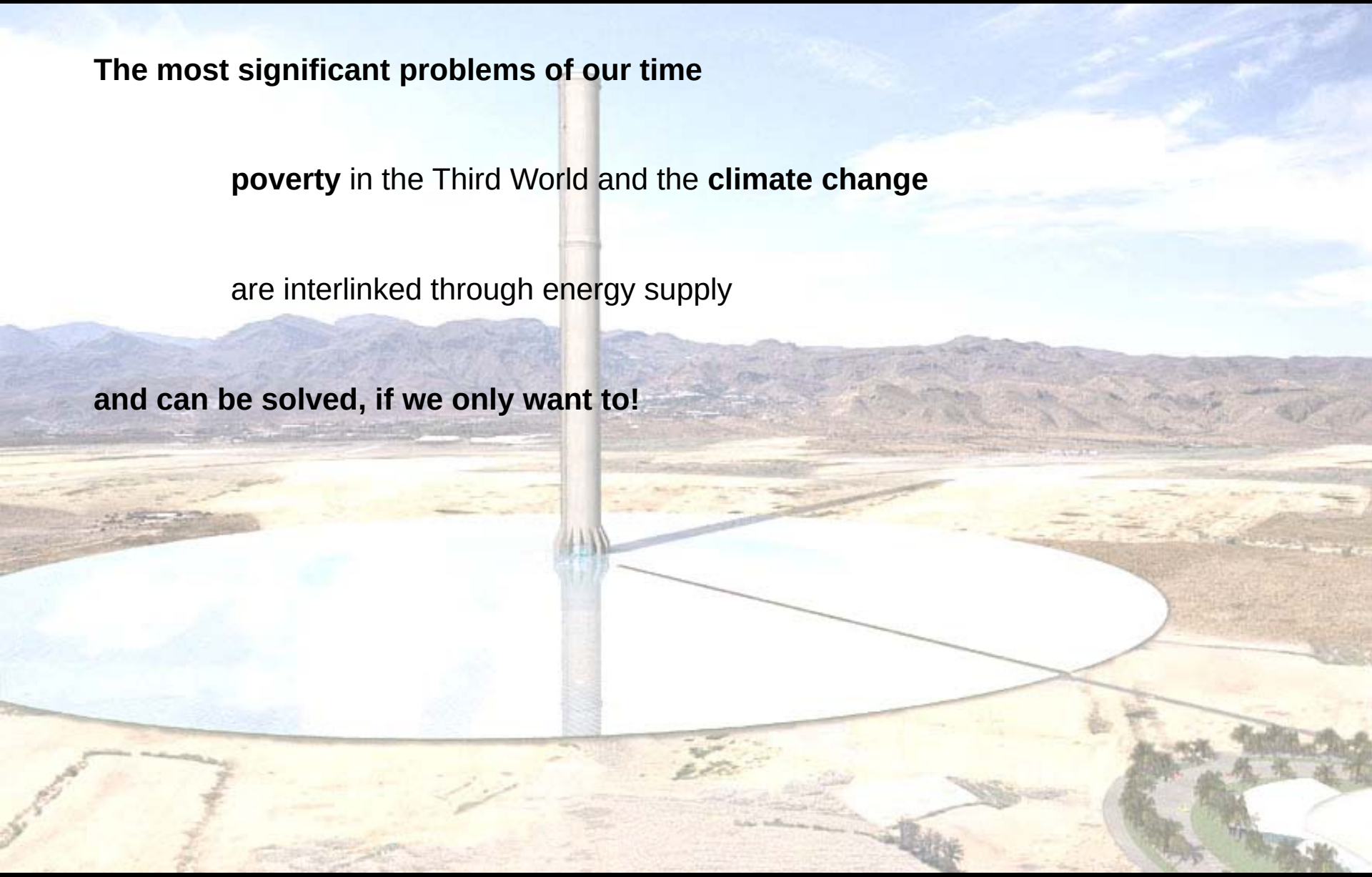
Arbeitskreis Energie (AKE) in der Deutschen Physikalischen Gesellschaft
Bad Honnef, 22. Oktober 2010

Das Aufwindkraftwerk

Jörg Schlaich

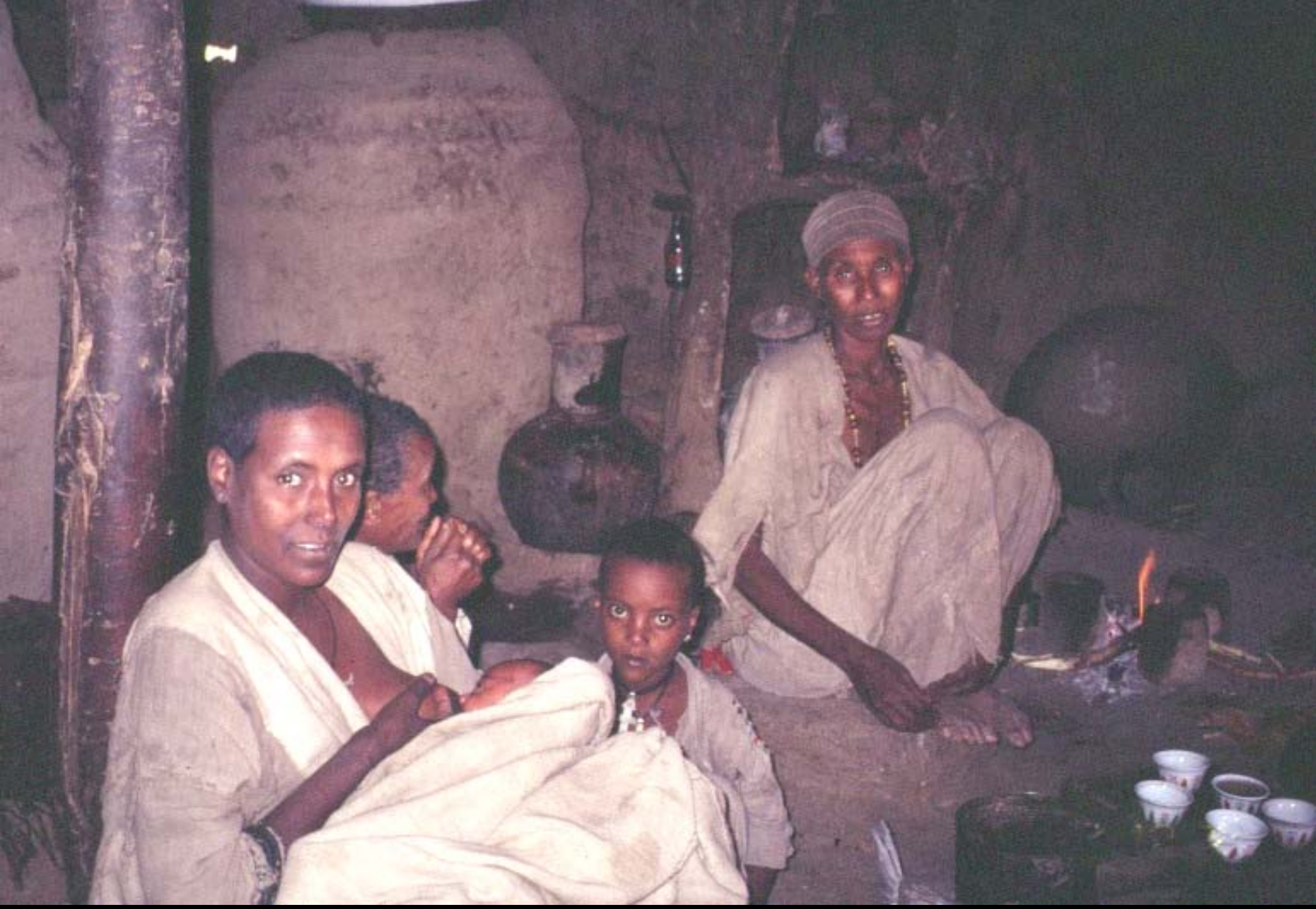


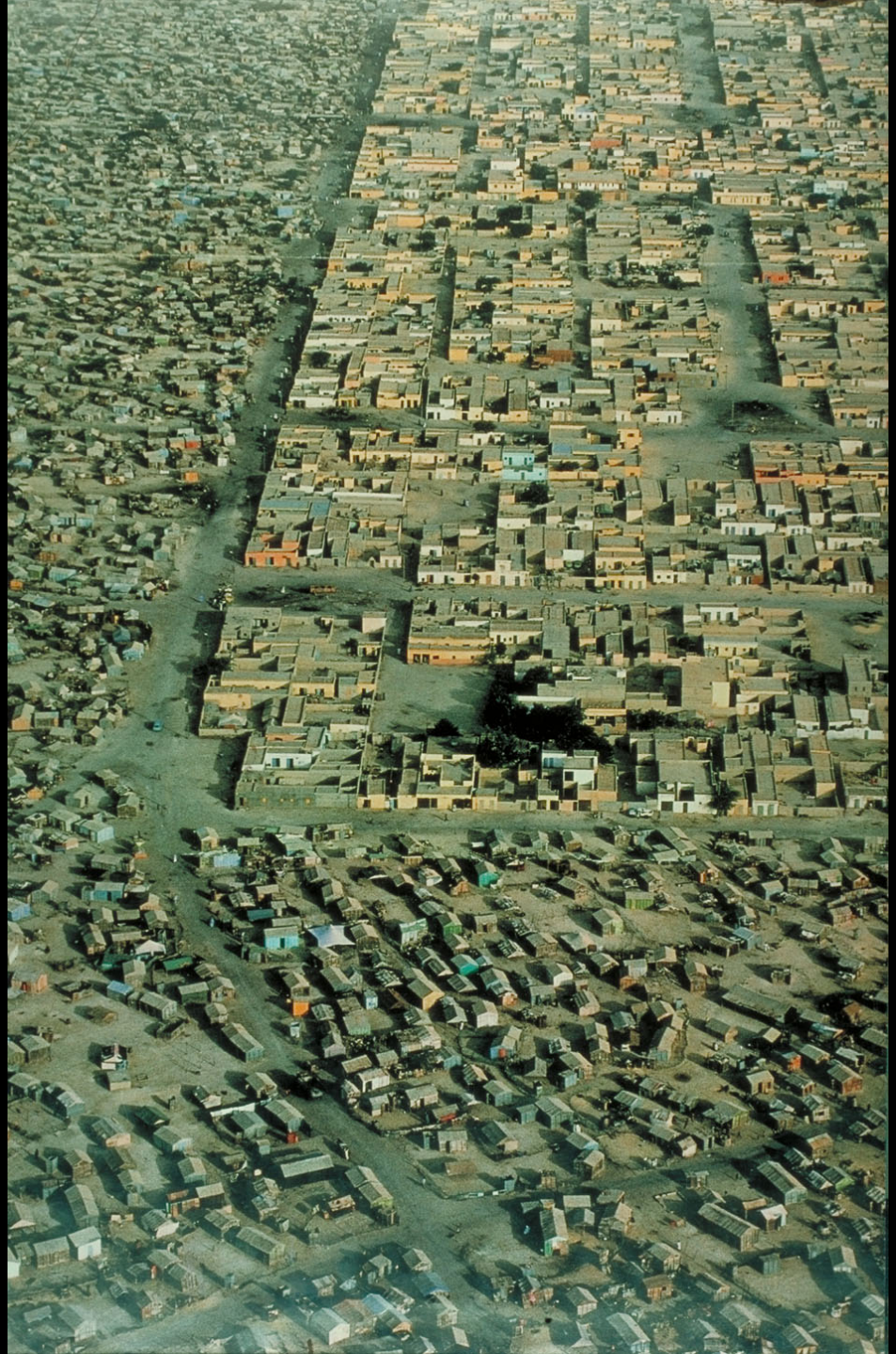
The most significant problems of our time

poverty in the Third World and the **climate change**

are interlinked through energy supply

and can be solved, if we only want to!



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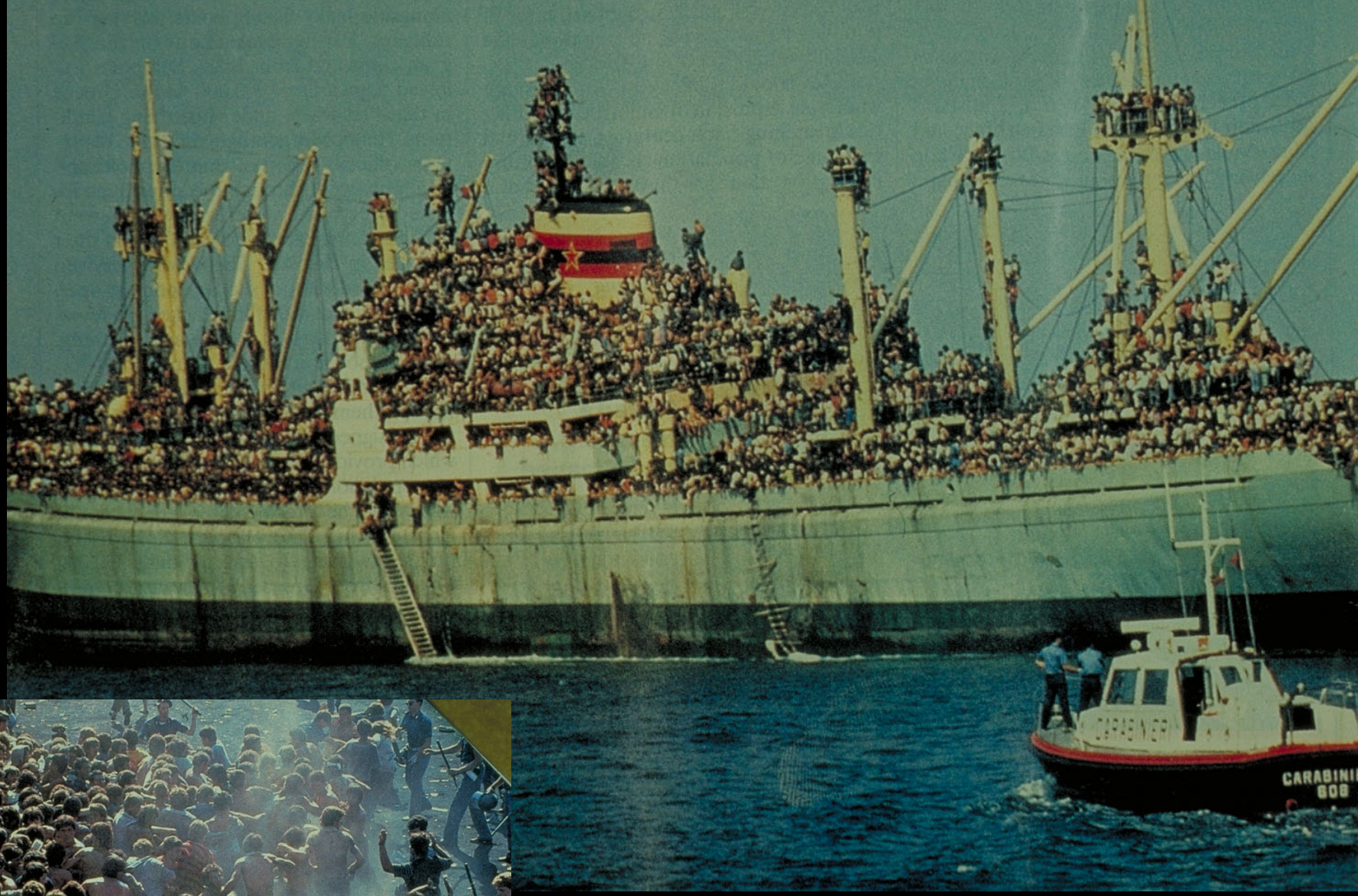
3029


CARABINIERI
808

'The Taliban aren't fighting for religion [but] for money. If they had jobs, they would stop fighting.'

—SHAM SHER KHAN

from: TIME April 20, 2009, p. 21

15 Hindus Guilty in Deaths of 14 Muslims

AHMADABAD, India, Nov. 24 (AP) — A court in the western Indian state of Gujarat on Monday convicted 15 Hindus accused of killing 14 Muslims during Hindu-Muslim riots last year.

Judge C. K. Rane said the 15 were found guilty of a number of charges, including murder. He will sentence them on Tuesday.

The killings took place last year in Ghodasar, when Gujarat was in the grip of fierce riots. The victims, all Muslims, were hiding in the fields when they were hacked to death by a Hindu mob, Judge Rane said.

More than 1,000 people, mostly Muslims, were killed in rioting in Gujarat last year after Muslims set fire to a train carrying Hindu religious pilgrims, killing 60.

Gujarat's Hindu nationalist government and its police were accused of failing to stop attacks on Muslims, and in many cases ignoring Hindu mobs that attacked and killed Muslims and set their homes on fire.

The court on Monday acquitted 48 others who were accused in the case.

