SolarPaces2010 Opening, 21 September

CSP/STE in the IEA Perspectives

Cédric Philibert
Renewable Energy Division
International Energy Agency

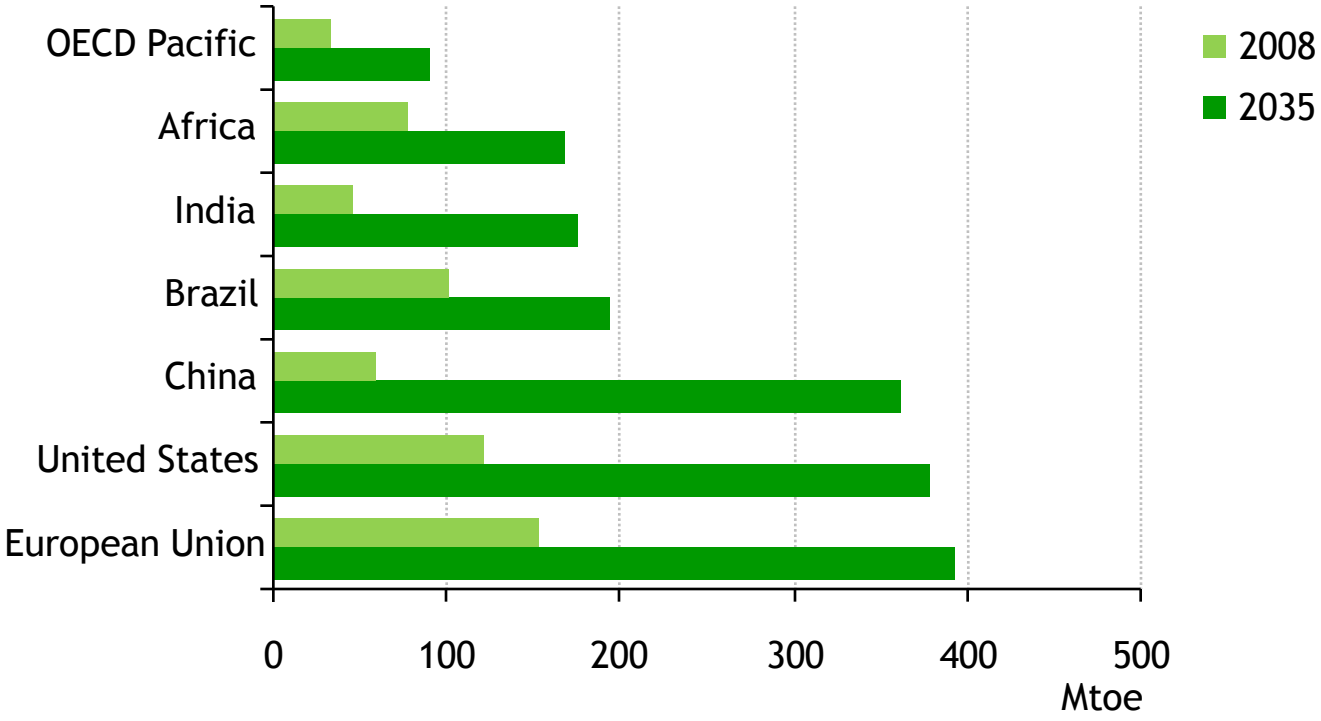
The IEA and SolarPaces

- SolarPaces is one out of 40 Implementing Agreements within the framework of the IEA
  - Co-operation amongst voluntary countries
  - Open to non-Member countries
  - 9 Ias devoted to renewable energy technologies
- SolarPaces one of the most successful of all IEA Implement Agreements
  - Possibly the largest participation by non-Members
  - At the origin of the technology in the 80s as well as the current deployment
  - SolarPaces annual symposium the largest scientific and industry conference
- The IEA is proud of SolarPaces!

Renewables enter the mainstream

World Energy Outlook 2010

Renewable primary energy demand in the New Policies Scenario

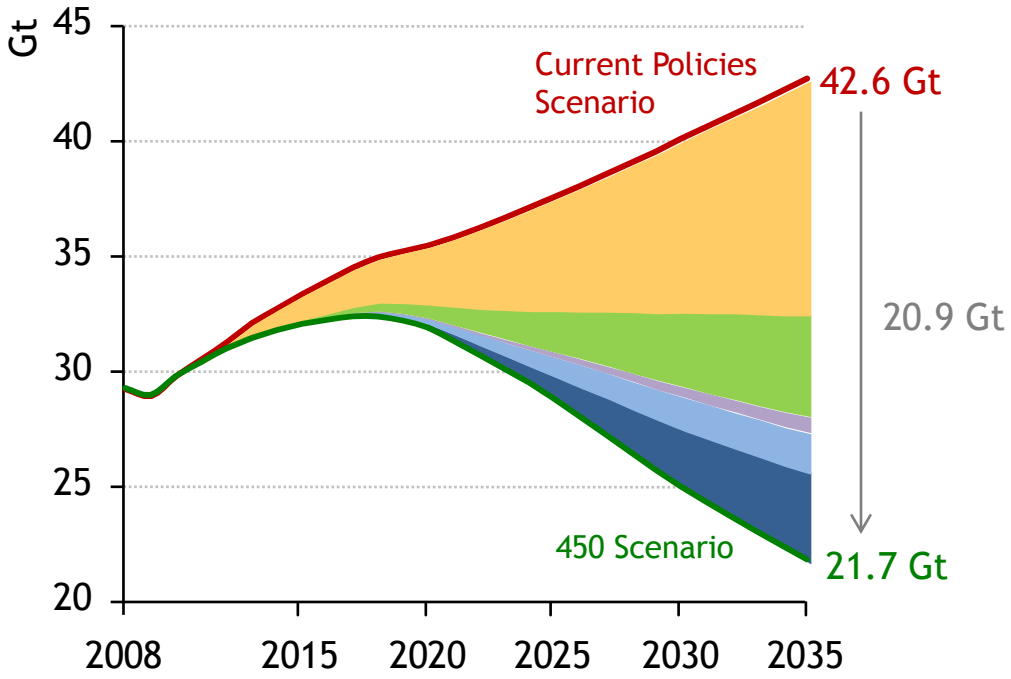


The use of renewable energy triples between 2008 & 2035, driven by the power sector where their share in electricity supply rises from 19% in 2008 to 32% in 2035

The 450 Scenario: *How do we get there now?*

World Energy Outlook 2010

World energy-related CO2 emission savings by country in the 450 Scenario relative to the Current Policies Scenario

