

The role of public finance in CSP Lessons Learned

CPI - FEEM Joint Seminar

10th July 2014, Venice

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Outline

- **Introduction**
- **Research questions and analytical approach**
- **CSP technologies and financing models**
- **Lessons on national policies**
- **International public finance**
- **Long term scale up**

Why CSP and challenges for scaling-up

- **Why CSP?**
 - Low-carbon electricity
 - Heat storage -> base load and peak load power
- **Challenges for scaling up CSP**
 - Viability gap: High costs of technology
 - High policy costs (for public)
 - High policy risks (for private)
 - Risk gap, particularly in emerging economies
 - Financing risks (due to high capital costs)
 - Technology risks (due to low experience with CSP)
 - Knowledge gap (policies and technologies)

Research questions and analytical approach

The Role of Public Finance in CSP: the project

- **Background Research**: landscape of technology and investment models
- **Case studies**: financial model, risks, effectiveness, scale-up
 - Morocco
 - India
 - South Africa
 - Spain (not project, whole market)
- **Policy paper**: lessons learned
- **Dialogues**: sharing, discussing and learning from experts
 - Venice, September 2013
 - Abu Dhabi, January 2014
 - Washington DC, May 2014



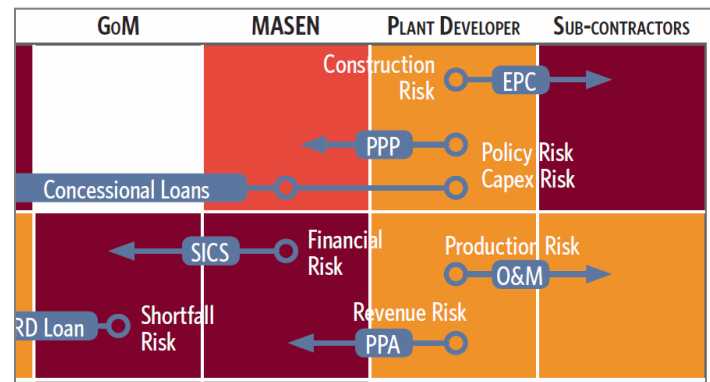
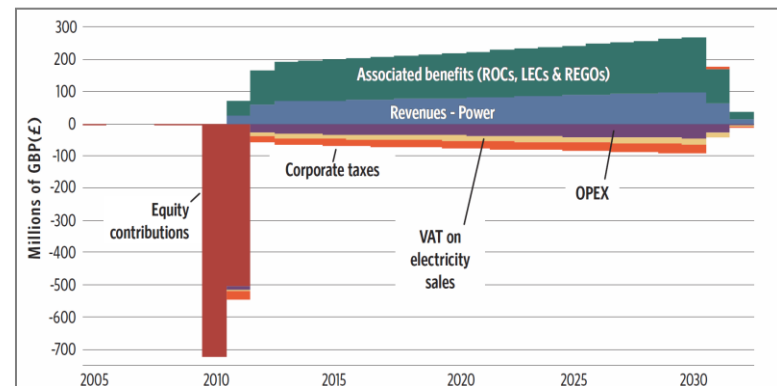
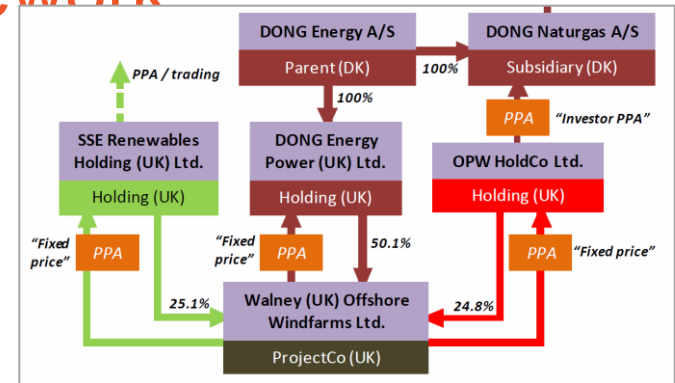
The CSP case studies

- **160 MW Noor 1, Morocco**
 - USD 800 mil Parabolic Trough with 3 hours storage
- **100 MW Reliance Power in Rajasthan**
 - USD 400 mil Fresnel technology
 - Clean electricity for >0.5 million Indians
- **100 MW Eskom Upington**
 - USD 1 bil Tower technology in South Africa
 - Clean electricity for 200,000 S. African homes
- **Spain CSP Market**
 - 2.3 GW installed (50 plants)
 - EUR 15 bil mobilized



Case studies: analytical framework

- Complex interactions between all stakeholders
- Investment, returns and profitability
- Risk allocation arrangements



Key questions

- **Key questions for the analysis**
 - When is public support needed for CSP?
 - How effective / cost-effective are different policy tools?
 - How can international public finance best support national policy efforts?
 - How can public support drive long—term cost reductions and ensure scale up?

