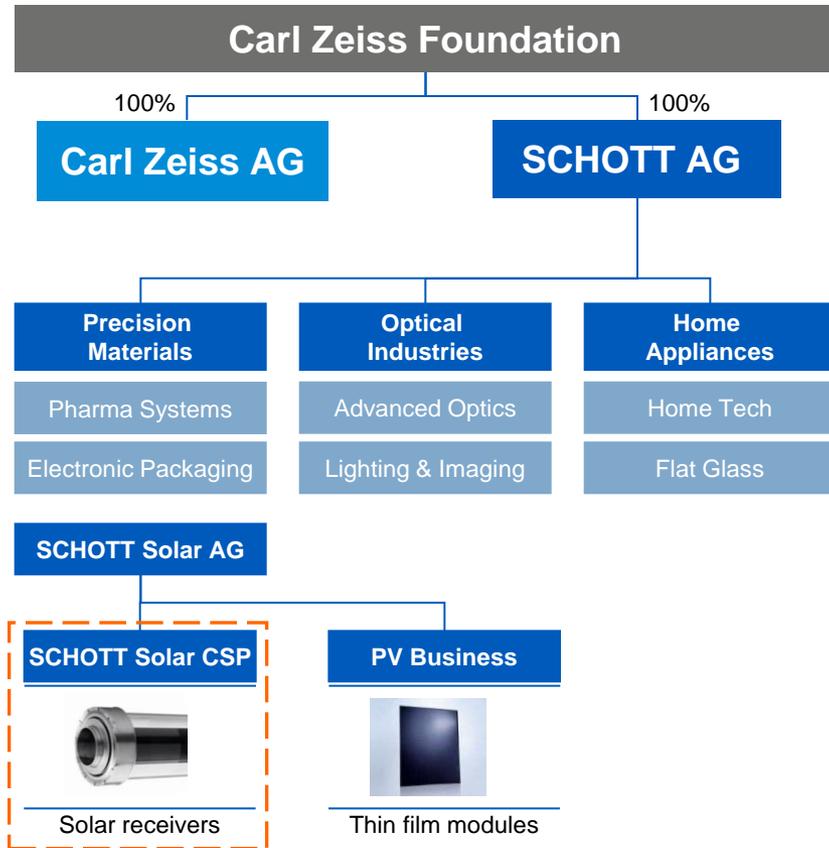




SCHOTT Solar CSP GmbH

Company Presentation
March 2014

SCHOTT Solar CSP is a subsidiary of SCHOTT Solar AG which is incorporated in the SCHOTT AG



- SCHOTT AG is a B2B technology company founded in Jena, Germany in 1884
- Ranks as number one in the world with many of its products, which include components and systems made from specialty glasses and materials
- €1.84bn sales in 2012/13
- c. 15,400 employees worldwide

SCHOTT Solar CSP develops and supplies receivers for linear focusing CSP technologies