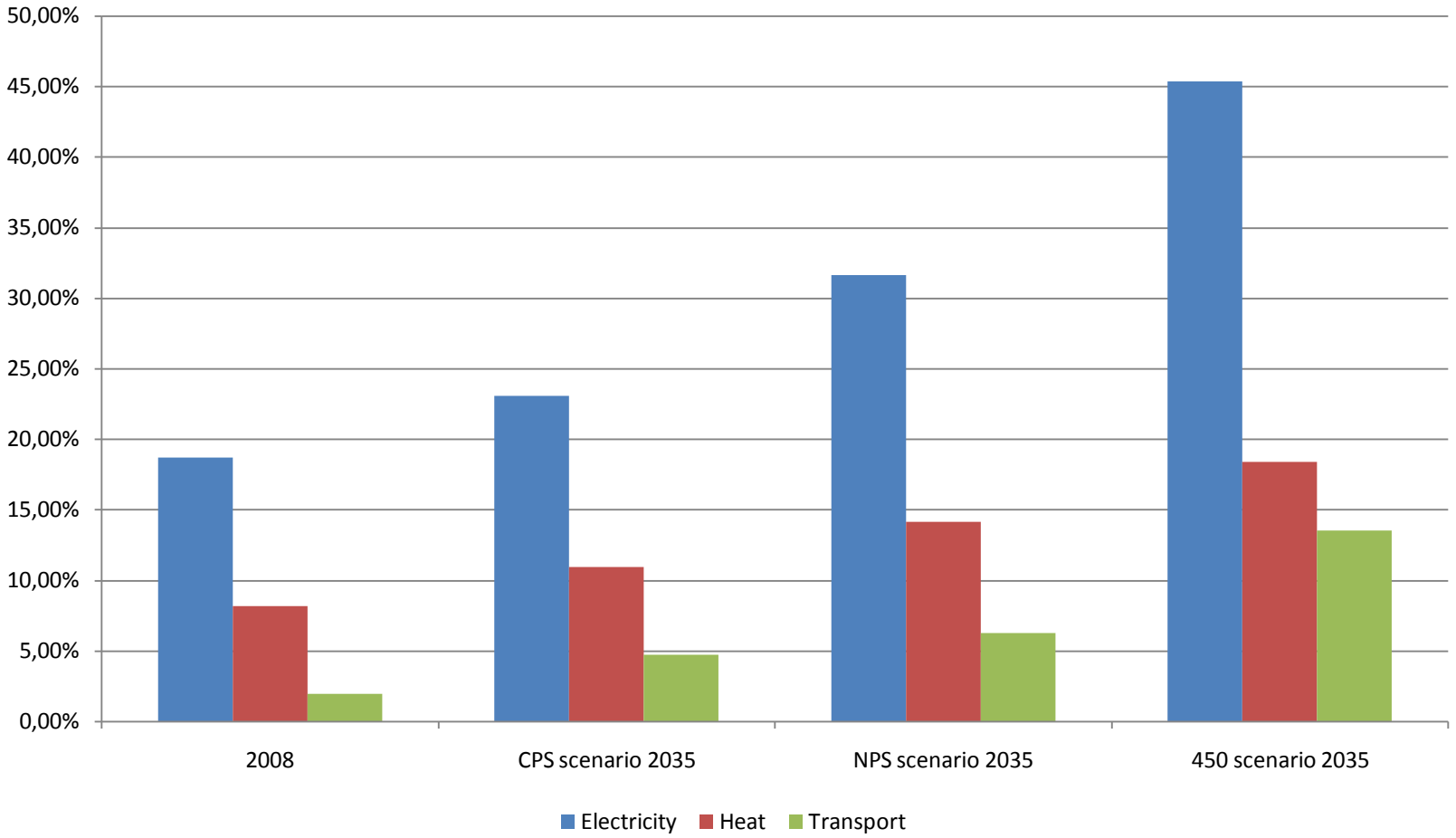


Share of cumulative abatement between 2010-2035	
Efficiency	53%
Renewables	21%
Biofuels	3%
Nuclear	9%
CCS	15%

Renewables are the second most important contributors to CO2 emissions reduction

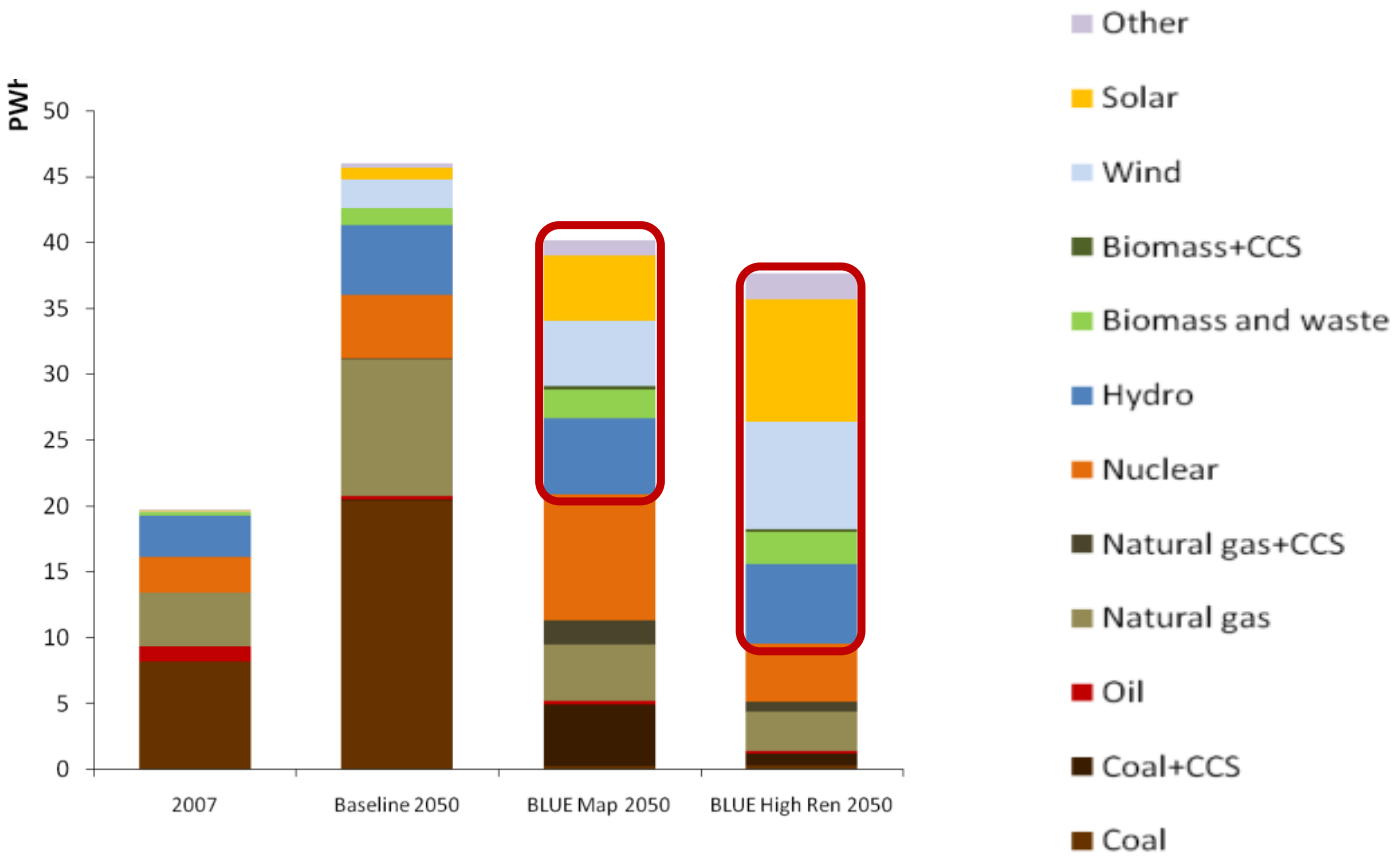
Growing shares of renewables in all sectors, for all scenarios