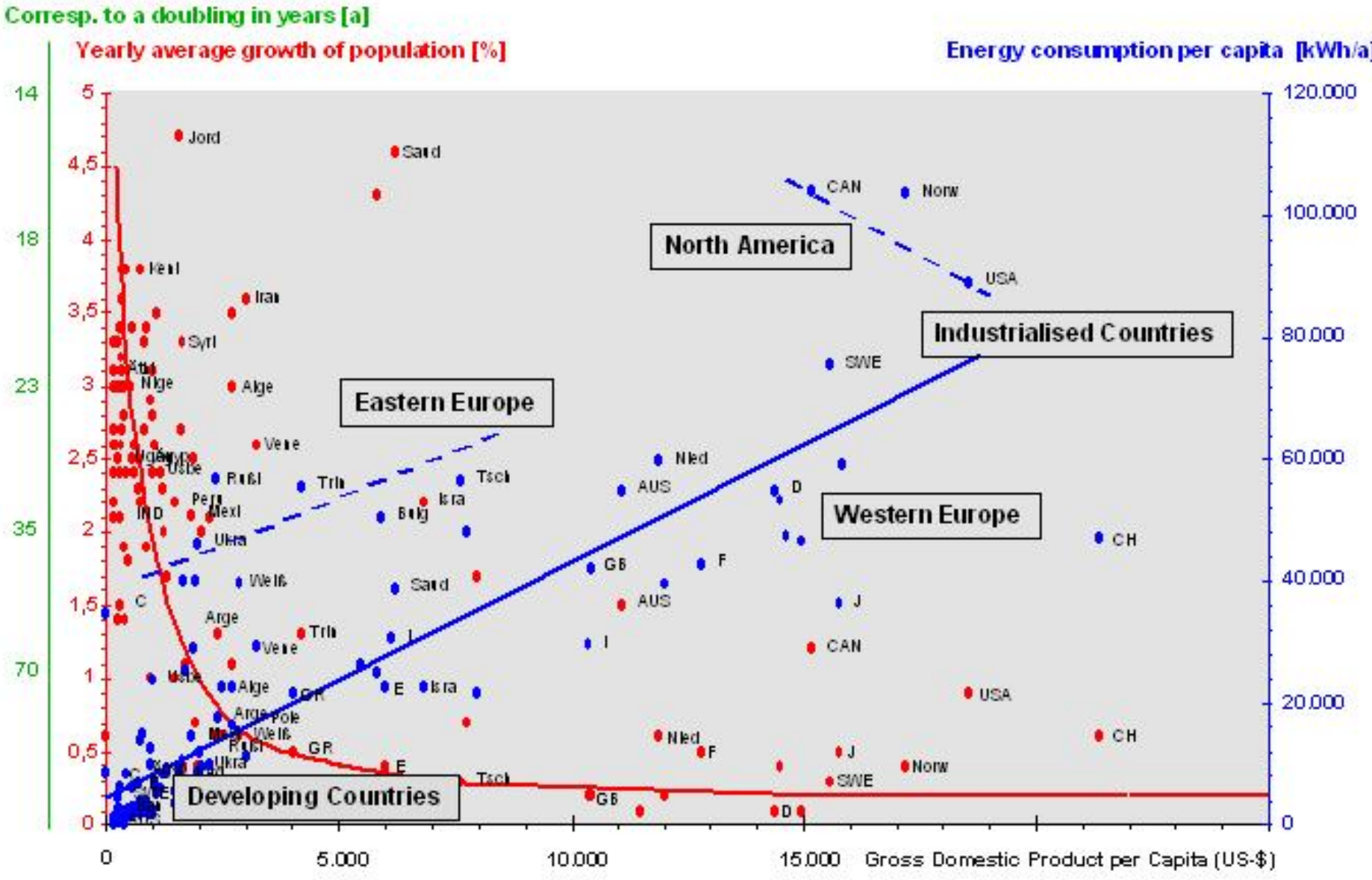
Defense lawyers said they would appeal the verdict, insisting that the killings had broken out after rumors that three Hindus had been murdered by a Muslim mob.

Paresh Dhore, the government's counsel, said 12 of the accused were convicted of murder, while three others were found guilty of lesser offenses.

Villagers said that a mob of nearly 7,000 people surrounded Ghodasar from three sides before the killings.

The maimed and dismembered bodies of the victims were found strewn in the fields near Ghodasar, said a representative of a nongovernmental organization, the Citizen's Tr[illegible]

Energy consumption and population growth in a country as a function of its per capita gross domestic product



3 Poor countries – rich countries
Income distribution

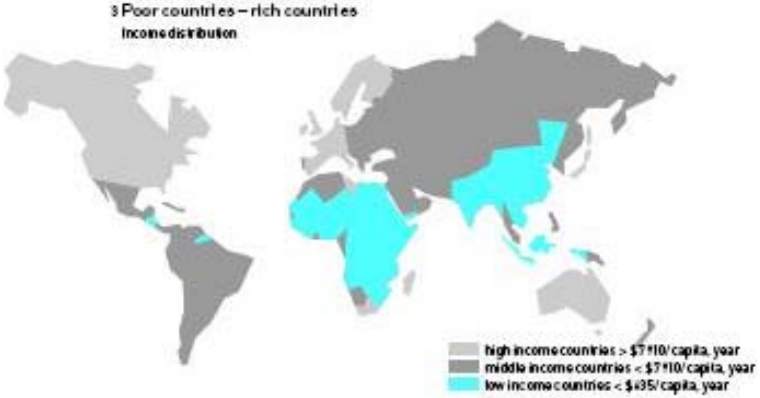
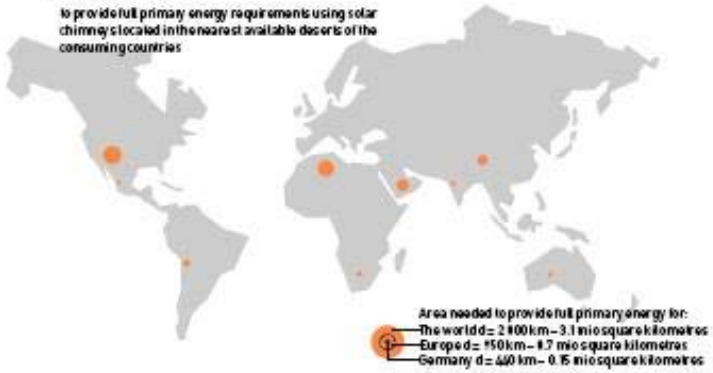
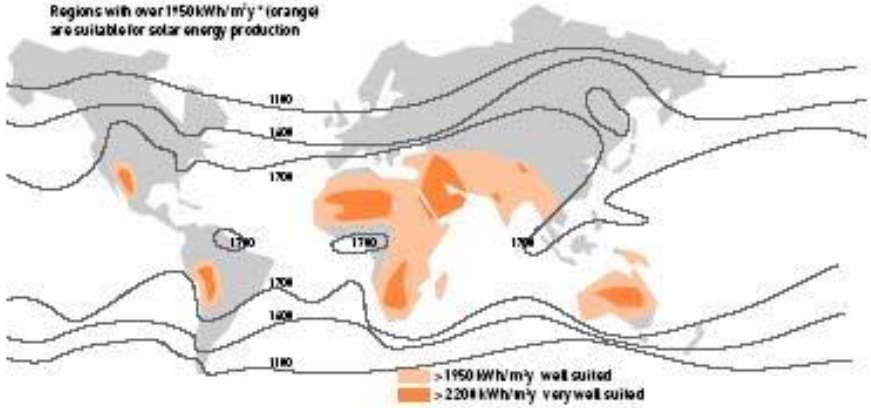


Fig. 1 - 3 are based on World Bank data, Washington D.C., USA, 1992.

5 Necessary area
to provide full primary energy requirements using solar chimneys located in the nearest available deserts of the consuming countries

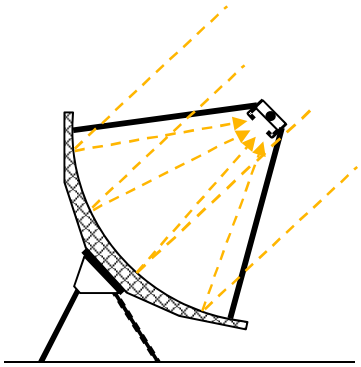


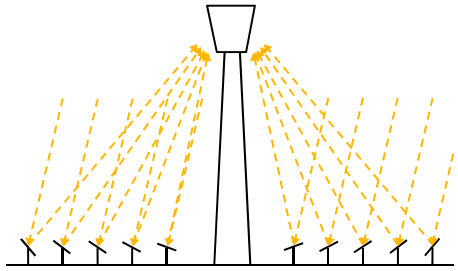
4 Global distribution of solar radiation
Regions with over 1*50 kWh/m²y * (orange) are suitable for solar energy production

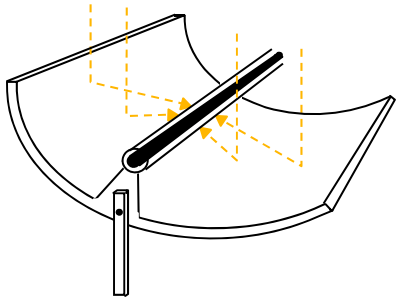


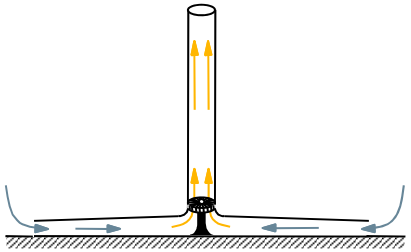
Solar Thermal Power Plants

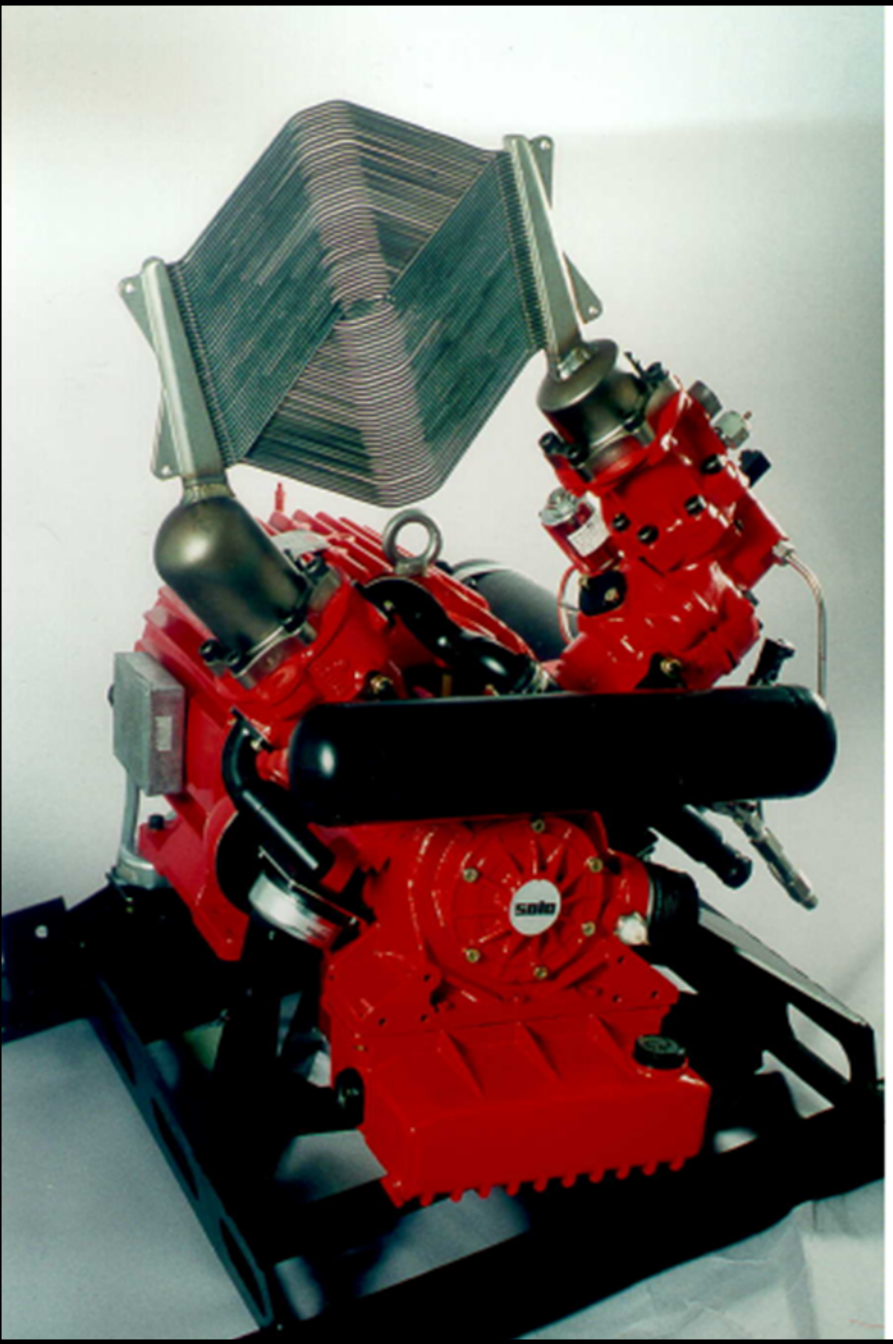
- Solar Thermal Power Plants
  - Point focusing
    - Dish/Stirling-Systems
    - Central Receiver Systems
  - Line focusing
    - Parabolic Trough Plants
  - Non focusing
    - Solar Chimney

