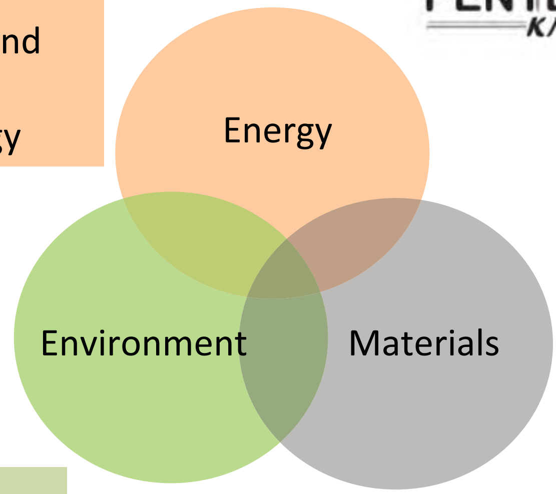
Thailand's Experiences on Testing and Rating Building Materials

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

APEC Policy Workshop for Energy Efficient Building Envelope
22 October 2013
Eastin Grand Hotel Sathorn, Bangkok, Thailand

- Graduate school
- 38 faculty members
- 24 staffs
- Approx. 400 students

- Renewable / alternative energy technology
- PV and energy storage
- technology
- Energy efficiency and management
- Thermal technology



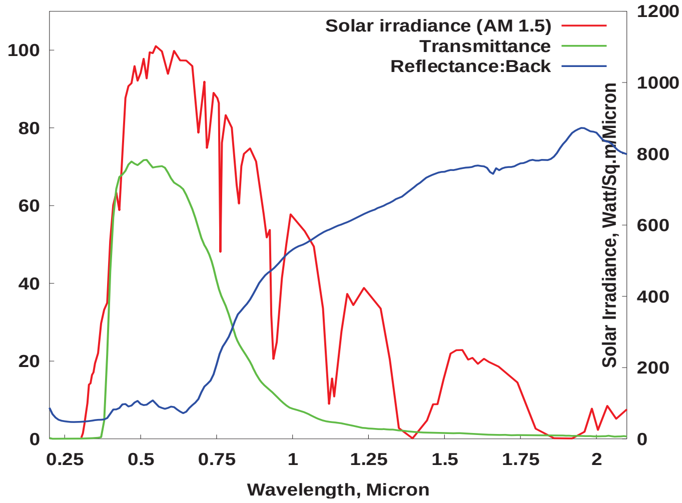
- Polymer technology
- Coating technology
- Metallurgy
- **Energy efficient building envelope materials**
- LCA

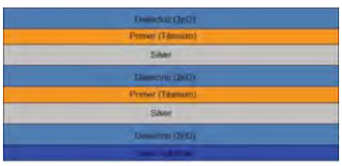
- Climate change and GHG mitigation
- LCA
- Waste management
- Indoor air quality

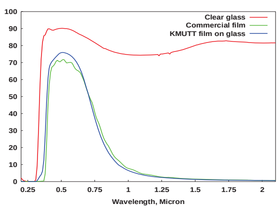
THIN FILM COATING ON GLASS

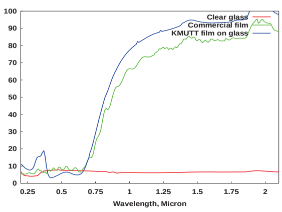
cylindrical stainless steel chamber (18" diameter, 15"-high ... rotary pump (Edwards, model RV12) and a turbo molecular pump (Edwards, model TMP 501)

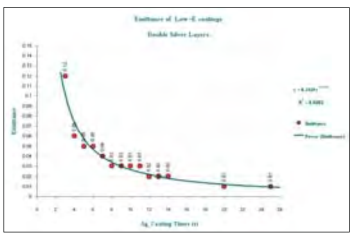
The system is fully equipped with necessary auxiliary equipment such as temperature, pressure gauges and mass flow transducer to control and monitor the system conditions.



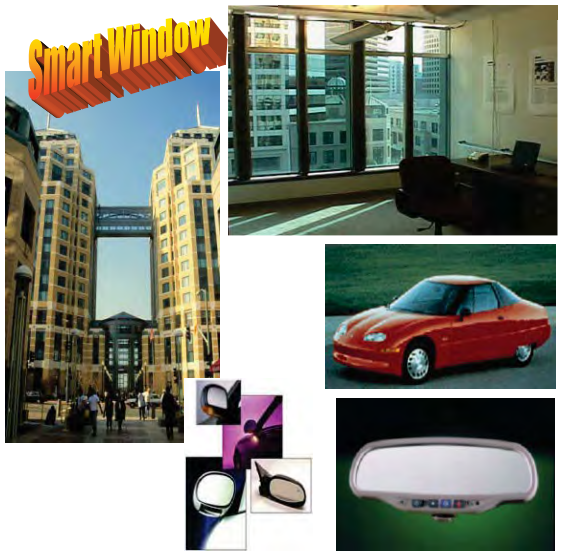


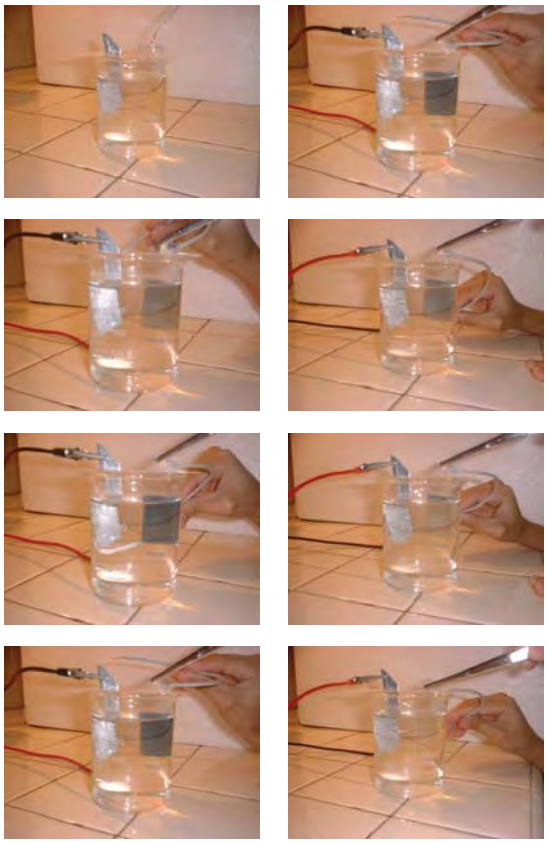


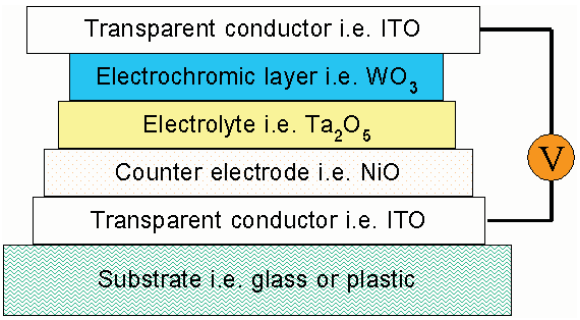




THIN FILM COATING ON GLASS

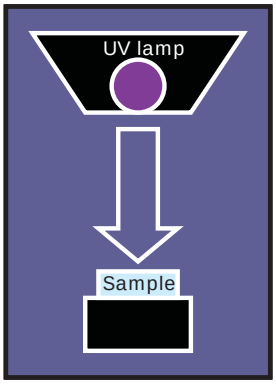






THIN FILM COATING ON GLASS

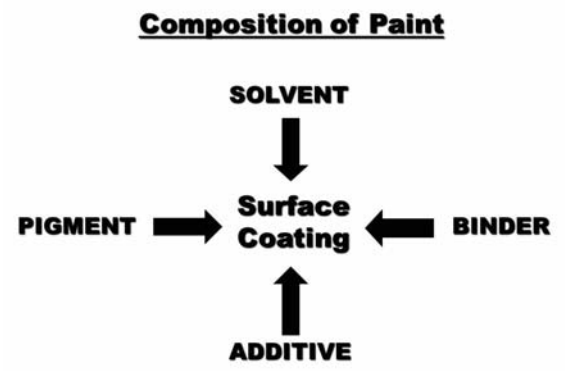
Self cleaning

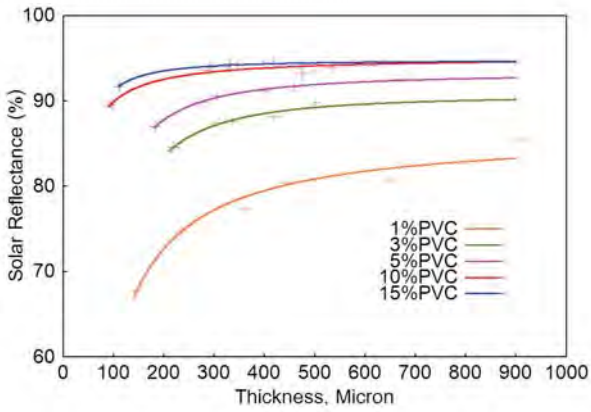


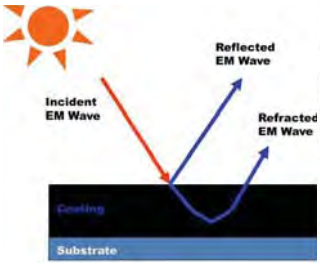
Samples were irradiated by UV light. Samples were taken for contact angle measurements every 5 minutes.

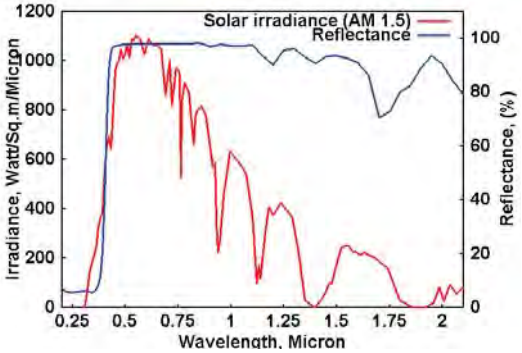
Evolution of surface wetting ability

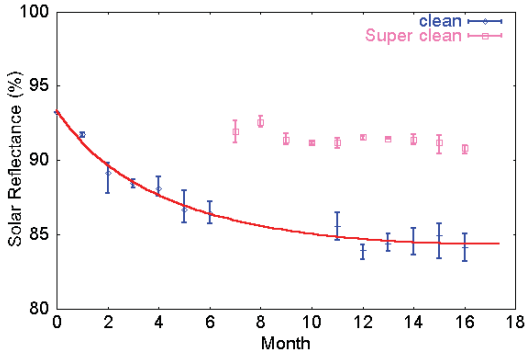
SOLAR REFLECTIVE COATING



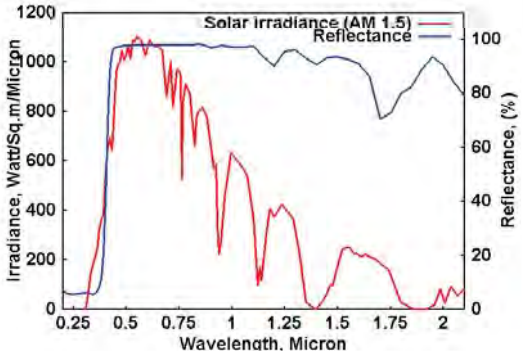






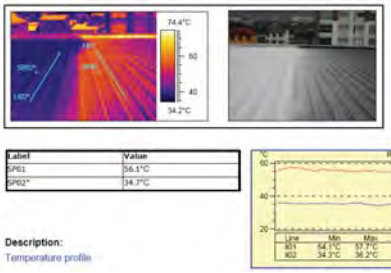


SOLAR REFLECTIVE COATING

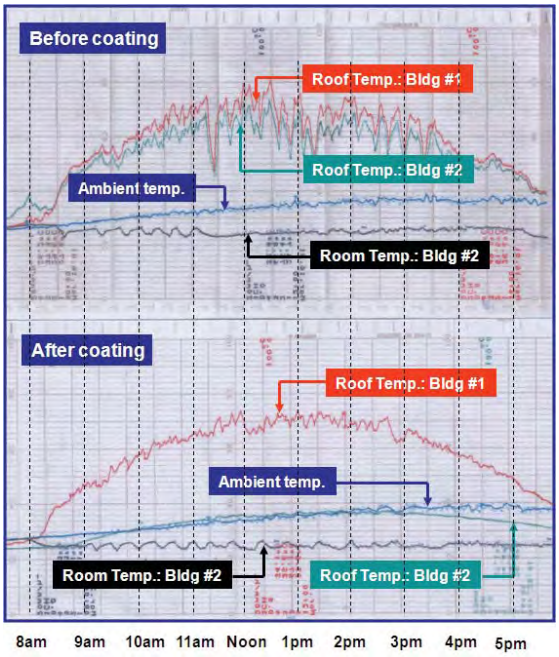


Desirable Energy Efficient Characteristics of High Solar Reflective Coating

- **High solar reflectance**
- **High infrared emissivity**



16.4% Reduction of Energy Consumption in the A/C System.



NIR REFLECTIVE COATING

NIR reflective pigment

Pigment

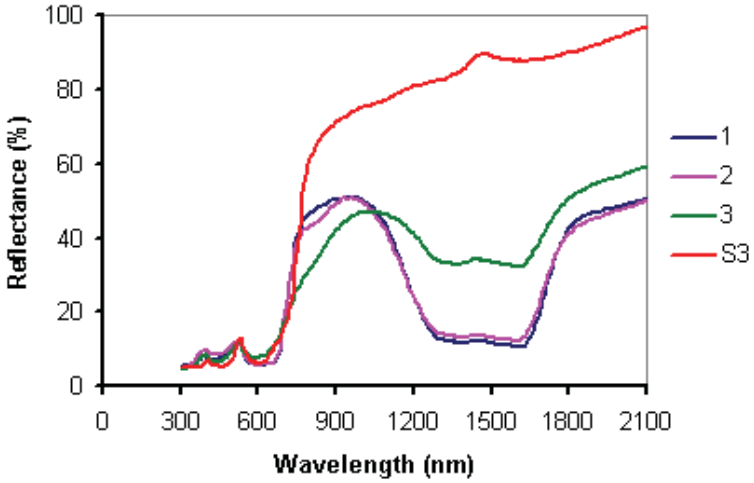
1

2

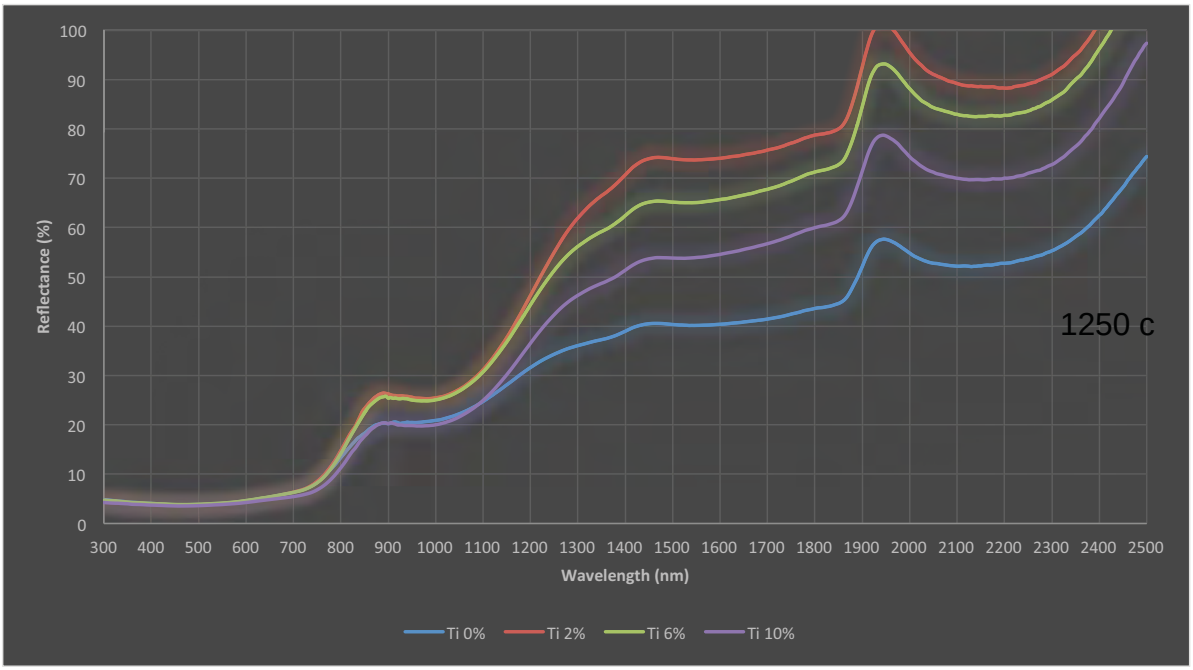
3

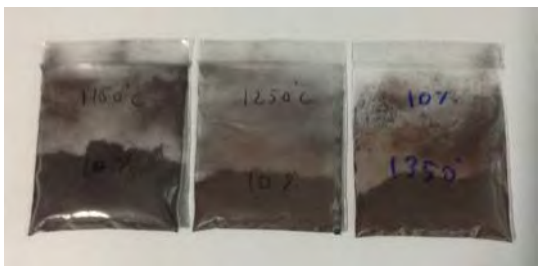
S3

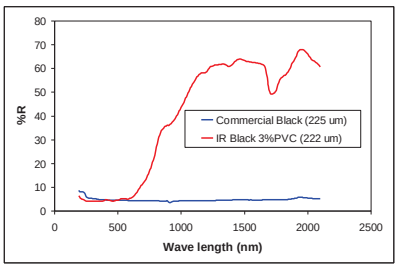
Ceramic tile



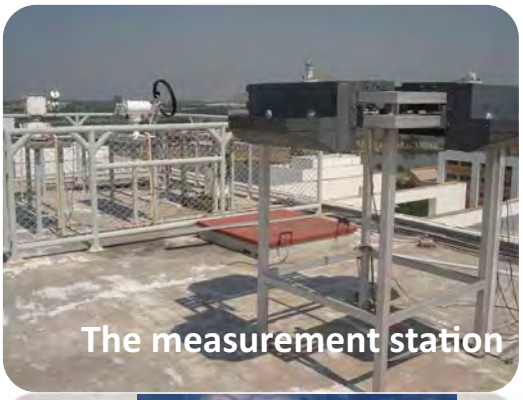
Black IR Reflective Pigment







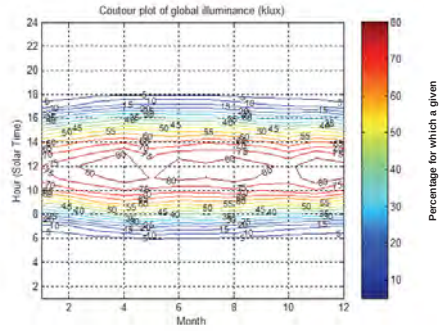
Daylight research

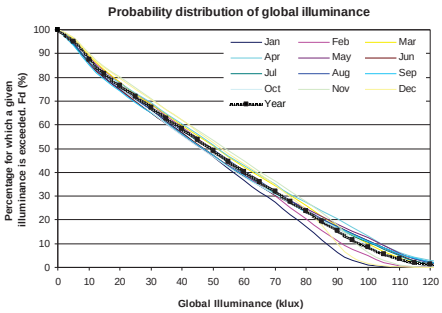


The measurement station

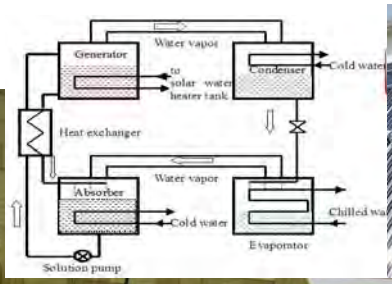
The experimental house

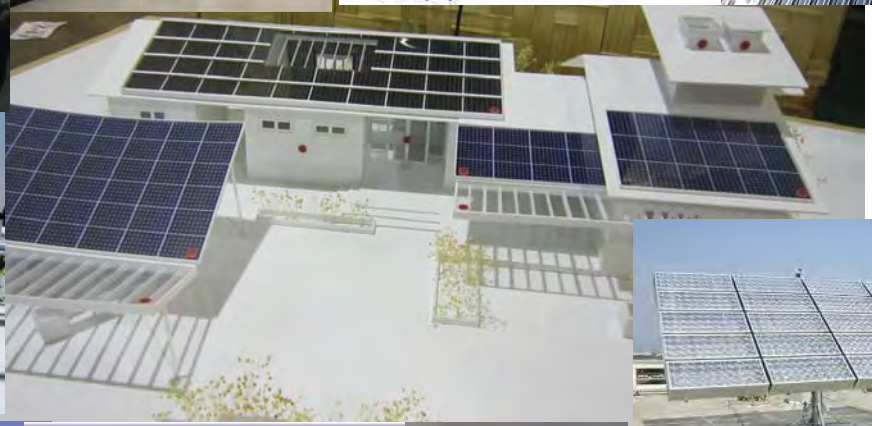
The experimental room with illuminance sensors.

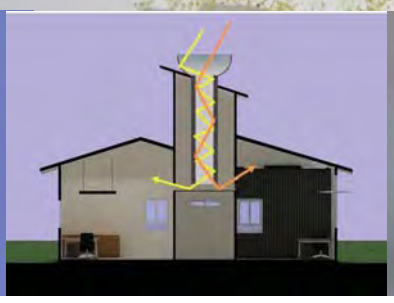


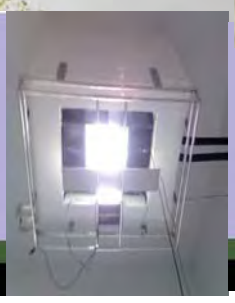


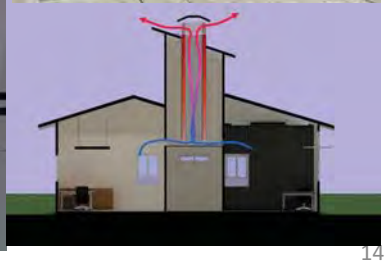
Low Energy Office to Net Zero Energy building…
But now…









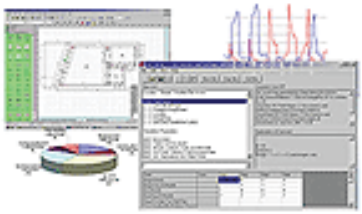


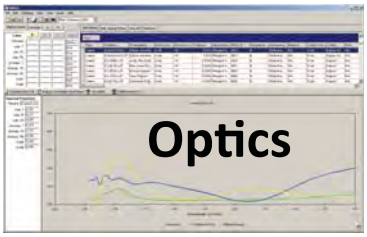
Equipment & Software Tools

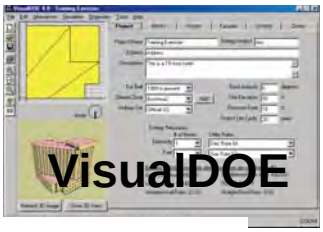
Spectrophotometer

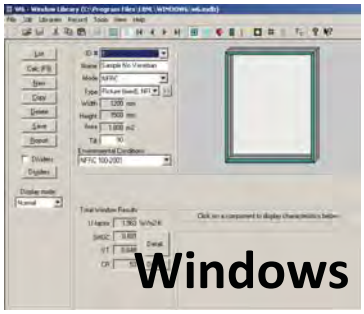
Emissometer [ASTM C1371]

EnergyPlus



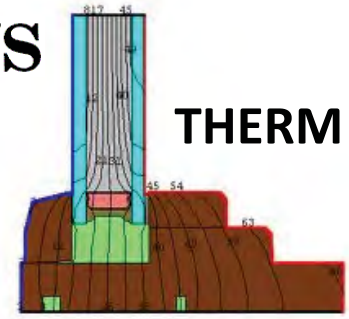






DesignBuilder

TRNSYS



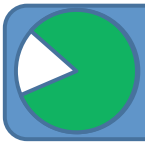
OUR ROUTINES ON A DAILY BASIS

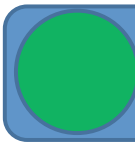
- ❑ Conduct researches.
- ❑ Provide technical services in related to energy performance of glass, glazing system and its components: and other building materials.
- ❑ Merely 500 requests per year.
- ❑ Consultation.

