

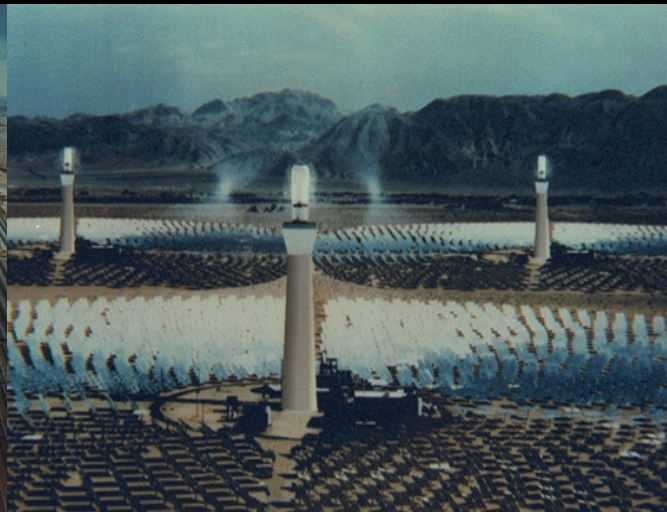


# Introducing Concentrated Solar Power on the International Markets

Worldwide Incentives, Policies and Benefits

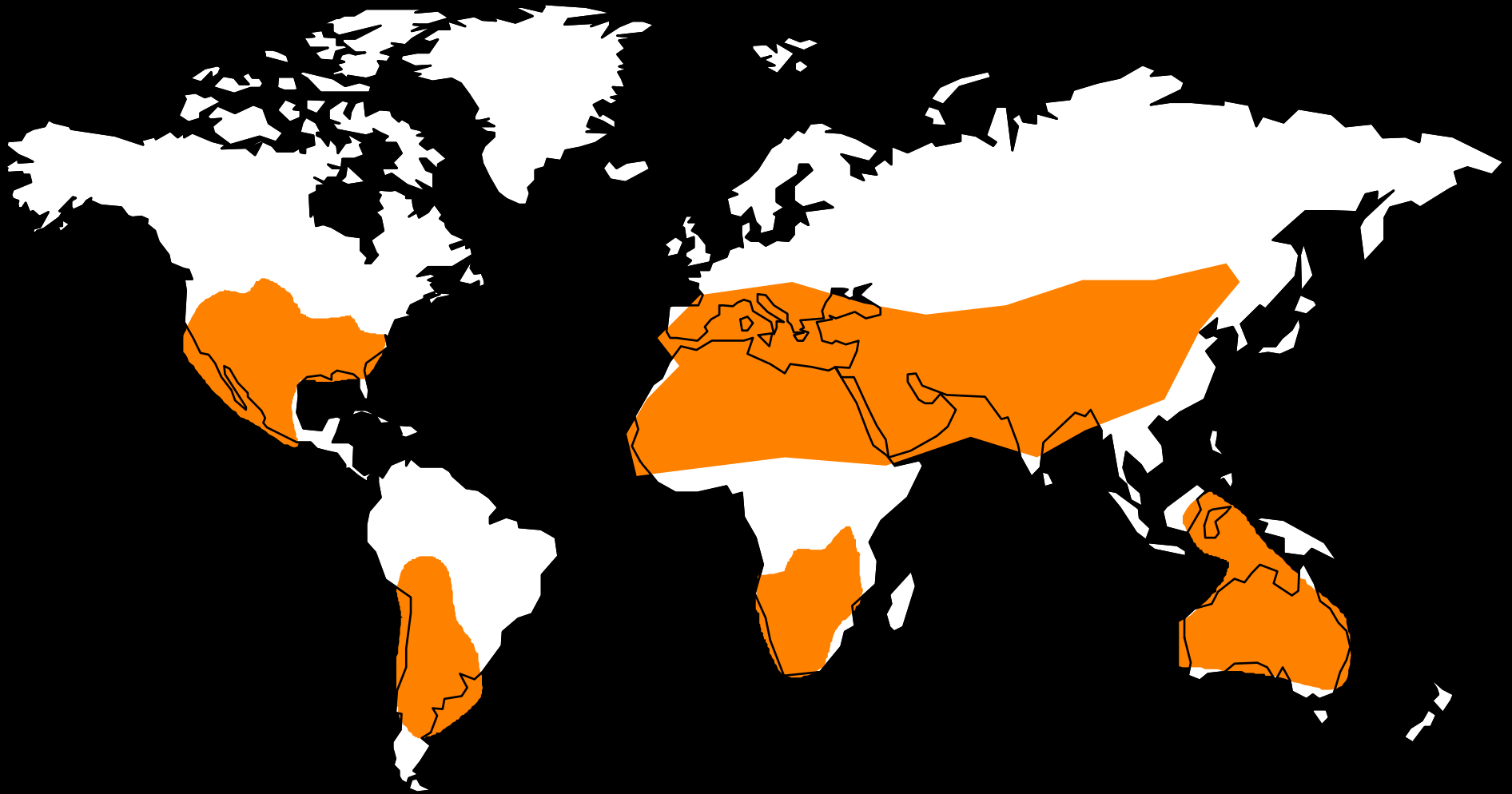
Dr. Michael Geyer

Director International Business Development, Abengoa Solar





## The CSP Marketplace: Where DNI is at least 5kWh/m<sup>2</sup>d





# Joint SolarPACES-ESTIA-Greenpeace Scenario

EXPLOITING THE HEAT FROM THE SUN TO COMBAT CLIMATE CHANGE

**CONCENTRATED SOLAR THERMAL POWER – NOW!**

GREENPEACE ESTIA SEPTEMBER 2005

**ENERGIA SOLAR TERMOELÉCTRICA**

↘ **2020**  
PASOS FIRMES CONTRA EL CAMBIO CLIMÁTICO

GREENPEACE



## 2005 SolarPACES-ESTIA-Greenpeace Study Predicted 2005 over 35GW of CSP Worldwide by 2025

Year	Total / MW	Total / MWh	Total / tCO <sub>2</sub>	Total / Investment	Total / Jobs
2005	355	887.500	532.500	888	
2010	2.154	5.635.000	3.381.000	4.815	12.036
2015	6.454	17.385.000	10.431.000	4.200	18.880
2020	16.854	44.635.000	26.781.000	10.875	33.040
2025	36.854	95.885.000	57.531.000	16.450	54.280
Total 2000 till 2025			361.804.500		



