Let the sun work for you

Luc Graré
REC Solar

RETAIL MASTERS
08 - 10 - 2015

ENERGIZING LIFE TOGETHER

REC

Let the sun work for you:

electricity from sunlight

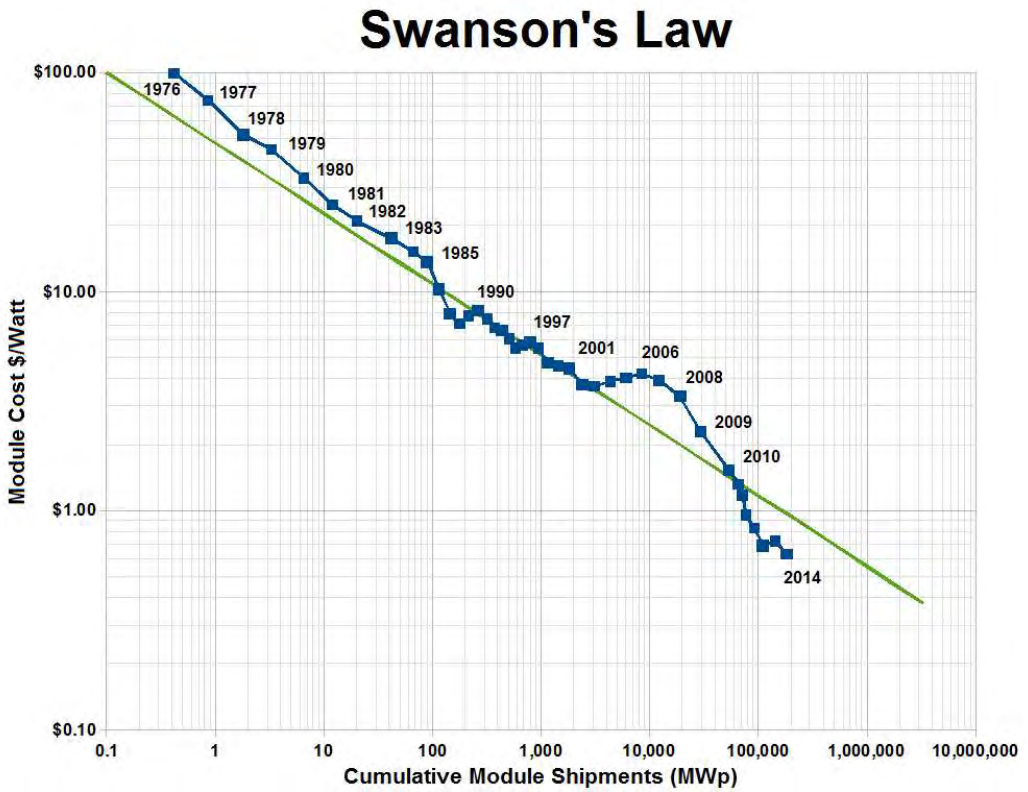
Luc Graré
October 8, 2015

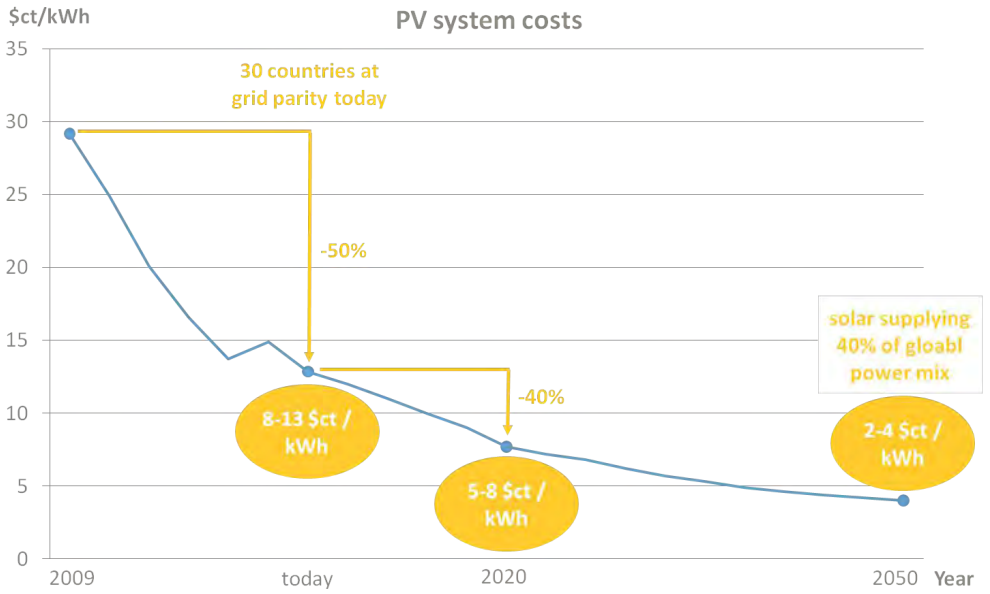
Agenda

Learning curve Solar

price of solar panels tends to drop 20 percent for every doubling of cumulative

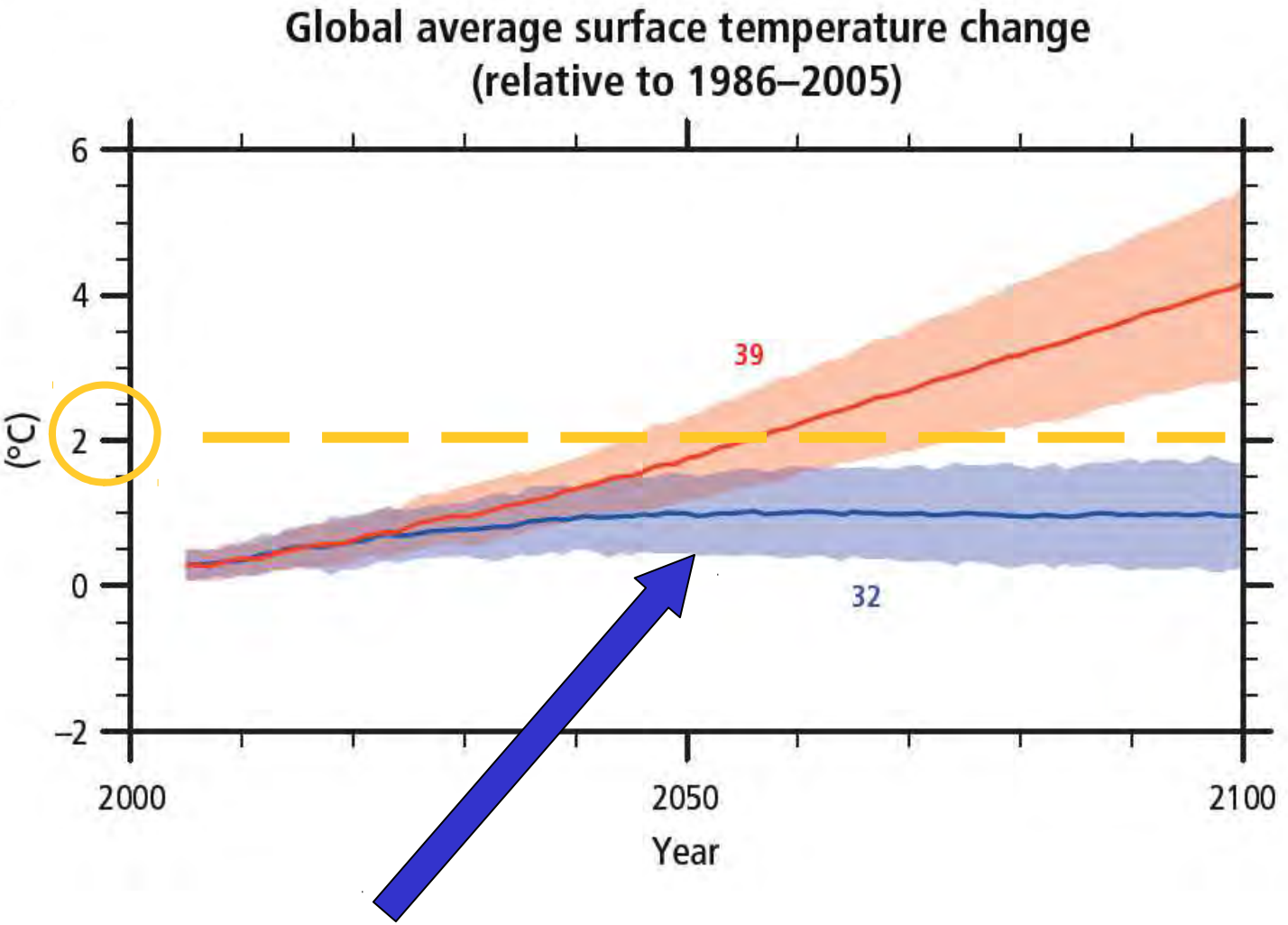
