

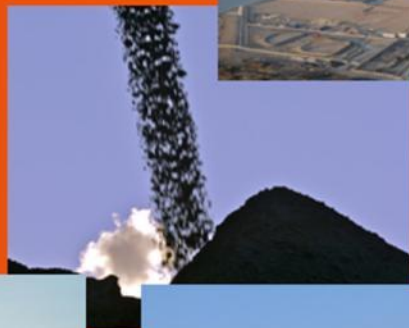


# UNCONVENTIONAL ENERGY SOURCES – NEW SOLUTIONS AND PERSPECTIVES

**Michael BORRELL**

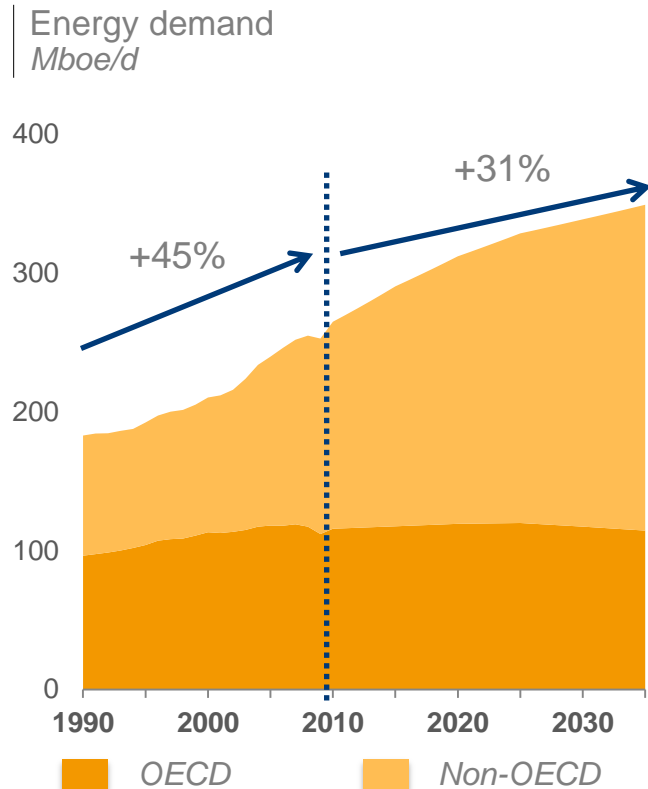
**TOTAL E&P Continental Europe and Central Asia Senior Vice President**

