SOLAR NEW YORK 2007
May 14, 2007, Albany

IS THERE REALLY ENOUGH SUN IN THE EMPIRE STATE?

Richard Perez
University at Albany, ASRC
http://www.asrc.cestm.albany.edu/perez/

Richard Perez, et al.


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Courtesy AltPower

Richard Perez

Courtesy SolarOne

PowerLight

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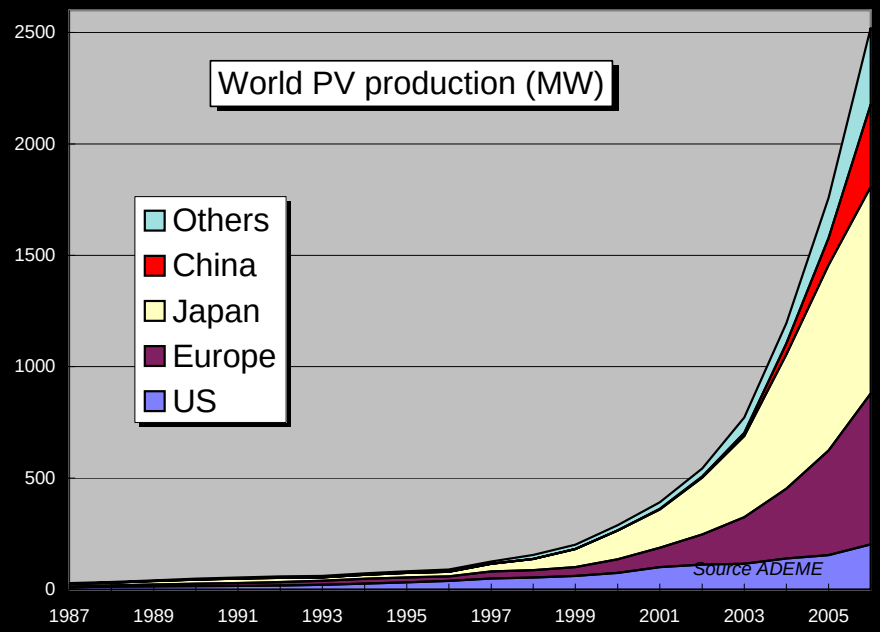
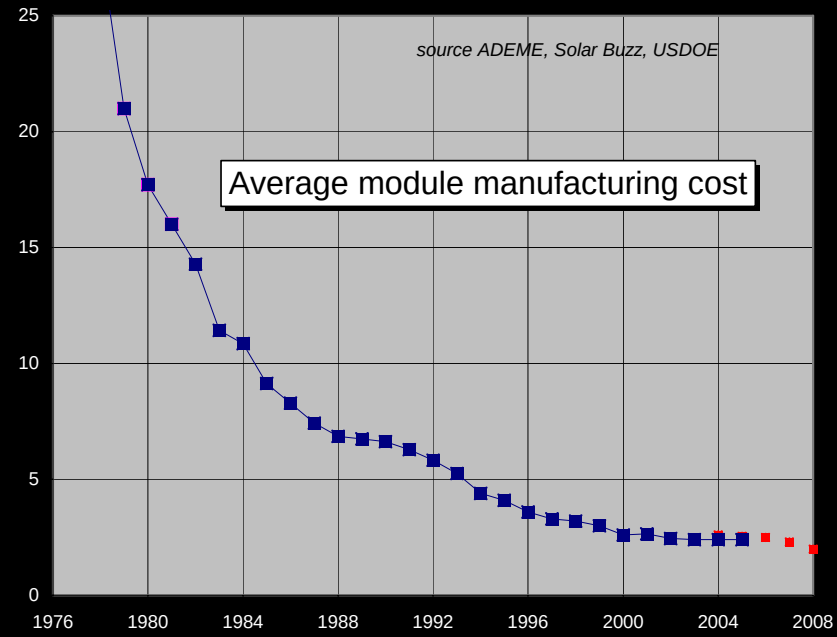
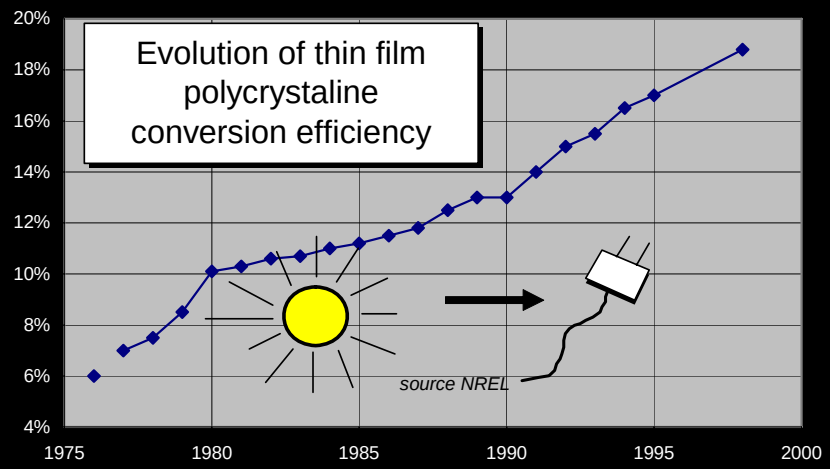




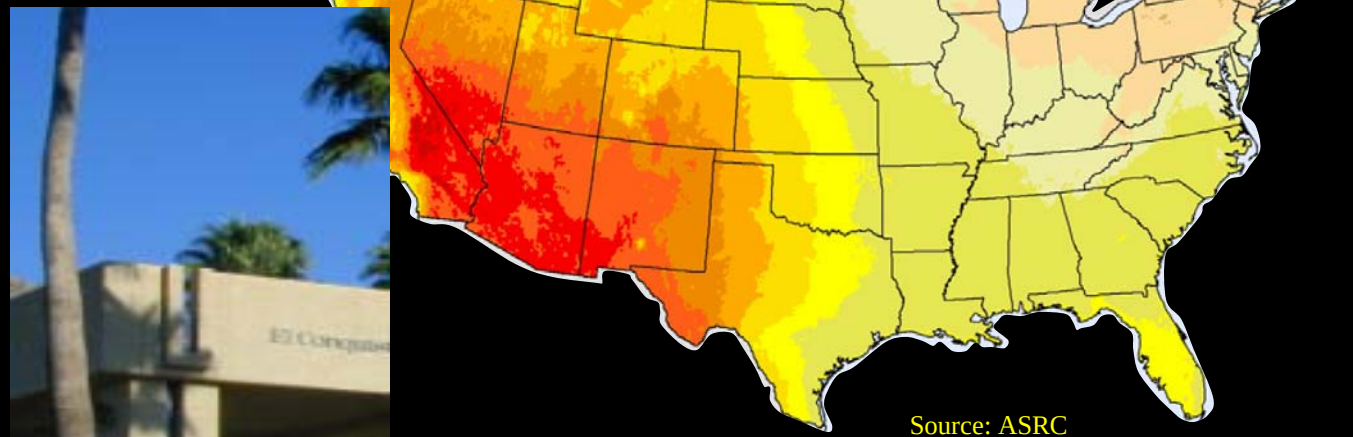
PHOTOVOLTAIC TENDENCIES

- **PRODUCTION**
- **COST**
- **EFFICIENCY**



Common misconceptions about PVs in New York

- No Sun



Source: ASRC

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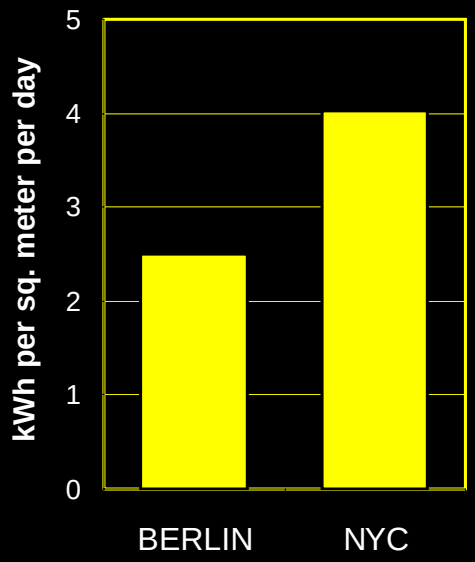

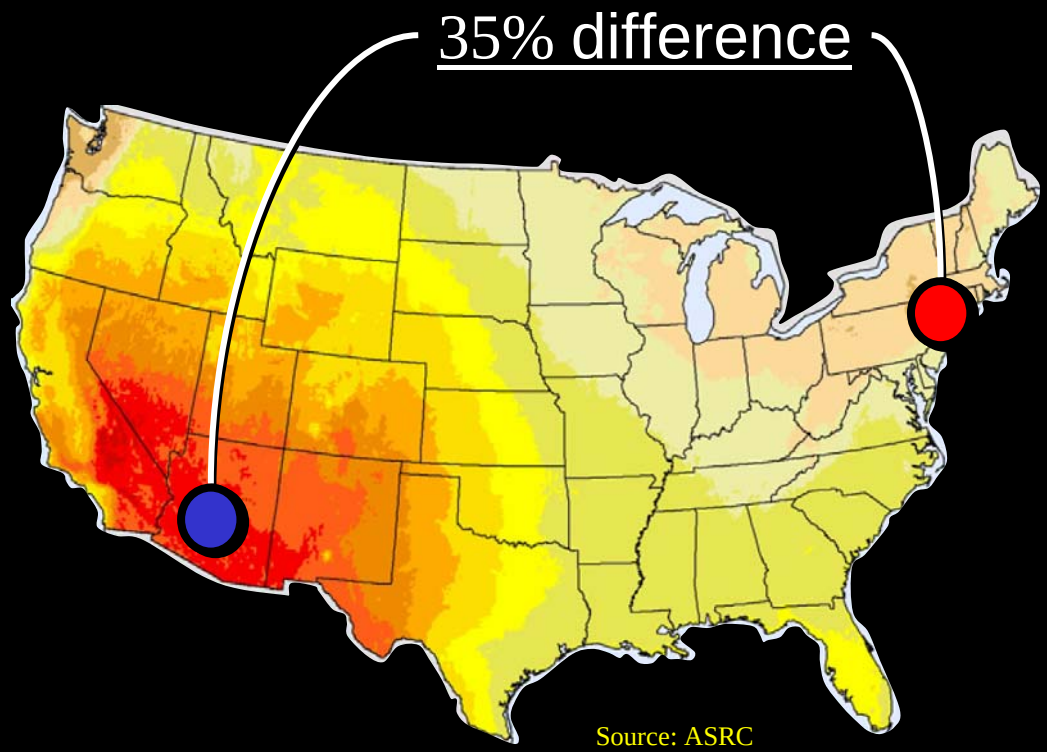

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Common misconceptions about PVs in New York

- No Sun
- No Space

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- No Sun
- No Space

"..PV would require the largest structure ever built …"

WIRED MAGAZINE Feb' 2005

"..PV would require 5 billion square meters…."