shipped volume





No other technology has such a strong learning curve as solar power

Possible Scenarios on Climate Change



Mean over 2081–2100

Baseline Scenario – „business as usual“

Best case Scenario –

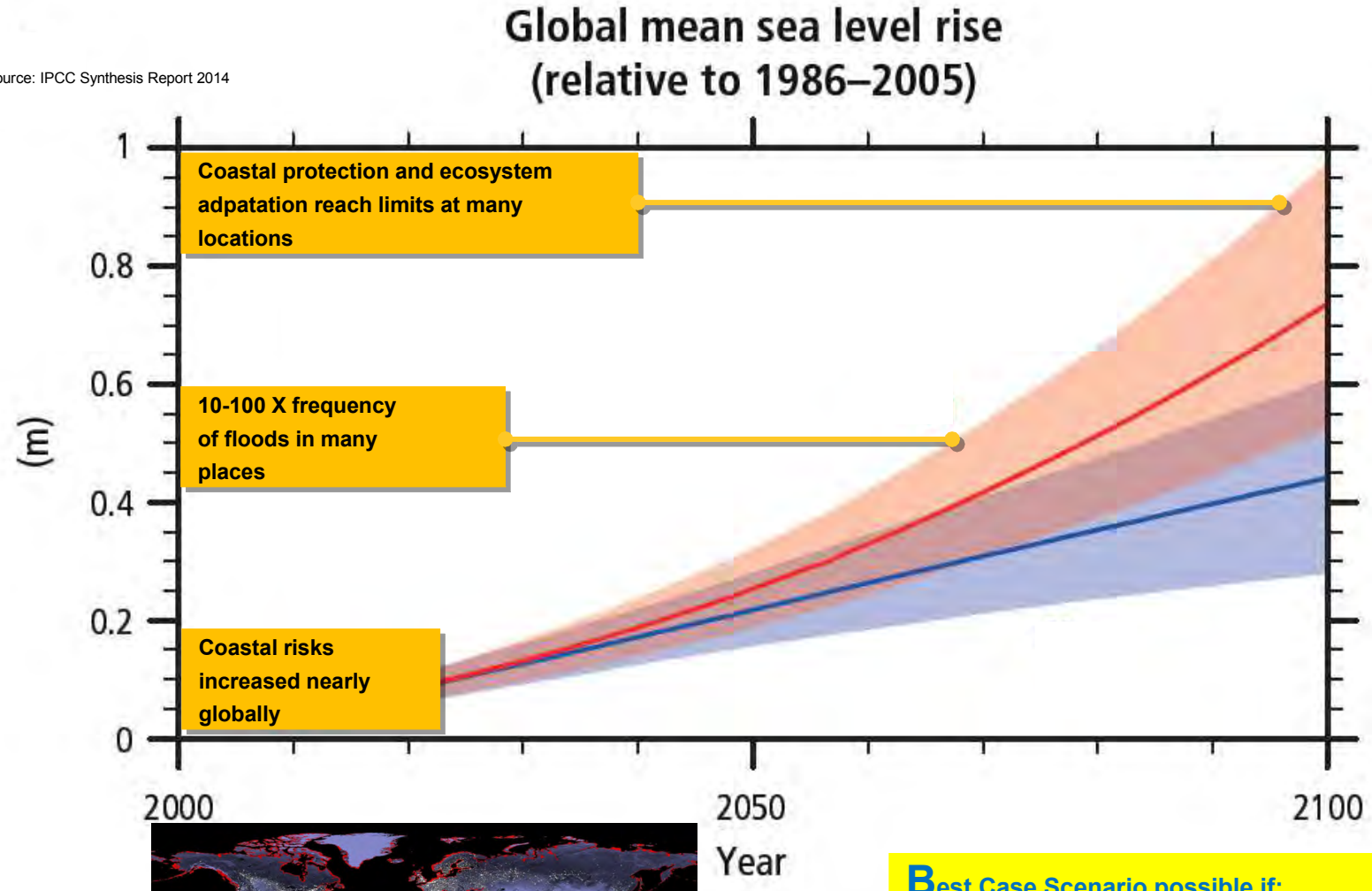
including huge mitigation efforts

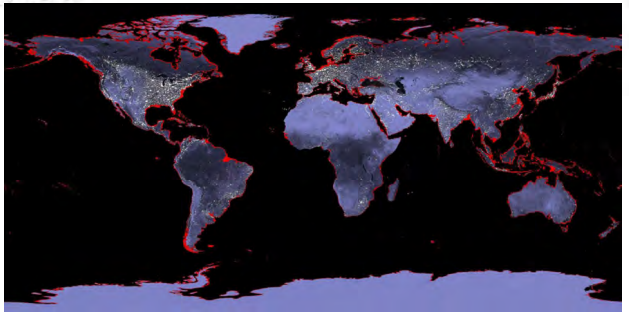
Only possible path to limit temperature increase to max 2ºC

