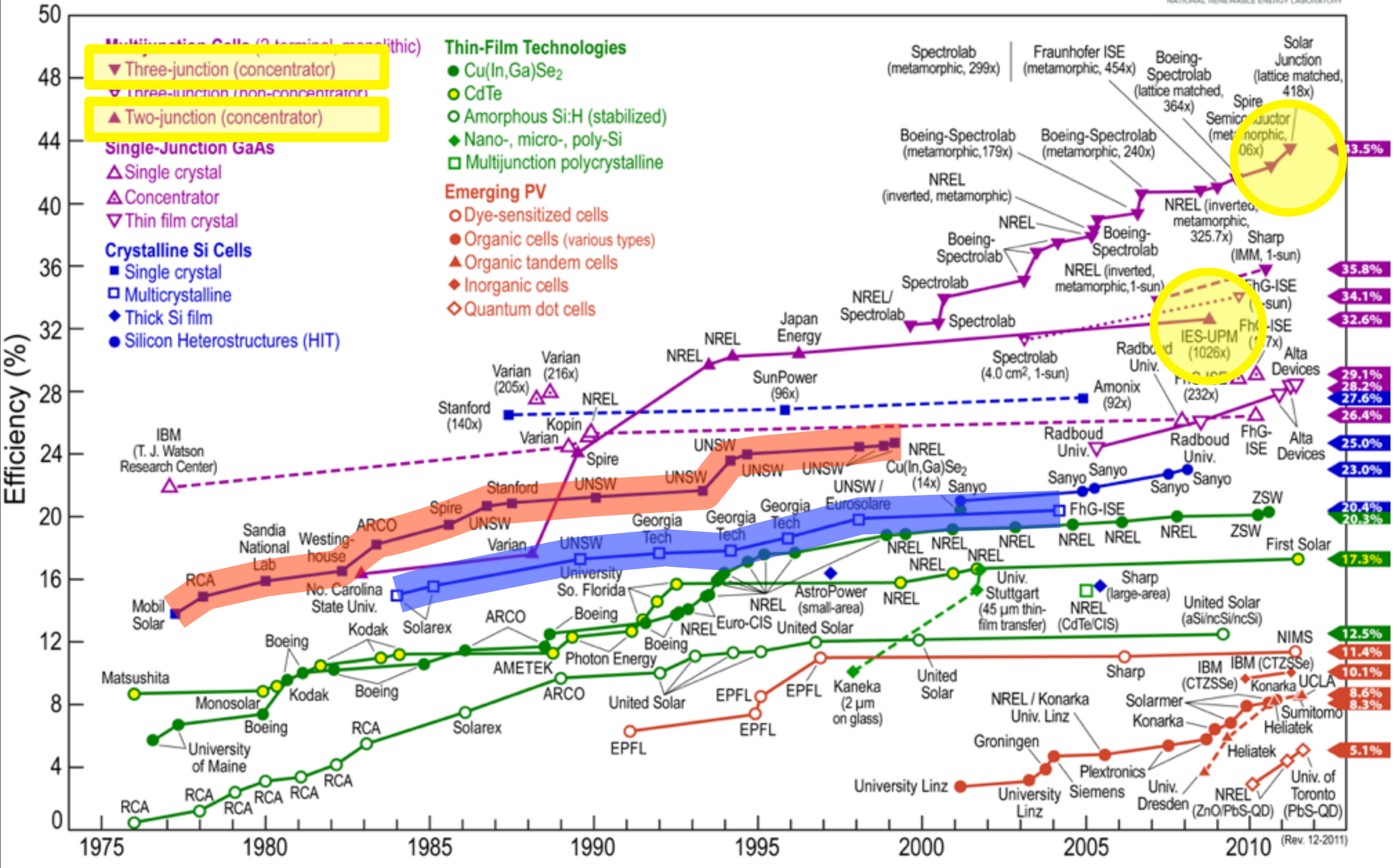
Balance of system
Tracking methods
Concentrating systems
Solar lighting
Solar thermal