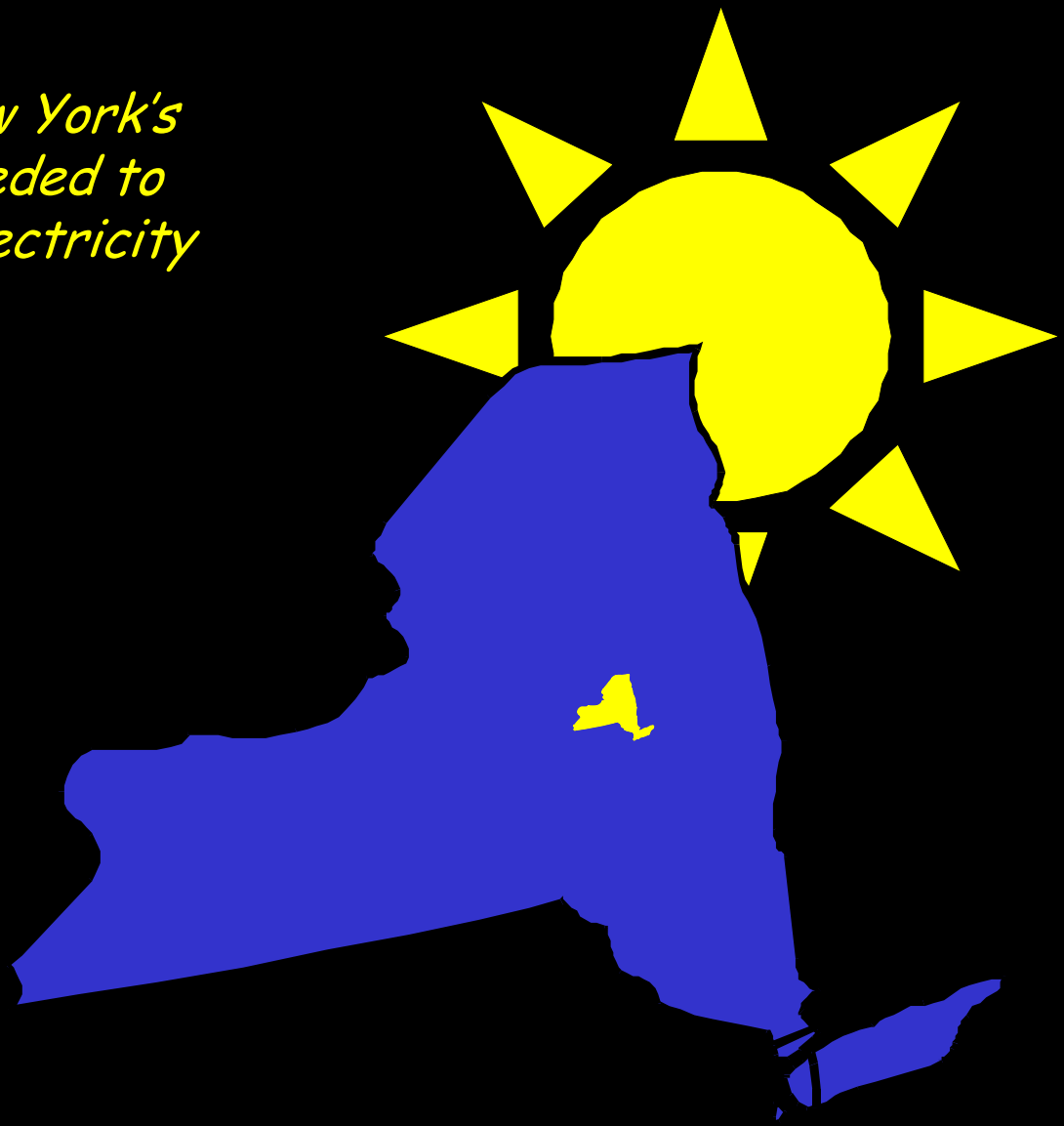
NEW YORKTIMES March 25, 2005

"..huge solar farms would take too much space…."

WAMC Roundtable / E Magazine Interview September 25, 2006

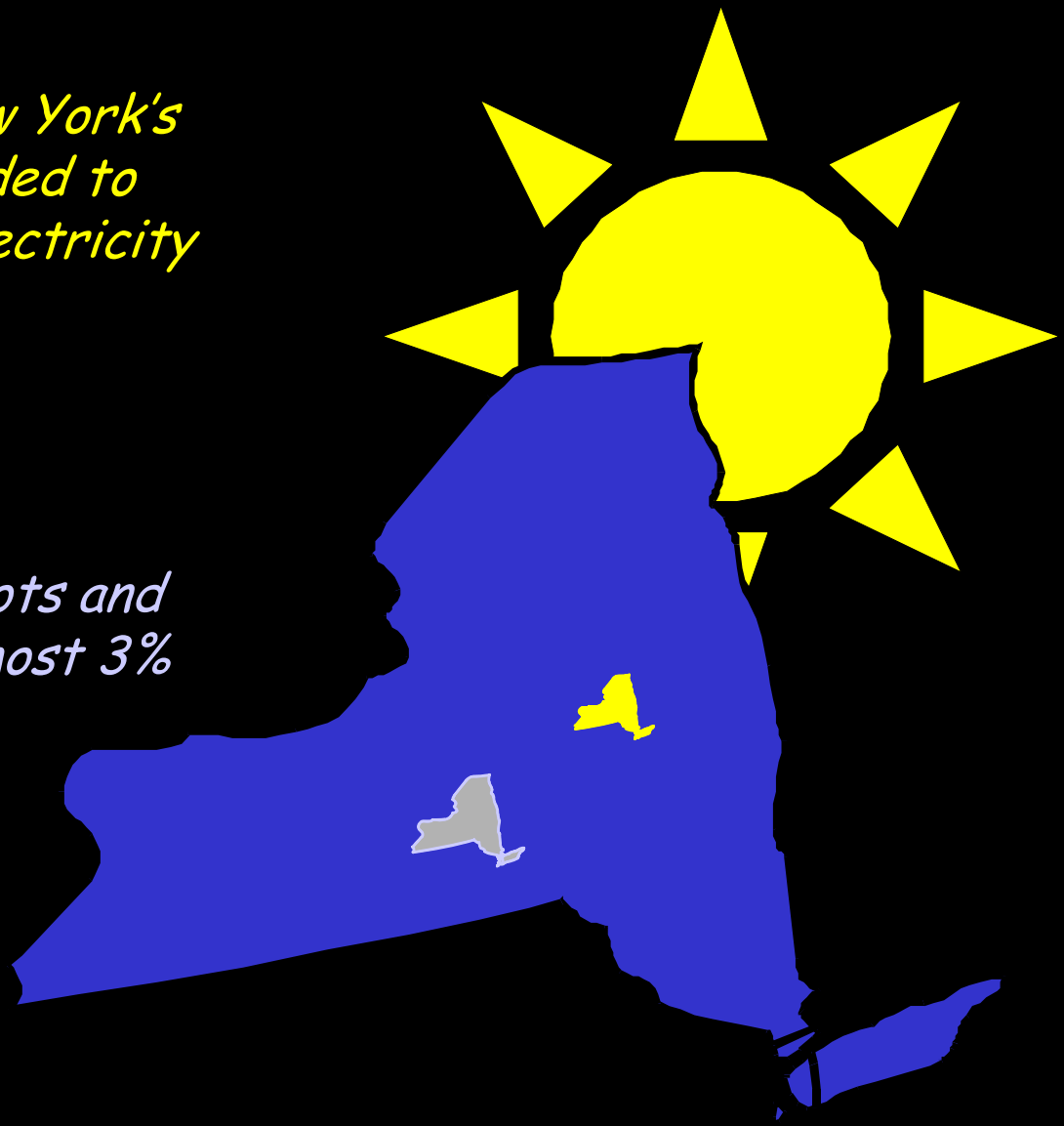
Only 0.75% of New York's area would be needed to produce all the electricity we use*

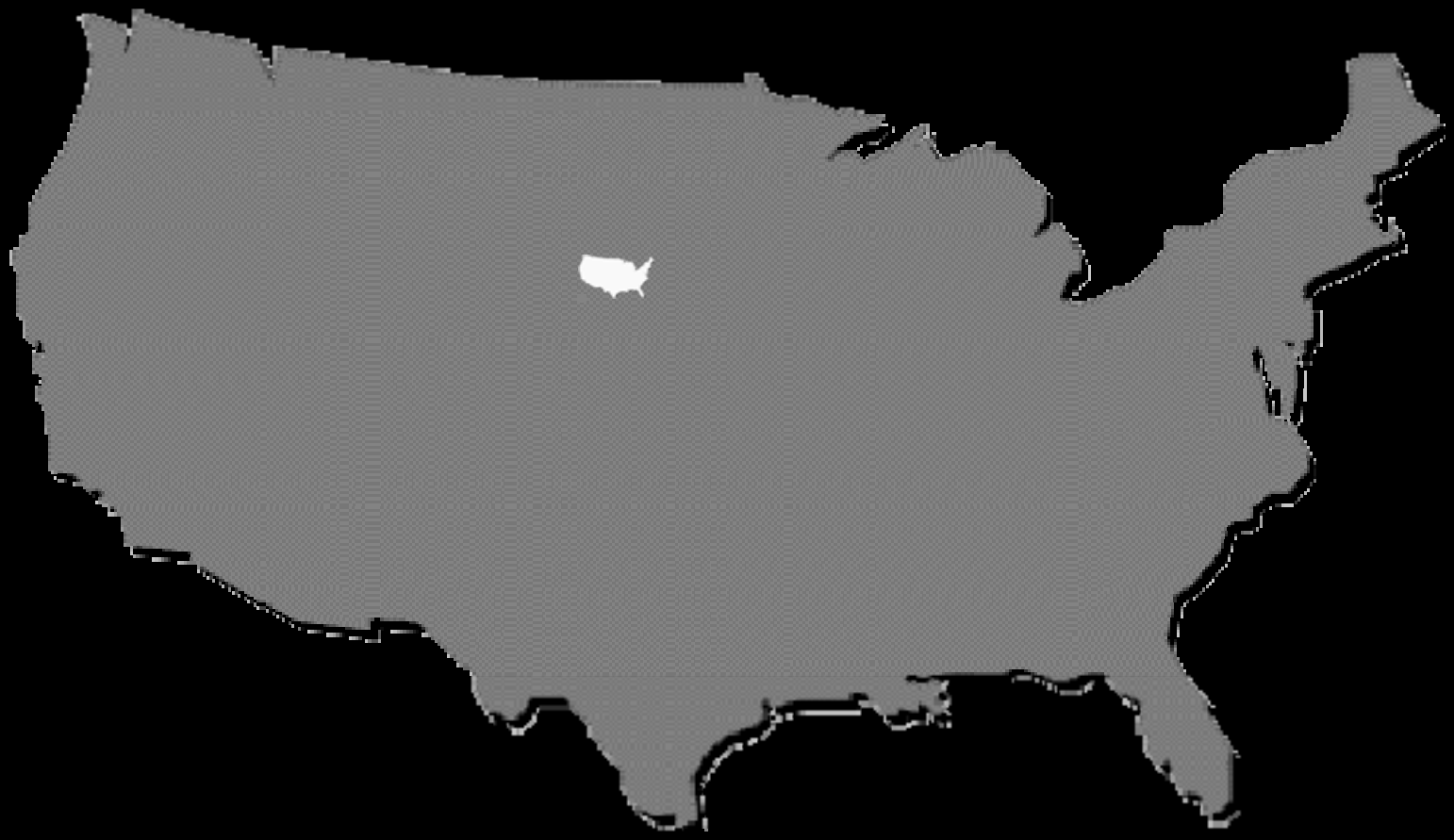
**using 10% PV conversion*



Only 0.75% of New York's area would be needed to produce all the electricity we use

