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# From the Learning Curve to Competitiveness

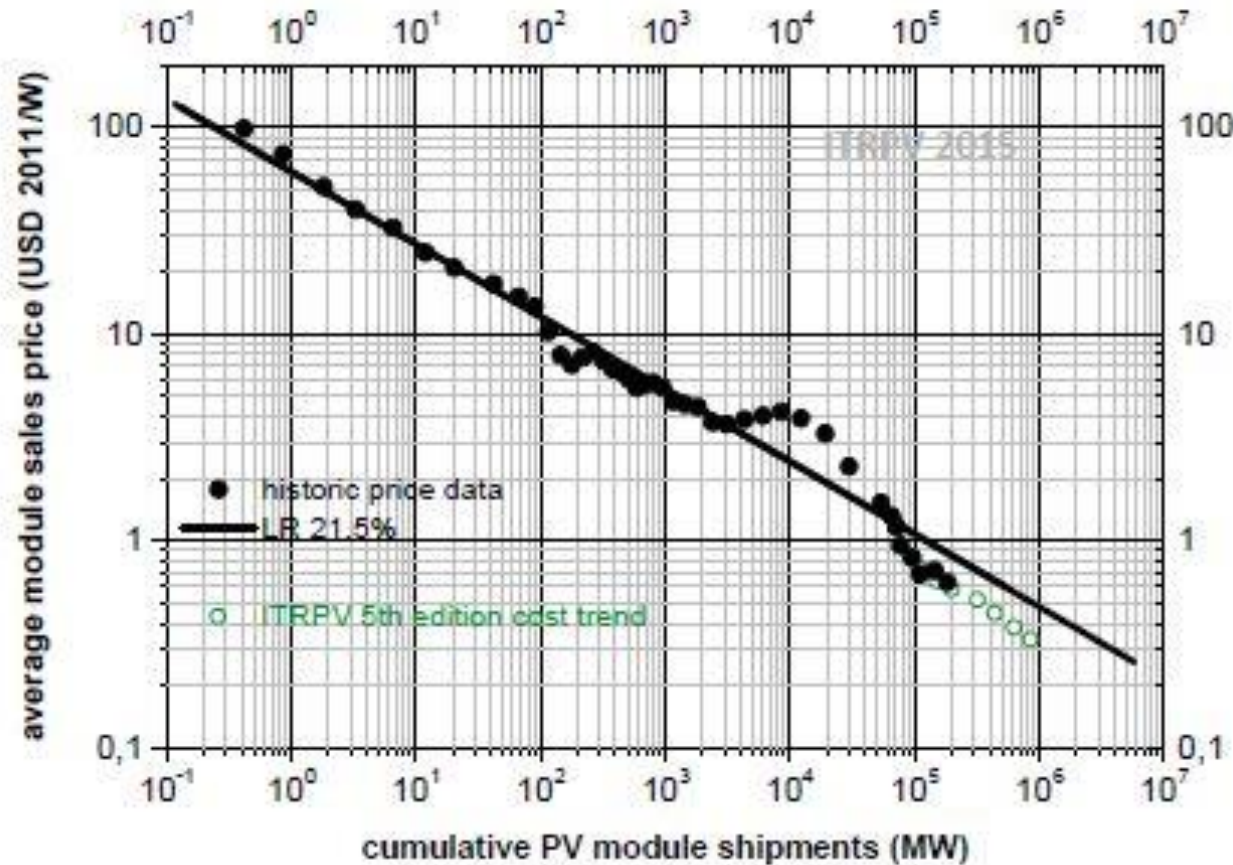
Eero Vartiainen

IEA PVPS Task 1 Workshop

Hamburg, 14.9.2015

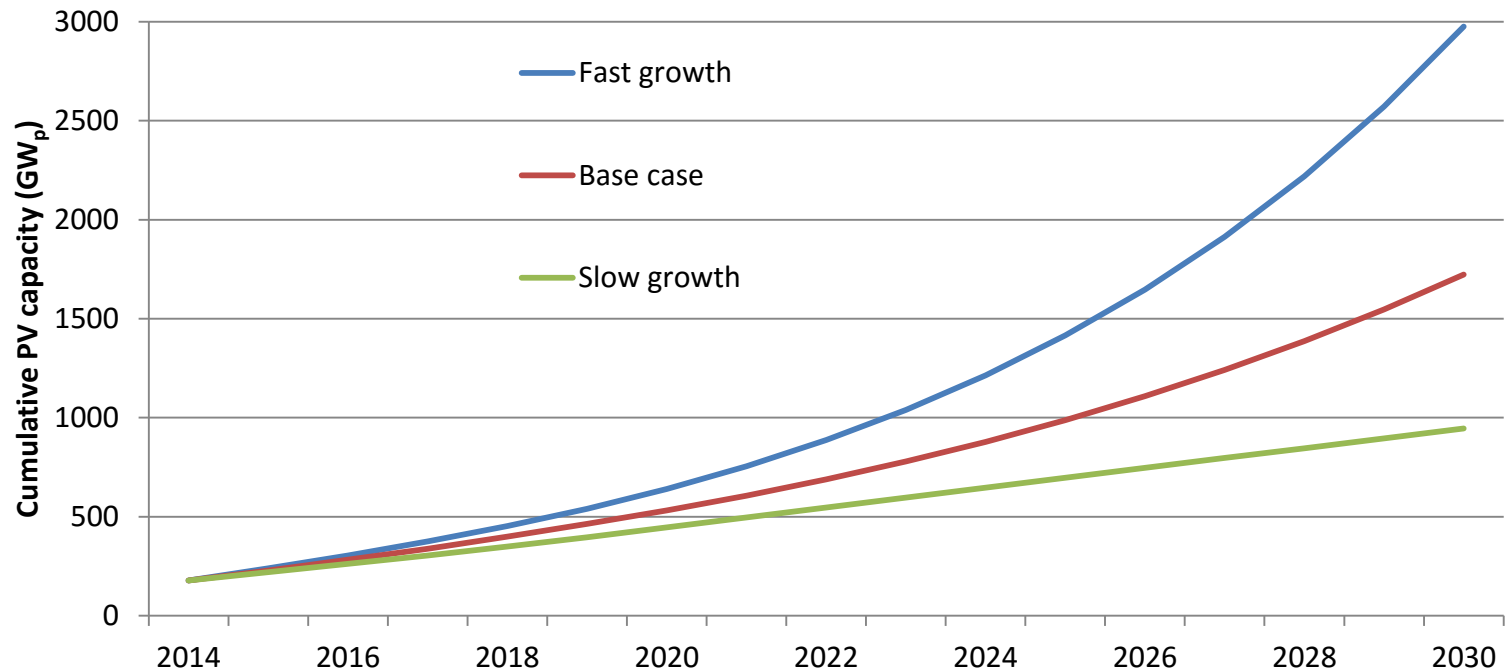
# Historical learning rate for PV modules is about 20%

Every time the global cumulative PV capacity has doubled, module price has reduced by 20%



Source: International Technology Roadmap for Photovoltaic, 2014 results (April 2015)