also:
Kardashev scale
Space based solar power
Dyson swarms

Best Research-Cell Efficiencies

NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Source: DOE NREL

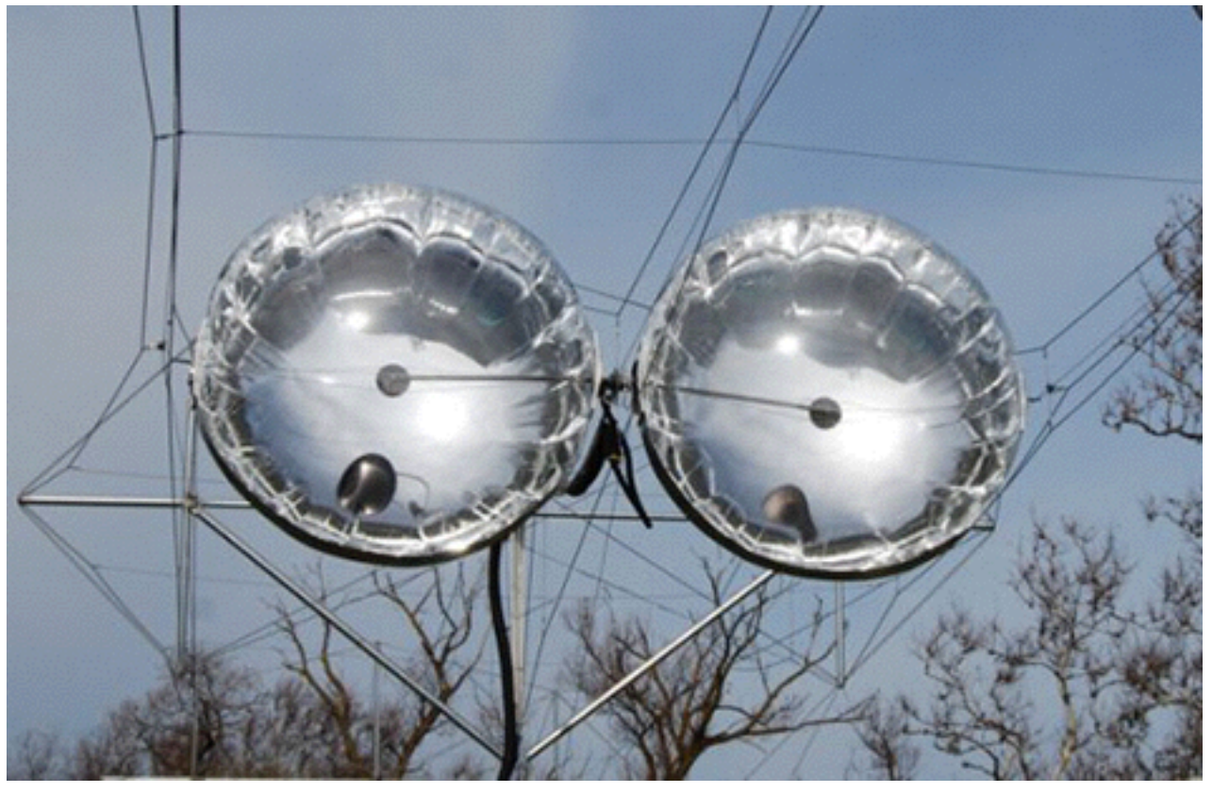
Differences

Concentrating

mirrors

Concentrating

cheap mirrors



Concentrating

lenses

How it Works

Concentrating
Fresnel Lens

The C-MAX Solar Energi optimizes the intake of solar power through a Fresnel lens concentrator by autonomously moving in the direct path of the sun's rays.

