

# Solar energy in tropical buildings

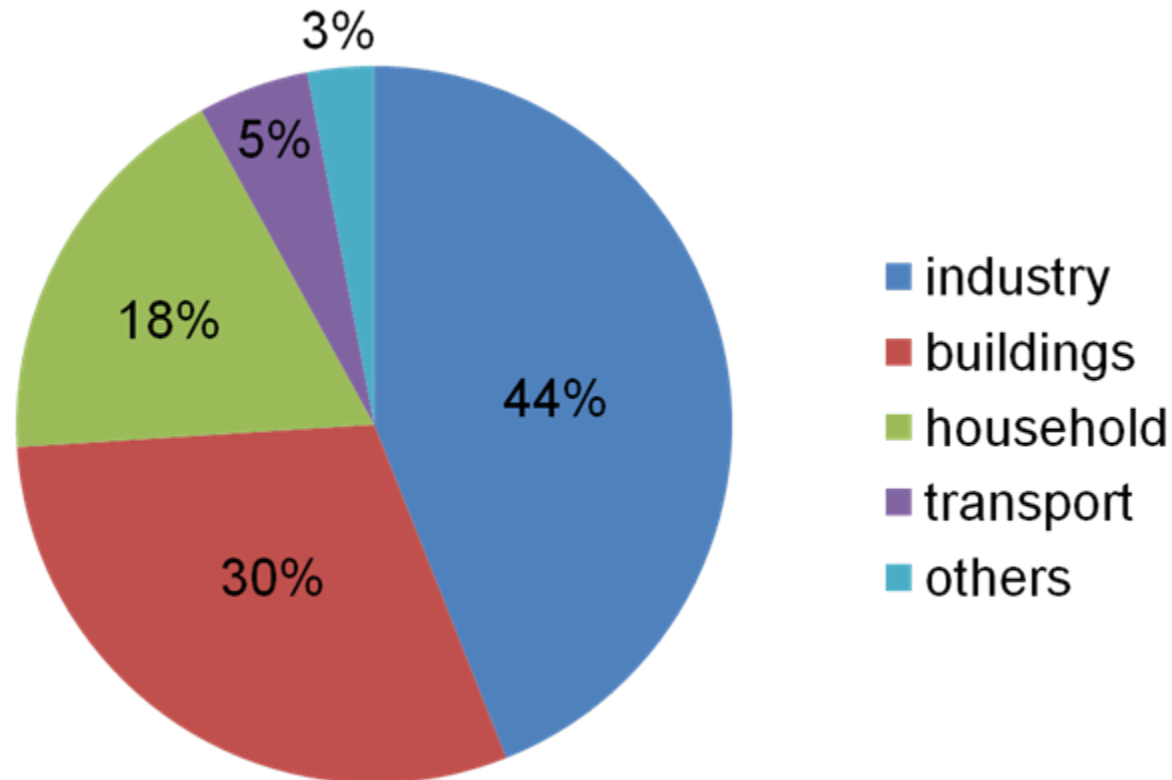
Associate Professor Stephen WITTKOPF

Solar Energy Research Institute of Singapore (SERIS)

Energy for the future, Clean Energy Expo  
Session 14: Energy Efficiency Technologies  
4 November 2010