Source: IPCC Synthesis Report 2014

Why +2ºC Matter – in the Future

Source: IPCC Synthesis Report 2014





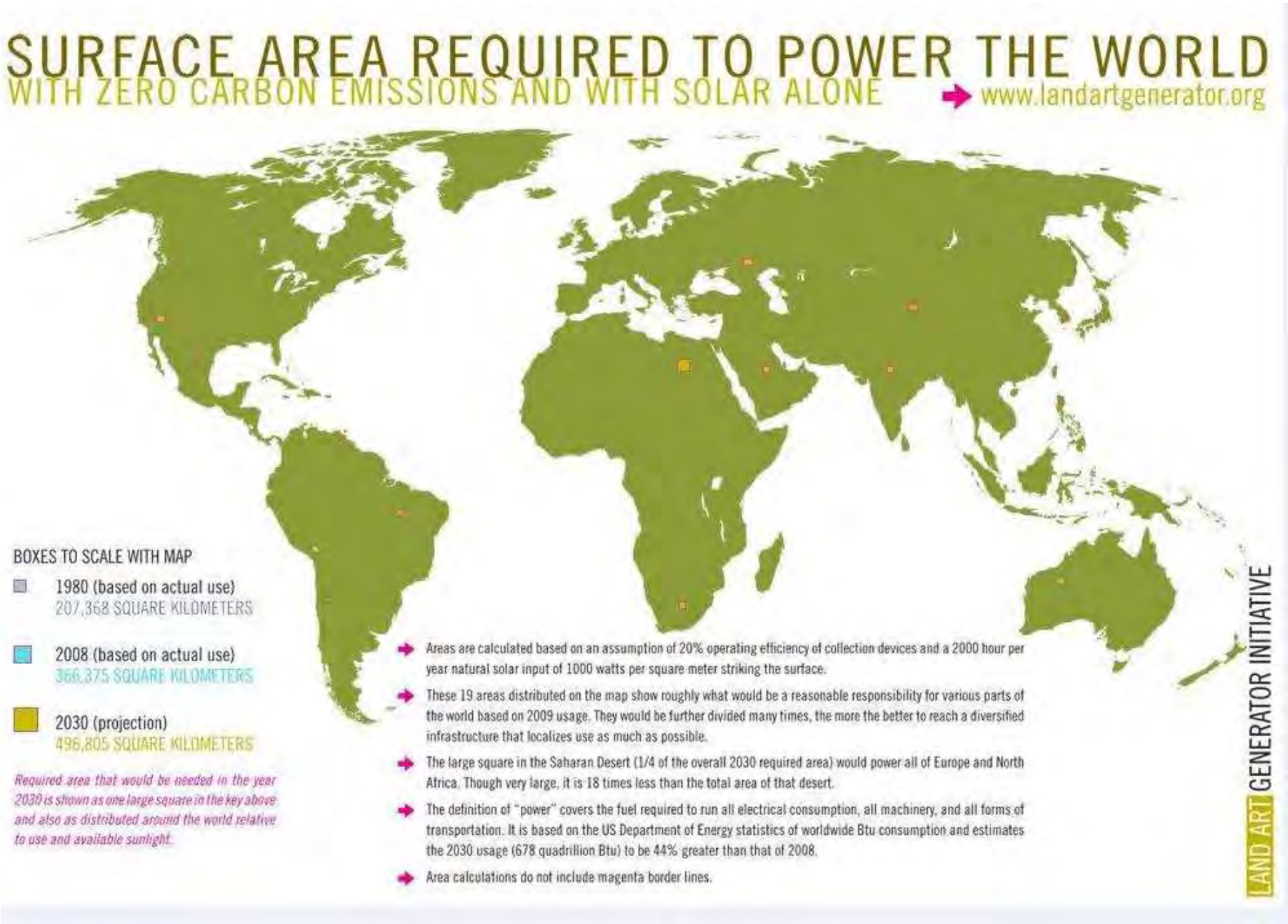
Best Case Scenario possible if:

Low carbon energy share of primary energy

- **increase to 60 % by 2040**
- **Increase to 90 – 95 % by 2100**
- **take CO2 out of atmosphere**

Graffiti by Banksy (photo: Romany WG)

The Sun Supplies Virtually Unlimited Energy



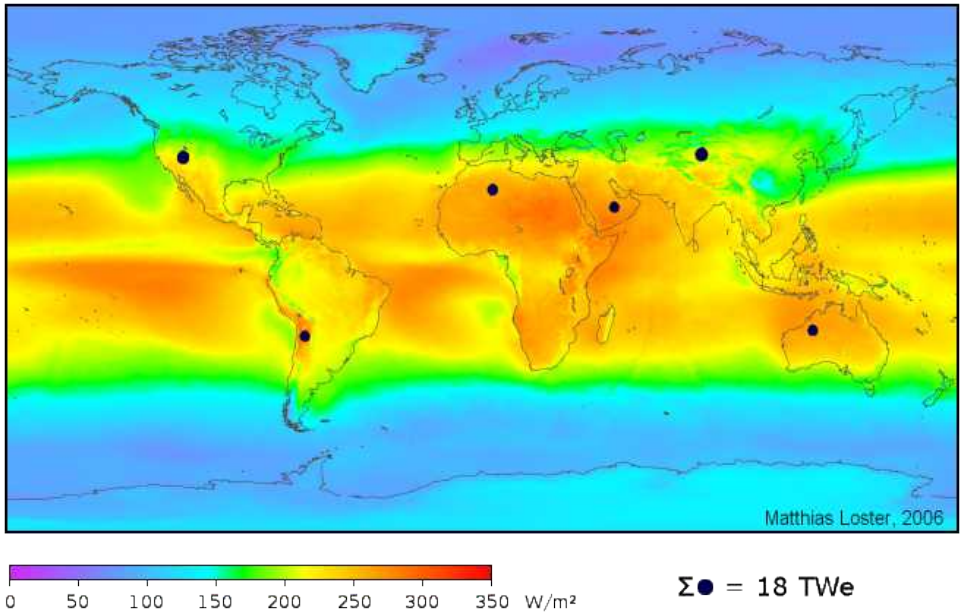
Reference case installations

Heineken Wieckse Brewery	Aldi Store Overpelt	Audi Production Plant
921 kW	50.4 kW	2.3 MW
855 MWh/year	47.3 MWh/year	2,025 MWh/year
3,683 REC solar panels	194 REC solar panels	9,288 REC solar panels
640 tons CO_2 saved/yr.	9.46 tons CO_2 saved/yr.	2,200 tons CO_2 saved/yr.
Den Bosch, Netherlands	Overpelt, Belgium	Brussels, Belgium

Irradiation and temperature

- Irradiation is often expressed in kWh per m2.
  - Germany: 1100-1400
  - Italy: 1600-2200
  - Belgium: 1150-1350
- Ambient temperature:
  Heat may increase degradation processes and therefore reduce performance
- Belgium is in a quite good position for solar energy in terms of irradiation and ambient temperature

Photovoltaic electricity potential worldwide



Quality at every step

➔ The main ingredient for a solar cell is very clean and pure silicon

➔ The silicon is molten in a big container and then slowly cooled

➔ The big block is sawn into smaller blocks

➔ The small block is sawn into thin ‘wafers’

➔ The ‘wafers’ are made into solar cells

➔ The cells are packed into larger modules

REC's Integrated Manufacturing Facility in Singapore

US$2 billion investment with construction started in 2008, production ramp in 2010

Focus on operational excellence to ensure high reliability

- Fully automated soldering leads to world leading low claim rates: out of 3 million panels manufactured yearly, less than 300 are returned