# PV capacity to grow from 178 GW<sub>p</sub> in 2014 to 1700 GW<sub>p</sub> in 2030



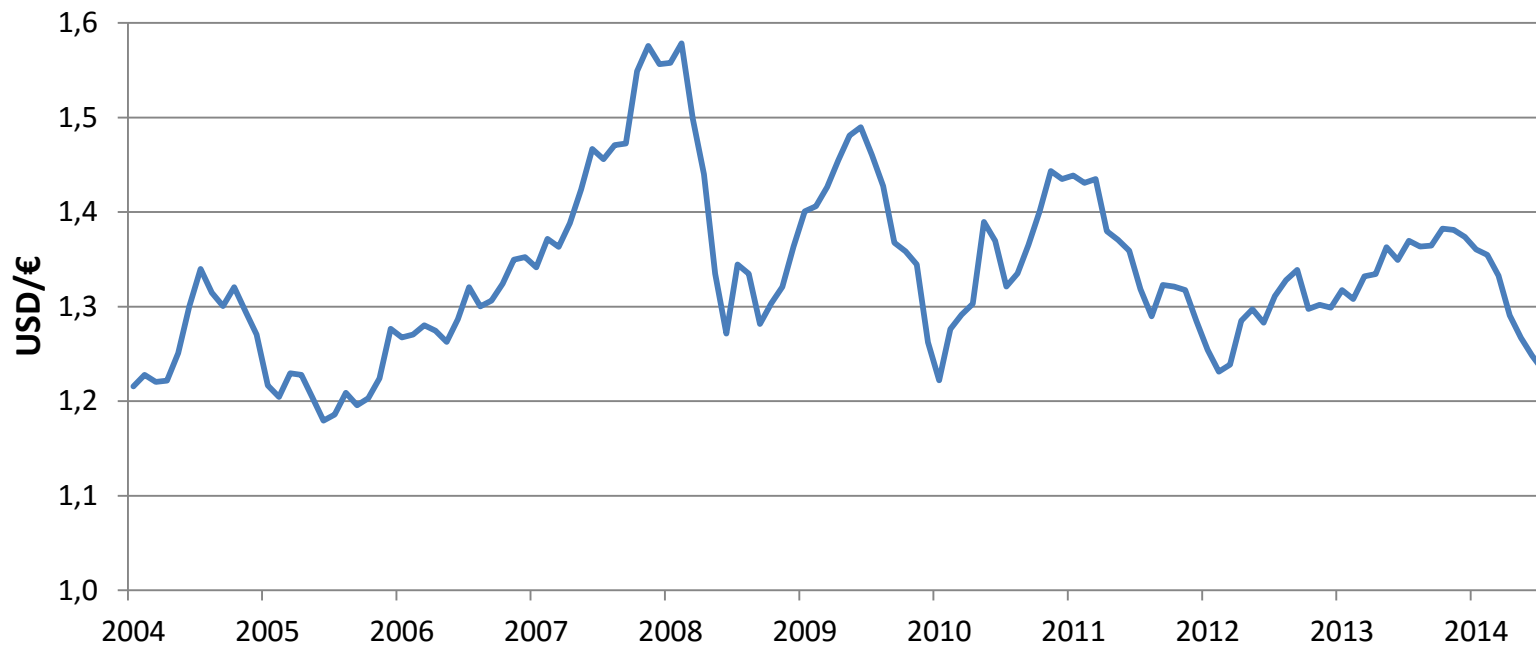
Base scenario according to IEA Technology roadmap for PV (2014); 10% CAGR

Slow scenario SolarPower Europe (6/2015) low scenario until 2019, 50 GW<sub>p</sub> annually 2020-30 (0% CAGR 2019-30)