CSP technologies and financing models

CSP Technologies

CSP technologies use mirrors and lenses to concentrate the sun's thermal power to heat a fluid (heat transfer fluid) and generate steam

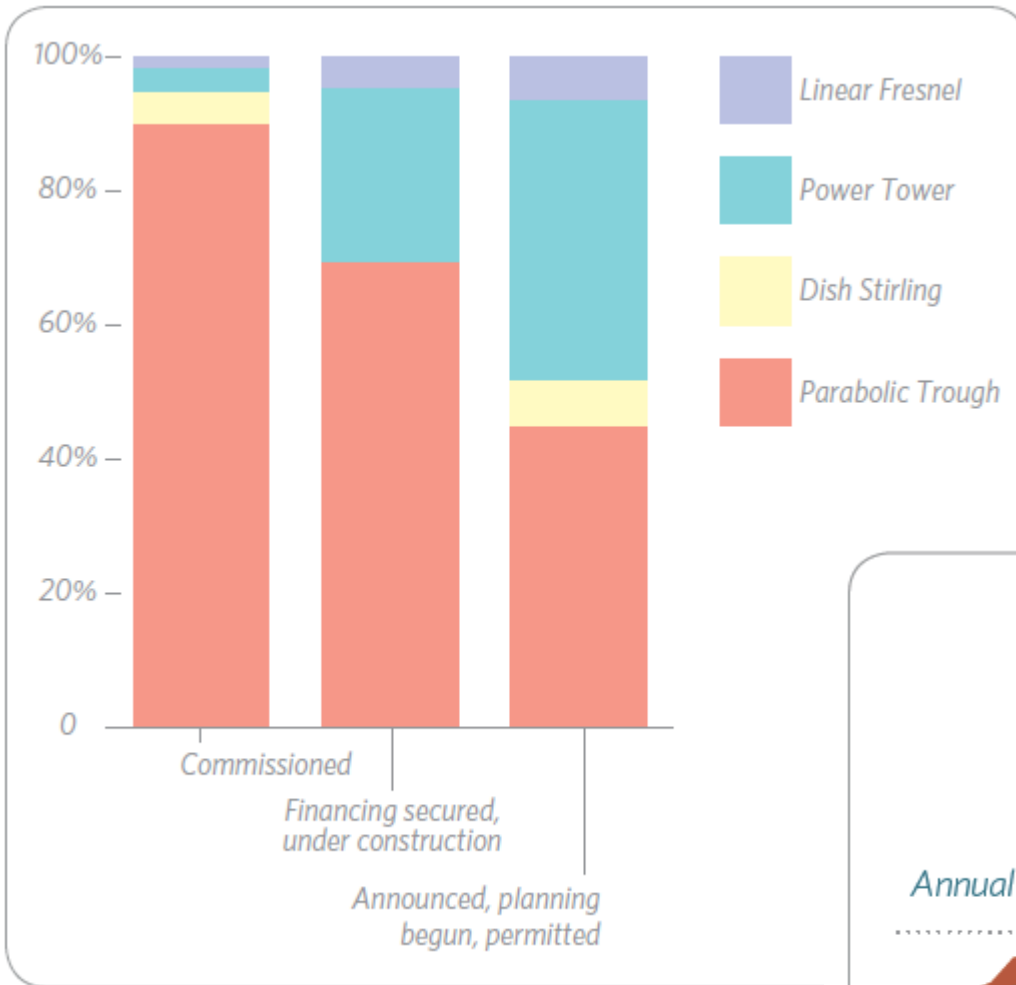
- Line-focusing : **Parabolic trough** and **Linear Fresnel**