C-MAX Ford
SOLAR ENERGI CONCEPT

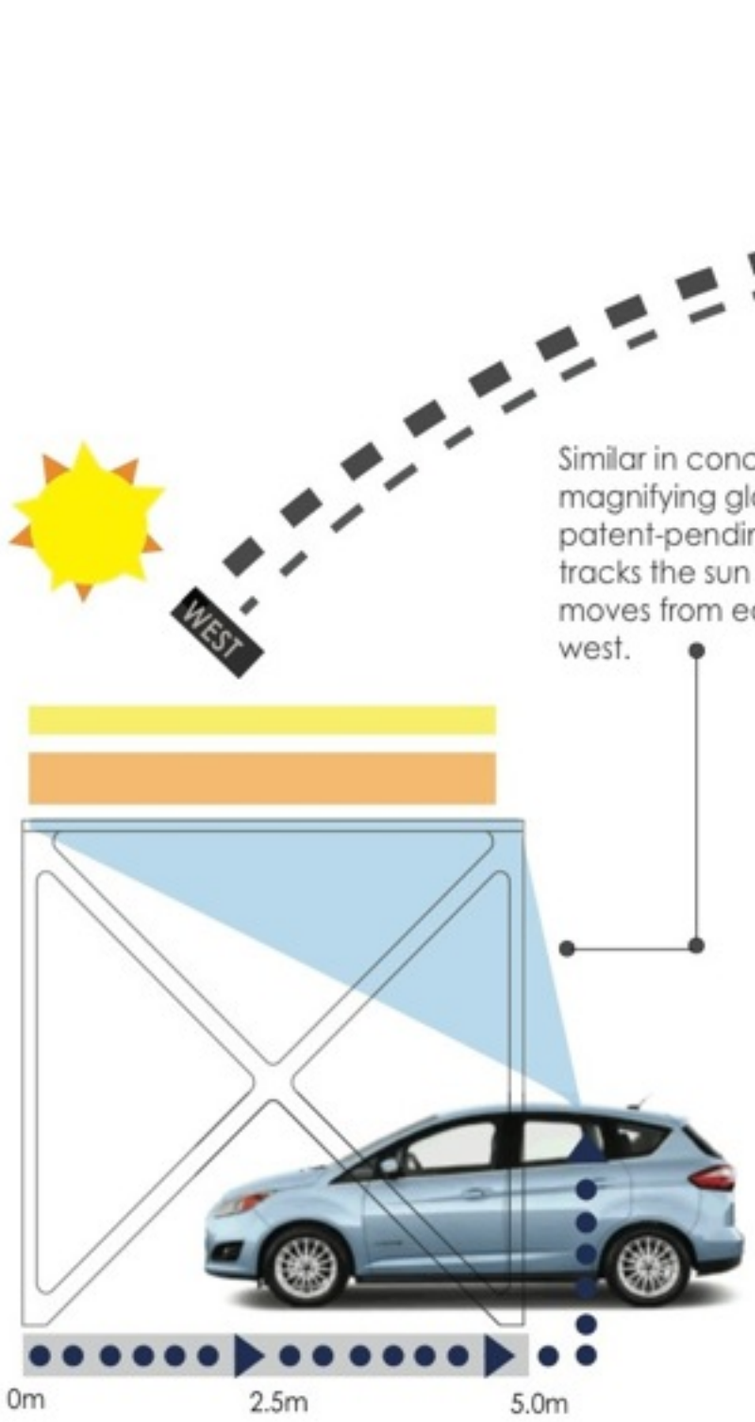
12:00pm

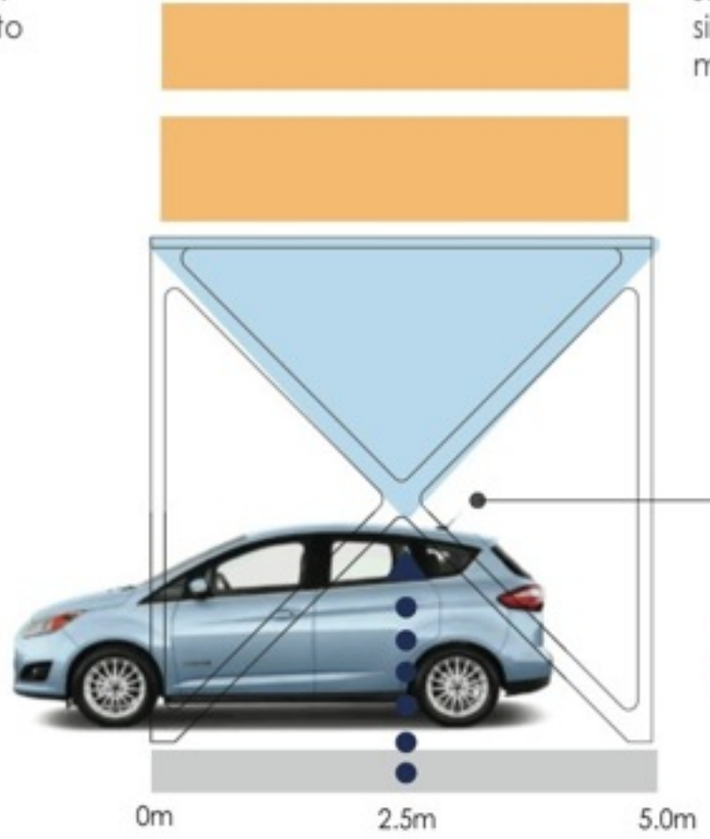
WEST

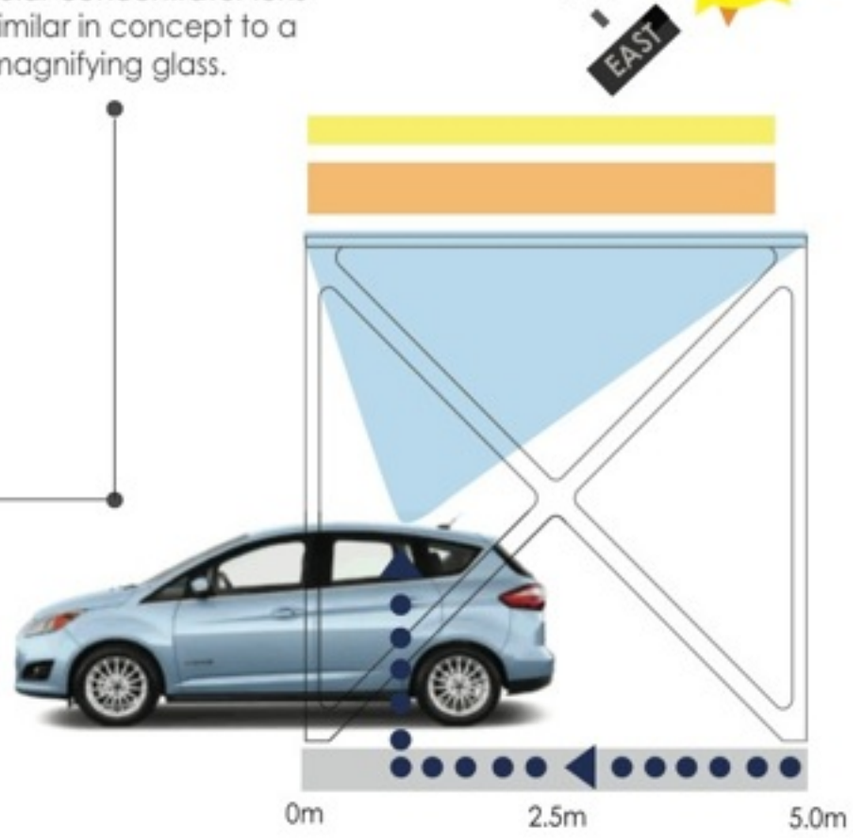
EAST

Similar in concept to a magnifying glass, the patent-pending system tracks the sun as it moves from east to west.

With a solar panel roof, the vehicle draws power from a special solar concentrator lens similar in concept to a magnifying glass.