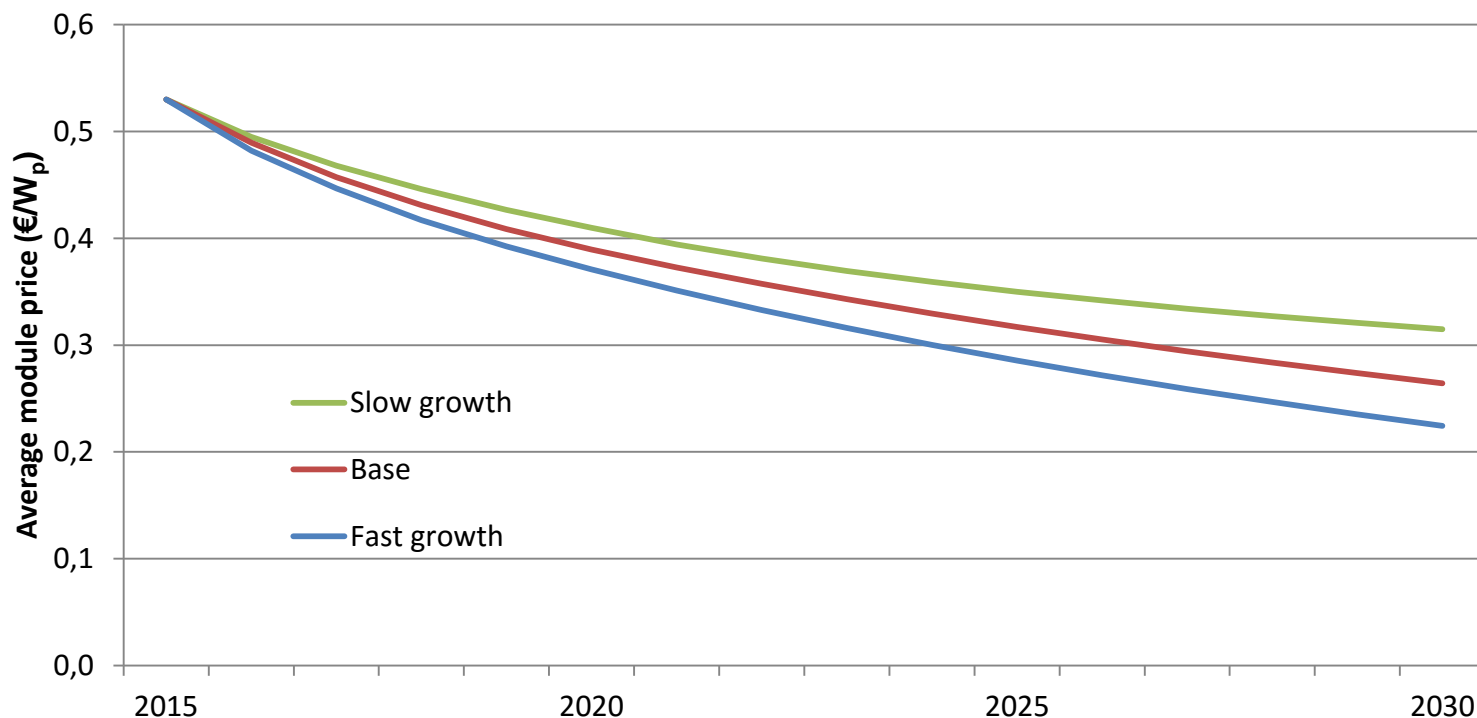
Fast scenario SolarPower Europe (6/2015) high scenario until 2019, 15% CAGR 2019-30

# Average USD to EUR ratio 2004-2014 is 1.33

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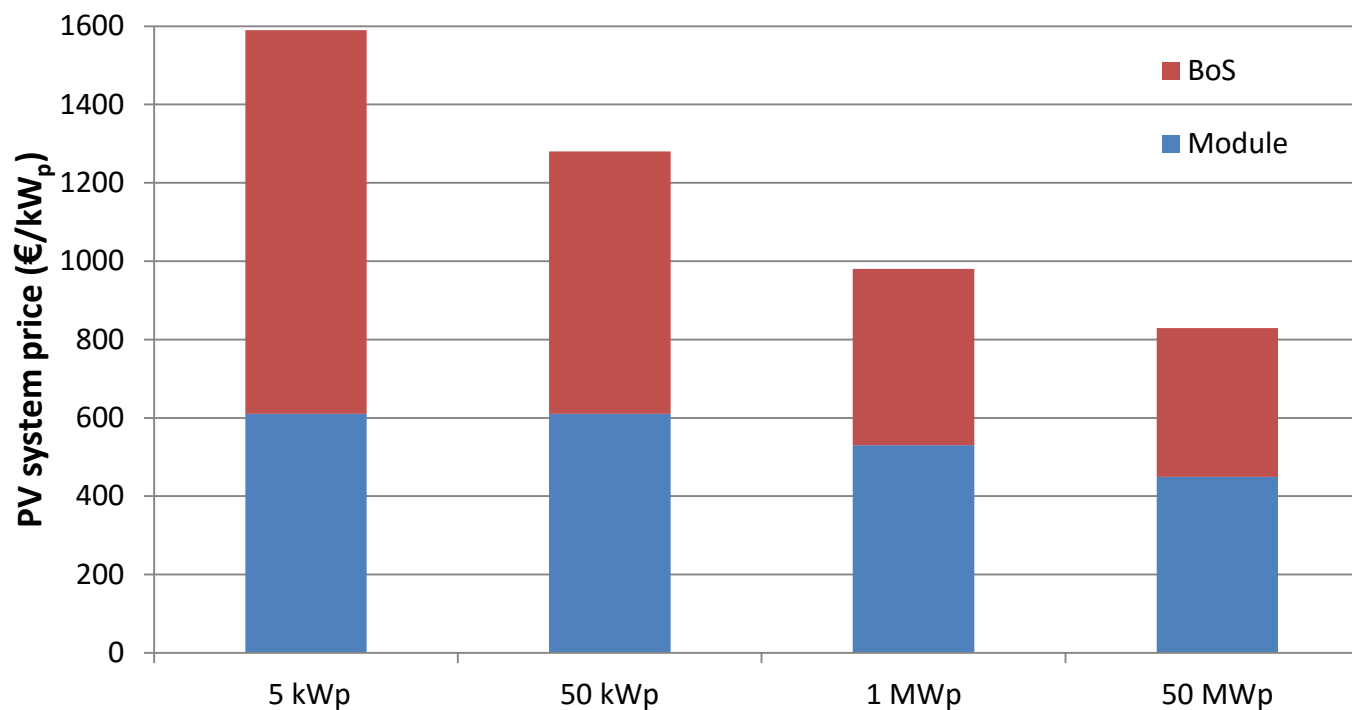


