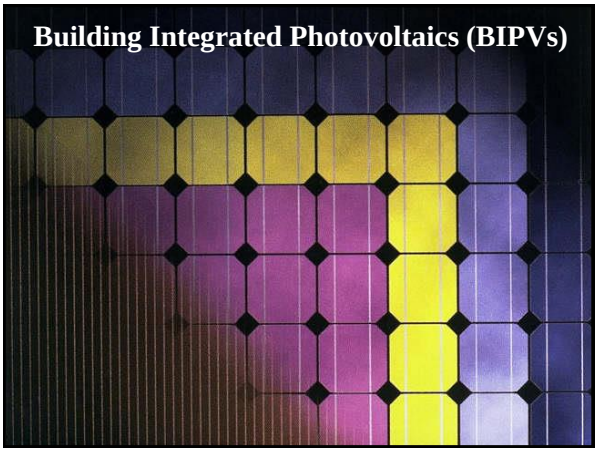
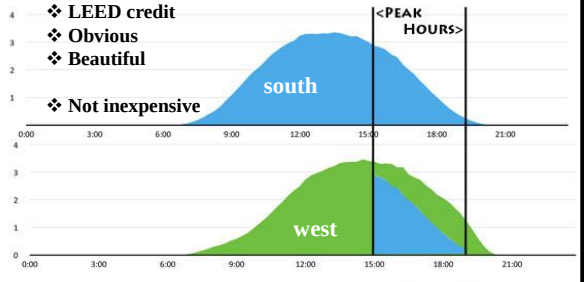
Building Integrated Photovoltaics (BIPVs)



1

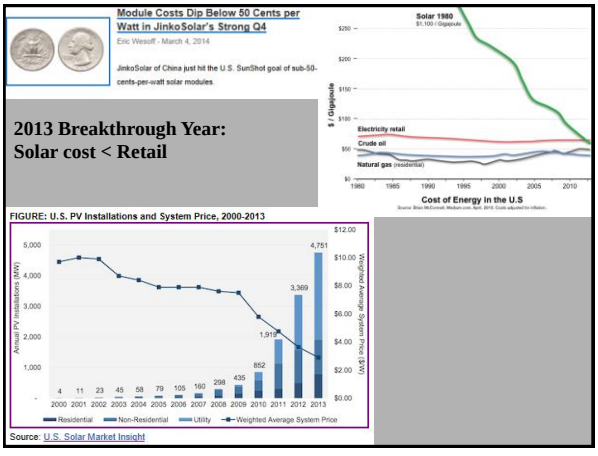
Why PVs?

- ❖ Stable source
- ❖ Tax credit
- ❖ LEED credit
- ❖ Obvious
- ❖ Beautiful
- ❖ Not inexpensive



Average daily generation profile (kW) from rooftop PV systems for south and west systems. Source: *Pecan Street Research Institute*

2



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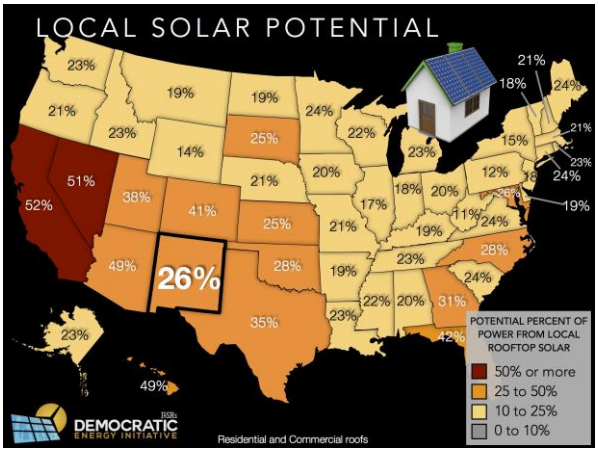
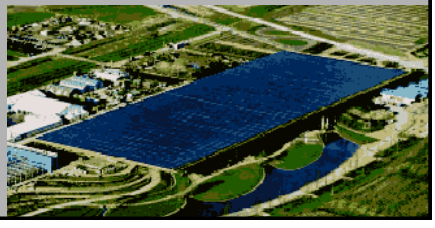