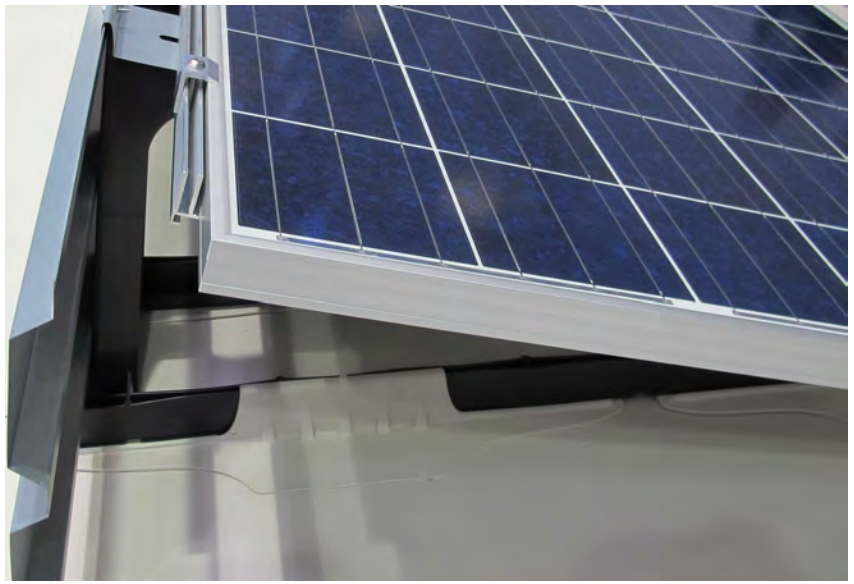
Automated interconnection soldering for accurate placement and consistent good soldering

100% controlled induction soldering

Dual Interconnection Preparation unit

By comparison …

Installation quality matters for overall performance



Electricity prices will increase

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‘Elektriciteit wordt komende jaren veel duurder’

17/10/2014 om 13:41 | Bron: DS/BELGA

De prijs van elektriciteit kan de komende jaren heel snel stijgen, waarschuwt het Federaal Planbureau. Door de grote investeringen die nodig zijn in de sector kunnen de productiekosten van stroom binnen zes jaar al meer dan 60 procent hoger liggen. Dat zou de factuur voor kleinverbruikers met ongeveer een kwart de hoogte in jagen.

- Electricity generation costs may increase by 60% during the next six years.
- Electricity purchase prices might therefore increase by 25%.

REC's C&I Self-Consumption Calculation – Approach
in collaboration with BET (Aachen)

Assumptions in the model regarding investment costs and feed-in tariffs were adapted to the Belgian market conditions

Investment costs and Degradation

- CAPEX: 1.116 € for 2015
- OPEX: 18.63 €/(a*kWp) for 2015
- Degradation: 0.5% p.a.

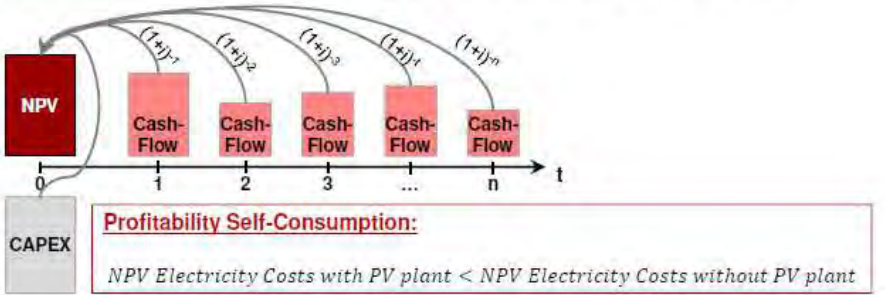
Feed-in tariffs

- Conservative assumption for earnings from selling green energy certificates made
  - Legally guaranteed prices used
  - Certificate prices on market may be higher in reality