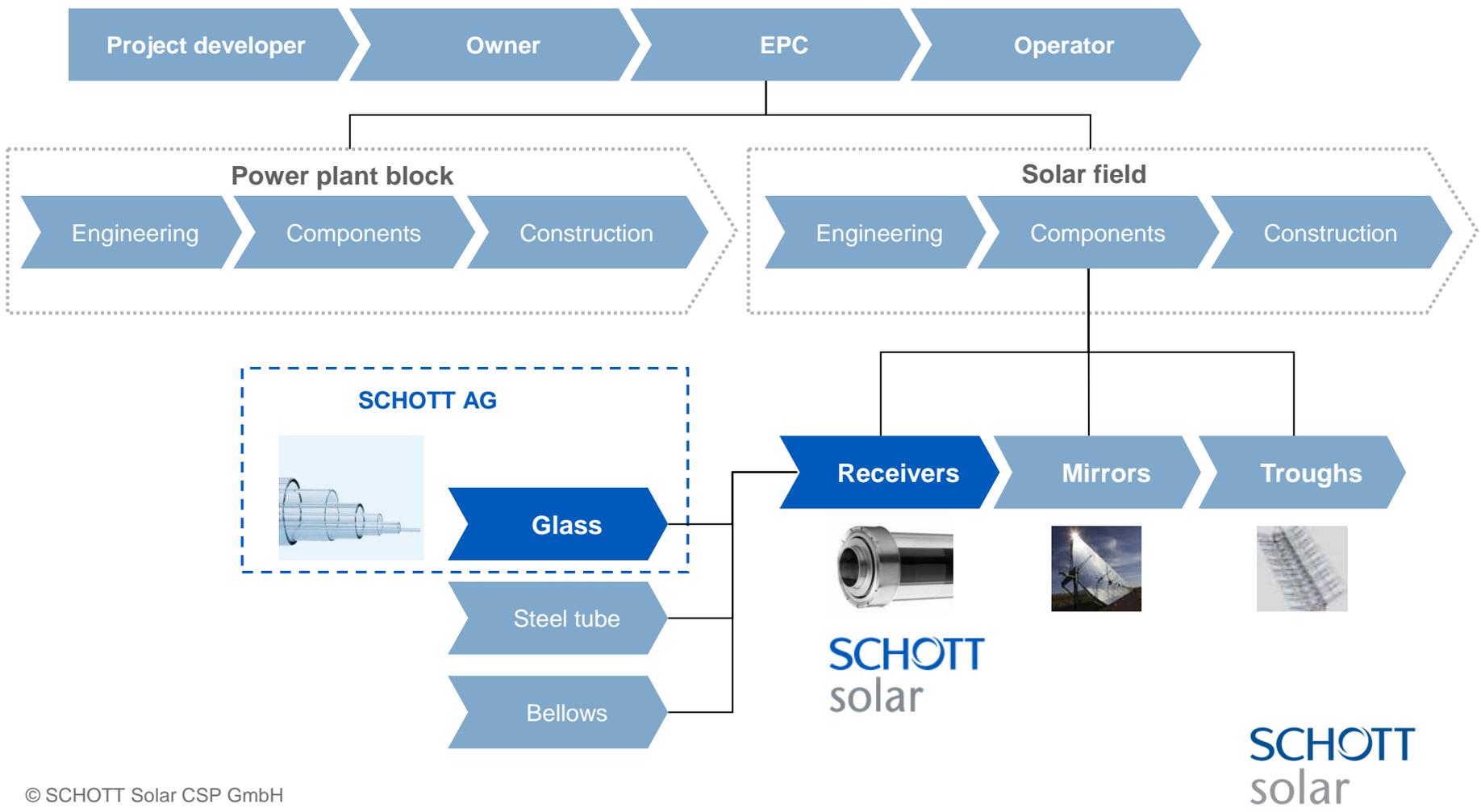


The heart comes from SCHOTT – Receivers as the core components of parabolic trough power plants

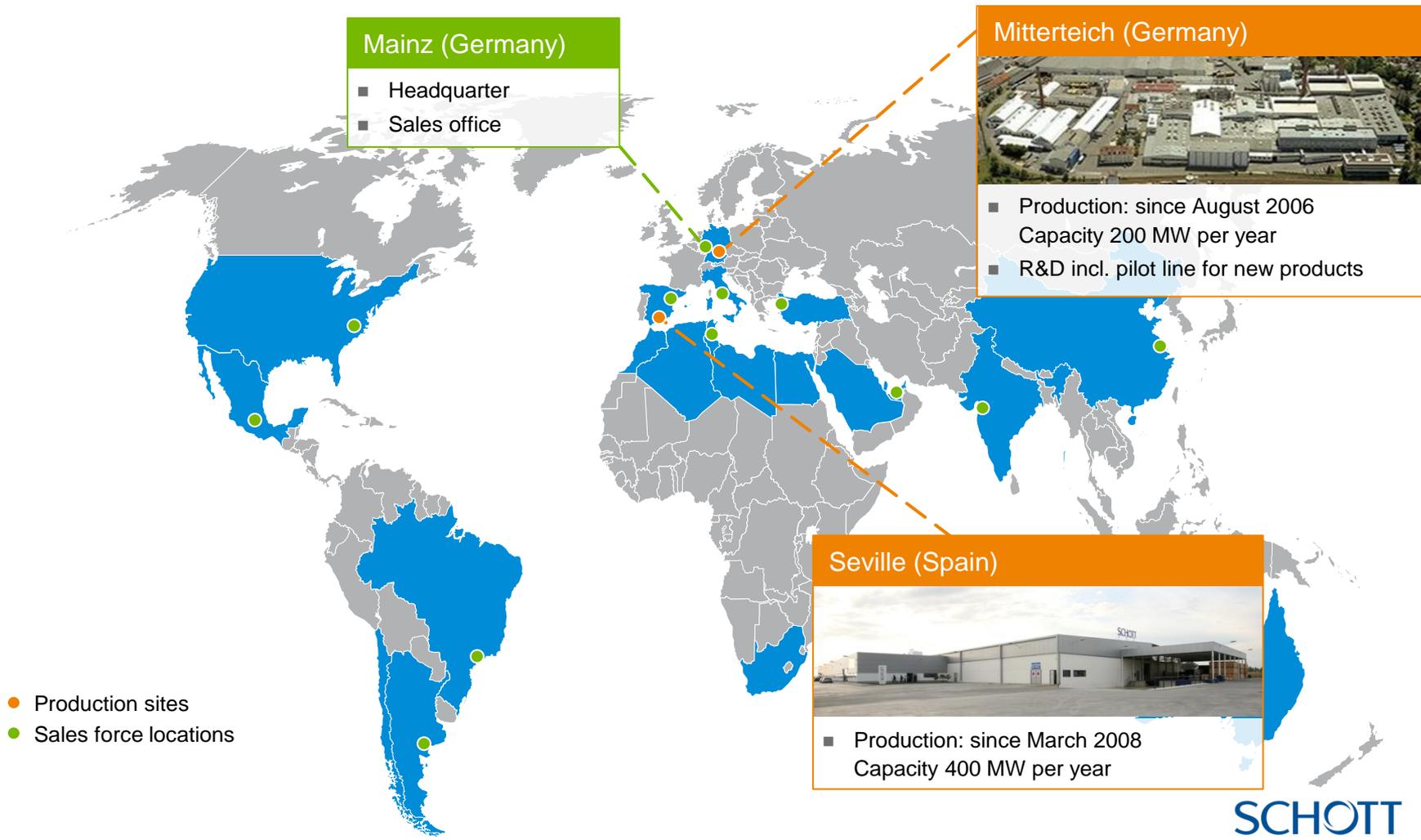
- As the core component of the solar field, the quality of the receiver has a decisive influence on how efficiently solar radiation can be converted into heat
- The **Receivers** ...
 - ... have to achieve maximum solar absorptance and at the same time minimal emittance of heat
 - ... need to deal with mechanical and thermal stress
 - ... need to show long-term performance stability and keep maintenance costs low during operation