# Singapore electricity consumption

## Importance of the building sector

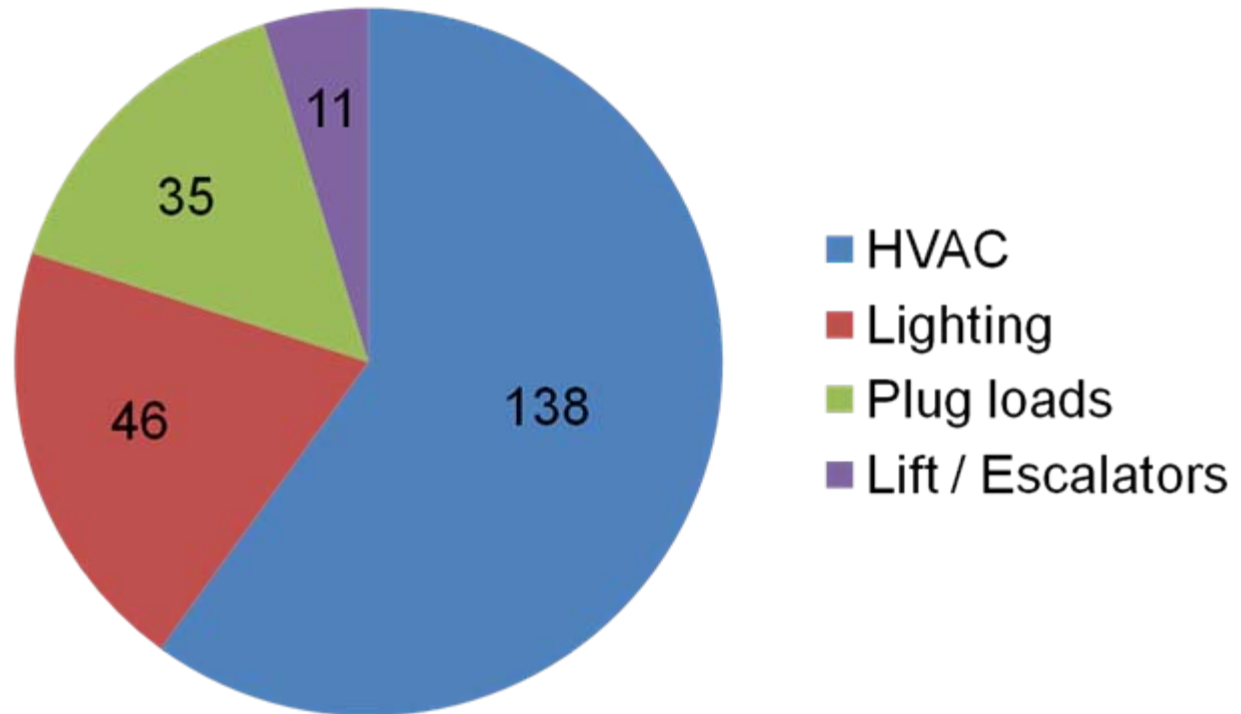


Sources: BCA, SEAS, 2007

# Building electricity consumption

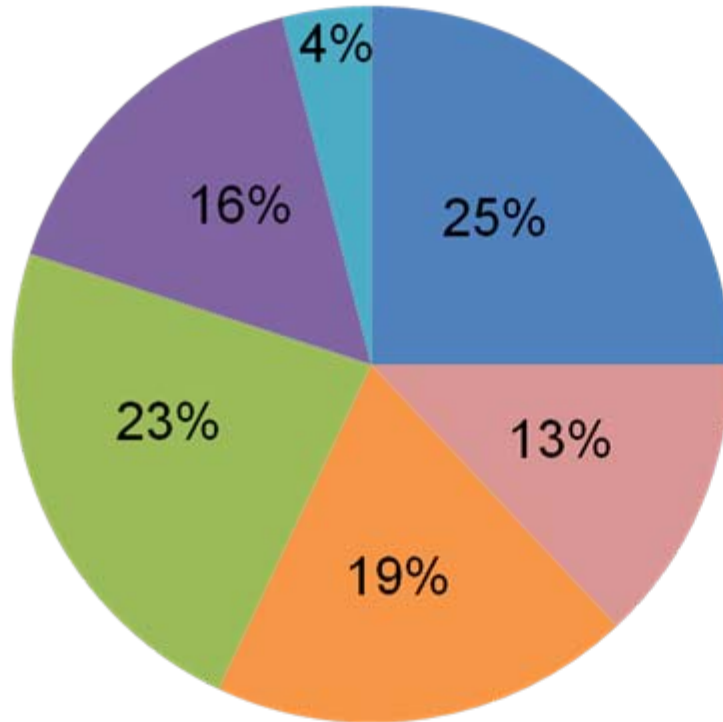
## Importance of air-conditioning in Singapore

consumption in  
 $\text{kWh}_{\text{el}}/(\text{m}^2 \cdot \text{yr})$ ,  
Singapore,  
gross floor area



Sources: NUS Energy Sustainability Unit (ESU), based on energy auditing on 104 office buildings

# Thermal cooling loads in buildings



- Heat input via solar radiation
- Wall / glass conduction
- Ventilation / infiltration
- Lighting
- Occupants
- Others, including plug loads

Source: SK Chou. Large building cooling load.  
In: International Journal of Energy Research 1997