**VIII KAZENERGY EURASIAN FORUM, Astana, October 8<sup>th</sup>, 2013**



# Our vision of the energy mix

# CHALLENGES TO CHANGING THE ENERGY MODEL

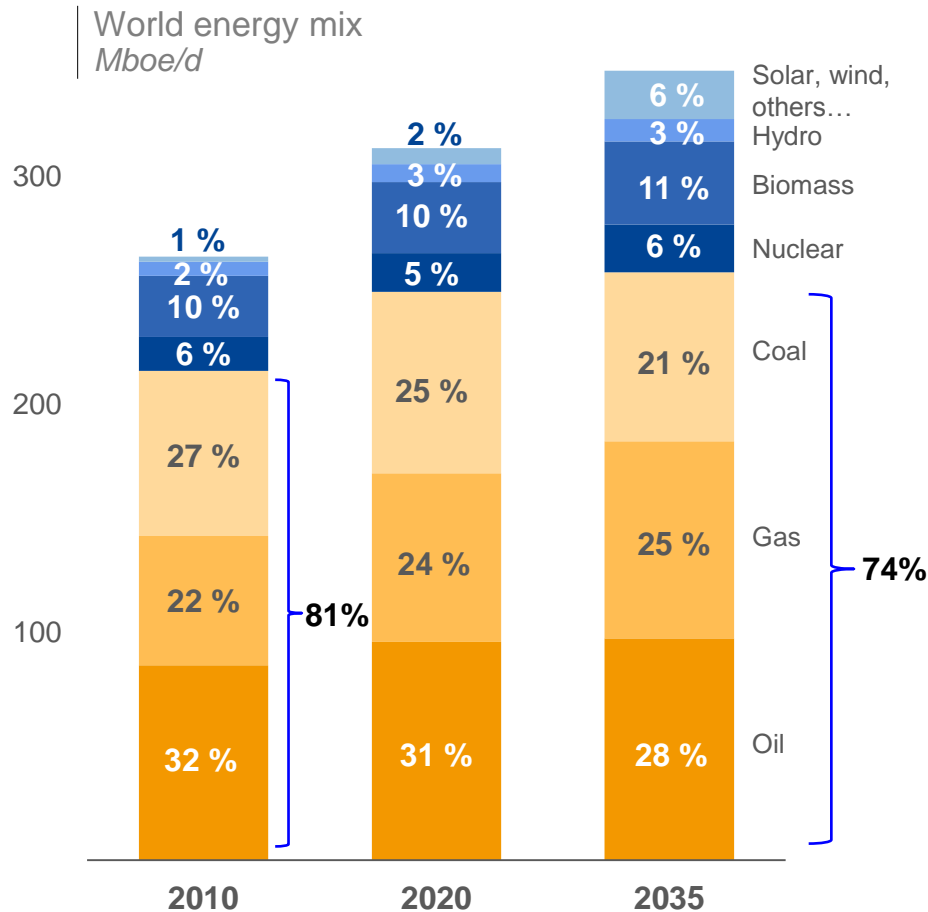


- Under Total's vision, energy demand will increase by **31%** between 2010 and 2035 driven by non-OECD countries' needs
- To secure enough **energy supply** to meet the needs of 8.6 billion people (vs. 7 bn. in 2012), the energy industry will need to focus on:
  - **Diversifying** the energy supply
  - **Dedicating** each energy to uses where it is most efficient
    - oil in transport and petrochemicals;
    - gas in power generation and heating
  - **Progressively reducing the carbon content** of the energy mix
  - Contributing to **improve energy efficiency**

Reaching a **new energy model** will be a long process that will require technology, innovation and massive investment



# PROGRESSIVE CHANGE OF THE WORLD ENERGY MIX



- By 2035 and beyond, **all kinds of energies** will be needed to meet the demand
- **Fossil energies** to represent 74% of energy supply in 2035
- **Gas** to become the second largest energy source before 2030
- Share of **nuclear** to remain steady
- Strong growth of **new energies**, in particular solar energy and biomass (non-traditional)

Renewable energies are a promise for **a bright future** but substitution of fossil fuels will be slow



# SOLAR ENERGY

A new energy future

# MORE THAN AN OIL COMPANY...

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To **MEET** growing demand  
for energy and address climate change