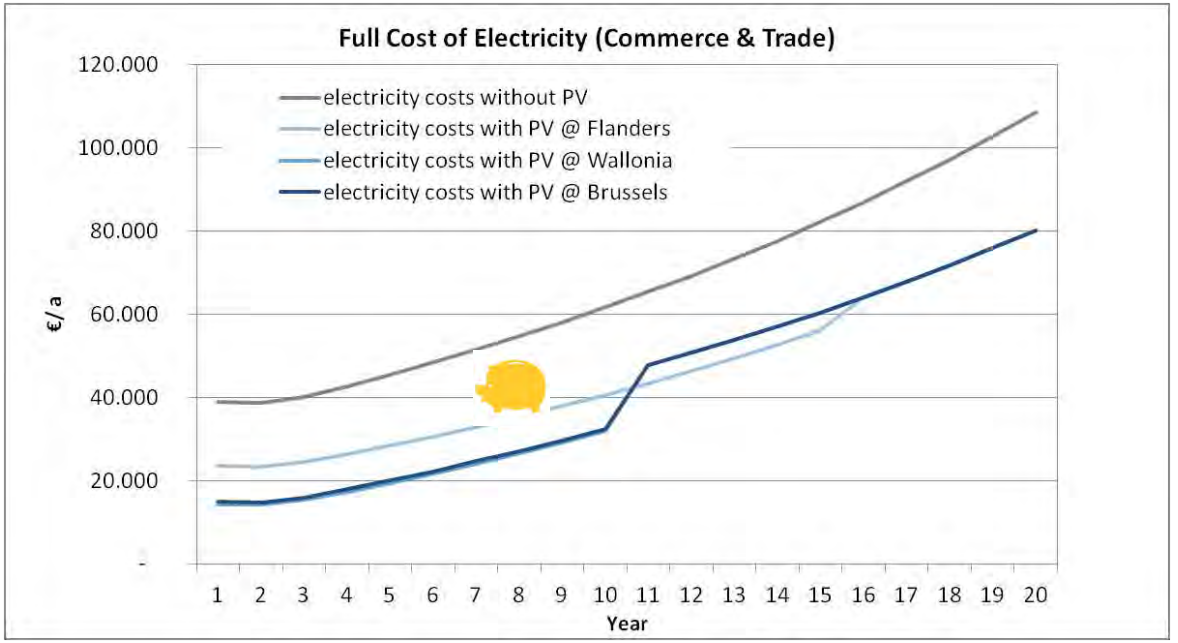
Financing Conditions

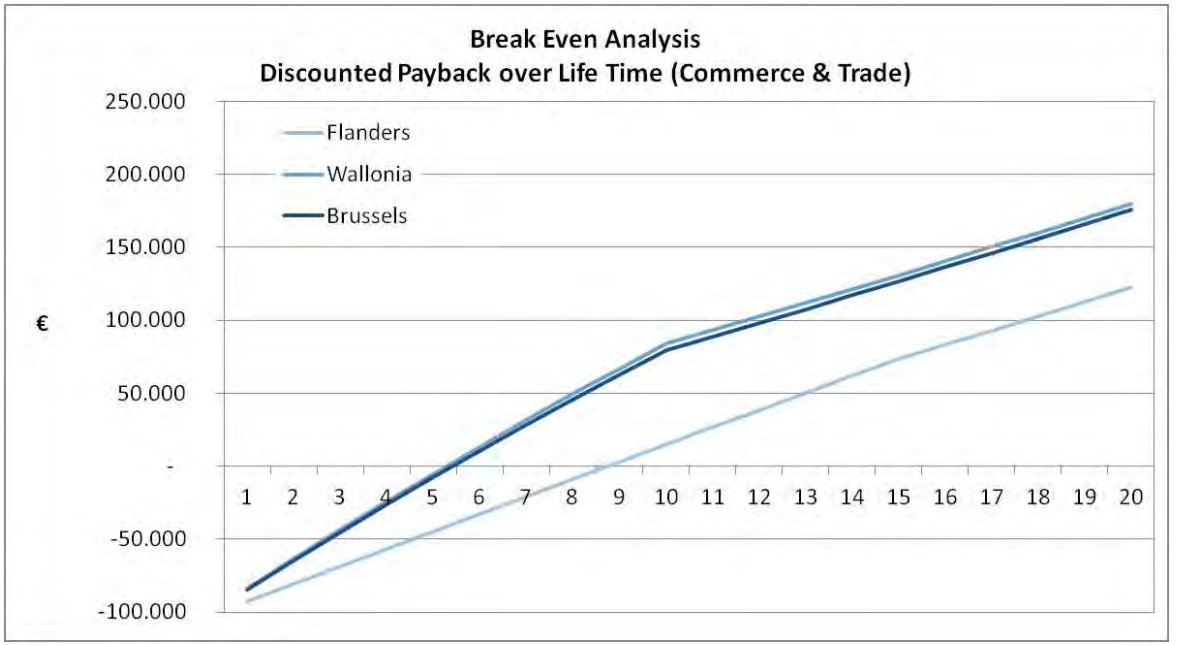
- Equity ratio (ER): 35%
- Capital gearing (BR): 65%
- Cost of debt (rd): 4.60%
- Risk free rate (rf): 5.25%
- General market risk premium (rmr): 6.25%
- Tax rate (t): 31.4%
- Beta-factor (β): 1.13

- Expected market rate of return (rm): 11.50%
- Cost of equity (re): 12.31%
- Weighted average cost of capital (WACC): 6,36%



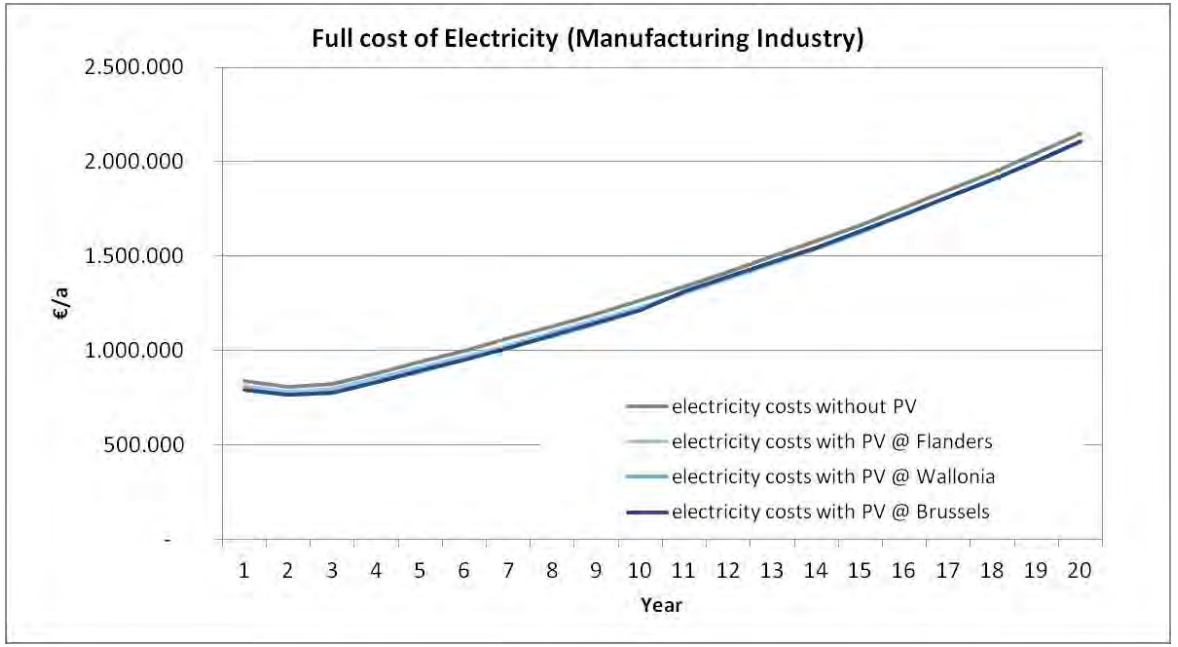
REC‘s C&I Self-Consumption Calculation – Trade

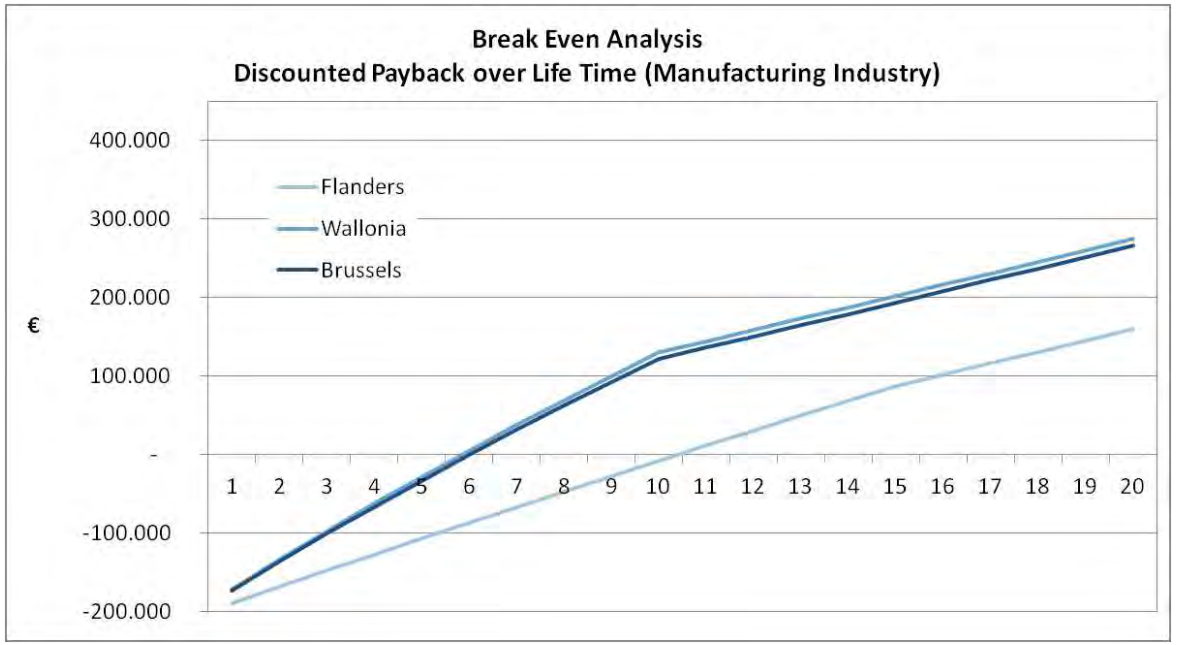




	Commerce & Trade (high levies and taxes)		
	Flanders	**Wallonia**	**Brussels**
Electricity Demand [MWh/a]	254		
Size PV plant [kWp]	95		
Investment costs PV plant [€]	105.881		
Investment costs PV plant [€/kWp]	1.116		
Rate of Self Consumption [%]	83,7%		
NPV Profitability Self Consumption [€]	122.624	179.852	175.662
NPV Profitability Self Consumption [€/kWp]	1.292	1.896	1.852
Internal Rate of Return [%]	14,75%	21,62%	21,13%
Payback Period [a]	9	6	6
Rate of Return on Equity [%]	36,58%	56,20%	54,82%

