DTU Library

Cooperation mechanisms between EU Member States and RES4Less Case Studies

Klinge Jacobsen, Henrik; Hansen, Lise-Lotte Pade; Tantareanu, Cristian; Gomez, Natalia

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Cooperation mechanisms between EU Member States and RES4Less Case Studies

Henrik Klinge Jacobsen & Lise-Lotte Pade Hansen, DTU, Denmark
Cristian Tantareanu, Enero, Romania
Natalia Gomez, Ciemat, Spain

IEE Project Res4less www.res4less.eu

Agenda

- Cooperation mechanisms
- Barriers and critical success factors
- Case study: Offshore wind
- Case study: Biomass
- Case study: Concentrated solar power

Cooperation mechanisms

- EU commission 20 percent targets in 2020
- Cooperation mechanisms
  - flexibility
  - achieve the targets the most cost efficient way

    - implement the RES where cheapest

  - Statistical transfers
  - Joint project
  - Joint support scheme

Cooperation mechanisms – statistical transfer

- Ex-post transfer of RES credits
- No prior agreements to assure the sale of the credits
- Ad-hoc means of ‘filling the gaps’

- Does not induce additional RES development
    - does not promote more efficient distribution of RES development

- Final stage transferring of RES certificates for joint projects and joint support schemes

Cooperation mechanisms – joint project

• Gives MS with lack of sufficient low-cost RES potential (user country) the possibility to develop projects in another MS (host country)

- Investors supported
  - user country
  - jointly by user and host countries
    - costs are balanced via a compensation scheme
- Project-to-project basis
- Special project support framework
  - technology/area specific

Cooperation mechanisms – joint support scheme

- Broad cooperation of MS on a national level
- MS agree on a common support scheme
- Greatest potential to efficiently utilise RES potential in the involved MS

- Less ambitious option: MS partially coordinate their national support schemes
  - technology/area specific

Cooperation mechanisms

- Focus in the RES4Less project
  - **Joint project**
  - **Joint support scheme**

- Statistical transfers not addressed, as
  - barriers and the complexities related to statistical transfers are assumed to be limited
  - do not provide more efficient RES development

Cooperation mechanisms

- Focus in the RES4Less project
  - **Joint project**
  - **Joint support scheme**

→ cooperation mechanisms actually implemented might be somewhere in between, as they may contain elements from both types.

- Statistical transfers not addressed, as
  - barriers and the complexities related to statistical transfers are assumed to be limited
  - do not provide more efficient RES development

Barriers

- Overall precondition for cooperation:
    - Both (all) MS should benefit
        - positive net-benefits are required

- Different political agendas embedded in the support schemes
- Power market effects
- Differences in network regulation
- Costs of non-compliance
- Compensatory challenges
- Post 2020 targets

Barriers – different support schemes

- Different support schemes
    - Administrative barriers
    - Investor risk
  - Combinations of support schemes
  - Technology-specific support versus general support
- Differences in support level

- Critical success factor:
  - ability/willingness to agree on chosen support scheme
  - coordination with existing support schemes

Barriers – power market effects

- Inflexibility of the energy system
- Changes in price level and volatility
  - Loss to existing producers
  - Lack of investment incentives
- Less diversified generation mix
  - More vulnerable system

- Critical success factors
  - Ability to agree on a compensation scheme

Barriers – network regulation

- Network regulation impacts the incentives for networks to facilitate efficient connection of new technologies
- If reinforcement investment costs included in revenue cap the costs will be borne by the network customers

- Crucial success factors
  - ability/willingness to agree on the cost sharing between the cooperating countries
  - ability/willingness to agree on a regulatory set up assuring the installation of RES where it is most effective

Barriers – cost of non-compliance

- Unknown consequences of non-compliance
  - lack of penalty
    - alternative costs compared to complying = zero

- Critical success factor
  - Ability to establish clear costs of non-compliance

Barriers – Compensatory challenges I

- Overall precondition for cooperation: Both (all) MS should benefit
- Direct benefits: reduced target compliance costs for the user country
- Indirect benefits:
  - Technology: faster RE technological progress in the host country
  - Power generation efficiency: investments where capacity is needed
  - Employment: positive employment effects in the short run
  - Environmental: binding CO2 target, emission reductions
  - Security of supply: increased interconnection
  - Investor risk: international agreements givers certainty of support
  - National risk of compliance: agreements assures compliance

Barriers – Compensatory challenges II

- Critical success factors
  - All direct costs and benefits have to be captured in a compensation scheme:
  - Indirect costs and benefits should be considered in the negotiations

Barriers – Post 2020 target

- No targets for post 2020 specified
    - Potential user countries will focus on the 2020 RES contributions
    - Investments in renewable technologies with 15-25 years lifetime
        - costs from investments large compared to value of RES credits for a single year
            - extreme case: value of credits post 2020 = zero
    - Unwillingness of the host country to engage in cooperation involving their cheapest surplus resources.
- Critical success factor:
    - Settlement of post 2020 targets

Barriers – Critical success factors

- Incorporate the additional costs of several support mechanism or support levels for different technologies
- Agreement on how to share the costs associated with network regulation
- Market price and investment incentives
- Compensation of changes in market price
- Willingness and ability to adjust to the changes in the energy market
- Incorporate the costs legal agreements and design of agreement
- Settlement of exact non-compliance costs
- All costs and benefits have to be mirrored in a compensation scheme
- Settlement of clear post 2020 targets

WIND CASE STUDY OF COOPERATION MECHANISMS

Henrik Klinge Jacobsen & Lise-Lotte Pade Hansen

Case study for off-shore wind in the Danish North Sea

Joint project cooperation with tendering of off-shore wind farms

The host country (DK) specifies the tender conditions and negotiate with user country (NL) a transfer price for the RES credits in 2020. The total size of off-shore wind farms are **2GW** corresponding to **8200GWh** in 2020.

Why this case study?