The value chain of CSP parabolic trough power plants is diversified. SCHOTT Solar CSP supplies a key component. Customers include big EPCs, developers, etc.



Headquartered in Mainz, SCHOTT Solar CSP has two production sites: Mitterteich (Germany) and Seville (Spain), as well as dedicated sales forces in the relevant markets



Outperforming technology, excellent production and service and a unique track record make SCHOTT Solar CSP the most bankable receiver supplier

Track record

- 3,2 GW installed base (out of 4,2 GW total)
- More than 50 projects supplied around the globe
- More than 1 Million receivers delivered

Excellence in Production and Service

- Lean manufacturing
- Reliable high volume capability
- Technical customer service on-site
- After-sales service

Technology

- Superior product durability and lifetime
- Benchmark product performance
- Strong product development capabilities

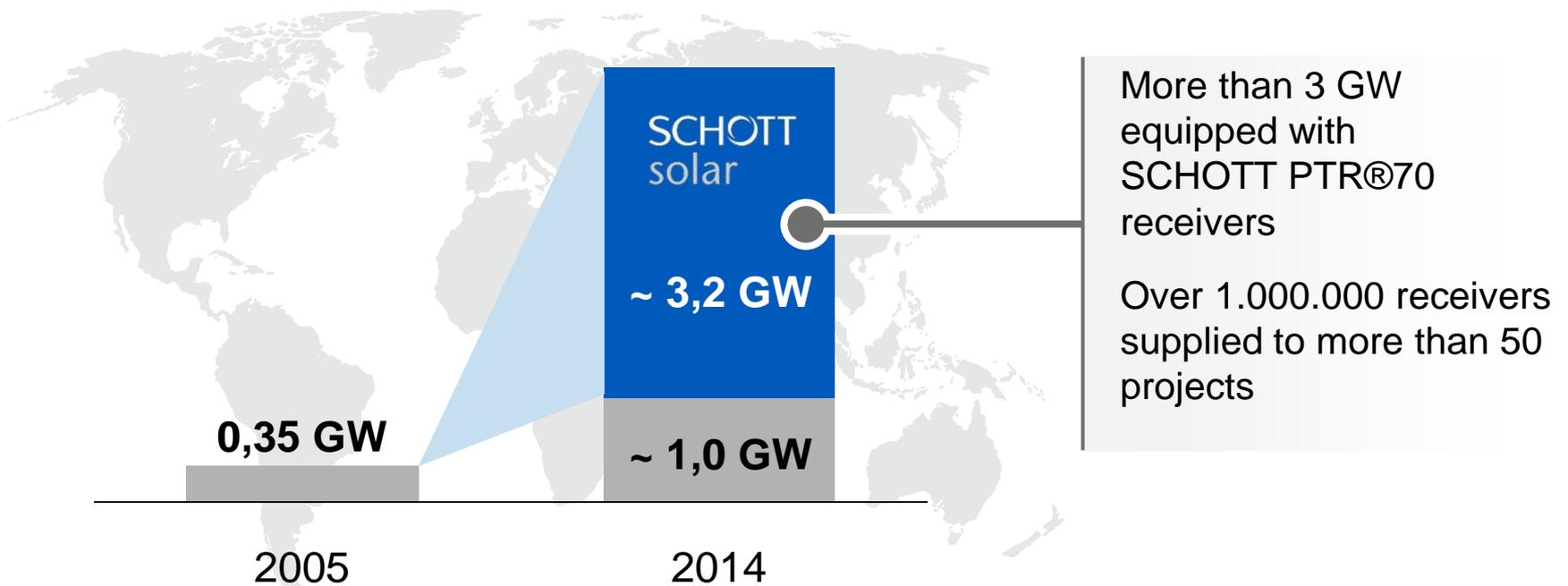
Most bankable receiver supplier

SCHOTT
solar

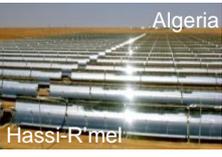
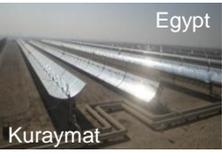
SCHOTT
solar

Track Record: SCHOTT Solar is the unrivaled market leader with over 1 Mio. receivers supplied to more than 50 projects

CSP capacity installed or under construction



SCHOTT CSP Track record in CSP

(1984-2005)	(2005-today) project examples	
<p style="text-align: center;">SCHOTT Glass-tube supplier for receiver manufacturers</p>	<p style="text-align: center;">SCHOTT solar Receivers for more than 50 parabolic trough power plants</p>	
<ul style="list-style-type: none"> ■ USA: <ul style="list-style-type: none"> ■ 9 commercial-scale parabolic trough power plants “SEGS I – IX” in Californian Mojave Desert 	<ul style="list-style-type: none"> ■ US Loan Guarantee program <div style="display: flex; justify-content: space-around;">    </div> ■ Spain: Renewable Energy Plan (REP) <div style="display: flex; justify-content: space-around;">    </div> ■ MENA: Several Gas-Solar hybrid solar plants (ISCCS) <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;">    </div>	

● plants supplied with SCHOTT PTR®70 ● other suppliers ○ other technologies

Excellence in production: A lean and flexible production setup provides high volume capability

- Lean philosophy as basis for the setup and operation of the receiver manufacturing sites and the supply chain
- Holistic manufacturing approach integrating lean production, quality system and occupational safety
- Continuous improvement / Kaizen



High volume
capability

Stringent cost
roadmap

High production
flexibility

100% delivery
reliability

High personnel and
machine productivity

Occupational safety

 VBG
Ihre gesetzliche
Unfallversicherung



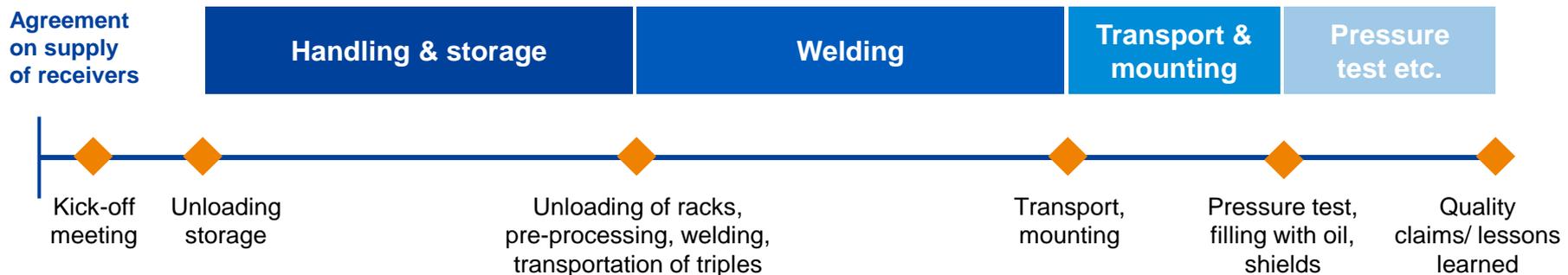
Excellence in Service: SCHOTT's Technical Customer Service provides on-site support and training

Key benefits of the Technical Customer Service

- By providing our expertise and trainings, we **help the customers to improve their performance** and to **reduce their project risks** during plant construction
- We **avoid “unnecessary” issues** by conducting preventive measures together with the customer, thus increasing the customer satisfaction
- The customers consider the Technical Customer Service a **USP of SCHOTT**