REC‘s C&I Self-Consumption Calculation – Manufacturing Industry

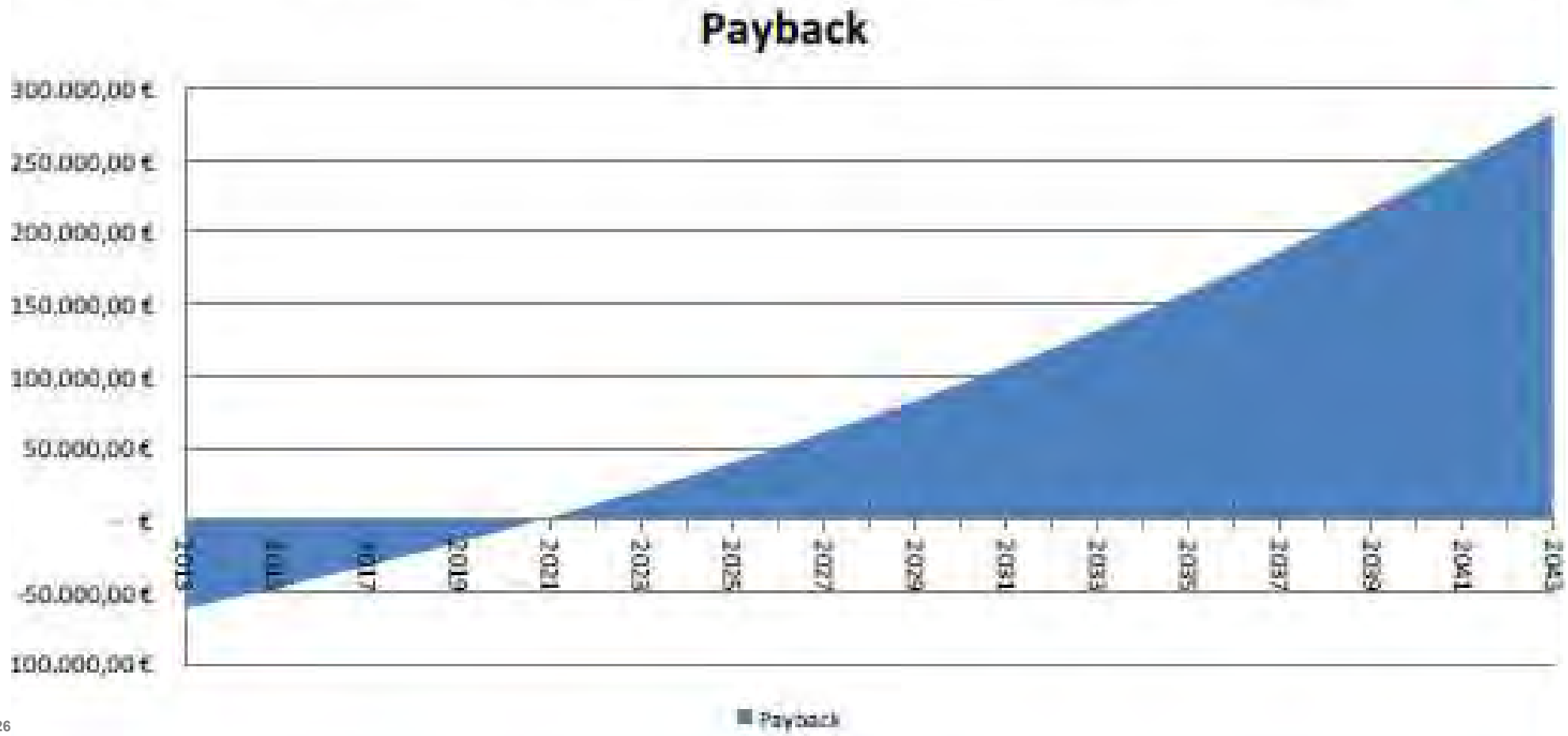




	Manufacturing industry (medium levies and taxes)		
	Flanders	**Wallonia**	**Brussels**
Electricity Demand [MWh/a]	7.956		
Size PV plant [kWp]	190		
Investment costs PV plant [€]	211.761		
Investment costs PV plant [€/kWp]	1.116		
Rate of Self Consumption [%]	100,0%		
NPV Profitability Self Consumption [€]	160.308	274.764	266.383
NPV Profitability Self Consumption [€/kWp]	845	1.448	1.404
Internal Rate of Return [%]	11,98%	18,95%	18,46%
Payback Period [a]	11	6	7
Rate of Return on Equity [%]	28,67%	48,59%	47,17%