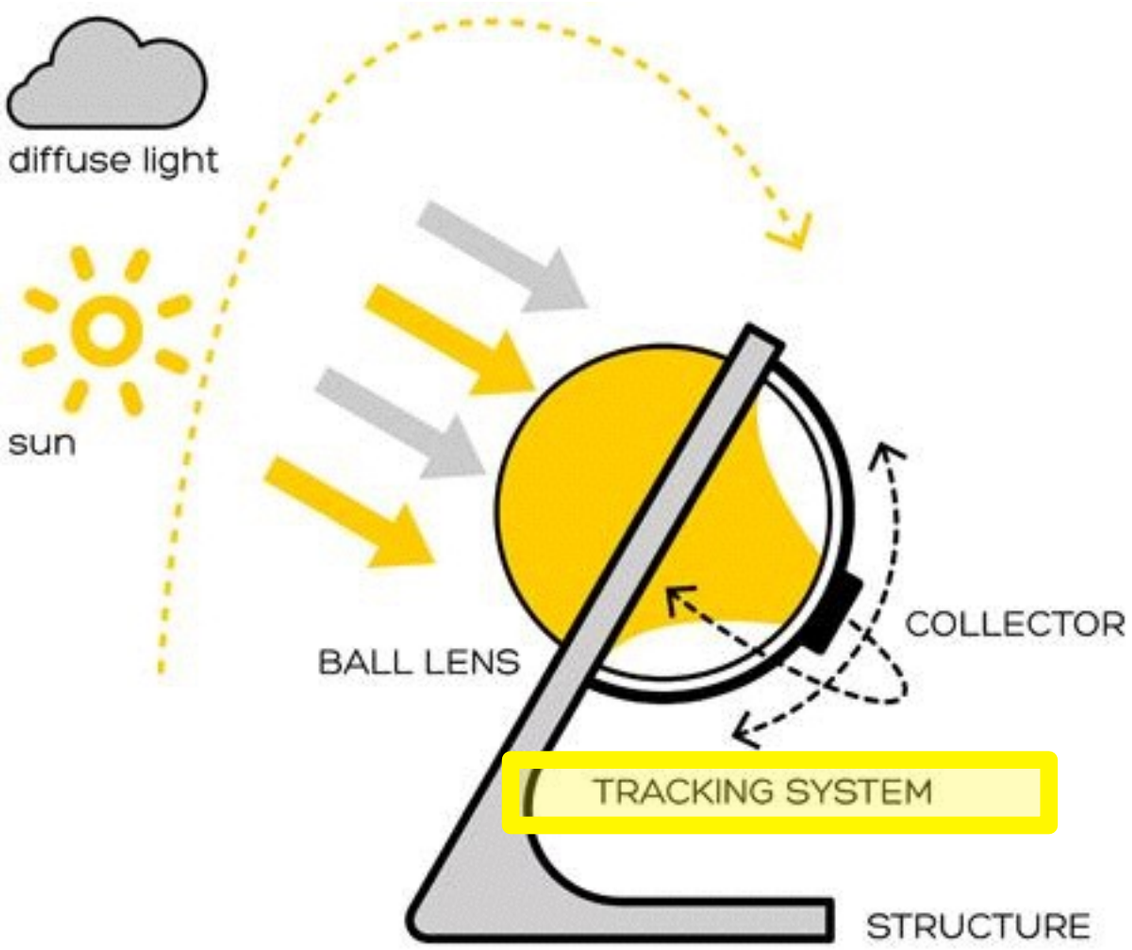


Concentrating

spherical lenses

Challenge:

Concentrating systems also require tracking systems, so same issues (**space between arrays** and **mechanical parts**) apply. Concentrated sunlight can reach very high temperatures and could focus on surrounding structures if tracking system fails.



Concentrating
(sort of...)