**TOTAL INVESTS**

in renewable energies to diversify our solutions

## TOTAL holds a 66% stake in SUNPOWER

More than  
**5,000**  
employees

Revenue in 2012  
**\$2.42**  
billion

World-record panel  
efficiency  
**21.5%**

**1,000**  
Megawatts/year  
production capacity

SUNPOWER®  
MORE ENERGY. FOR LIFE.™

World's

**#2**

in solar



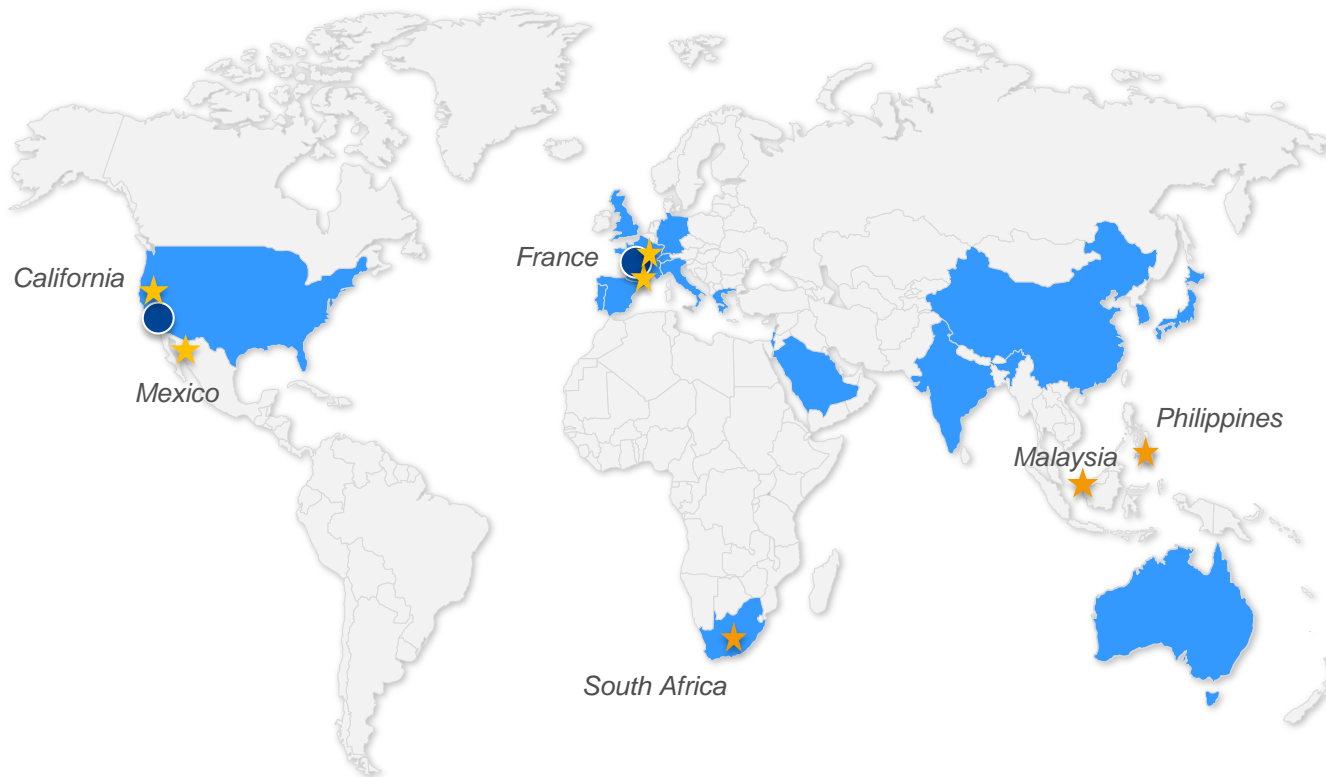
\* by 2012 revenue

# SUNPOWER

## A global international footprint

SUNPOWER®

MORE ENERGY. FOR LIFE.™



### UPSTREAM

-  Regional headquarter
-  Factories
-  Main markets





# SUNPOWER

## A solar market leader

An **innovative technology**: Maxeon® cells, used by NASA and Solar Impulse, convert more solar energy to electricity per square foot than conventional cells.

SunPower panels are the world's most efficient : **21.5%** efficiency, **highly resistant** to wear, corrosion and temperature fluctuations.

SUNPOWER®

MORE ENERGY. FOR LIFE.™

21.5%

World's most efficient  
solar panels \*



\* SunPower 345W solar panel vs. conventional panel (240W, 15% efficient, approx. 1.6 m2)