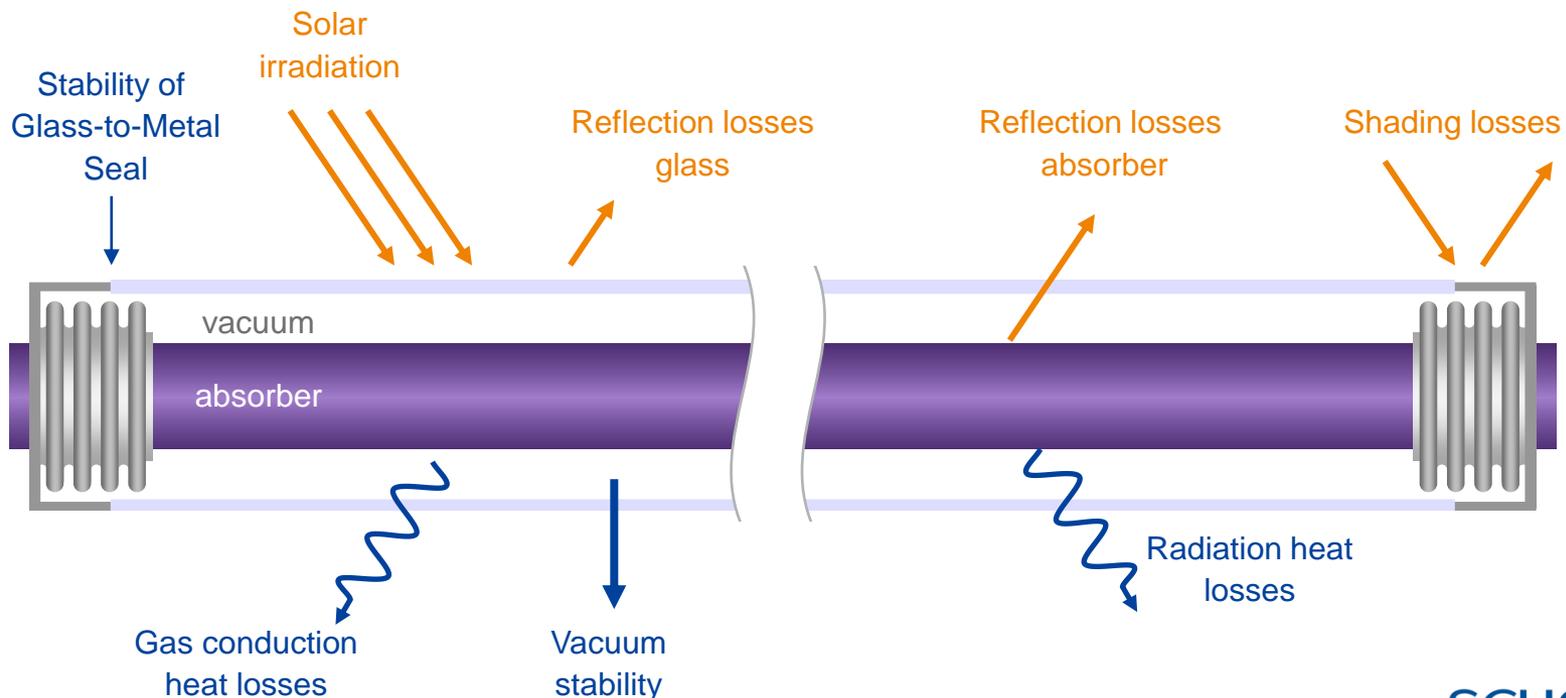


Technical Customer Service on-site presence during CSP project construction phase



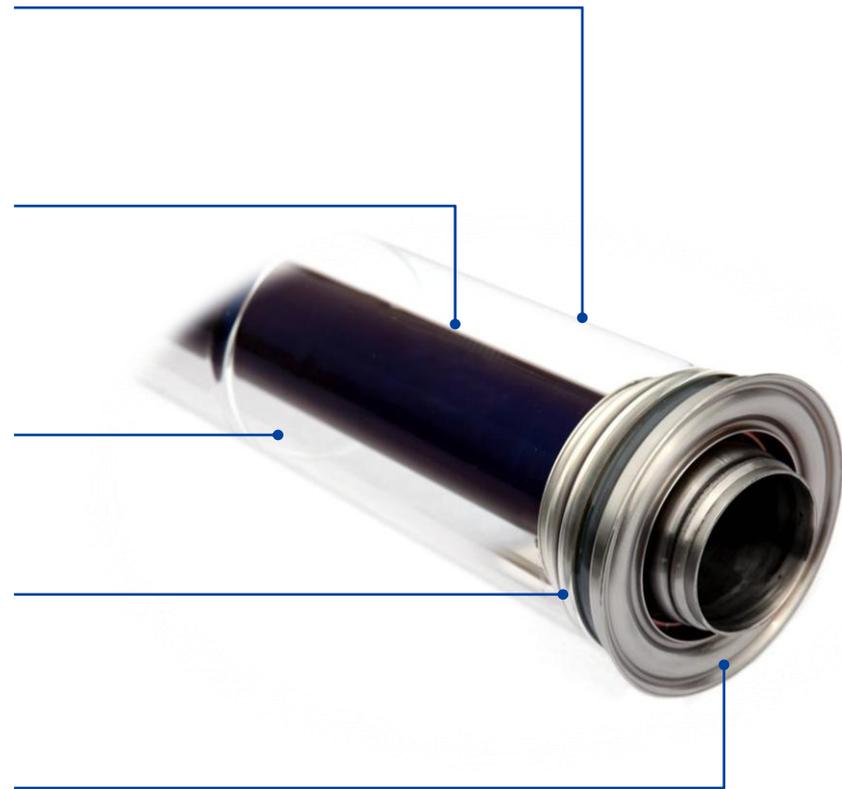
Technology: The receiver is designed for maximum efficiency of the solar field