4

***Renewable Energy World,* March-April 2002**

WORLD'S LARGEST PV ROOF COMPLETED AND CONNECTED

The largest PV roof in the world was connected to the grid in the Netherlands at the Floriade 2002 horticulture exhibition in Haarlemmermeer, Amsterdam. Siemens Netherlands worked on the installation - for the Dutch utility Nuon - over a period of nine months. The 2.3 MW roof, comprising 19,000 panels, generates 1.23 GWh per year, and involved a capital outlay of €17.5 million, €5.2 million of which was subsidized by the Dutch Ministry of Economic Affairs. The plants and flowers at the exhibition will thrive under 26,100 m^2 of PV panels - an area comparable to three football pitches - as they are specially designed so light can filter through.



The world's largest solar roof, at the Floriade exhibition, Amsterdam.

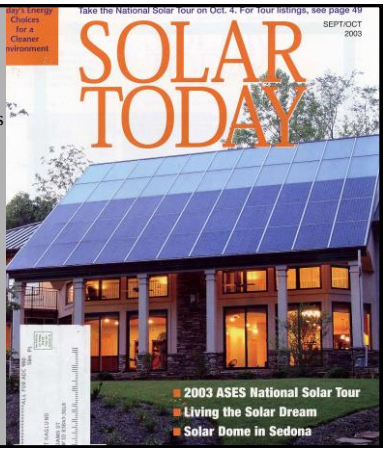
Photo:ANP/Nuon

5

6

BIPV systems

Architectural elements
Electricity producers



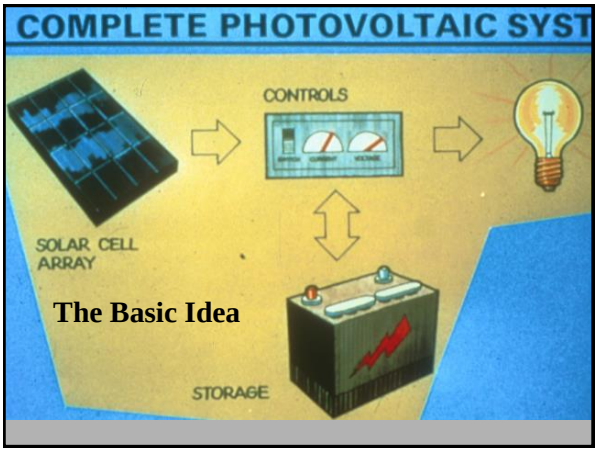
Martin House, Charlotte, NC

7

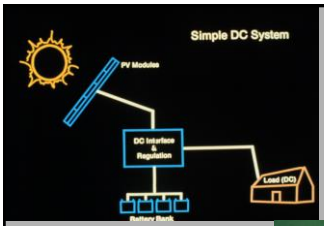
Discovery Science Center, Santa Ana, CA

JPS-Presse und Vertriebs bldg, Meckenheim, Germany

8

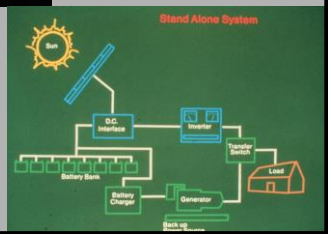


9

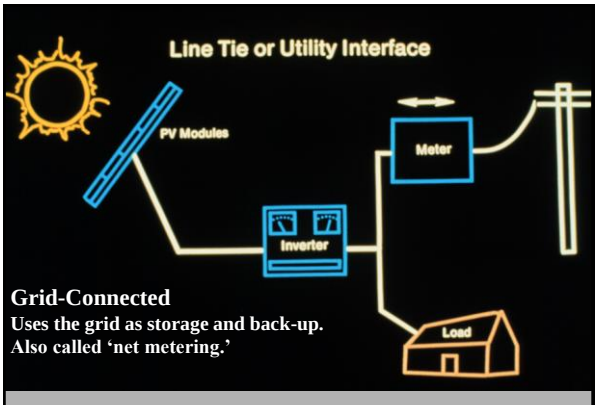


← Stand Alone
Can only use what the sun produces.