## Predicted CSP Potential in OECD Europe

**Table 4.1: Solar Thermal Power Plant Market by Regions – Key Results**

Year	OECD-Europe / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	600	1.500.000	900.000	1.125
2015	1.200	3.000.000	1.800.000	400
2020	2.400	6.000.000	3.600.000	1.125
2025	4.500	11.250.000	6.750.000	2.100
<b>Total 2000 till 2025</b>			<b>49.470.000</b>	
Year	Spain / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	500	1.250.000	750.000	900
2015	1.000	2.500.000	1.500.000	400
2020	1.500	3.750.000	2.250.000	375
2025	2.000	5.000.000	3.000.000	350
<b>Total 2000 till 2025</b>			<b>30.795.000</b>	



# Predicted CSP Market Potential in OECD North America

Year	OECD North America / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005	354	885.000	531.000	
2010	1.054	2.635.000	1.581.000	2.025
2015	3.354	8.385.000	5.031.000	2.000
2020	8.054	20.135.000	12.081.000	4.125
2025	15.354	38.385.000	23.031.000	5.950
<b>Total 2000 till 2025</b>			<b>158.445.000</b>	
Year	California / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005	354	885.000	531.000	
2010	854	2.135.000	1.281.000	1.350
2015	2.354	5.885.000	3.531.000	1.200
2020	4.854	12.135.000	7.281.000	1.875
2025	7.354	18.385.000	11.031.000	1.750
<b>Total 2000 till 2025</b>			<b>93.195.000</b>	



## Predicted CSP Market Potential in Africa and Middle East

Year	Middle East / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	200	500.000	300.000	405
2015	800	2.000.000	1.200.000	520
2020	2.100	5.250.000	3.150.000	1.500
2025	5.000	12.500.000	7.500.000	2.100
<b>Total 2000 till 2025</b>			<b>44.055.000</b>	
Year	Africa / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	100	250.000	150.000	360
2015	200	500.000	300.000	200
2020	1.300	3.250.000	1.950.000	1.500
2025	4.000	10.000.000	6.000.000	2.100
<b>Total 2000 till 2025</b>			<b>27.600.000</b>	



## Predicted CSP Potential South Asia

Year	South Asia / India / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	30	75.000	45.000	135
2015	100	250.000	150.000	160
2020	500	1.250.000	750.000	100
2025	1.500	3.750.000	2.250.000	700
<b>Total 2000 till 2025</b>			<b>11.040.000</b>	
Year	China / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	50	125.000	75.000	225
2015	200	500.000	300.000	200
2020	700	1.750.000	1.050.000	375
2025	1.500	3.750.000	2.250.000	700
<b>Total 2000 till 2025</b>			<b>13.125.000</b>	