- The quality of the receiver has a decisive influence on the efficiency of the solar field and the profitability of the CSP power plant
- The most important issues are:

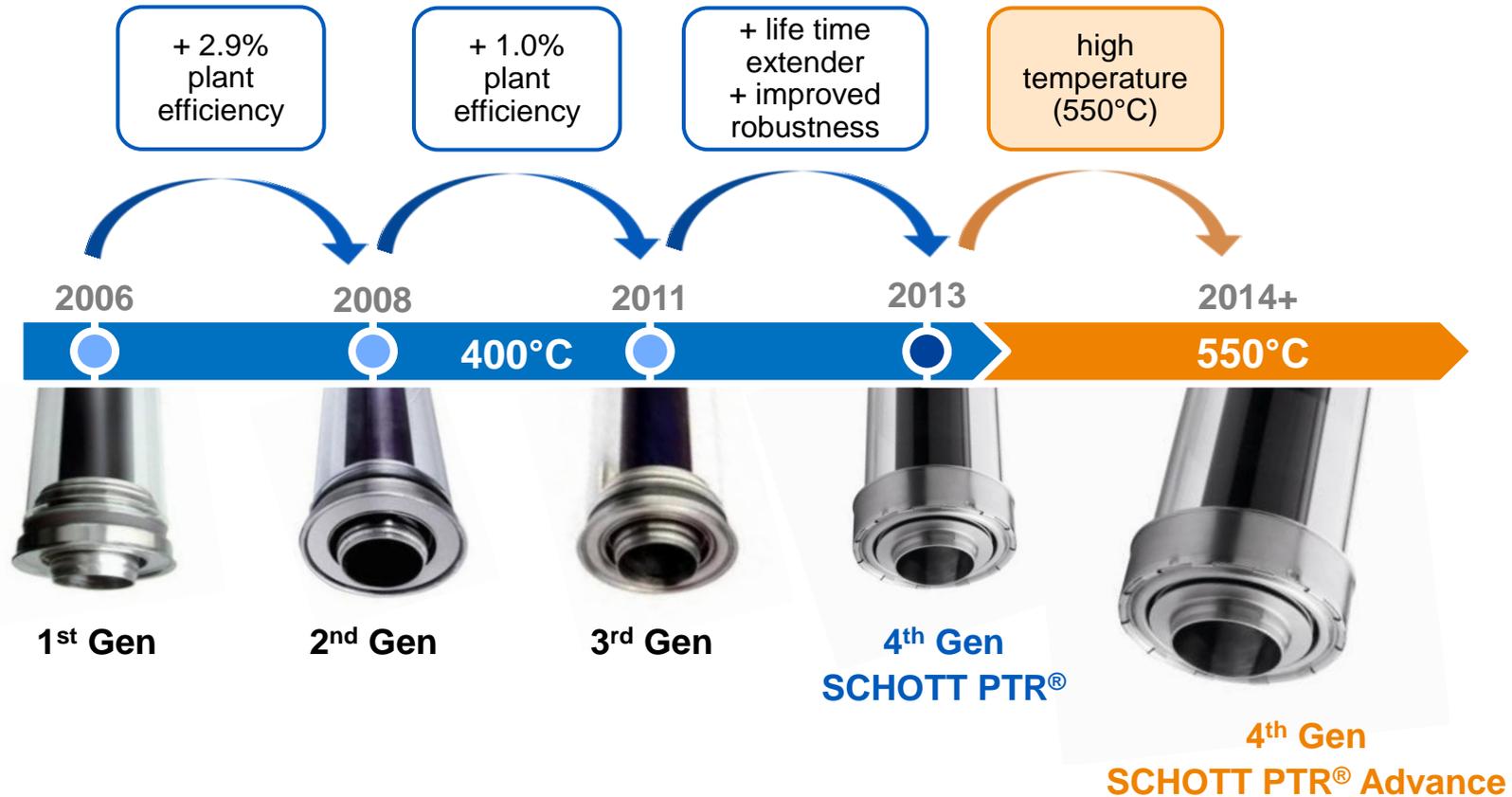


SCHOTT PTR[®]70 Receiver– More than 1 Million already delivered to power plants around the globe