Solyndra

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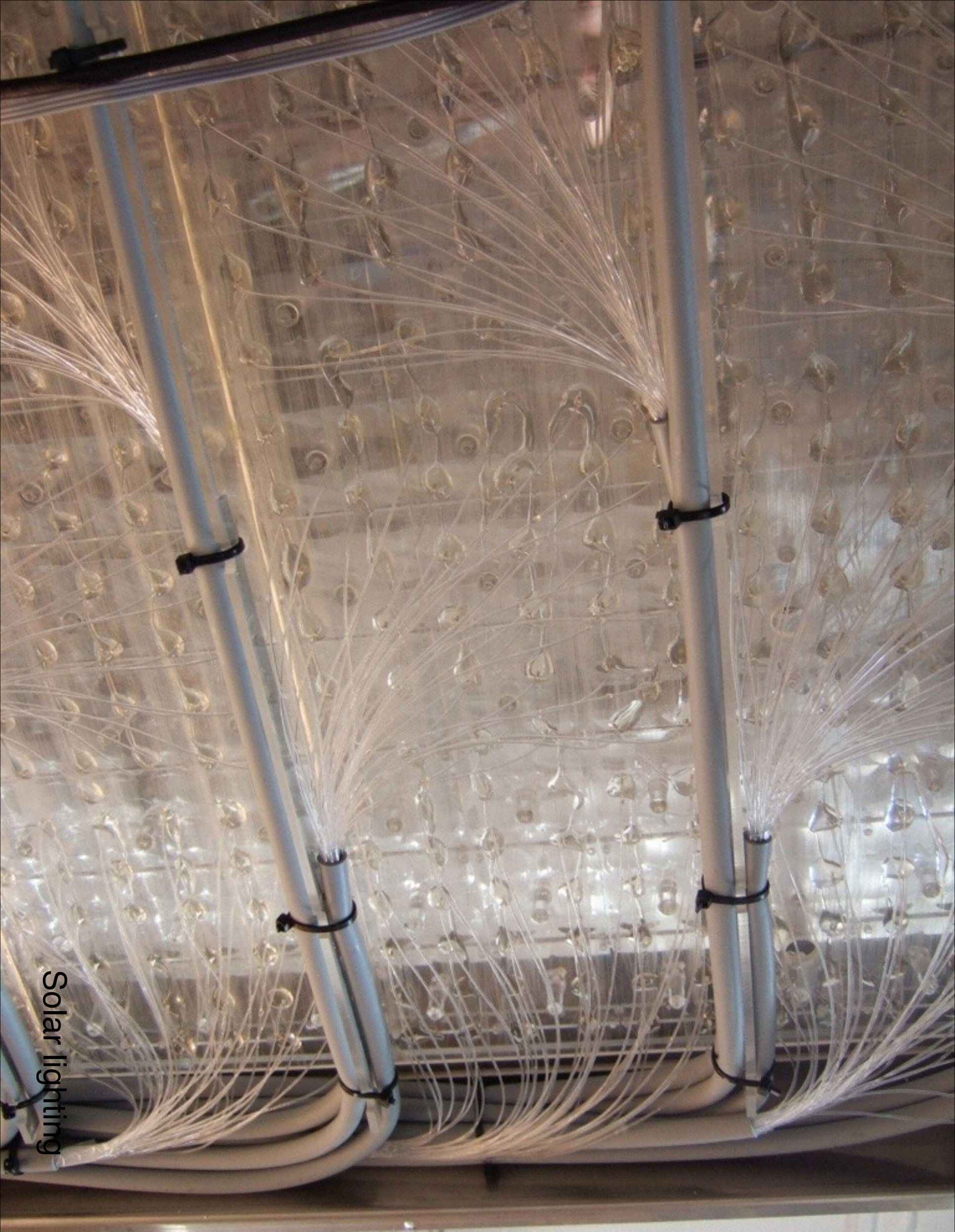
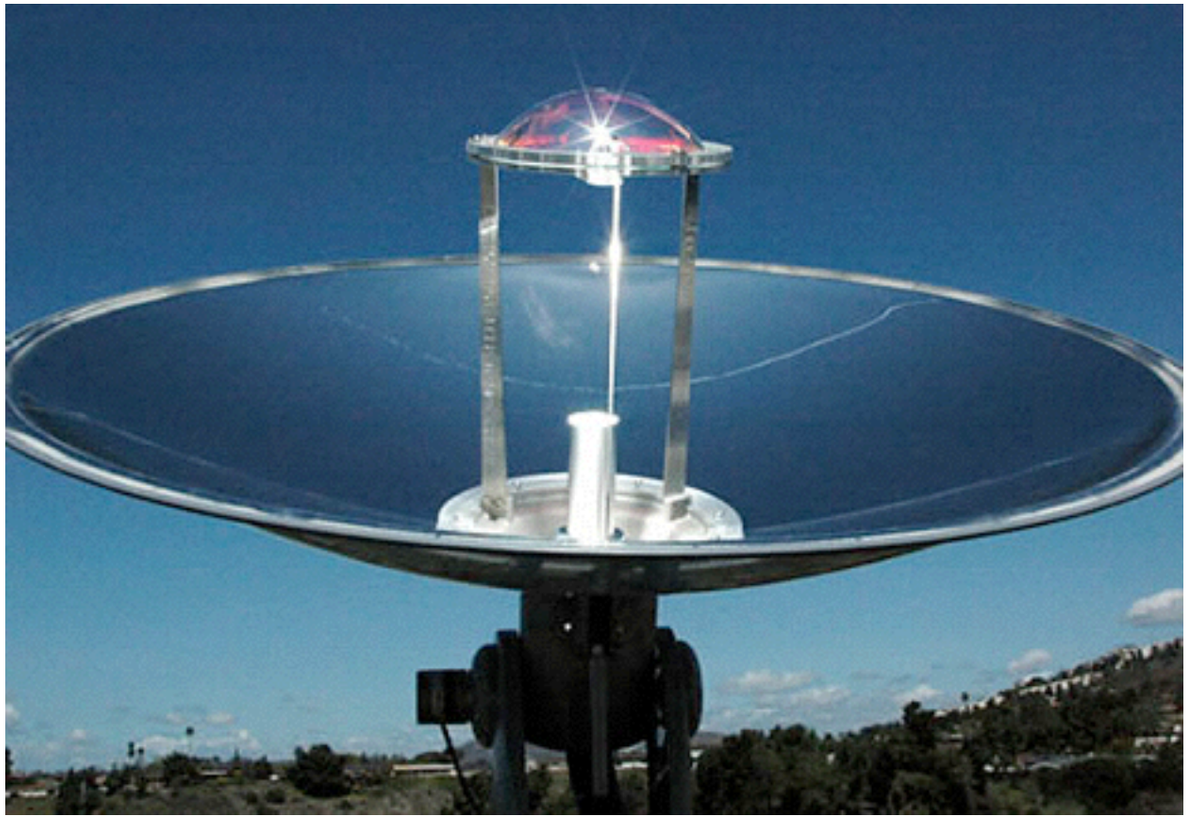
Solar lighting