# Where can we improve

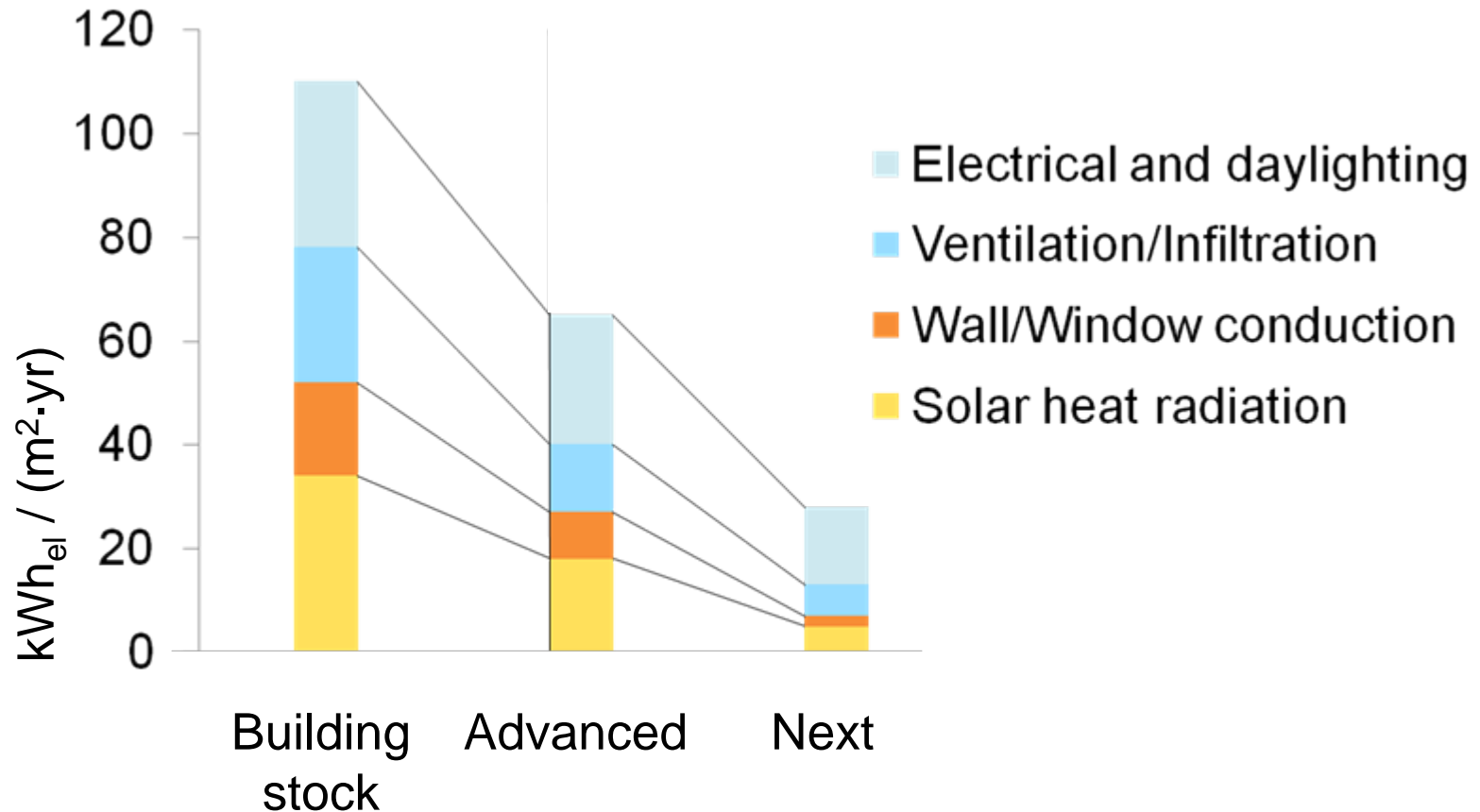


National Library Building  
Singapore

- Better windows for lower thermal transmission of solar radiation, reduced heat conduction and infiltration/ventilation
- Better walls and roofs for reduced heat conduction
- Use of daylight for reduction of electrical lighting
- Building integrated photovoltaics harnessing solar energy
- Energy efficient air-conditioning systems (e.g. solar assisted)