# Average PV module price in Europe most likely halved by 2030



Price estimation based on the three cumulative volume scenarios and historic 20% learning curve

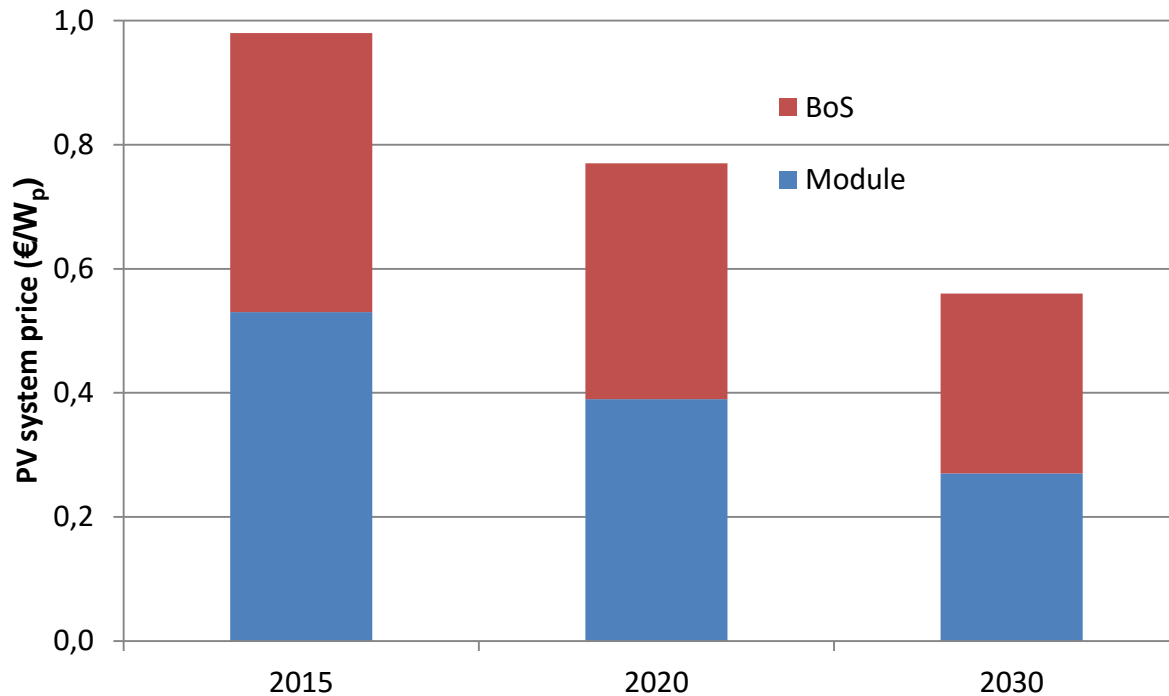
# System prices in 2015 for various market segments