Features of the New Building Energy Code

- New and Retrofitting Buildings only
- System Performance Requirements
- Differentiation of Building Types based on time of use
- Promote the use of Renewable Energy
- Whole Building Energy Compliance

- Envelope
- Lighting
- Air-conditioning



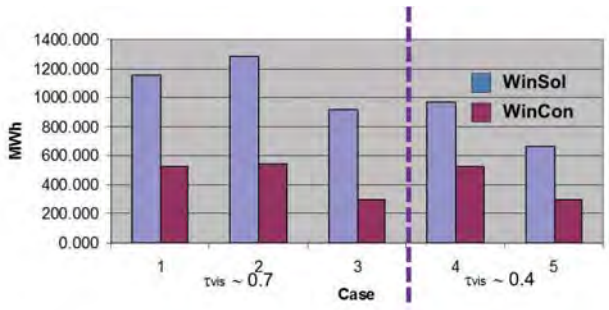


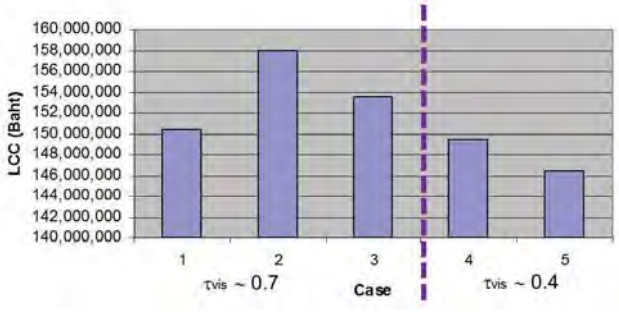
- ✓ **New set of Min Requirements**
- ✓ **New OTTV formula and calculation procedure**

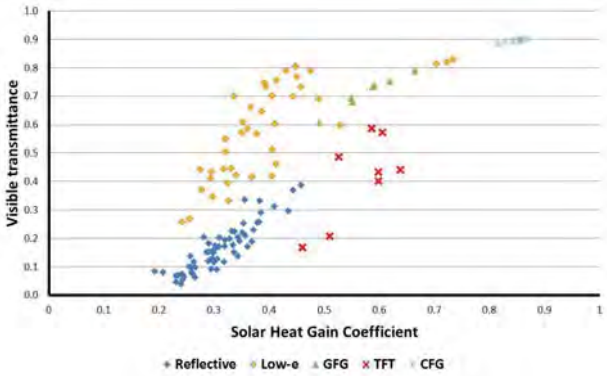
กรมพัฒนาพลังงานทดแทน
และอนุรักษ์พลังงาน
กระทรวงพลังงาน

Proposed criteria for High Performance Energy Efficient Glazing

- ✓ Low heat transmission
- ✓ Possible use of natural daylight
- ✓ Provision of thermal comfort

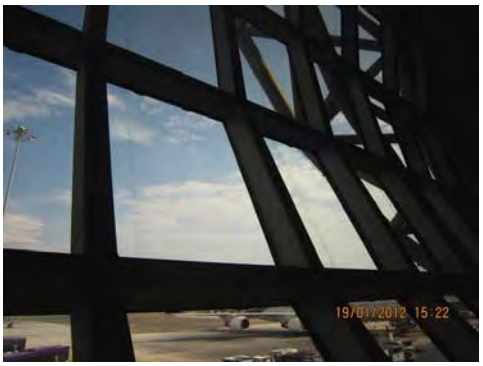




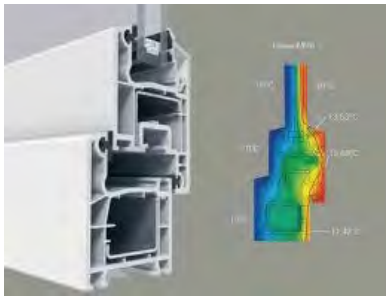


SHGC ≤ *0.55*
LSG ≥ 1.2

WINDOW FRAME



- Restrict heat transfer and avoid thermal bridge.
- Thermal bridge is characterized by U-Value.
- HEPS: 2.5 W/m2 K
- MEPS: 4.0 W/m2 K



MEPS and HEPS
For Insulation, Roof Tiles and Gypsum Boards

Short-term-5-year work plans
Of Thailand 20-Year Energy Efficiency Development Plan

Thailand
20-Year Energy Efficiency
Development Plan
(2011 - 2030)

Work plan: Develop standard testing laboratories

"To develop testing standards and support the establishment of energy efficiency testing laboratories for testing energy efficiency of machinery/equipment and appliances/vehicles including energy-saving materials."

กระทรวงพลังงาน
MINISTRY OF ENERGY

5-2

Table 5.2: Work Plans and Activities in the First 5-Year Period.

CROSS-SECTOR	
Measure: Mandatory energy efficiency labeling	
Work Plan: Develop standard testing laboratories	
Objective	To develop testing standards and support the establishment of energy efficiency testing laboratories for testing energy efficiency of machinery/equipment and appliances/vehicles, including energy-saving materials.
Major Activities	• Compile energy efficiency testing standards, both domestic and overseas, of machinery/equipment and appliances/vehicles. • Develop Thailand's testing standards and put the standards into effect. • Encourage the establishment of testing laboratories pursuant to the established standards.

ROADMAP OF A SET-UP FOR TESTING AND RATING CENTER

Phase 1 [2014]

- **Get ISO 17025 certified**
- **Critical equipment required for the glazing system**
- **Necessary infrastructure**
- **Material database system**
- **Development of rating and labeling processes**

Phase 2 [2015]

- More equipment to serve other material/construction properties
- Start operating the center at full scale `

Thank you for your attention ...

Q & A...

pattana.rak@kmutt.ac.th

Fenestration System Thermal Performance Rating for Summer Condition

Dr. CHEN Fangzhi

Solar Energy Research Institute of Singapore (SERIS)
National University of Singapore (NUS)

APEC Policy Workshop for Energy Efficient Envelopes
Eastin Grant Hotel Sathorn, Bangkok, Thailand, 22 October 2013

SERIS

Solar Energy Research Institute of Singapore

- Founded in 2008; focuses on applied solar energy research
- Part of the National University of Singapore (NUS)
- Rapid growth (now ~140 people and > 6000 m^2 of space)
- > USD 30m investments for labs
- R&D focus is on PV (cells, modules, systems) and solar buildings
- Specialised in professional services for the PV industry
- ISO 9001 & ISO17025* certified

* PV Module Testing Lab

Main R&D areas at SERIS

- Photovoltaic (PV) electricity generation
- Solar and energy efficient buildings
  - Façade technology
  - Simulation and building integrated PV
  - Solar thermal systems

One of the façade technology labs

Zero energy building project

Solar collectors testing lab

Presentation outline

- Current envelope thermal performance rating approach in Singapore
- R&D efforts at SERIS
  - 1. Is frame thermal performance important in summer condition?
  - 2. How to measure summer condition U-value and G-value?
  - 3. How to rate fenestration thermal performance in Singapore?
- Concluding remarks

BCA Green Mark Scheme

- Launched by Singapore's Building and Construction Authority (BCA) in 2005

- Building rating system according to five key criteria
  - Energy efficiency
  - Water efficiency
  - Environmental protection
  - Indoor environmental quality
  - Other green and innovative features

- Goal of BCA's 2nd Green Building Masterplan
  - "At least 80% of the buildings in Singapore to achieve BCA Green Mark Certified rating by 2030"

Requirements for the building envelope

- Code on envelope thermal performance for buildings in Singapore
  - Envelope Thermal Transfer Value (ETTV) for air-conditioned non-residential buildings
  - Roof Thermal Transfer Value (RTTV) for air-conditioned non-residential buildings (with skylight)
  - Residential Envelope Transmittance Value (RETV) for residential buildings
  - Roof insulation for air-conditioned non-residential buildings (without skylight) and residential buildings

ETTV for non-residential buildings

- ETTV = 12 (1- WWR)U_w+3.4(WWR)U_f+ 211(WWR)(CF)(SC_f·SC_s)
  - WWR = window to wall ratio
  - U_w = wall U-value
  - U_f = fenestration U-value
  - CF = correction factor for solar heat gain (typical value 0.5 ~ 1.5)
  - SC_f = fenestration shading coefficient (SC = G/0.87)
  - SC_s = shading device shading coefficient
  - G = fenestration G-value
- Green Mark points awarded for ETTV < 50 W/m^2

Remarks

- The system was originated from ASHRAE 90.1 (1974)
- The system is easy to implement
- In practice, it is acceptable to use centre-of-glazing U-value and SC-value to represent fenestration U-value and SC-value
  - Frame and edge-of-glazing areas are assumed to have the same thermal properties as the centre-of-glazing area
- There is no explicit requirement on centre-of-glazing U-value and SC-value test method
  - In practice, NFRC summer condition is more commonly used

ASHRAE: American Society of Heating and Air-Conditioning Engineers
NFRC: National Fenestration Rating Council

Presentation outline

- Current envelope thermal performance rating approach in Singapore
- R&D efforts at SERIS
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- Concluding remarks

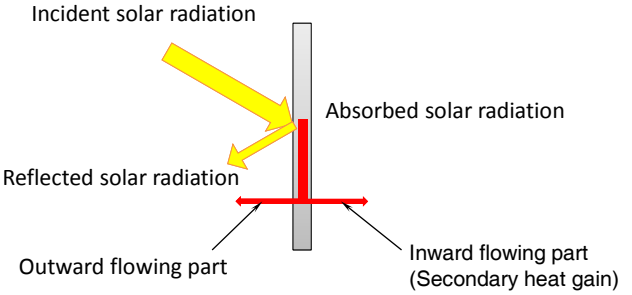
Frame thermal performance in summer condition

- High performance low solar gain type low-e DGUs are now increasingly used in Singapore, particularly for premier office buildings
- However, the DGUs are installed with normal aluminum frames without thermal break
- Arguments
  - 1. The indoor/outdoor temperature difference in Singapore is small; therefore the U-value improvement by thermal break is unnecessary
  - 2. Frames are opaque; therefore there is no solar heat gain through them
- The challenge: is frame thermal performance important in summer condition?

DGU: Double glazing unit

Solar heat gain through opaque materials

- For opaque materials (e.g. frame), directly transmitted solar heat is zero
  - However, the outer side surface absorbs heat and part of the absorbed heat flows to indoor space (i..e secondary heat gain)
  - Dependent on: 1) outer surface solar absorptance; and 2) material U-value

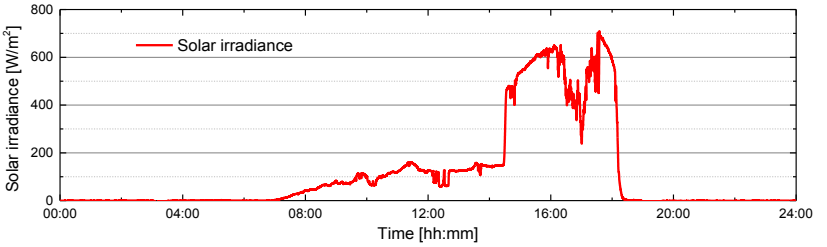


Test-bedding of frame thermal performance

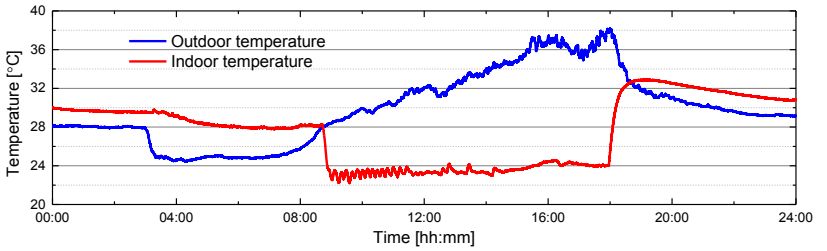
1	No thermal break, light color	AL_LC
2	No thermal break, dark color	AL_DC
3	With low performance thermal break, light color	TBL_LC
4	With low performance thermal break, dark color	TBL_DC
5	With moderate performance thermal break, light color	TBM_LC
6	With moderate performance thermal break, dark color	TBM_DC
7	With high performance thermal break, light color	TBH_LC
8	With high performance thermal break, dark color	TBH_DC
9	No thermal break, light color	Spare part
10	No thermal break, dark color	Spare part

Pink color: insulation material

Preliminary results (12 Sep 2013)

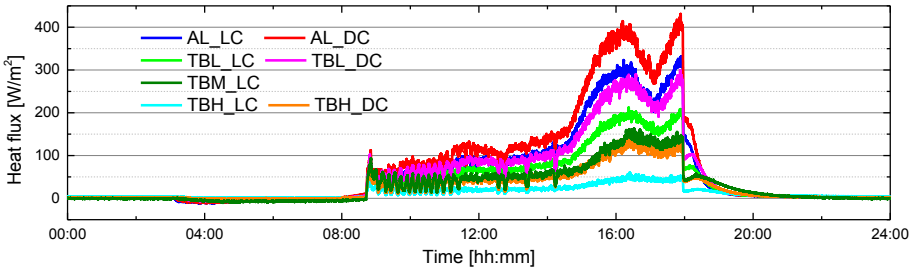


(a) Solar irradiance



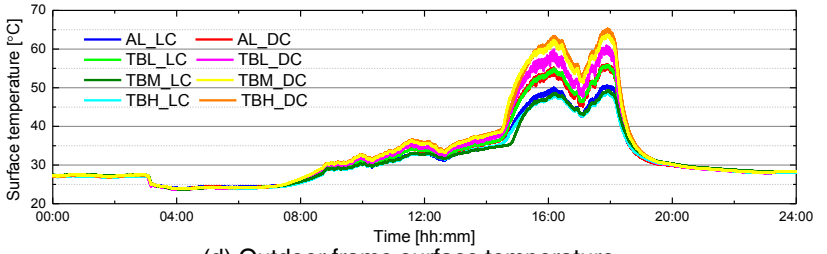
(b) Indoor and outdoor air temperature

Preliminary results (12 Sep 2013)

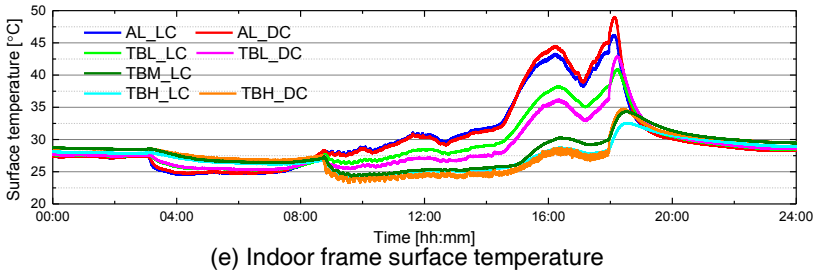


(c) Heat flux through frames

Preliminary results (12 Sep 2013)



(d) Outdoor frame surface temperature



(e) Indoor frame surface temperature

Preliminary conclusions

- 1. Window frames do admit significant amount of heat in the tropical climate
- 2. Solar heat gain through opaque window frames is the dominant heat gain mechanism in the tropical climate
- 3. Thermal transmission is still an important window frame heat gain mechanism, particularly with local heat island effect

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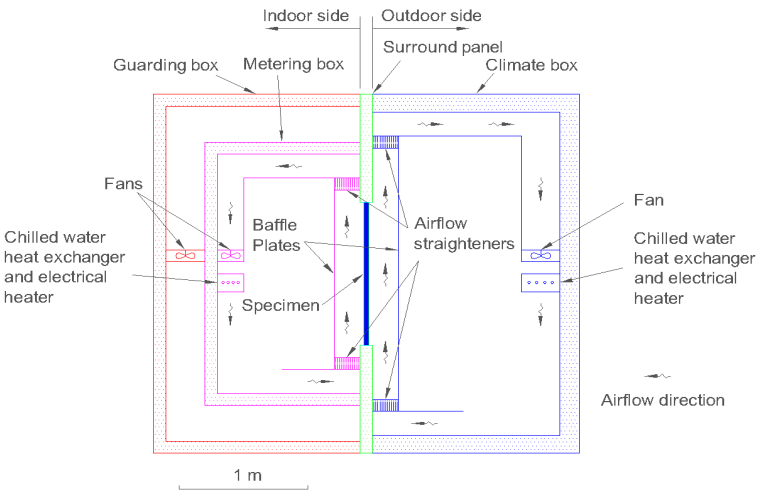
Summer condition U-value/G-value measurement

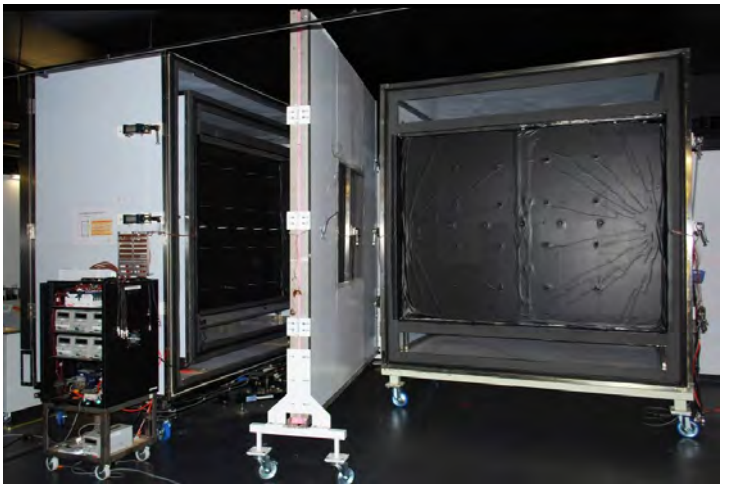
- Mature methods available for winter condition U-value measurement (e.g. ISO 12567-1, ASTM C1199)
  - However, the environment conditions are not practical for the summer condition/tropical climate
- No mature method available for G-value measurement
  - NFRC 201 is biased to outdoor calorimeter and it is not practical to implement it in Singapore due to the unsteady cloud cover
- The challenge: how to measure summer condition U-value and G-value?

Schematics of SERIS calorimeter (U-value)



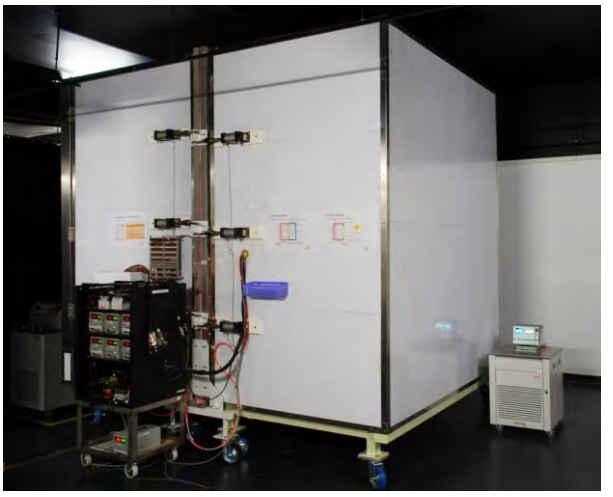
Schematics of SERIS calorimeter in U-value measurement mode

Pictures of SERIS calorimeter



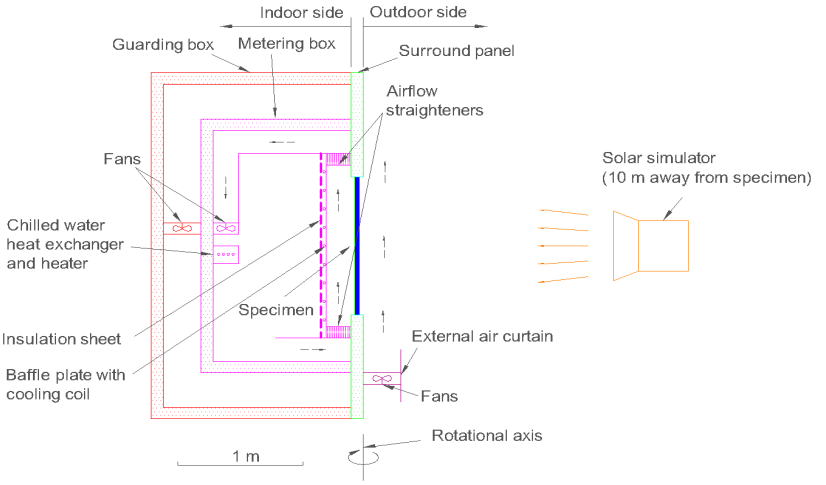
The system is in open position before U-value measurement

Pictures of SERIS calorimeter



A U-value measurement is in progress

Schematics of SERIS calorimeter (G-value)



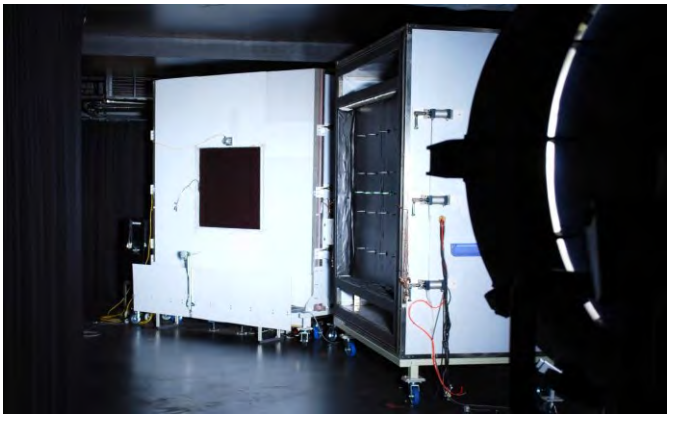
Schematics of SERIS calorimeter in G-value measurement mode

Pictures of SERIS calorimeter

Room side boxes, surround panel with specimen, external air curtain

Solar simulator

Pictures of SERIS calorimeter



An angular G-value measurement is in progress
The box in the middle is for U-value measurement and it does not block direct solar simulator radiation onto the specimen

Key specifications

- Environmental conditions for U-value measurement
  - Indoor side: T = 24 ˚C, h = 5 W/(m^{2}K)
  - Outdoor side: T = 32 ˚C, h =18 W/(m^{2}K)

- Environmental conditions for G-value measurement
  - Indoor side: T = 24 ˚C, h = 5 W/(m^{2}K)
  - Outdoor side: T = lab space temperature, h =18 W/(m^{2}K), I = 450 - 500 W/m^2

- Maximum specimen size: 1.5 m x 1.5 m (vertical installation only)
  - Specimen types: window, door, window frame, wall, blind and sunshade, BIPV, glass, insulation sheet

T: temperature; h: surface heat transfer coefficient; I: solar irradiance

Challenges and solutions

- Main challenges in summer condition U-value/G-value measurements
  - 1. High measurement uncertainty associated with chilled water heat exchange rate metering
  - 2. Low indoor/outdoor temperature difference in U-value measurement
  - 3. Spectral mismatch in G-value measurement

- Our solutions
  - 1. Chilled water measurement uncertainty can be substantially reduced by exploiting the correlative relationship between the calibration and the measurement runs
  - 2. Well-designed hot box system with very high temperature stability (better than ±0.01 ˚C)
  - 3. It is challenging to resolve the spectral mismatch issue, but some correction method was proposed

Publications

- Energy and Buildings, V53, 47-56 & 74-84
- Some updates of test method were made after the publications

Energy and Buildings 53 (2012) 47–56

Contents lists available at SciVerse ScienceDirect

Energy and Buildings

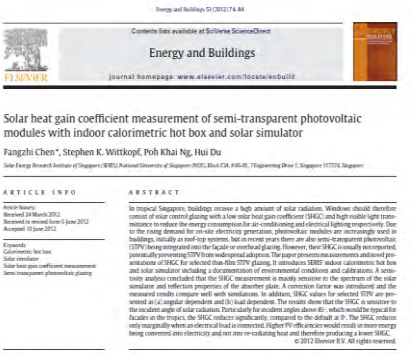
journal homepage: www.elsevier.com/locate/enbuild

Summer condition thermal transmittance measurement of fenestration systems using calorimetric hot box

Fangzhi Chen*, Stephen K. Wittkopf

ARTICLE INFO

ABSTRACT



Energy and Buildings 53 (2012) 74–84

Contents lists available at SciVerse ScienceDirect

Energy and Buildings

journal homepage: www.elsevier.com/locate/enbuild

Solar heat gain coefficient measurement of semi-transparent photovoltaic modules with indoor calorimetric hot box and solar simulator

Fangzhi Chen*, Stephen K. Wittkopf, Poh Khai Ng, Hui Du

ARTICLE INFO

ABSTRACT

Presentation outline

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Thermal performance rating for summer condition

- Limitations of existing rating indices (U-value, G-value, ETTV)
  - Correlated to cooling load, but do not directly represent cooling load
  - Difficult to rate shading devices projected from façade (e.g. horizontal overhang)
  - Difficult to rate active façade systems (e.g. motorized blind, thermochromic glazing)
- The challenge: How to rate fenestration thermal performance in Singapore?