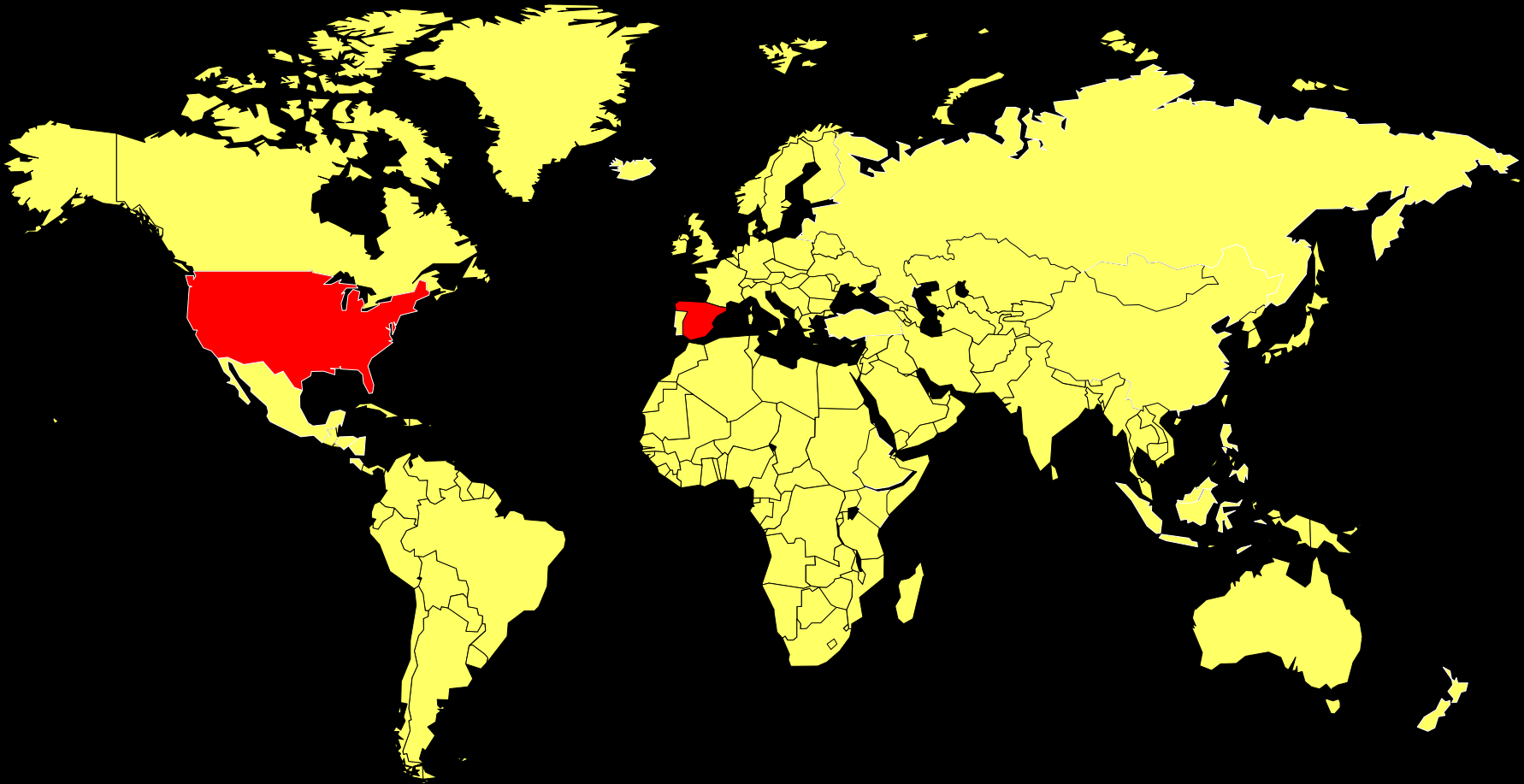


## Predicted CSP Market Potential Australia and Latin America

Year	OECD Pacific/Australia / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005	1	2.500	1.500	3
2010	100	250.000	150.000	225
2015	500	1.250.000	750.000	320
2020	1.000	2.500.000	1.500.000	375
2025	2.000	5.000.000	3.000.000	700
<b>Total 2000 till 2025</b>			<b>20.734.500</b>	
Year	Latin America / MW	MWh	tCO <sub>2</sub>	Market volume in MUS\$
2005				
2010	20	50.000	30.000	90
2015	100	250.000	150.000	80
2020	800	2.000.000	1.200.000	1.125
2025	3.000	7.500.000	4.500.000	1.750
<b>Total 2000 till 2025</b>			<b>18.855.000</b>	