# SUNPOWER

## World's largest photovoltaic solar power plants

### CALIFORNIA VALLEY SOLAR RANCH

San Luis Obispo, California, USA

**250** MW AC (315 MW DC)

**800,000** SunPower panels

**100,000** homes powered

Construction started: 2011

Completion: 2013



### ANTELOPE VALLEY SOLAR PROJECTS

Rosamond, California, USA

**579** MW AC (709 MW DC)

**1,717,920** SunPower panels

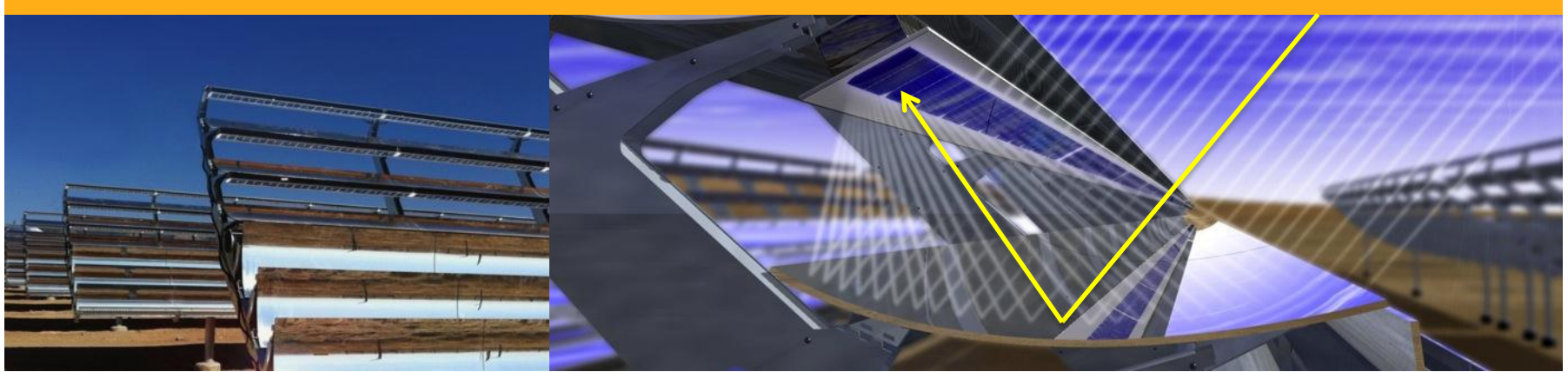
**400,000** homes powered

Construction started: 2013

Expected completion: 2016

# C7 PRODUCT

## Solar concentrator



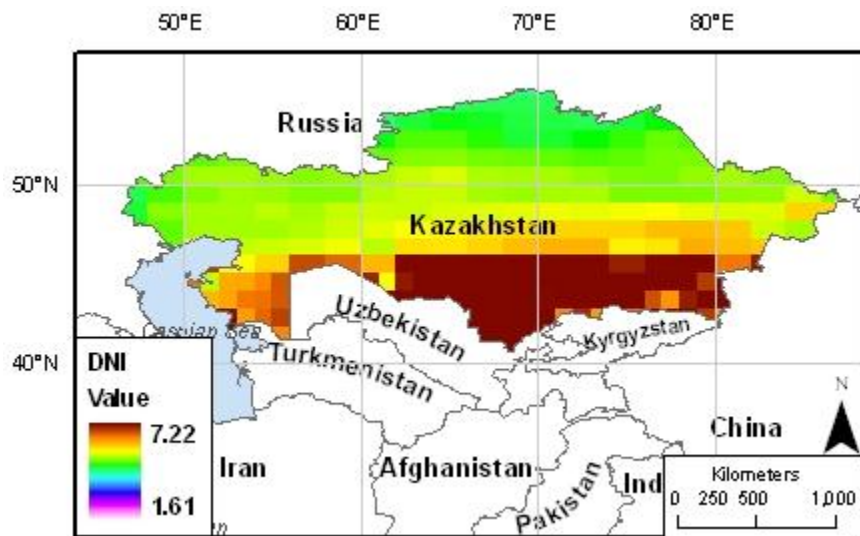
### The future of low cost solar energy

- The power of 7 suns focused on each high efficiency solar cell
- Only possible with SunPower Maxeon cell technology
- Certified by TUV (European standards IEC62108 for product quality and IEC62688 for safety), & UL (8703 certificate) for installation in the U.S.

#### Kazakhstan's Solar Power Generation Potential

Support the Nazarbayev University's Research Center's solar activities (PhD students - Icube),  
Install and operate a pilot to test the system under different sunlight and weather conditions.