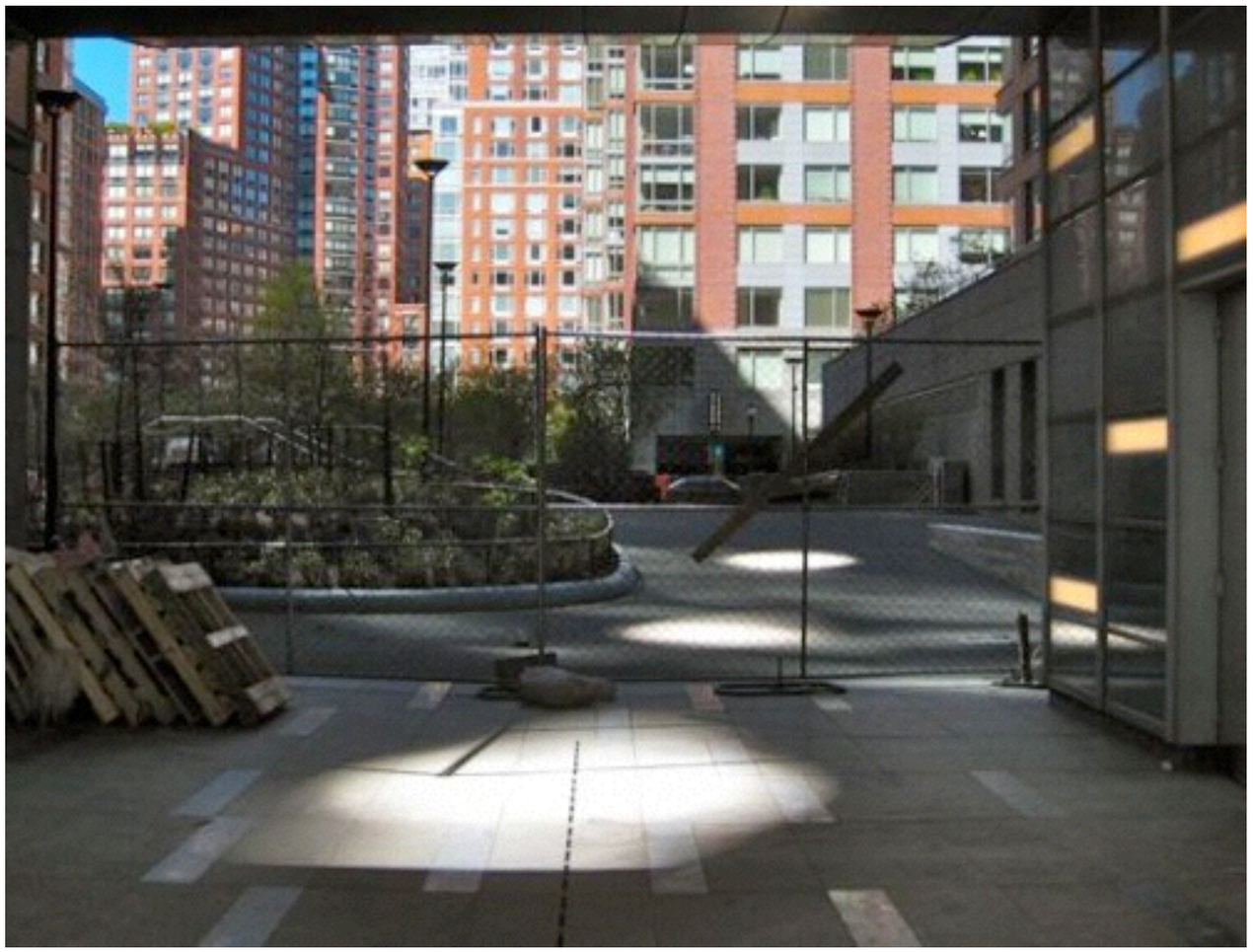


Solar lighting

Solar lighting

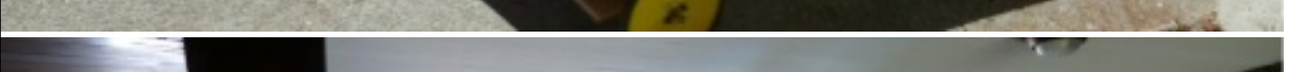


Solar lighting



Solar lighting: Teardrop park heliostats

Carpenter Norris Consulting Inc.