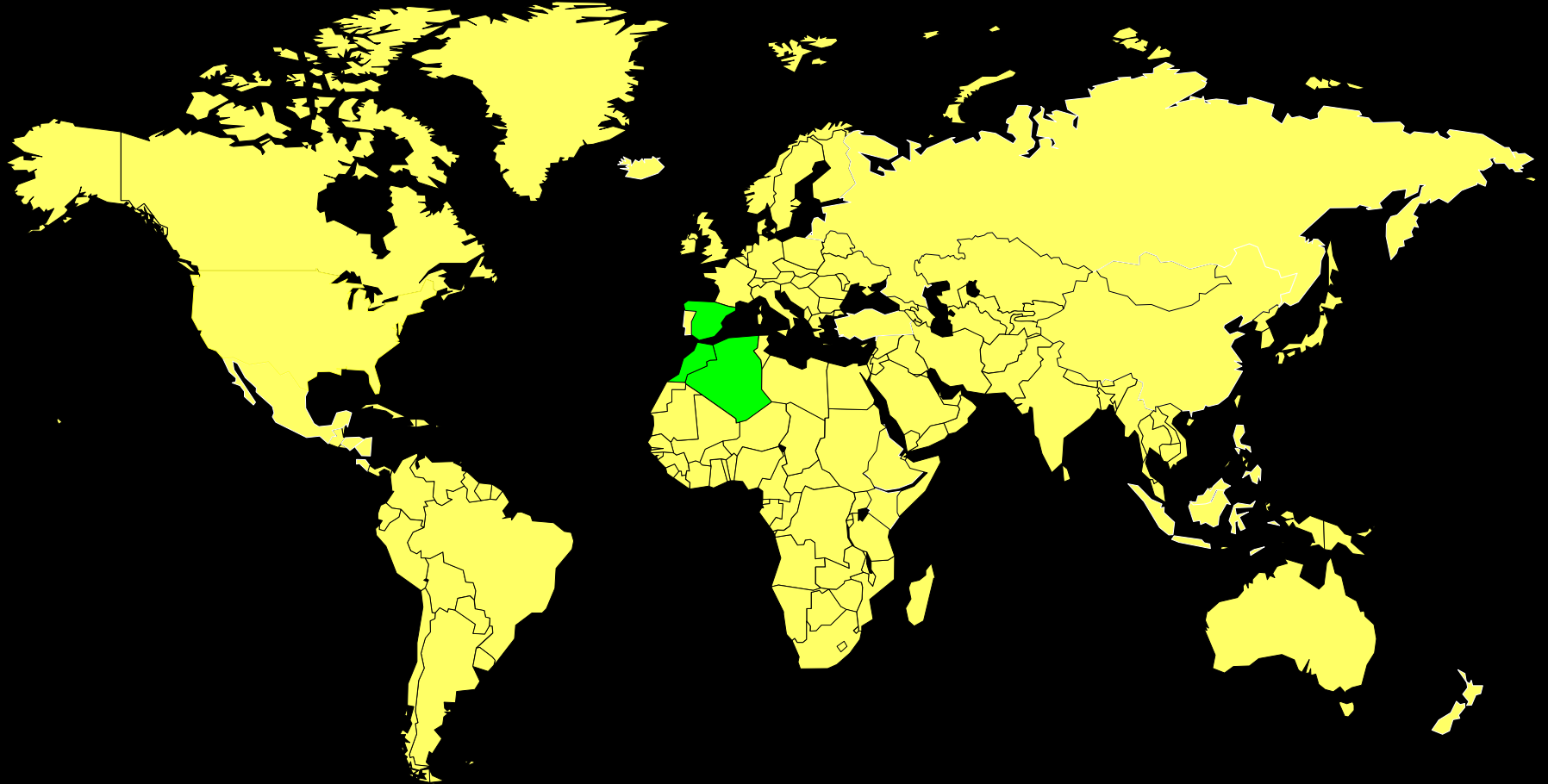


# CSP Plants in Operation: 410MW in US and 10MW in Spain





## CSP Plants in Construction:



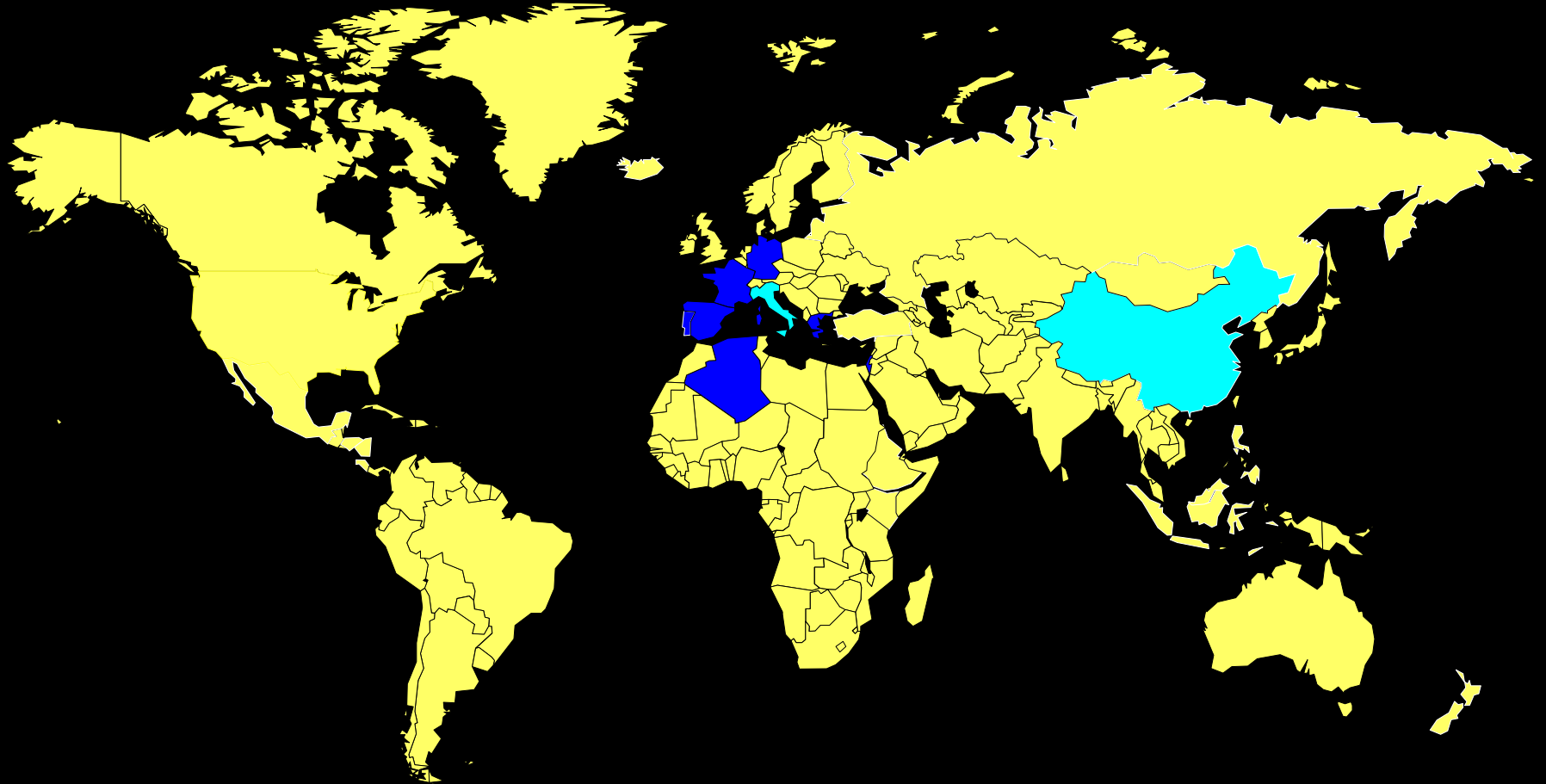
Algeria: 135MW ISCCS  
with 30MW CSP

Morocco: 300MW ISCCS  
with 30MW CSP

Spain: 270MW CSP



## Countries with Published CSP Tariff



Algeria: 135MW ISCCS  
with 30MW CSP

Morocco: 300MW ISCCS  
with 30MW CSP

Spain: 270MW CSP



# Mother of European Feed In Tariffs

27.10.2001

EN

Official Journal of the European Communities

L 283/33

DIRECTIVE 2001/77/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
of 27 September 2001

on the promotion of electricity produced from renewable energy sources in the internal electricity  
market

## 1. Four simple principles

**Member states must commit renewable targets**

**Member states are free in incentive Mechanism**

**Portugal, Spain, France, Germany, Greece, Italy have  
chosen mechanism of feed-in tariff**

**Member states must report fulfillment**

**Member states must setup objective, transparent and  
nondiscriminatory rules for grid access**



# New Spanish Feed-In Law for CSP: Real Decreto 661/2007

MINISTERIO DE INDUSTRIA,  
TURISMO Y COMERCIO

**10556** REAL DECRETO 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial.

- ➔ Cost covering with 0.27Euro/kWh
- ➔ Bankable with 25 year guarantee
- ➔ Annual adaptation to inflation
- ➔ 12-15% natural gas backup allowed to grant dispatchability and firm capacity
- ➔ After implementation of first 500MW tariff will be revised for subsequent plants to achieve cost reduction

Subgrupo b.1.2. Instalaciones que utilicen únicamente procesos térmicos para la transformación de la energía solar, como energía primaria, en electricidad. En estas instalaciones se podrán utilizar equipos que utilicen un combustible para el mantenimiento de la temperatura del fluido transmisor de calor para compensar la falta de irradiación solar que pueda afectar a la entrega prevista de energía. La generación eléctrica a partir de dicho combustible deberá ser inferior, en cómputo anual, al 12 por ciento de la producción total de electricidad si la instalación vende su energía de acuerdo a la opción a) del artículo 24.1 de este real decreto. Dicho porcentaje podrá llegar a ser el 15 por ciento si la instalación vende su energía de acuerdo a la opción b) del citado artículo 24.1.

Subgrupo	Potencia	Plazo	Tarifa regulada c€/kWh	Prima de referencia c€/kWh	Límite Superior c€/kWh	Límite Inferior c€/kWh
b.1.2		primeros 25 años	26,9375	25,4000	34,3976	25,4038
		a partir de entonces	21,5498	20,3200		



## Algerian Feed In Law 28-3-04

Renewable Energy Target  
5% of Electricity Production by 2010


Art. 12. — Pour l'électricité produite à partir d'installations utilisant de l'énergie solaire thermique par des systèmes hybrides solaire-gaz, la prime s'élève à 200% du prix par KWh de l'électricité élaboré par l'opérateur du marché défini par la loi n° 02-01 du 22 Dhou El Kaada 1422 correspondant au 5 février 2002 susvisée, et ceci quand la contribution minimale d'énergie solaire représente 25% de l'ensemble des énergies primaires.

Pour les contributions de l'énergie solaire inférieure à 25%, la dite prime est servie dans les conditions ci-après :

- pour une contribution solaire 25% et plus : la prime est de 200%,
- pour une contribution solaire 20 à 25% : la prime est de 180%,
- pour une contribution solaire 15 à 20% : la prime est de 160% ,
- pour une contribution solaire 10 à 15% : la prime est de 140% ,
- pour une contribution solaire 5 à 10% : la prime est de 100% ,
- pour une contribution solaire 0 à 5% : la prime est nulle.