Buildings, parking lots and roadways cover almost 3% of New York's area





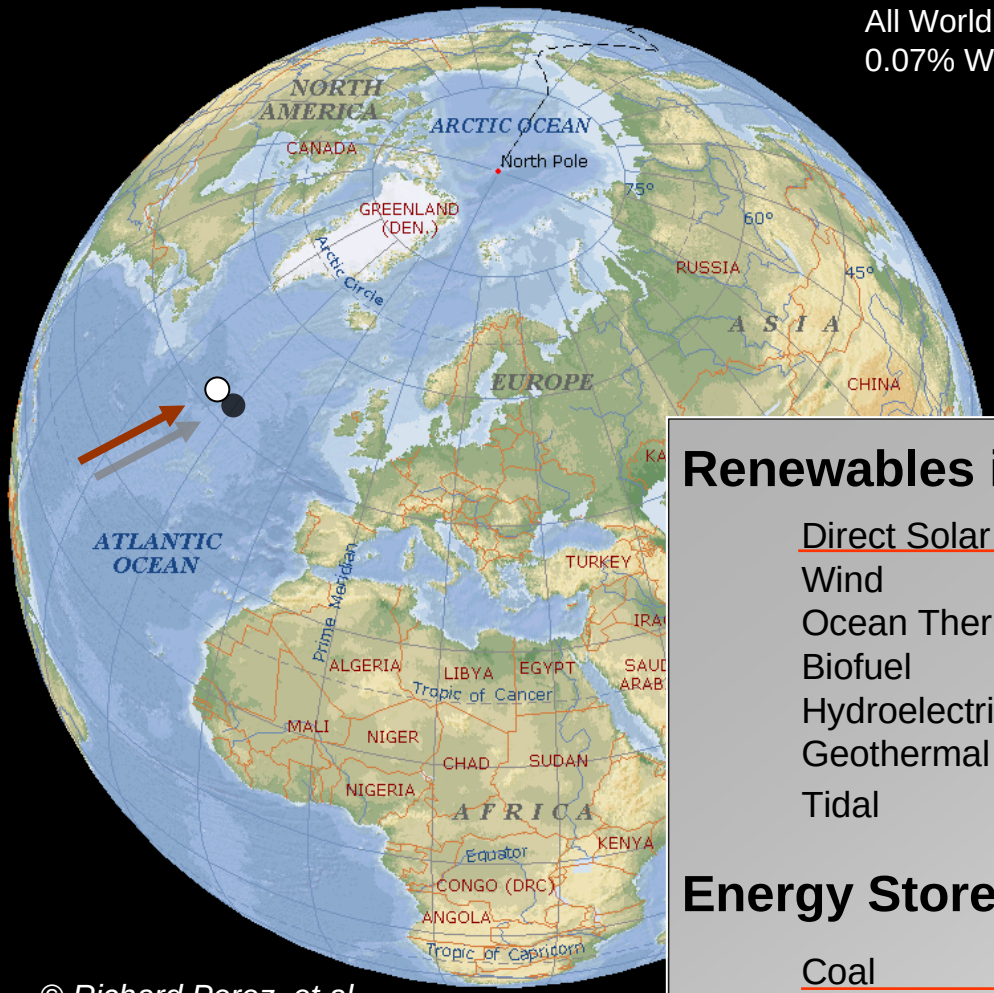
All US electrical energy → 25,000 km^2 PV
0.32% US Land Area

Hydropower artificial lakes in 2004 > 100,000 km^2

Hydropower artificial lakes in 2004 > 100,000 km^2

Hydropower accounts for 7% of US electrical production

All World electrical energy from solar:
0.07% World Land Area



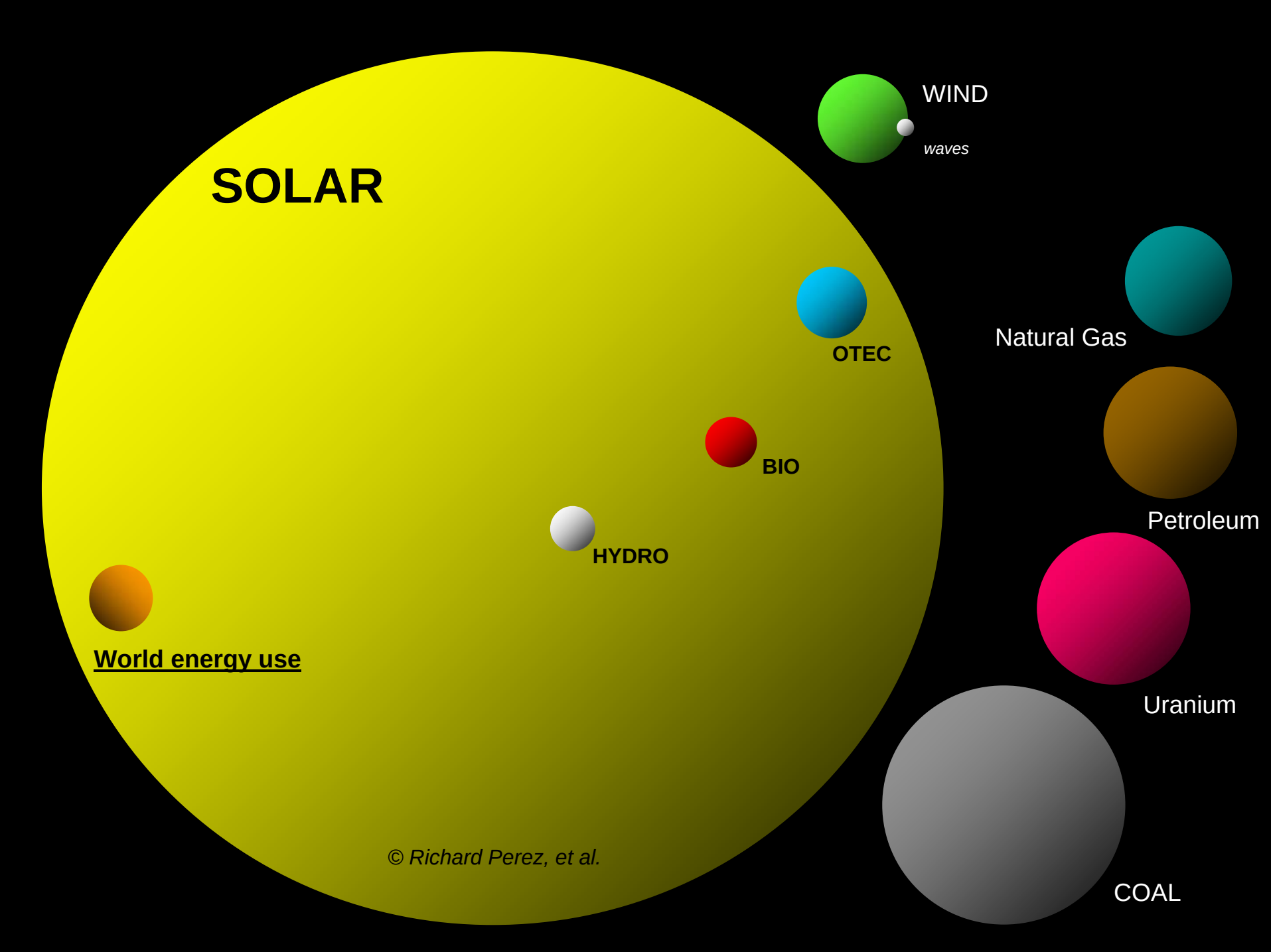
© *Richard Perez, et al.*

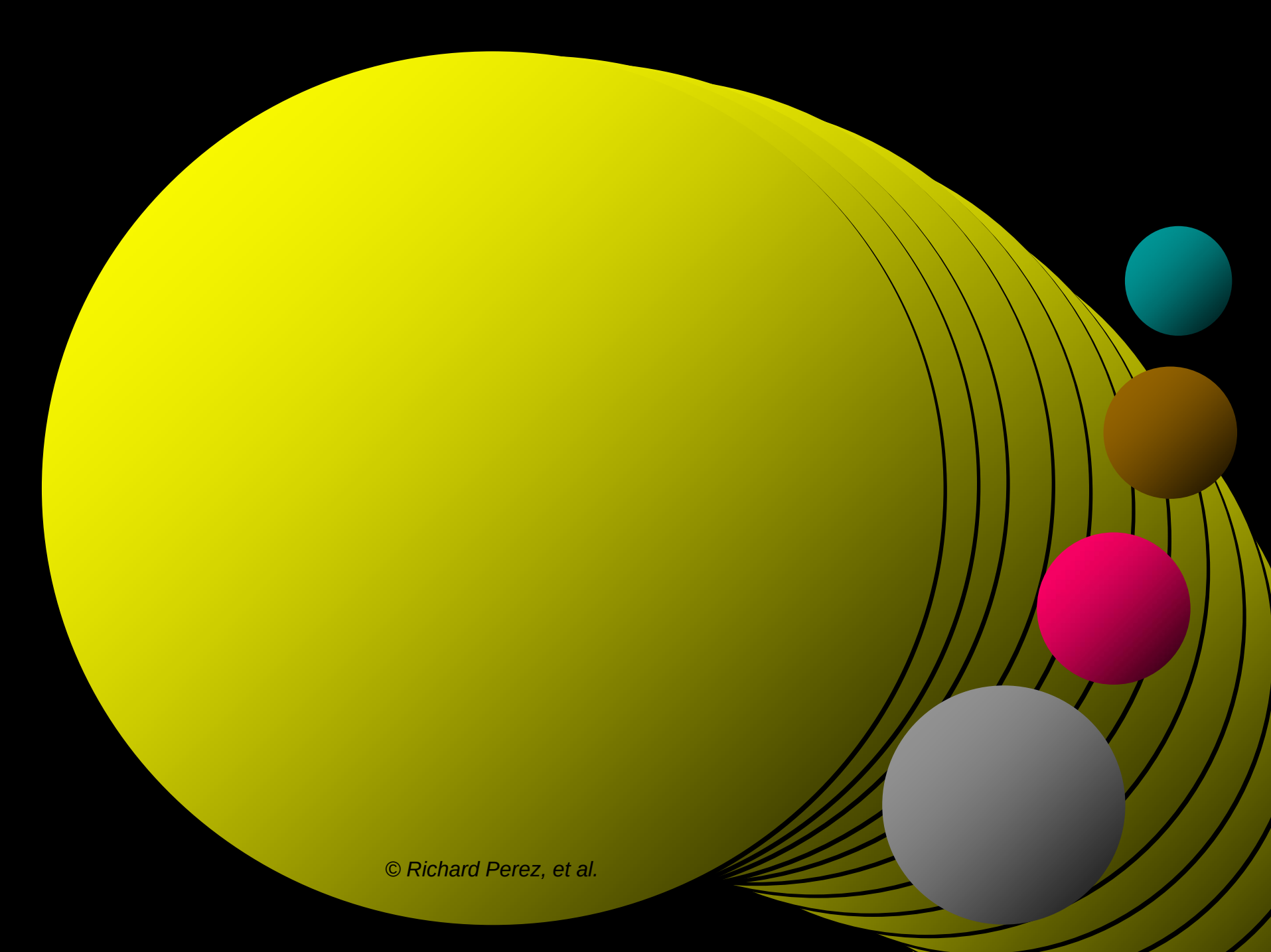
Renewables in Perpetuity	terawatt hours **EACH YEAR**
Direct Solar Radiation	350,000,000
Wind	200,000
Ocean Thermal	100,000
Biofuel	50,000
Hydroelectric	30,000
Geothermal	10,000
Tidal	1,000

Energy Stored in the Earth	terawatt hours **TOTAL**
Coal	6,000,000
Uranium 235	1,500,000
Petroleum (US ½ Gone 1970)	1,000,000
Natural Gas (US ½ Gone 2005)	400,000
Tar Sands	200,000