Off shore wind energy in the North Sea is a very large potential for RES and potential cooperation benefits
Limiting factors are the availability of low cost shallow and close to shore locations without interfering activities

Denmark has a 2020 surplus of medium cost offshore wind potential that is available for cooperation:

- ❑ wind farms have good wind conditions
- ❑ relatively shallow area
- ❑ transmission grid can absorb generation
- ❑ planning is already there

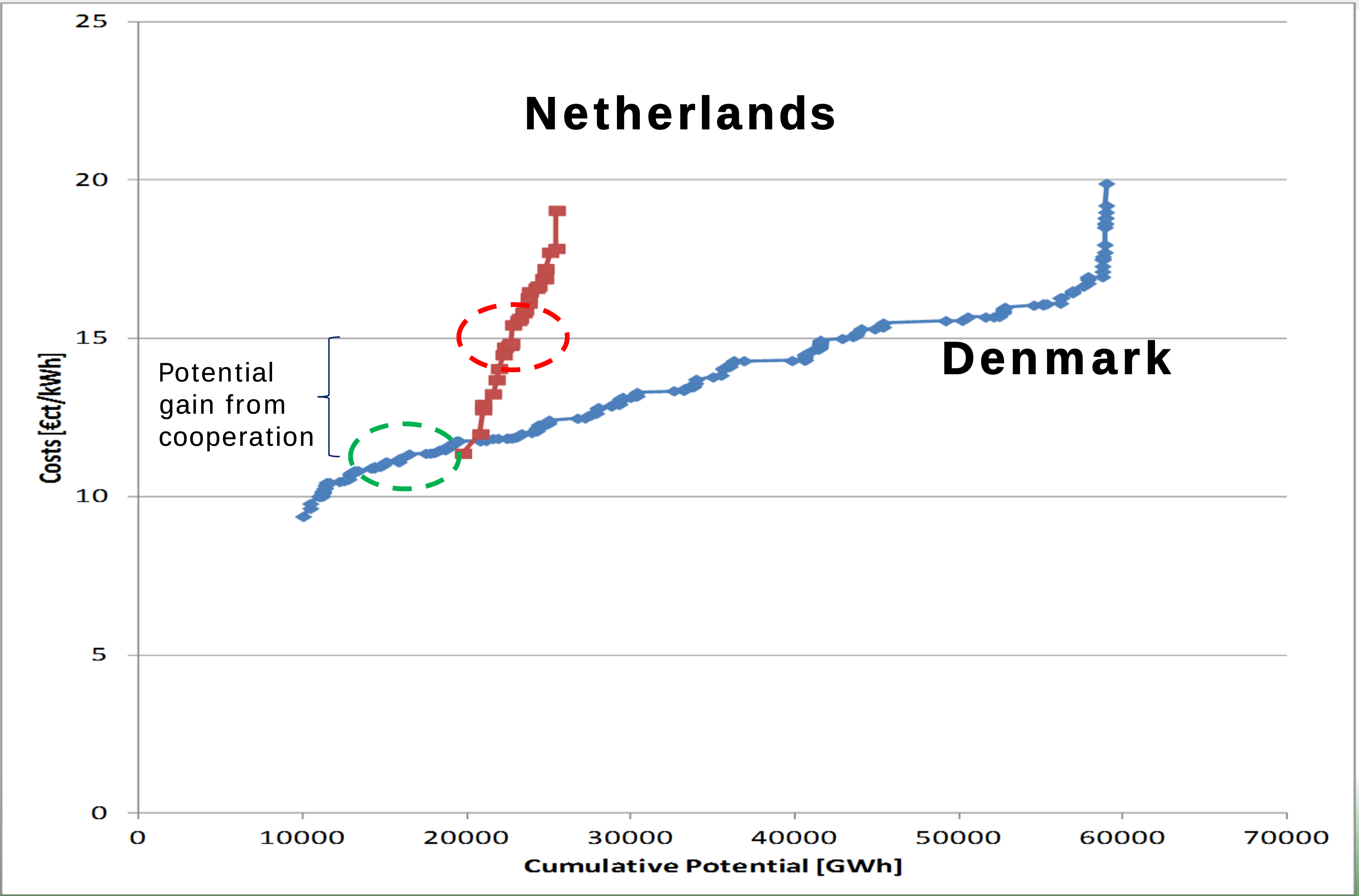
WP2 Results points to considerable Valleys of Opportunities for off-shore wind

Table: Main pairwise off-shore VoO's in 2020 sorted by size of host (TWh)

Host\user	UK	Netherlands	Poland	Greece	Belgium
Denmark	30.8	19.7	13.0	11.2	6.0
Germany	15.7	13.6	9.2	9.2	3.5
Ireland	0?	7.0	6.7	8.1	4.4

The case study is focusing on 8.2 TWh out of the identified 19.7 TWh VoO between DK and The Netherlands

Offshore wind costs 2020



Joint project cooperation: Danish offshore wind of 2GW in the North Sea

2020 potential below 15 €ct/kWh is available in Denmark

- Distance from shore: 20-25 km
- Depth: 20-25 m
- Windspeed: 10-11 m/s
- Close to support port (Esbjerg)

In the Horns Rev area and nearby there are considerable potentials for expanding capacity from the already existing 369 MW and the 400 MW addition decided

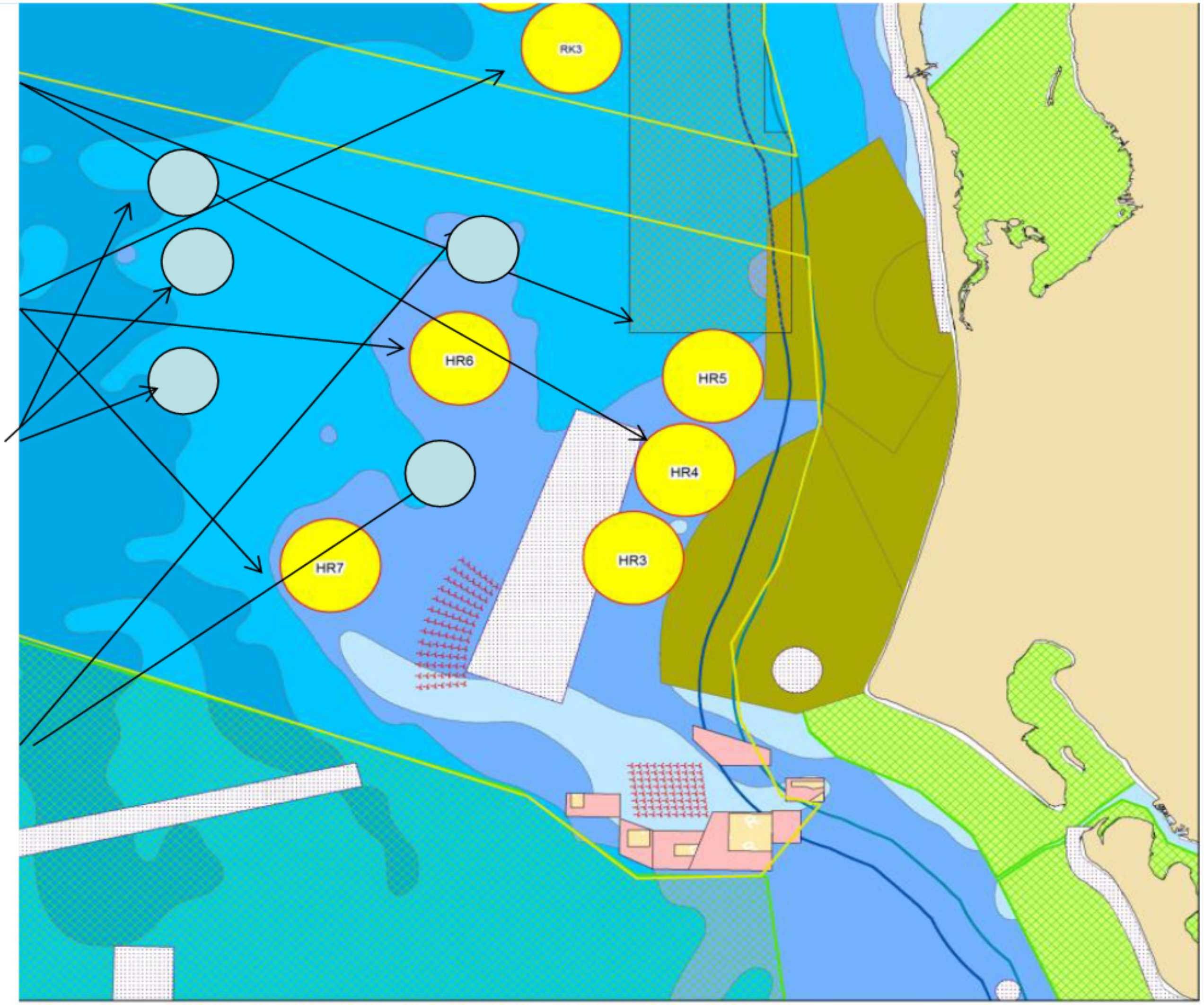
Horns Rev planned wind farms and additional locations