Stand Alone w/Generator
Assured of uninterrupted power, but must use fuel. →

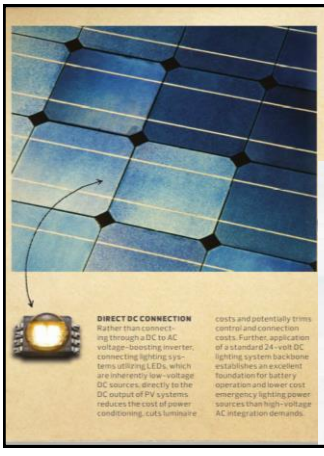


10



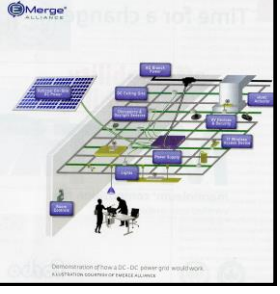
Grid-Connected
Uses the grid as storage and back-up.
Also called 'net metering.'

11

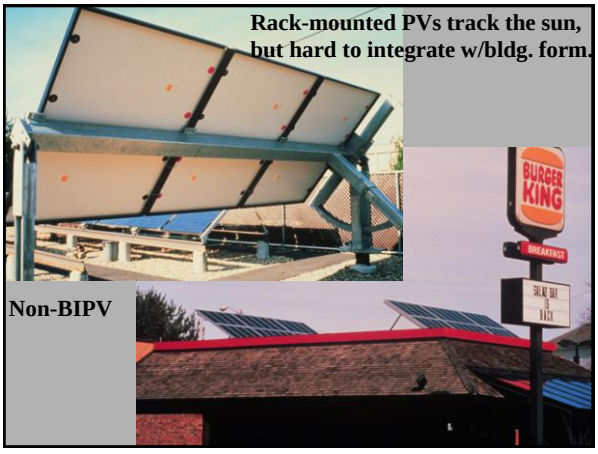


PV to LED

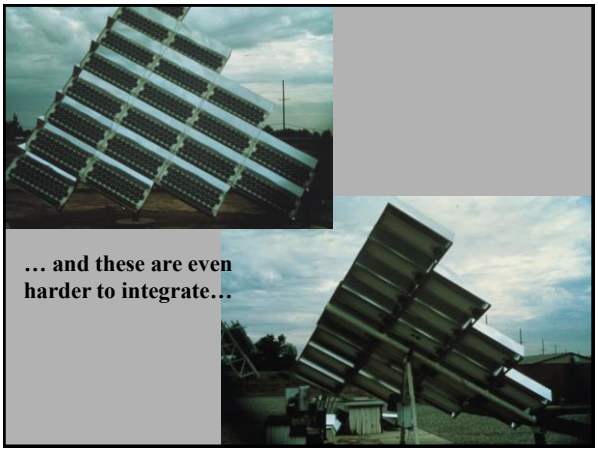
- Higher efficiency
- Longer LED life
- Direct battery use



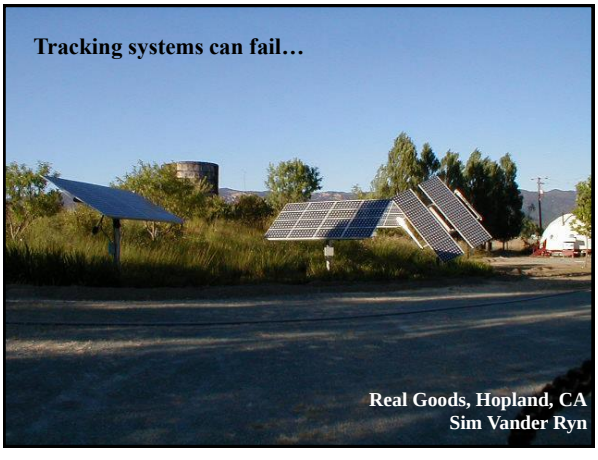
12


Rack-mounted PVs track the sun,
but hard to integrate w/bldg. form.
BURGER KING
Non-BIPV

13


… and these are even
harder to integrate…

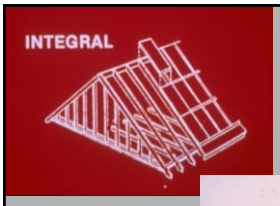
14


Tracking systems can fail…
Real Goods, Hopland, CA
Sim Vander Ryn

15

Partial integration is problematic.