Cooling energy index (CEI)

- Cooling energy index (CEI): annual additional cooling load contributed by unit area of fenestration (Tsikaloudaki et al., 2012)
- The fenestration CEI, CEI_f, can be expressed as

$$CEI_f = \frac{Q_{c,f} - Q_{c,no-f}}{A_f}$$

  - $Q_{c,f}$: annual cooling load of a reference room with the fenestration of interest
  - $Q_{c,no-f}$: annual cooling load of the same reference room with the fenestration replaced by an adiabatic wall (i.e. with $U_f = 0$ and $G_f = 0$)
  - A_f: area of the fenestration

Annual Equivalent Shading Coefficient (AESC)

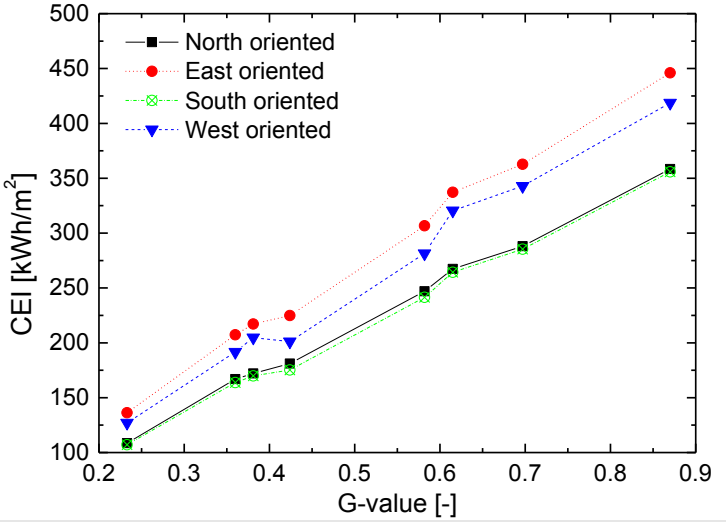
- CEI is an absolute value and it is necessary to define a new relative index for fenestration thermal performance comparison and rating
- The annual equivalent shading coefficient (AESC), of a fenestration of interest, $AESC_f$, can be expressed as (Chen, 2013)

$$AESC_f = \frac{Q_{c,f} - Q_{c,no-f}}{Q_{c,3mm} - Q_{c,no-f}} = \frac{CEI_f}{CEI_{3mm}}$$

  - CEI_{3mm} represents the CEI of a 3 mm clear reference glass
- AESC of a fenestration is directly proportional to the additional cooling load introduced by the fenestration

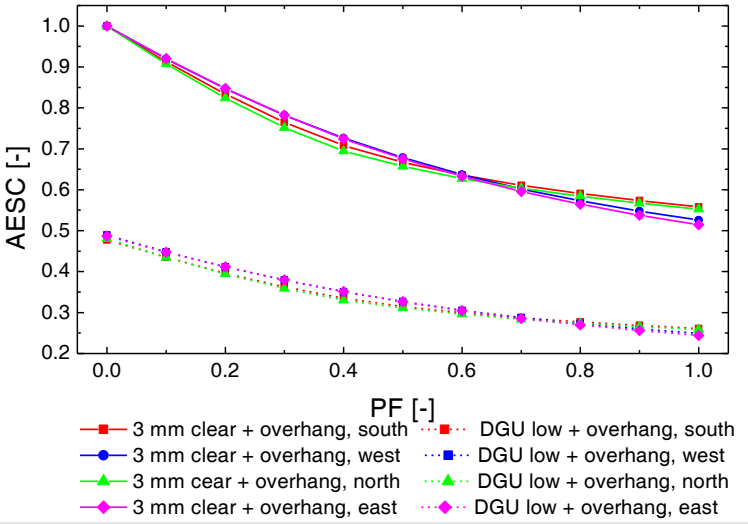
CEI of simple glazing systems

- CEI is strongly dependent on façade orientation



AESC of simple horizontal overhangs

- AESC with horizontal overhang is only weakly dependent on façade orientation



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Fenestration heat transfer: winter vs. summer

- In winter condition
  - Solar heat gain reduces heating load
  - Heat addition by equipment and people reduces heating load
  - Worst case scenario is at night-time
    - Affected by U-value only
  - **100% of the heat loss is through building envelope (excluding ventilation)**
  - Part of the heat addition is by heating equipment
- In summer condition
  - Solar heat gain increases cooling load
  - Heat addition by equipment and people increases cooling load
  - Worst case scenario is at day-time
    - Affected by both U-value and G-value
  - Part of the heat gain is through building envelope
  - **100% of the heat removal is by cooling equipment (excluding ventilation)**

Concluding remarks

- There are more pending issues for summer condition fenestration thermal performance rating
- The dominant heat gain mechanism through frame is solar heat gain
- Practical test methods are needed for summer condition fenestration G-value measurement
- New thermal performance rating indices were proposed

Thank you for your attention!

More information

chen.fz@nus.edu.sg
www.seris.sg

SERIS is a research institute at the National University of Singapore (NUS). SERIS is sponsored by the National University of Singapore (NUS) and Singapore's National Research Foundation (NRF) through the Singapore Economic Development Board (EDB).

SIMULATION AND TESTING ROLE IN RATING PROGRAM IN THE USA

D. Charlie Curcija

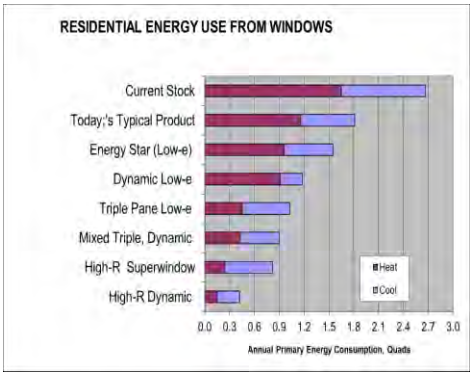
October 22, 2013

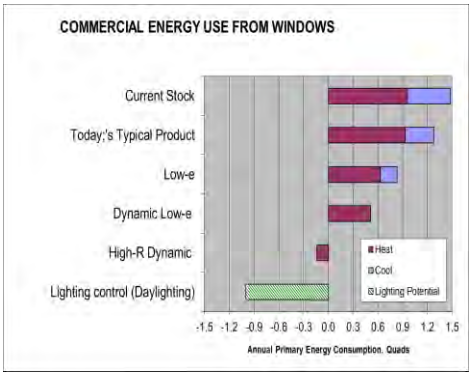
ENERGY END USE BY WINDOWS

Overall market opportunity:

Residential – 2.4 quads (2.7 quads current stock – 0.4 quads for best windows);

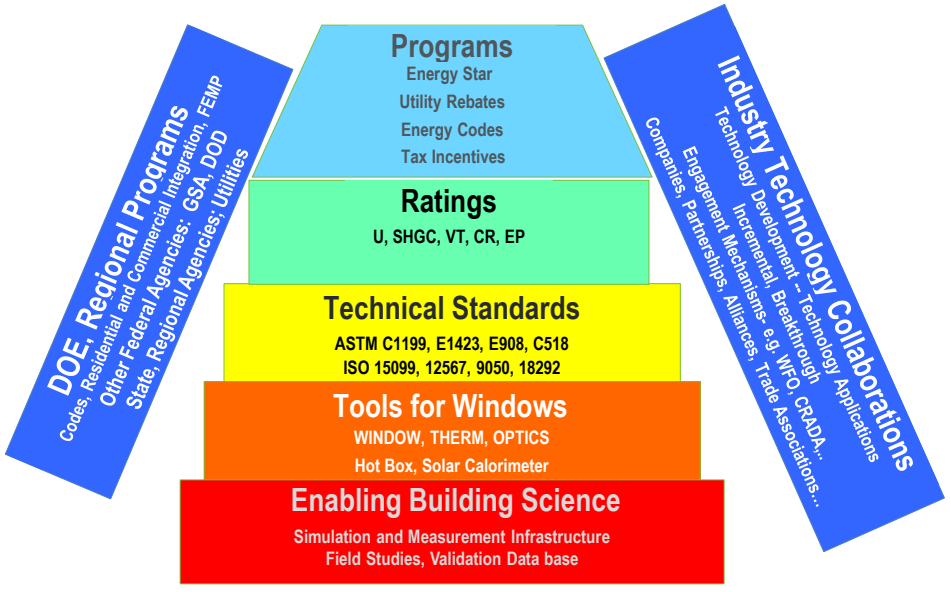
Commercial – 1.5 quads / 2.5 quads with lighting savings from daylighting controls



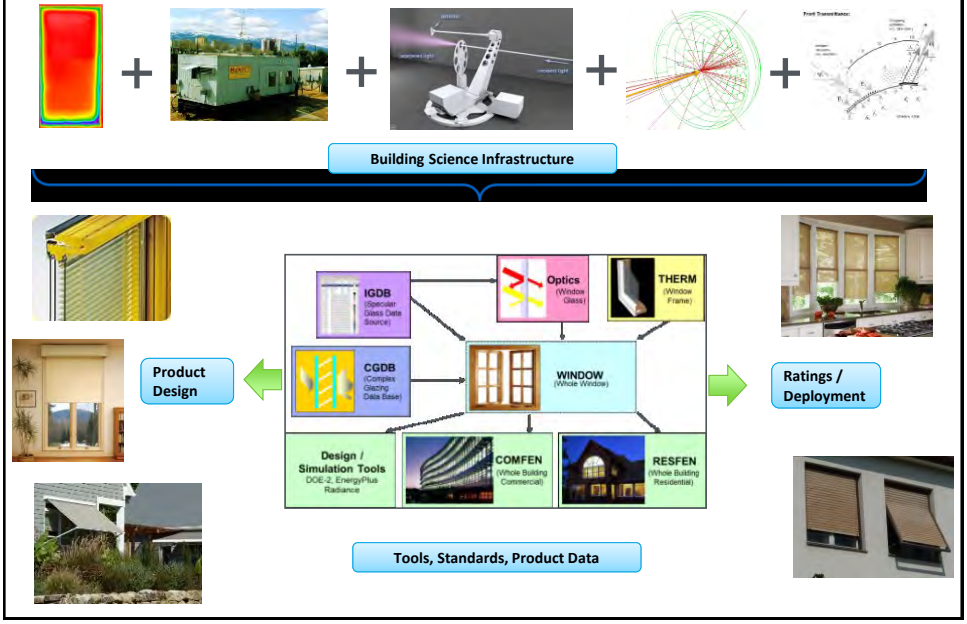


Current Energy Use Based on US Energy Information Administration Data

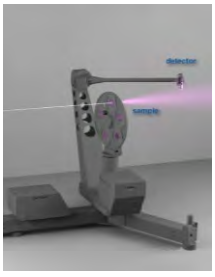
FROM BUILDING SCIENCE TO MARKET

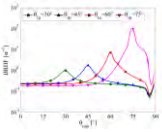


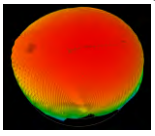
WORKFLOW FOR CREDIBLE PRODUCT SIMULATION

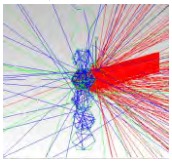


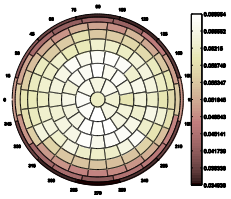
BASIC PROPERTY MEASUREMENTS ARE INPUTS TO COMPUTER MODELS

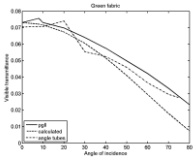




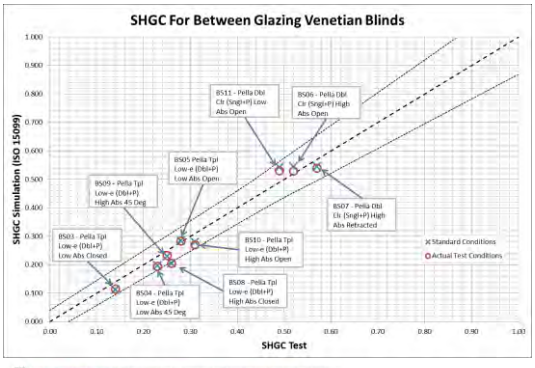


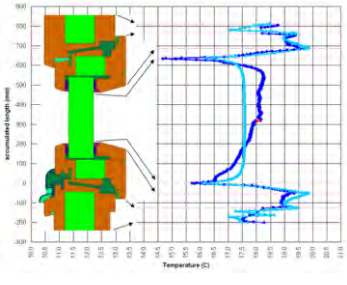


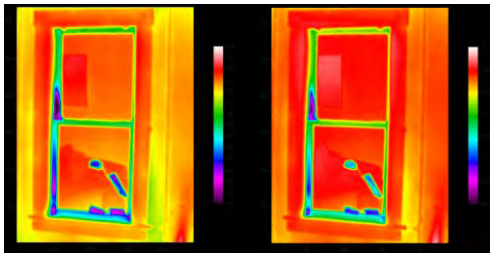




EXPERIMENTAL VALIDATION OF SOFTWARE TOOLS

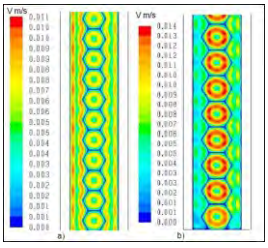


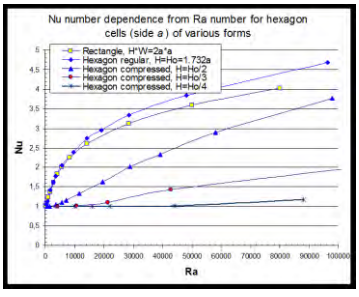




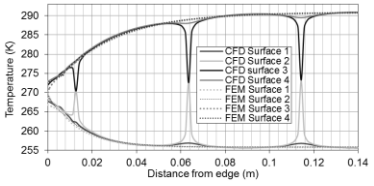
DETAILED NUMERICAL MODELING TO DEVELOP MODELS & BETTER UNDERSTAND EXPERIMENTS

Cellular shade thermal model:





Vacuum glazing thermal model:



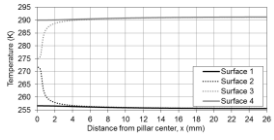


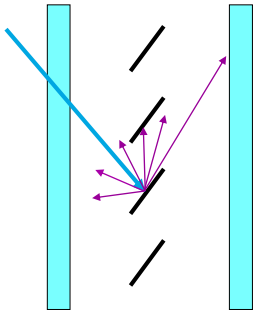
TABLE 7. COG thermal transmittance (U-Factor) using three solution methods

	Surface 2 emissivity: 0.02		Surface 2 emissivity: 0.84	
Model	**U-Factor ($W/(m^2 K)$)**	**% Diff.**	**U-Factor ($W/(m^2 K)$)**	**% Diff.**
Analytical	0.444	5.7%	2.271	0.5%
Analytical[1]	0.487	-3.5%	2.307	-1.0%
2D FEM	0.444	5.7%	2.271	0.5%
2D FEM[1]	0.486	-3.3%	2.289	-0.2%
3D FVM Solid	0.471	-	2.284	-
3D FVM Radiation	0.470	0.2%	2.225	2.6%

[1]Solved using analytical equation that accounts for pillar conductivity (Curcija and Hart 2012)

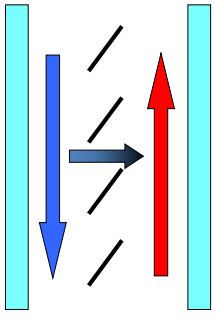
MODELING OF COMPLEX (SCATTERING) PRODUCTS

Optical



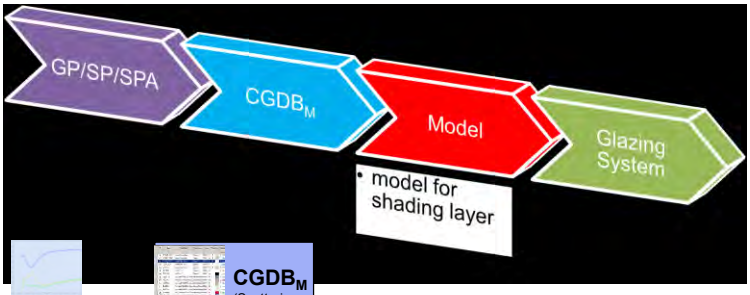
- Visible & Solar: T_f, T_b, R_f, R_b
- Far Infrared: T_{IR}, ε_f, ε_b

Thermal



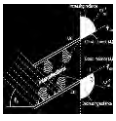
- Conduction
- Convection
- Radiation

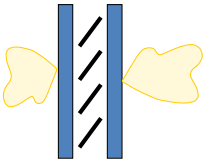
FROM MATERIAL COUPON TO WHOLE PRODUCT SIMULATION



Each Angle of incidence

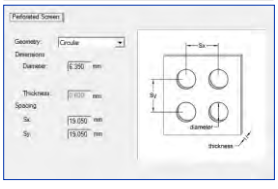
CGDB$_M$ (Scattering Material Database)



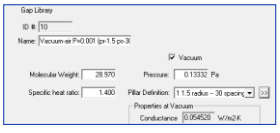


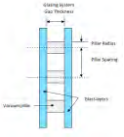
RECENT ADVANCEMENTS

Perforated screens:

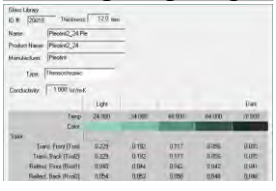


Vacuum glazing

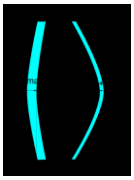




Chromogenic glazing:



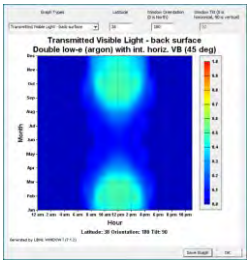
Glazing deflection:



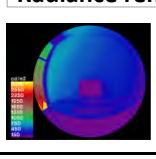
Cellular shades:

Vertical Louvers:

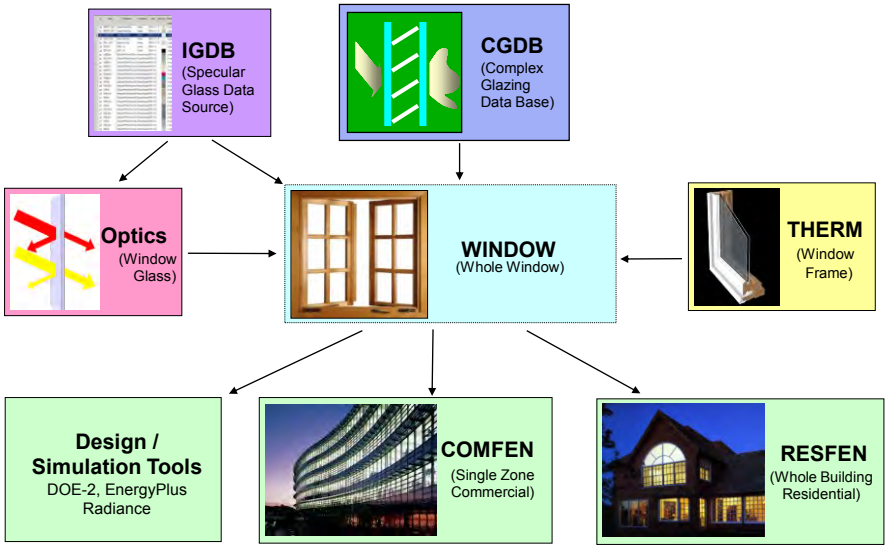
Angular data:



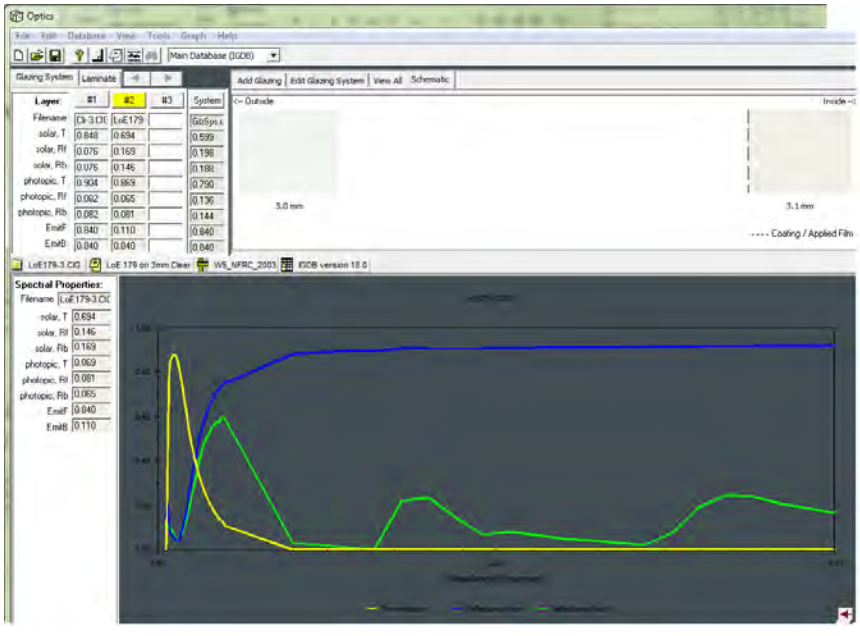
Radiance renderings:



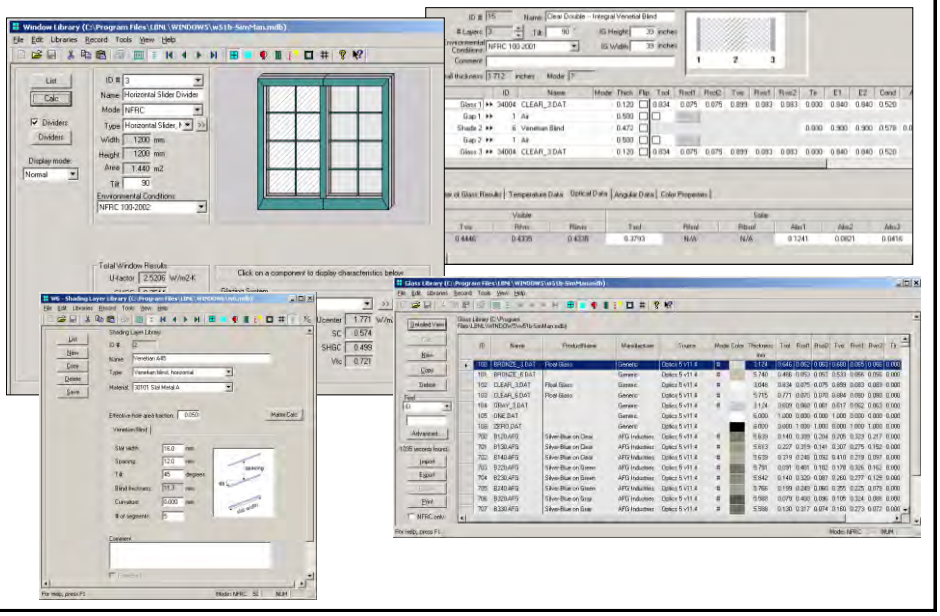
SUITE OF SOFTWARE TOOLS



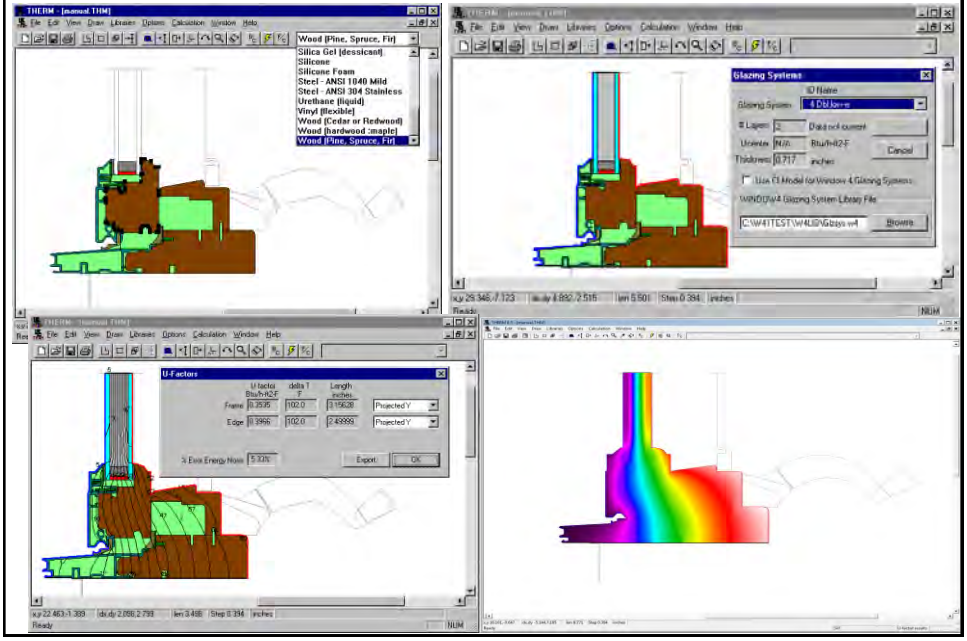
OPTICS: VIRTUAL GLASS LABORATORY



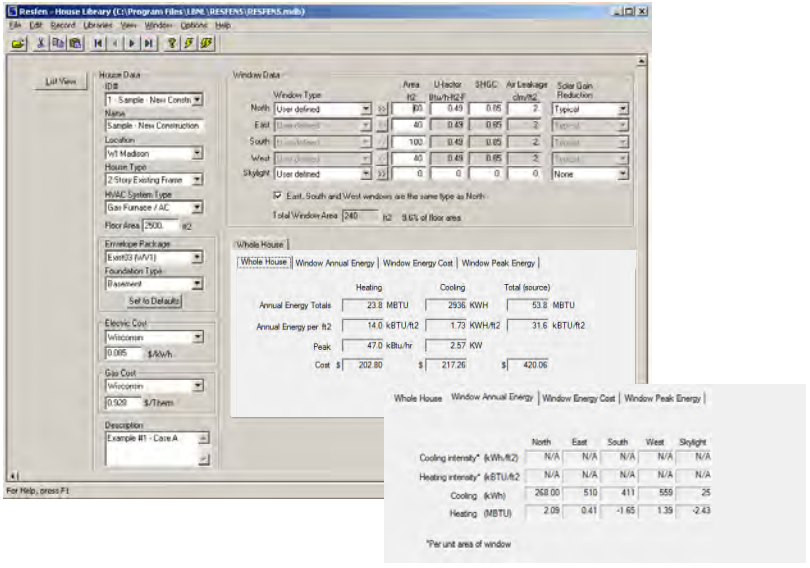
WINDOW: GLAZING SYSTEM AND WHOLE PRODUCT TOOL



THERM: 2-D HEAT TRANSFER MODELING SYSTEM



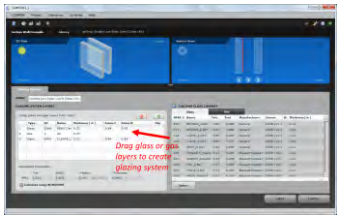
RESFEN: ENERGY USE BY WINDOWS IN RESIDENTIAL BUILDINGS



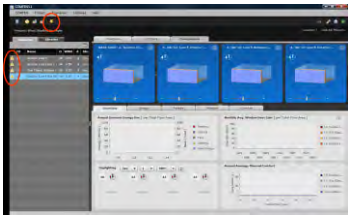
COMFEN: ENERGY USE BY WINDOWS IN COMMERCIAL BUILDING

COMFEN: RAPID MODEL GENERATION AND VISUALLY COMPELLING REPORTS

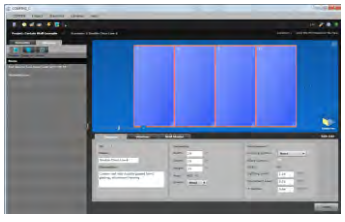
Glazing definition:



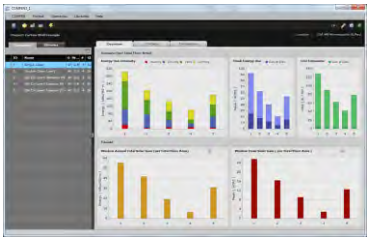
Run scenarios



Façade scenario:

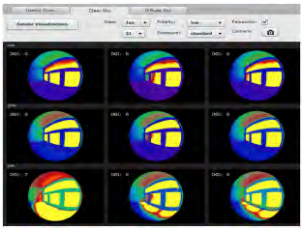


Annual energy results:

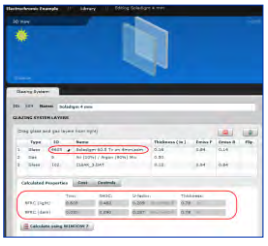


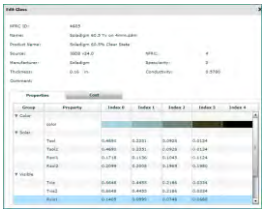
ADVANCED COMFEN FEATURES

Radiance rendering:

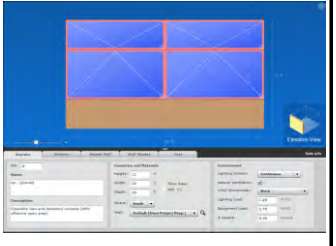


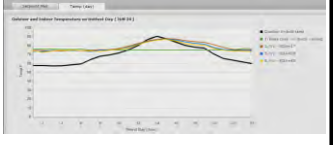
Electrochromic Glazing:





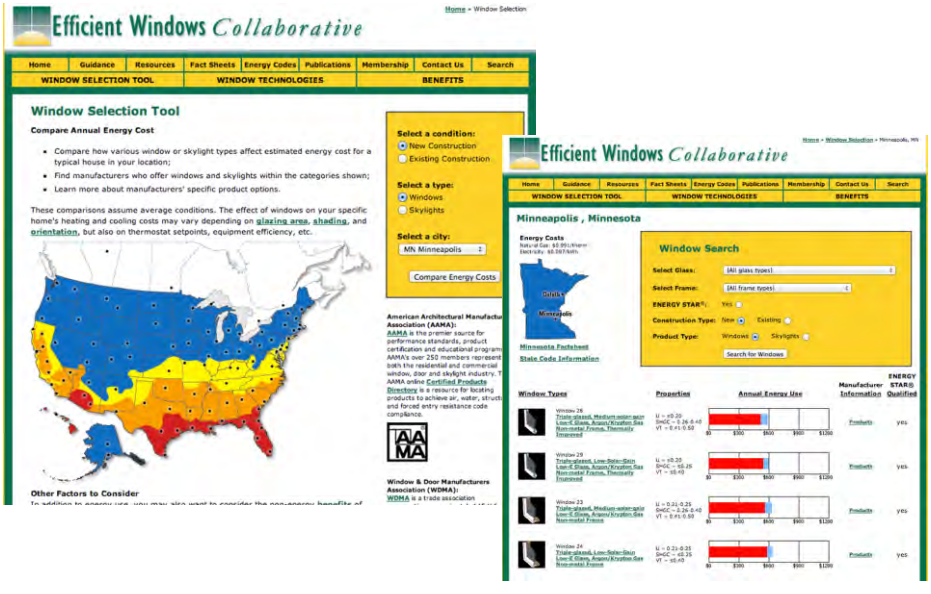
Natural Ventilation:



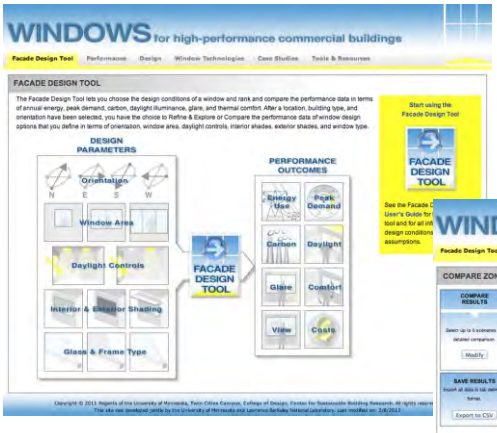


OUTREACH THROUGH WEB SELECTION TOOLS

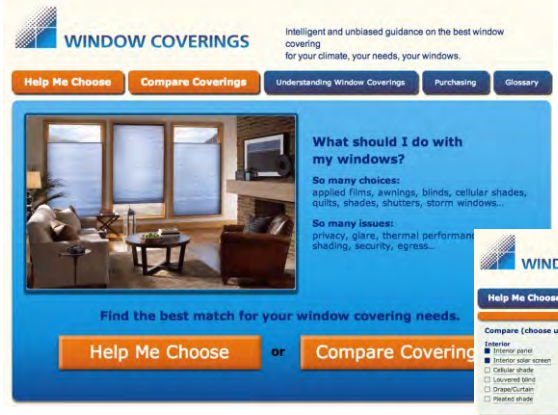
RESIDENTIAL EFFICIENT WINDOWS COLLABORATIVE

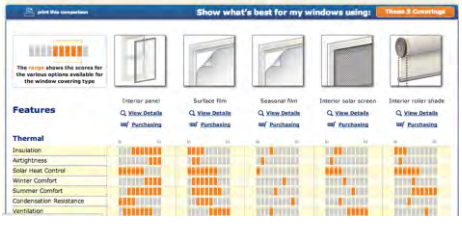


COMMERCIAL WINDOWS WEBSITE



EFFICIENT WINDOW COVERINGS





Energy Efficiency Code, Testing and Rating Systems for Building Envelope Components in Korea

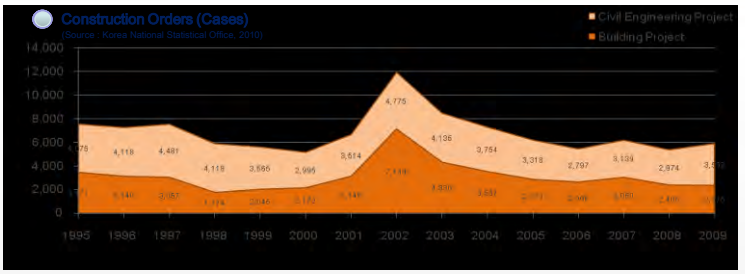
22th October 2013

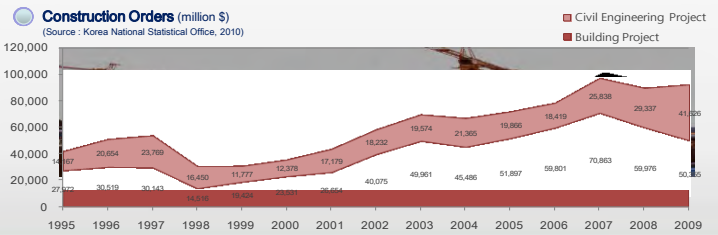
Seung-Eon LEE

Korea Institute of Construction Technology

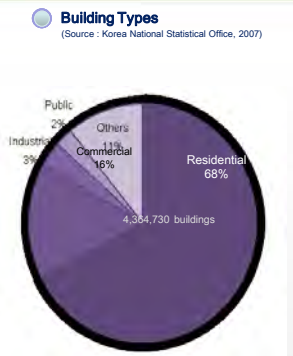
Summary of Korean Building Market

Korean Construction Industry

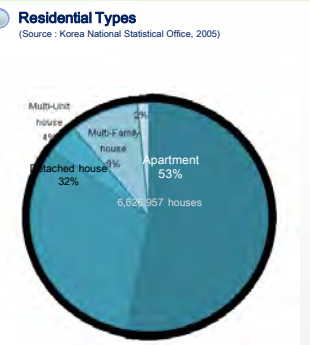




Building Stocks



Total : 6,460,489 buildings (year 2007)

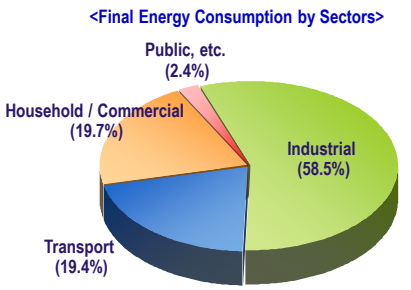


Total : 12,494,827 houses (year 2005)

Energy Consumption Breakdown

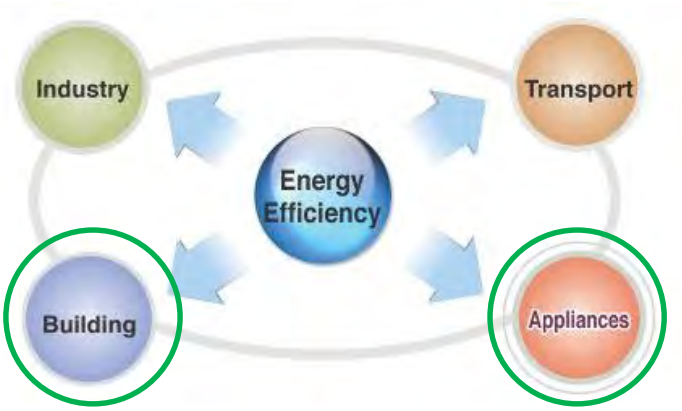
◆ **Building Sector is 19.7% at energy consumption**

- Final : Industrial 58.5%, Transport 19.4%, Household/Commercial 19.7%



Energy Efficiency Policy

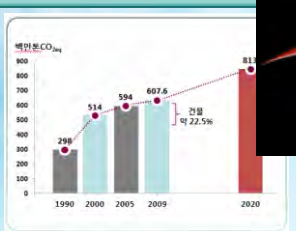
◆ **4 Major Energy Efficiency Fields**



Target for CO2 Emission Reduction Building Sector

National Reduction Goal of Energy and GHG of Korea

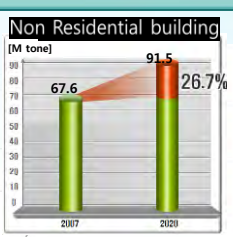
30% reduction of national GHG from estimated emissions in 2020



emissions
813 $MtonCO_{2eq}$

By year 2020
National reduction Plan
569 $MtonCO_{2eq}$

26.9%(about 480 million tons) energy reduction in building sector ('11.7.12)



- Load reduction techniques
- Improvement of equipment efficiency
- Policies and enforcement

KICT 한국건설기술연구원

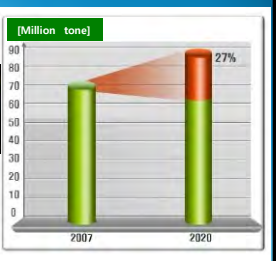
Reduction Goal and measures in Building Sector

Load reduction techniques

- Enhanced insulation of Envelopes
- Cooling Load reduction Technology
  - Window Shading, Cross ventilation

BAU emission projected for 2020 and annual reduction plan for residential sector

	Million tone	Reduction rate(%)			
	'20	'12	'13	'15	'20
Residential	87.4	1.8	5.0	8.9	27.0

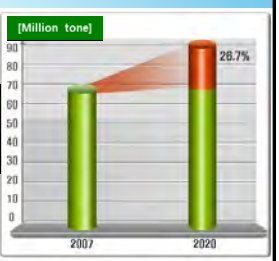


Improvement of equipment efficiency

- Efficiency improvement of Heating/Cooling equipment, replacement of obsolete equipments
- Expansion of High-efficiency Air-conditioner and Building Energy Management System
- Expansion of LED Lighting (by 2020, 60% of total lightings]
- Efficiency Improvement of Home & Office Appliances

BAU emission projected for 2020 and annual reduction plan for non-residential sector

	Million tone	Reduction rate(%)			
	'20	'12	'13	'15	'20
Cmmercial	91.5	1.9	4.4	8.8	26.7



Policies and enforcement

- Expansion of Green Home,
- Energy Consumption Verification (for all building)
- Improvement of Occupant's Behavior of Energy consumption
- Spread New & Renewable Energy System
- Total Energy Management of Buildings (First for Public buildings)
- (Cap of Total Energy Consumption : linked with Building Permit)

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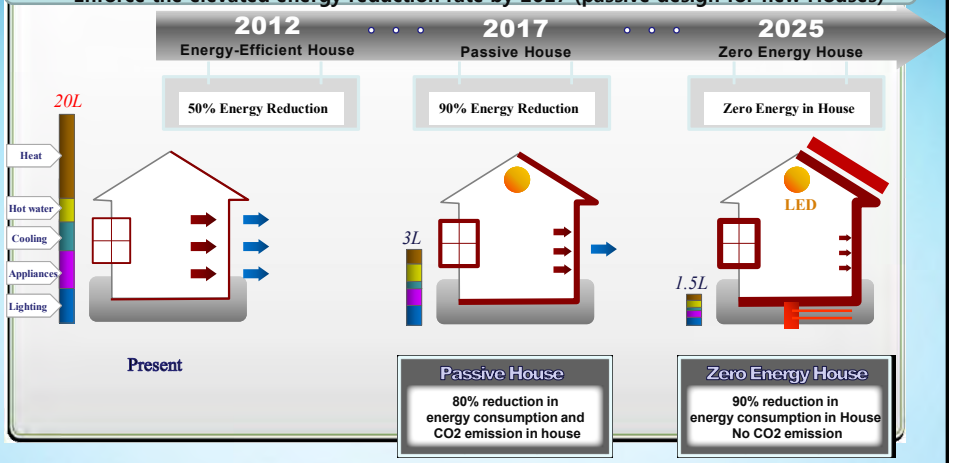
Korean Target for Reduction in Building Sector

26.9% Reduction of greenhouse gases in buildings by 2020

Obligate Zero-energy for new House by 2025,
Enforce the elevated energy reduction rate by 2017 (passive design for new Houses)



Policies for the Improvement of Energy Efficiency in Building Sector

Korea's Green Building Policy for energy efficiency

◆ Building Energy Efficiency Policy by MOLIT

(Ministry of Land, Infrastructure and Transport)

1 Green Building Acts
2 Green Building Certification Program
3 Building Energy Efficiency Rating Certification
4 Evaluation of Energy Saving Plan for New Buildings
5 GHG Target Management in Building Sector
6 Energy Consumption Verification
7 Green Retrofit
8 Energy assessor
9 Building maintenance
10 Digitization of Construction Administration
11 Building Code for Envelope Insulation & Energy-efficient Design

Korea's Green Building Policy for energy efficiency

◆ Building Energy Efficiency Programs by MOTIE

Ministry of Trade, Industry & Energy

1 Energy saving investment financing and tax credit system
2 Energy Service Company (ESCO) system
3 Energy diagnosis mandatory system
4 Energy-efficiency Standard & Labeling Program
5 Building energy efficiency grading certification system
6 Enforcement of e-standby Program
7 High-efficiency equipment certification
8 Public sector energy use rationalization plan
9 Building greenhouse gas· energy goal management system
10 Energy performance grading indication system
11 High-efficiency energy equipment certification system
12 Standby power Reduction Program

Korea's Green Building Policy for energy efficiency

◆ Building Energy Efficiency Programs by MOTIE

Ministry of Trade, Industry & Energy

13 High-efficiency equipment subsidy support and Energy Welfare project
14 Energy and climate change professional manpower education
15 Energy saving early education
16 Industrial company and building energy usage reporting system
17 1 million green homes distribution project
18 Renewable energy building certification system
19 Renewable Energy General Dissemination Subsidizing project
20 Renewable energy province distribution project
21 Renewable facilities public institution mandatory installation system
22 Renewable energy loan support system
23 Renewable energy portfolio standards (RPS)

Korean Energy Standards & Labeling on Windows
KOREA INSTITUTE OF CONSTRUCTION TECHNOLOGY

Energy Labels and Standards

Policy Implementation Organization

◆ Korean energy standards & labeling

Energy Labels & Standards for Equipment

◆ 3 Main programs in Energy Labels & Standards

Energy Efficiency Label and Standard Program (including MEPS)

- **Mandatory**
- 5-grade labeling & MEPS
- 34 items : Windows, Refrigerators, Air-conditioners, Automobiles, etc

Energy Labels & Standards

High-efficiency Equipment Certification Program

- **Voluntary**
- 37 items : Transformers, Pumps, LED Lightings, etc

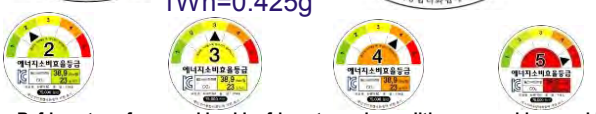
e-Standby Program

- **Voluntary -> Mandatory**
- Standby Korea 2010
- 22 items : PCs, STBs, etc

Display CO2 Emission & Energy Expense in Label

◆ the Amount of CO2 emission per hour & energy expense per year label displayed (but, U-value & Air tightness only for windows)

1Wh=0.425g



Refrigerators, freezers, kimchi refrigerators, air conditioners, washing machines drum washing machines, dish washers, dish driers, coolers, rice cookers, vacuum cleaner, electric fans, air cleaners, incandescent lamps, fluorescent lam CFLs, Automobiles, windows

Energy Efficiency Label and Standard Program

Building Envelope U value required by Building Code

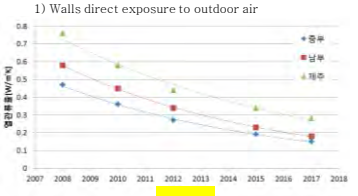
U-value of Building Envelope (building code)

- Building Design Criteria (30% Reinforcement in 2013)

	U-value (W/㎡K) of Building Components (Residential Apartment Case in Central Districts of Korea)		
	Before 2013	From 2013	After 2017(Passive House Level)
Wall	0.36	0.27	0.15
Windows	2.10	1.50	0.80
Roof	0.20	0.18	0.15
Floor	0.30	0.23	0.15

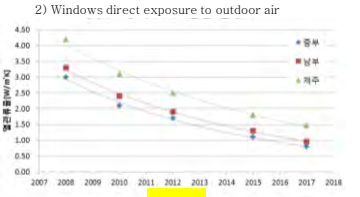
✓ Plans for Strengthening U-value of Building Components

1) Walls direct exposure to outdoor air



Passive house level by the Year 2017

2) Windows direct exposure to outdoor air



Passive house level by the Year 2017

U-value of Windows (building code)

• Building Design Criteria

Remarks			Weather Zone: Central District (W/㎡·K)	South District (W/㎡·K)	Jeju Island (W/㎡·K)
Windows	Direct exposure to outdoor air	Apartment buildings	1.5	1.8	2.6
		Others	2.1	2.4	3.0
	Indirect exposure to outdoor air	Apartment buildings	2.2	2.5	3.3
		Others	2.6	3.1	3.8

Standards and Labelling Program for Building Windows

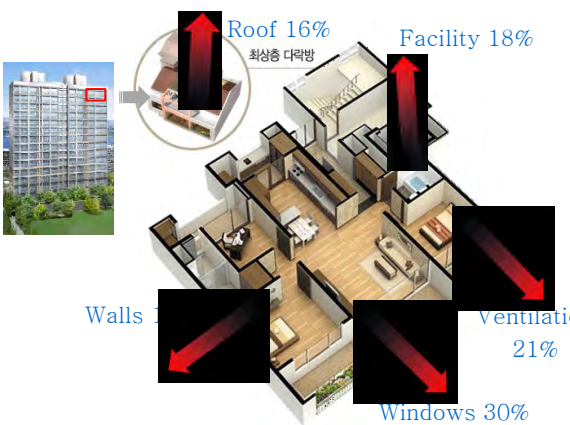
Background of Korean Window Policy

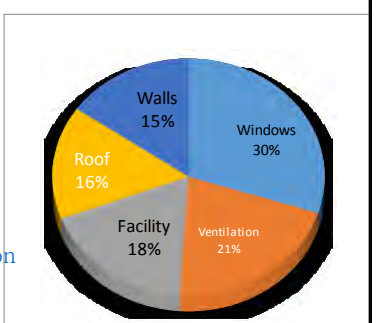
Items		Products phase
Windows		- The core of building energy-efficiency - 7 times lower than the performance of wall - 20~45% of total heat loss of buildings - from Jul 1, 2012