Probably available

Planned and available

Additional deeper locations with higher costs

Additional options with minor compensation payment to other parks



Brussels

Suggested design of the cooperation mechanism:

Cooperation include two options for the **Netherlands:**

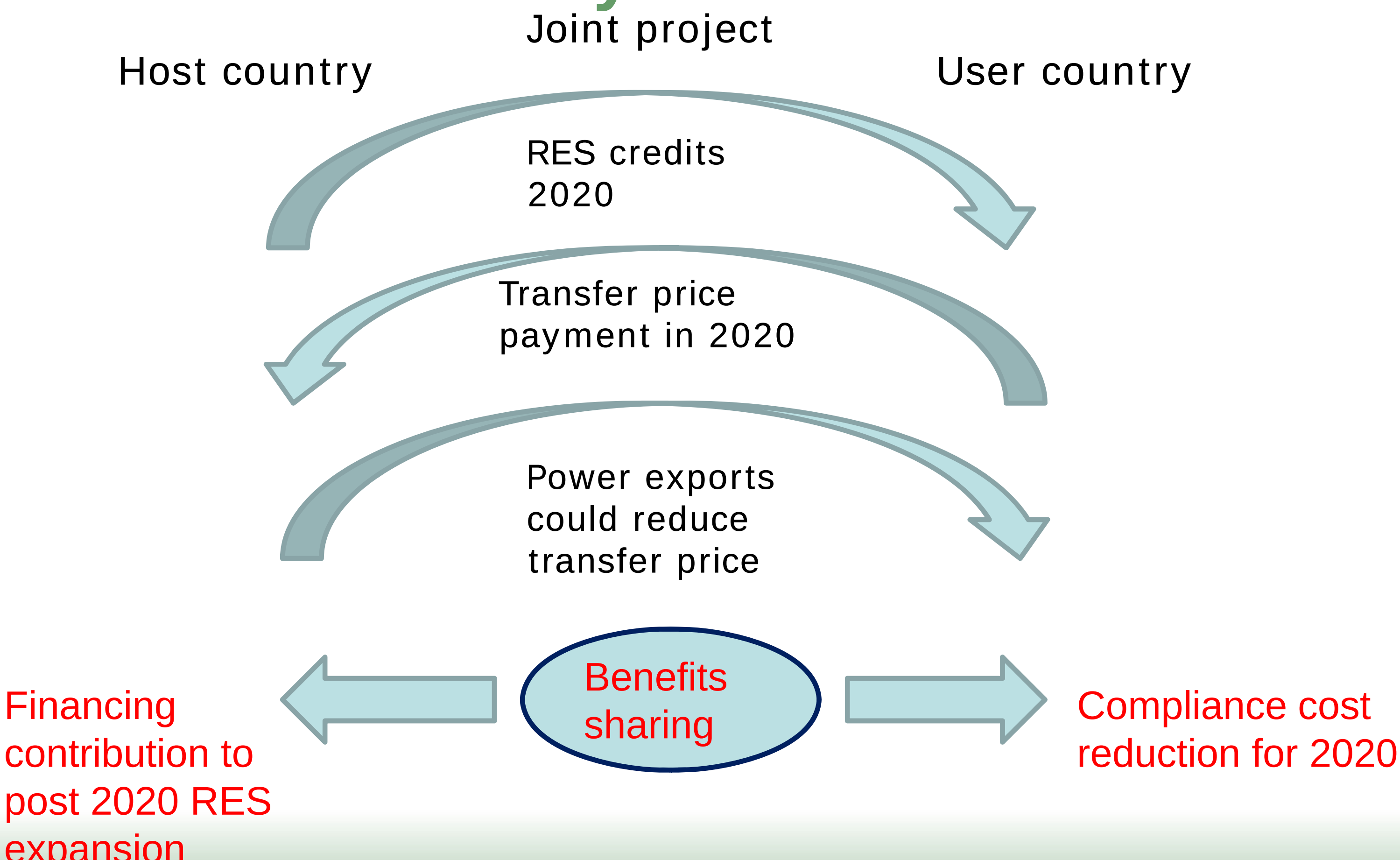
I. Acquire only the credits necessary for 2020 compliance: Cost example, **350 Euro/MWh in 2020**

⇨ **Full risk on post 2020 compliance**

II. Acquire the full RES capacity credits necessary for 2020 compliance but not the power generation: Cost example, support cost for 15 years: **80 Euro/MWh annually corresponding to 1200 Euro/MWh for 2020 credits**

⇨ **Capacity counts towards NL post 2020 targets (reduced risk)**

Transfer price and RES credits principles
Host and user country transfer of 2020 credits



Benefits for the Netherlands (preliminary illustration)

Total credits: **8200 GWh**	**Option 1 Credits price 35 c€ per KWh 2020 generation (physical transfer)**			**Option 2 Transfer of all *capacity* credits to NL (no physical transfer)**		
	Total costs of credits	Cost savings NL development support (10 c€) – 15 years	Net benefit 2020 (excluding post 2020 targets)	Total DK support costs financed by NL 8c€/kWh	Cost savings NL develop-ment support (10 c€) for 15 years	Net benefit 2020 (capacity available for post 2020 targets)
Results	**2870 mill €**	12300 mill €	**9430 mill €**	9840 mill €	12300 mill €	**2460 mill €**

Case study off-shore wind (NL-DK) 2000MW

Timeline example (Option I)