16



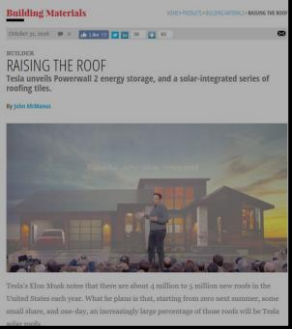
BIPVs are the building skin

17

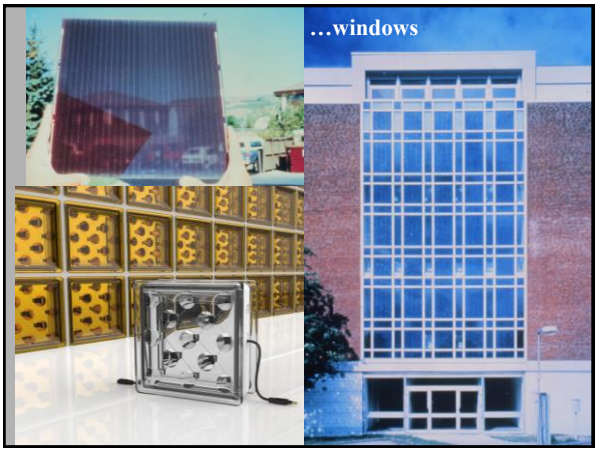
Sustainability at CIS from Copenhagen International School on Vimeo.

<…walls

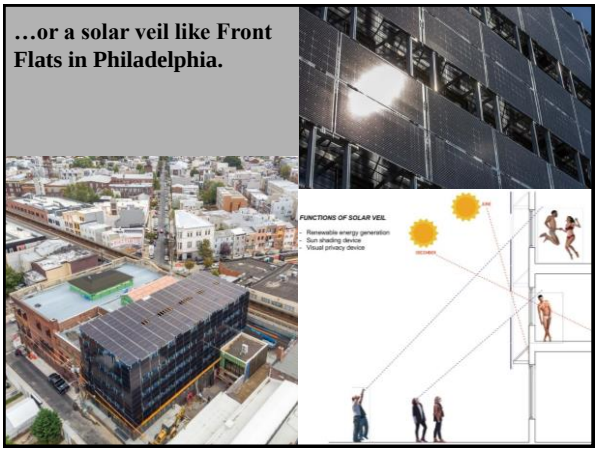
V…roofs



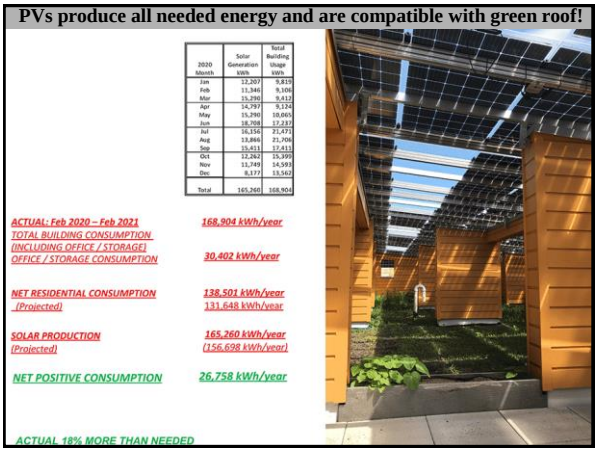
18


…windows

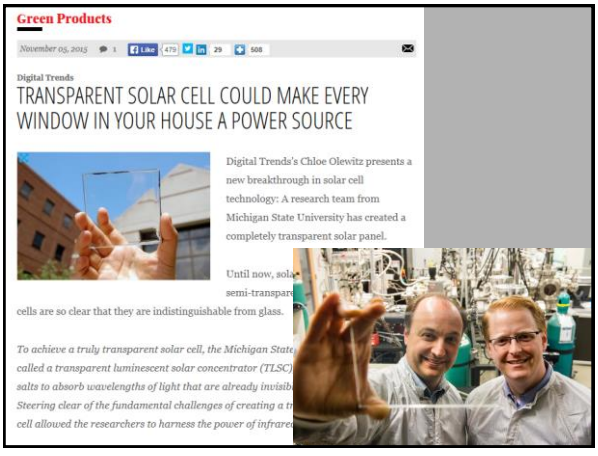
19


…or a solar veil like Front Flats in Philadelphia.
FUNCTIONS OF SOLAR VEIL
Renewable energy generation
Sun shading device
Visual privacy device