- Point-focusing systems: **Power Tower**

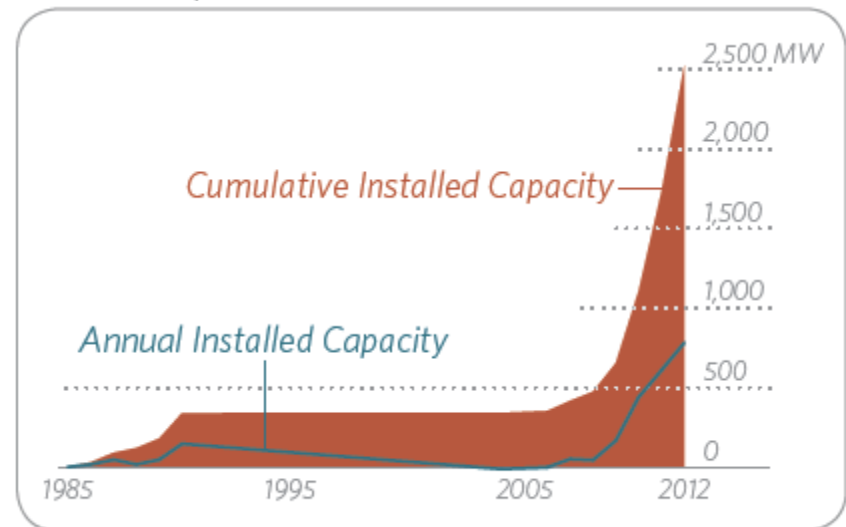


Installed and expected capacity by CSP technology type



Source: BNEF, 2012

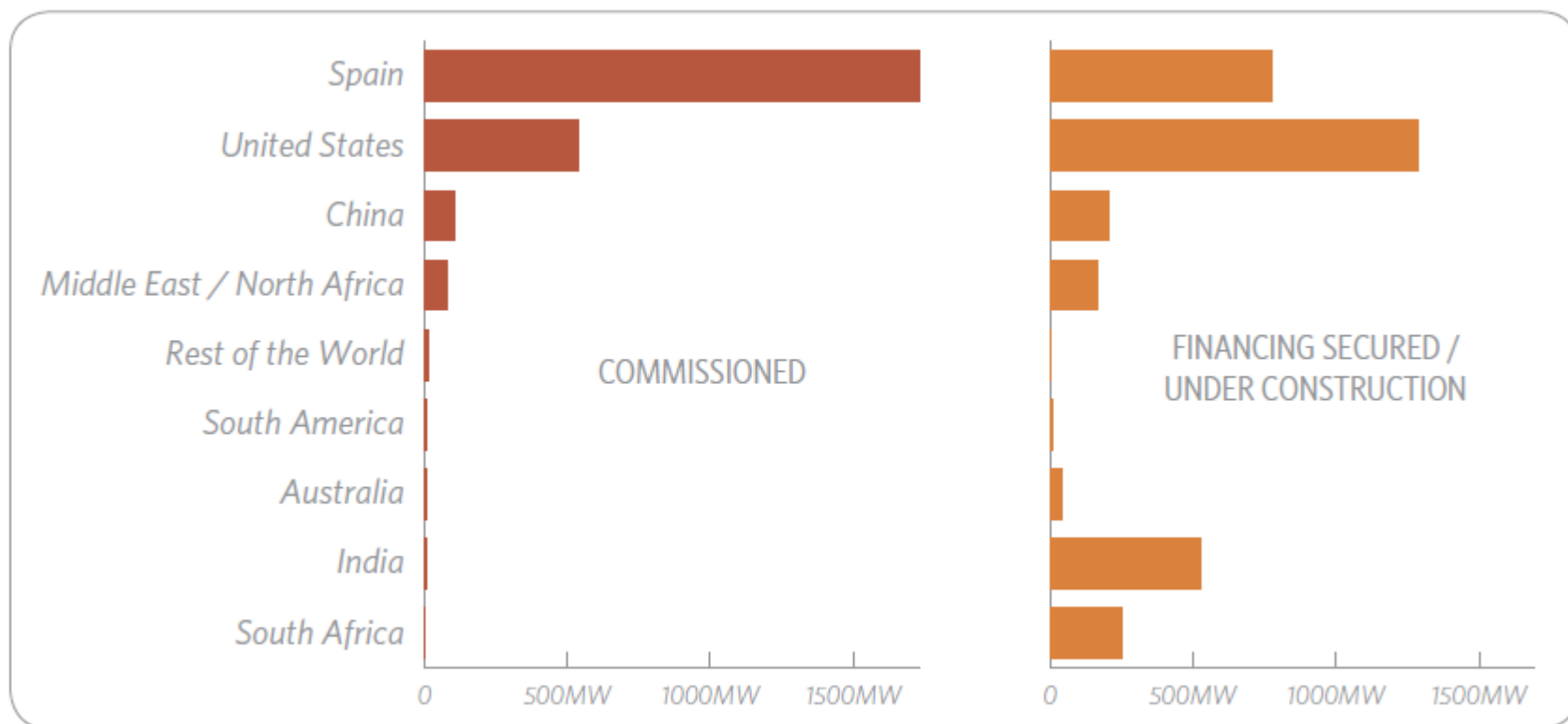
- Technical differences across CSP technologies have significant impacts on cost, achievable electrical efficiency, and water needs.
- Lack of data on historical performance results in high perception of risks for investors