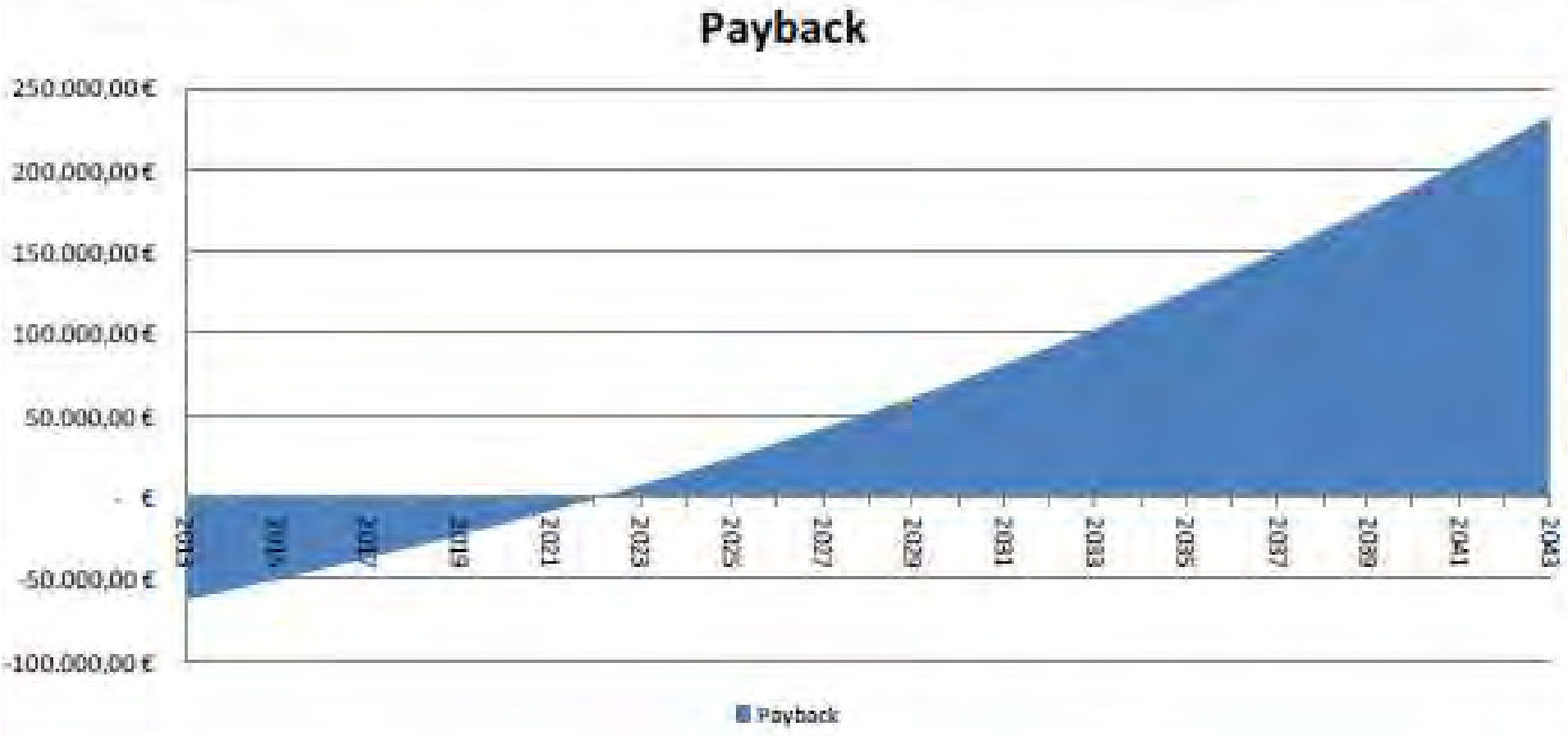
Case: Aldi Store in Kapellen

PV installation size: 50.4 kWp	Self-consumption rate: 90%	Payback Time: 8 years
Energy demand: 180 MWh/year	Electricity price: 0.18 €/kWh	ROE: 17.7%
Energy production: 47.4 GWh	Investment: 65,500 €	



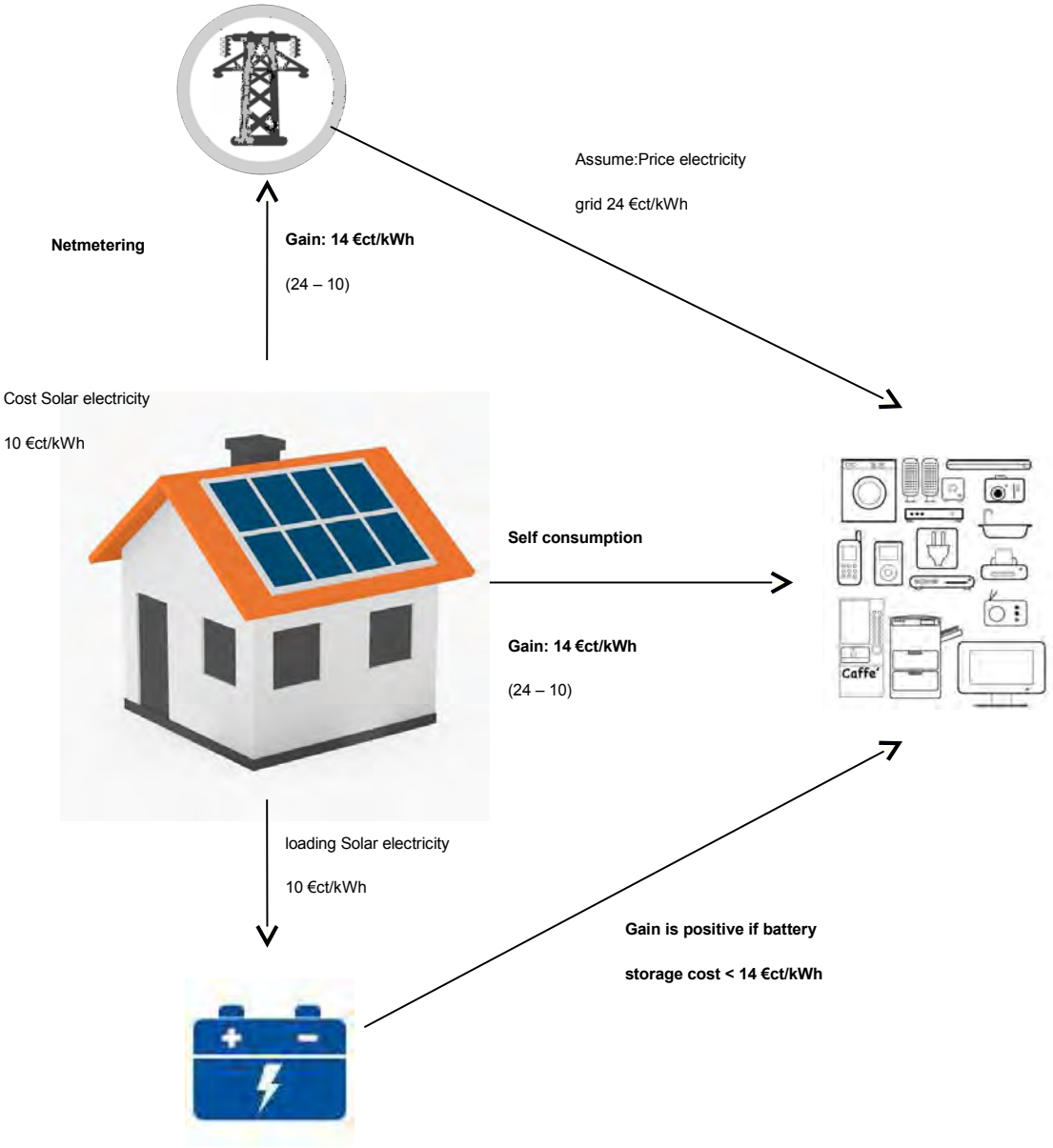
Case: Aldi Store in Schoonaarde-Dendermonde

PV installation size: 50.4 kWp	Self-consumption rate: 79%	Payback Time: 9 years
Energy demand: 140 MWh/year	Electricity price: 0.18 €/kWh	ROE: 15.14%
Energy production: 46.4 GWh	Investment: 65,572 €	