N° 19 Dimanche 7 Safar 1425

43ème ANNEE Correspondant au 28 mars 2004



الجمهورية الجزائرية  
الديمقراطية الشعبية

# الجريدة الرسمية

اتفاقات دولية، قوانين، ومراسيم  
قرارات وآراء، مقررات، منشور، إعلانات وبلاغات

**JOURNAL OFFICIEL**  
DE LA REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

CONVENTIONS ET ACCORDS INTERNATIONAUX - LOIS ET DECRETS  
ARRETES, DECISIONS, AVIS, COMMUNICATIONS ET ANNONCES  
(TRADUCTION FRANÇAISE)



# Combine Solar and Gas for Power Export





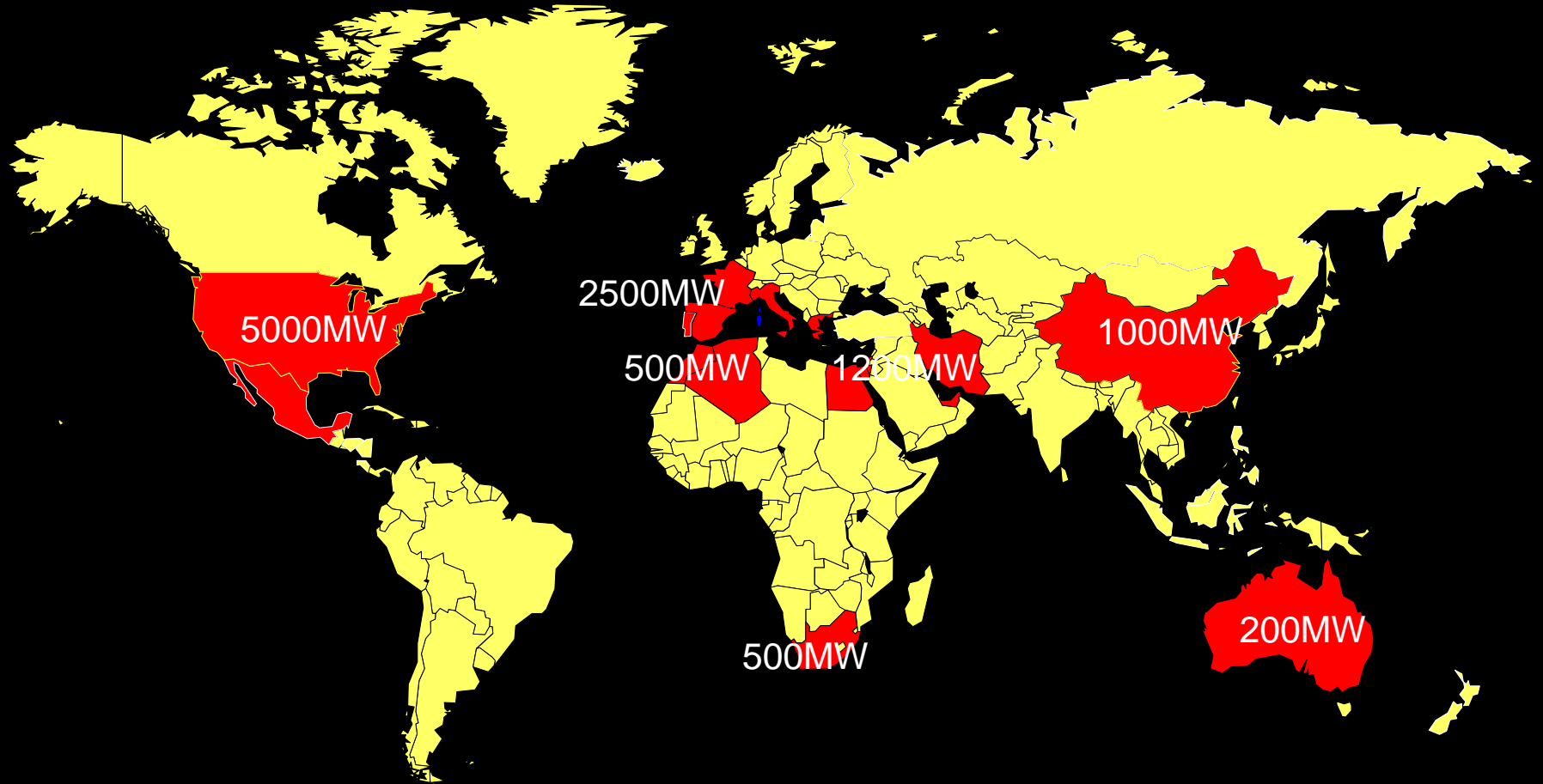


# Published CSP Feed In Laws

Feed-In Tariff	Capacity	Tariff	Duration Years	Inflation Adjustement	Restrictions	Hybrid
Algeria	ISCCS	100-200%	life time			
France	max 12MW	0.30€/kWh	20+	no	max 12MW, max 1500h/a	no
Germany		0,46€/kWh	lifetime	no		no
	up to 5MW	0,23-0,25€/kWh	10+10	no		yes
Greece	over 5MW	0,25-0,27€/kWh	10+10	no		yes
	up to 20MW	0.20USD/kWh	20+10	yes		max 30%
Israel	over 20MW	0,16USD/kWh	20+10	yes		max 30%
	up to 10MW	0.21€/kWh	15	no		no
Portugal	over 10MW	0,16€/kWh	15	no		no
Spain	up to 50MW	0.27€/kWh	25+	yes	max 50MW	max 15%