2004 Global consumption of stored energy = 80,000 terawatt hours/year

Table courtesy of Stephen Heckeroth, at Renewables.com


SOLAR
WIND
waves
OTEC
Natural Gas
BIO
Petroleum
HYDRO
World energy use
Uranium
COAL
© Richard Perez, et al.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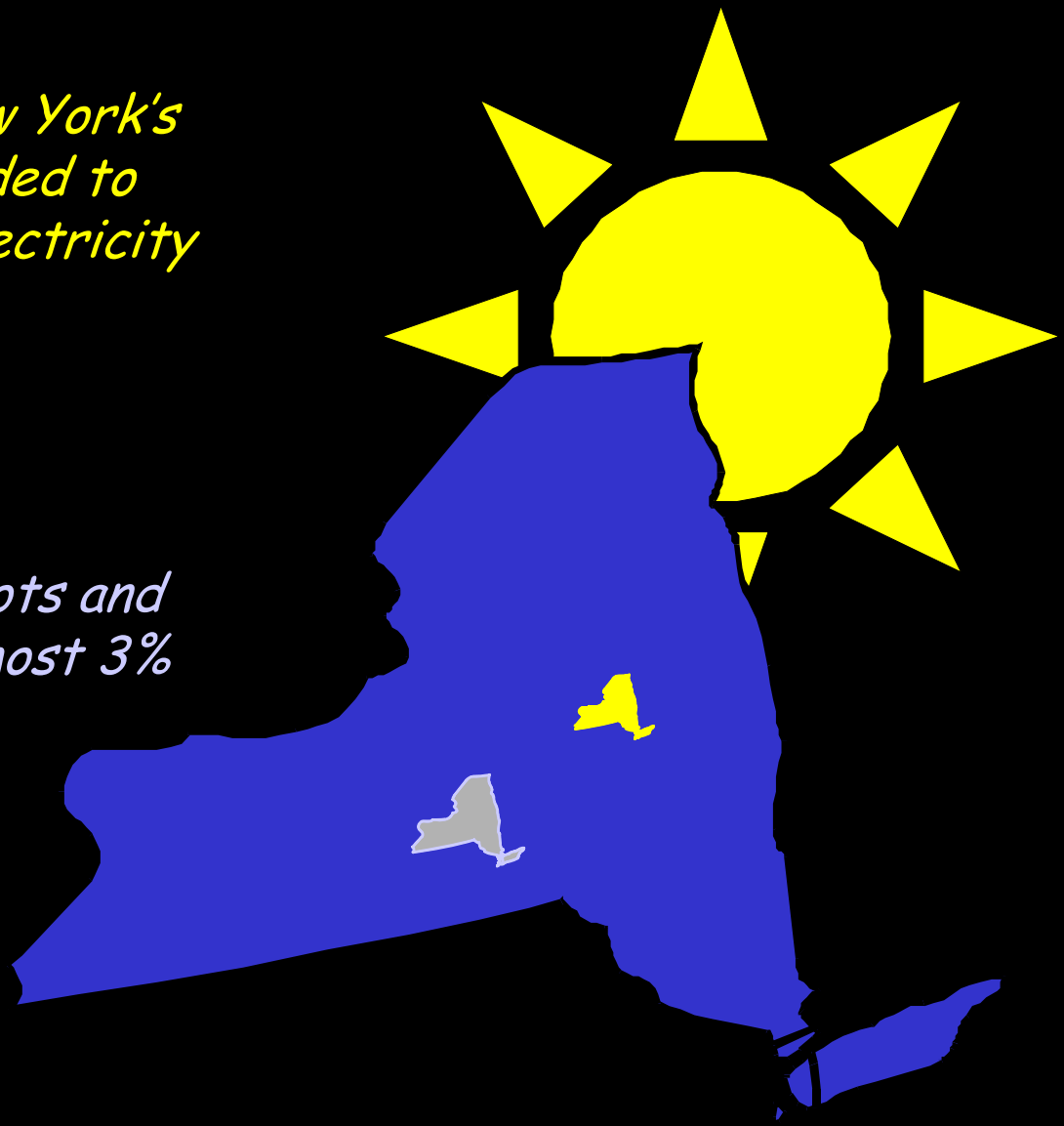


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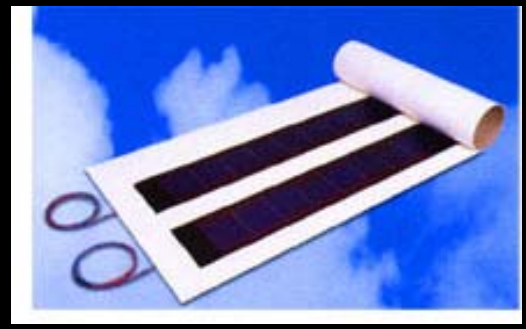
Open Energy



Evalon Solar

Uni-solar

PowerLight

Richard Perez, et al.

Common misconceptions about PVs in New York

- No space
- No sun
- **No reliability**

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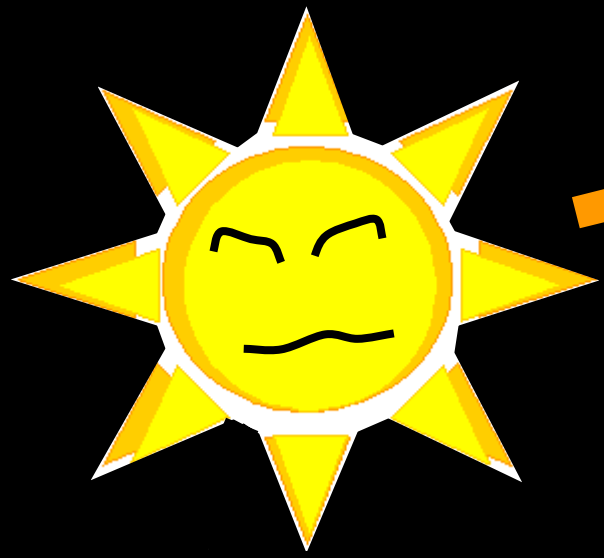
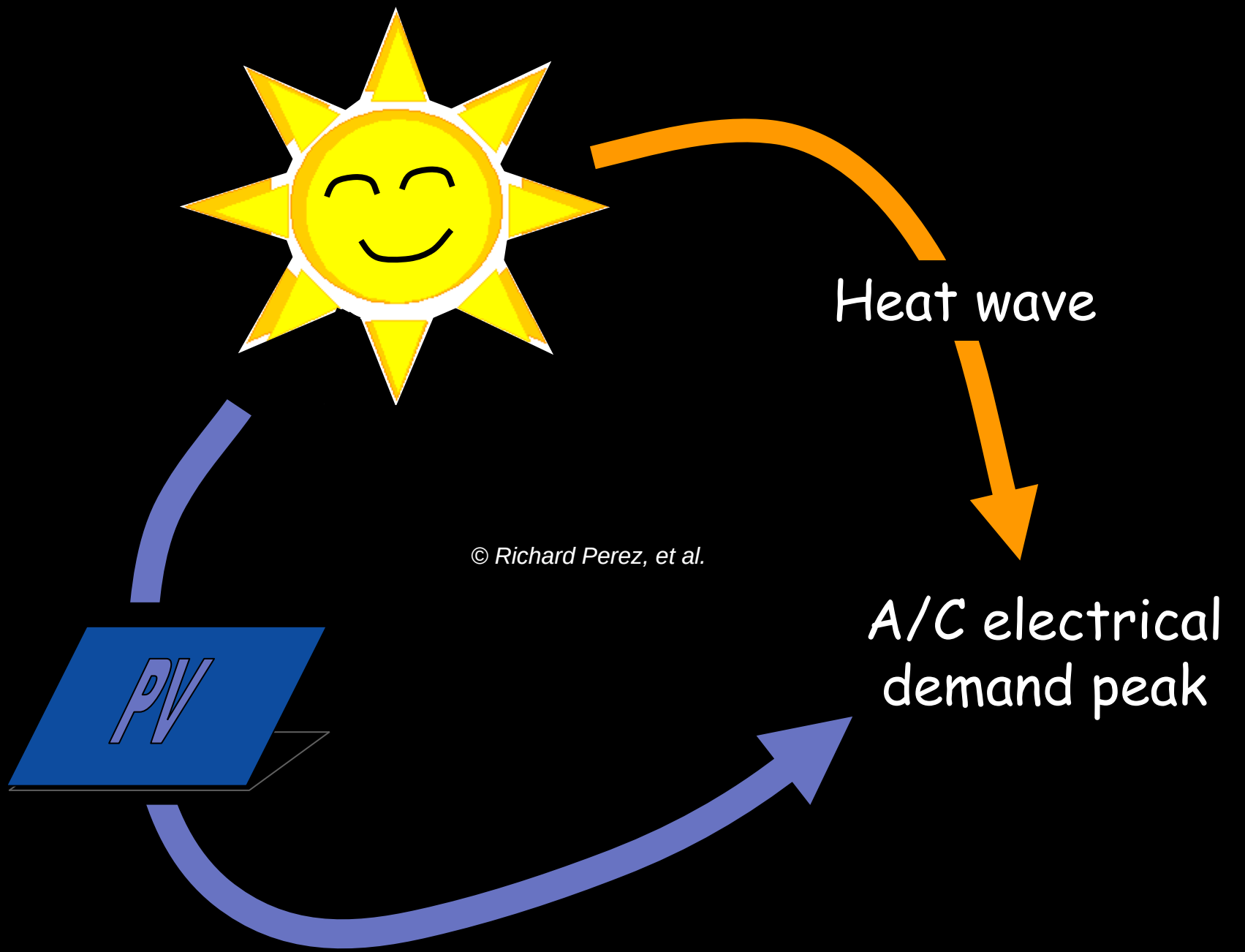
Is Power available when needed ?



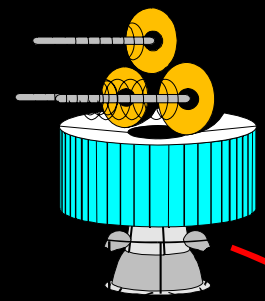
Heat wave

A/C electrical demand peak

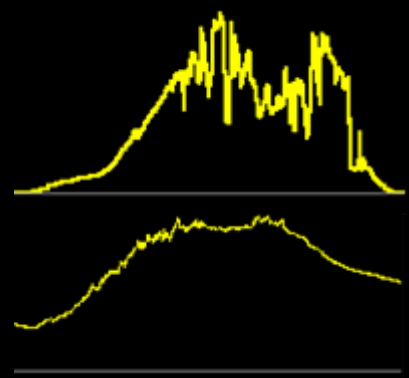

Heat wave
© Richard Perez, et al.
A/C electrical demand peak
PV

Exhaustive study 100+ utility load-years

Perez et al., ASRC



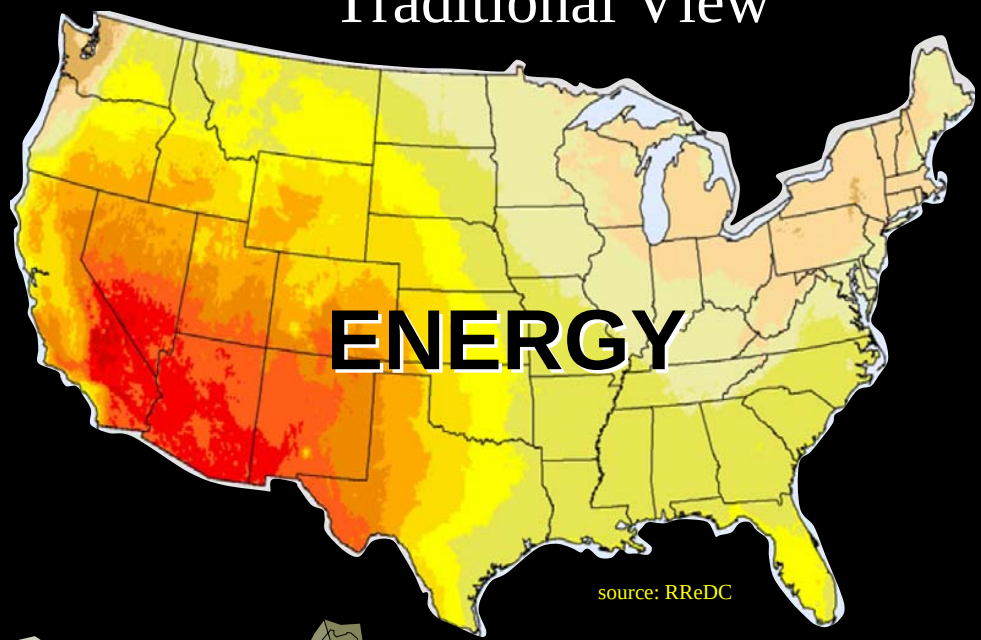
- Time/site specific PV output data
- Coincident electric load data