2012/13	Sites and conditions for tenders defined – negotiation on transfer price and volume
2013	Negotiation phase concluded – tender material prepared
2013/14	Tender for offshore wind parks of 1000MW
2014	Contract with investor/-developer signed Signed DK-NL transfer agreement
2014-16	Construction phase I
2016	Construction finalised New tender for additional 1000MW New signed agreements
2017-19	Construction phase II
2020	Transfer of RES credits DK-NL settlement payments
2020-32	Continued DK support payment to RES investor

Preliminary conclusions: Danish offshore wind of 2GW in the North Sea

Danish off-shore wind development is available for cooperation and joint projects with tendering is relatively simple to establish

Benefits in terms of compliance cost savings for Netherlands can be substantial
2.5 bill € - 9.4 bill € depending on design option

Denmark will have more wind development and in option 2 have additional credits to comply with increased post 2020 RES targets or domestic RES targets

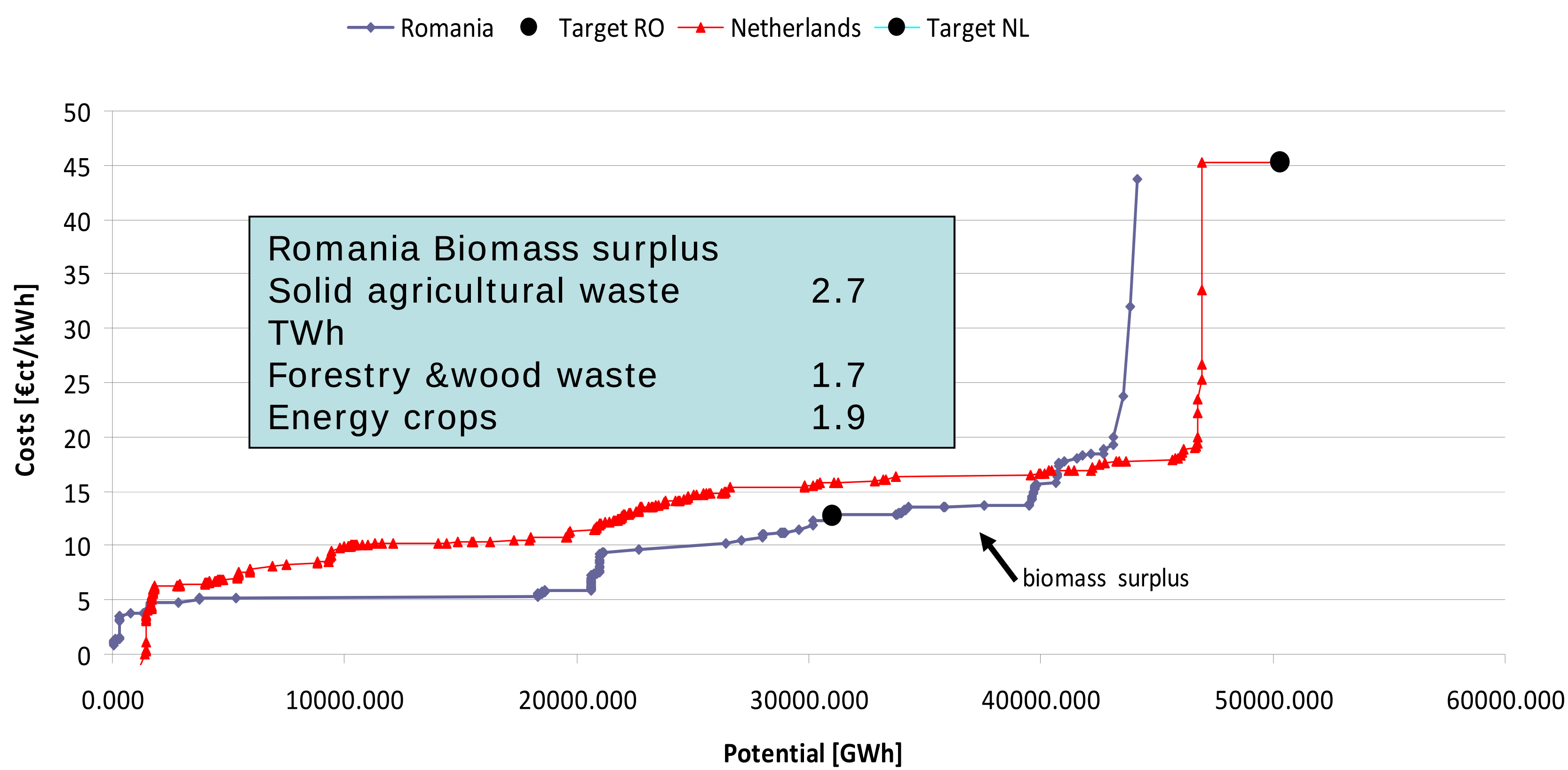
The results for both countries are extremely sensitive to the assumptions regarding the value of post 2020 credits (5c€/kWh) **EU post 2020 targets?**

The physical transfer option is included in option 1, but will be studied in more detail

Indirect effects have not yet been quantitatively accounted for

Biomass energy – Case study of cooperation mechanisms design

RES CSCs for Romania (Host country) and the User country, the Netherlands



The market, the RES national support systems and the political approach create real conditions, different than the CSCs

Only part of this surplus is realistic to be offered by the Host country for a cooperation mechanism:

We choose in the case study to dimension to **2 TWh/year** the quantity to be agreed within a cooperation mechanism.

Market conditions are favoring a biomass cooperation mechanism

- The RO target is on track to be fulfilled, with a plus on the expected contribution from wind and PV. Many wind and PV projects are on the pipe line, securing by PPA the selling of their output (Green Certificates) up to 2020.
Biomass projects are arriving with a "delay" on the market, and risk to find a low domestic demand for their GCs, therefore welcoming any other arrangement.
- After 2016 there is no national support scheme for new RES projects, therefore appears an "open" space for other programs/schemes to promote RES-E projects

Technology choice and specifics

The biomass for power chains are **very diverse**

Selected biomass resources

Not forestry resources: sensitive for public and politicians, but

- Agricultural waste
- Vegetal product from energy crops on unused land
- Animal waste