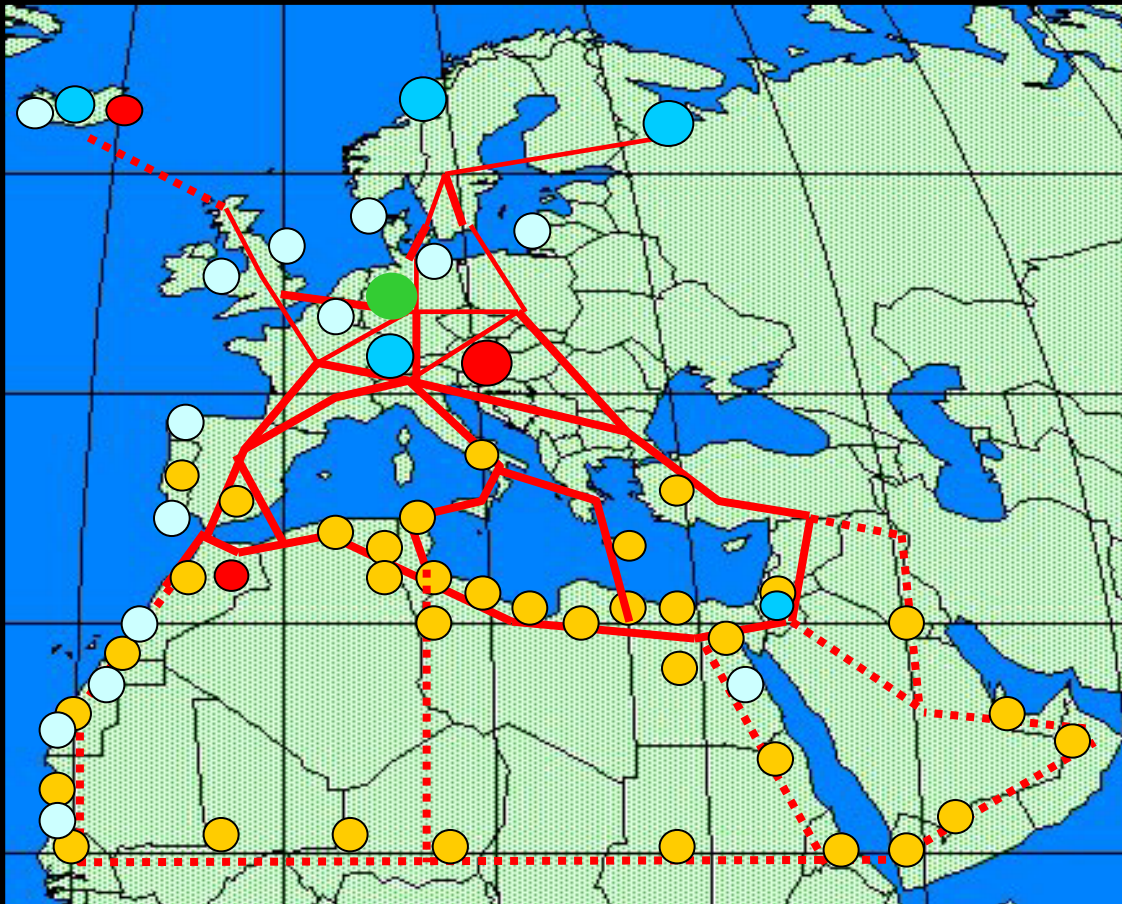


# 11GW of CSP Projects Currently under Development





# The TREC Vision of the EUMENA Renewable Power Link



CSP

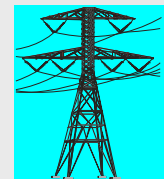
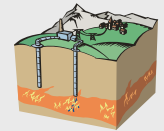
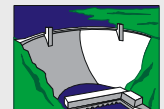
Wind

Hydro

Geothermal

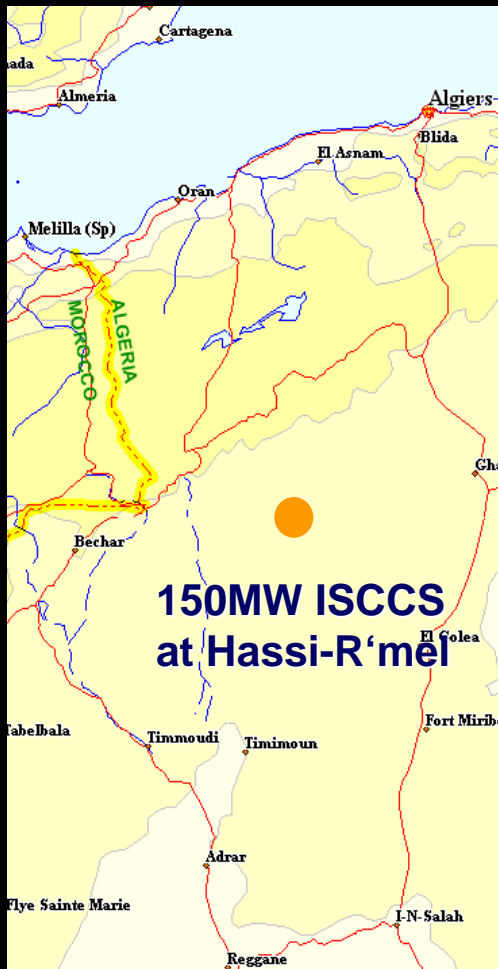
Biomass

Transmed  
HV Grid





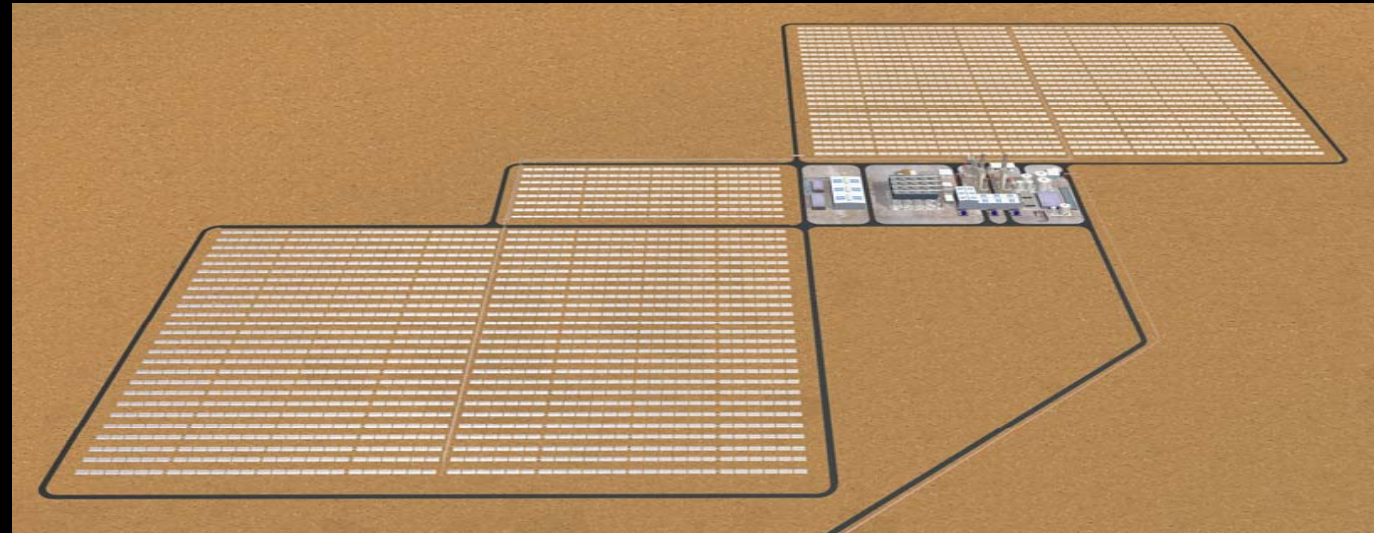
# World's First Integrated Solar Combined Cycle in Algeria