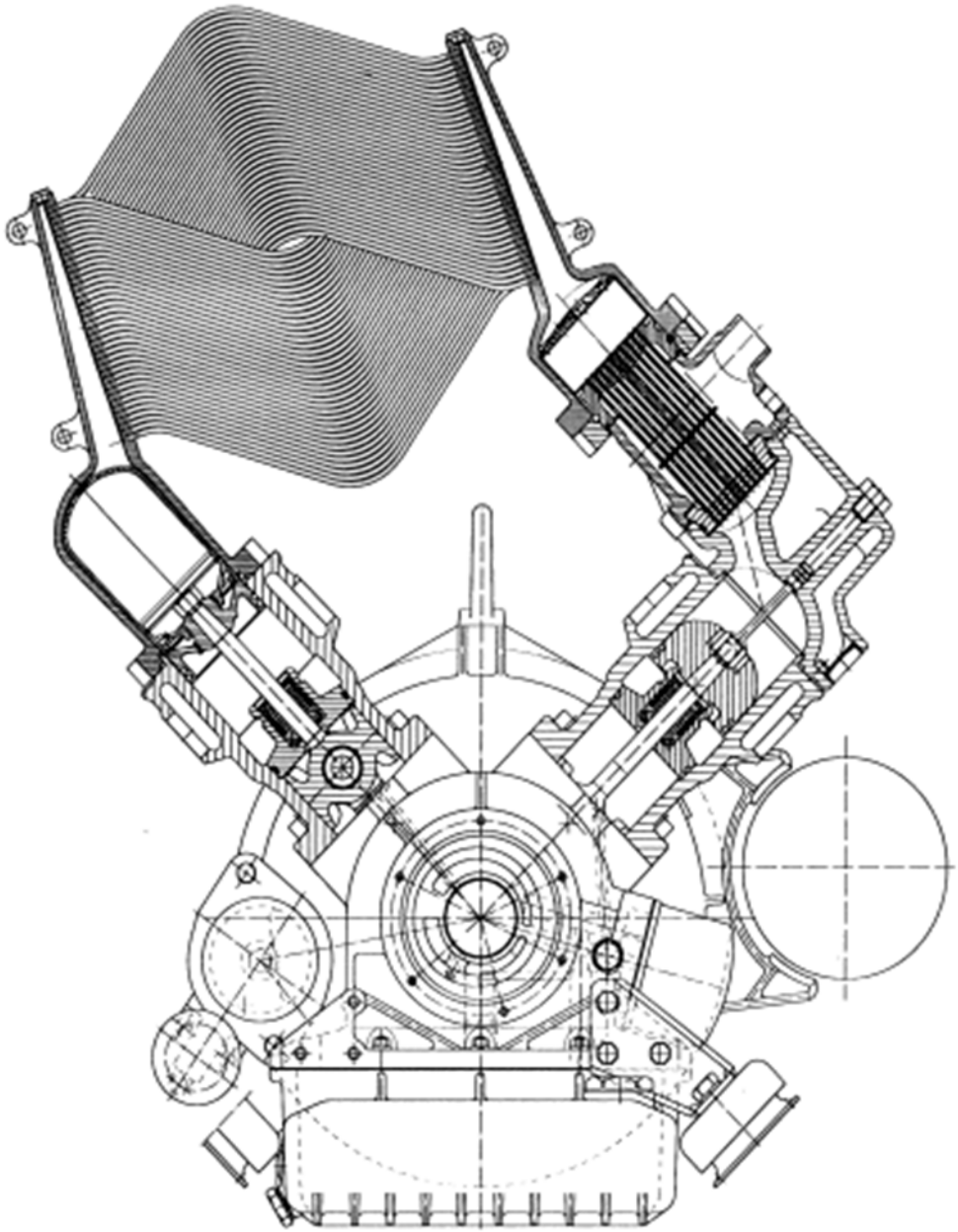


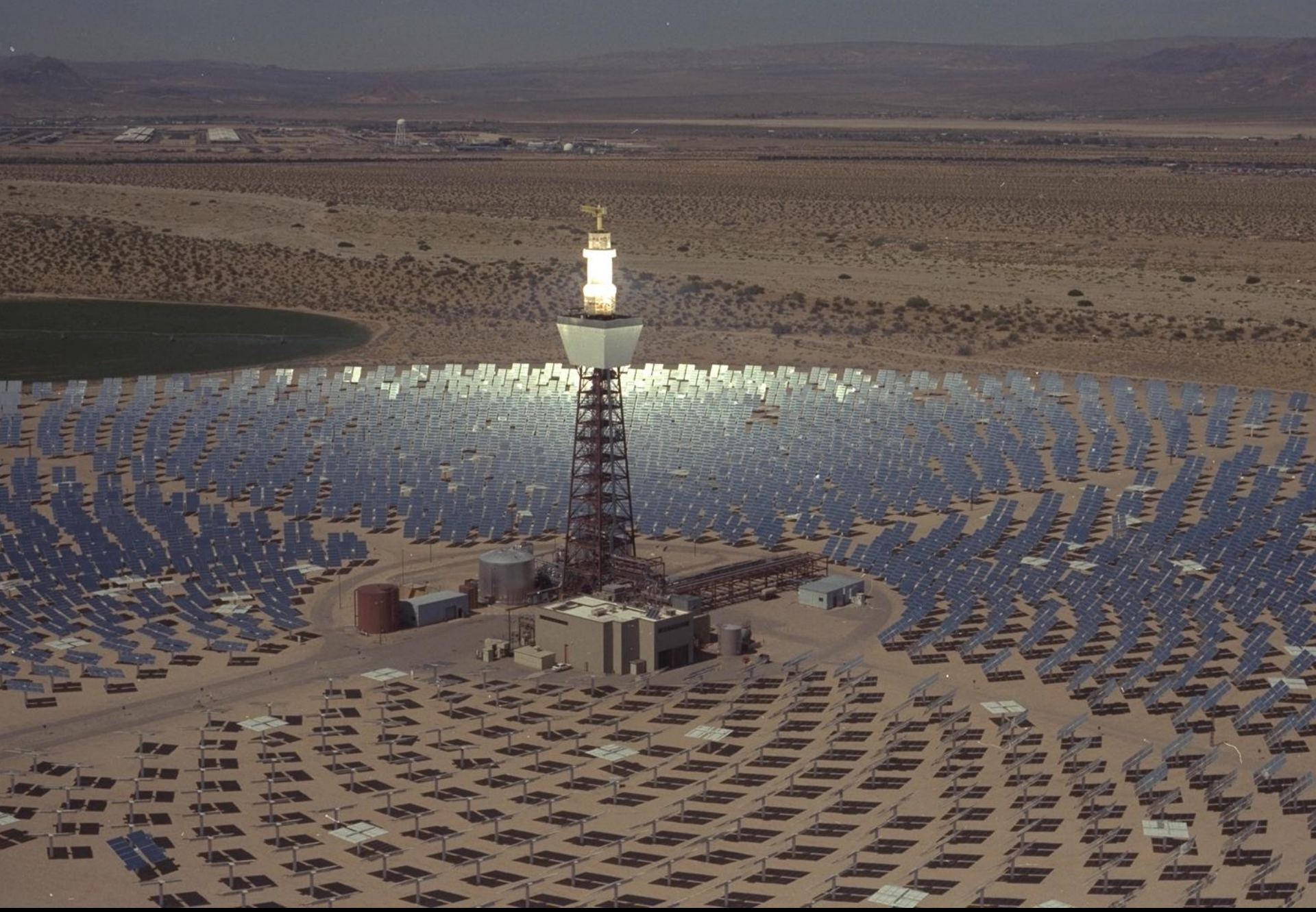


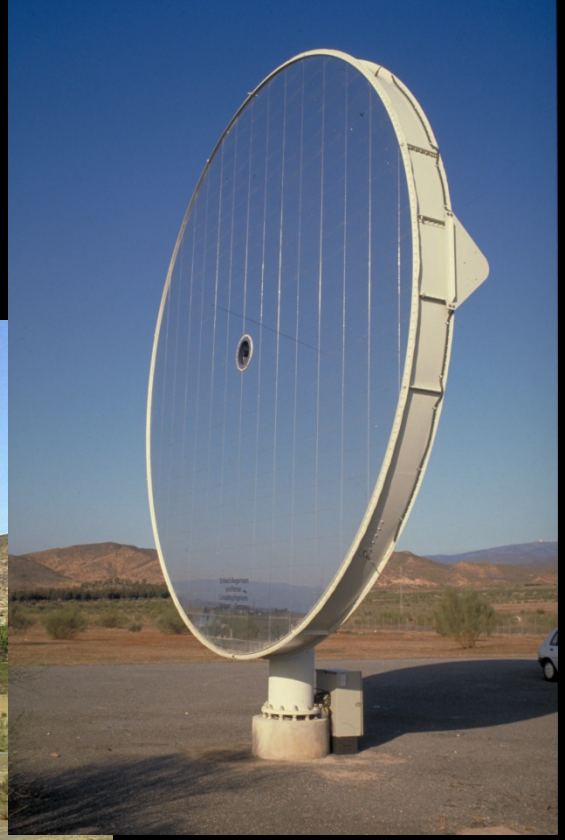


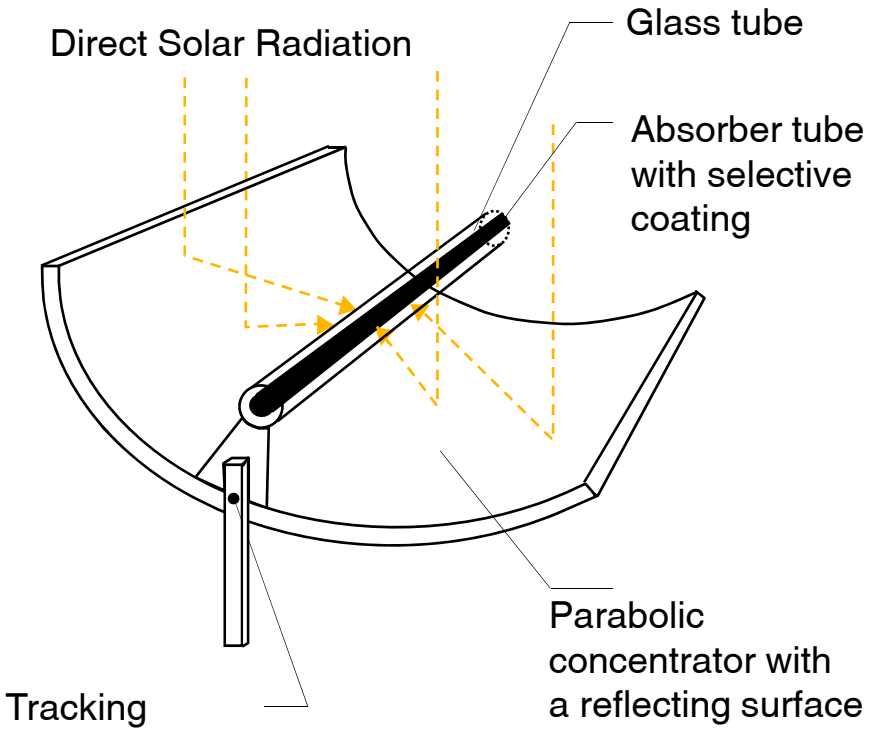


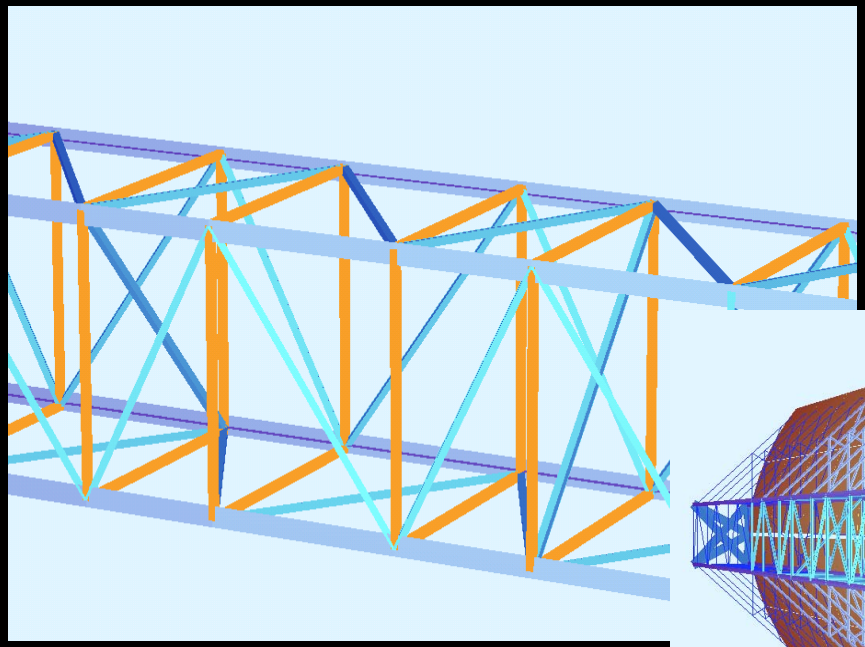


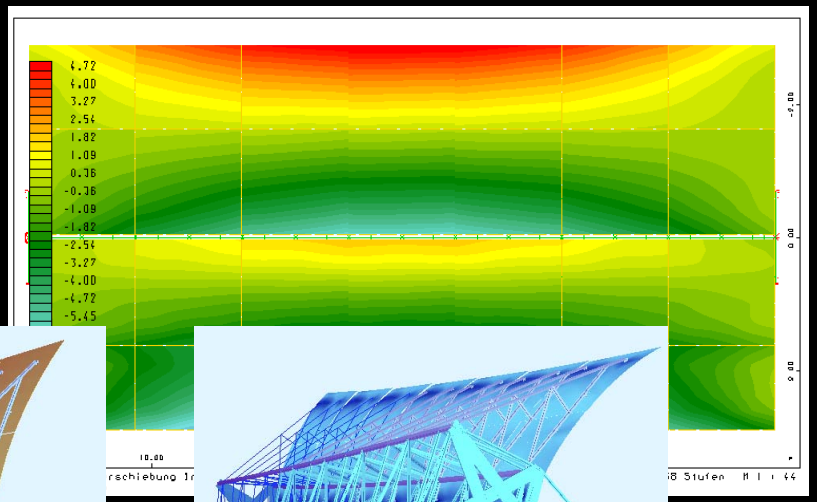


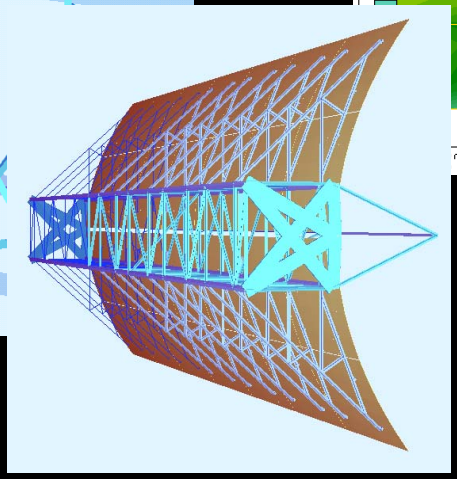


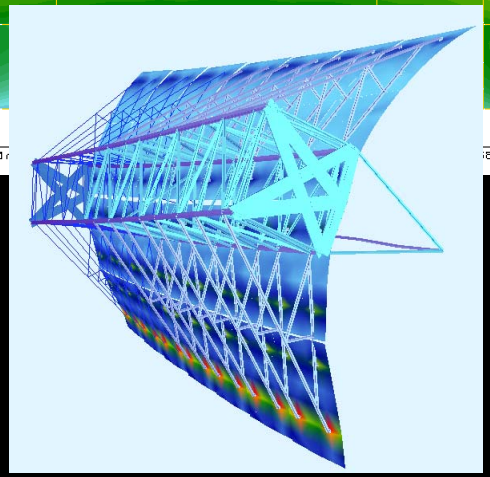



Direct Solar Radiation
Glass tube
Absorber tube with selective coating
Parabolic concentrator with a reflecting surface
Tracking



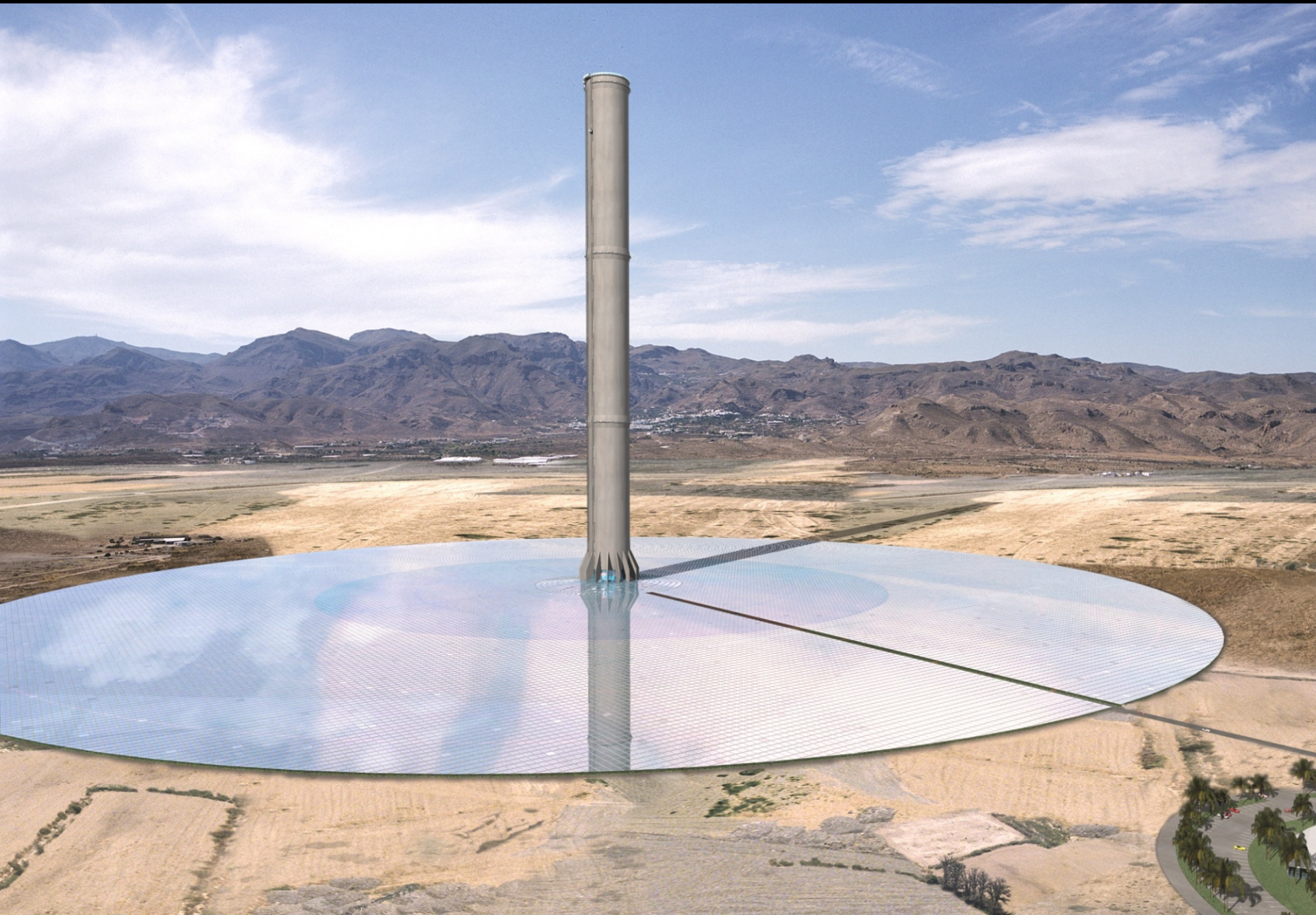

4.72
4.00
3.27
2.54
1.82
1.09
0.36
-0.36
-1.09
-1.82
-2.54
-3.27
-4.00
-4.72
-5.45

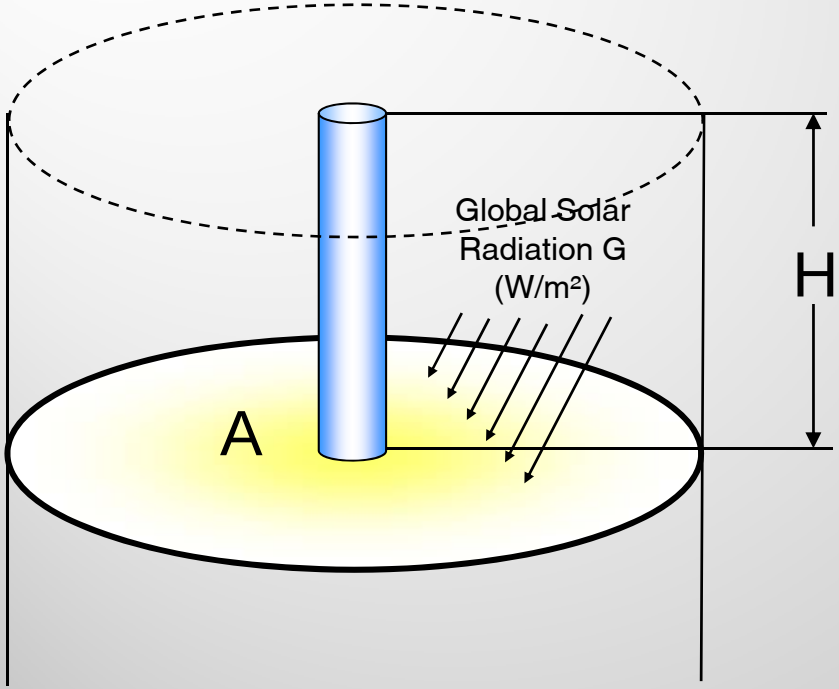


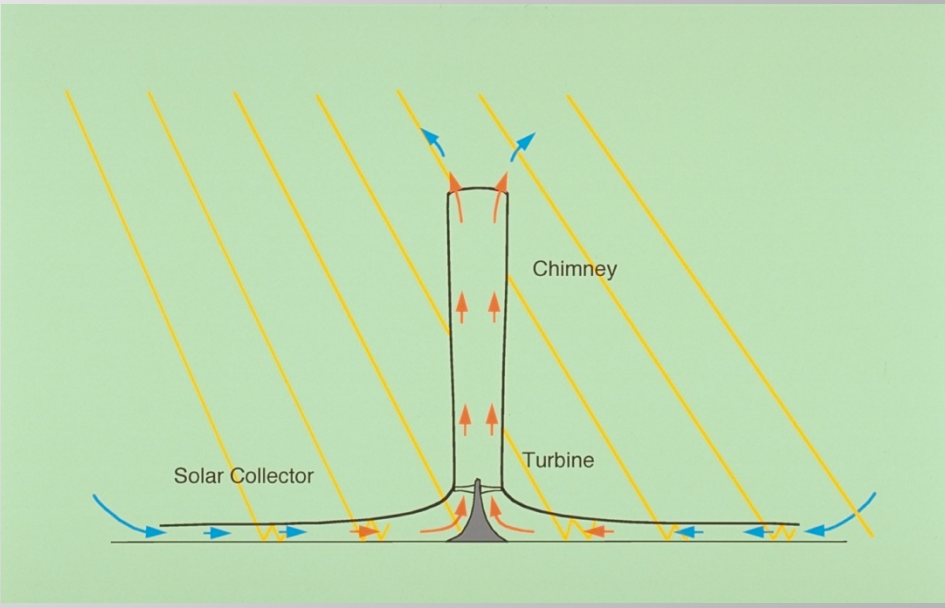


- Nominal Power: 50 MW
- Storage: 7.5 h full load, Salt
- Plant size: 1.500 m x 1.300 m
- Aperture Area: 510. 200 m²
- No. of Collectors: 7.488
- Yearly Energy: 178 GWh/year