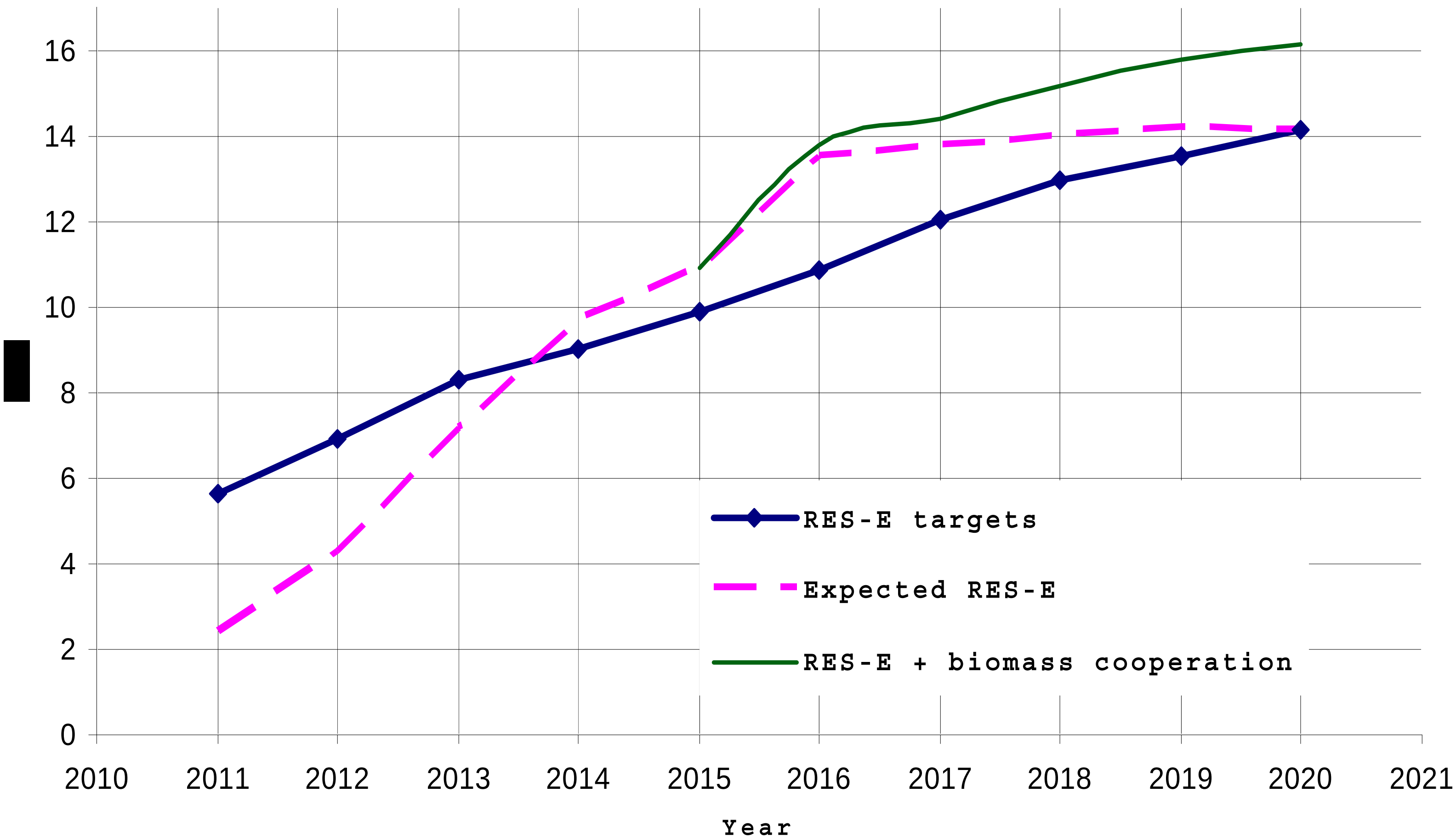
Technology

No specific restriction on technology, **if efficient**:
anaerobic digestion, gasification of woody material etc.

Biomass projects have usually a **small / medium size**, due to the cost of biomass collection, transport and management: 5...20 MW.

Therefore, already appears the challenge to put in place a mechanism able to manage **several projects totalling a significant output**, rather than a single joint project.

Estimated evolution of RES-E production (without large hydro) versus the targets, with and without the biomass cooperation mechanism



What kind of CM ?

Joint projects: fitted more for large size projects
Joint support scheme: the support schemes are very different, there is no similar to Romania quota support scheme in potential user countries

Suggested variant:
A special support framework in Romania for a number of small and medium size projects able to provide a defined quantity of energy, rated realistically to 2 TWh in the case study. The green energy value is transferred (statistically) to and bought by the User country for at least 10 years from a project life.

The management of biomass projects registered in Romania for the cooperation mechanism and their output could be organized starting from the good experience on the Green Certificates procedures. A similar managing track with the same actors as for GCs (Regulatory body ANRE, Transport and Distribution System Operators, the Commercial Operator OPCOM) may be put in place for the cooperation mechanism.

Design of the scheme. Accreditation and Registration of biomass projects for CM.	Issuing of Guarantee of Origins for the biomass resource	Validating and reporting green power from biomass projects, possible together with its Guarantee of Origin	Administration of a Register of the green power due for the CM, and of the respective producers (sellers)	Statistical transfer of the green power from the sellers account to the User country, who is paying the green energy “value” to the producers and the indirect costs to the Host country.
ANRE	Agricultural departments	TSO and DSOs	OPCOM	OCOM and/or specific new body

The price for the transferred power within a CM is negotiated

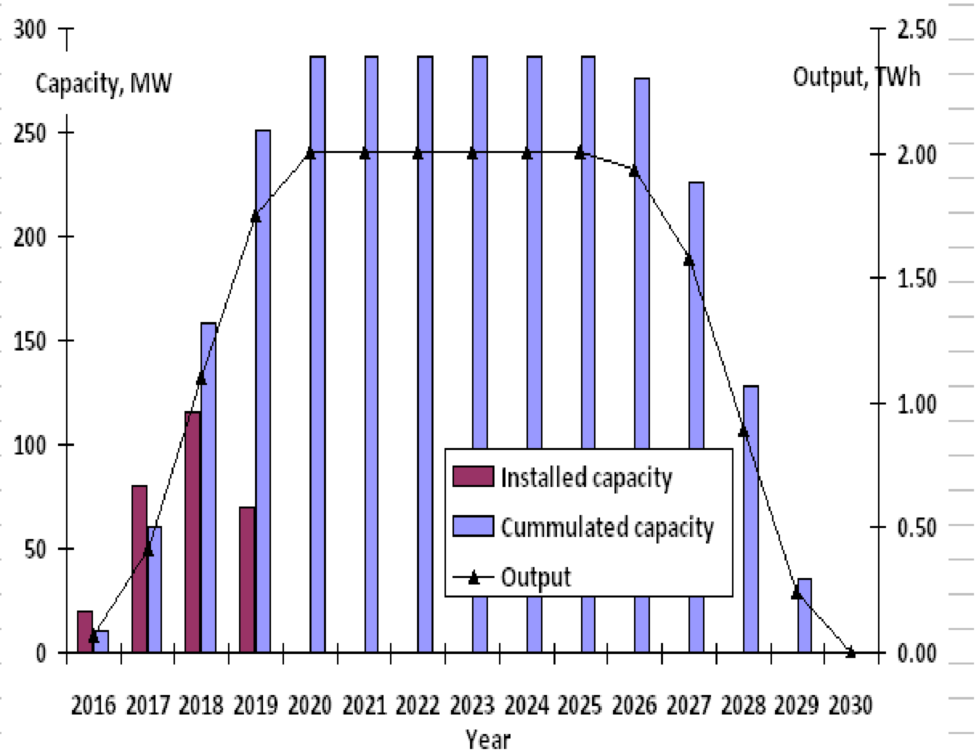
Costs to go to the projects operators as premium for the "green" energy.
A reference to estimate these costs may be the incentives of biomass RES producers according to the national support schemes, in Romania and the User country as well (80………160 Euro/MWh, depending on technology)