- ➔ Joint European-Algerian private power plant  
Joint Venture Abengoa (66%) and NEAL (34%)
- ➔ 130MW Gas Combined Cycle plus 25MW Parabolic Trough Solar Field of 183.000 m<sup>2</sup>
- ➔ First Project Finance for CSP plant in North Africa  
some 200Mio Euro financed by Algerian Banks
- ➔ BOT project according to Algerian Feed-in Law 04-92  
of March 25th 2004



## ONE of Morocco awards first GEF ISCCS project

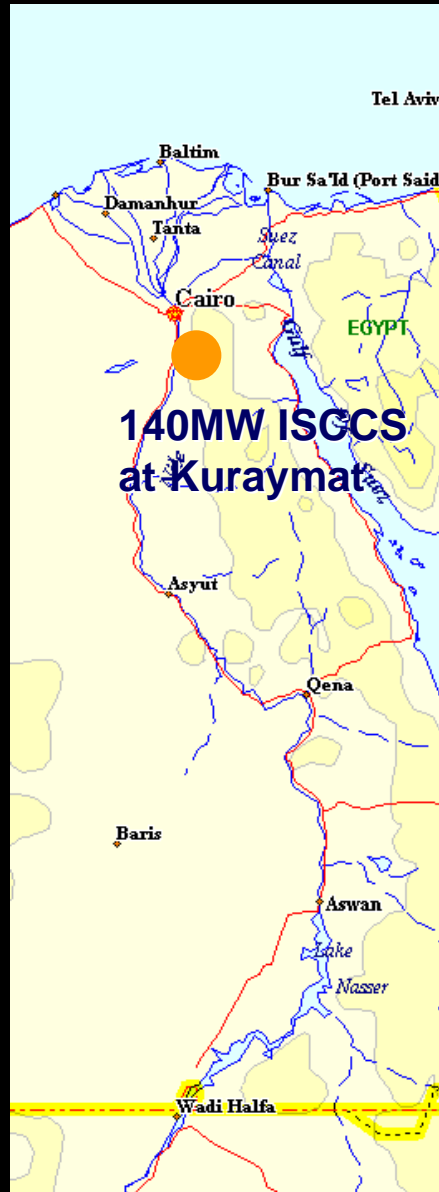


- ➔ Owner ONE Office Nationale d'Electricité
- ➔ EPC financed by ADB, ONE and 50Mio GEF Grant
- ➔ 450MW ISCCS with 183.000m<sup>2</sup> solar field
- ➔ Abener has been awarded contract in July 2007



## Egypt: 146MW ISCCS with 30MW CSP in Kuraymat

Project Site Kuraymat: 2400kWh/m<sup>2</sup>a DNI



- ➔ Developer NREA New & Renewable Energy Agency
- ➔ EPC financed by JBIC and NREA with 50Mio Grant
- ➔ 984GWh per year, of which 64.5GWh solar
- ➔ Awarded to Iberdrola (CC) and Orascum/Flagsol (Solar Field)



## Mexico: 535MW ISCCS with 30MW Solar

Sábado 23 de septiembre de 2006

[Mi cuenta](#) | [Regístrate](#) | [Centro Meteorológico](#)

BUSCAR

**CFE** *Comisión Federal de Electricidad*

[Inicio](#) | [Mapa del sitio](#) | [English](#)

[La empresa](#) | [Servicios en línea](#) | [Información al cliente](#) | [Negocios con CFE](#) | [Sala de prensa](#) | [Contáctanos](#)