Kazakhstan Solar Direct Normal Insolation (Source: NASA)



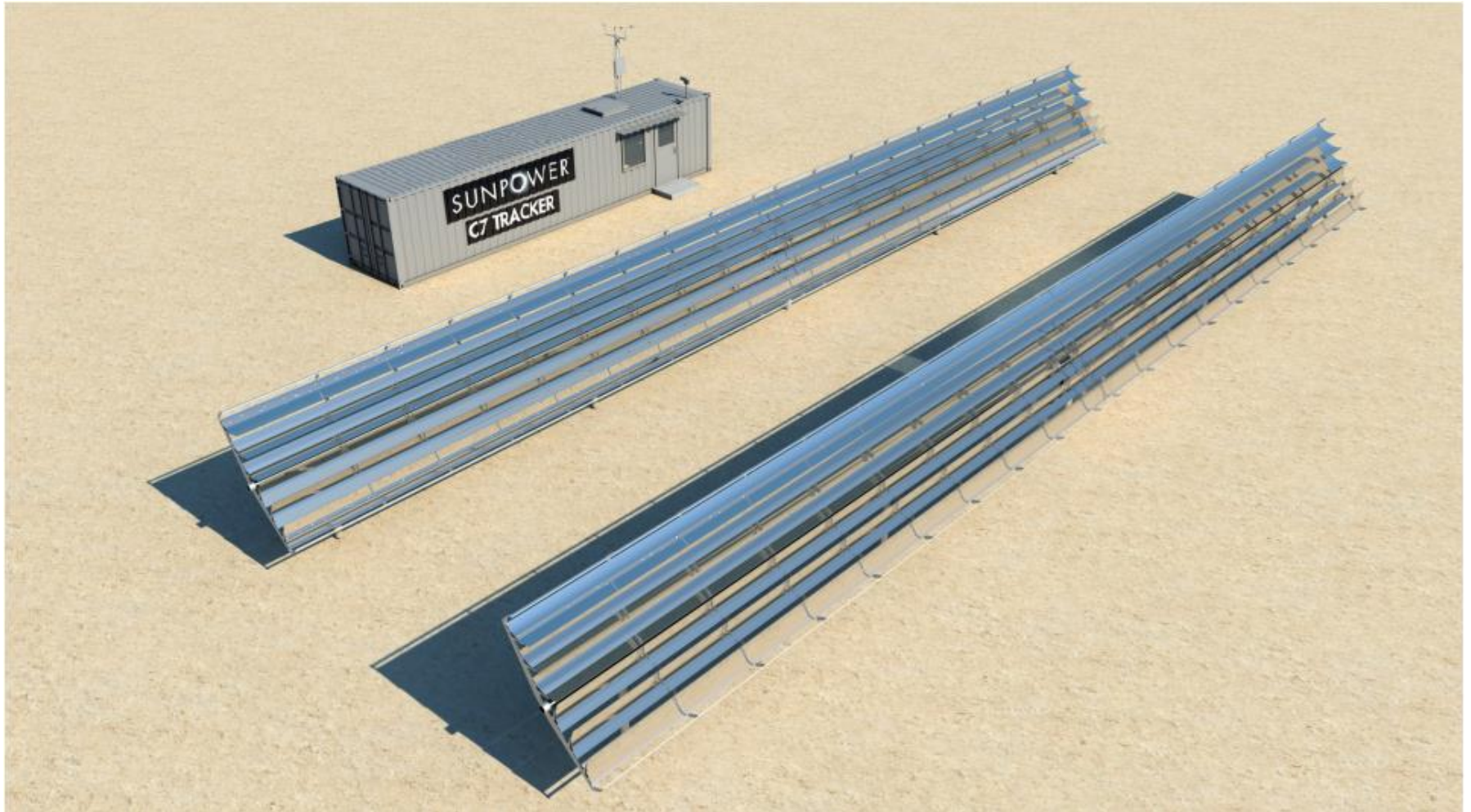


# SunPower

## SunPower<sub>TM</sub> OASIS<sub>TM</sub> C7 Proposal

### C7 Demo

Kazakhstan



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