Source: BNEF, 2012

Installed capacity by region

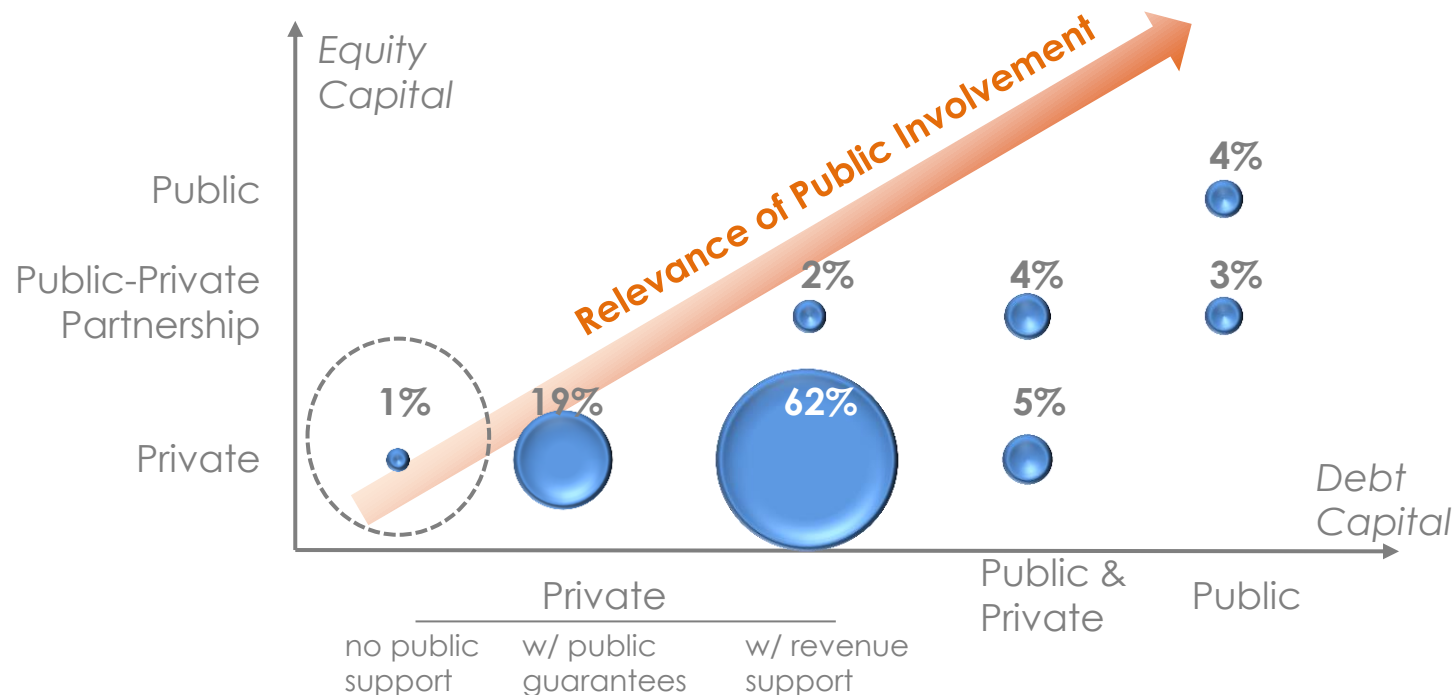
- Spain has 70% of global installed generation capacity
- Shift towards emerging markets