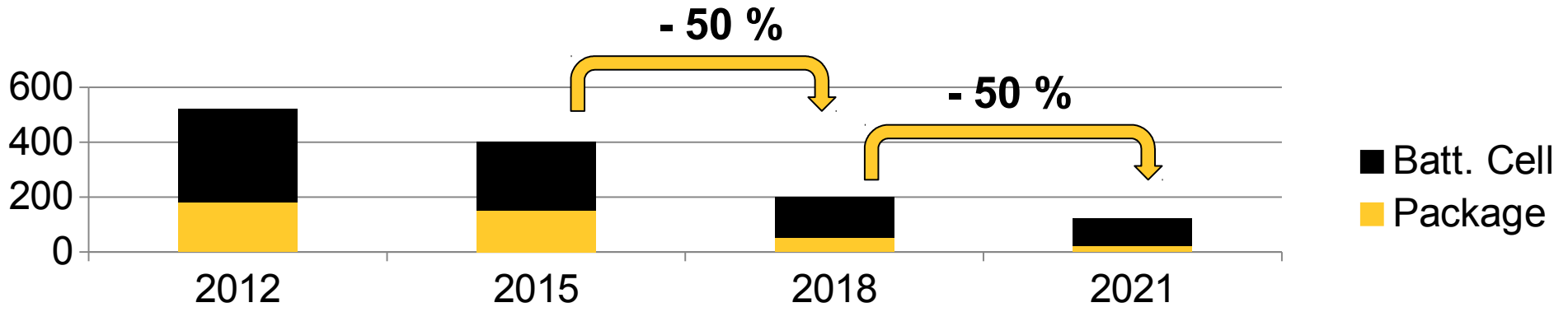


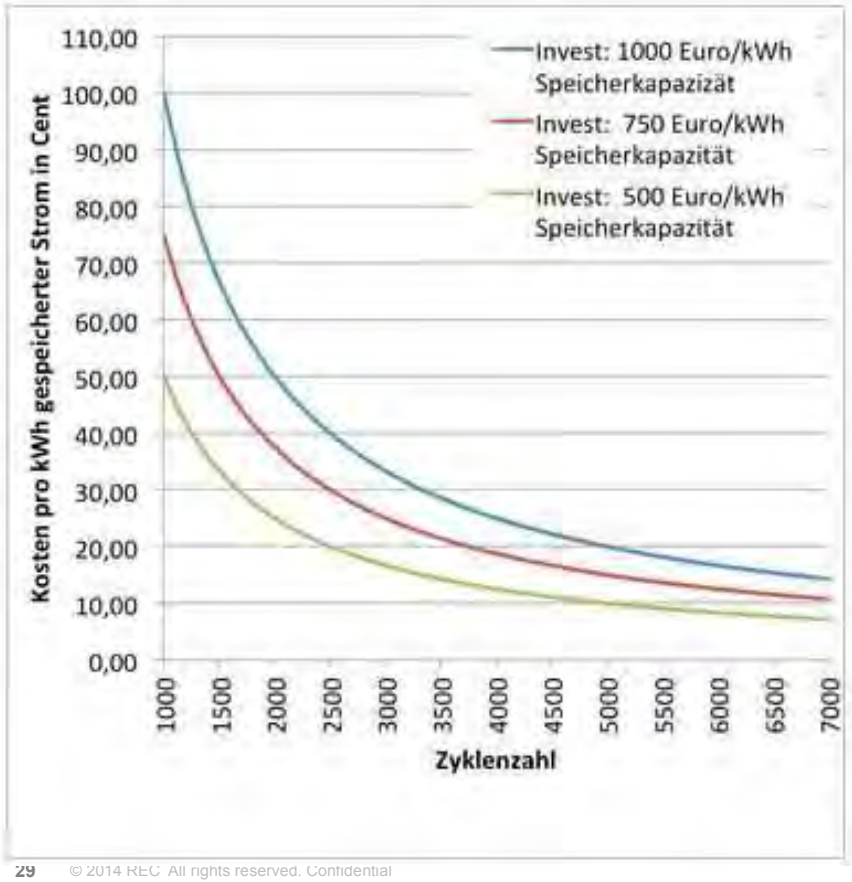
Battery storage: what to consider ?

- Assume Tesla Powerwall
  - 7 kWh capacity, 92 % eff., 10 years warranty, 2800 €
  - Formula:
    - cost price/Kwh = Batt cost / (Cycles x cap x % charge x eff.)
    - Cycles = warranty time x days/year
  - Lets assume that in Belgium, due to limited sunshine days only 50 % of cycles will be used.
  - Cycles = 365 days x 10 years = 3650
  - Cost price = 2800 € / (3650 x 7 kWh x 50 % x 92 %) = **23 €ct/Kwh**
- **Key specifications:**
  - Cycles or warranty in years
  - Degradation performance
  - Technology dependent: Depth of Discharge (DoD)



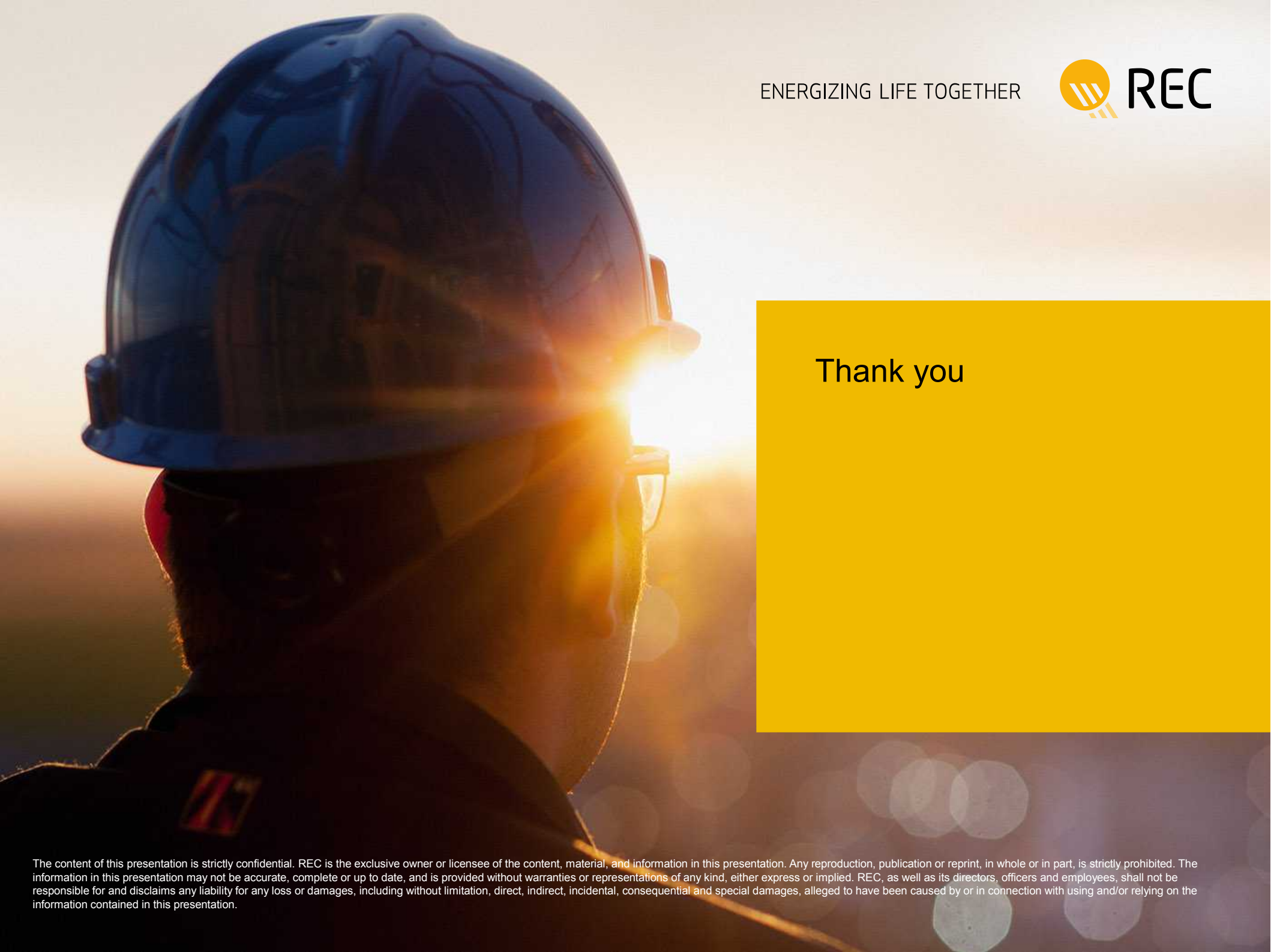
Status Battery storage





Cost / kWh

- **Cycles**
- **Price battery / kWh**



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Thank you

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08 - 10 - 2015

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