### Licitaciones de CFE

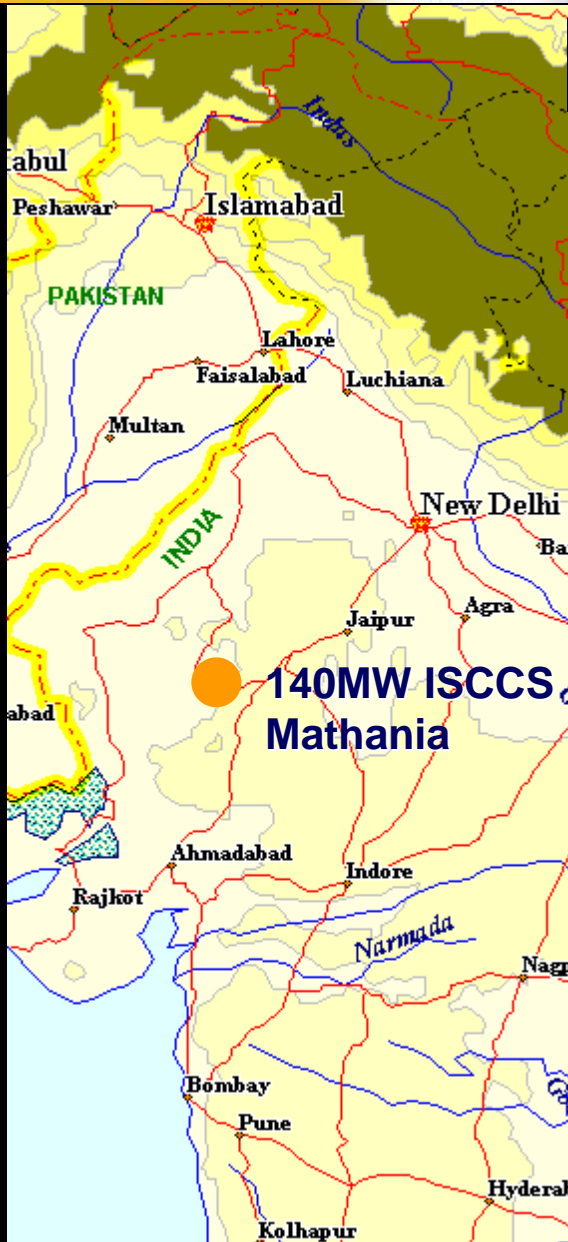
Resultados de la búsqueda

Detalle de la licitación de Obra pública

Licitación pública

Número licitación	de	18164093-022-06
Descripción del bien o de los trabajos:	171 CC Agua Prieta II (con campo solar). Clave 0518TOQ0047. "Diseno, la ingenieria, el suministro de equipos y materiales, la construccion, la instalacion, las pruebas, el apoyo tecnico, fletes, seguros, aranceles, impuestos y manejo aduanal, requeridos para tener una operacion segura, confiable y eficiente de una Central de Generacion de Ciclo Combinado denominada CC Agua Prieta II, con una capacidad neta garantizada de 535.64 MW (+/- 15%) a condiciones de diseno de verano, considerando gas natural como combustible principal. La Central estara conformada por dos o tres turbogeneradores de gas con sus sistemas auxiliares, cada uno con su respectivo generador de vapor por recuperacion de calor con sistemas auxiliares, un (1) turbogenerador de vapor con sus sistemas auxiliares, un (1) aerocondensador, todos los equipos necesarios para integrar un ciclo combinado, y un campo solar con concentradores solares tipo canal parabolico de no menos 30 MW, con todos los equipos y sistemas necesarios para generar y suministrar vapor al ciclo combinado, incluyendo la interconexion con la subestacion "Las Americas" de 400 kV, de conformidad con los terminos y condiciones establecidos en la seccion 6 (Contrato) y seccion 7 (Especificaciones Tecnicas) de las bases de licitacion; la Central estara localizada en el predio denominado "Las Americas", Municipio de Agua Prieta, Sonora, Estados Unidos Mexicanos.	

- EPC financed by CFE with 50Mio USD GEF Grant
- The first CFE BOT was not compatible with GEF
- RFP published on 29-08-2006
- Deadline 16-01-2007 and Award 14-02-2007



## India: 140MW ISCCS with 30MW Solar

Project Site Mathania: 2200kWh/m<sup>2</sup>a DNI

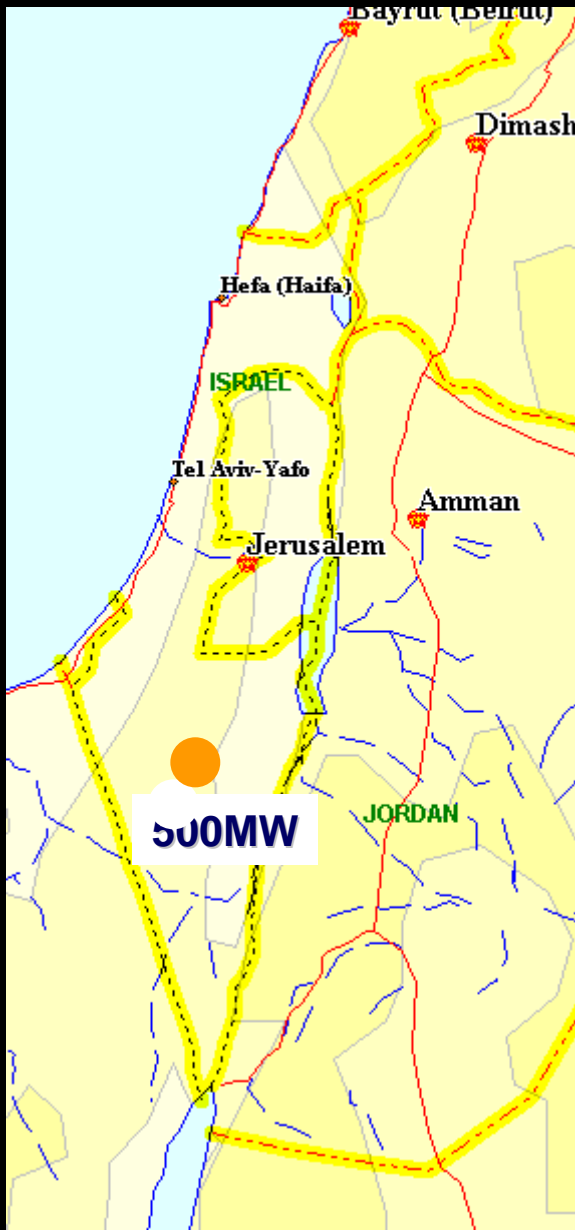


- ➔ KfW had financing with 50million USD GEF Grant
- ➔ To the RfP in June 2002 no bids were received
- ➔ In 2002 no EPC contractors ready to take the risk
- ➔ Project cancelled in December 2006





## ISRAEL: 500MW CSP Plants



Project Site Negev Desert: 2400kWh/m<sup>2</sup>a DNI



- Israel Ministry of National Infrastructures decided 2002 to introduce CSP in electricity market
- Objective 500MW
- Site qualified at Ashalim in the Negev



# Abu Dhabi Announced 500MW CSP



- ➔ Masdar Initiative
- ➔ Announced 500MW
- ➔ Feasibility Study completed
- ➔ RFP in preparation



# Italy: Archimedes Project in Sicily



- ➔ Lead by ENEA
- ➔ Integrate a molten salt parabolic trough field into an existing 700MW Combined Cycle



# IRAN: 400MW ISCCS with 60MW Solar Field



- Upgrade of existing 250MW GT Plant with 366.000m<sup>2</sup> solar field and 150MW ST to 400MW ISCCS
- EPC sponsored by Iranian Power Development Company (IPDC),
- 2850GWh per year, of which 120GWh solar
- RFP now under development



## South Africa: 100MW Power Tower

Project Site Upington:  $>2800\text{kWh/m}^2\text{a}$  DNI



- **ESKOM develops 100MW Demo Power Tower in Upington**
- **EPC Project of 100MW Molten Salt Tower**
- **Now technology risk reduction study**



# Looking into the Glass Ball for the Future CSP Developments

- ☀ **Support and Monitor CSP Plants**
- ☀ **Improve and Reduce Costs of CSP Components**
- ☀ **Build Global DNI Database**
- ☀ **Advance CSP Technology for Output Improvement and Cost Reduction**
- ☀ **Reduce Cooling Water Needs**
- ☀ **Develop Solar Water Treatment Technologies**
- ☀ **Develop Solar Hydrogen Technologies**
- ☀ **Develop Markets, Financing, Regulations in the Global Market Initiative**
- ☀ **Make CSP Known Globally**