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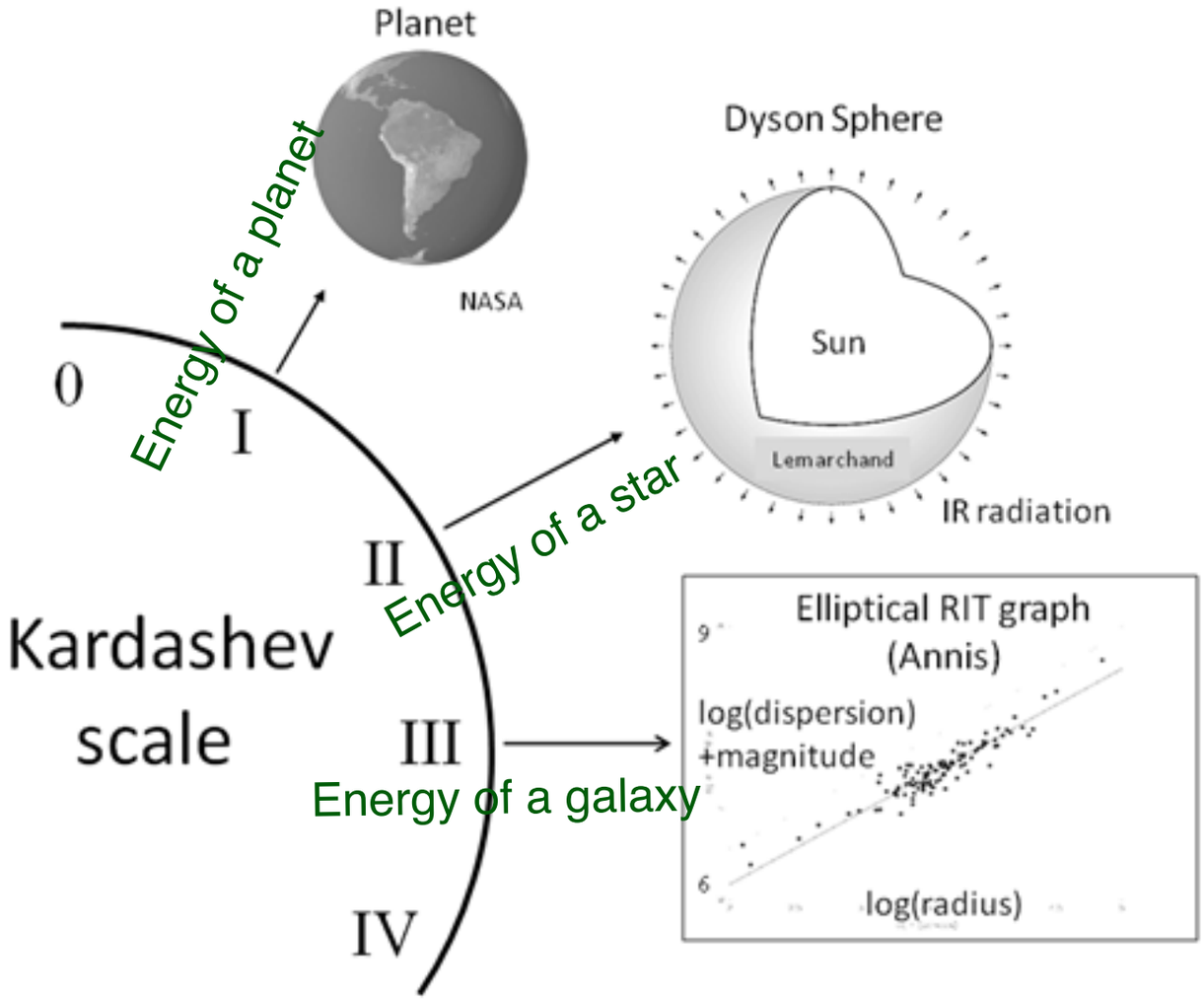
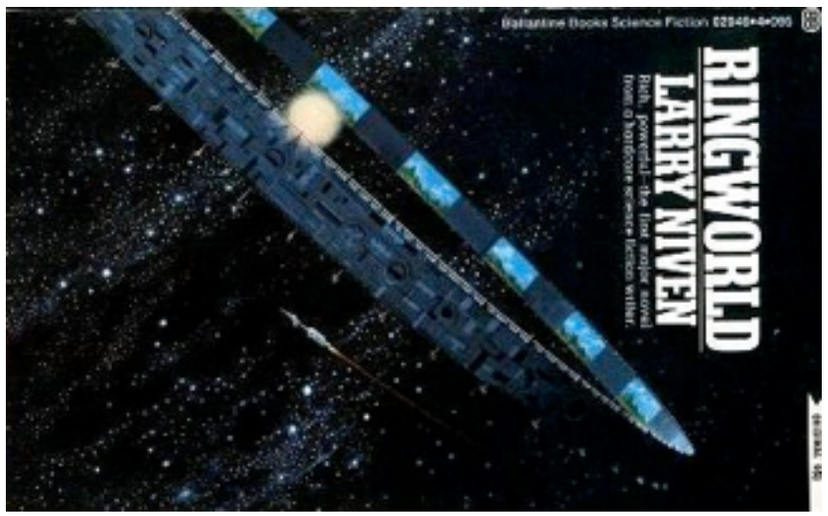
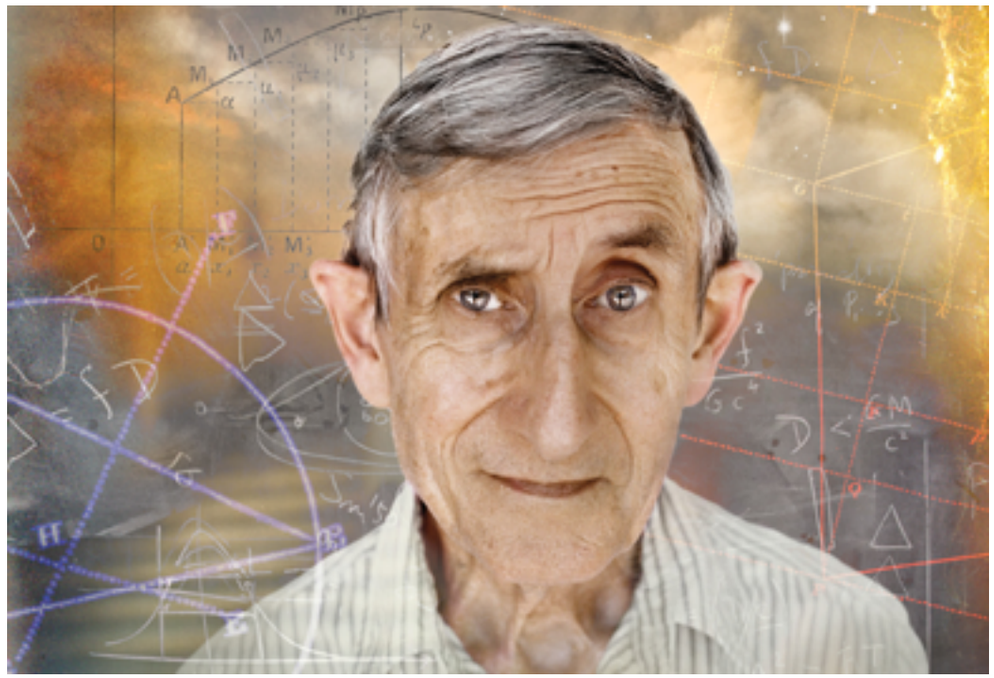