World Energy Outlook 2010



All scenarios point out a large growth of renewables

The primary role of renewables in the BLUE scenarios

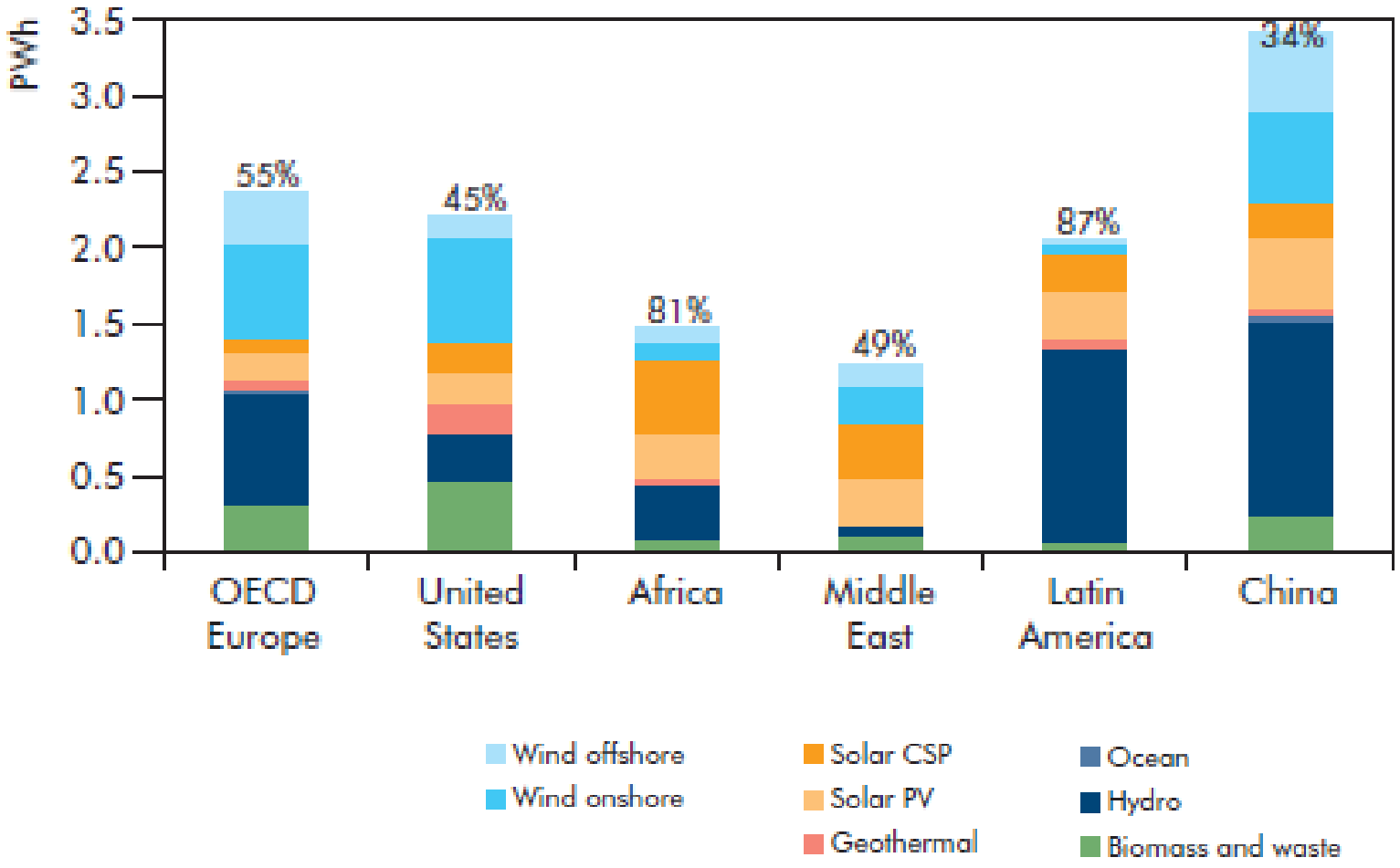


Renewables provide from almost half to three quarters of the global electricity mix in 2050

ENERGY TECHNOLOGY PERSPECTIVES 2010

Scenarios & Strategies to 2050

RE generation in 2050 for key countries/regions



The mix varies according to resources

ENERGY TECHNOLOGY PERSPECTIVES 2010

Scenarios & Strategies to 2050

Technology Roadmap

Concentrating Solar Power

International Energy Agency

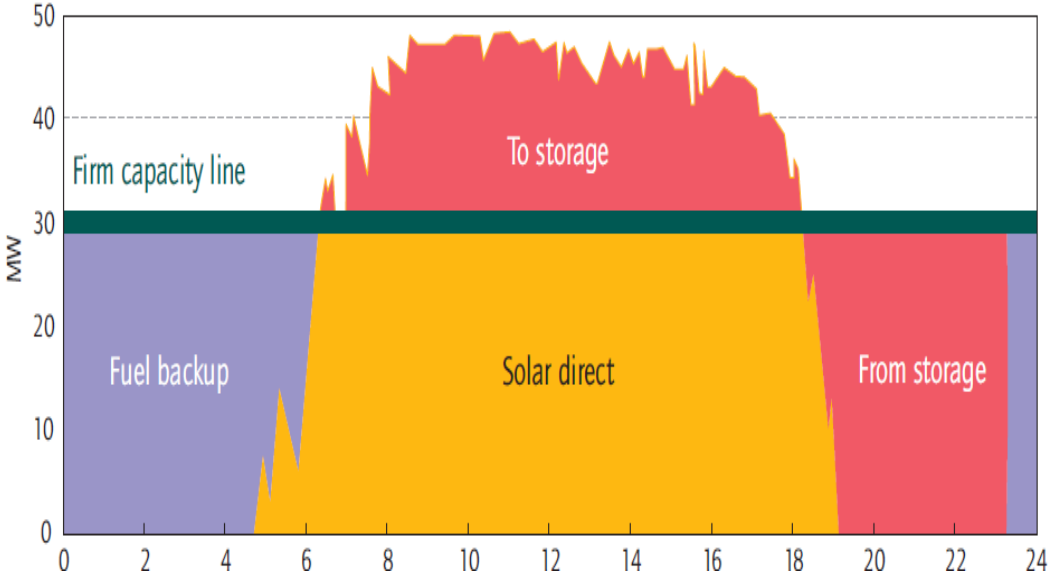
PV & CSP technology roadmaps

- Launched by IEA's Executive Director Nobuo Tanaka in Valencia, 11 May 2010 (MSP Conf.)
- PV and CSP **complementary** to each other
- Solar electricity could represent **up to 20% to 25%** of global electricity production **by 2050**
  - Roughly half CSP, half PV
  - Producing up to 9000 TWh per year
  - Saving almost 6 billion tonnes CO_2 per year
- **This decade crucial for effective policies** to enable the development of solar electricity
- Need to plan and invest in **grid infrastructure**

PV & CSP complementarities

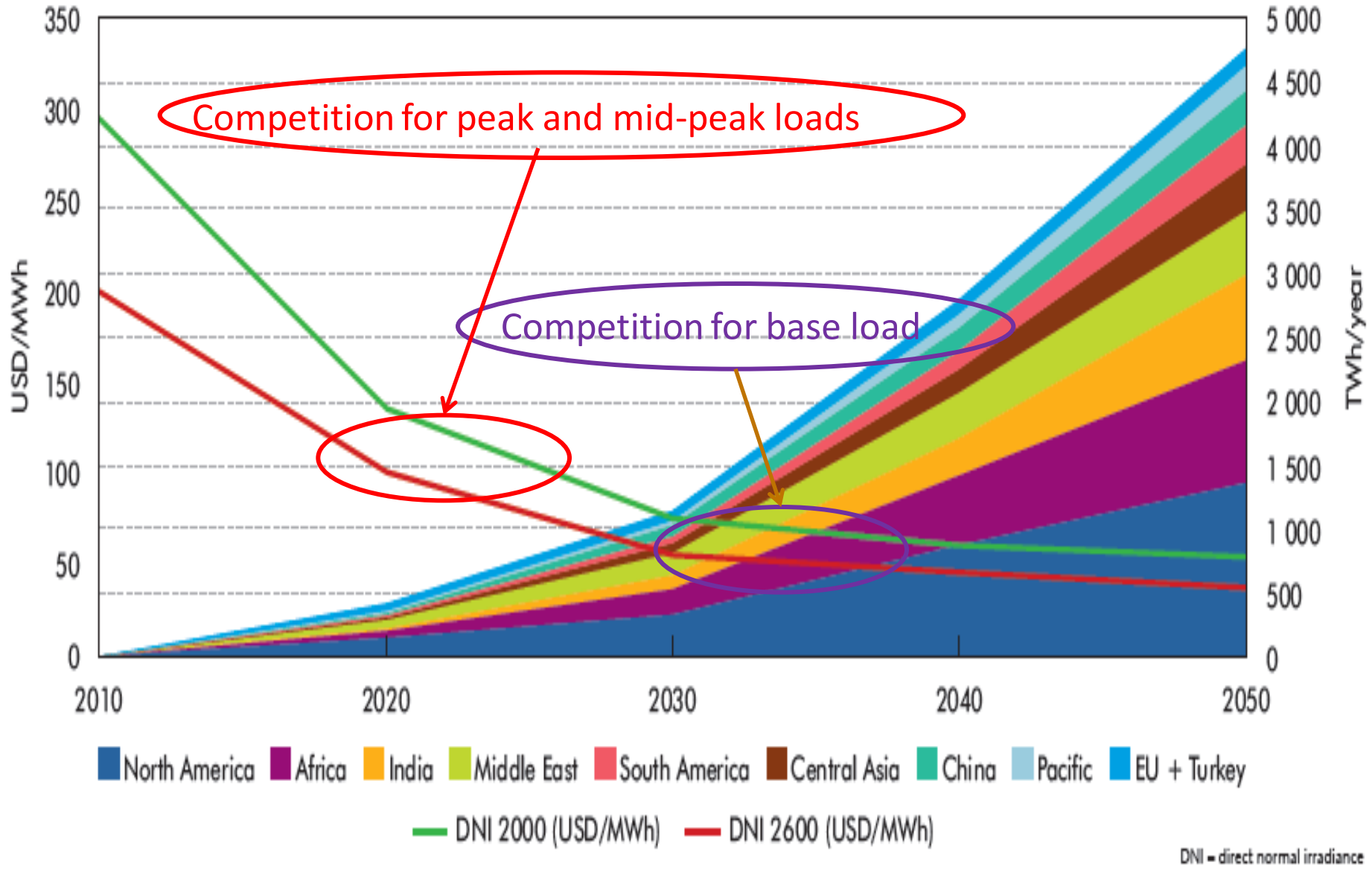
- PV takes **all** light
- PV almost **everywhere**
- Mostly at **end-users'**
- **Variable**
- Peak & mid-peak
- Grid parity (retail prices) **by 2020**
- **Smart grids** for integration