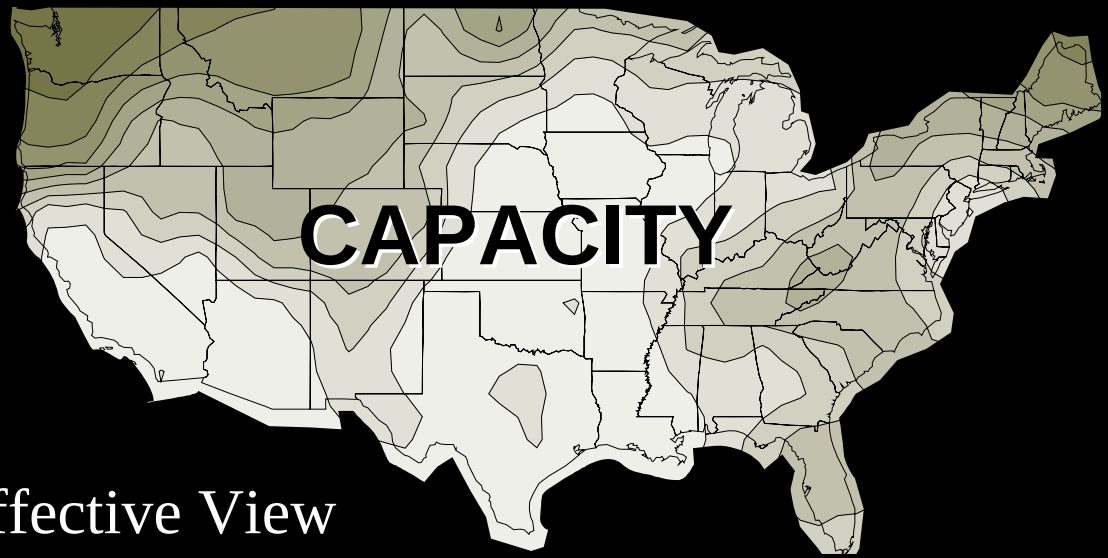
Traditional View

Lowest Capacity
Random Energy
output Power Plant

Highest Capacity
Ideally Dispatchable
Power Plant



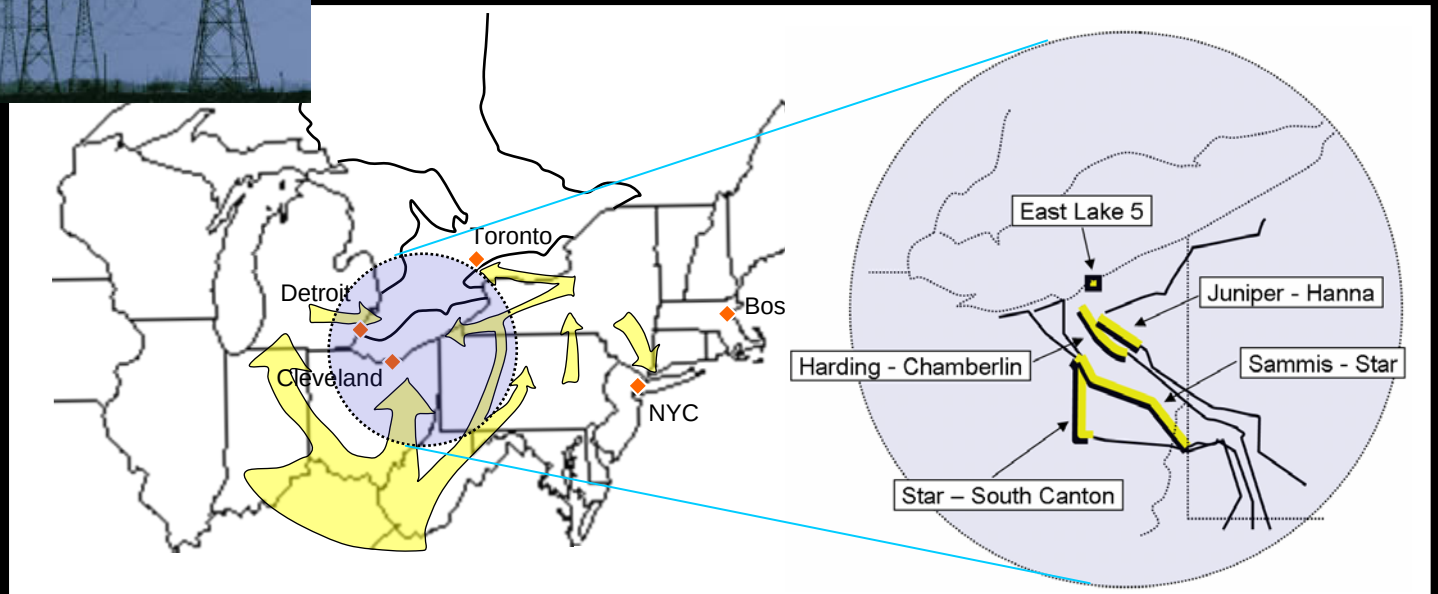
source: RReDC



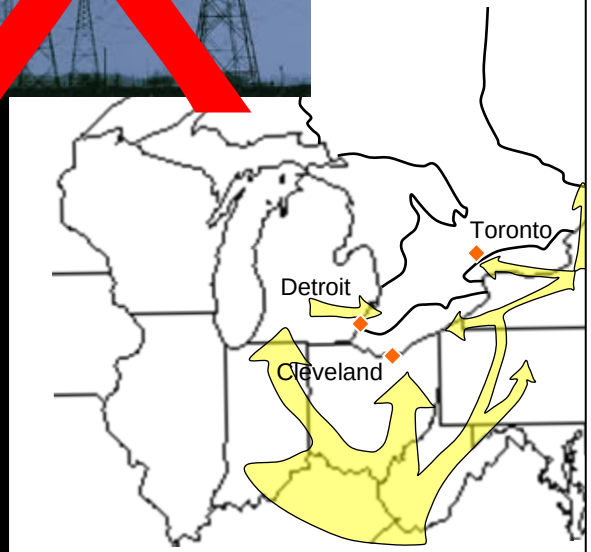
Effective View

Perez et al. ASRC

Northeast US – AUG 14th, 2003



	Before 1:31 PM	1:31 PM	3:05 PM	3:32 PM	3:41 PM	4:05 PM	Cause
East Lake 5 Plant	100% (600MW)	Failed	Failed	Failed	Failed	Failed	Exceeding MVAR limit
Harding-Chamberlain	35% (400MW)	45% (500MW)	Failed	Failed	Failed	Failed	Tree Contact
Juniper-Hanna	55% (800MW)	70% (1 GW)	80% (1.2 GW)	Failed	Failed	Failed	Tree Contact
Star-South Canton	65% (650MW)	80% (800MW)	90% (900MW)	120% (1.2 GW)	Failed	Failed	Overaload
Star-Sammis	55% (650MW)	60% (700MW)	65% (800MW)	85% (1 GW)	120% (1.4 GW)	Failed	Overaload



	Before 1:31 PM	1:31 PM	3:0
East Lake 5 Plant	100% (600MW)	Failed	
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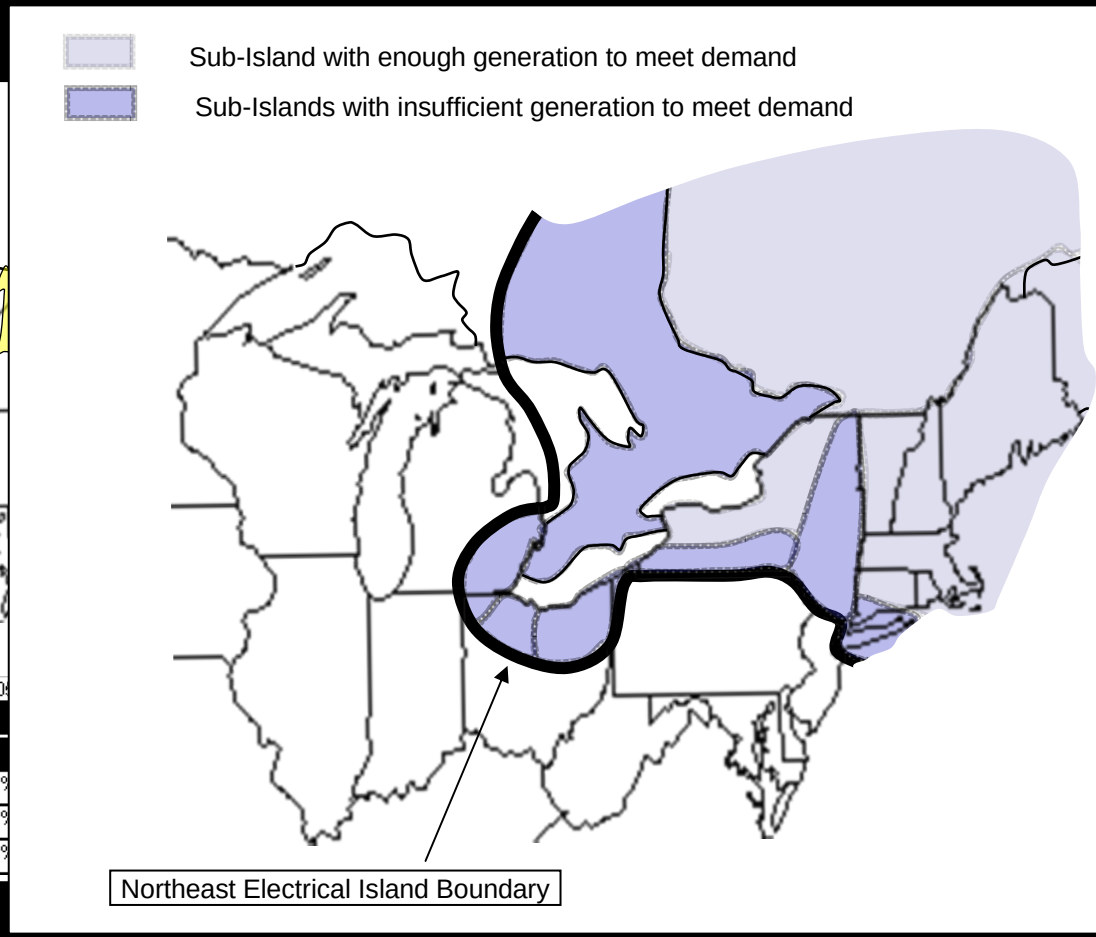
Star-Sammis	55% (650MW)	60% (700MW)	65%



NYC $1 Billion

(Reuters)

$1.1 Billion

(The Guardian)

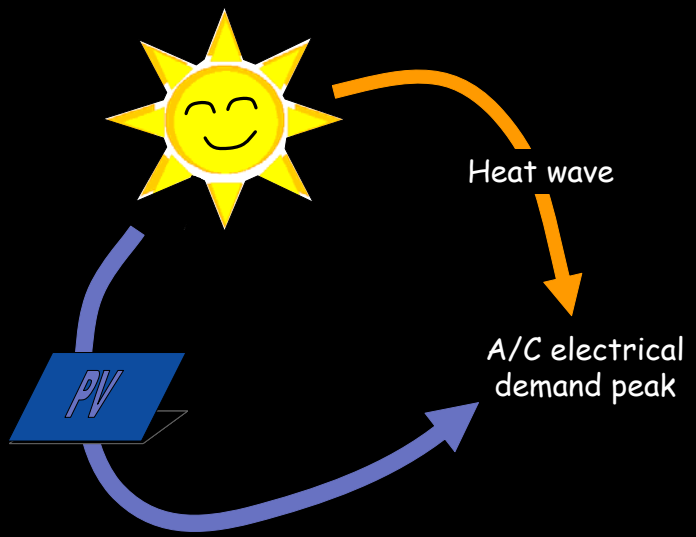
US-Can $6.8 - $10.3 B

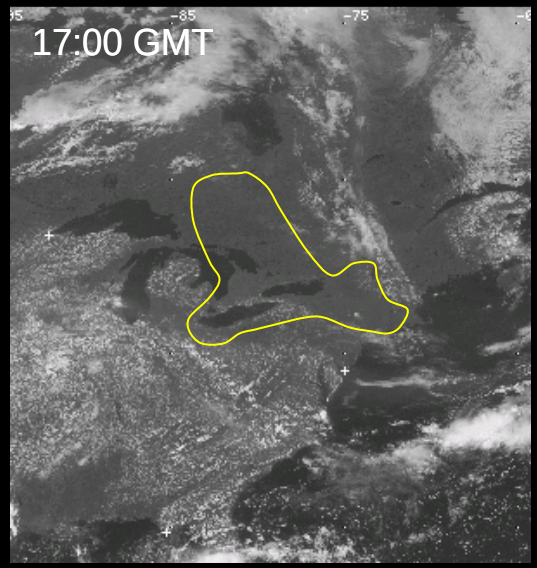
(ICF Consulting)