Partner:
COBRA; SENER; FlagSol; sbp

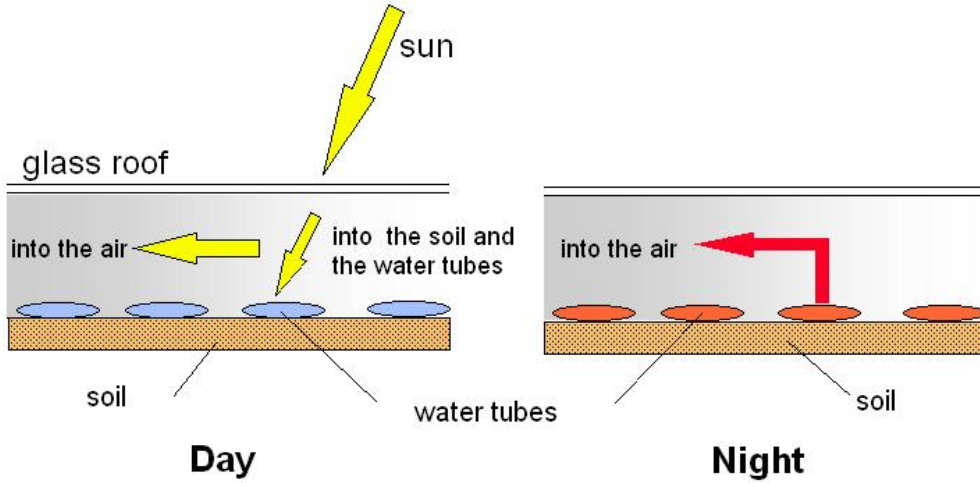


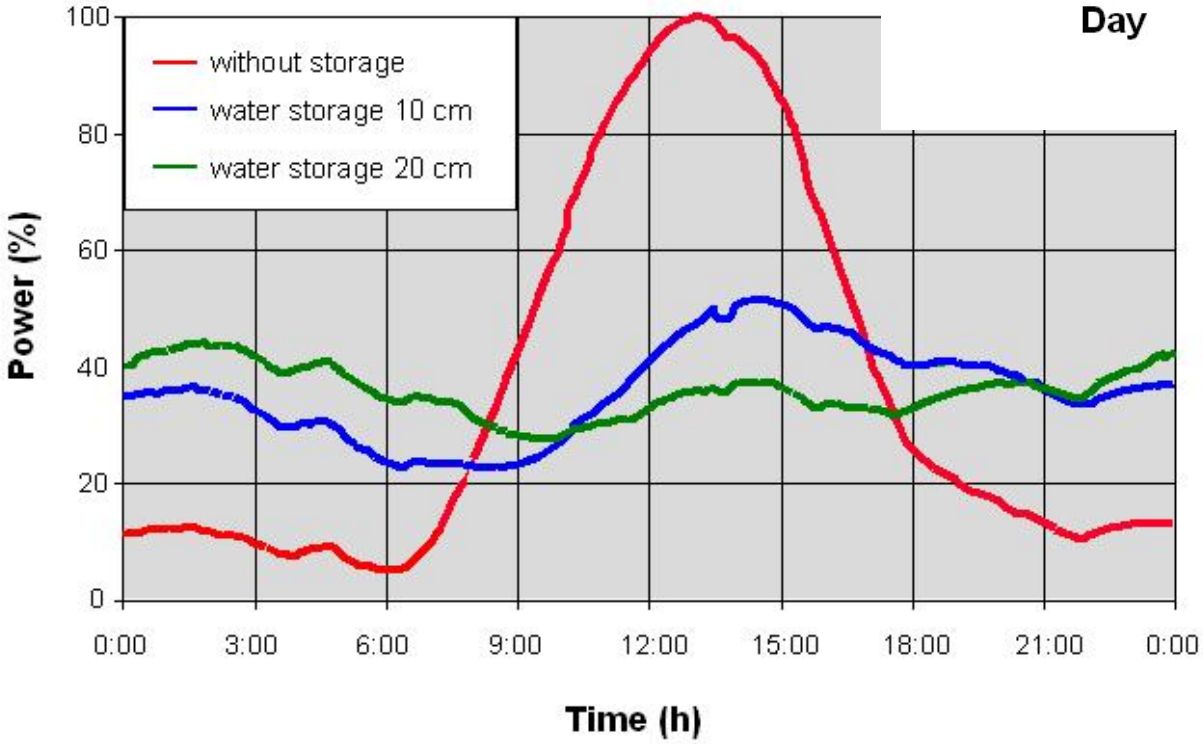


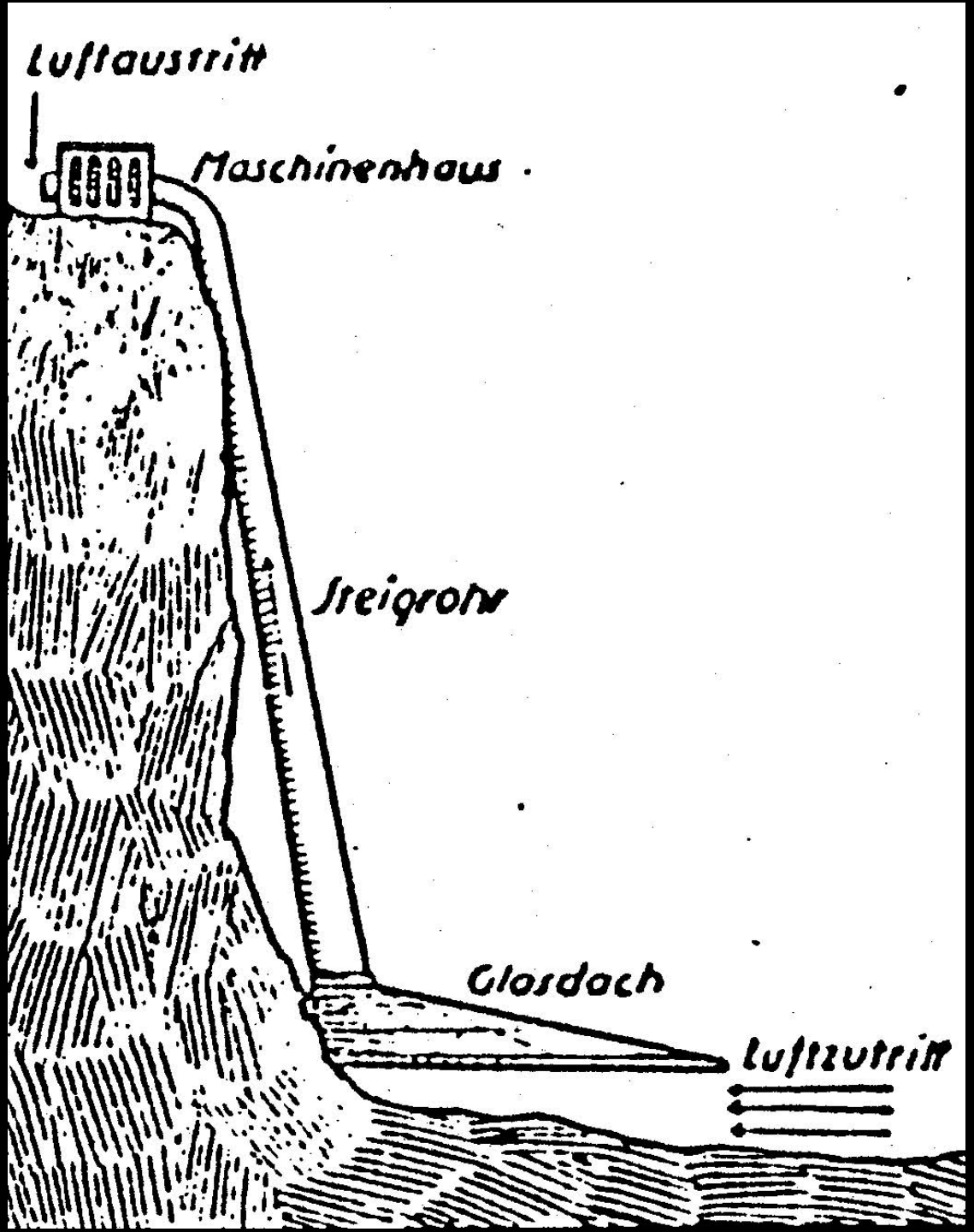


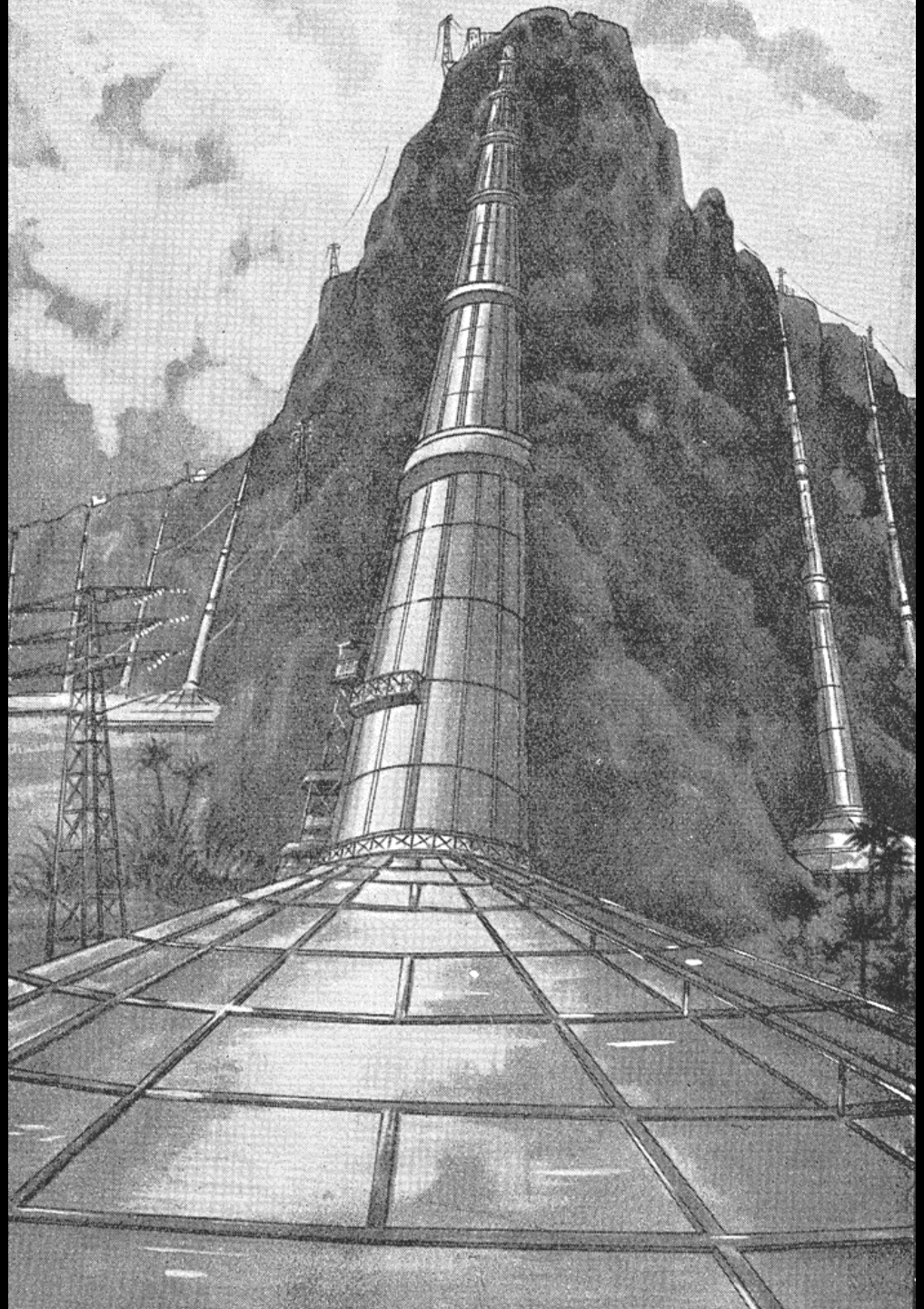
$$P_{el} \sim A \times H$$

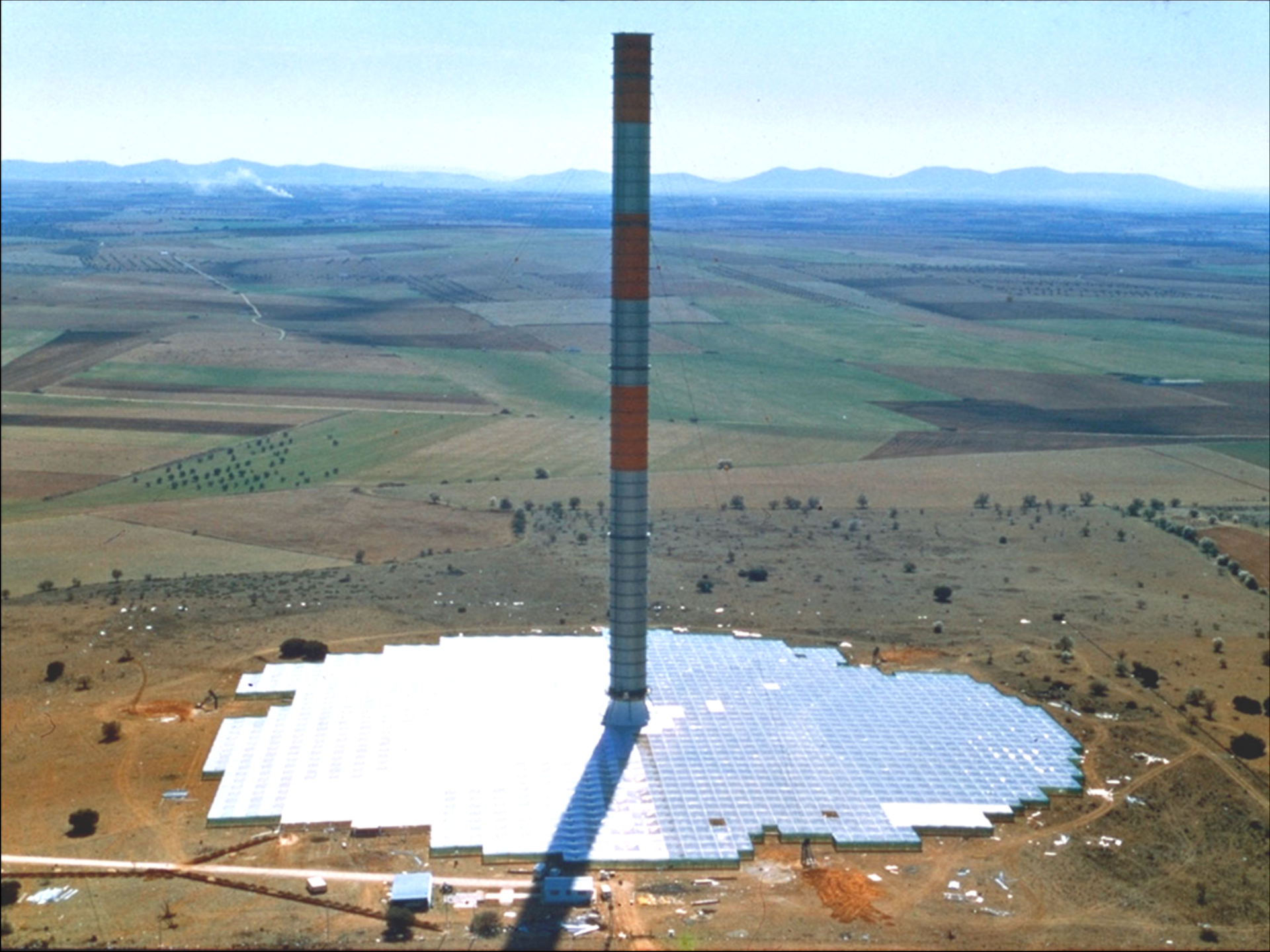
Leistung	**MW**	**5**	**30**	**200**
Turmhöhe	m	550	750	1.000
Turmdurchmesser	m	45	70	120
Kollektordurchmesser	m	1.250	2.950	7.000


sun
glass roof
into the air
into the soil and
the water tubes
soil
water tubes
into the air
soil
Day
Night

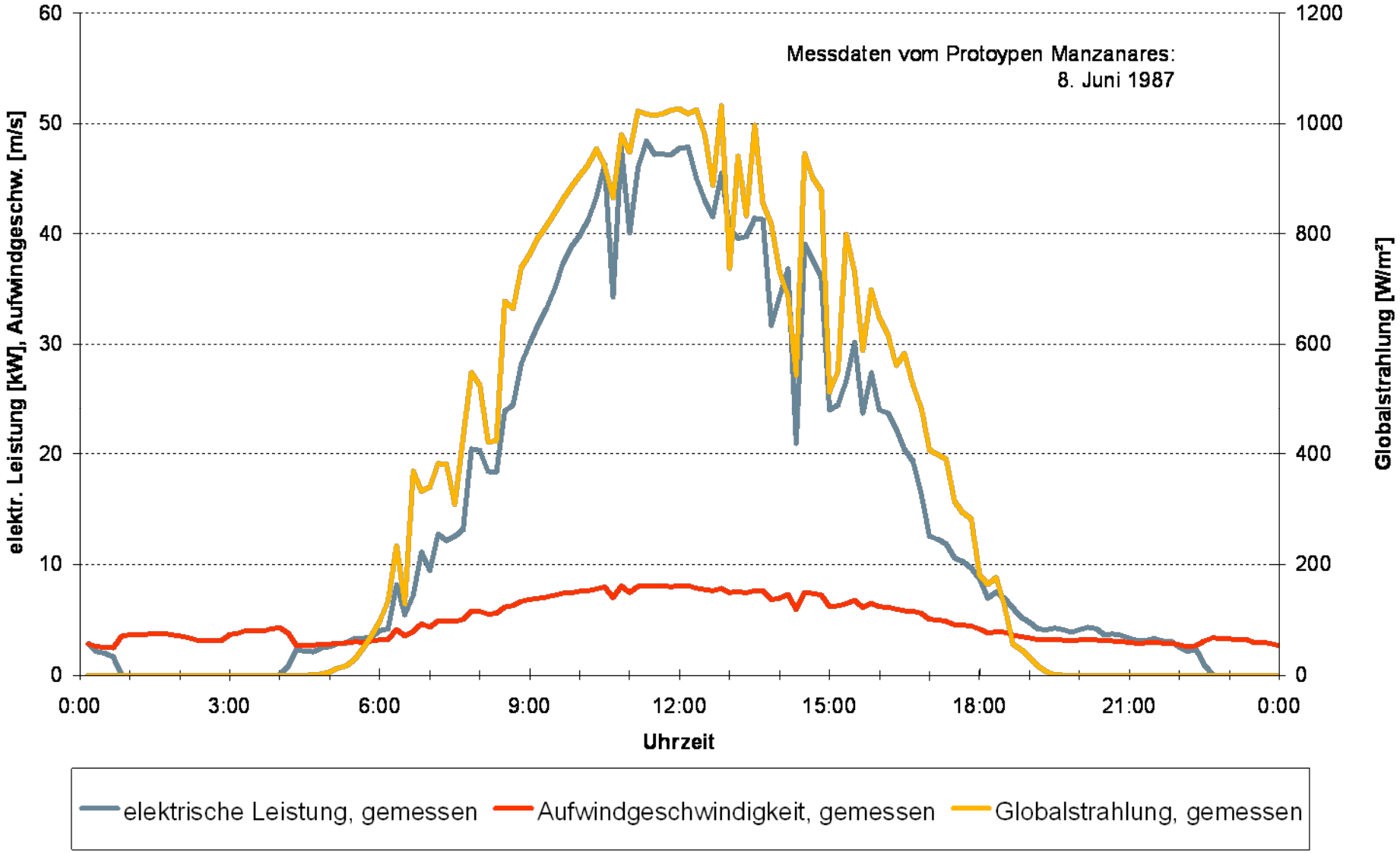

without storage
water storage 10 cm
water storage 20 cm
Power (%)
100
80
60
40
20
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time (h)