- **Anti-reflective coating of the glass tube**
ensures high transmittance and high abrasion resistance
- **Absorber coating**
achieves low emittance and high absorptance of the absorber tube
- **Vacuum insulation**
minimizes heat conduction losses
- **Durable glass-to-metal seal**
material combination with matching coefficients of thermal expansion
- **Optimized design of bellows**
achieves a maximum optical aperture length of the receivers



SCHOTT Solar paves the way to competitiveness of CSP technology



Based on a new receiver platform, SCHOTT issues three 4th generation receiver products

SCHOTT PTR[®] 4th generation receiver platform



SCHOTT PTR[®]70 Advance

The technology leap towards Molten Salts

SCHOTT PTR[®]70 Premium

The profitability booster

SCHOTT PTR[®]70

The receiver benchmark in CSP industry

Based on a new receiver platform, SCHOTT issues three 4th generation receiver products

SCHOTT PTR[®] 4th generation receiver platform



SCHOTT PTR[®]70 Advance

- + New steel grade for 550°C
- + Novel absorber coating



Molten Salt

SCHOTT PTR[®]70 Premium

- + Integrated Noble Gas Capsule as lifetime extender



Oil

SCHOTT PTR[®]70

- New bellow design, suitable for high-temperature operation
- Glass-to-metal seal with matching coefficients of thermal expansions
- Protection cap for improved product robustness and easy handling

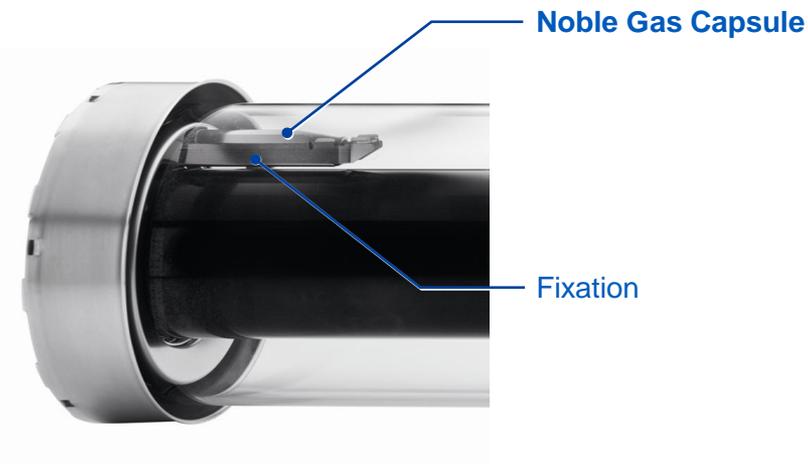
Oil

SCHOTT
solar

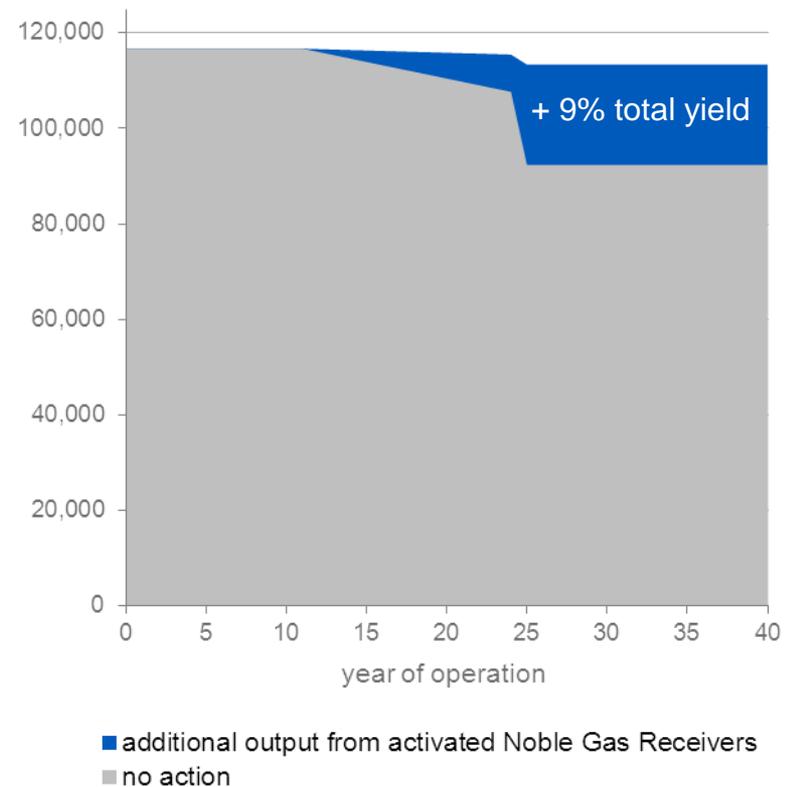
SCHOTT PTR[®]70 Premium: Over 40 years of operation, the SCHOTT Premium Receivers facilitate 9% higher electricity output of a CSP plant