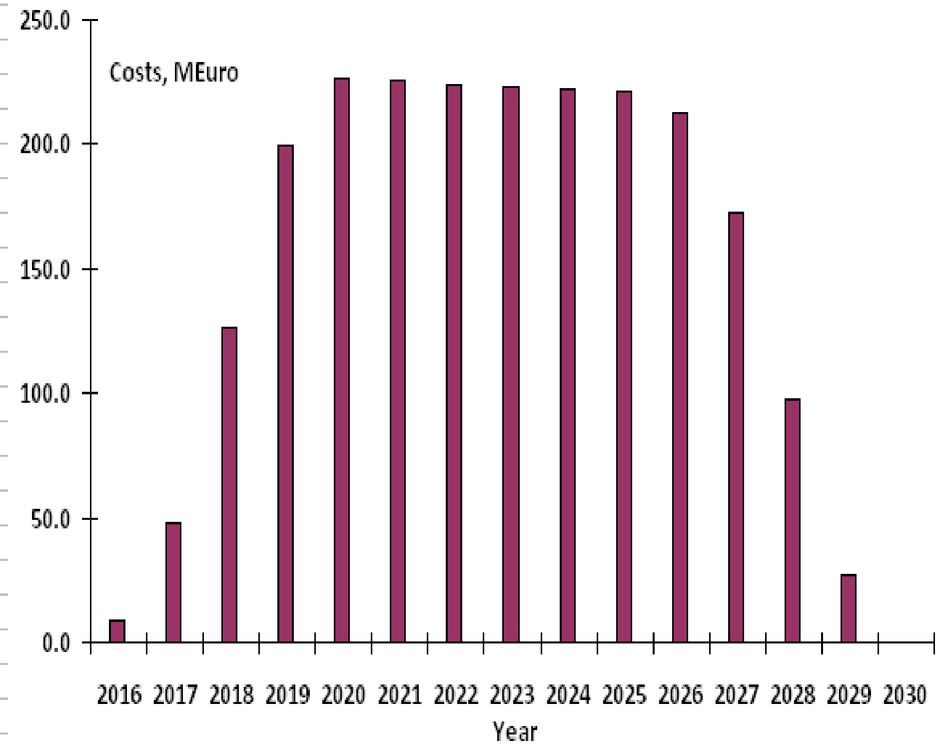
+

Costs to go to the Host country to recover the net between indirect costs (environment, scheme management, sell-out of RES potential etc**) and advantages (**investments effect, cheap electricity, distributed generation into the grid etc**)**

The investments in the corresponding biomass projects, with an average capacity of 5-10 MW, total c.a. 1 billion Euro.
E.g. if the average CoE from the biomass projects is 150 Euro/MWh, the agreed transfer price may be 110…120 Euro/MWh, for at least 10 years of the project life.
The User country has to pay c.a. 2.28 billions Euro in 14 years, of which c.a. 0.62 bEuro until 2020.

A scenario for capacities and output of biomass projects within the CM scheme





Conclusion

The present case study scheme has the advantages of **flexibility and possible step by step development**, a pragmatic approach agreed usually by the User,
starting with lower targets, and adjusting its main parameters (target, the price of the green electricity, period) following the real market feed backs and policy needs.

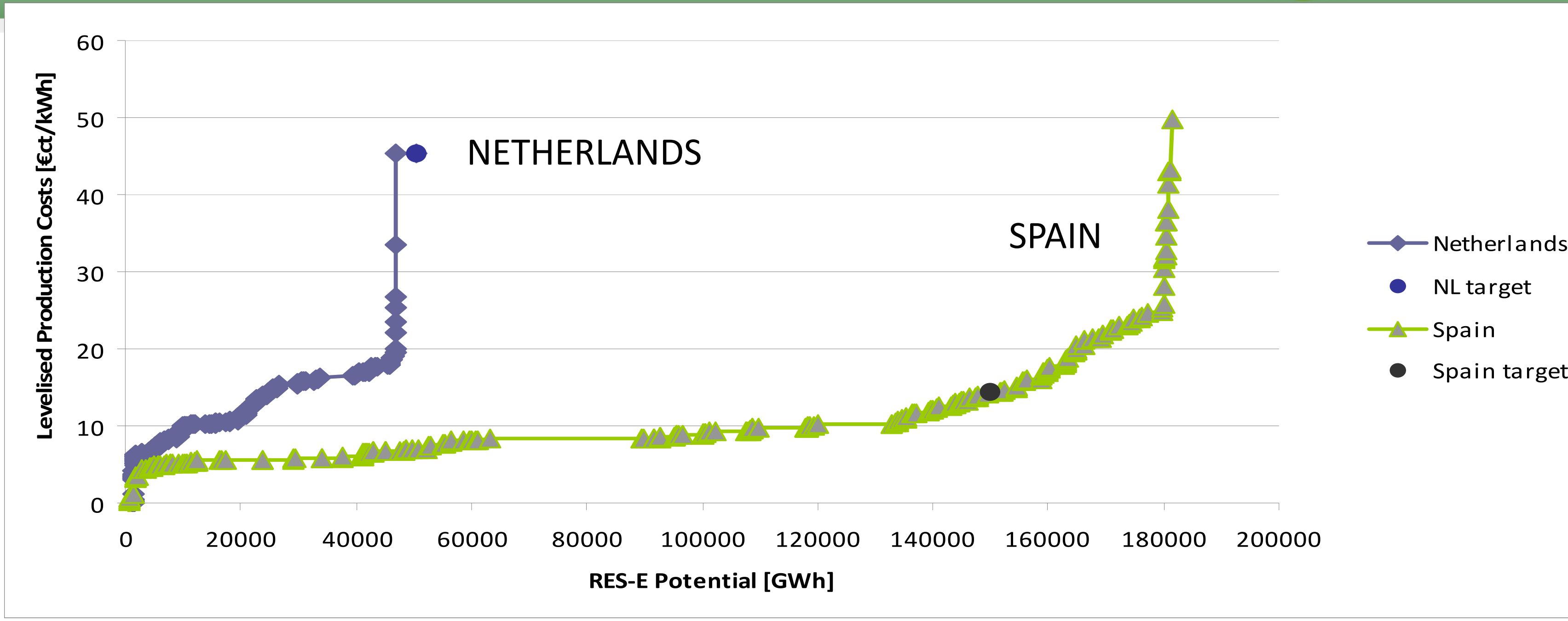
SOLAR CASE STUDY OF COOPERATION MECHANISMS