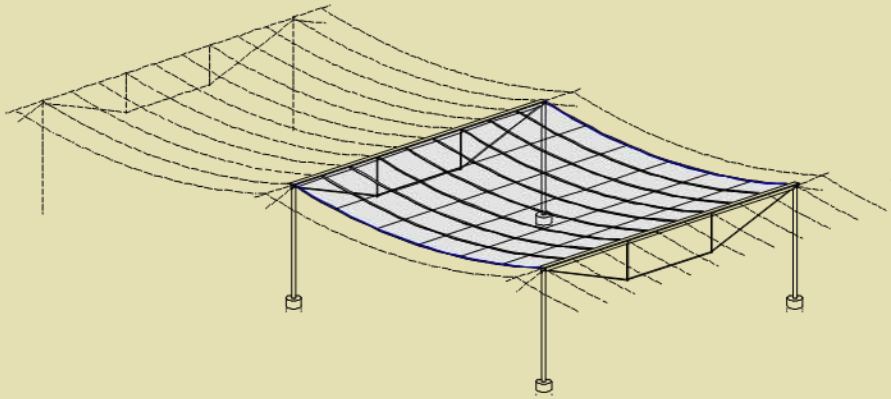

Luftaustritt
Maschinenhaus
Steigrohr
Glasdach
Luftzutritt

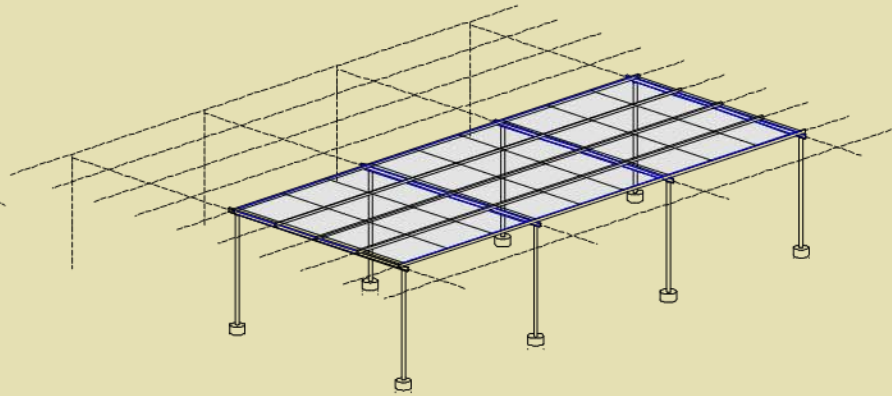


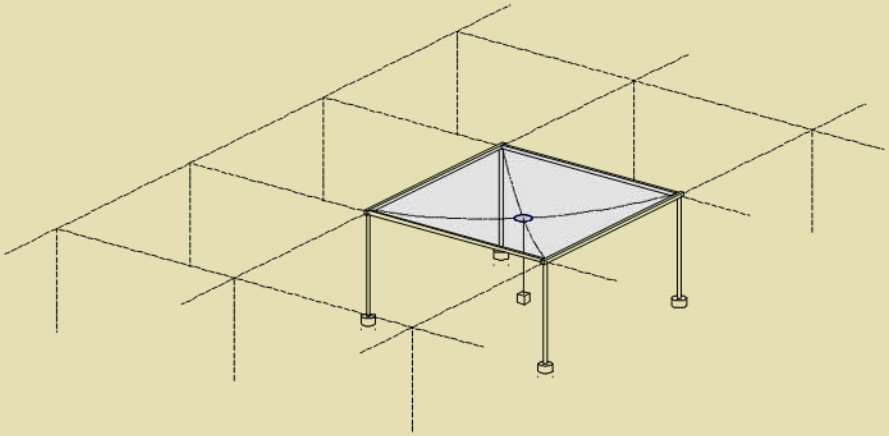


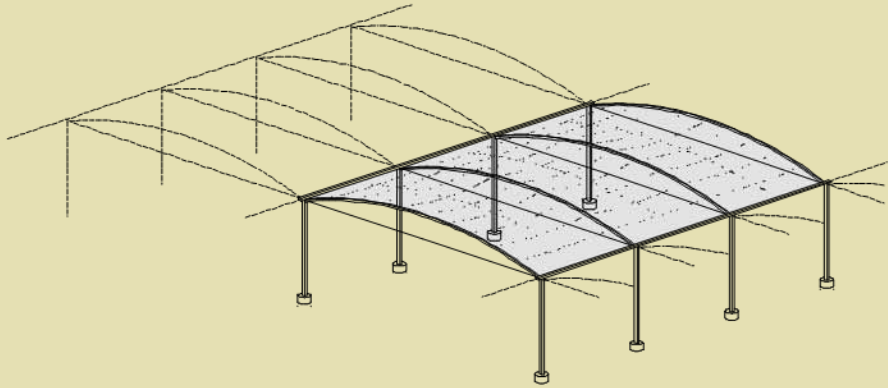
Measurements Manzanares

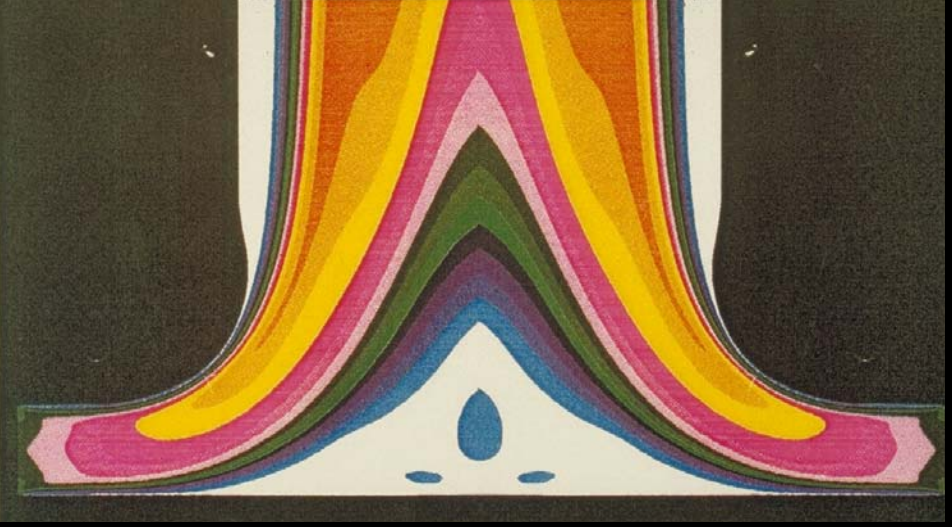


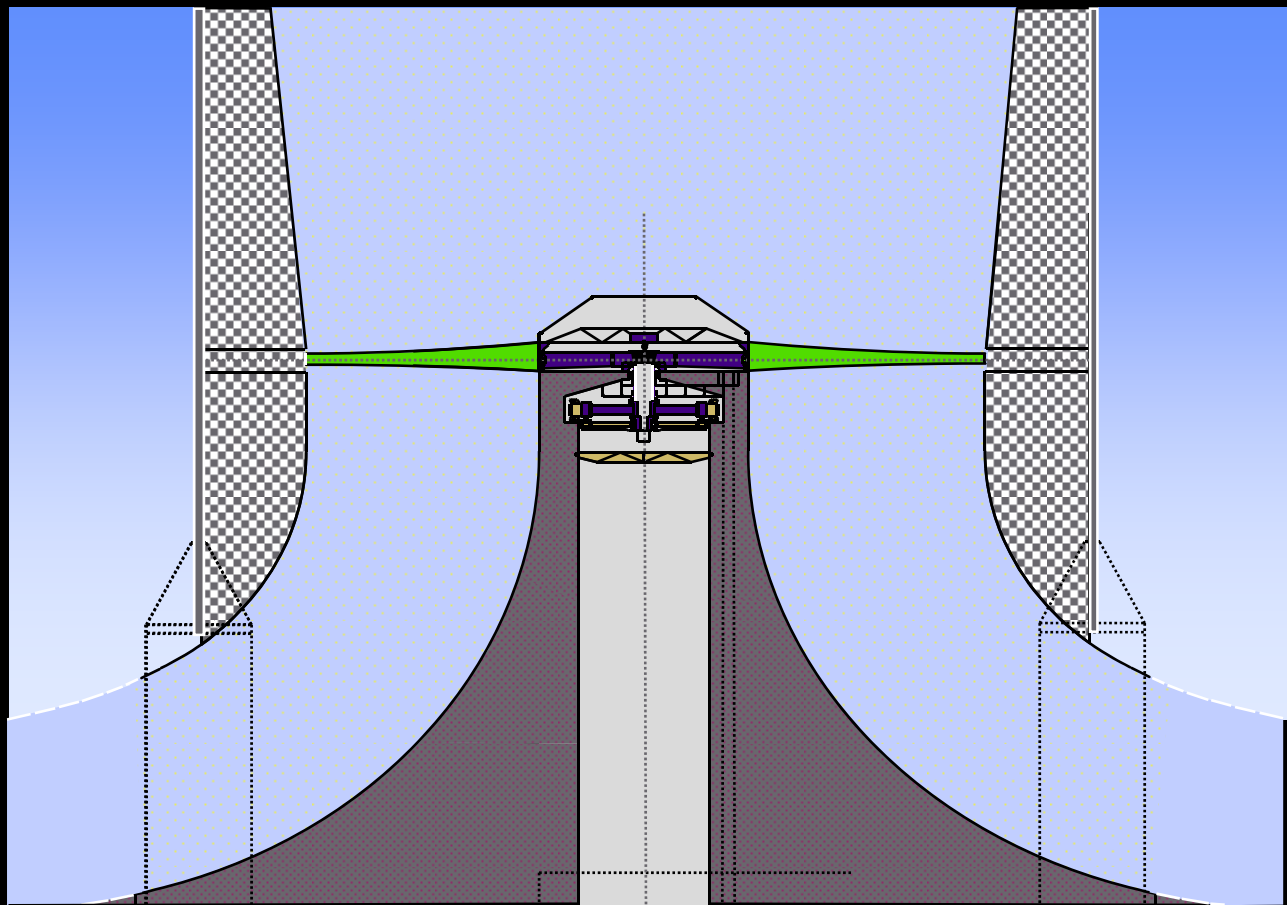


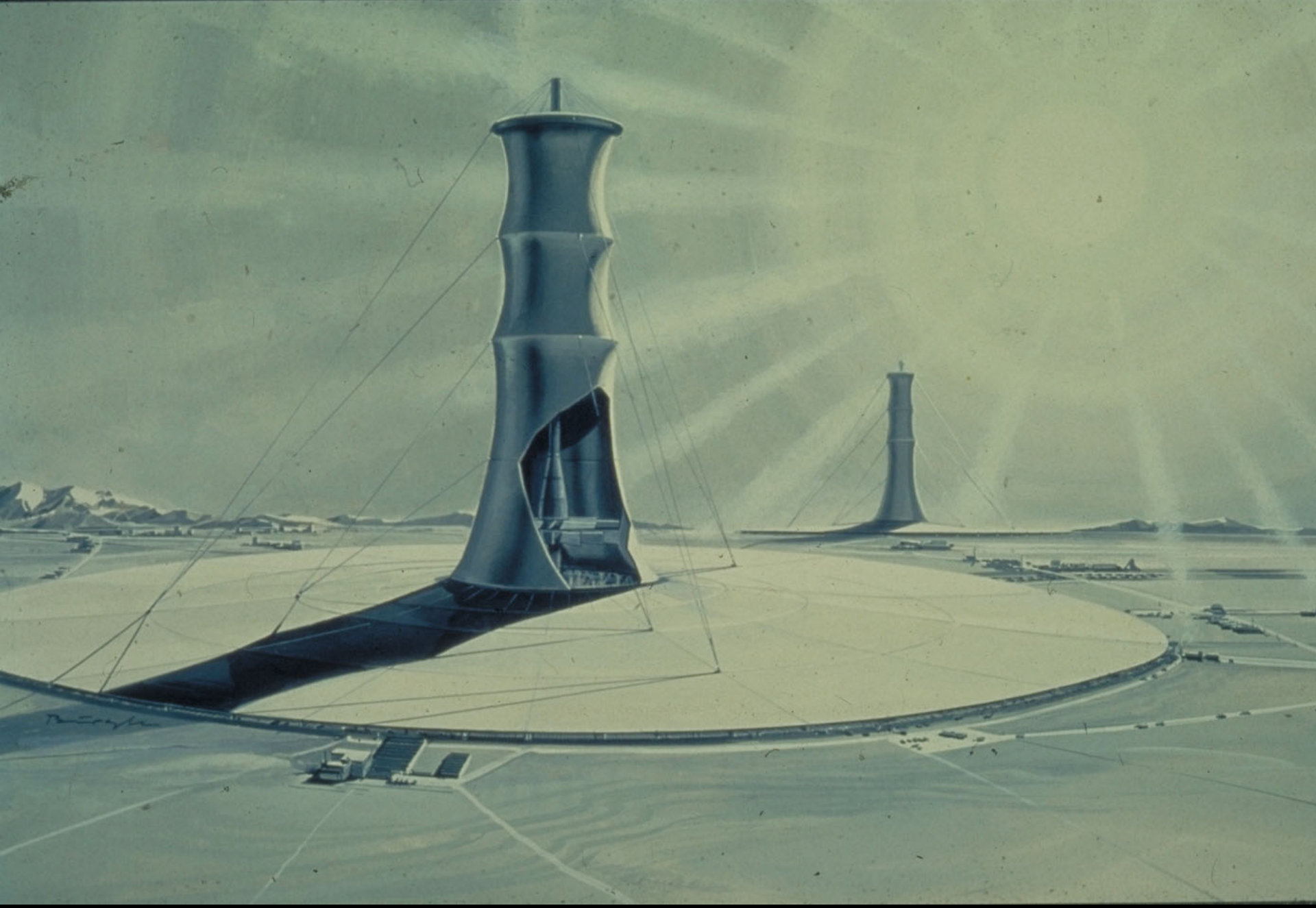


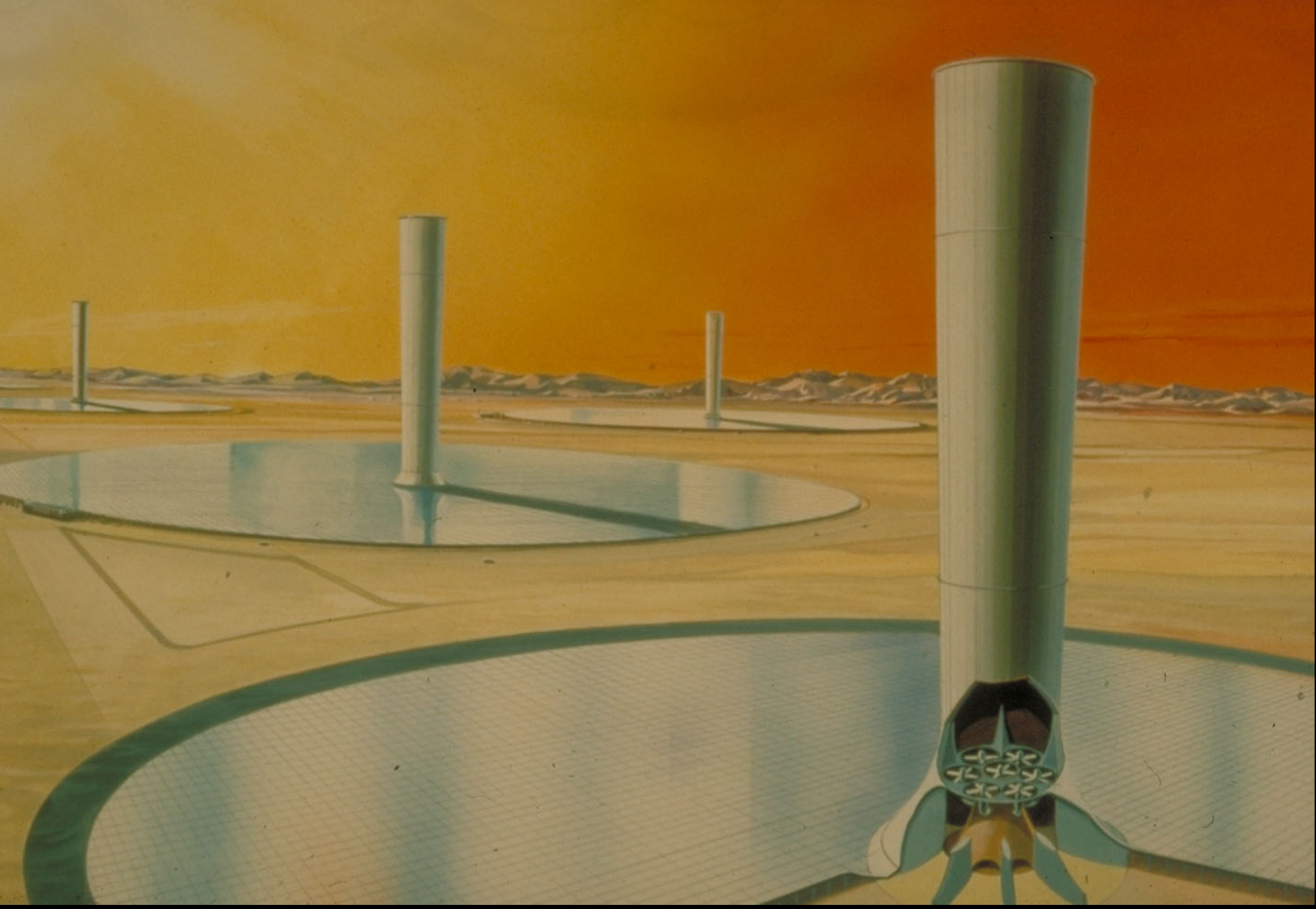


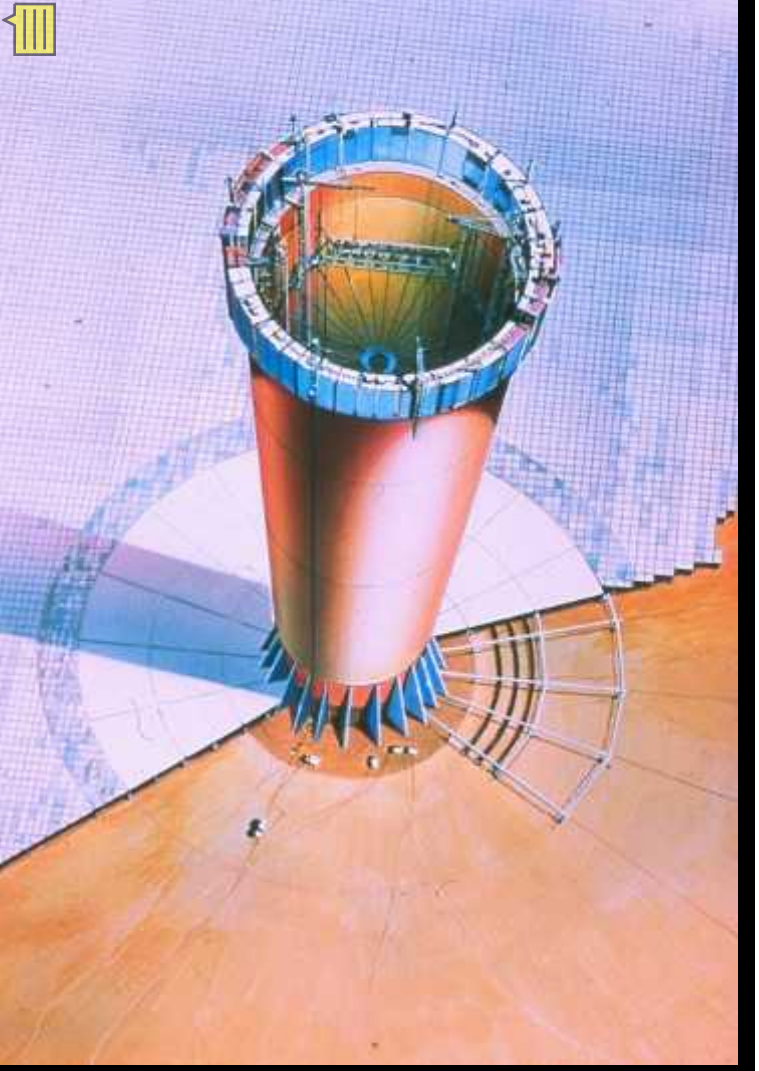