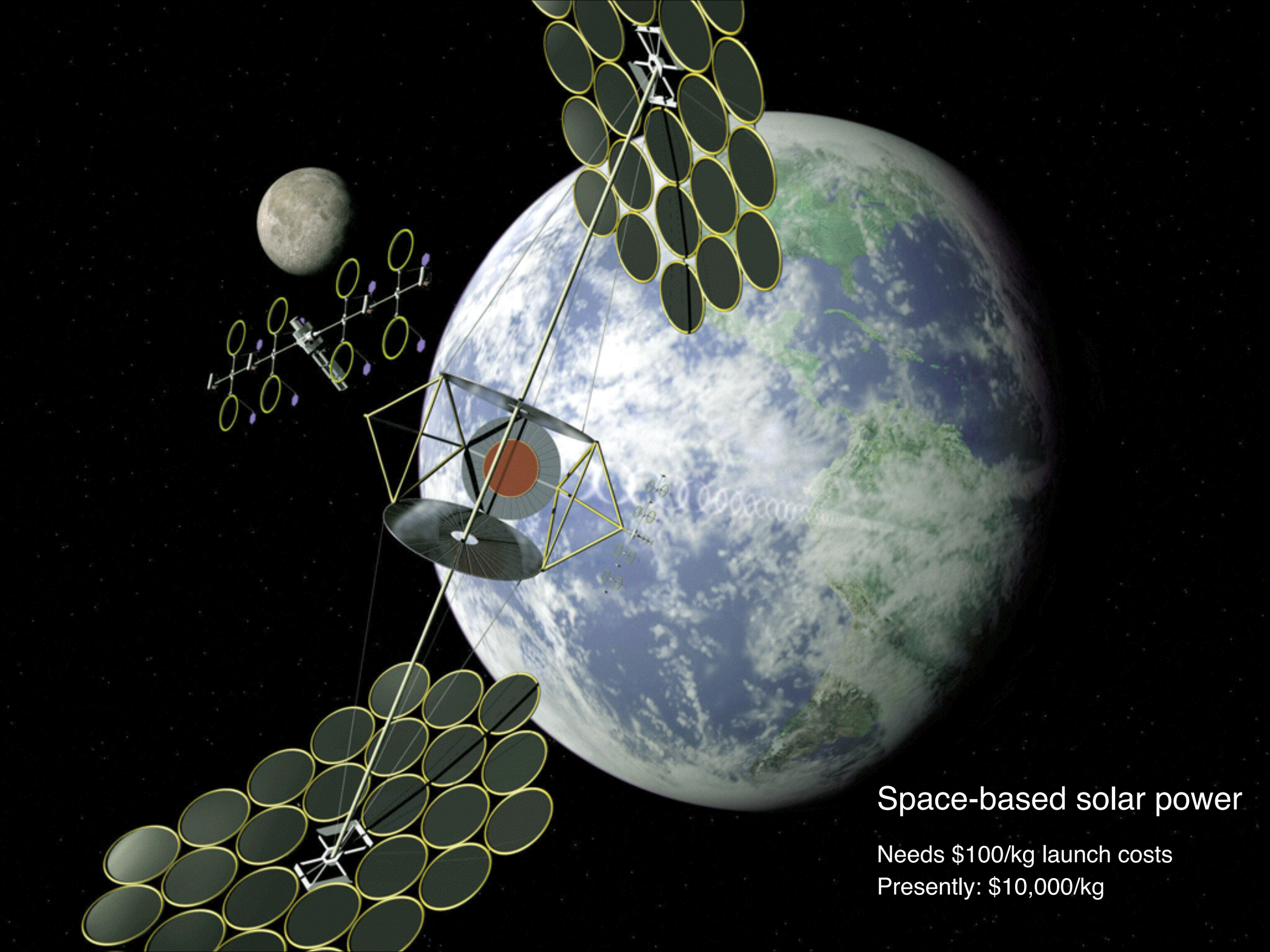
Nikolai Kardashev





Freeman Dyson

Kardashev scale, Dyson swarms (or rings or spheres)



Space-based solar power

Needs $100/kg launch costs
Presently: $10,000/kg

CAPABILITIES & SERVICES

SpaceX offers open and fixed pricing for its launch services. Modest discounts are available for contractually committed, multi-launch purchases. Prices shown below are paid in full standard launch prices for 2013. SpaceX can also offer crew transportation services to commercial customers seeking to transport astronauts to alternate LEO destinations. Please contact sales@spacex.com for details.

FALCON 9 →

FALCON HEAVY →

PRIVATE CREW PROGRAM →

PRICE	FALCON 9	FALCON HEAVY	
PAID IN FULL STANDARD LAUNCH PRICES (2013)	$56.5M	$77.1M Up to 6.4 ton to GTO	$135M Greater than 6.4 ton to GTO

PERFORMANCE	INCLINATION	PERFORMANCE	INCLINATION	PERFORMANCE
LOW EARTH ORBIT (LEO)	28.5°	13,150 kg 28,991 lb	28.5°	53,000 kg 116,845 lb
GEOSYNCHRONOUS TRANSFER ORBIT (GTO)	27°	4,850 kg 10,692 lb	27°	21,200 kg 46,738 lb

$11,700/kg

$6,370/kg

Space-based solar power

Needs $100/kg launch costs

From “**Do the Math**”

I sense that people have a tendency to think space is easy… Once in space, failures cannot be serviced. The usual mitigation strategy is redundancy, adding weight and cost. A space-based solar power system might sound very cool and futuristic, and it may seem at first blush an obvious answer to intermittency, but this comes at a big cost. Among the possibly unanticipated challenges:

- **The gain over the a good location on the ground is only a factor of 3 (2.4× in summer, 4.2× in winter at 35° latitude).**
- It’s almost as hard to get energy back to the ground as it is to get the equipment into space in the first place.
- The microwave link faces problems with transmission through the atmosphere, and also flirts with roasting ducks on the wing.
- Diffraction of the downlink beam, together with energy density limits, means that very large areas of the ground still need to be dedicated to energy collection.

- See more at: http://physics.ucsd.edu/do-the-math/2012/03/space-based-solar-power/#sthash.k4Wv6o77.dpuf