- CSP takes **direct** light
- CSP **semi-arid** countries
- Mostly for **utilities**
- **Firm**, dispatchable } backup
- Peak to **base-load** } storage
- Competitive peak power **by 2020**
- **HVDC lines** for transport

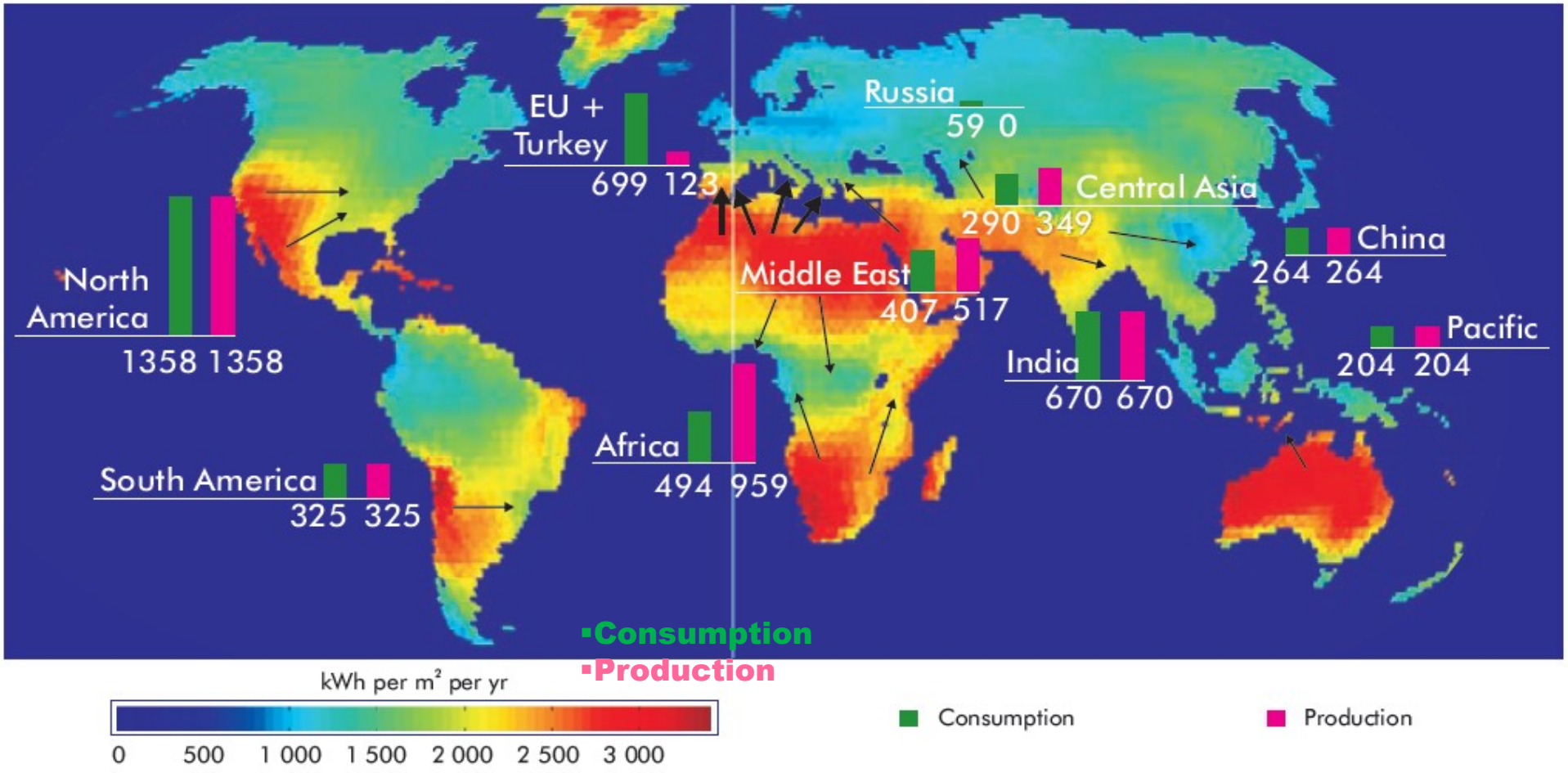


Firm & flexible CSP capacities can help integrate more PV

CSP costs and global output



The CSP Roadmap: 2050



Repartition of the solar resource for CSP plants in kWh/m²/y, and of the production and consumption of CSP electricity (in TWh) by world region in 2050 as foreseen in this roadmap. Arrows represent transfers of CSP electricity from sunniest regions or countries to large electricity demand centres.

Sources: Breyer & Knies, 2009 based on DNI data from DLR-ISIS and IEA Analysis.

More on it on Wednesday 23/09 in the morning!

How accurate are our DNI Data?

International Energy Agency

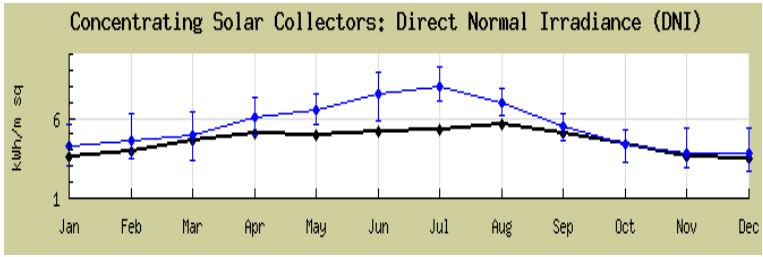
The case of Morocco

SWERA:

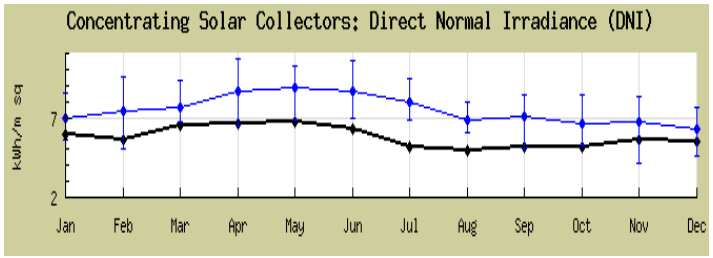
NASA

NREL

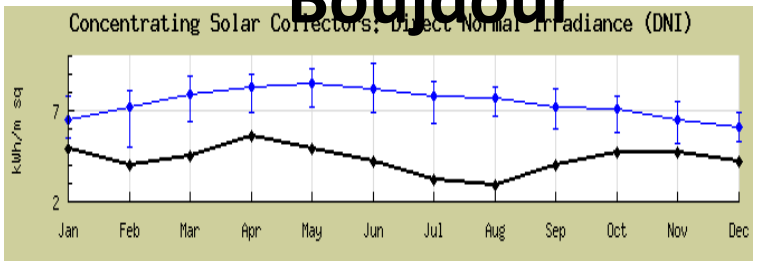
Ain Béni Mathar



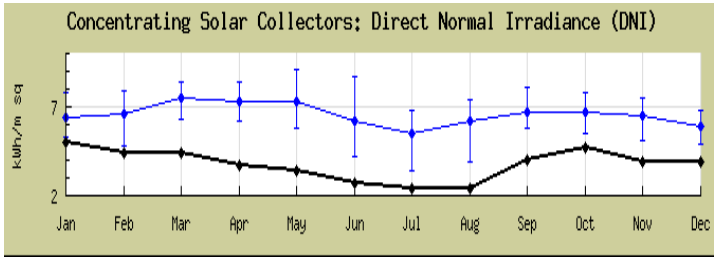
Ouarzazate



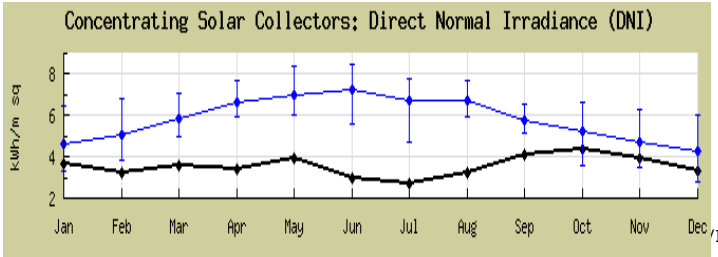
Boujdour



Foum Al Oued

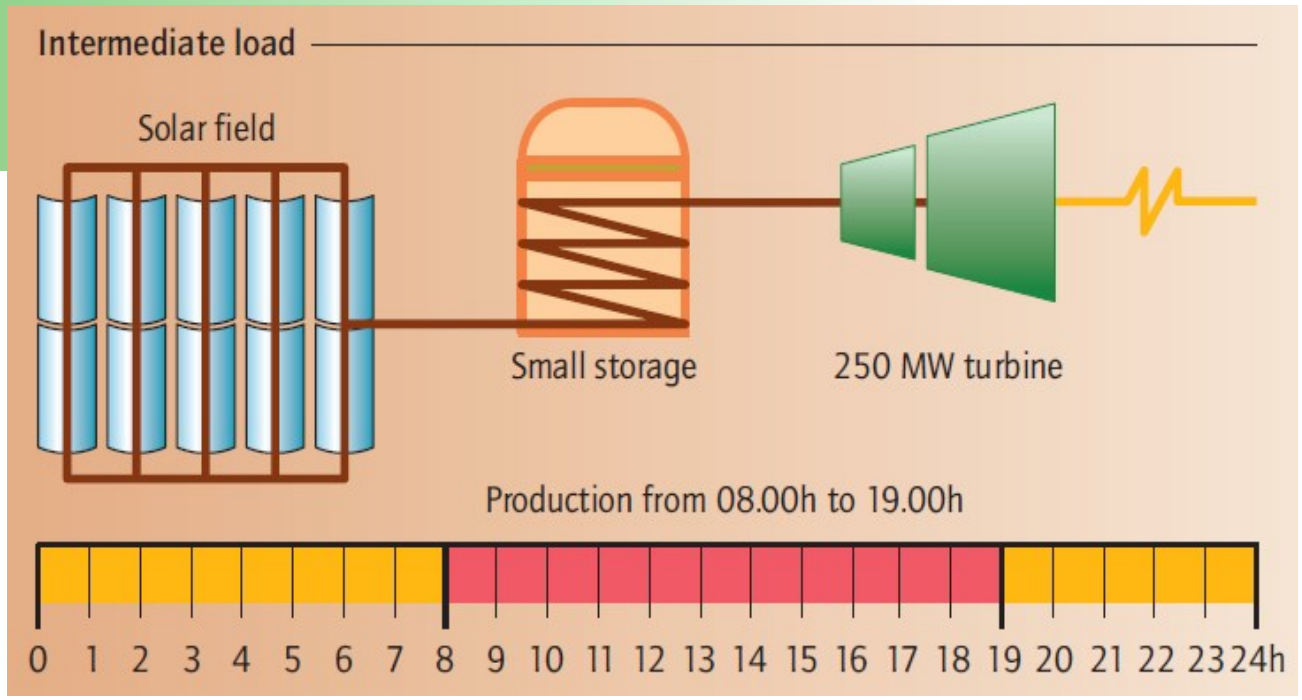


Sabkhat Tah

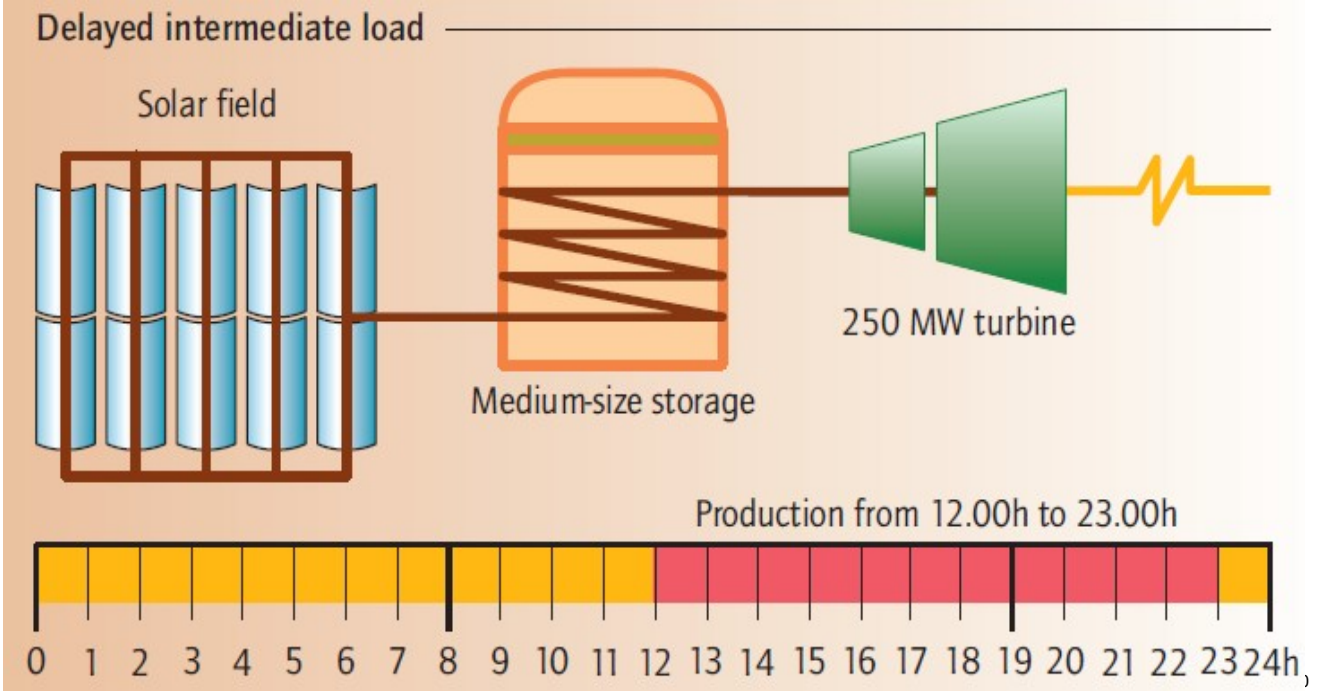