Natàlia Caldés and Marta Santamaría
CIEMAT

IEE Project Res4less www.res4less
Brussels, June 22st 2012

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD
Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

BACKGROUND (WP2 results)

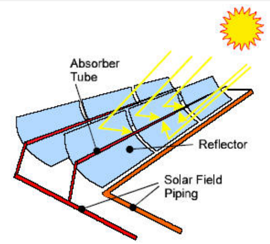


The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

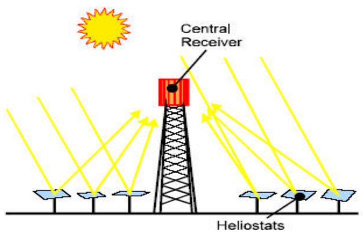
The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

THE TECHNOLOGY: Concentrated Solar Power

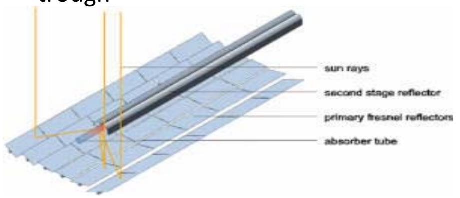
The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.



Parabolic trough



Central Receiver (tower)



Fresnel

The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

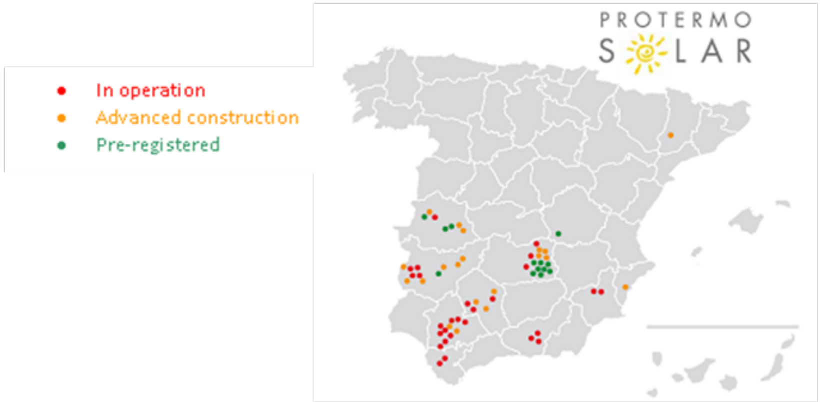
Stirling Dish

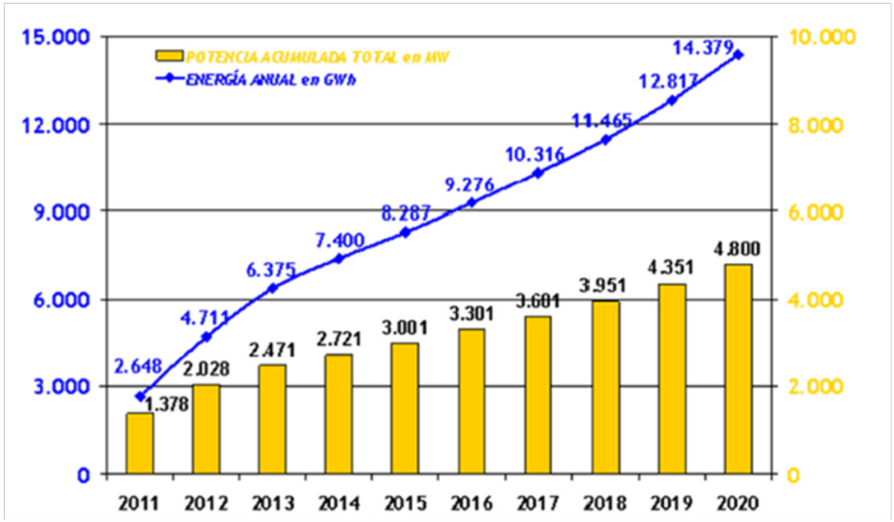
The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

Pictures: Protermosolar

CSP DEPLOYMENT in SPAIN

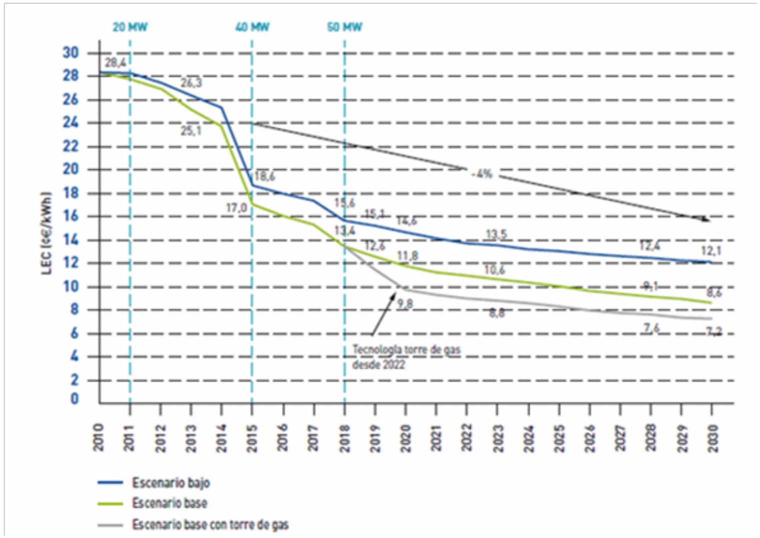




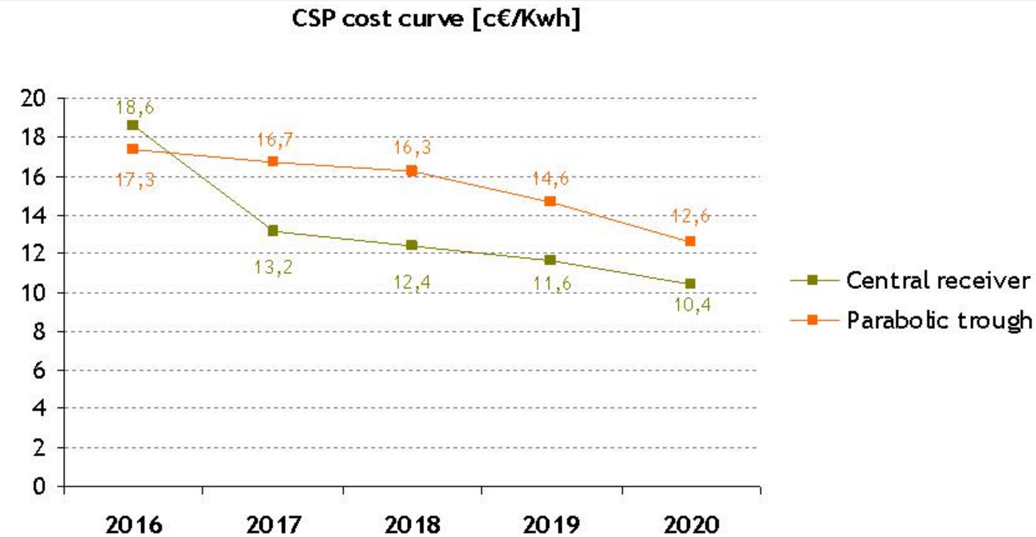
KEY SUCCESS FACTORS FOR CSP DEPLOYMENT IN SPAIN