- Korea Window's Features have been over 50% of Building surface
- Most of Korea Windows are sliding system
- Window insulation performance is 7 times lower than the wall

Heat Loss from Window in House

The parts of heat loss of Building





Korean Standards of Window

◆ Fundamental Plan

- **Target** : Window 1㎡ over

- **Energy efficiency indication** : Overall heat transmission coefficient, **U-value**(W/(㎡·K)), **Air Leakage(**㎥/h ·㎡)
  * **Glaze** ; The element of glass characteristics (thickness, film, vacuum)

- **Measurement** : KS F 2278, KS F 2292

- **Enforcement** : From 2012. 7. 1

Rating Standard

◆ Rating and MEPS Standard

- Rating(1-5grade) Standard

R	Air-Leakages	Grade
R≤1.0	1st grade	1
1.0 < R≤1.4	1st grade	2
1.4 < R≤2.1	2nd grade over	3
2.1 < R≤2.8	None	4
2.8 < R≤3.4	None	5

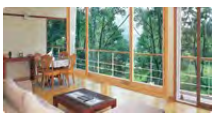
R=W/(㎡. K)

- MEPS Standard(Overall heat transmission coefficient) : 3.4
  * Bans of production and sales of low energy efficiency products

Labels Indication

◆ Energy efficiency grade(1-5grade) label

- U-value : 0.74W/(㎡·K)
- Air Leakage : 0.35 ㎥/h ·㎡
- Glaze ; Indication of glass factors (Low-E 6mm, Air 12mm, Thickness 12mm)

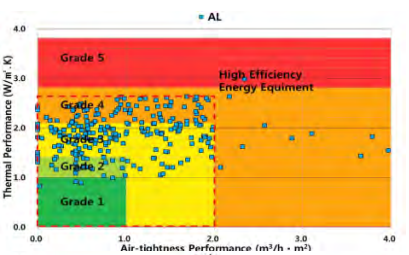


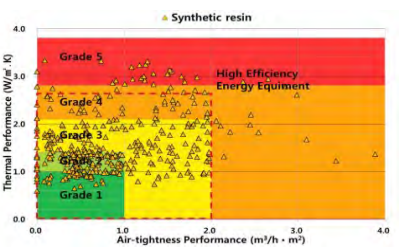
Results of Measurements

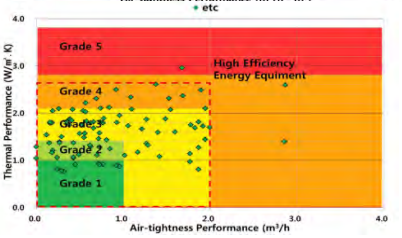
◆ Distribution

- **Measured Items : 760 EA**

- **Aluminum : 34.9%**
  Synthetic Resin : 52.5%
  ETC : 12.6% (incl. wooden)







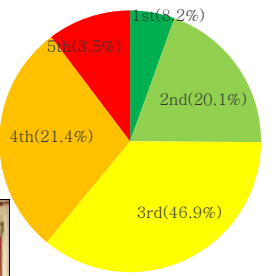
Distribution of Grade

◆ Estimated distribution of grade

- 1st grade 8.2%

- Estimated distribution of grade

Rating	Distribution
1st grade	8.2%
2nd grade	20.1%
3th grade	46.9%
4th grade	21.4%
5th grade	3.5%

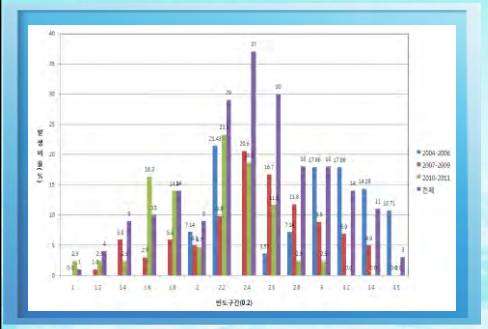


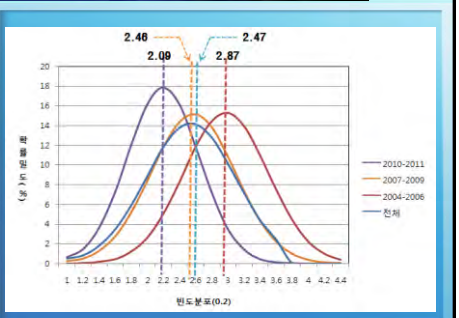
한국건설기술연구원

U-value Improvement of Window in Market Productions

Average U-value ot total 2.47W/㎡.K, Average U-values registered in 2004~2006, 2007~2009년, 2010~2011 are individually 2.87W/㎡.K, 2.46W/㎡.K, 2.09 W/㎡.K (U-value of 2010-2011 registered are improved as 35% than those of registered in 204-2006)

Average U-value Change of Window according to the year registered

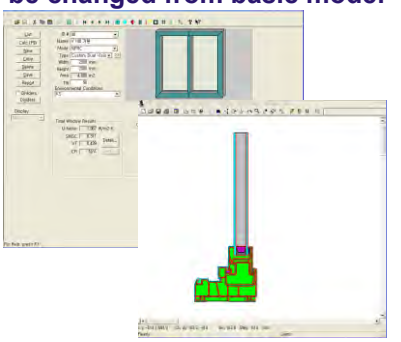




Windows set rating by simulation

- U-value evaluation by simulation
- Basic model : conducting simulation is after physical test
  Series model : conducting simulation is without physical test
  glazing, spacer of gas can be changed from basic model

www.window-sim.or.kr



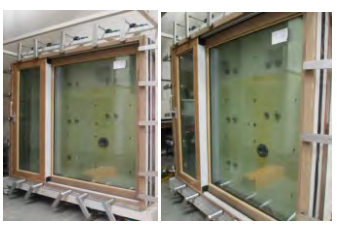
Windows set simulation

Testing Institutes of Windows

<Designated national testing Institutes>

- KICT(Korea institute of Construction Technology),
- KIER(Korea Institute of Energy Research)
- KFPA(Fire Insurers Laboratories of Korea)
- KCL(Korea Conformity Laboratories)
- KOMERI(Korea Marine Equipment Research Institute)
- KOLAS Laboratory

U-value test



Air Leakage test

Compliance Checking and Research Plan

Korean Compliance Checking

◆ Compliance Checking

- Target : Some model of registered Products :
  windows, refrigerators, Freezers, Air conditioners,
  Dish washing machine…34 products
- Inspection Items : Indication of Labeling
- Penalty : The Fine is 5million won ~ 20million won

◆ Research

- Parallel operating both experimental measurements and simulation measurements in future

Thank you

Seung-eon LEE
E-mail : selee2@kict.re.kr

Energy Rating Programs & Labelling for Fenestration in Australia

Tracey Gramlick

Executive Director – Australian Window Association (AWA)

President – Australian Fenestration Rating Council (AFRC)

President – Building Products Innovation Council (BPIC)

National Construction Code of Australia

A building must have to the degree necessary, a level of thermal performance to facilitate the efficient use of energy for artificial heating and cooling appropriate to-

- The function and use of the building
- The geographic location of the building
- Solar radiation being
  - *Utilised for heating*
  - *Controlled to minimise energy for cooling*
- The sealing of the building envelope against air leakage
- the utilisation of air movement to assist heating and cooling; and
- the energy source of the *services*.

The aim is to reduce greenhouse gas emissions, to the degree necessary—

(a) a building, including its *services*, is to be capable of efficiently using energy; and

(b) a building's *services* for heating are to obtain energy from:

(i) a low greenhouse gas intensity source; or

(ii) an on-site renewable energy source; or

(iii) another process as reclaimed energy.

Extracts from BCA 2011 – Volumes One & Two

Environmental Conditions

- Recognised international reporting conditions include NFRC-100, Ashrae Summer, CEN.
- Globalisation brings increasing opportunities but also increasing non compliance and conformity issues.
- Different environmental conditions employ different temperature ranges, sizes and display results for simulation modelling.
- CEN and other testing results compare with AFRC.
- Even NFRC results are displayed as Imperial Units which are different to the AFRC Metric results.
- Australian conditions are:

NFRC-100 ONLY in SI units (W/m².K)

Australian Fenestration Rating Council

www.afrc.org.au

- ✓ Established in 2007 with support from NFRC
- ✓ AFRC is an international partner of the NFRC (National Fenestration Rating Council)
- ✓ AFRC is the Australian body that sets and maintains the procedures and protocols for the rating of fenestration products in Australia
- ✓ AFRC adopted all NFRC rating procedures and has developed further procedures for products specific to Australia
- ✓ AFRC accredited results are referenced in the NCC - BCA and are the only results that can be used for compliance
- ✓ AFRC also provides access for accredited ratings into the National House Energy Rating Software, glazing calculators and BIM
- ✓ More than 250,000 residential results and 220,000 commercial sets

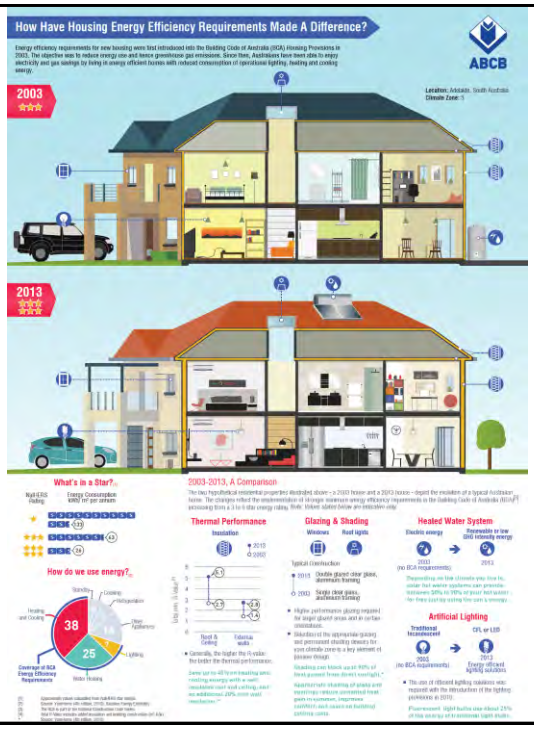
Where are we now?

- Stringency level for housing capped at 6 star
- Increased stringency levels for residential and commercial buildings with a move to simulation
- Significant reduction in allowable Uw and SHGC
- Increasing Consumer Awareness
- Increased use of insulated glass units
- Education programs and materials to address knowledge gaps
- Product energy ratings mandatory in Australian Standard for window performance
- Default windows for energy rater use with accredited software
- Access to accredited custom window results through AFRC portal
- Development of support tools as an outcome of joint industry & government projects

TG:AWA:APEC:2011

5

Option 1: Energy Rating Software - achieve the required energy rating for reducing heating and cooling loads (verified by approved software). The required minimum energy rating for reducing heating and cooling loads is 6-stars; however concessions are available in certain climate zones when providing outdoor living areas

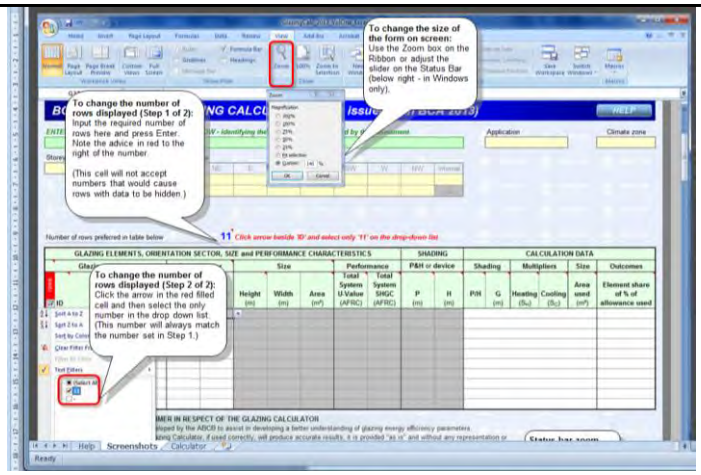


Option 2: Elemental BCA DtS Provisions - comply with all the relevant BCA DtS Provisions for the building fabric including floors, walls, roof, glazing and air movement.

Additionally, **both** options must comply with specific energy saving features such as the testing and installation of insulation, thermal breaks, compensation for downlights, floor edge insulation and building sealing.

TG:AWA:APEC:2013

6



For all Other Buildings:

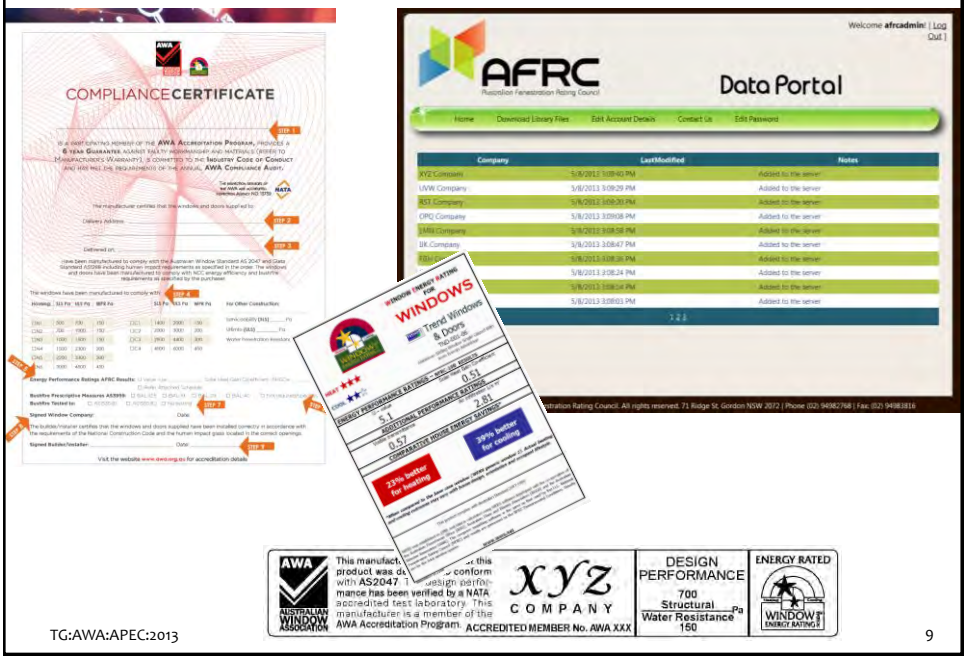
1. DtS through Glazing Calculators
2. Full simulation
3. BIM

Where are we heading?

- Increasing energy costs
- Higher Energy Efficiency Performance Levels
- Advanced glass technology
- Growing interest in alternative materials & integrated systems
- Mandatory disclosure (point of sale disclosure)
- Increased Compliance and mandatory labelling
- Sustainability tools
- Increased complexity and cost to meet all regulatory requirements in one product
- Better global alignment

BUT ALL IN ALL MORE EFFICIENT GLAZING ALL ROUND

Verification and Validation



THANK YOU

Dr. Prof. Igor SHUBIN
Dr. Alexander SPIRIDONOV; Dr. Nina UMNYAKOVA; Mr. Lyubim SHUBIN

«RUSSIAN WINDOW MARKET DEVELOPMENT»

Spokesperson: Lyubim SHUBIN

APEC Policy workshop for Energy Efficient Building Envelopes
Bangkok, October 22, 2013

AUTHORS

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Mr. Lyubim SHUBIN – Commercial director OOO PKP Velko-2000

2

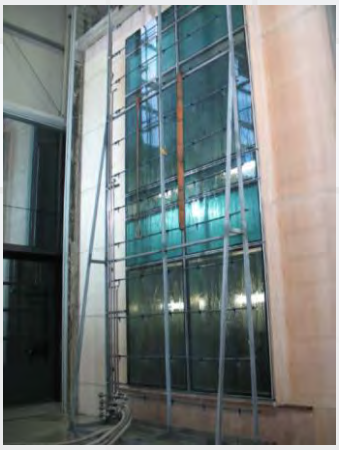
RESEARCH INSTITUTE of BUILDING PHYSICS (NIISF) under Russian Academy of Architecture and Construction Science (RAASN)

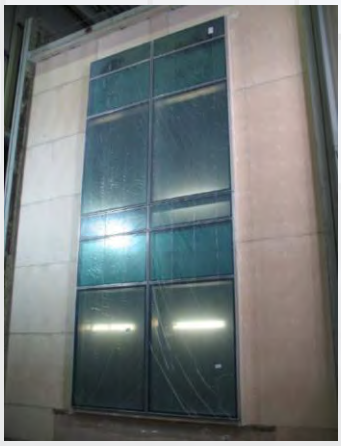
Main aims of NIISF RAASN, which is nonprofit research organization, are:

- ✓ Development of scientific based theory of building thermal physics:
  - Durability, and reliability of the bearing capacity of building structures;
  - Building acoustics and lighting;
  - Climatological and environmental aspects of the building.
- ✓ Research on the buildings protection from the harmful physical factors and influences.
- ✓ Development of technical standards for thousands sq.m. every year, determining construction, physical characteristics and properties of building materials, structures, equipment, products, facilities construction.

3

RESEARCH INSTITUTE of BUILDING PHYSICS Wind and Water inspection tests.





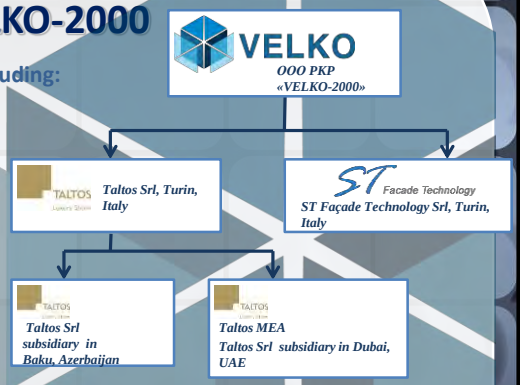
RESEARCH INSTITUTE of BUILDING PHYSICS
Fire inspection tests.

Before **30 min** **After**

LCC Commercial Manufacturing Enterprise VELKO-2000

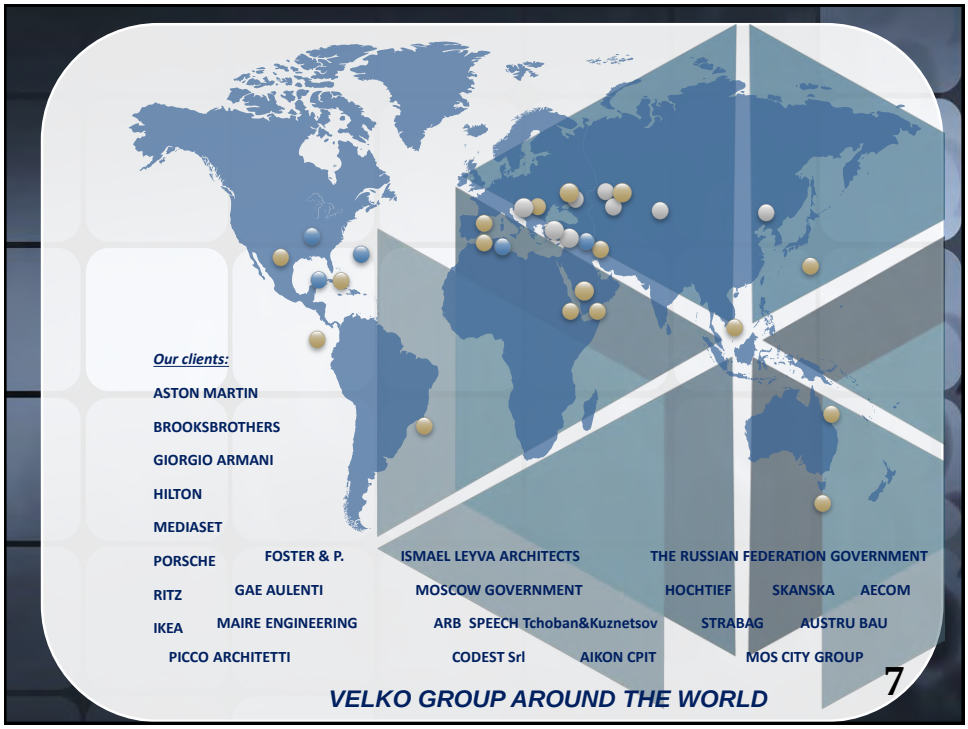
Full-range package of facade works including:

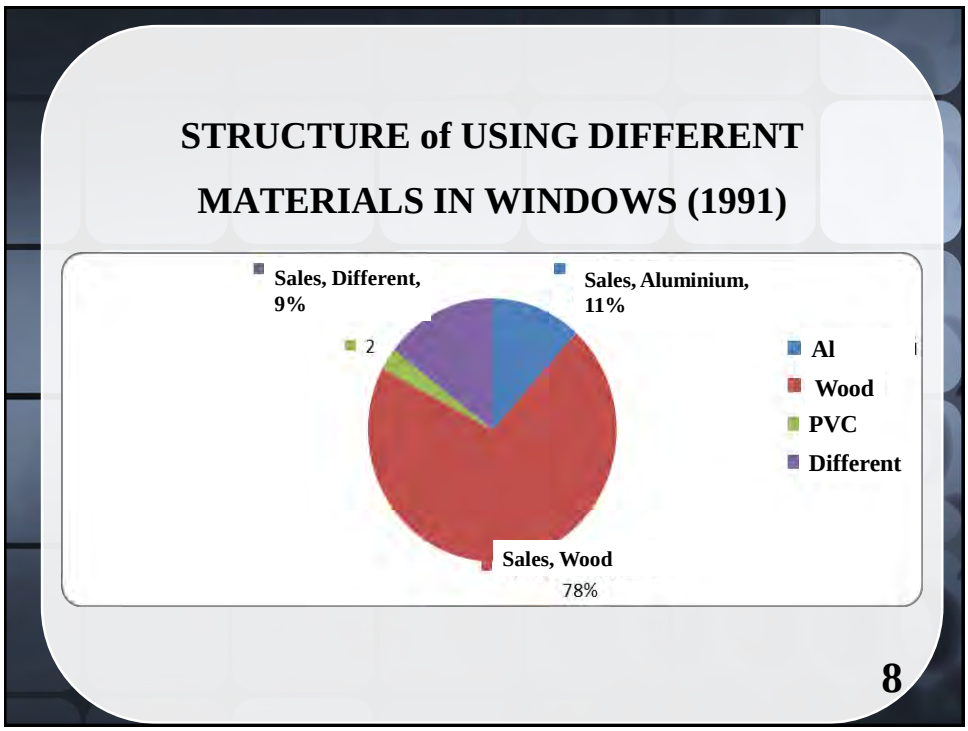
- ✓ *design*
- ✓ *production*
- ✓ *supply*
- ✓ *installation*
- ✓ *PROVIDE 10 000sq m /m*



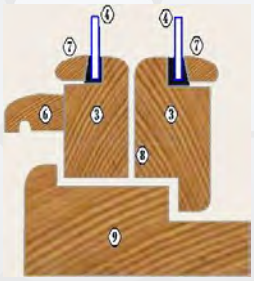
Our philosophy **is to provide the client with the packaged design solutions and ensure reliable façade products of best quality in manufacture and installation, which is possible to keep up thanks to considered development strategy and well-coordinated teamwork inside the company.**

6


Our clients:
ASTON MARTIN
BROOKSBROTHERS
GIORGIO ARMANI
HILTON
MEDIASET
PORSCHE
RITZ
IKEA
PICCO ARCHITETTI
FOSTER & P.
GAE AULENTI
MAIRE ENGINEERING
ISMAEL LEYVA ARCHITECTS
MOSCOW GOVERNMENT
ARB SPEECH Tchoban&Kuznetsov
CODEST Srl
AIKON CPIT
THE RUSSIAN FEDERATION GOVERNMENT
HOCHTIEF
SKANSKA
AECOM
STRABAG
AUSTRU BAU
MOS CITY GROUP
VELKO GROUP AROUND THE WORLD
7

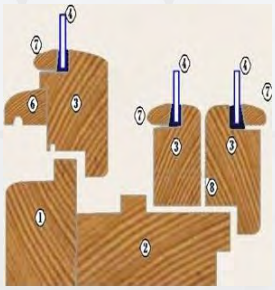

STRUCTURE of USING DIFFERENT MATERIALS IN WINDOWS (1991)
Sales, Different, 9%
Sales, Aluminium, 11%
2
Sales, Wood 78%
Al
Wood
PVC
Different
8

Popular Types of wooden windows (USSR period)



wooden coupled (OS)

separate (SHOUTING)



separate coupled (ORS)

FORMING of RUSSIAN WINDOW MARKET – 1

Stage	Years	Main characteristics	Demand (consumers)	Proposals (producers)
1	1988 – 1995	Acquaintance of producers and consumers with modern windows, their advantages	Formation of steady demand (generally among the provided fellow citizens)	Leading position of foreign suppliers of fenestration, system of profiles and accessories
II	1996-1998	Prompt growth of number of window producers (first of all, on manufacturing of windows from PVC profiles)	"Euro Windows" – prestige, a fashion and the high prices	Increase of competitive fight between domestic and foreign producers of windows

10

FORMING of RUSSIAN WINDOW MARKET - 2

Stage	Years	Main characteristics	Demand (consumers)	Proposals (producers)
III	1999-2000	Overcoming of consequences of crisis August, 1998, Closing of many small companies.	Decrease in population purchasing power, increase in demand at cheap windows	General reduction of window prices, transition to domestic profiles and accessories, decrease in window quality
IV	2001 – 2008	Transition beginning from "wild" to the civilized market. Increase of requirements to a ratio "price/quality	Increase in demand at various windows. Manifestation of interest to energy saving production	Production expansion of the range. 90 % of windows parts are made in the Russian Federation. Boom of window production

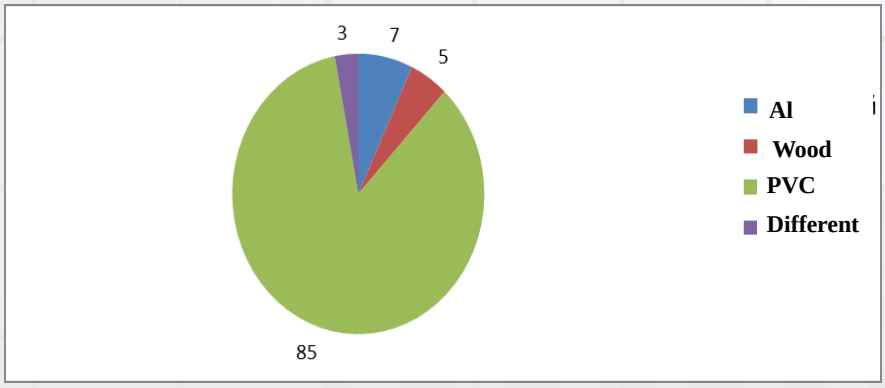
11

FORMING of RUSSIAN WINDOW MARKET - 3

Stage	Years	Main characteristics	Demand (consumers)	Proposals (producers)
V	2009 – till today	Overcoming of consequences of crisis of 2008. Sharply reduction of the construction volume. Continuation of process of integration of fenestration producers. Emergence of federal and regional programs of energy saving	Decrease in consumer demand and, as a result, volume of private replacement of old windows in houses. Sharp decrease in demand for expensive window, and also for aluminum windows and facades	In Russia any types of windows and facades can be made practically. Unfortunately, volumes of orders for an energy saving glazings and use of windows for passive and active buildings while are insignificant. Equipment loading at many regional enterprises less than 40 %, on the average through the country – around 45-55 %.