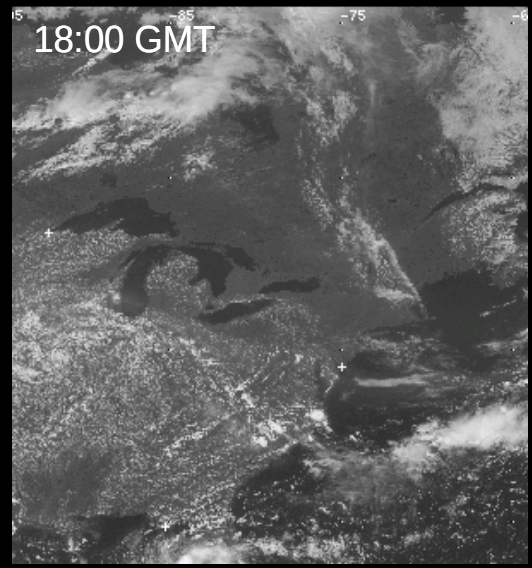

PV

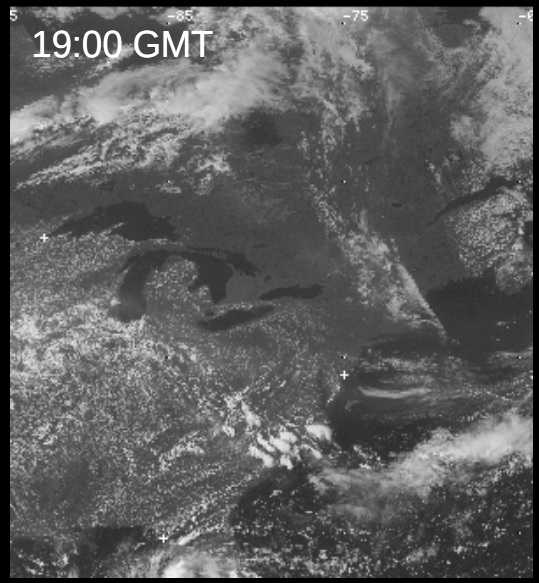
?

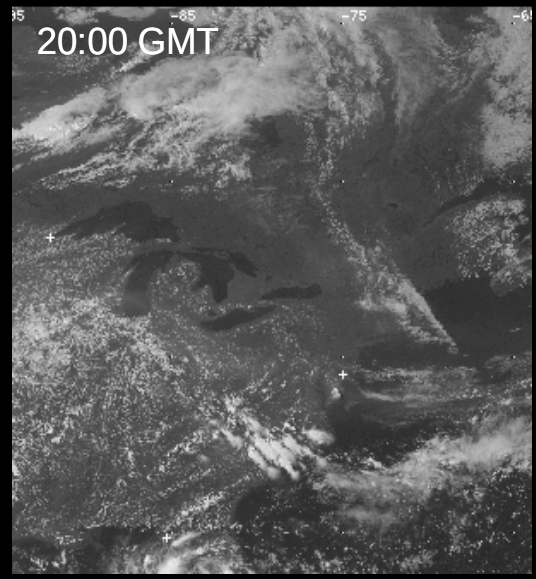
AUGUST 14th









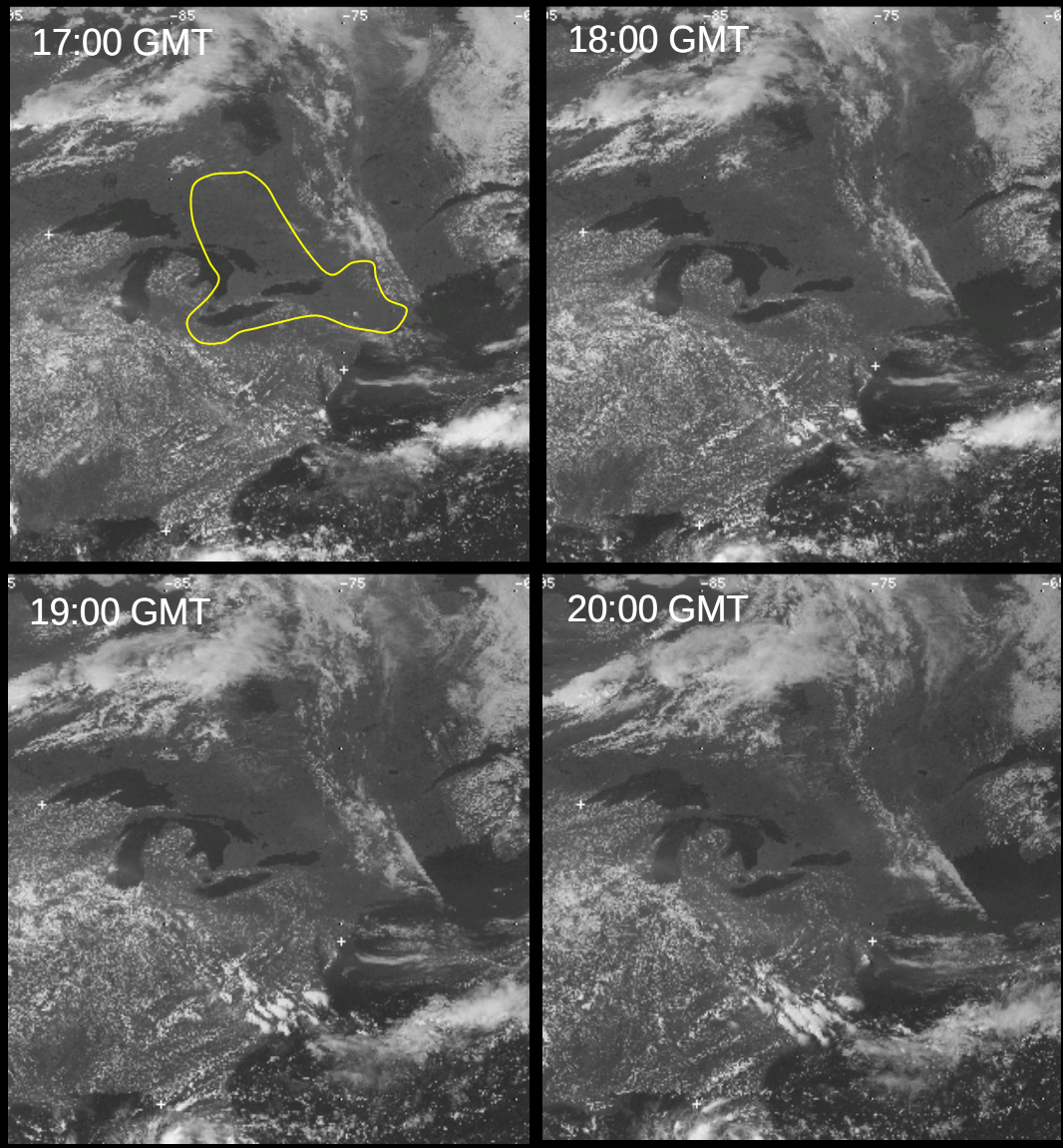


AUGUST 14th

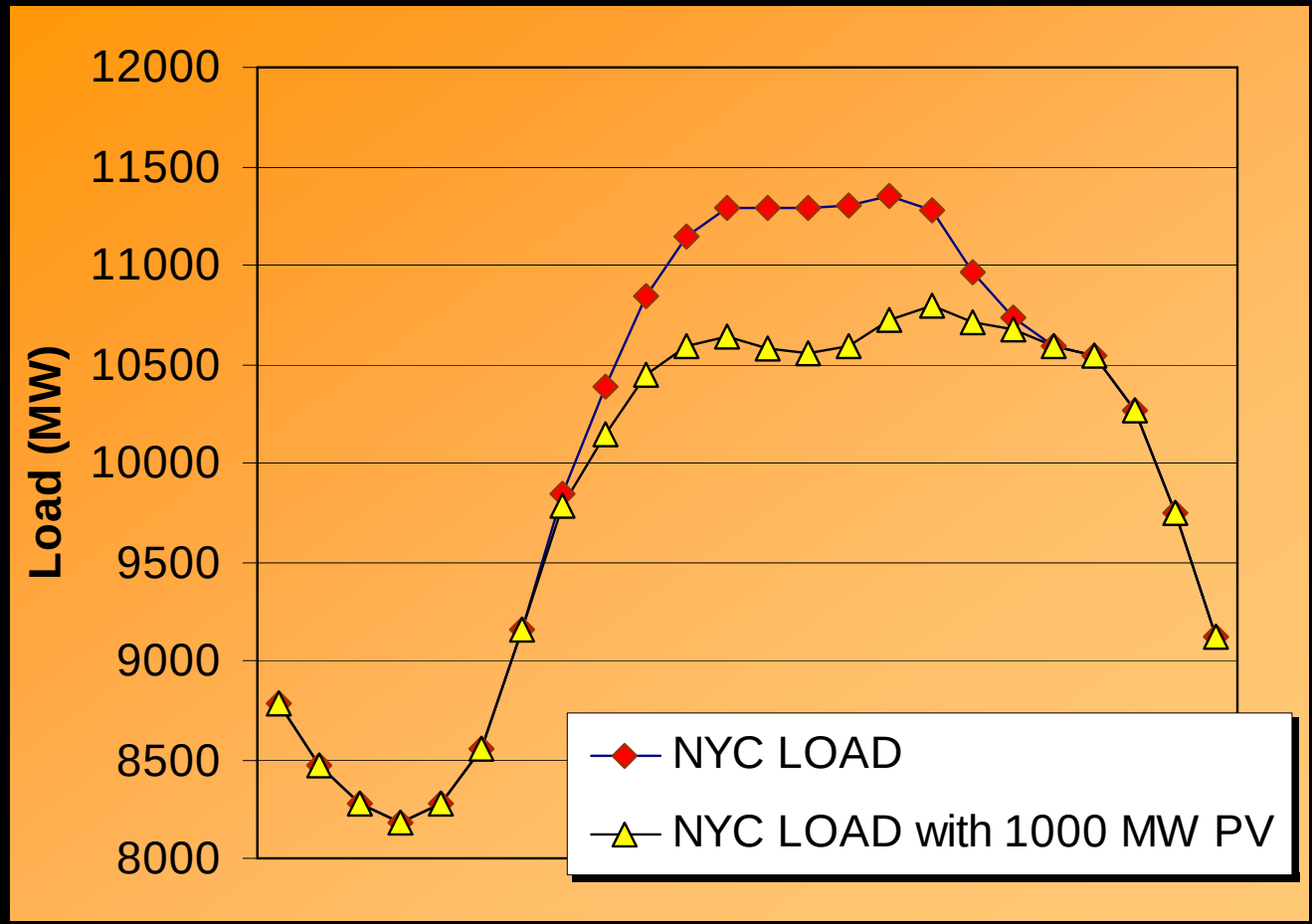
As little as 500 MW of PV dispersed around the major northeastern cities would have prevented the blackout

An investment of $ 3 billion

Outage cost $ 8 billion



Summer 2006 peak demand day
New York City



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- No space
- No sun
- No reliability
- **Too Expensive**

Case Study:
Residential PV system
3000 $Watt_{dc}$ PV system

Richard Perez et al.