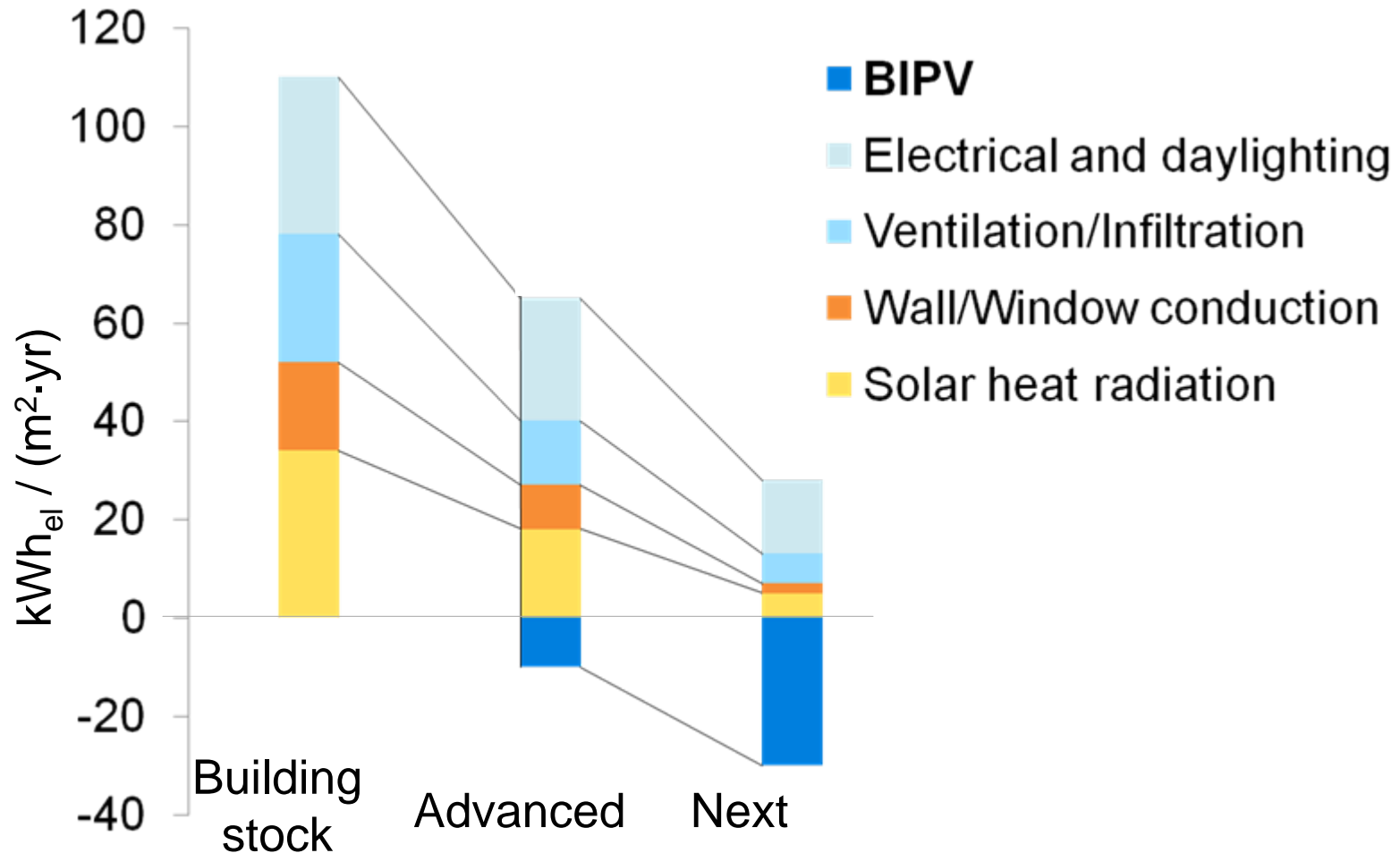
# Possible improvements - 1

Reduction of electricity consumption for envelope related loads



# Possible improvements - 2

## On site electricity generation

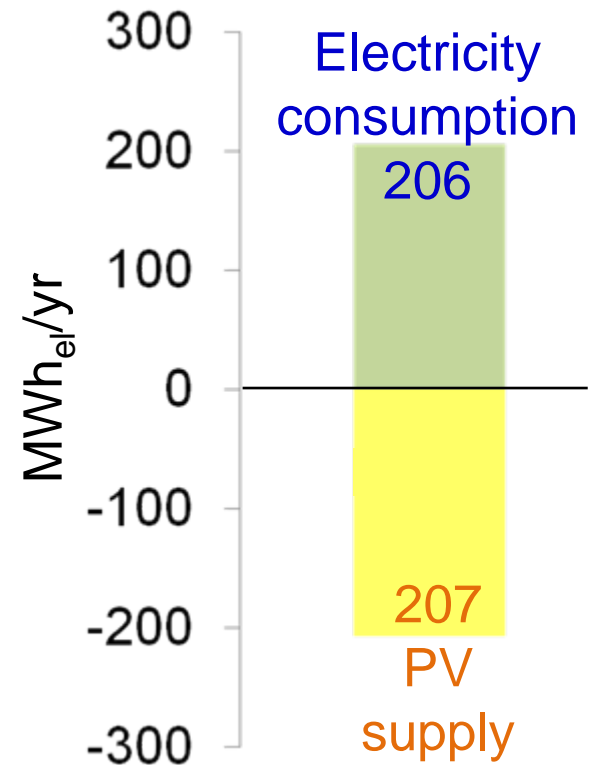


# Case study: Zero-energy building

## Building integrated photovoltaic



*(Building integrated PV at ZEB)*



# Case study: Zero-energy building

## Complex fenestration systems



Solar control with:

- Integrated blinds
- Electrochromic films
- See-through photovoltaic

# Case study: zero-energy building

## Daylight collection and transportation



### Daylight utilization:

- Vertical light pipes
- Horizontal mirror ducts

# SERIS R&D

## Solar and energy efficient buildings

### Technologies:

Facade  
(e.g. fenestration  
systems)

Building integrated  
photovoltaic

Heat powered air-  
conditioning (e.g.  
dehumidification)

### R&D scopes:

Design:  
concept, simulation,  
specification, prototype

Assessment:  
analytical monitoring,  
feasibility study

Measurements:  
laboratories and on-site

Thank you for your attention!  
More information at  
[www.seris.sg](http://www.seris.sg)