12

STRUCTURE of USING DIFFERENT MATERIALS IN WINDOWS (2011)



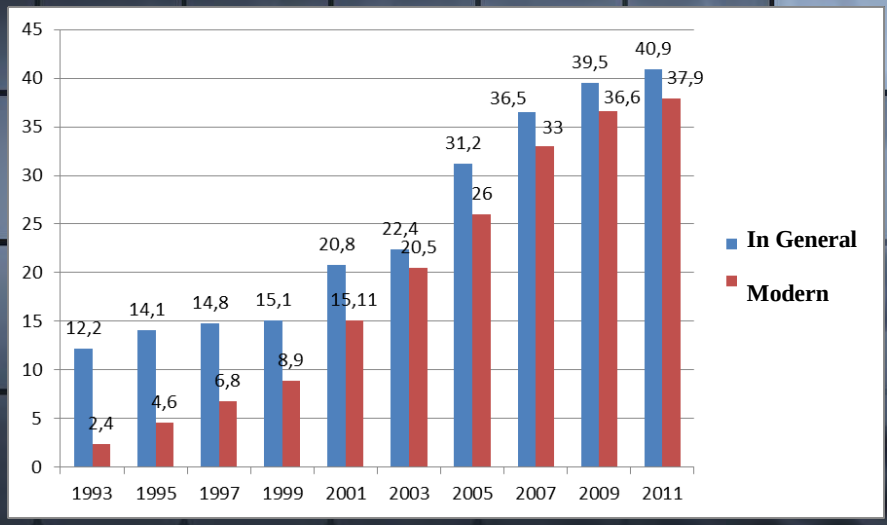
13

HOUSING CONSTRUCTION AND OIL PRODUCTION IN RUSSIA

Рис. 11. Динамика годового ввода жилья и добычи нефти в России в 1990 – 2010 гг.

14

FENESTRATION PRODUCTION IN RUSSIA



15

RESULTS of RUSSIAN WINDOW MARKET DEVELOPMENT

- **1. In 20 years (1991 - 2011), window market in Russia was turned into modern industry on designing, manufacturing and installation. Today Russia confidently holds the 3rd place in the world (after China and the USA) in volume production.**

- **2. Russian window companies are capable of producing windows and facades of almost any complexity - existing equipment in the country allows it. Unfortunately the loading of modern window production in Russia does not exceed 55% of equipment capacity, that is a negative aspect that affects the mentality of the leaders, who really want to load all their production.**

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RESULTS of RUSSIAN WINDOW MARKET DEVELOPMENT

- **3. Russian window market for 20 years of development had peaks (2004-2007) and downs (1999, 2010 - 2011).**
- **In 2011 - 2012, stagnation of the market (most likely) will spread up to 2015. The growth of the market (if it is - some experts say about 3-5%) is rather symbolic. Rather it is not the growth of sales volumes and a decline (in different regions, this situation is very different) with an increase of the average cost structures, and it is some growth of the market according to experts.**
- **4. Russia has a well developed system of normative documents, created in 1998 - 2003, which, needs urgent updating. Recently (2010 – 2012), this work has been intensified.**

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RESULTS of RUSSIAN WINDOW MARKET DEVELOPMENT

- **5. Despite the adoption in 2009 of the Federal law №261-FZ «On energy saving and energy efficiency....», consumers (including state) are not ready, that the new window design, corresponding to the requirements of this law, will cost more expensive. Most serious of window companies are ready to produce designs that meet the requirements of the law №261-FZ and the corresponding regional programs on energy saving.**
- **6. Significantly changed the structure of the window market in comparison with Soviet times.**

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FENESTRATION PRODUCTION IN SOME COUNTRIES (sq.m/ year/ person)

Country	2004	2010
USA	0.35	0.37
Germany	0.27	0.30
China	0.15	0.34
Russia	0.16	0.29

19

FENESTRATION PRODUCTION IN SOME RUSSIAN REGIONS (sq.m/ year/ person)

Region	2004	2010
Moscow	0.32	0.38
Moscow region	0.25	0.43
Saint-Petersburg	0.19	0.35
Rostov	0.21	0.29
Hanty-Mansiysk	0.41	0.24
Samara	0.22	0.28
Ekaterinburg	0.21	0.34
Novosibirsk	0.20	0.30
Vladivostok	0.05	0.16

20

RECOMMENDED R-VALUE FOR WINDOWS

	Minimal mandatory requirement					
ГСОП	2 000	4 000	6 000	8 000	10 000	12 000
R (м²К/Вт)	0.3	0.45	0.6	0.7	0.75	0.8
	Recommended requirement					
ГСОП	До 4000		4000-6000	6000-8000	8000 и более	
R (м²К/Вт)	0.60		0.75	0.80	0.90	
Climatic Zone	1		2	3	4	

21

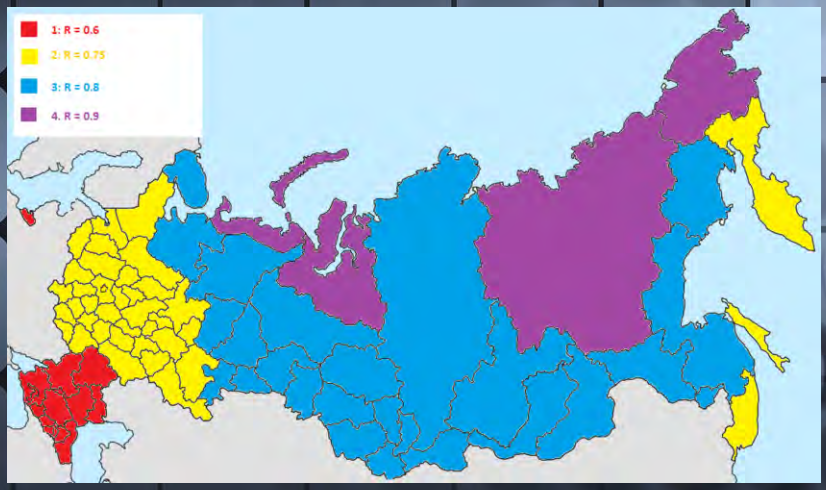
THERMAL LOSSES THROUGH FENESTRATION IN DIFFERENT CLIMATIC CONDITIONS

R, (m²K/W)	Degree-Day of heating season									
	1 000	2 000	3 000	4 000	5 000	6 000	7 000	8 000	10 000	12 000
0.3	80	160								
0.35	69	137								
0.4	60	120	180				Forbidden			
0.45	53	107	160	213						
0.5	48	96	144	192						
0.55	44	87	131	175	218					
0.6	40	80	120	160	200	240				
0.65	37	74	111	148	185	222	258			
0.7	34	69	103	137	171	206	240	274		
0.75	32	64	96	128	160	192	224	256	320	
0.8	30	60	90	120	150	180	210	240	300	360
0.85	28	56	85	113	141	169	198	226	282	339
0.9	27	53	80	107	133	160	187	213	267	320
0.95	25	51	76	101	126	152	177	202	253	303
1.0	24	48	72	96	120	144	168	192	240	288

Recommended definitions

22

RECOMMENDED R-VALUE FOR FENESTRATION IN RUSSIA



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THANK YOU FOR ATTENTION!

shuig@mail.ru
spiridonov@aprok.org
n.umniakova@mail.ru
9201808@mail.ru

Green Building

22 October 2013
Songpol Bumpensanti

AGC

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Content:

1. Thailand Energy Situation at a Glance
2. Thailand Energy Efficiency (EE) & Renewable Energy (RE) Policy & Target
3. Glass for Building Envelope , GBE (EE)
4. Glass Integrated Photo Voltaic, GI PV (RE)
5. Show case in Thailand

AGC

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1. Thailand Energy Situation at a Glance

Economic Sector	Energy Consumption (Ktoe)				
	2009	2010	2011	2012	2012 share
Agriculture	3,477	3,499	3,686	3,790	5.2%
Industry	24,060	25,571	25,087	26,910	36.7%
Residential	10,089	10,963	10,967	11,083	15.1%
Commercial	4,940	5,620	5,356	5,303	7.2%
Transportation	24,132	24,594	25,466	26,230	35.8%
Total	66,698	70,247	70,562	73,316	100.0%

Source: Thailand Energy Statistic 2012

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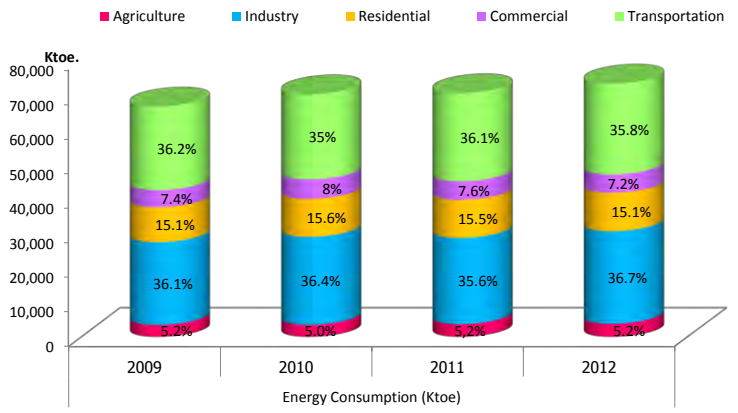
1. Thailand Energy Situation at a Glance



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2. Thailand Energy Efficiency & Renewable Energy Policy, Target

-Energy Efficiency (EE)

Target to reduce Energy Intensity by 25% in 2030

Thru **Green Building**, building envelope, lighting, air conditioning and etc.

-Renewable Energy (RE)

Target increase RE % to be 25% to Total Energy Consumption by 2021

Thru **Solar**, wind, biomass, biogas, MSW and etc.

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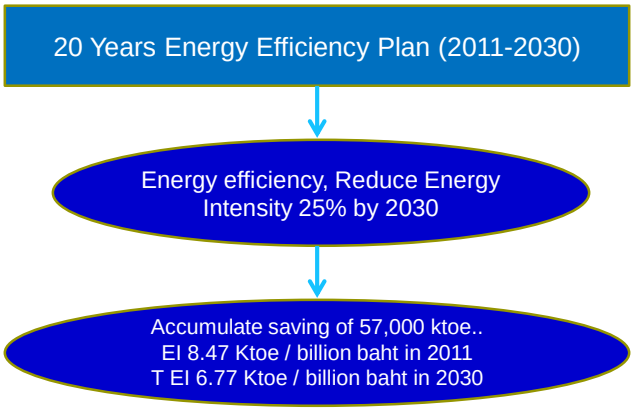
2. Thailand Energy Efficiency & Renewable Energy Policy, Target

Energy Efficiency



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2. Energy Efficiency & Renewable Energy Policy, Target

-Energy Efficiency (EE)

Target to reduce Energy Intensity by 25% in 2030

Thru **Green Building**, building envelope, lighting, air conditioning and etc.

-Renewable Energy (RE)

Target increase RE % to be 25% to Total Energy Consumption by 2021

Thru **Solar**, wind, biomass, biogas, MSW and etc.

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2. GI PV as Renewable Energy & Energy Efficiency Policy, Target

Renewable Energy

10 Years Renewable Energy-Development Plan (2012-2021)

Target 25% of RE in Total Energy Consumption By 2021

New energy		Solar	Wind	Hydro power plant			Bio-energy			Biofuels		
Ocean&Tidal	Geothermal			Small	Micro	Pumped-Storage	Biomass	Bio-gas	MSW	Ethanol	Bio-diesel	2nd-Gen. Biofuels
2 MW	1 MW	2,000 MW	1,200 MW	324 MW		1,284 MW	3,630 MW	600 MW	160 MW	9 ML/day	5.97 ML/day	25 ML/day
3 MW		**3,200 MW**		**1,608 MW**			**4,390 MW**			**Renewable fuel 44%**		

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2. Renewable Energy & Energy Efficiency Policy, Target

Renewable Energy

Current Situations and Renewable Energy Targets			
Type	**Units**	**Current Capacity (Mar-13)**	**Goal 2021**
Electricity		**3,031.8**	~~9,198.0~~
Solar	MW	486.3	2,000
Wind	MW	215.2	~~1,200~~
Small Hydro	MW	101.8	1,608
Biomass	MW	1,988.9	3,630
Biogas	MW	197.0	600
MSW	MW	42.7	160
Heating		**4,882.0**	**9,335.0**
Solar	Ktoe	4.0	100
Biomass	Ktoe	4,342.0	8,200
Biogas	Ktoe	458.0	1,000
MSW	Ktoe	78.0	35
Biofuel		**5.1**	**40.0**
Ethanol	ML/day	2.3	9
Biodiesel	ML/day	2.8	31
% RE to T E C		**9.9%**	**25.0%**

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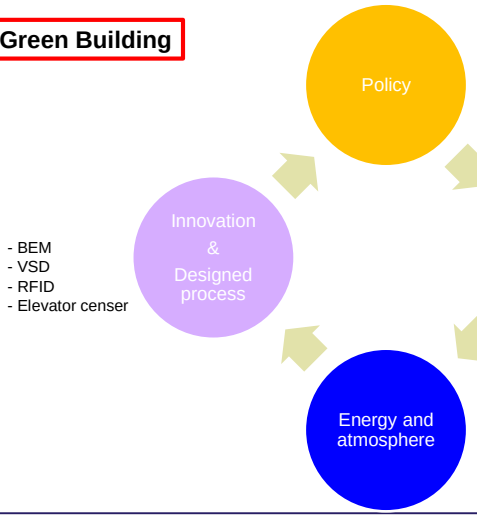
3. Glass for Building Envelope as EE

Green Building



- Management
- Human Resource
- PDCA

- Location, landscape, architect
- Water efficiency
- Quality of environment
- Environmental impact
- Material & construction

- Lighting
- Air conditioning
- **Envelope**
- Monitoring
- Consumption
- Renewable Energy

- BEM
- VSD
- RFID
- Elevator censer

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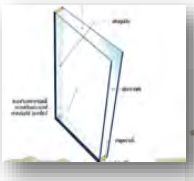
3. Glass for Building Envelope as EE

Lots of thing can be reduced heat & energy consumption in Building
One of the major item is " Building Envelope" …





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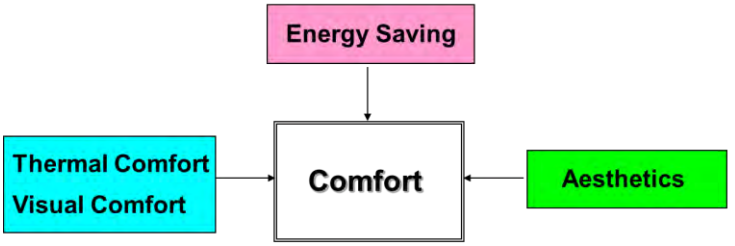
3. Glass for Building Envelope as EE

Benefits of High Performance Glass



' AGC Concept support to determine glass selection'
"3 benefits,
1) Energy saving 2)Aesthetics 3) Comfort."

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3. Glass for Building Envelope as EE

- **To Design Green Building :**
  - **Solar control Low-E is optimal (Low "SHGC"& Moderate "LT")**
    - *SHGC: Solar Heat Gain Coefficient, LT : Light Transmission
  - **Benefits: 1) Low cooling load & thermal comfort**
    2) Large window & natural lighting
    -> Good day lighting, good view & office productivity improvement

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3. Glass for Building Envelope as EE

Using Solar control Low-E

You can get

- Energy saving (A/C & Lighting)
- Good Environment (thermal, light & View)
- Office productivity improvement
- Good Appearance of façade
- Flexibility to design "Green Building"

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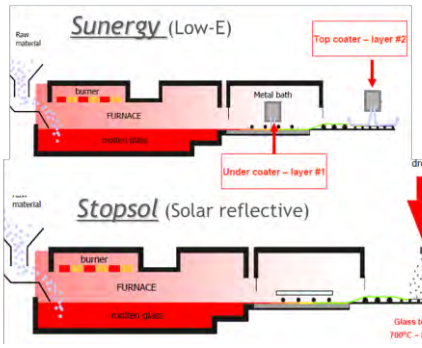
3. Glass for Building Envelope as EE

Production methods (online coating)

We have three methods for surface coating, which apply various functions such as optics, durability and so on.



CVD

(Chemical vapor deposition)

Spray coating

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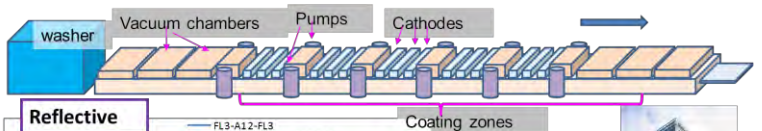
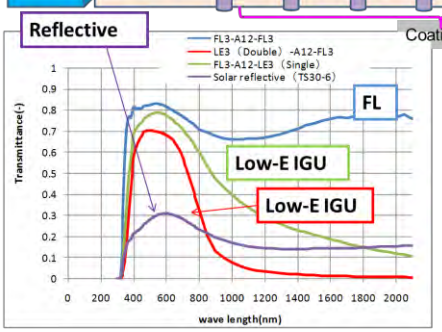
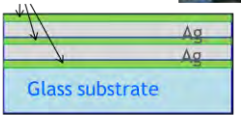
3. Glass for Building Envelope as EE

Production methods (offline coating: Magnetron sputtering)





Dielectric layer



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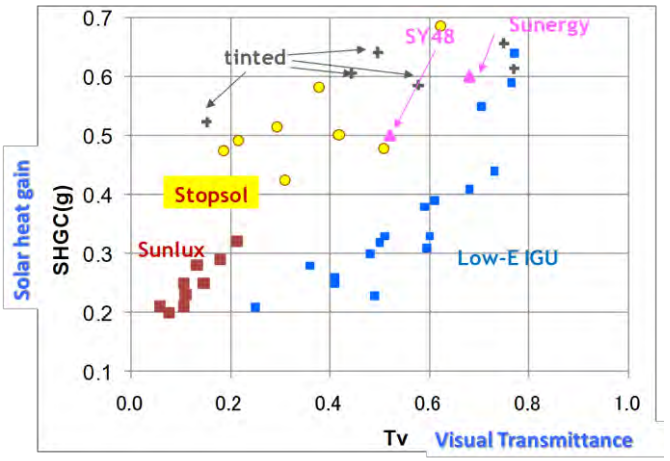
3. Glass for Building Envelope as EE



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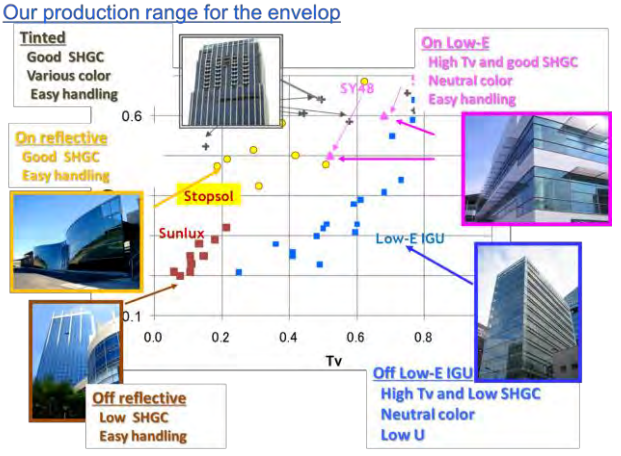
3. Glass for Building Envelope as EE



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3. Glass for Building Envelope as EE

AGC Flat Glass (Thailand) : Product range

Pair Tag Low-E
(off Low-E IGU)

Sunergy (on Low-E)

Solartag
(off reflective)

Lamitag (laminated)

Stopsol
(on reflective)

Tinted

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3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
Sunergy Clear	5	68	9	0.61	4.1
Sunergy Clear	6	68	9	0.61	4.1
Sunergy Clear	8	67	9	0.59	4.1
Sunergy Clear	10	66	8	0.58	4.1
Sunergy Green	6	56	7	0.42	4.1
Sunergy Green	8	52	7	0.39	4.1
Sunergy Blue Green	6	48	7	0.41	4.1
Sunergy Blue Green	8	42	6	0.37	4.1
Sunergy Euro Grey	6	34	5	0.42	4.1
Sunergy Euro Grey	8	26	4	0.37	4.1
Planibel G	3.2	82	11	0.74	3.7
Planibel G	4	82	11	0.73	3.7
Planibel G	5	81	11	0.72	3.7
Planibel G	6	81	11	0.71	3.7
Stopsol Super Silver Dark Blue	6	41	17	0.44	5.7
Stopsol Classic Green	6	31	20	0.38	5.7