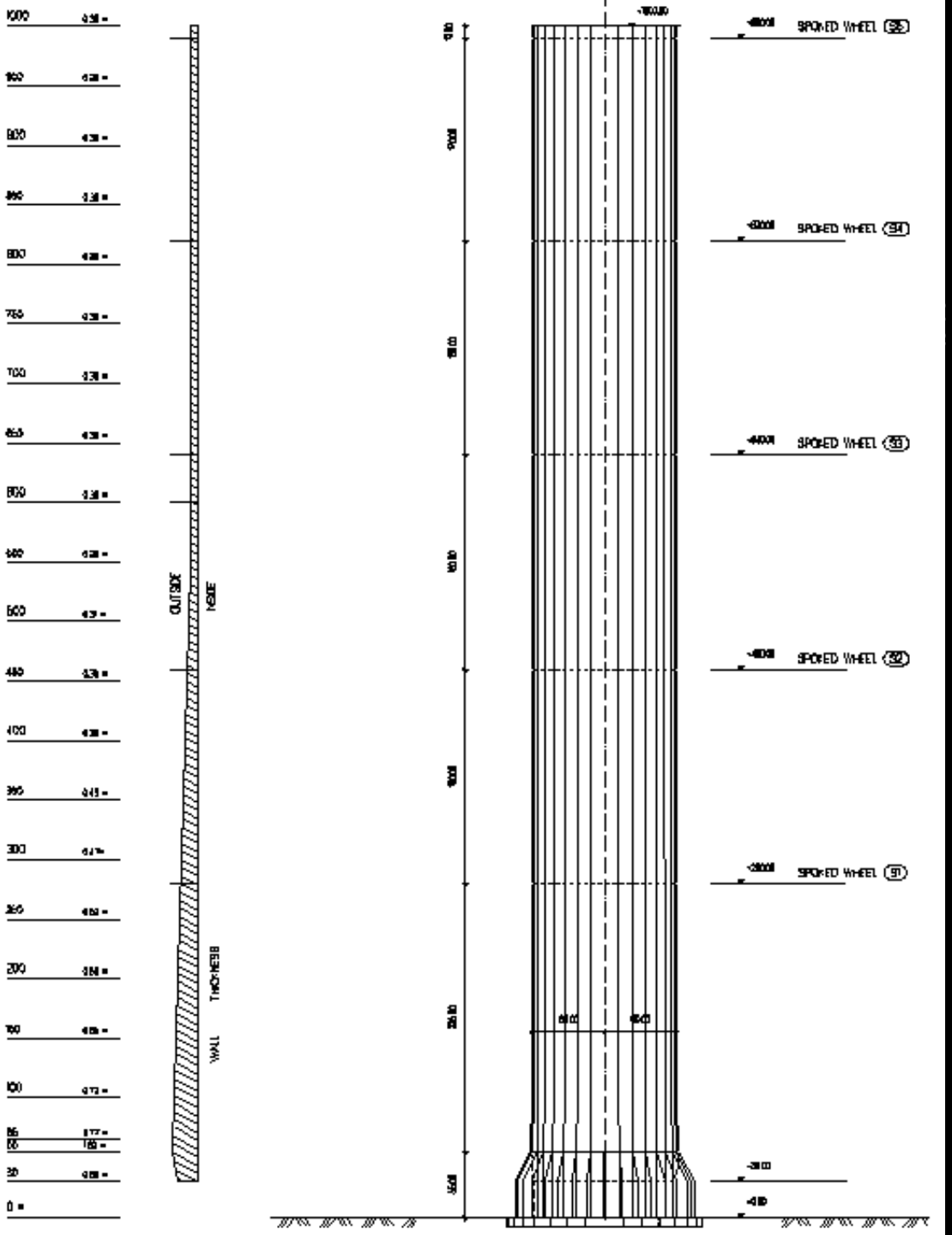


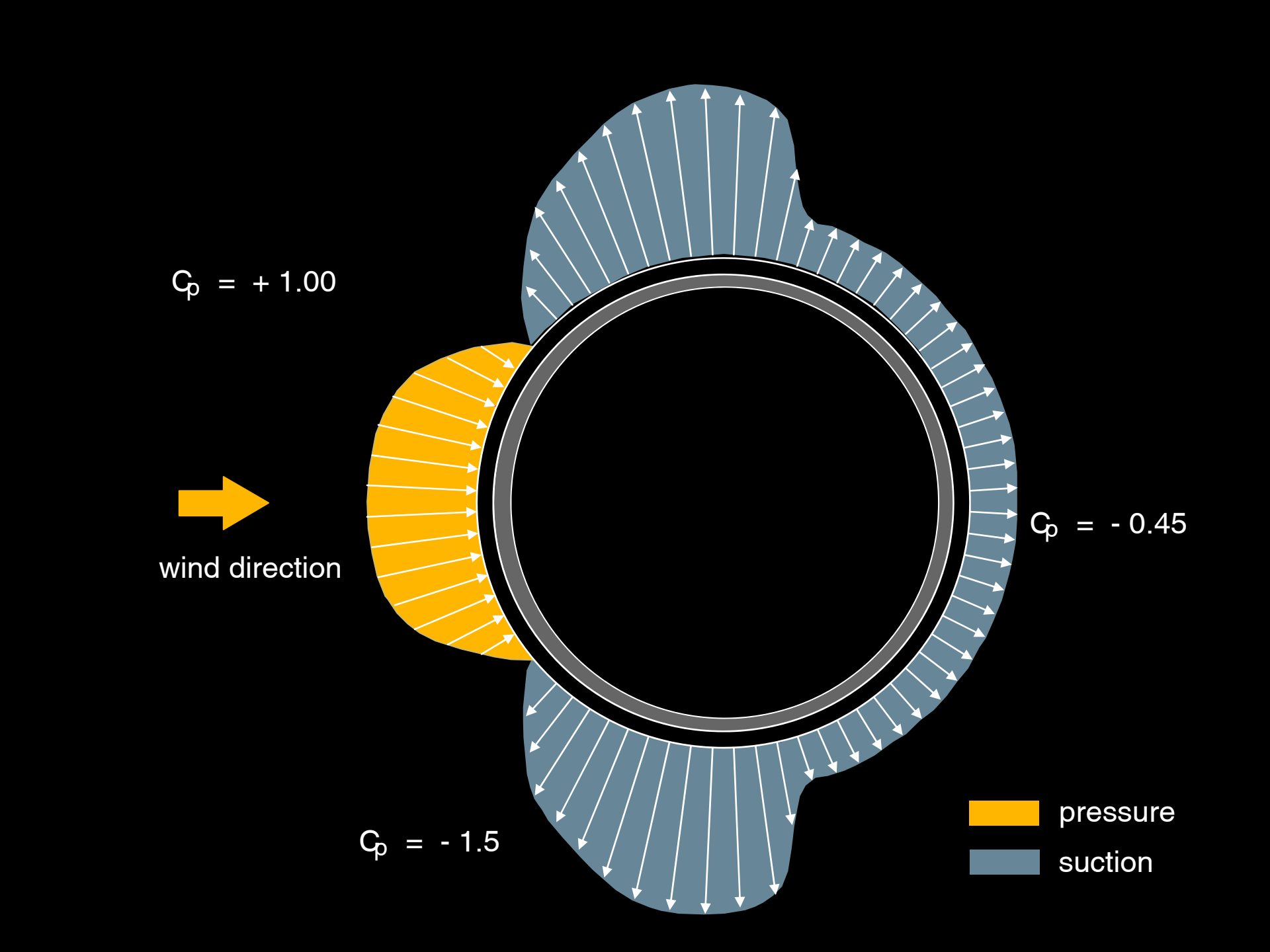


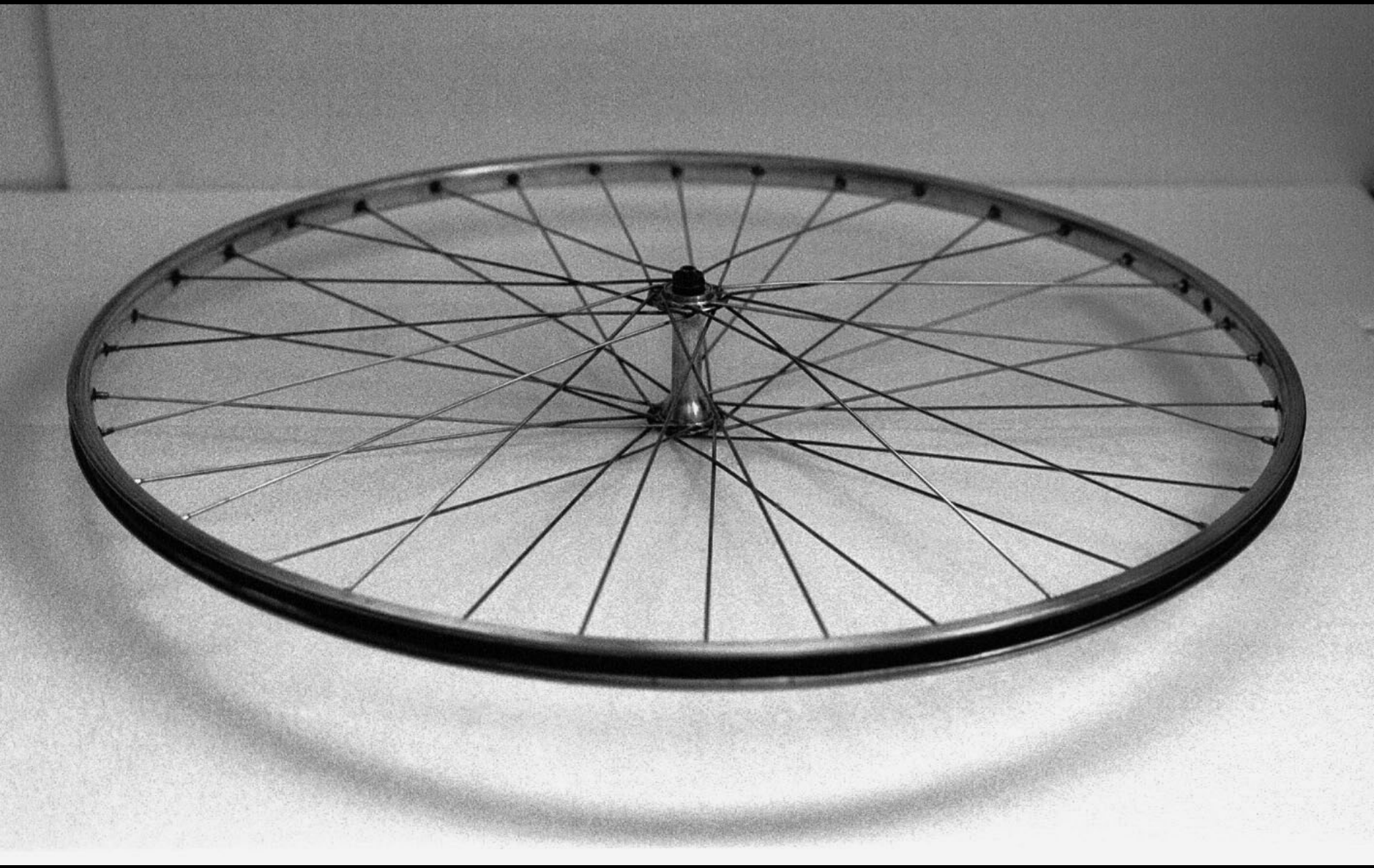




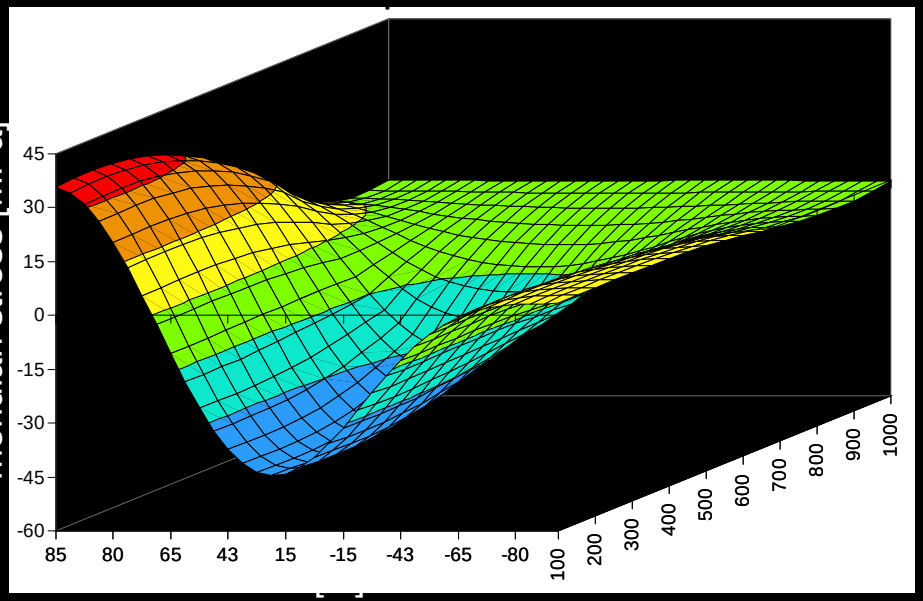



OUTSIDE
SIDE
WALL THICKNESS
SPOKED WHEEL (95)
SPOKED WHEEL (94)
SPOKED WHEEL (93)
SPOKED WHEEL (92)
SPOKED WHEEL (91)

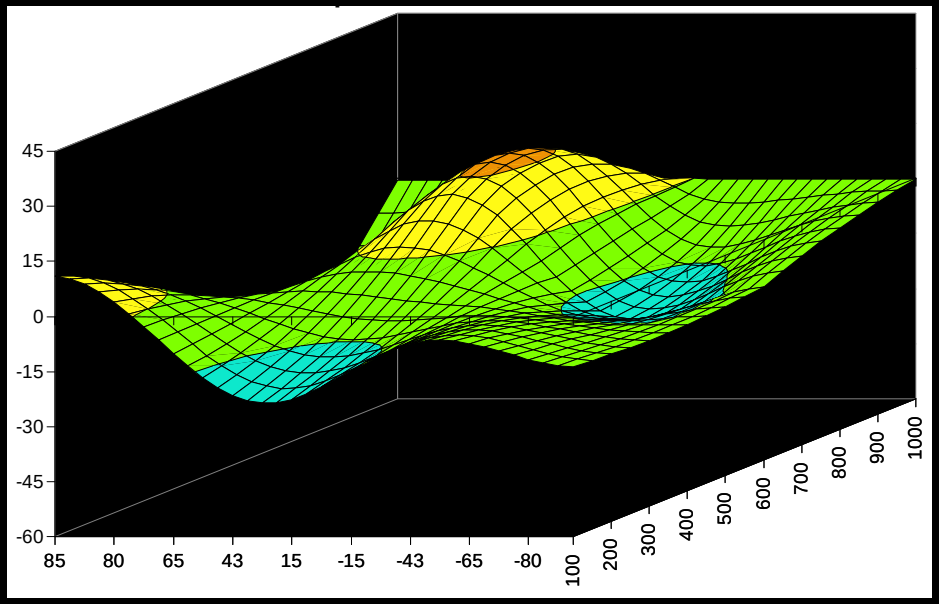

C_p = + 1.00
wind direction
C_p = - 0.45
C_p = - 1.5
pressure
suction



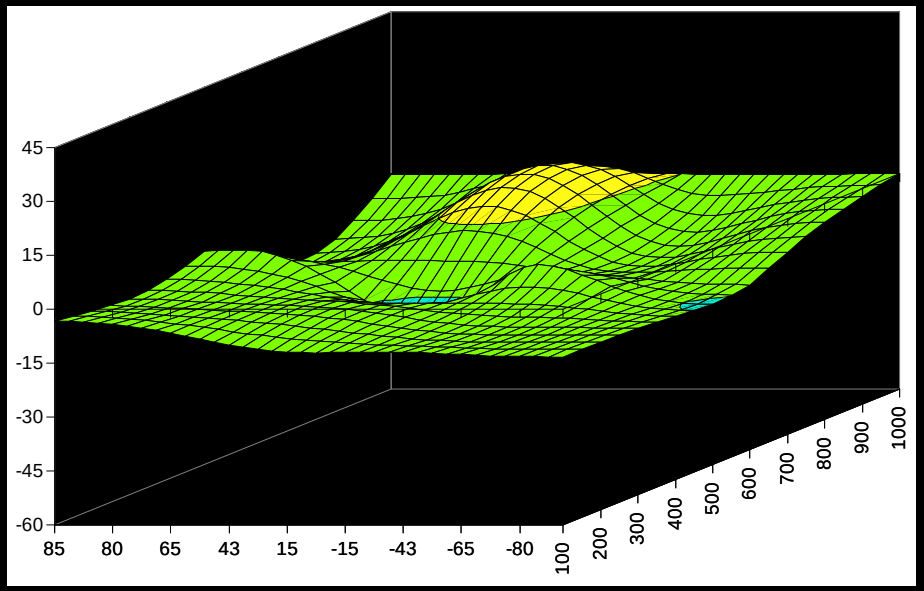
structural behaviour without spoked wheel