Source: BNEF, 2012

Equity and Debt capital for CSP Projects

- Private sector main provider of equity capital
- Only 1% of CSP projects (by value) developed without any public support



Values in USD million (share of total)

Cost comparisons between renewable technologies

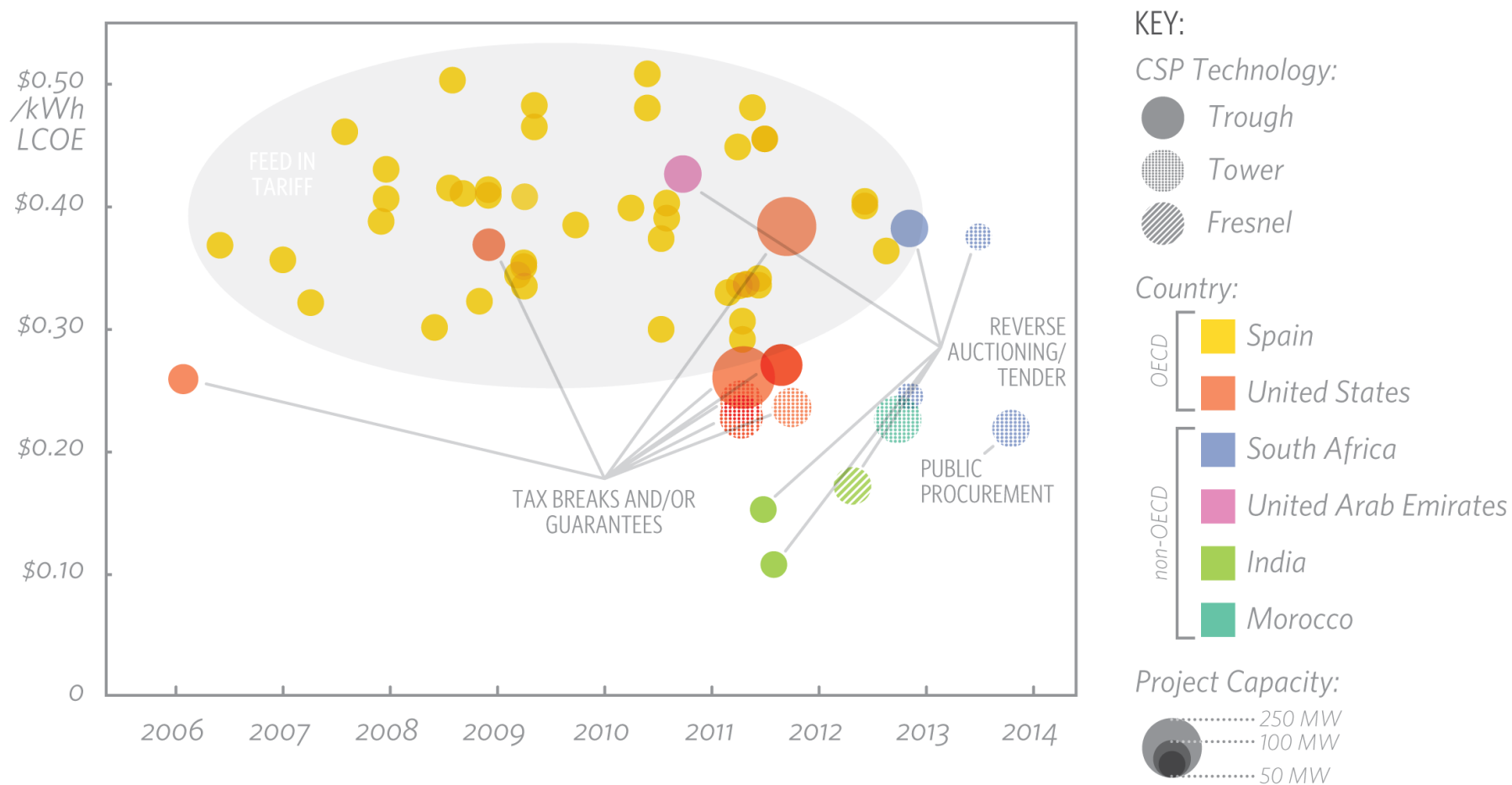
- Levelized cost of electricity (LCOE) calculations do not reflect the true benefits of CSP, since it
 - cannot assign any premium to electricity produced in peak times;
 - cannot ascribe any value to CSP's system benefits