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3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
SolarTAG PLUS CS 120	6	20	27	0.31	5.20
SolarTAG PLUS CS 130	6	32	16	0.41	4.77
SolarTAG PLUS CS 214	6	10	25	0.24	5.05
SolarTAG PLUS CS 220	6	16	18	0.29	5.39
SolarTAG PLUS CS 230	6	24	14	0.35	5.66
SolarTAG PLUS CS 514	6	9	17	0.25	5.14
SolarTAG PLUS CS 520	6	12	14	0.27	5.18
SolarTAG PLUS CS 530	6	21	11	0.35	5.79
SolarTAG Selective CS140	5	37	18	0.47	5.63
SolarTAG Selective TBL135	5	38	19	0.44	5.53
IGU, 6LE1P01C+0.76+LNFL4+A12(AR)+8LE1P01C	30	60	14	0.32	1.68
LG, OFL6C+0.76+4LE1P01S	10	59	10	0.43	5.50
LG, SL4TS130P+0.38+I4SN101 #4	8	26	22	0.28	4.33
LG, OFL6C+0.38+4SN101#3	10	51	6	0.41	5.56
IGU, INSFL6+0.38+FL6+A12+6LE1P01S	30	44	8	0.29	1.94
LG, IPOFL6+0.38+4LE1P01S	10	58	10	0.40	5.56
IGU, IGEFL6 + 1.52 + 6SN101#4 + A12 + FL8	32	28	6	0.29	2.26
IGU, SP6CS120 + 1.52 + FL6 + A12 + FL8	32	22	28	0.24	2.95

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3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
World Medical Center					
Insulating Glass Unit , INSFL6+0.38+FL6+A12+6LE1P01S	30	44	8	0.29	1.94

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3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
Provincial Administration Office, Rayong					
Laminated Safety Glass, OFL6C+0.76+4LE1P01S	10	59	10	0.43	5.50

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3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
Daily Max					
Laminated Safety Glass, IPOFL6+0.38+4LE1P01S	10	58	10	0.40	5.56

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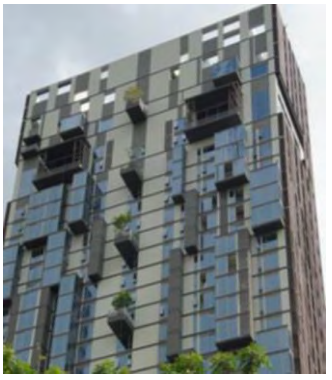
3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
Ashton					
Laminated Safety Glass, SL4TS130P+0.38+I4SN101 #4	8	26	22	0.28	4.33



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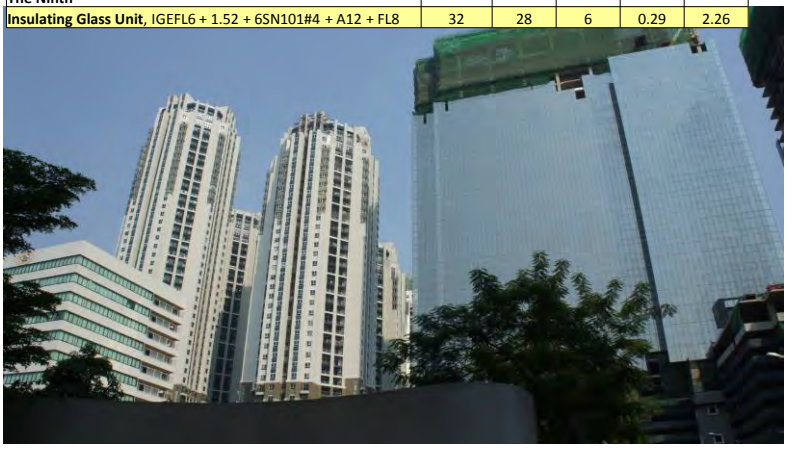
3. Glass for Building Envelope as EE

Kind of Glass	Thick	LT	LR out	SHGC	U-value
The Ninth					
Insulating Glass Unit, IGEFL6 + 1.52 + 6SN101#4 + A12 + FL8	32	28	6	0.29	2.26



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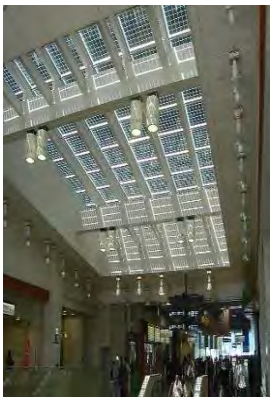
4. Glass Integrated PV

Standard Module

Light Through Module



See Through Module

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4. Glass Integrated PV: Features

1. Custom made GI PV
2. Free Style Design for Solar Cell positioning
3. Laminated Tempered Glass composition
   (Glass + EVA + Solar Cell + EVA + Glass)

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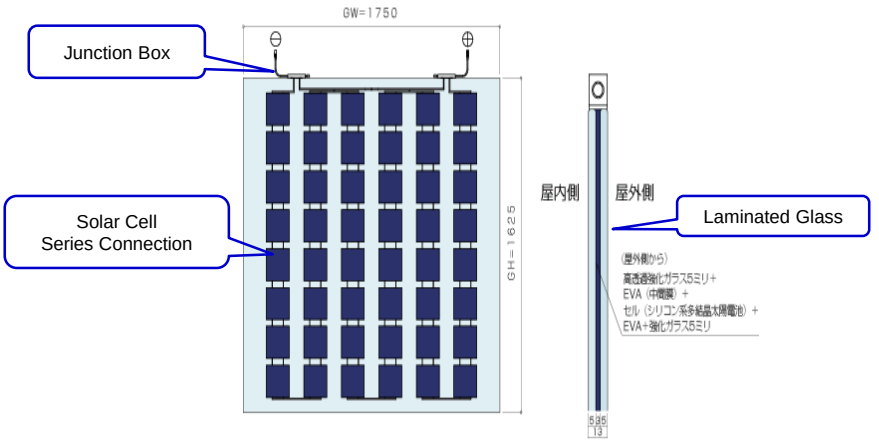
4. Glass Integrated PV: Basic Structure



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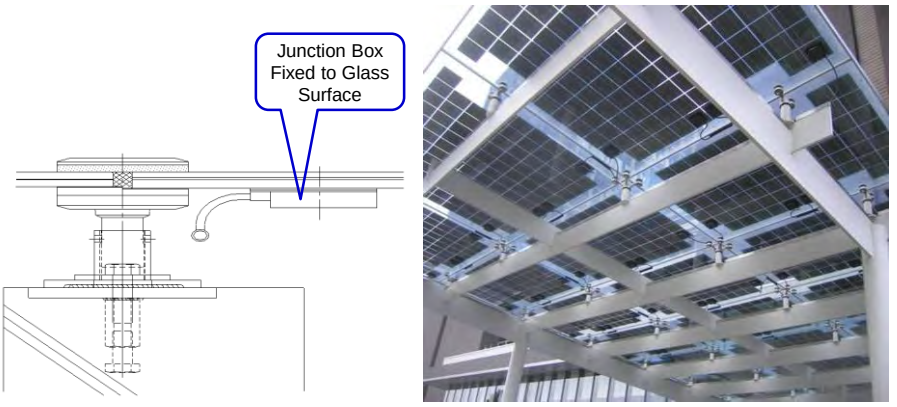
4. Glass Integrated PV: Basic Structure



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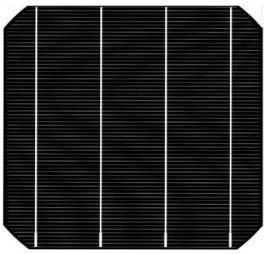
4. Glass Integrated PV: Type: Silicon

Single Face Solar Cell



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4. Glass Integrated PV: Type: Silicon

Bi Facial Solar Cell

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4. Glass Integrated PV: Curtain Wall

- Yokohama DIA Bldg 31F
- Module
  T Glass 5 +T Glass 5
- Main Glass size
  1,738 x 1,625 mm
- Total 1,500 ㎡
- Max Power 91KW
- Installed in 2008
- Solar Cell Single Face

AGC

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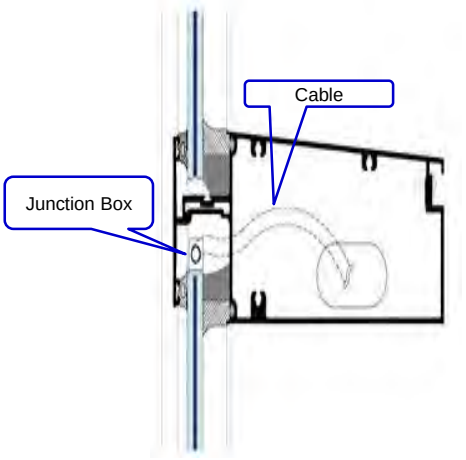
4. Glass Integrated PV: Curtain Wall



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4. Glass Integrated PV: CW : Vision

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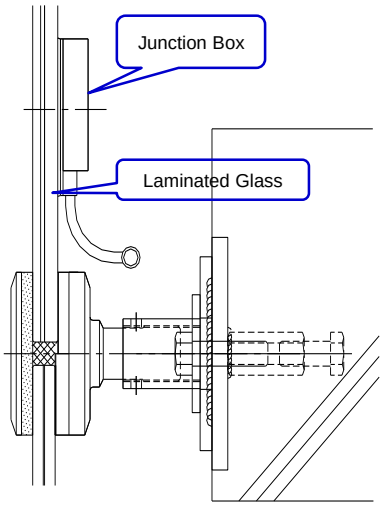
4. Glass Integrated PV: FC : Dot Point



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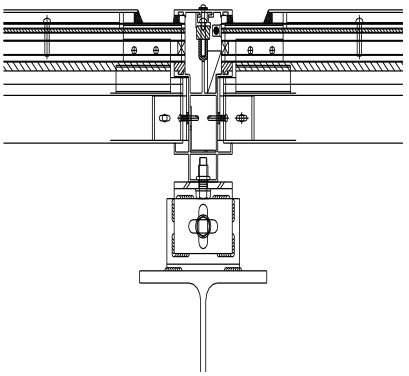
4. Glass Integrated PV : Canopy : IGU



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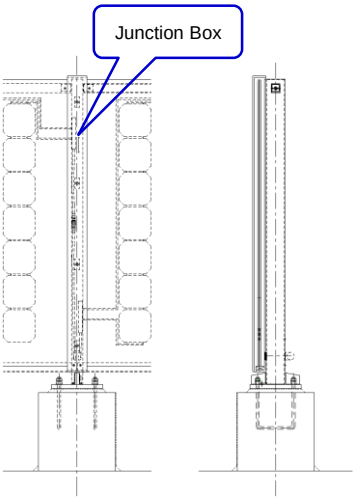
4. Glass Integrated PV : Roof Top Fence



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4. Glass Integrated PV : Sound Barrier

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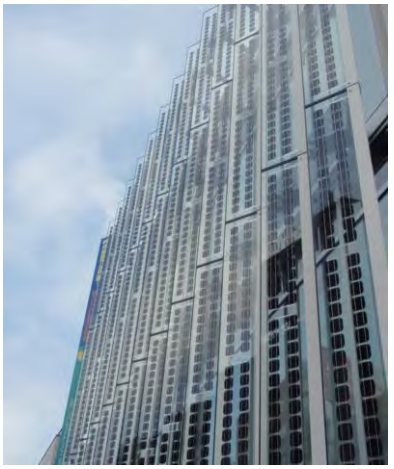
4. Glass Integrated PV : Vertical Louver

- Module
  Tempered 8mm + Tempered 8mm
- Main Module size
  600x4100mm
- Total SQM 112 ㎡
- Max Power 5KW
- Installed in 2011
- Solar Cell Bi-Facial



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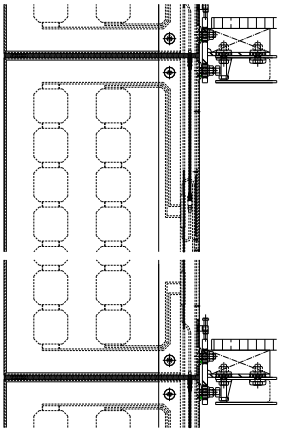
4. Glass Integrated PV : Vertical Louver



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5. Smart case : Green Showroom

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5. Smart case : Green Showroom

1. A pond in front of the project

The excavation of a large pond in front of the project provides an outstanding view of the building and also serves to detain and delay the flow of water through reusing such water for gardening purposes. Moreover, cool wind passing from the pond area also help cooling the building, while the pond itself act as a buffer zone to trap any dust or particles from the road.

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5. Smart case : Green Showroom

2. Conservation of large trees

Large trees within the project are conserved. All buildings are designed concerning the position of large trees, especially trees that are originally planted since 100 years ago such as the one in front of the project site or the bael tree (Aegle marmelos) beside the showroom are being conserved to reflect its origin while providing shade.

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5. Smart case : Green Showroom

3. Planting trees within the project site to provide shade

Other trees that have been planted within the project site are from seedlings which have been planted in preparation for the garden in advance; the position of the new planted trees is considered for the maximum shade. The area within the project site is intentionally created to be the center for environment education; to give knowledge about the landform of Pakchong District. In order to establish a learning center for the community,variety of Palm Trees one planted as well to encourage the learning for those who are interested.

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5. Smart case : Green Showroom

4. Building placement

Placement of the buildings within the project site is different from other showrooms and customer services. The two departments are connected by an open space to allow air circulation.

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5. Smart case : Green Showroom

5. Parking space for eco cars and bicycles

Parking space are allotted for Eco cars, CNG, Hybrid, E20+ and Electric cars in front of the project site; to enhance awareness and advocate the use of eco-friendly cars. Moreover, parking space for bicycles is provided for customers and employees to heighten awareness on the use of bicycles and lower the use of cars and motorcycles which consume fuel.

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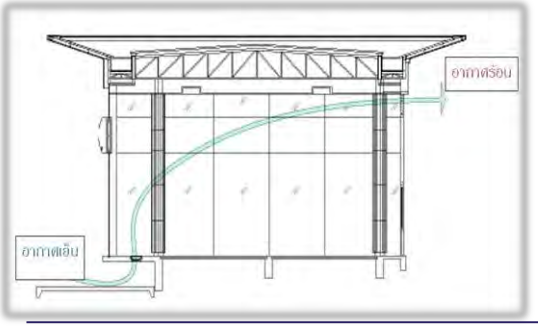
5. Smart case : Green Showroom

6. Ventilation dents within the showroom

The showroom is designed to ensure maximum ventilation. Ventilation dents are placed along the flooring area next to the glass door at the front of the showroom, while the back area of the showroom features panel windows that can be opened or closed for natural ventilation. During winter months in Pakchong District, cold winds flow from the north eastern side into the showroom for a period of 4 months, reducing the use of air-conditioning during these months.



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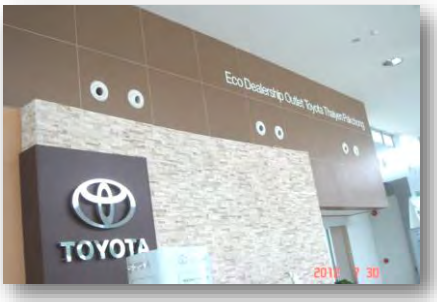
5. Smart case : Green Showroom

7. High efficiency air-conditioning system

The air-conditioning system within the showroom features a high efficiency jet system which releases air from the back walls of the showroom. The jet system enables air to be released to longer distances within the showroom compared to the regular air-conditioning system and is more practical and energy efficient for such buildings.



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5. Smart case : Green Showroom

8. Energy efficient building

The buildings are designed to cater for use of energy efficient materials to prevent excessive heat from entering into the buildings. Insulations are installed along the walls, while the roof is made of eco-friendly materials. Light weight bricks are used for walls to reduce heat emission from the outside, combined with the use of high-efficiency jet air-conditioning system and the use of fluorescent T5 bulbs, the overall building is ensured to consume less energy.

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5. Smart case : Green Showroom

9. Use of LED bulbs for the sign post and Fascia

LED bulbs will be used for the sign post and fascia to reduce energy use.

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5. Smart case : Green Showroom

10. Water saving sanitary ware

Sanitary wares and faucets used within the buildings are those with saving water usage and lower environmental impact.

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5. Smart case : Green Showroom

11. Use of local materials

Selection of materials for walkways and exterior walls are based on the use of local materials such as local clay from the project site area. The staircases and interior walls are laid with local marble, while exterior walls on the lower floor of the building are decorated with slate from the local mines. The uses of local materials help generating income for the local community and lower the use of energy and cost of transportation

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5. Smart case : Green Showroom

12. Use of Energy Savings Glass

The thermally effective insulated glass is used for the showroom and customer lounge windows. These insulated dual layer glass windows consist of a laminated surface on the exterior and are coated with a soft coat Low-E (low emission). There is also an air pocket between the outer and inner layer which is also coated. This particular coat provides high light transmittance, which saves energy by its ability to diminish the heat transfer (low solar heat gain coefficient).

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5. Smart case : Green Showroom

Kind of Glass	Thick	LT	LR out	SHGC	U-value
Toyota Pakchong					
Insulating Glass Unit, 6LE1P01C+0.76+LNFL4+A12(AR)+8LE1P01C	30	60	14	0.32	1.68

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Thank You

Gov't policy to support GB in Thailand:

- Building Energy Code
  - Mandatory for designed building which area over 2,000 m^2.
  - Minimum performance of buildings
  - Focus on new & retrofitted buildings
- Concept of BEC
  - Push & Pull mechanism
  - Promote sustainable technology knowledge
  - Analyze whole building energy compliance

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Gov't policy to support GB in Thailand:

- Concept of BEC
  - Analyze life cycle costing
  - Design for environment and health
- Component of BEC
  - Building envelope, OTTV & RTTV
    - Office & Academic Institute wall 50 w.m2, roof 15 w/m2
    - Super store, wall 40 w/m2, roof 12 w/m2
    - Hotel & Hospital, wall 30 w/m2, Roof 10 w/m2

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Gov't policy to support GB in Thailand:

- Component of BEC
  - Lighting system allowable rated power (LPD)
    - Office & Academic Institution 14 w/m2
    - Super store, 18 w/m2
    - Hotel & Hospital, 12 w/m2
  - Air conditioning system
    - Split type size less than 12,000 watt get COP 3.22 or ERR 11 Btu/hr/Watt
    - Chiller & absorption chiller
    - Other parts

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Gov't policy to support GB in Thailand:

- Component of BEC
  - Hot water generating system
    - Steam boiler/ Hot water boiler
    - Heat pump water heater
  - Renewable energy utilization
    - Solar
    - Wind
    - Biogas
    - Biomass

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Gov't policy to support GB in Thailand:

- Component of BEC
  - Whole building energy performance
    - The overall energy consumption of the proposed building must less than the overall energy consumption of reference building

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Gov't policy to support GB in Thailand:

- Standard & Labels in Thailand
  - Standard for appliance
    - General Standard
    - Mandatory Standard
  - Labels for appliance
    - Electrical appliance
    - Non electrical appliance in home, office & electrical in industries
    - For material



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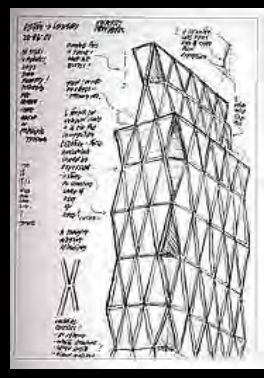


Glass and Energy Savings

Location: Bangkok
Date: November 22, 2013

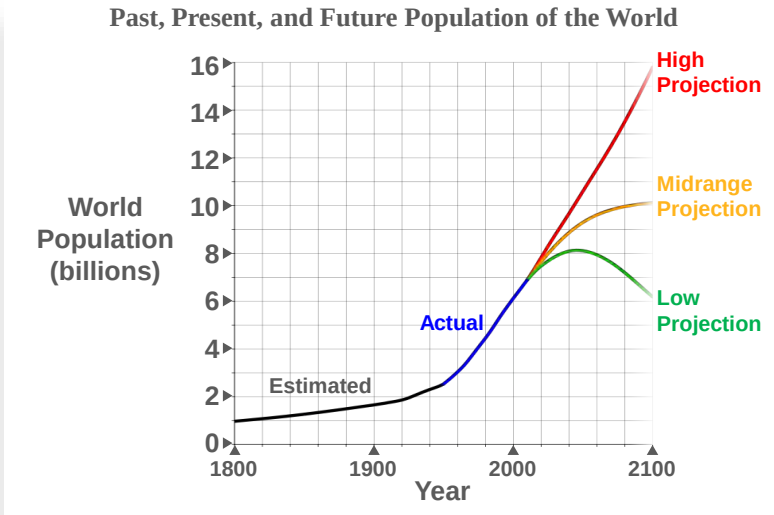
Objectives

- Understand the importance of achieving energy efficiency in building design.
- Be aware of codes and standards associated with sustainable and energy-efficient construction.
- Glass Selection
- Be familiar with the performance characteristics of today's high performance low-E glazings.

Presentation Agenda

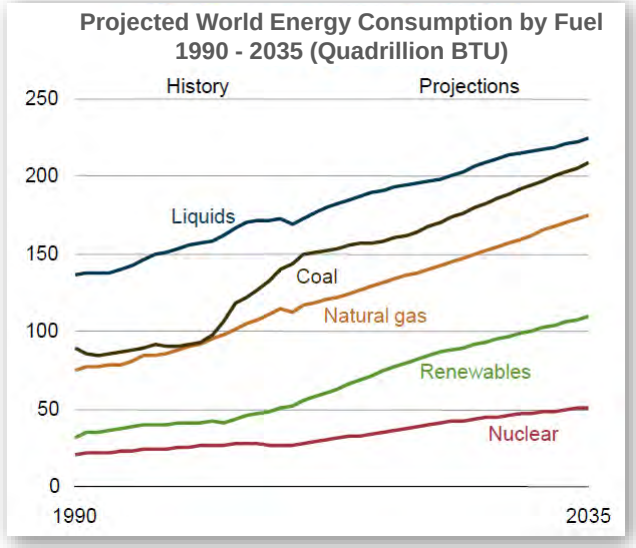
- The Importance of Sustainable Design
- Glass Performance Properties
- Latest Low-E Glass Coatings
- Glass Selection

World Population is Increasing



Source: U.N. 2010 Projections and US Census Bureau Historical Estimates.

Global Energy Demand Continues to Rise

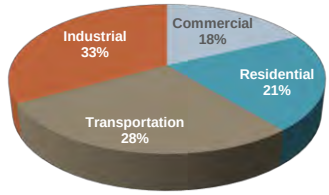


Source: 2011 International Energy Outlook by the US Department of Energy Information Administration

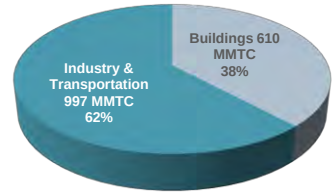
5

Buildings Consume Substantial Energy

39% of U.S. Primary Energy Consumption



38% of U.S. Carbon Emissions



72% of U.S. Electricity Consumption

Source: US Energy Information Administration Annual Energy Review - 2009

6

Code Requirements are Intensifying

- Implementation of 30% energy saving from recent editions of national standards

ASHRAE 90.1-2010 (relative to 90.1-2004)

Energy standard for buildings except low-rise residential buildings

2012 IECC (relative to 2006 IECC)

International Energy Conservation Code

7

Code Requirements are Intensifying

International

- 2012 IGCC
- International Green Construction Code

National

- ASHRAE 189.1-2011
- Standard for the Design of High Performance Green Buildings

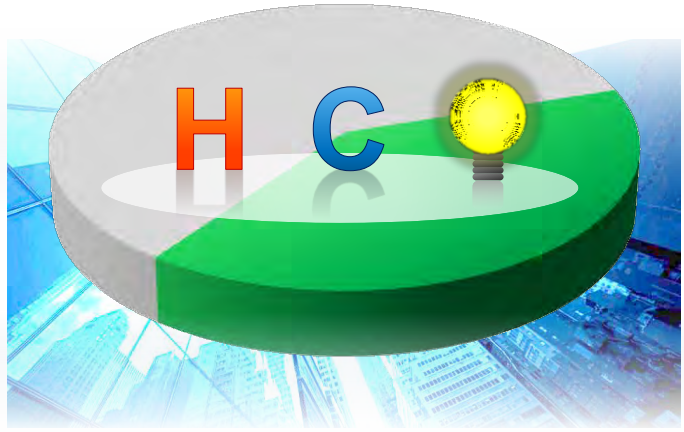
State

- 2010 CALGreen Code
- California Green Building Standards Code

8

Glazing Influences Building Efficiency

- Glazing design can affect 40% or more of a building's energy consumption for heating, cooling, and lighting.