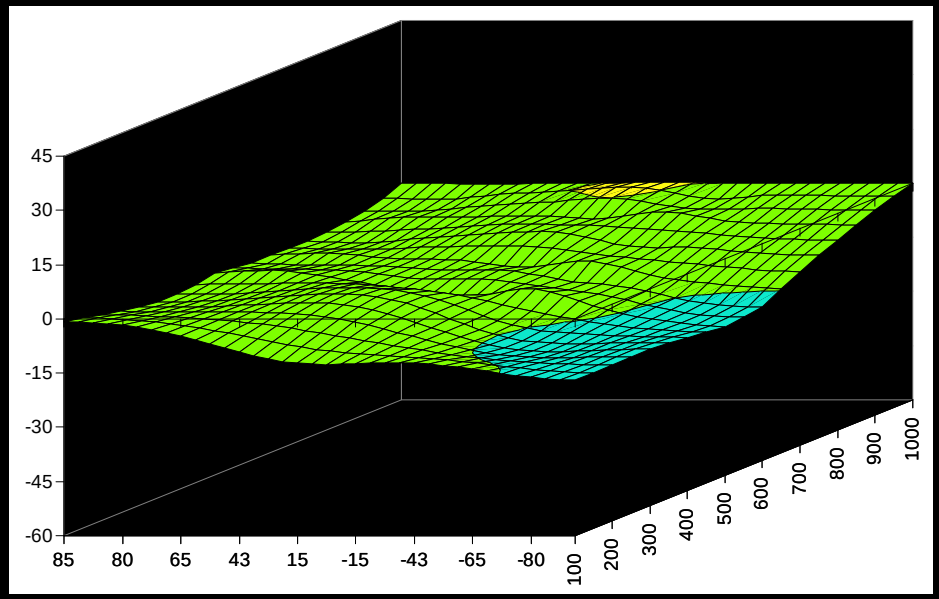
structural behaviour with 1 spoked wheel at 1000 m

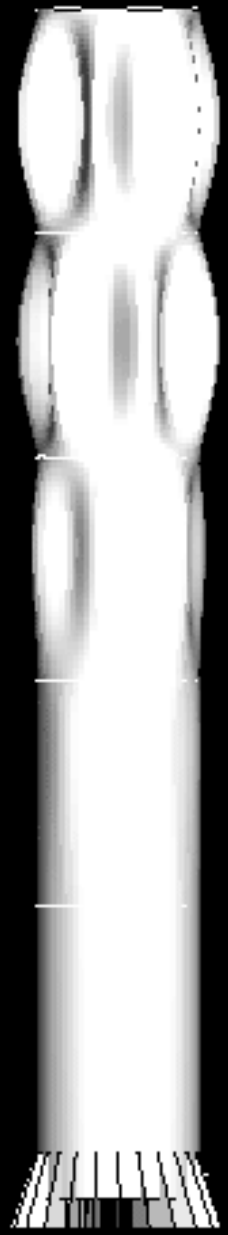


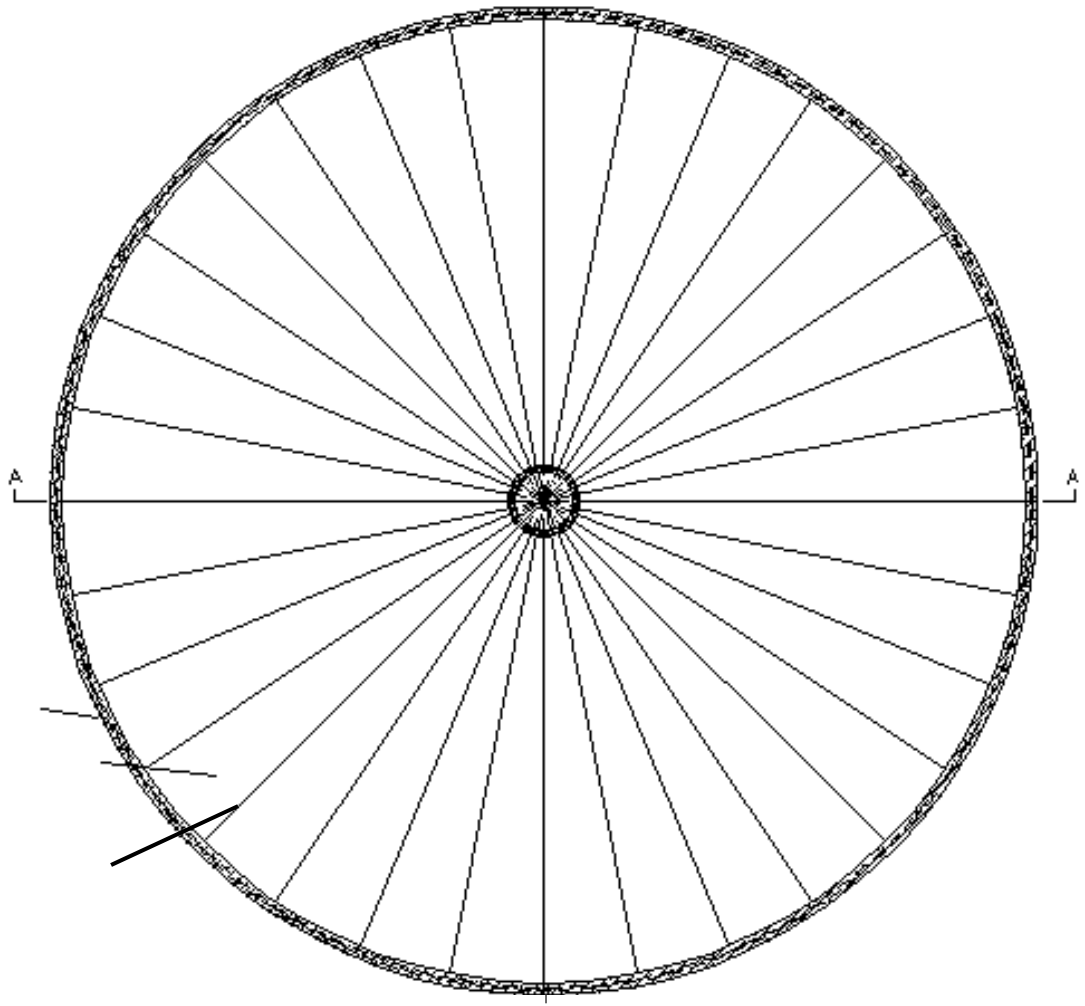
structural behaviour with 2 spoked wheels at 500 and 1000 m



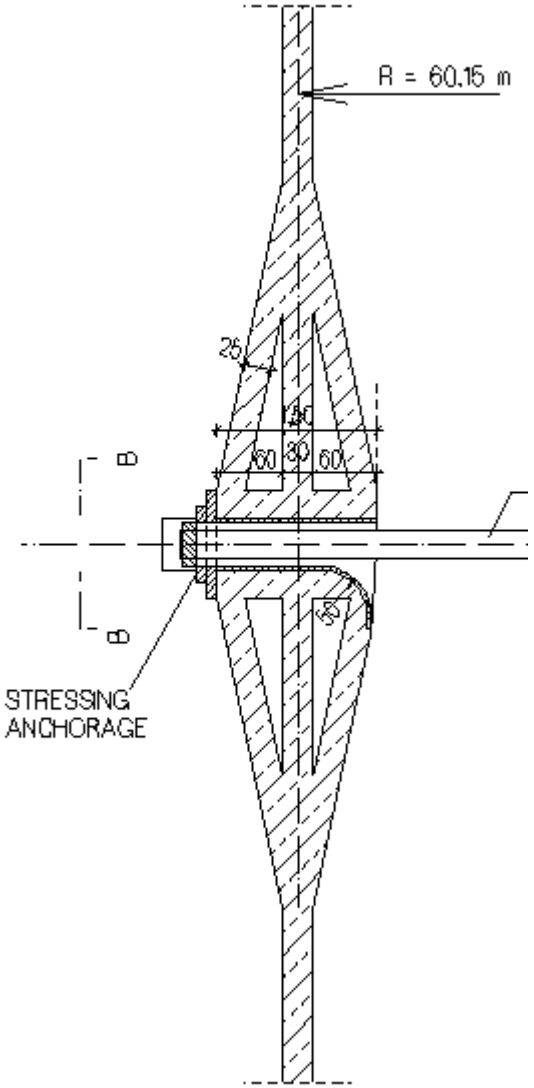
structural behaviour with 4 spoked wheels at 500, 600, 850 and 1000 m