20

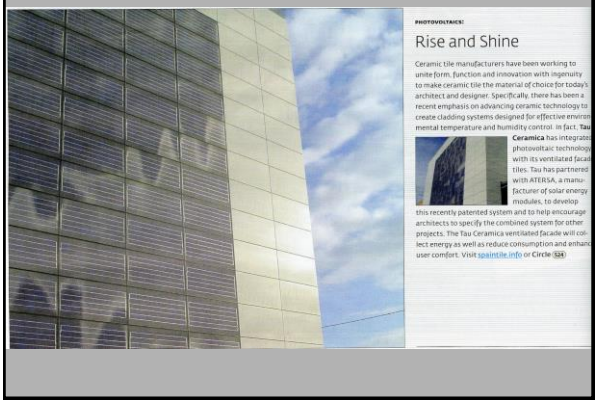

PVs produce all needed energy and are compatible with green roof!
2020 Month
Solar Generation kWh
Total Building Usage kWh
Jan 12,207 9,819
Feb 11,346 9,106
Mar 15,290 9,412
Apr 14,797 9,124
May 15,290 10,665
Jun 16,708 17,237
Jul 16,156 21,471
Aug 13,866 21,706
Sep 15,411 17,411
Oct 12,262 15,399
Nov 11,749 14,593
Dec 8,177 13,562
Total 165,260 168,904
ACTUAL: Feb 2020 – Feb 2021
TOTAL BUILDING CONSUMPTION (INCLUDING OFFICE / STORAGE)
168,904 kWh/year
OFFICE / STORAGE CONSUMPTION
30,402 kWh/year
NET RESIDENTIAL CONSUMPTION (Projected)
138,501 kWh/year
131,648 kWh/year
SOLAR PRODUCTION (Projected)
165,260 kWh/year
(156,698 kWh/year)
NET POSITIVE CONSUMPTION
26,758 kWh/year
ACTUAL 18% MORE THAN NEEDED

21



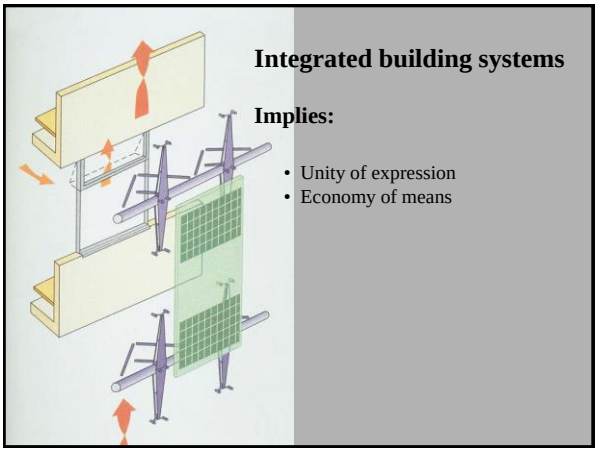
22

Façade cladding (PV ceramic tile)



23

24

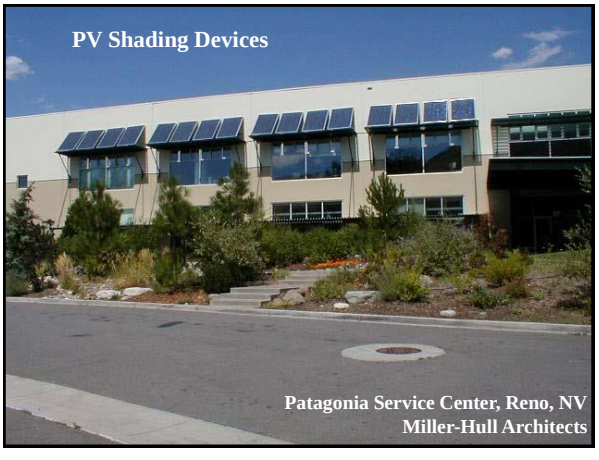


Integrated building systems

Implies:

- Unity of expression
- Economy of means

25



26

27

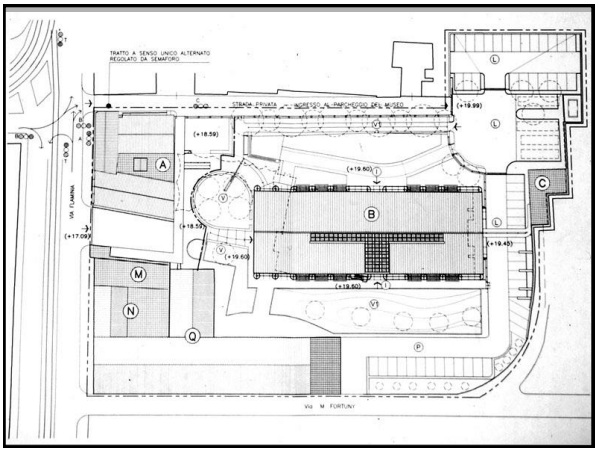
Charging stations for electric forklifts

28

29

Children's Museum, Rome, Italy

30



31

PV panels mixed with vision glazing in a checkerboard pattern… with operable skylights at eave and ridge.

32

Creates shading pattern at two scales…

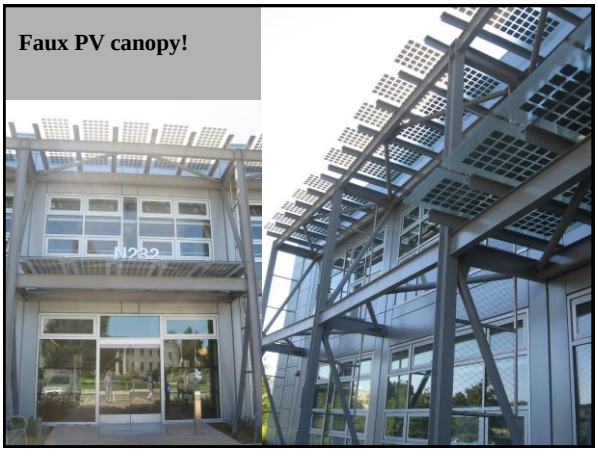
33

34

35

36

Faux PV canopy!



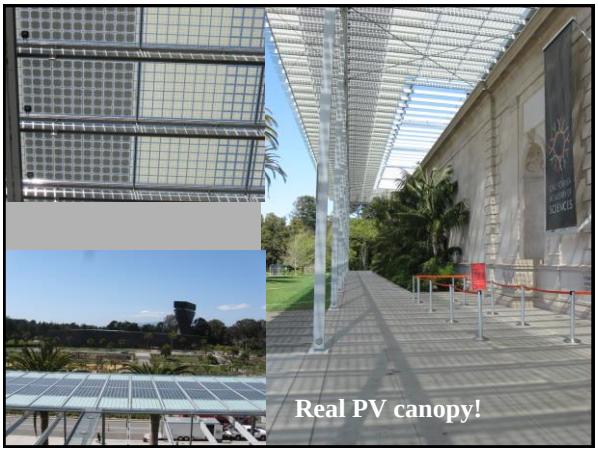
37

Roof mounted PVs

38

California Academy of Sciences
—Renzo Piano

39



40

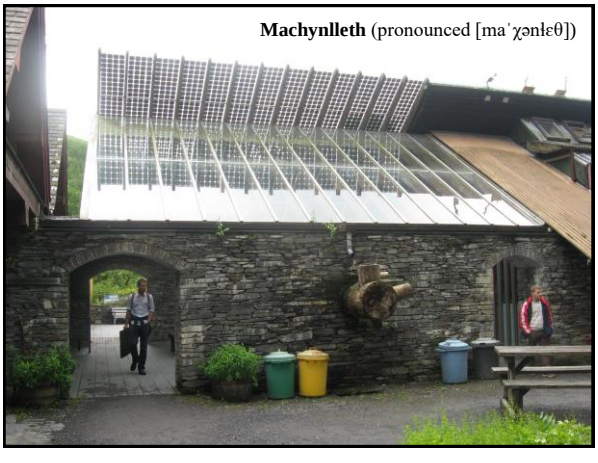
41

42

43

20 KW PV roof at CAT,
Machynlleth, Wales

44


Machynlleth (pronounced [maˈχənɬɛθ])