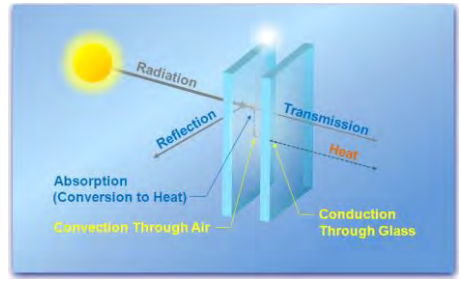


9

Energy Transfer Through Glazing

Energy from the sun arrives as radiation and ultimately converts into heat.

- Reflection: Redirection back toward the atmosphere
- Transmission: Continuation in the original direction
- Absorption: Conversion to heat
- Heat is transferred by convection (within a gas) and by conduction (within a solid).



10

Key Glazing Performance Terms

- VLT (or VT): visible light transmission
- U-value (or U-factor): coefficient of heat transfer (BTU / hr ft^2 ^oF)
- R-value: resistance to heat transfer (hr ft^2 ^oF /BTU); U=1/R
- SHGC (solar heat gain coefficient): percentage of transmitted solar energy
- SC (shading coefficient): ratio of transmitted solar energy to that of 1/8" thick clear glass
- LSG (light-to-solar gain): LSG=VLT/SHGC

11

Advanced Low-E Coatings

Double- and Triple-Layer Low-E Coatings

- Silver Layers are the Workhorses of Low-E coatings
- Single Silver Low-E:
  - Wide range of VLT and SHGC values available for different geographies
- Double Silver Low-E:
  - Lower SHGC
  - High VLT for more natural lighting
- Triple Silver Low-E:
  - Currently the best combined performance of VLT (maximized) and SHGC (minimized)
- Each silver layer adds a slight green cast to the coating's transmitted color

12

Evolution of Glazing and Performance

COMPOSITION	VLT	U	SHGC	LSG
¼" Monolithic	89%	1.03	0.84	1.06
¼" Monolithic Tint	76%	1.03	0.59	1.28
1" IG Unit	80%	0.47	0.73	1.09
1" IG Unit w/ Outboard Tint	68%	0.47	0.48	1.42
1" IG Unit w/ Single-Silver Low-E	61%	0.30	0.40	1.52
1" IG Unit w/ Double-Silver Low-E	68%	0.29	0.38	1.80
1" IG Unit w/ Triple-Silver Low-E	62%	0.28	0.27	2.30
1 ¾" Triple-Glazed IG, Low-E #2, Argon	55%	0.18	0.24	2.31
1 ¾" Triple-Glazed IG, Low-E #2 & #6, Argon	54%	0.16	0.23	2.32

13

"Who Selected This Glass?"

Design Considerations When Using Architectural Glass

Not all Glass is Created Equal!

In a world that seems focused on energy efficiency, sustainability, zero carbon footprint, LEED certification, spectrally selective coatings, warm edge spacers etc….

Why do so many projects end up using the wrong type of glass?

A fundamental approach always needs to be considered.

- Is this presentation better suited for architects?
- Large architectural firms = monumental projects, experienced people .
- Small architectural firms = small / medium sized projects, inexperienced people
- Hundreds of different building materials and glass is only one of them.
- Smaller markets = glass decisions are made based on the decisions that were made many years ago

Key is Education

Glass Selection Criteria:
Aesthetic Appearance
Thermal Performance
Safety
Energy Efficiency
Price

- We have a responsibility to advise, educate and respond to the needs of the architectural community.
- Every one of us is involved in glass design or application in some manner.
- Recognizing these issues can be fundamental to the success of a project.
- We have an obligation, both professionally and sometimes legally, to recommend changes in design.

The Glass insustry pro should advise…One design is best for the building Others are less than Best!! For energy savings, occupant comfort….etc.

- Too often we see architectural glass applications that frankly don't work! These projects may be small, medium or large in size.
- Common design principals are often overlooked or misunderstood.

Architects/designers need to ask themselves 3 questions.

Question #1

Does this glass selection meet the needs of the occupants, the mechanical engineer and the building design intent?

All too often the answer is no!

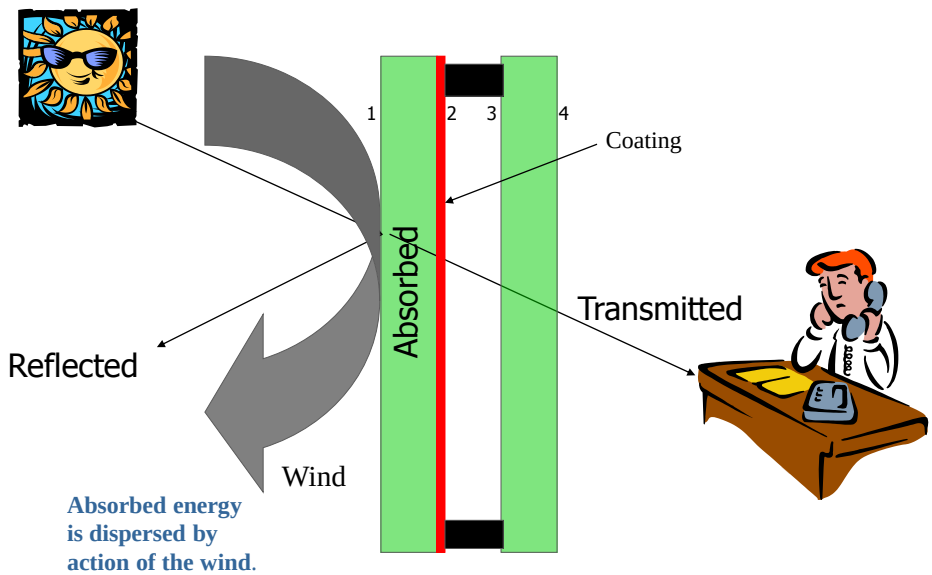
Question #2

Will my glass selection today, meet the needs of an ever changing world 5, 10 or 20 years from now?

Question #3

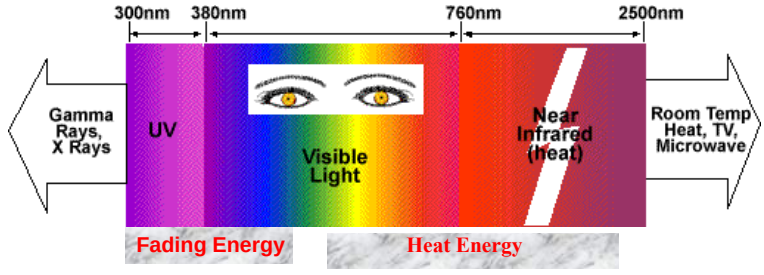
Have I found a balance between appearance, performance and cost?

100% Solar Energy = R.A.T.



Absorbed energy is dispersed by action of the wind.

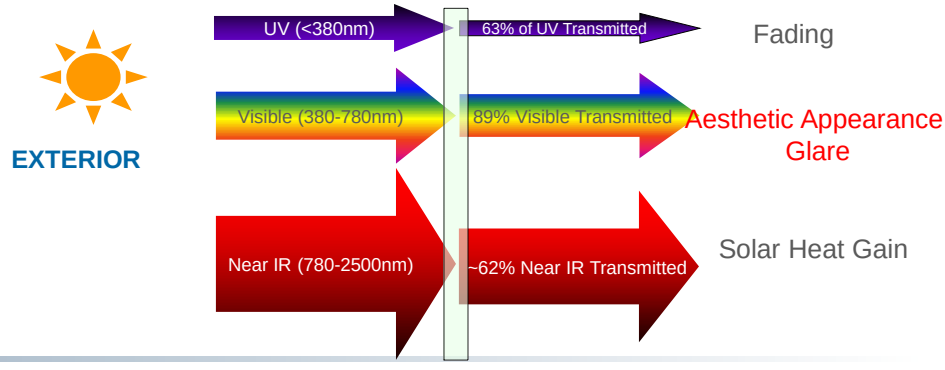
The Solar Energy Spectrum



Ultra Violet (3%): 300 – 380 nanometers
Visible (43%): 380 – 780 nanometers
Near Infrared (54%): 780 – 2500 nanometers

Solar Energy Transmittance

The percentage of ultraviolet, visible, and near infrared energy within the solar spectrum (300-2500nm) that is transmitted through the glass.



Guardian Proprietary

Visible Light Transmission

How much Visible Light Transmission is too much?

- 60% -70% is too high for most commercial applications.
- Blinds are necessary for occupant comfort
- If the blinds are always closed then why have windows? Just put in a wall.
- < 50% Visible Light Transmission – Cloudy northern regions
- < 30% Visible Light Transmission – Sunny southern regions
- Impacted by Window/Wall ratio

Visible Light Transmission – Con't

High Light Transmission affects the appearance of the building

a) 'Visual Noise'

b) 'Laundry on the Balcony'

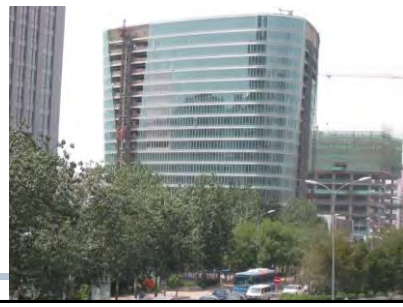
c) 'Aesthetic Pain'

"Why doesn't the building look like the rendering?"

Visible Light Transmission – con't

Less Visible Light Transmission

- Blinds are either not necessary or only used sparingly
- A reduced amount of Visible Light Transmission creates a m uniform appearance to the building
- The window treatments, as viewed from outside, are cloaked and they don't have as much of a visual impact
- The lower the Visible Light Transmission the better the colour match between the spandrel and vision glass



CNOOC Building
Beijing
Green 60

Visible Light Transmission – Con't Daylighting

LEED – Indoor Environmental Quality
Credit 8.1- 1 LEED point
Daylight and Views
Daylight for 75% of the spaces

Credit 8.2 – 1 LEED point
Daylight and Views
Daylight for 90% of the spaces

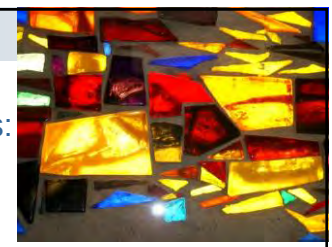
- Misunderstanding - maximum visible light transmission will provide the most light to the interior of the office space.
- If the blinds are closed how will this be effective?

Visible Light Transmission – Con't Daylighting

Fact:

- The sun provides 7,000 to 10,000 foot-candles of light,
- Indoor office spaces need only about 50 foot-candles.
- Too much light causes glare and the "cave effect" (back of the room appears dark compared to other areas)
- As a result people close the blinds and turn on overhead lights
- Well-designed daylighting lets in natural light that balances overhead electric lighting while curtailing glare.

Tinted Glass



The use of a tinted glass substrate impacts:

- Colour Rendering Index
- Colour of the transmitted light
- Thermal Stress

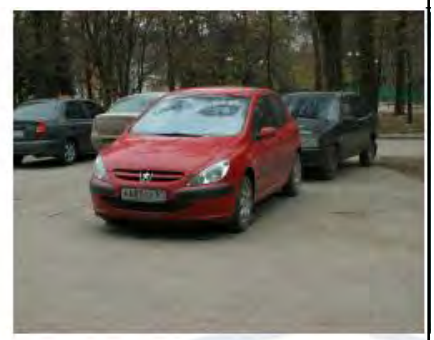
Colour Rendering Index Ra(D65) = The ability of transmitted daylight to portray a variety of colours compared to those seen under daylight without the glazing.

Sunlight / Blue Sky = 100
Clear Glass = 90-99
Green Glass = 80-90
Blue Glass = 60-80

Tinted Glass – Con't

Colour Rendering Index – CRI

View through (blue) tinted glass



Original view

Solution: Colours on clear glass

Deep blue appearance from outside

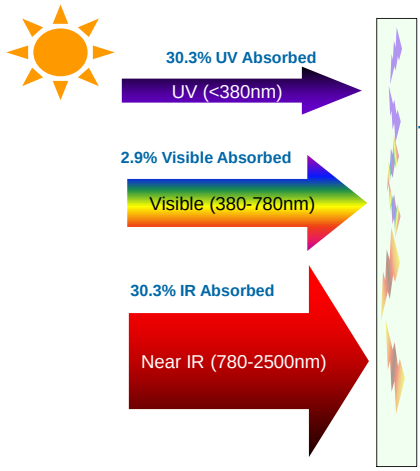
Natural „clear" view from inside

Tinted Glass – Colour of the Transmitted Light

- The transmitted light tends to take on the colour of the glass substrate. There is a blue hue or aura enveloping the room when blue glass is used and the same with other colours.
- The appearance of fabrics can change
- The tone of the room can become very subdued.

Thermal Breakage

Solar Energy Absorption



The absorption of all wavelengths between 300-2500nm

Thermal Breakage – Con't

If heat treated (tempered or heat strengthened) glass is required in exterior glazing
- No limitations on energy absorption

Thermal Stress Analysis – Annealed Glass
- Solar energy absorption < 55% - No heat treatment required
- Solar energy absorption 55 – 65% - Thermal analysis
- Solar energy absorption > 65% - Heat treatment required

Thermal Breakage – Con't

- A critical factor – will the glass will be shaded?
- When glass is partially shaded stress in the glass may occur, which can result in thermal breakage.

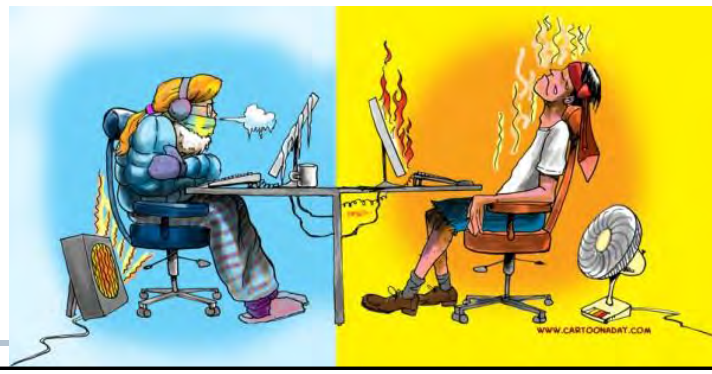
Additional Factors:

- Glass framing that is in direct contact with concrete or other materials
- Building not heated during the construction phase
- Excessive coverage of the glass edge by the frame
- Heat-absorbing films attached to the glass after installation
- The use of internal shading devices such as curtains, drapes or venetian blinds
- The greater the glass edge area, the greater the risk of thermal breakage

Solar Performance

Does the solar performance of the glass meet the needs of the mechanical engineer and the occupants?

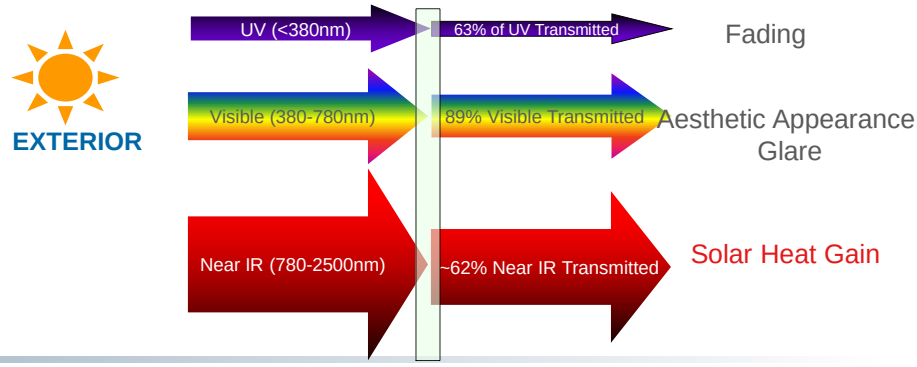
Focus on Low E Coatings!
In cold weather climates?
In hot weather climates?



Solar Performance

Solar Energy Transmittance

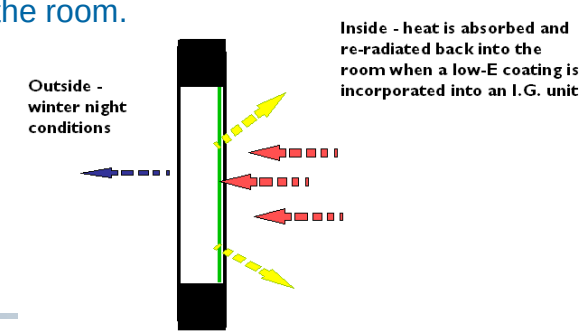
The percentage of ultraviolet, visible, and near infrared energy within the solar spectrum (300-2500nm) that is transmitted through the glass.



Guardian Proprietary

The Use of Low E Coatings Cold Weather Climates

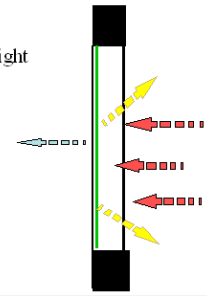
- A layer of silver is used when creating Low E coatings.
- Silver allows for the transmission of short wave radiation (ene
- Silver reflects long wave radiation (energy).
- Direct solar energy from the sun is short wave.
- Heat wants to go from "where it's hot to where it's not".
- Absorbed energy (heat) is reflected by the Low E coating bac into the room.



The Use of Low E Coatings Warm Weather Climates

- Same principal as Low E in cold weather climates except the absorbed energy is outside.
- Absorbed daytime heat is radiated in the form of long wave radiation. (both in daytime and nighttime)
- Silver reflects long wave radiation back into the environmen rather than entering home or office
- Significantly less heat gain than a standard double glazed u

Inside
Summer Night
Conditions



Outside summer night conditions – radiant heat is absorbed and re-radiated back into the environment when a low E coating is incorporated into an I.G. unit

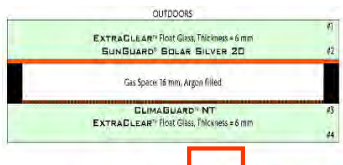
The Use of Low E CoatingsWarm Weather Climates

Relative Heat Gain

Example: Burj Khalifa

210 W/m² vs. 171 W/m² with Low-E

Δ ≈ 20 %



Example:
SunGuard Solar Silver 20 with and without additional Low-E (ClimaGuard NT on surface #3)

Type	Light Transmission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Solar Factor [%]	U-value [W/m²K]	Total Heat Gain [W/m²]
without Low-E	20	35	25	20	2,1	210
with Low-E	19	35	21	17	1,2	171

"Who Selected This Glass?"

Real World Examples of Questionable Glass Selection

Real World Example #1

		OUTDOORS	
Lite	Clear Thickness = 1/4" = 6 mm	#1 ----- #2 Triple Silver Low E	
Gap	Air Space = .472"		
Lite	Clear Thickness = 1/4" = 6 mm	#3 ----- #4 -----	
	Total Thickness = 23.5mm	Slope = 90° INDOORS	

Light Trans-mission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Colour Render. Index Ra(D65)	Solar Factor [%]	Shading Coef-ficient	Solar Energy			U-value Air [W/m²K]	U-value 90% Argon [W/m²K]
						Trans-mission [%]	Reflect. Outdoors [%]	Absorp-tion [%]		
64	**12**	**13**	**94**	**31**	**.36**	**28**	**46**	**26**	**1.6**	**1.2**

EN 410:1998 used for spectrophotometric values. EN 673:1997 used for U-values, temperature difference of 15 C°.

- Project in Saudi Arabia – 2 - 40 story towers – Floor to Ceilin windows - using Triple Silver Low E coating.
- Every window will have blinds and every blind will be closed!
- Why have windows? Have a wall!

Real World Example#2

		OUTDOORS
Lite	Clear Thickness = 1/4" = 6 mm	#1 ----- #2 Triple Silver Low E
Gap	Argon Space = .630"	
Lite	Clear Thickness = 1/4" = 6 mm	#3 ----- #4 Triple Silver Low E
Gap	Argon Space = .630"	
Lite	Clear Thickness = 1/4" = 6 mm	#5 ----- #6 White Frit 25% dots
	Total Thickness = 49.2mm	Slope = 90° INDOORS

Light Trans-mission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Colour Render. Index Ra(D65)	Solar Factor [%]	Shading Coef-ficient	Solar Energy			U-value Air [W/m²K]	U-value 90% Argon [W/m²K]
						Trans-mission [%]	Reflect. Outdoors [%]	Absorp-tion [%]		
39	**16**	**24**	**90**	**22**	**.26**	**15**	**48**	**37**	**.52**	**.54**

EN 410:1998 used for spectrophotometric values. EN 673:1997 used for U-values, temperature difference of 15 C°.

Selling Price –
Glass Fabricator to Glazier = **$ 122.00 SqM**

Real World Example #2 – Alternative Product

		OUTDOORS
Lite	Clear Thickness = 1/4" = 6 mm	#1 ----- #2 Double Silver Low E
Gap	Argon Space = .630"	
Lite	Clear Thickness = 1/4" = 6 mm	#3 ----- #4 -----
	Total Thickness = 27.5mm	Slope = 90° INDOORS

Light Trans-mission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Colour Render. Index Ra(D65)	Solar Factor [%]	Shading Coef-ficient	Solar Energy			U-value Air [W/m²K]	U-value 90% Argon [W/m²K]
						Trans-mission [%]	Reflect. Outdoors [%]	Absorp-tion [%]		
39	**16**	**31**	**90**	**23**	**.27**	**20**	**36**	**44**	**1.0**	**1.1**

EN 410:1998 used for spectrophotometric values. EN 673:1997 used for U-values, temperature difference of 15 C°.

Approx. Selling Price
Fabricator to Glazier = **$ 60.00 SqM**

Relative Heat Gain

The amount of heat gain through a glass product taking into consideration the effects of solar heat gain (shading coefficient) and conductive heat gain (U-value). (The lower the number the better the performance)

Double Glazed Unit
RHG – 163 W/m2

Light Trans-mission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Colour Render. Index Ra(D65)	Solar Factor [%]	Shading Coef-ficient	Solar Energy			U-value Air [W/m²K]	U-value 90% Argon [W/m²K]
						Trans-mission [%]	Reflect. Outdoors [%]	Absorp-tion [%]		
39	**16**	**31**	**90**	**23**	**.27**	**20**	**36**	**44**	**1.0**	**1.1**

EN 410:1998 used for spectrophotometric values. EN 673:1997 used for U-values, temperature difference of 15 C°

Triple Glazed Unit
RHG – 148 W/m2 – 9 % improvement for 2x price?

Light Trans-mission [%]	Light Reflect. Outdoors [%]	Light Reflect. Indoors [%]	Colour Render. Index Ra(D65)	Solar Factor [%]	Shading Coef-ficient	Solar Energy			U-value Air [W/m²K]	U-value 90% Argon [W/m²K]
						Trans-mission [%]	Reflect. Outdoors [%]	Absorp-tion [%]		
39	**16**	**24**	**90**	**22**	**.26**	**15**	**48**	**37**	**.52**	**.54**

EN 410:1998 used for spectrophotometric values. EN 673:1997 used for U-values, temperature difference of 15 C°

- Increased cost for insulated glass products only = $ 300,000
- Triple Glazed units add considerable weight therefore curtainwall system / window system needs to accommodate additional width and weight = $ 100,000
- Extra costs for packaging and shipping = $?
- Markups through the construction chain = $?
- Overall additional cost for owner / developer = **$ 500,000?**

This particular glass makeup concerns me as I think it attacks the credibility of the industry. The owner/developer will now be charged a considerable amount more to receive what he believes to be the 'latest technology'. I believe that this 'latest technology' is inappropriately used and I'm concerned that the owners may not be aware of their options.

Conclusion:

- Advise and educate others who use our glass products.
- In developing markets that means promoting energy efficiency and higher performing products.
- In more mature markets it means selecting the glass that meets the requirements of the project relative to the region and the needs of the occupants and owners.

Jin Mao Building
Shanghai
CS30 on clear

Conclusion: con't

- Need to create codes that are suited to the Thai environment and not the latest from Europe or the States
- Each application needs to be considered on it's own merits.
- This is true whether we have a monumental project in Bangkok or a 3 story office building in Bangalore.
- The correct glass selection in North America will not necessarily mean that the same glass selection is correct for Southeast Asia
- The professionals in this room do not necessarily create the specifications but we can certainly help influence them!

Thank you.


THE ROAD TO ENERGY CODES
You are the driver.