Noble Gas Capsule concept

- SCHOTT PTR[®]70 Premium Receiver equipped with noble gas capsule
- A new conceptual design patented by SCHOTT
- Avoids replacement of “hot tubes”
- Can be activated by operator at any time



Net annual electricity output (MWh) *



SCHOTT PTR[®]70 Advance: 4 major challenges are addressed for making receiver tubes ready for usage at temperatures up to 550°C

■ Stable performance:

- Absorber coating with long lifetime and stable optical and thermal performance

■ Low heat loss:

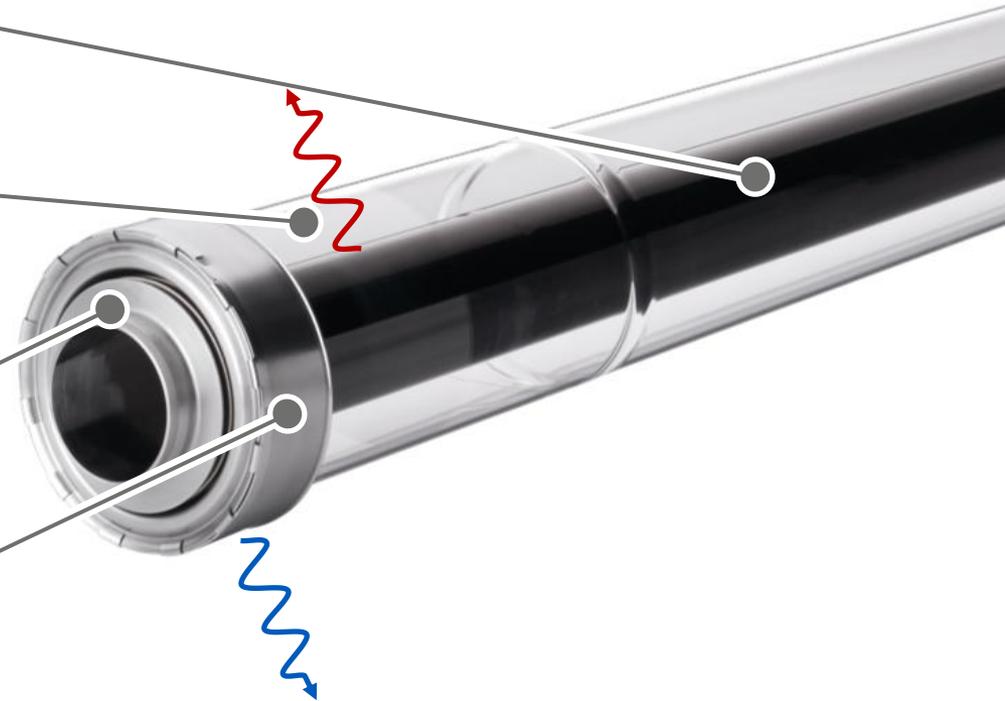
- Absorber coating option with optimized optical parameters at hot end of the loop
- Bellows specifically designed for low heat loss

■ Steel tubes and bellows:

- Steel grade qualified for high temperatures

■ Robust receiver ends:

- Glass-to-metal seal material combination accounting for elevated thermal stress
- Bellows design accounting for higher thermal expansion of absorber tube



SCHOTT Solar CSP received most significant industry awards

CSP Today Award 2012

“Best CSP Technology and Supplier”



CSP Today Award 2011

“Best CSP Technology and Supplier”

CSP Today Award 2010

“Best Applied Research and Development in Concentrated Solar Power Technology”



DEUTSCHER ZUKUNFTSPREIS
Preis des Bundespräsidenten
für Technik und Innovation

Germany's Federal President's Prize for Innovation and Technology 2008

Nomination of Dr. Nikolaus Benz
and Dr. Thomas Kuckelkorn
(Head of R&D SCHOTT Solar CSP)



Bayerischer Energiepreis 2004

SCHOTT
solar

SCHOTT Solar CSP is in the inner circle of the international CSP industry



- The DESERTEC concept forms the basis of the “Dii”, an industrial initiative, which aims at accelerated implementation of the DESERTEC Concept
- Dii was founded on 30th of October 2009 by twelve international companies and the DESERTEC Foundation, with **SCHOTT Solar as a founding member**



- Founded in 2007 by ACS, ProtermoSolar and SCHOTT
- Largest industry association with more than 60 members
- **SCHOTT Solar assumes vice-presidency since the beginning**



- Spanish Industry Network for Concentrated Solar Power
- Founded in 2004
- 100 commercial members, including Abengoa, Acciona, E.ON, Ferrostaal
- **SCHOTT Solar member of the board since 2005**



- German Association for Concentrated Solar Power
- **SCHOTT Solar CSP as a founding member since June 2012**

SCHOTT Solar CSP Key Highlights