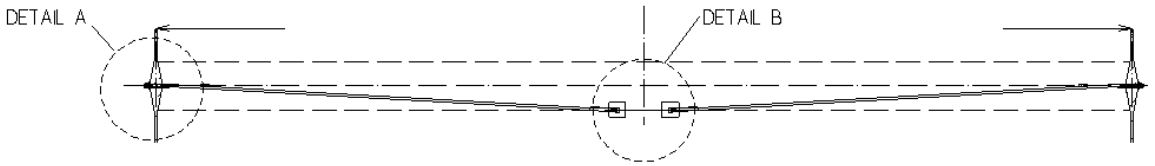


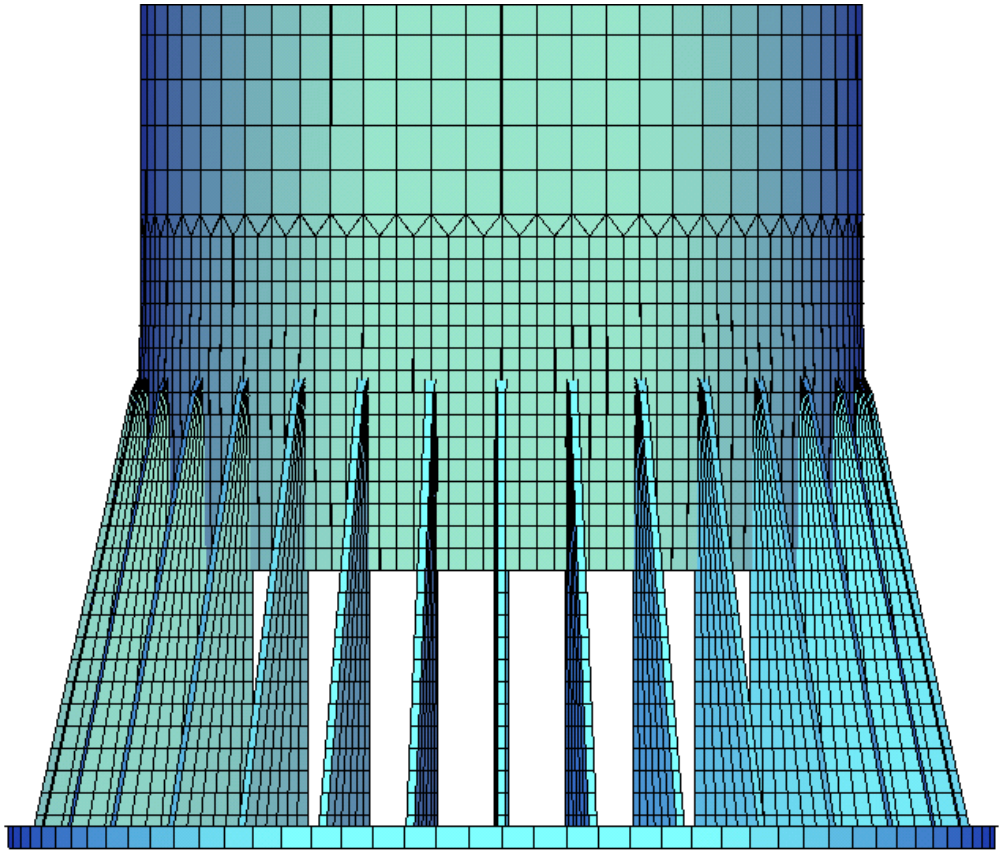


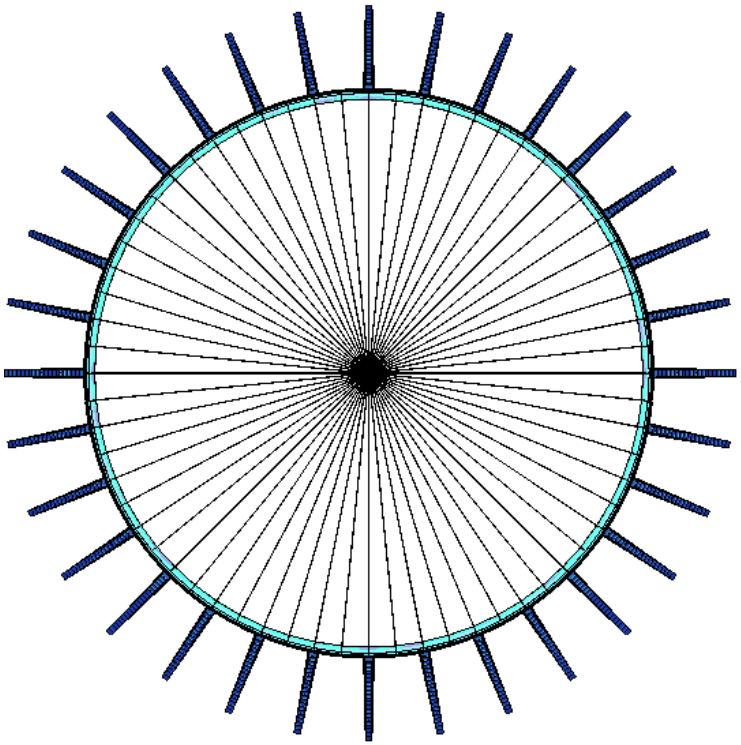

A
A

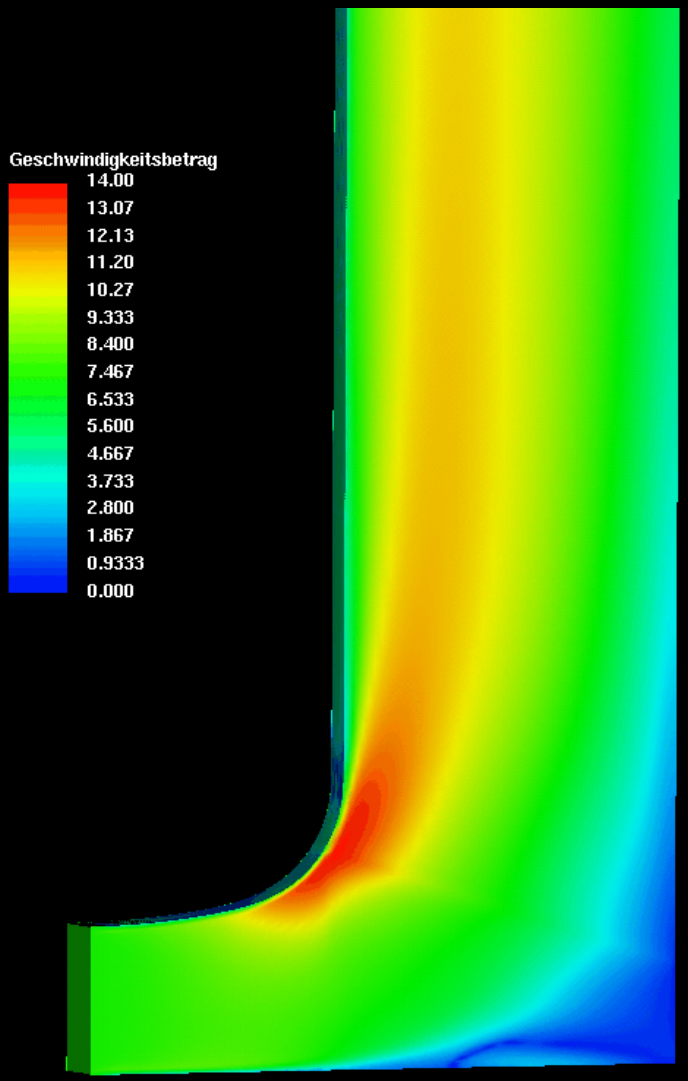
SECTION A - A

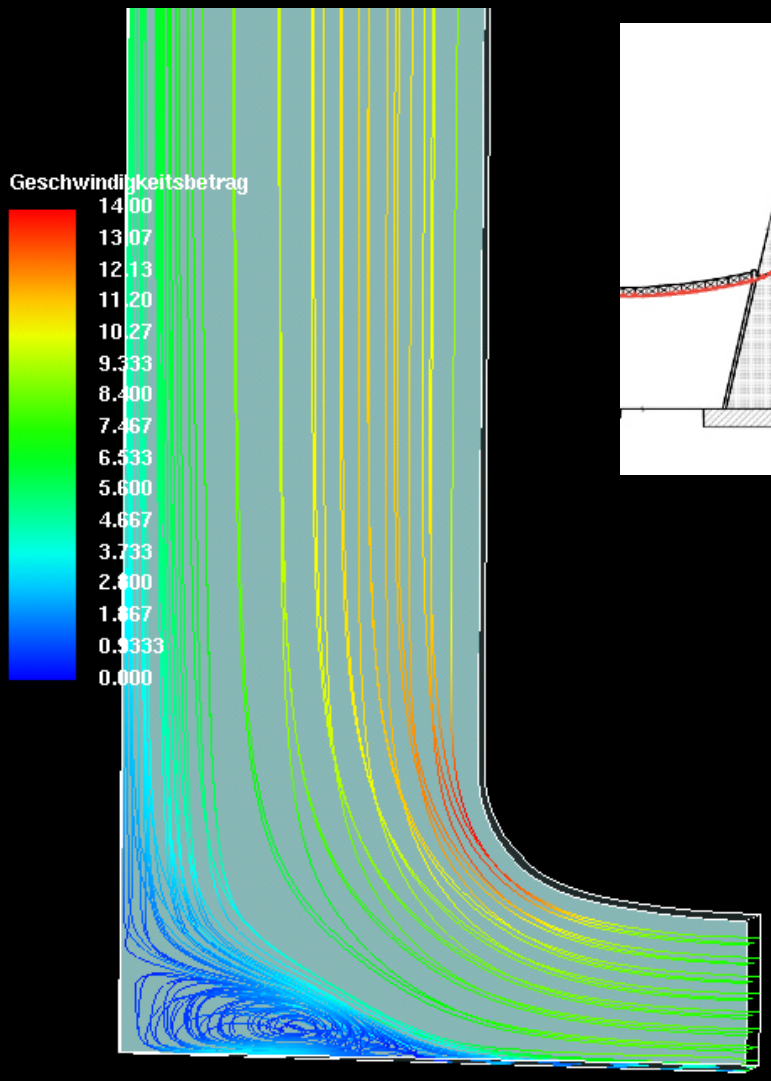

R = 60.15 m
26
50
60
30
60
B
B
STRESSING
ANCHORAGE


DETAIL A
DETAIL B






Geschwindigkeitsbetrag
14.00
13.07
12.13
11.20
10.27
9.333
8.400
7.467
6.533
5.600
4.667
3.733
2.800
1.867
0.9333
0.000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14.00
13.07
12.13
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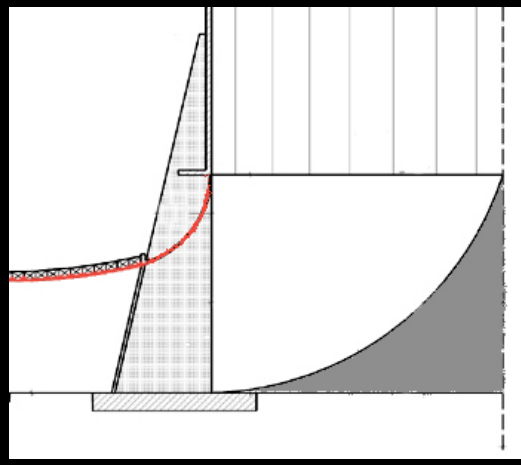
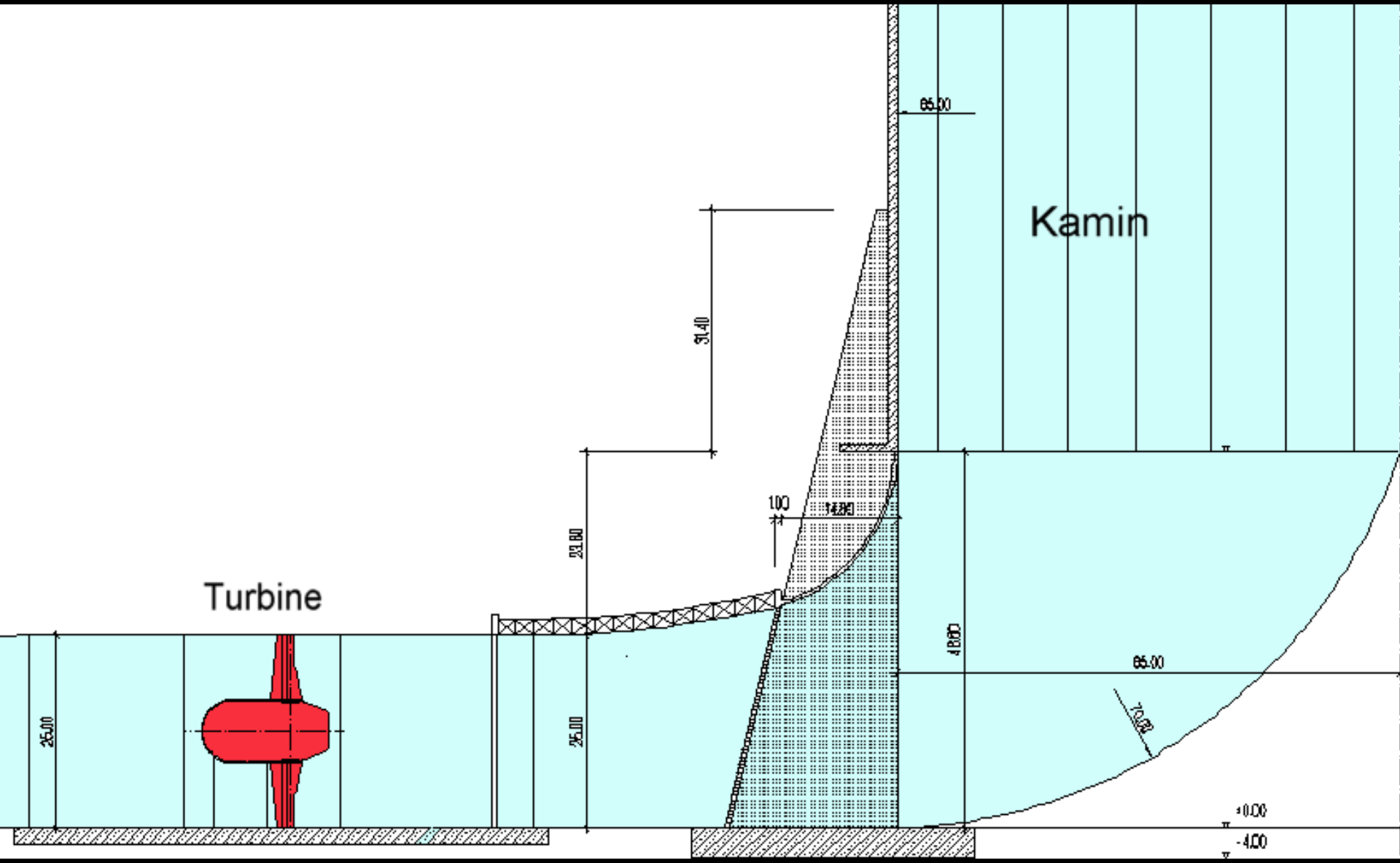
0.9333
0.000




Kamin
Turbine
85.00
31.40
23.80
1.00
48.60
85.00
25.00
25.00
+0.00
-4.00

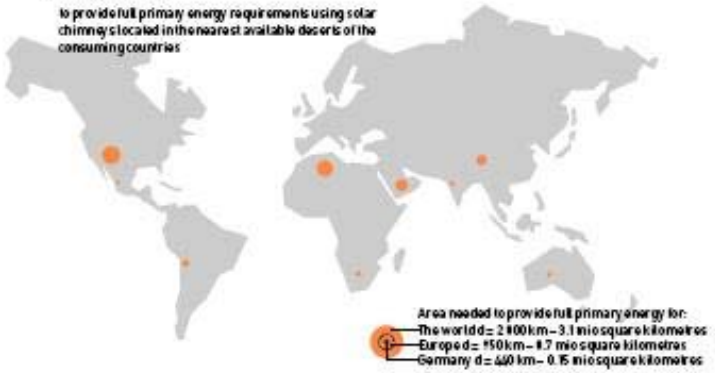
Schlaich Bergermann Solar
Hohenzollernstr. 1
D-70178 Stuttgart
Germany

	Solar Updraft Towers			
capacity	30	50	200	MW
tower height	750	750	1000	m
tower diameter	70	90	120	m
collector diameter	2950	3750	7000	m
tower cost	56	72	192	Mio. €
imported share: 20%	*11*	*14*	*38*	*Mio. €*
collector cost [A]	72	116	388	Mio. €
imported share: 0%	*0*	*0*	*0*	*Mio. €*
turbine cost incl. housing etc.	37	56	146	Mio. €
imported share: 90%	*33*	*50*	*131*	*Mio. €*
engineering, tests, misc.	21	32	53	Mio. €
imported share: 90%	*19*	*29*	*48*	*Mio. €*
total investment cost	**186**	**276**	**779**	**Mio. €**
total imported share	*63*	*94*	*218*	Mio. €
imported share in %	*34%*	*34%*	*28%*	%
total investment cost	**186**	**276**	**779**	**Mio. €**
annuity on investment [B,D]	14.5	21.6	60.9	Mio. €
o&m cost	0.9	1.4	3.2	Mio. €
electricity production [C]	**87**	**153**	**680**	**GWh/yr**
LEC (levelized electricity cost) [D]	**0.18 €**	**0.15 €**	**0.09 €**	**€/kWh**
non-energy revenues	3.1	3.1	3.1	Mio.€/yr
LEC incl. non-energy rev.	**0.14 €**	**0.13 €**	**0.09 €**	**€/kWh**

[A] average labor cost 5 Euro/h
[B] depreciation time: 25 years, interest rate: 6%
[C] at 2300 kWh/(m²yr) global solar insolation
[D] grant included in calculation

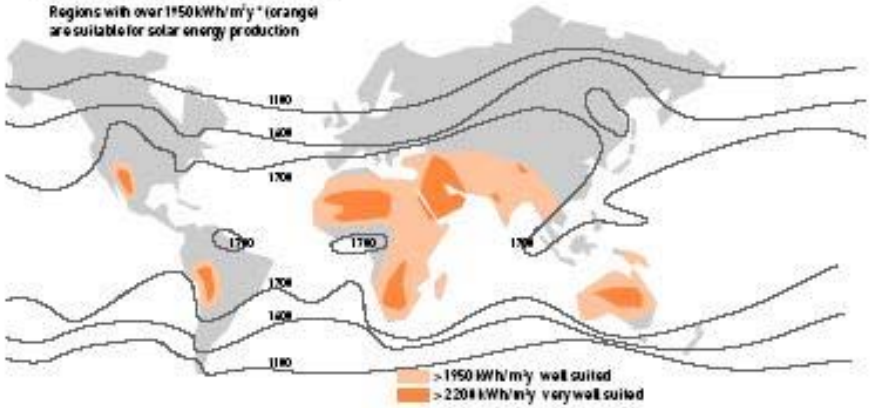
5 Necessary area

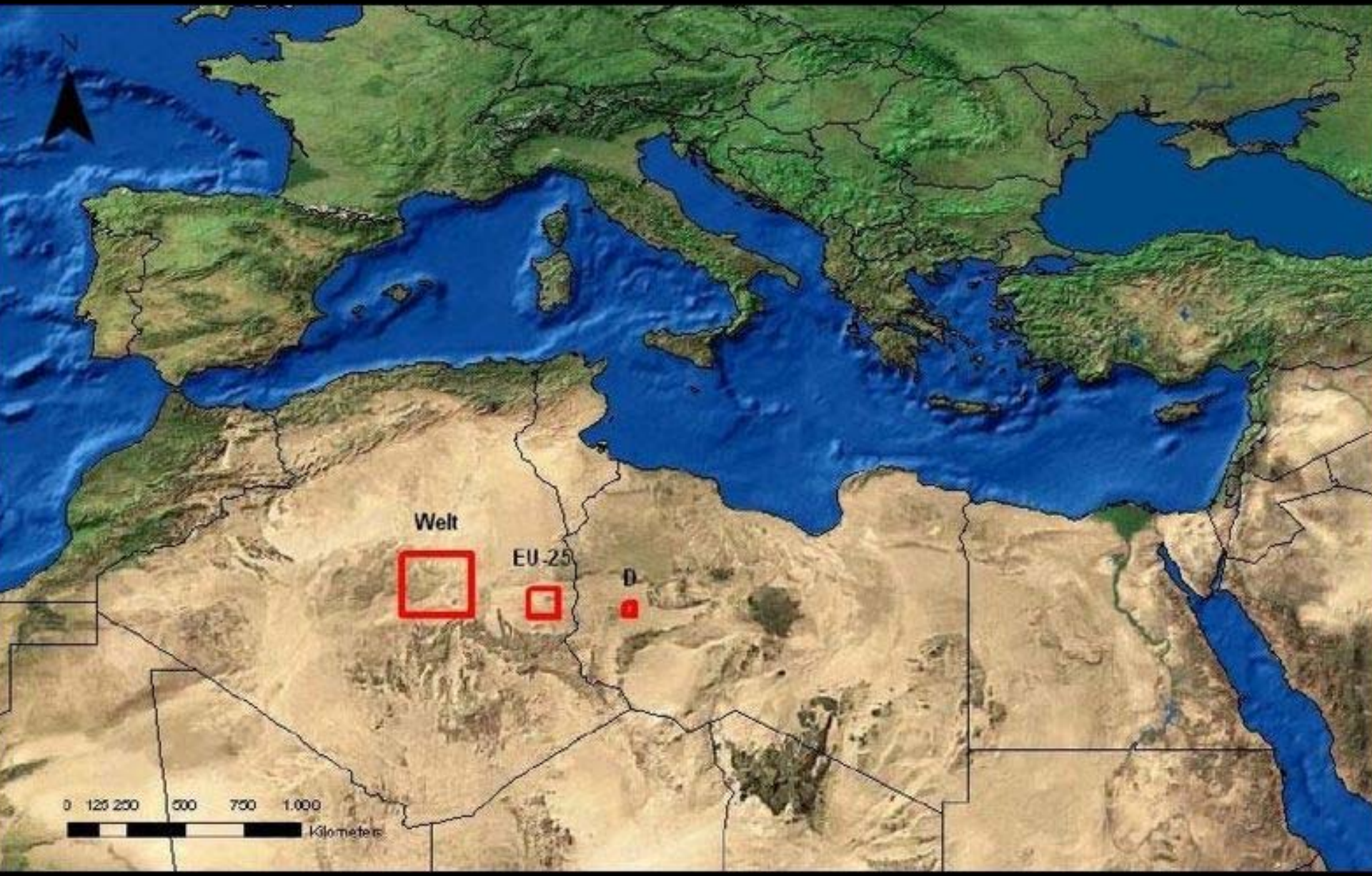
to provide full primary energy requirements using solar chimneys located in the nearest available deserts of the consuming countries



6 Global distribution of solar radiation

Regions with over 1950 kWh/m²y * (orange) are suitable for solar energy production

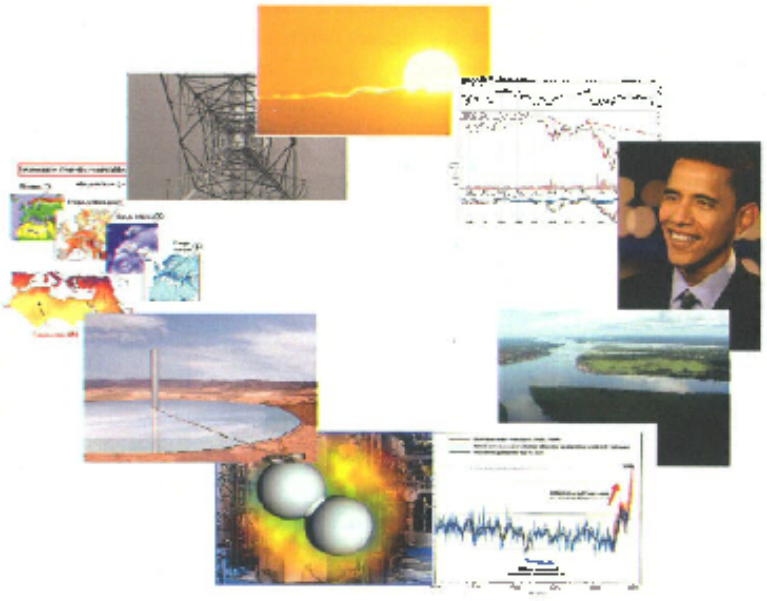



N
Welt
EU-25
D
0 125 250 500 750 1.000
Kilometers

Pourquoi le « New Green Deal » mondial à venir doit déboucher sur un plan Marshall pour l'Afrique

Contribution pour une solution globale

Synthèse



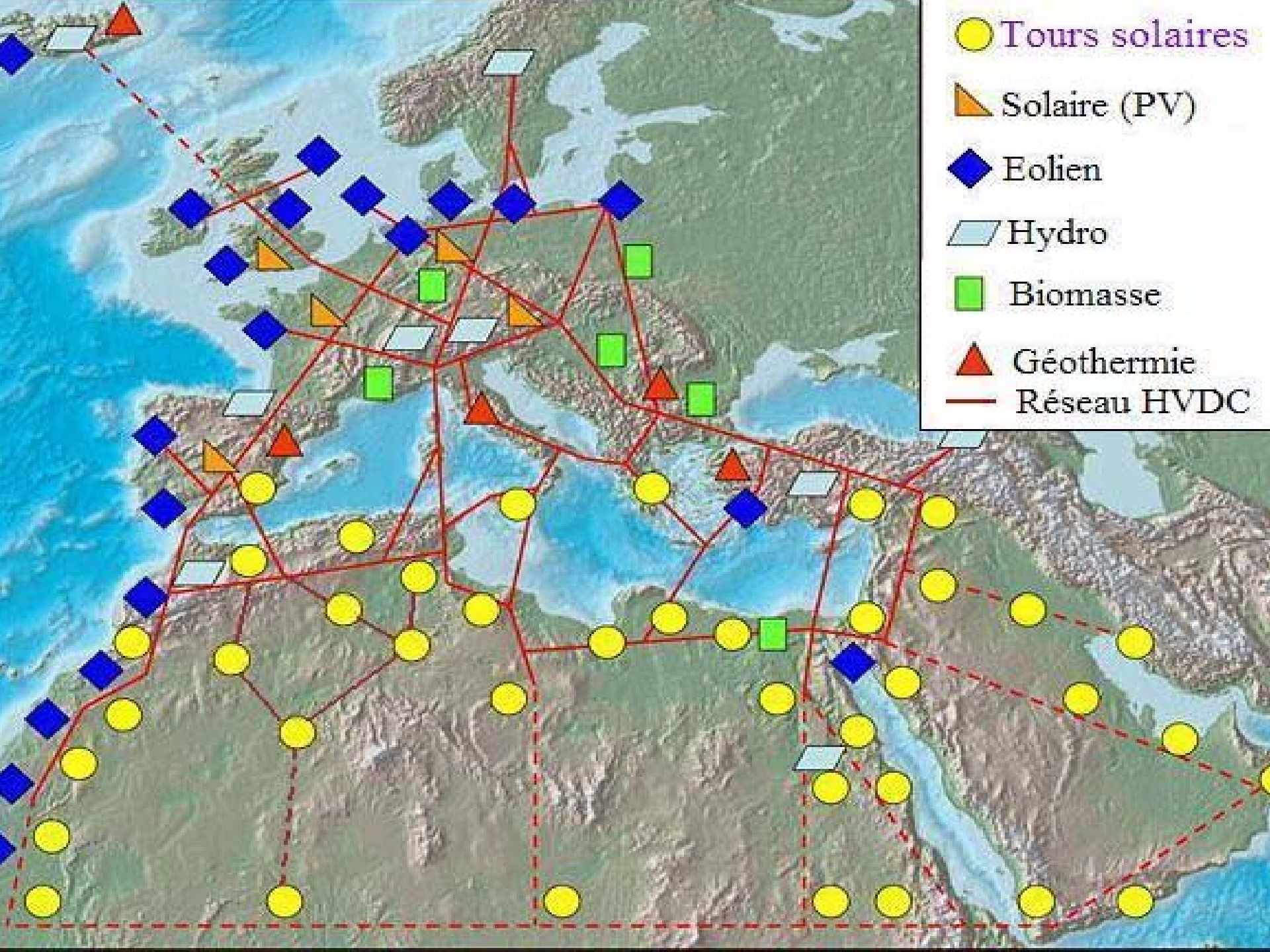
« Si nous pouvons exploiter l'énergie renouvelable, la stocker sous forme d'hydrogène et la distribuer via des réseaux électriques intelligents, les pays en voie de développement auront accès à l'électricité et deviendront eux aussi des acteurs de la troisième révolution industrielle et de la mondialisation. Voilà la véritable approche ascendante de l'idéologie de la mondialisation. »

Jeremy Rifkin

Par Kamel Mostefa-kara et Hakim Arif

Fig.6 Principes de fonctionnement de la tour solaire

Fig.7 Une serre agricole génératrice d'énergie verte


Tours solaires
Solaire (PV)
Eolien
Hydro
Biomasse
Géothermie
Réseau HVDC