Cumulative Cash Flow
10% down + 25 yr. Loan

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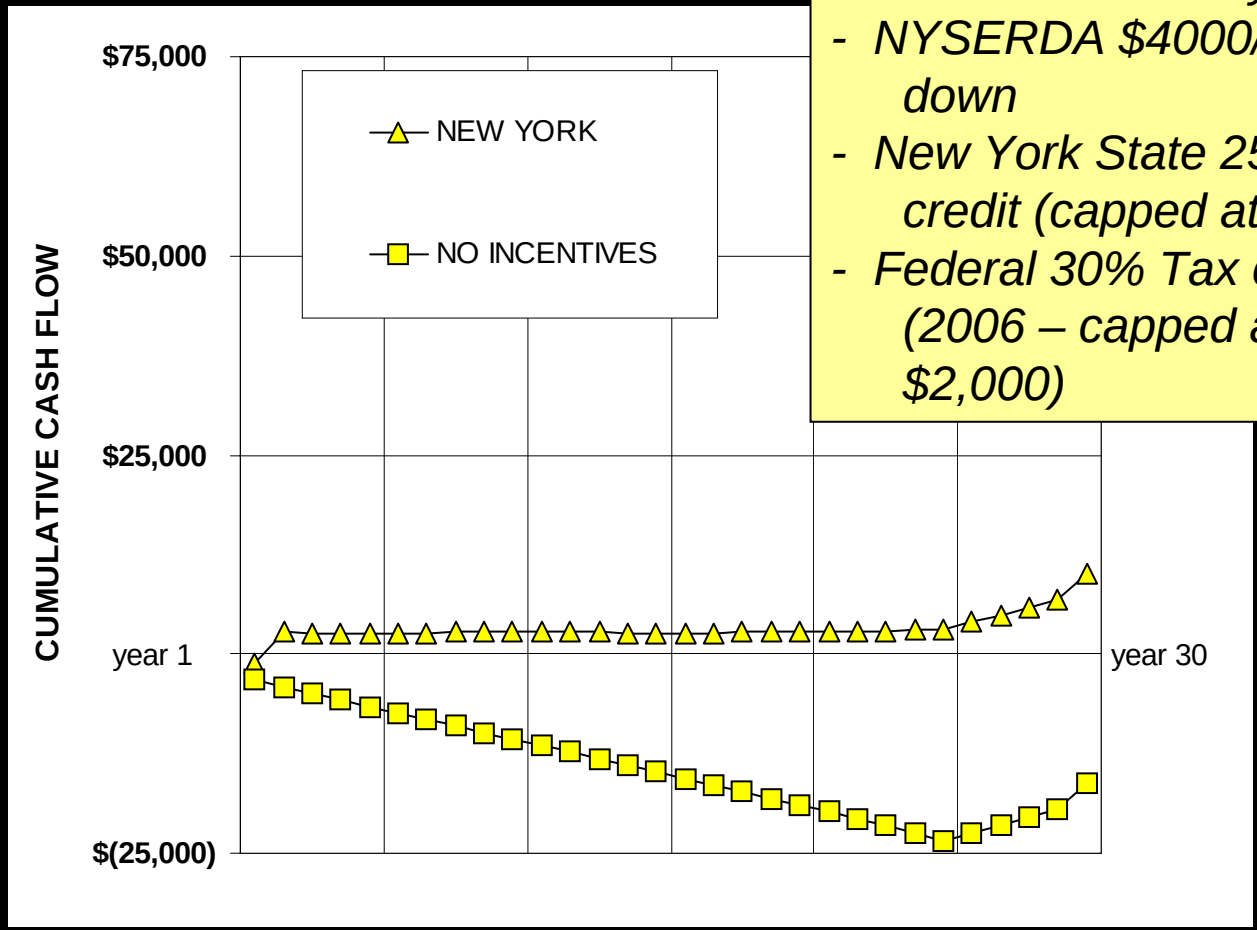
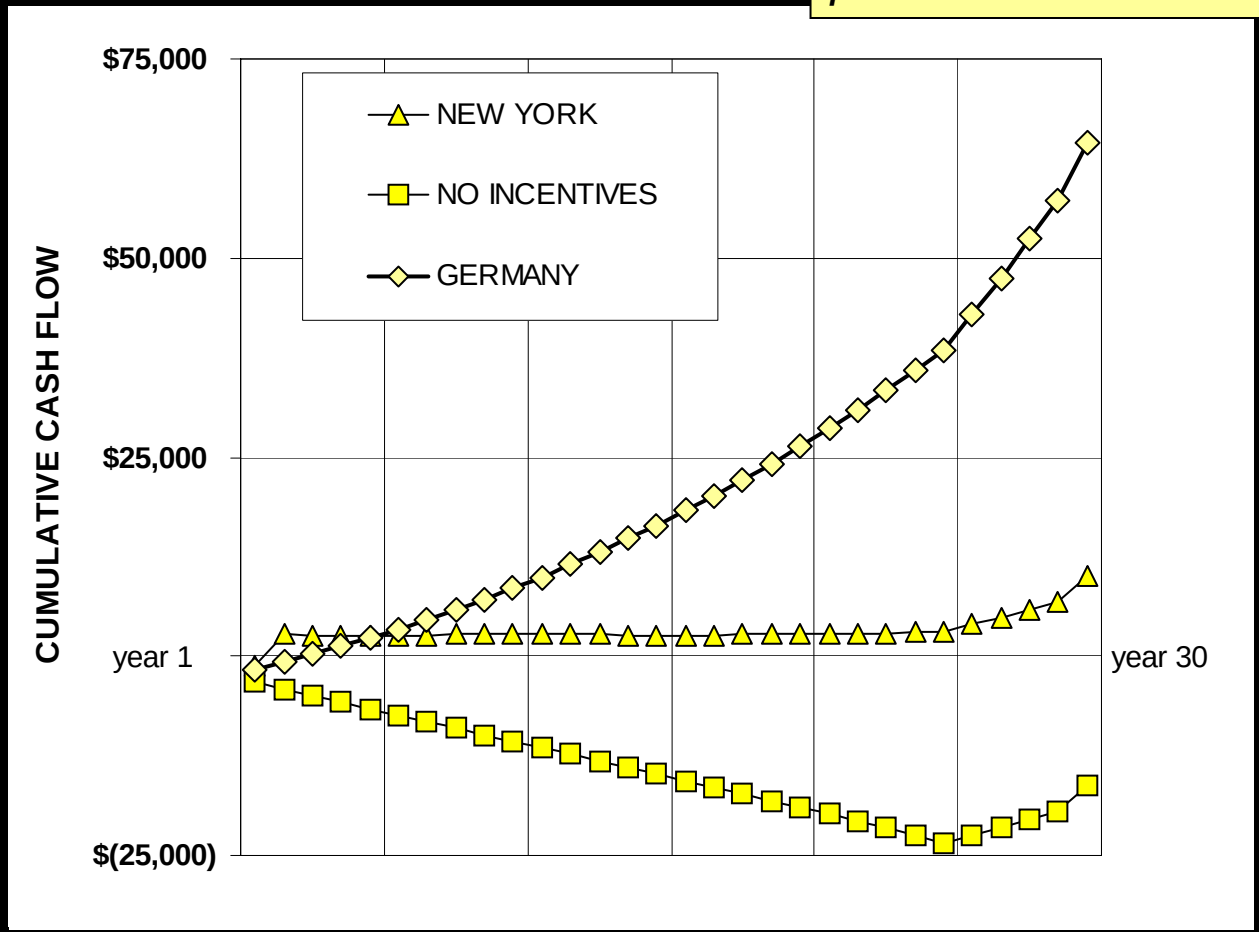


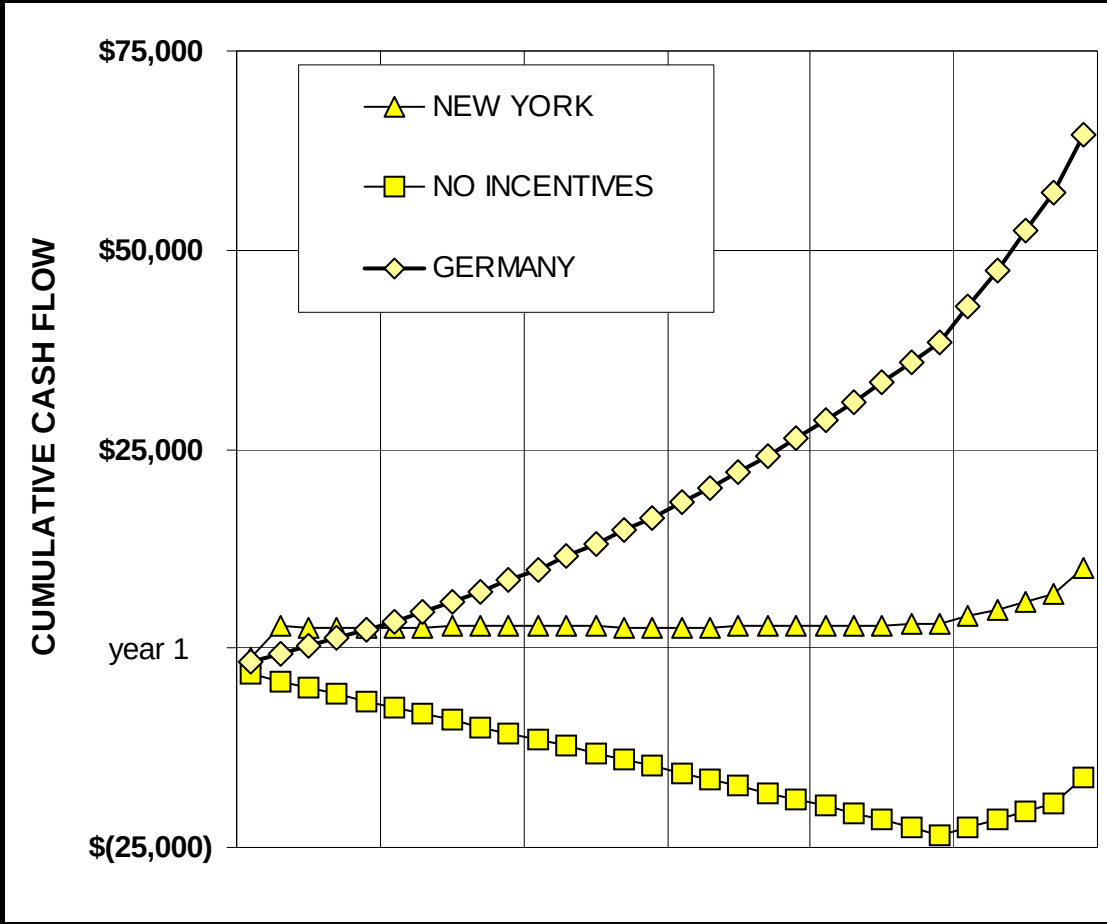
- *NYSERDA 4% loan rate reduction for 10 years*
- *NYSERDA $4000/kW buy-down*
- *New York State 25% Tax credit (capped at $5,000)*
- *Federal 30% Tax credit (2006 – capped at $2,000)*