Uses of storage

Intermediate load

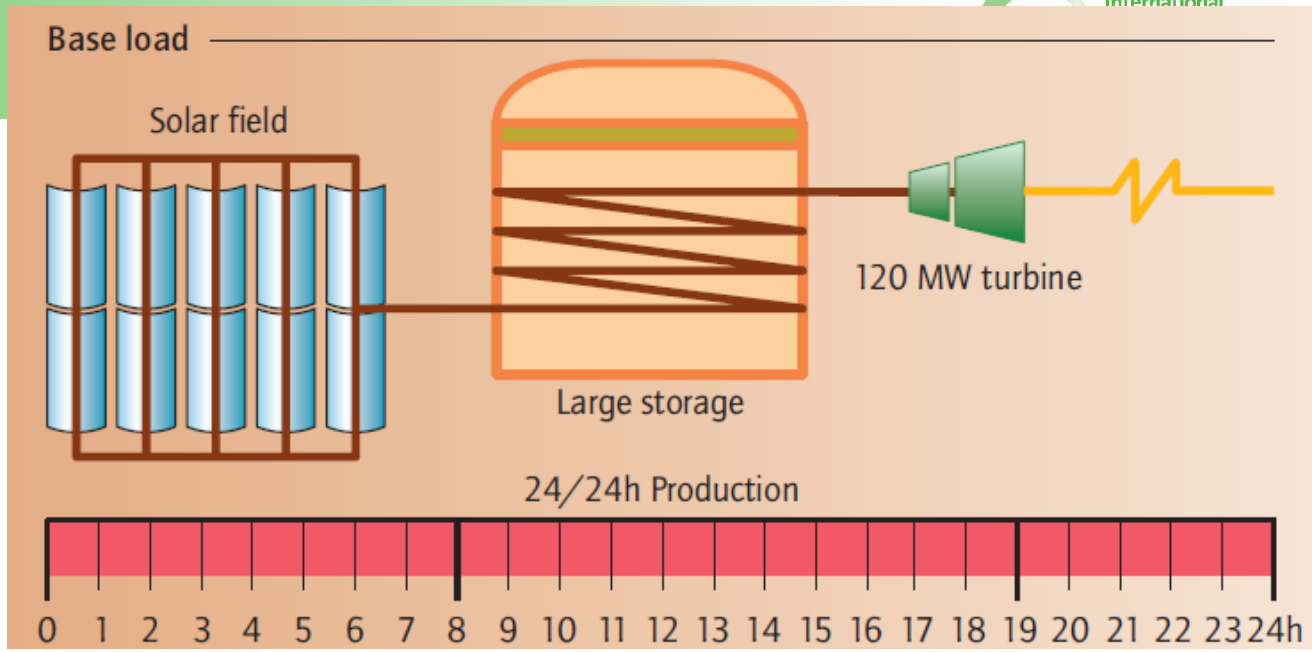


Delayed intermediate load

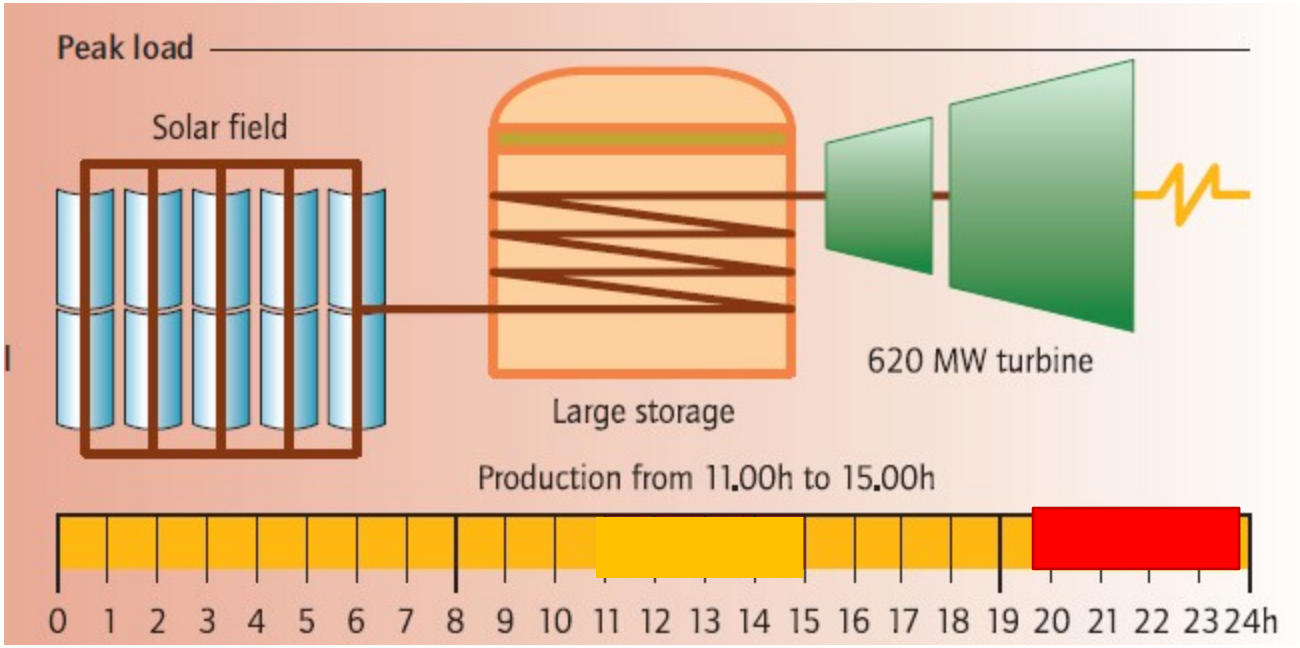


Uses of storage

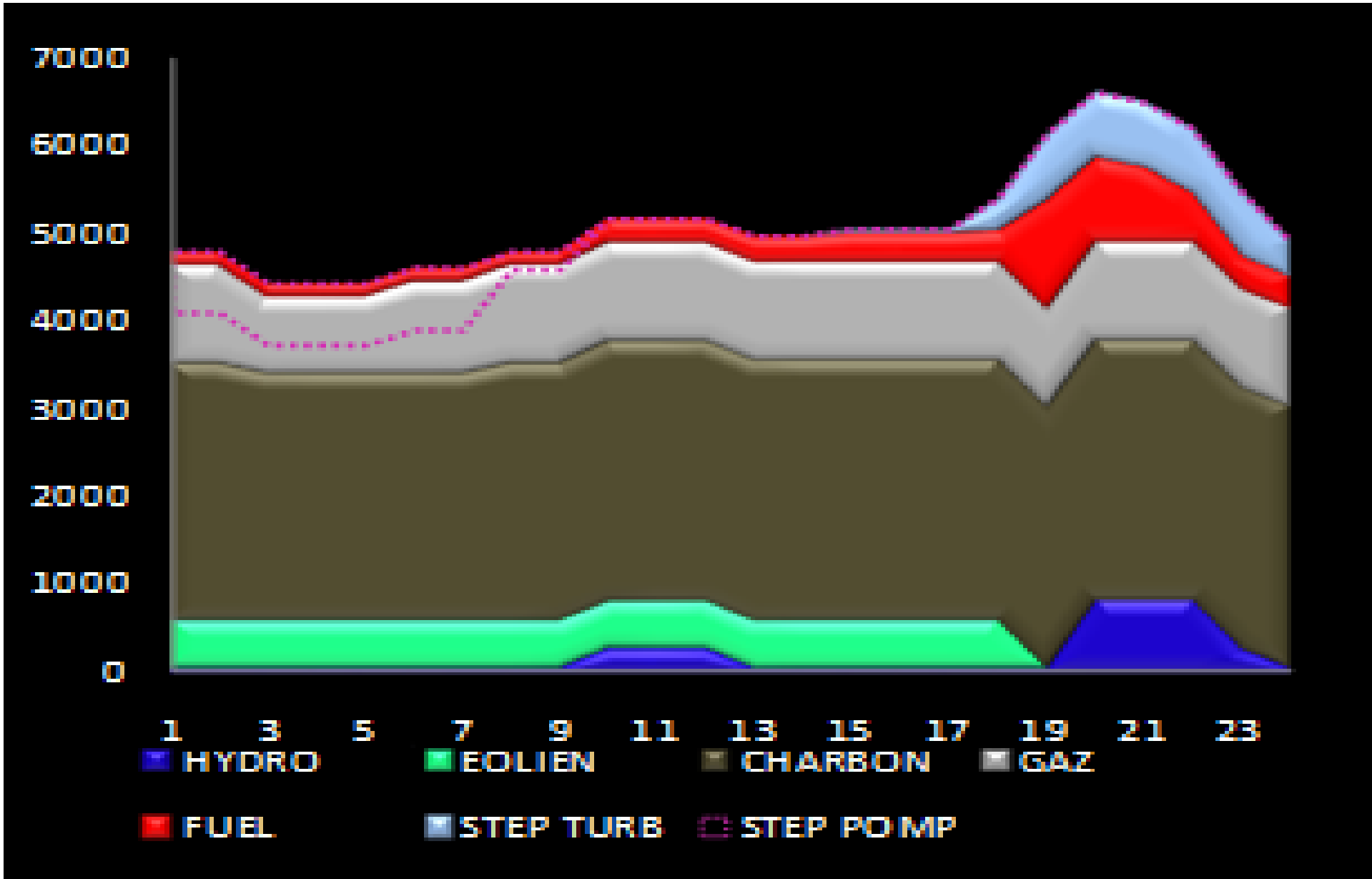
Base load



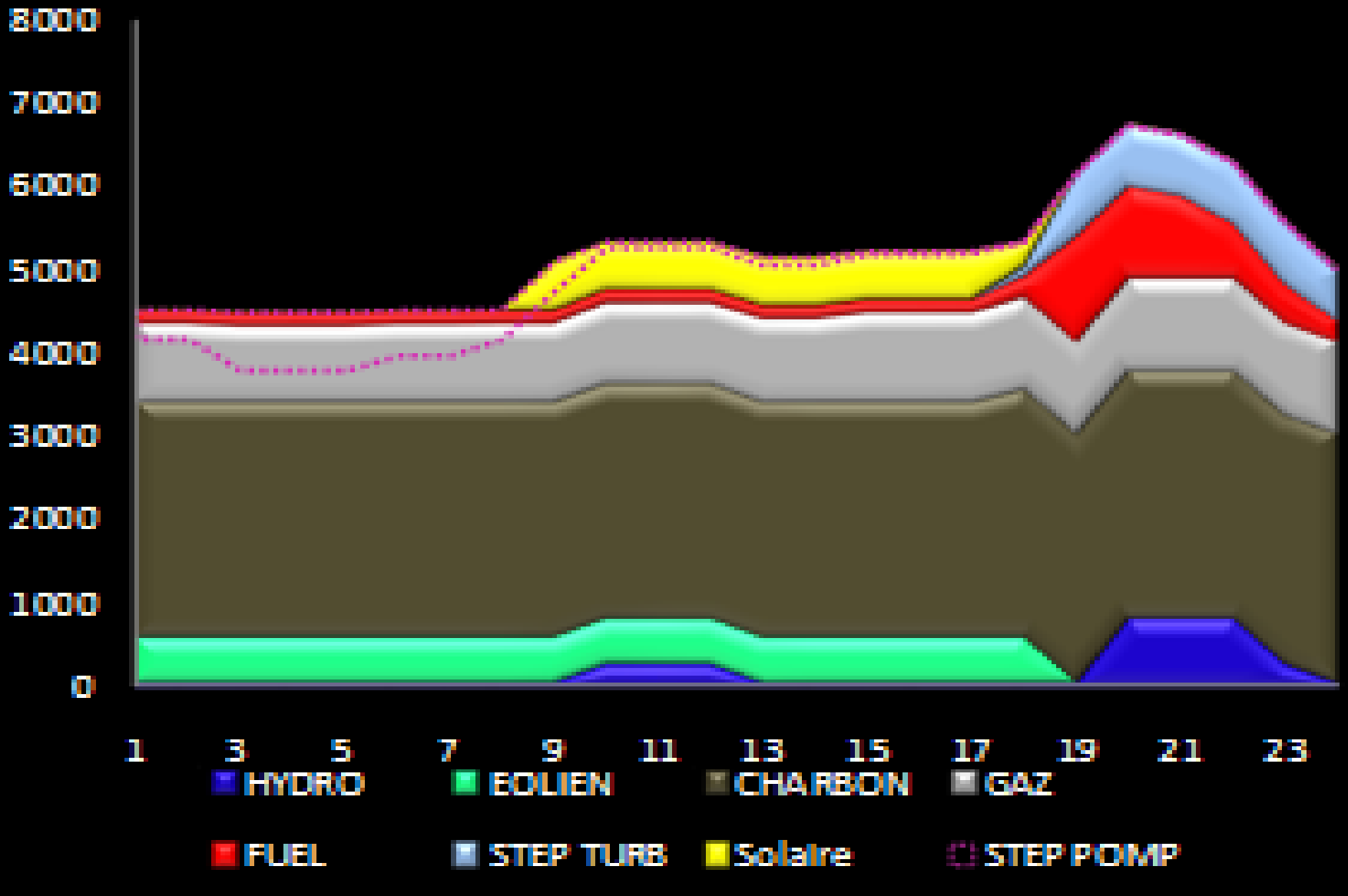
Extreme peak load



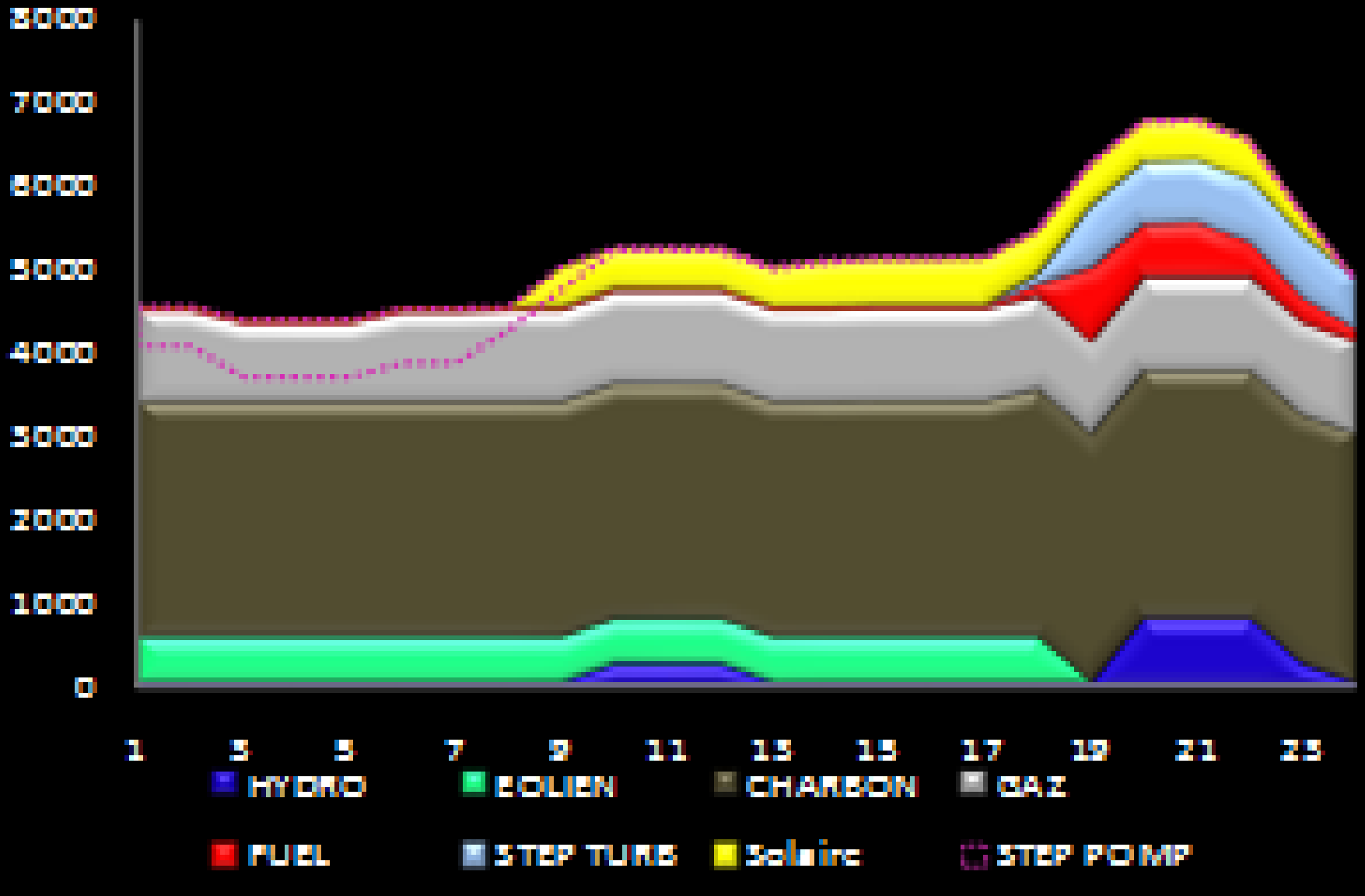
Morocco 2017: load curve & merit order



Morocco 2017: load curve & merit order with PV



Morocco 2017: load curve & merit order with CSP



Time of use payments are key

International Energy Agency

SCE

Monthly Period	On-Peak	Mid-Peak	Off-Peak	Super-Off- Peak
Winter		1.00000	0.83000	0.61000
Summer	3.13000	1.35000	0.75000	