- Enough **solar resource**
- Suitable **planning** – The Spanish Government has identified the barriers and proposed measures to overcome them and achieve the deployment objectives.
- **Legal framework**: has allowed economic viability and grid access guarantee
- **R&D** activities have taken place in Spain since the 80 s
- Mature **industrial sector** with capacity to develop the technology and invest great amounts (12,000 to 15,000 Million €)

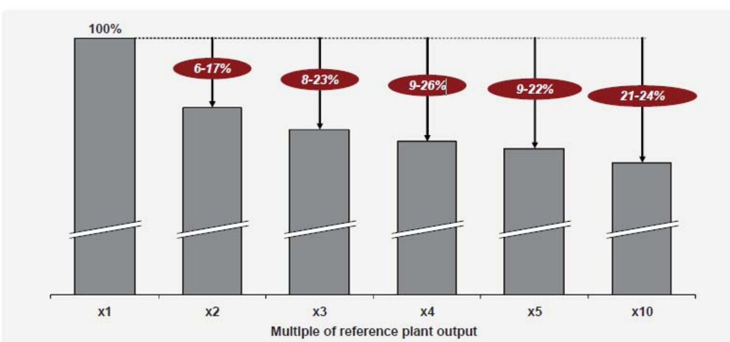
CSP GENERATION COST EVOLUTION



Source: Boston Consulting Group (2011)



Source: Own elaboration, on the base of BCG (2011) and ATKerney (2011)



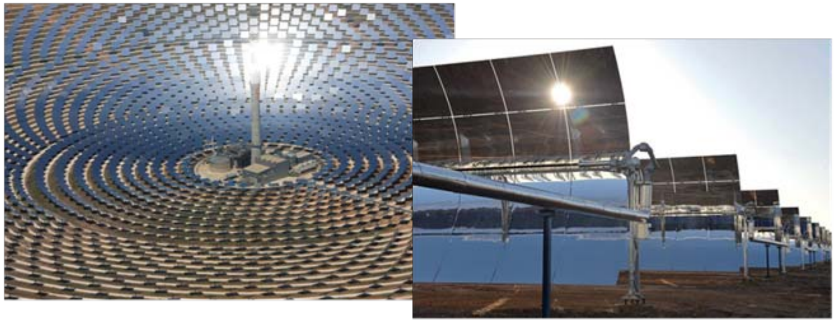
Notes: Percentages equal percentage reduction of capital expenditures and GWh annual output. Plant scaling refers to plant sizes from 50-500MW; 15MW Linear Fresnel plant has been excluded from overview; solar tower only scaled up from 50-200MW, Linear Fresnel from 15-250MW
Sources: Interviews with industry experts; A.T. Kearney analysis

Source: ATKerney (2011)

Ouarzazate CSP plant (Morrocco)

PROPOSED CASE STUDY

Parameter	Value
Type of cooperation mechanism	Joint project
Host country	Spain
User country	Netherlands
Physical Transfer	No
Size of the VoO	1st phase: 2,5 TWh 2nd phase: 2,5 TWh



Possible implementation scheme to generate 5 ThW

MW	2014	2015	2016	2017	2018	2019	2020
CCP en construcción	*200*	*400*	*400-625*	*200-425*	*225*	*0*	*0*
Torre en construcción	*200*	*400*	*400-625*	*200-425*	*225*	*0*	*0*
CCP en operación	**0**	**0**	**200**	**400**	**625**	**625**	**625**
Torre en operación	**0**	**0**	**200**	**400**	**625**	**625**	**625**

1.250

Parameter	Value
Technology	**CSP (central receiver – Tower)** **CSP (parabolic trough)**
Construction time	**2 years**
Capacity of the Plants	**200 MW (*)**
Generation costs (2020)	**10 c€/kwh**
Location	**Southern Spain (to be further detailed based on an existing registre application)**
Load factor	**4.000 (45%)**
Storage capacity	**9 hours**
Hybridization	**Possibility to use Natural Gas or Biomass up to 15% (*)** *(*) Total generation taking into account hybridization 5,75 TwH*
Production	**1200 MW installed capacity - 5 Twh**
Number of plants	**6 plants (2 200 MW plants and 1 225 MW)**
Cooperation mechanism	**Joint project without physical transfer**
Displaced technology in the Spanish Energy mix	**Natural Gas Combined Cycle**

BASE CASE SCENARIO (NL PRODUCES WIND OFFSHORE ELECTRICITY DOMESTICALLY)

8,80 C€/kwh

- NL (WO) RES Generation Cost → 15 cost c/kwh
- Domestic RES cost and Electricity mkt price → 6,3 c/kwh
- Grid related costs → 0,10
- CO_2
- Other pollutants
- Economic activity
- Employm
- Energy Security
- Industrial Leadership
- Other tech Specific effects

Indirect benefits related to a less carbon intensive Dutch Energy mix

COOPERATION SCENARIO (NL "BUYS" CSP ELECTRICITY FROM IN SPAIN)

Associated Indirect costs & benefits for Spain

GRID costs = (+0,35)

Indirect benefits related to a less carbon intensive Spanish Energy mix (0,49) + (0,26)

- Spanish RES Generation Cost → 10 cost c/kwh
- Domestic RES cost and Electricity mkt price → 6,5 c/kwh
- Grid related Costs (savings)
- CO_2
- Other pollutants
- Economic activity
- Employm
- Energy Security
- Industrial Leadership
- Other tech Specific effects

10 cost c/kwh - 6,5 c/kwh

Transfer / kwh = 3,5 c€/ kwh

3,85 C€/kwh

Indirect costs related to a more carbon intensive Dutch Energy mix (0,60) + (0,41)

IDENTIFIED BARRIERS

Ranking	Type of barrier
1	Cost reduction
2	Institutional set-up
3	Uncertainty about post 2020
4	Grid capacity limitations
5	Payment scheme
6	Coordination with the existing National Regulatory scheme
7	Grid interconnection capacity limitation
8	Risk of non-compliance
9	Identification, quantification and monetization of those indirect costs and benefits
10	Oposition from those sectors that will be negatively affected
11	Social acceptability
12	Spanish Economic Situation

Real cooperation opportunities exist for CSP

Only materialize if projected cost reductions are met

Grid implications have to be taken into account

Good opportunity for indirect benefits for Spain and the CSP sector

Thank you for your attention