TECHNOLOGY	LCOE RANGE USD/KWH	CAPITAL COSTS RANGE USD/KW	TOTAL INSTALLED CAPACITY GW
Wind onshore	0.05 - 0.15	1000 - 2500	270
Wind offshore	0.15 - 0.25	4000 - 4500	6.1
Solar PV	0.15 - 0.35	2000 - 5000	91.3
Biomass	0.05 - 0.25	1000 - 7000	77.4
Hydro large	0.03 - 0.15	1500 - 5000	1102
Geothermal	0.03 - 0.12	2000 - 6000	11.4
CSP parabolic trough	0.18 - 0.38	3500 - 8000	
CSP parabolic trough with storage	0.15 - 0.35	7000 - 10000	2.6
CSP power tower with storage	0.18 - 0.28	6000 - 10500	

Source: IRENA 2013; IEA, 2012b

Lessons on national policies

CSP National Policies: why do they matter?



CSP National Policies: Lessons on Effectiveness

What national policies can do to ensure effectiveness:

- Provide **sufficient** financial support to **close the viability gap**
- Make support **sustainable** over time and link it to technology costs and deployment
- Ensure **alignment of interest** of public and private sector and **long-term policy goals** to reduce perception of **policy and investment risks**
- Ensure **reliable on-site solar irradiation data** is available
- **Remunerate** the benefits of **peak and baseload power**

CSP National Policies: Lessons on Cost-Effectiveness

Policymakers can ensure low cost and high effectiveness of revenue support policies if the **level of support is close to real technology costs**

Auctions and bidding have proved the most effective in pushing down the level of support but their effect on deployment can be adverse

Feed-in-Tariff, on the contrary, have the strongest effect on deployment, but they have struggled to reflect technology costs reductions

International public finance

How to use international public finance to enable CSP deployment

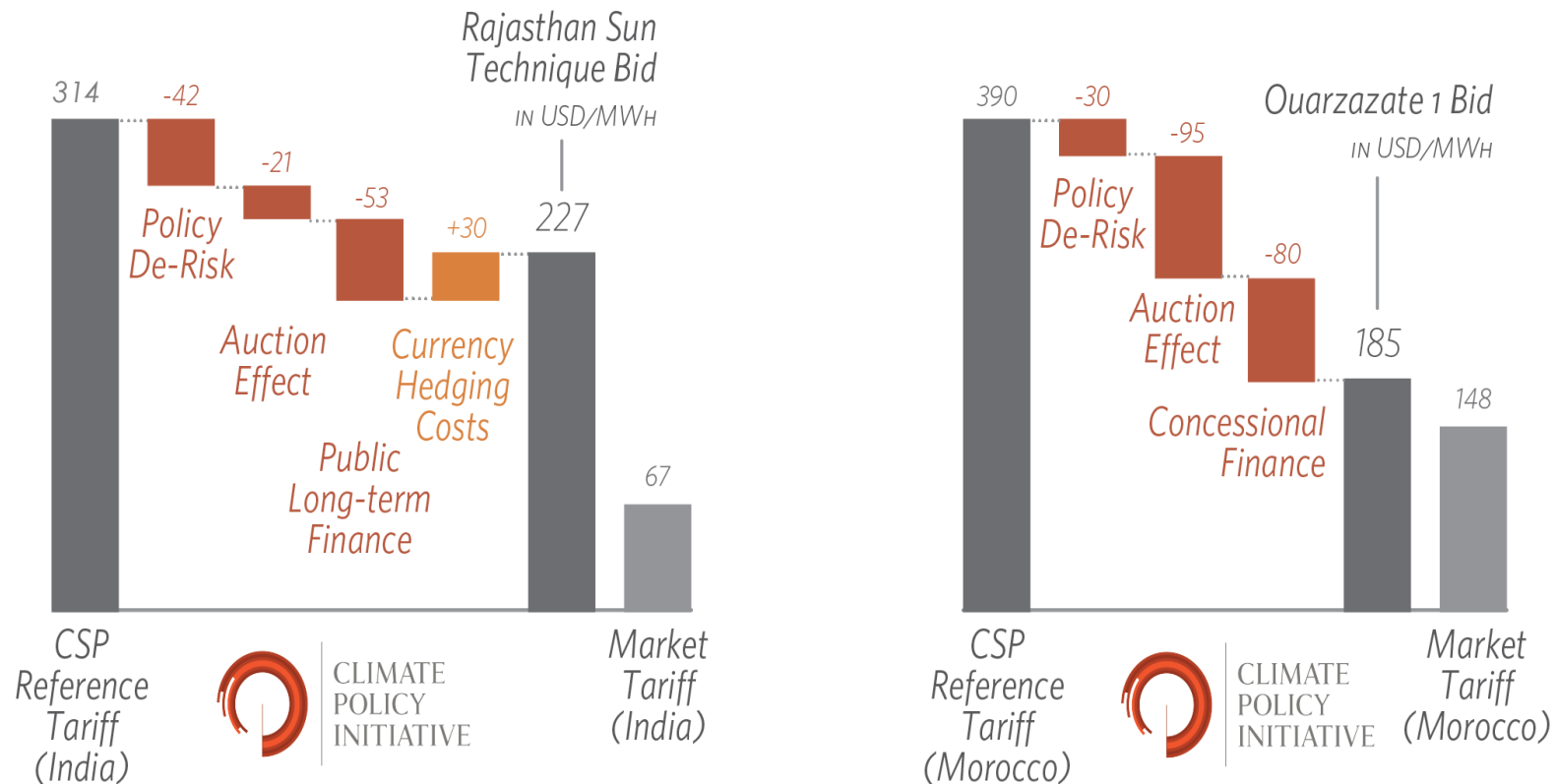
Role	India	South Africa	Morocco
Mitigate those risks that the private sector is not yet willing to bear	provide non-subsidized debt	provide low-cost debt	Provide concessional debt
Close the viability gap where single countries are willing, but unable to bear the full cost		reduce cost for the national project owner	reduce CSP tariffs
Provide knowledge on policy tools and technology to local decision makers	capacity building	kick-start nat. knowledge generation process	capacity building