45

20kW Solar Roof
To Heulol
7800
36596
208

46

Green Developments
Conde Nast Building at Four Times Square
Commercial
Case Study Name: Conde Nast Building at Four Times Square
City: New York
State: NY
Country: USA
Owner/Developer: The Durst Organization
Project Completion Date: 1999
Project Type: Commercial/Office
Building Type: New Construction
Project Size: 1,600,000 SF
Location Description: Between 42nd and 43rd Street on Broadway, at Times Square in Manhattan
Project Description:
A cornerstone of redevelopment in New York's famous Time Square, the Conde-Naste Building at Four Times Square is a 47 story office tower with ground floor retail and entertainment space that's
Summary
Process/Finances
Features
Results
1st PV skyscraper 1999
4 Times Square
Fox & Fowle

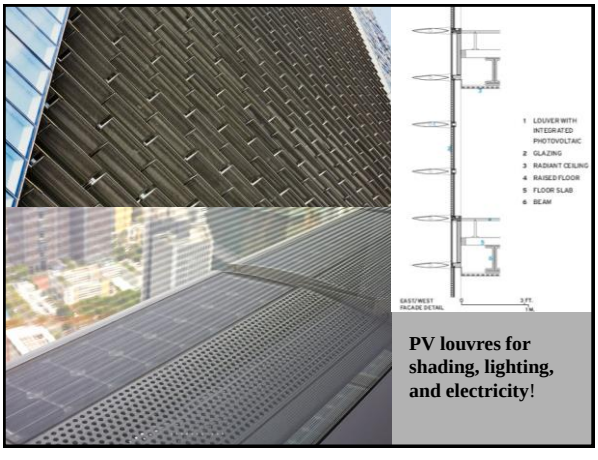
47

Xcel Energy
Xcel Energy Building, Denver
More PVs near top , than near street level…

48

Pearl River Tower, Shanghai
by SOM

49

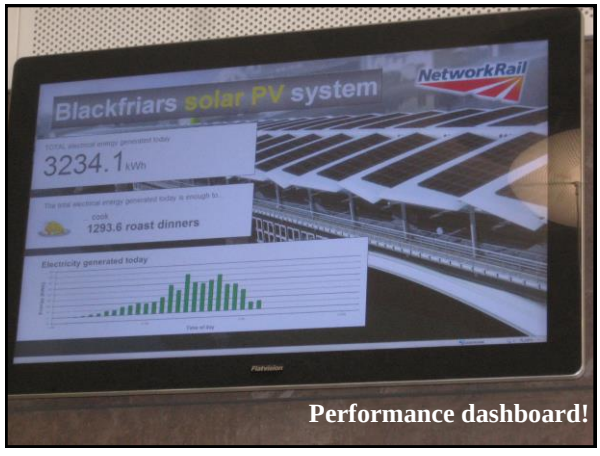


PV louvres for shading, lighting, and electricity!

50

Blackfriars Railway Bridge, London

51


Blackfriars solar PV system
NetworkRail
3234.1 kWh
1293.6 roast dinners
Electricity generated today
Performance dashboard!

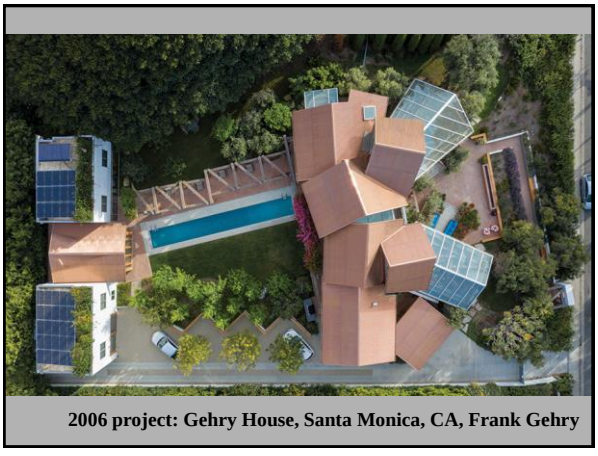
52

One New Change, Jean Nouvelle

53

Tate Modern
Herzog and DeMeuron

54



2006 project: Gehry House, Santa Monica, CA, Frank Gehry

55

56

57