Cumulative Cash Flow
10% down + 25 yr. Loan

50 euro-cents (65 US) per solar kWh



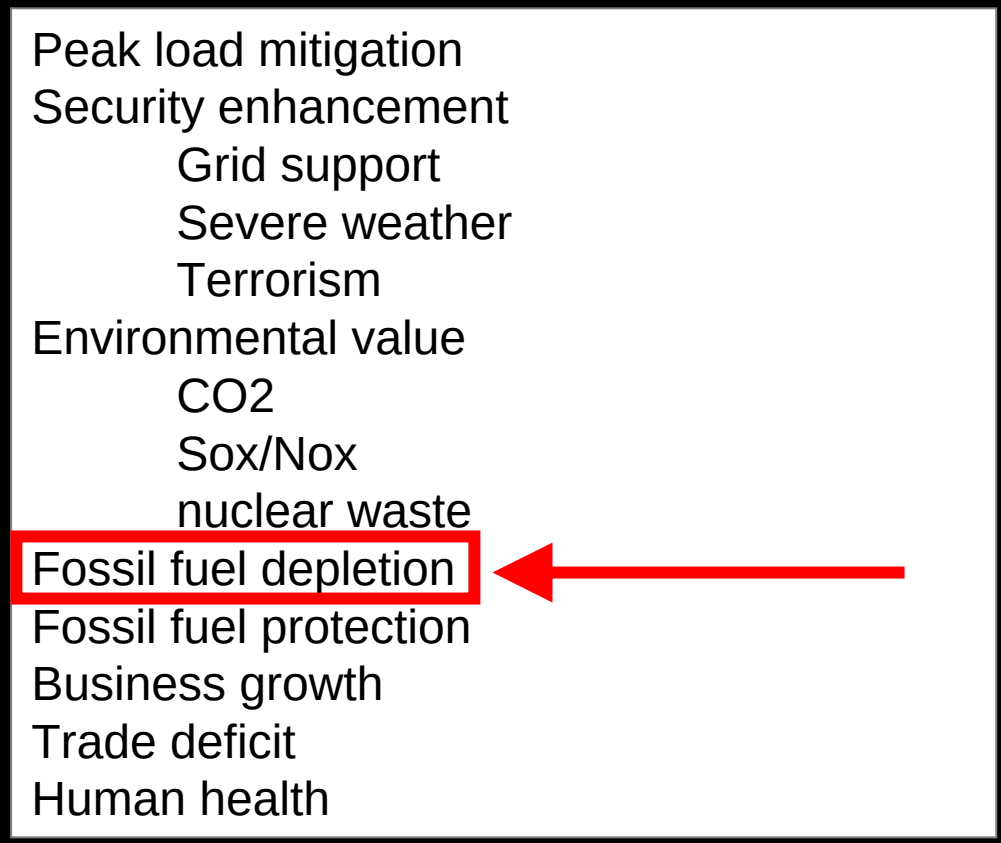
Externalities



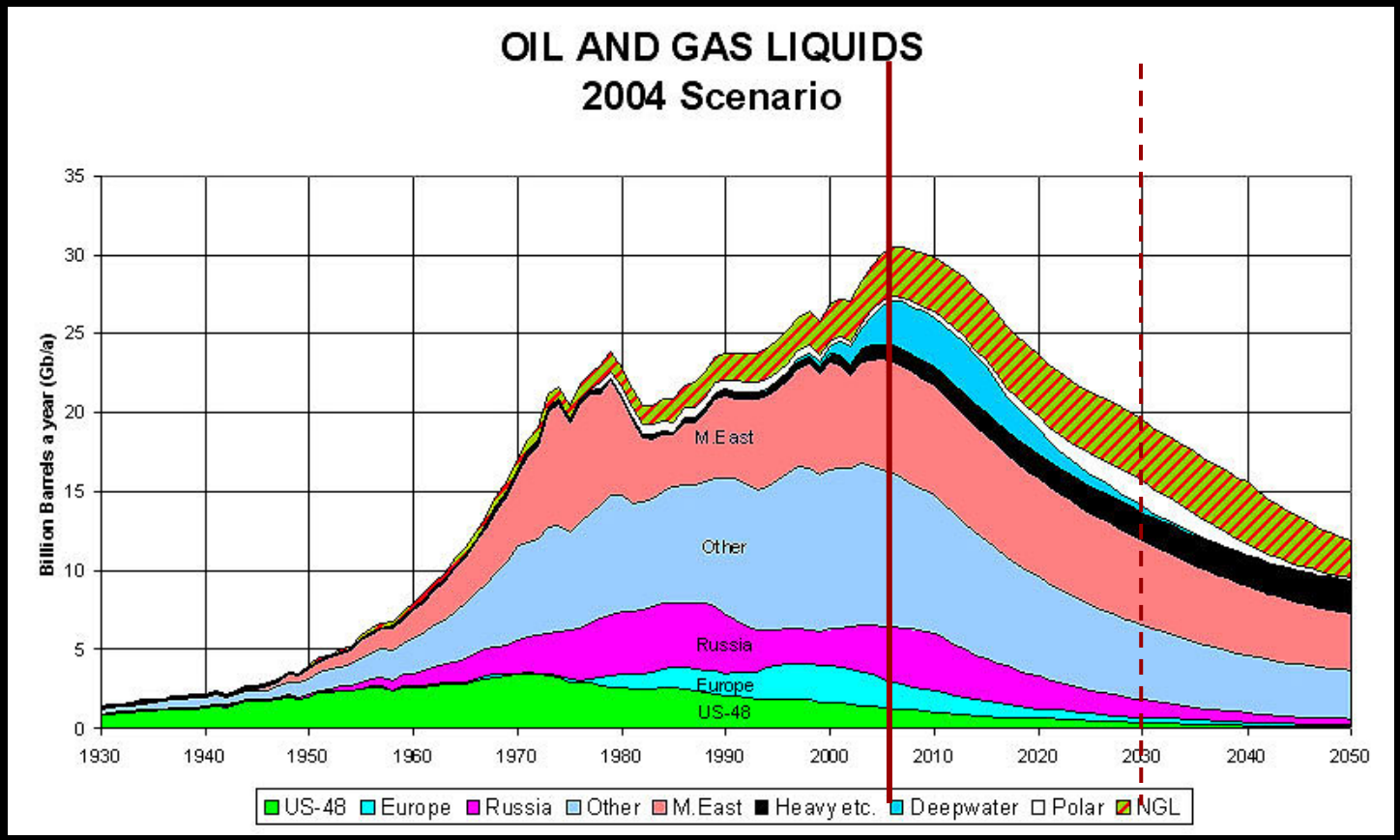
Externalities

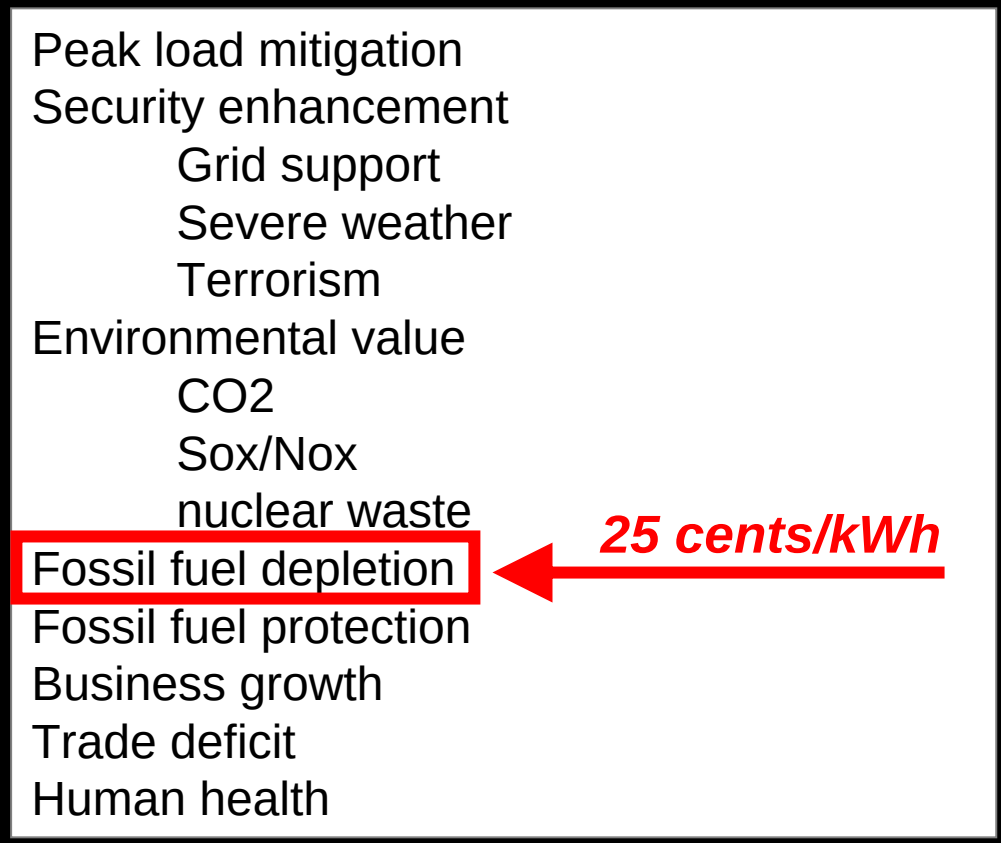
Value not captured by PV. Costs not [yet] included in utility bills

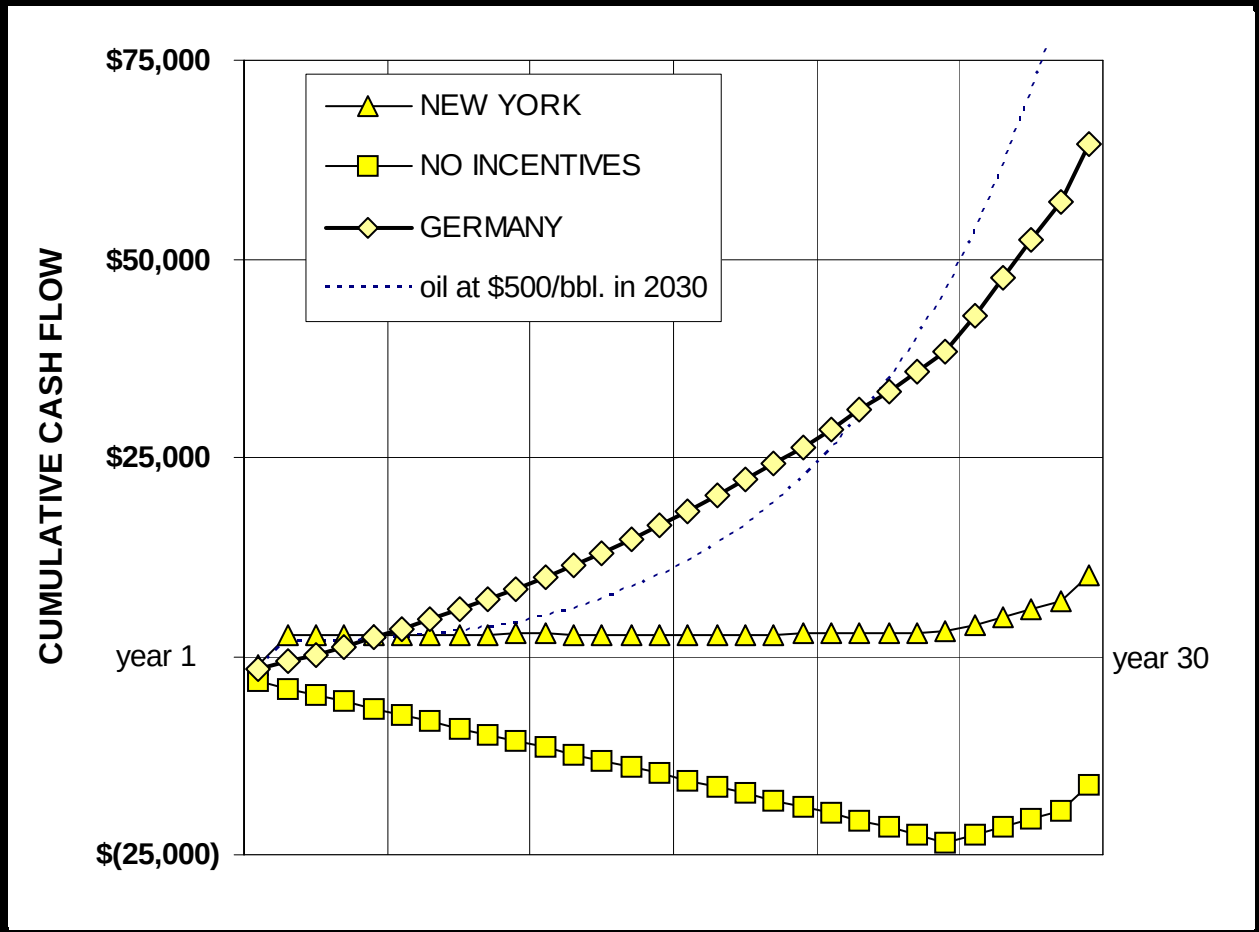
- Peak load mitigation
- Security enhancement
  - Grid support
  - Severe weather
  - Terrorism
- Environmental value
  - CO2
  - Sox/Nox
  - nuclear waste
- Fossil fuel depletion
- Fossil fuel protection
- Business growth
- Trade deficit
- Human health



Value of hedging oil at $500 /bbl. in 2030 ?







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Bottom line:

The solar energy resource is very large in the Empire State

NOT A NICHE MARKET

It is well suited to meet New York's growing electrical demand

IT IS AFFORDABLE

Thanks for your attention

NOT A NICHE MARKET

Thanks for your attention