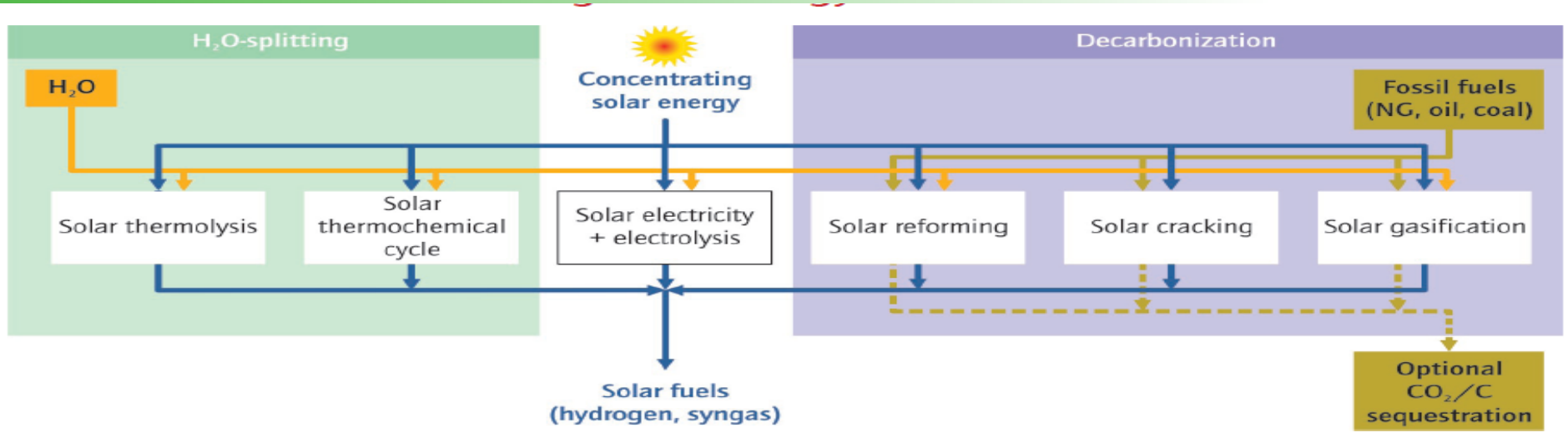
PG&E

Monthly Period	Super Peak	Shoulder	Night
Jun-Sept	2.204900	1.122370	0.689880
Oct -Dec, Jan&Feb	1.057830	0.934770	0.763840
Mar-May	1.145880	0.846340	0.642350

SDG&E

Monthly Period	On-Peak	Semi-Peak	*Off-Peak*
Nov-June	1.1916	1.0790	0.7928
July-Oct	1.6411	1.0400	0.8833

Concentrating solar fuels



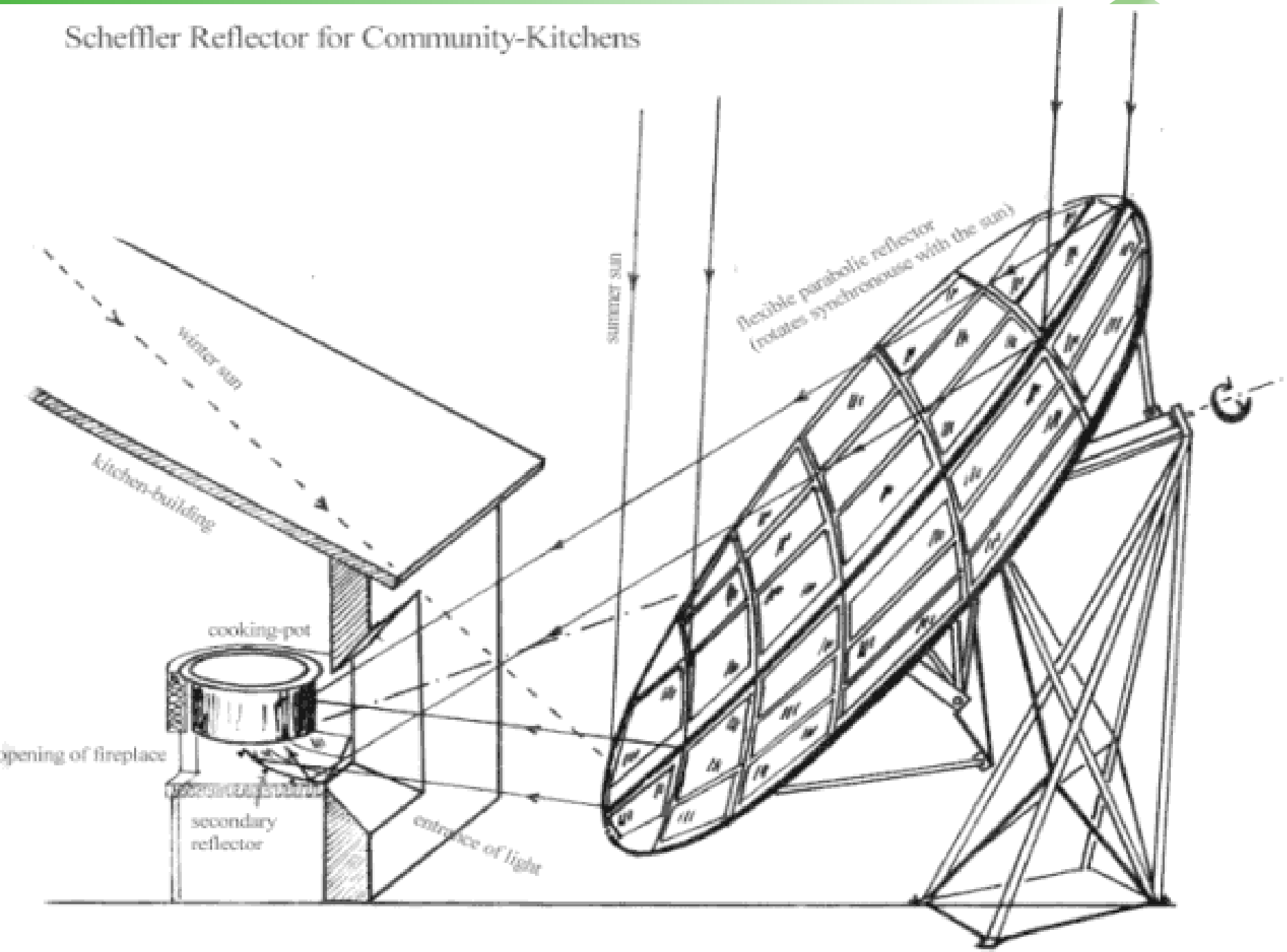
Source: PSI/ETH-Zürich.

- Solar assisted steam reforming of natural gas
- Hydrogen in natural gas grids
- Direct de-sulfuration of H_2S in refineries
- Solar-enhanced biofuels (gasification)
- Liquid fuels (with CO_2 footprint) for security
- Metal oxydes and fuel cells

Scheffler dishes

Steam cooking at Shiridi for 20 000 meals per day

Scheffler Reflector for Community-Kitchens



Forthcoming

RE Roadmaps

- Geothermal
- Biofuels
- Hydro Power
- Solar Heating & Cooling
- Bioenergy for Heat & Power

Books

- Harnessing Variable Renewables
- Deploying Renewables
  - Worldwide Prospects and Challenges
  - March
- Solar Publication

Solar publication: a primer

- Publication in September
- All technologies, all sectors, all countries, all timescales

- Markets and Outlook
  - Resource
  - Electricity
  - Buildings
  - Industry
  - Transport
  - Costs and Benefits
  - Policies
- Technologies
  - Photovoltaics
  - Heat
  - Solar thermal electricity
  - Solar fuels

Non-concentrating STE?

- Improvements in collectors allow considering non-concentrating solar thermal electricity
- Includes advanced flat-plates, evacuated tubes and… "concentrating compound collectors"
- Takes diffuse light, needs no sun-tracking
- At 160 C, solar-to-electricity ratio of <10%
- Relatively cheap storage (but volumes?)
- Could complement PV and shift load
- Possibly combined with solar heating & cooling
- Pre-heated water feed for fossil power plants
- One of several options to push the limits up

Conclusion: A considerable potential

- Solar energy has the potential to become the largest source of electricity, and contribute to heating, cooling, process heat, transport fuels – could become the primary energy source
- Solar may also change million lives with access to modern energy services
- Efforts to bring solar energy technologies to maturity and competitiveness must be broadly shared on global scale