How to increase effectiveness of international public finance in enabling CSP investment

Effectiveness	India	South Africa	Morocco
Reduce costs for hedging the risks of using low-cost foreign debt			denominate CSP tariff in foreign currency
Involve private actors to share part of the project risks	involve via equity and technology warranties	involve via engineering, procurement and construction (EPC)	involve via equity in a PPP structure
Streamline requirements and make them more flexible			contribute through a joint financing package

DE-Risking CSP through National and International Policymarkers

- **Good policy and a tariff setting** mechanism that prompts competition can significantly reduce the cost of the technology even for developing countries
- **Public financial institutions** have a significant role in reducing the weight of CSP support on public budgets



Long-term scale up and competitiveness

CSP long-term scale up: overview

All policymakers

- Provide high enough support but linked to falling CSP costs
- Cover risks of novel technology
- Initiate transition to local and private debt

National policymakers

- Complement viability gap funding with public (low-cost) debt
- Remunerate system benefits

International policymakers

- Focus public finance on countries with high willingness to support CSP

Join forces
to buy down
the learning
curve

(5-20 GW)

Economies of
scale & learning
Planning certainty
(if road map)
-> **Cost
reductions**

CSP long-term scale up: selected lessons (1)

All policymakers

- **Join forces to buy down the learning curve: for 5 to 20 GWs**
 - Equal: 1 to 3 doubling of 2.6 GW capacity
 - Cost reductions of 10-15% to 30-45%
- **Provide high enough public support but link it to falling technology costs over time** to both ensure effectiveness and reduce costs and policy risks
- **Special incentives for early-stage technologies with long-term potential** (power tower, storage)

CSP long-term scale up: selected lessons (2)

National policymakers

- **Complement viability gap funding with public (low cost) debt** that reduces financing and policy risks in emerging economies

International policymakers

- **Focus international public finance on countries where political willingness to support CSP is high**

Conclusions

When is public support needed?

- **Viability gap**
 - Public support needed in all cases (geographies, technologies) to close the viability gap
 - Different tools (feed-in tariffs, grants, tenders)
- **Risk gap**
 - To address risks of early stage but promising technology (e.g. power tower, storage)
 - To address risks in countries with low experience and unfavourable terms on capital market
- **Knowledge gap**
 - If capacity on policies and technologies can be transferred

CPI Field Research



Thank you



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