Source: EU PV Technology Platform report on PV LCOE (9/2015)

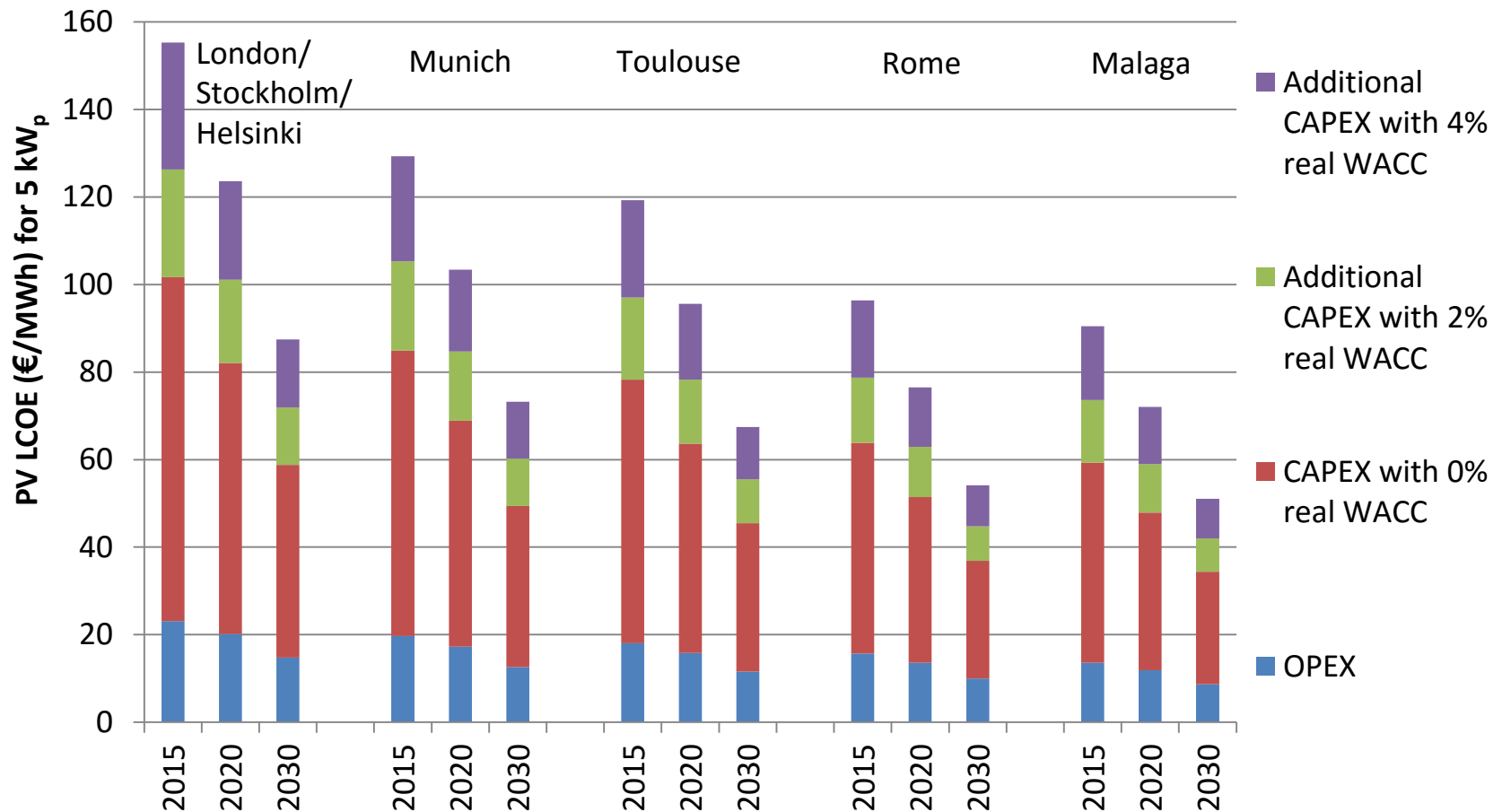
# System prices for a 1 MW<sub>p</sub> system 2015-30

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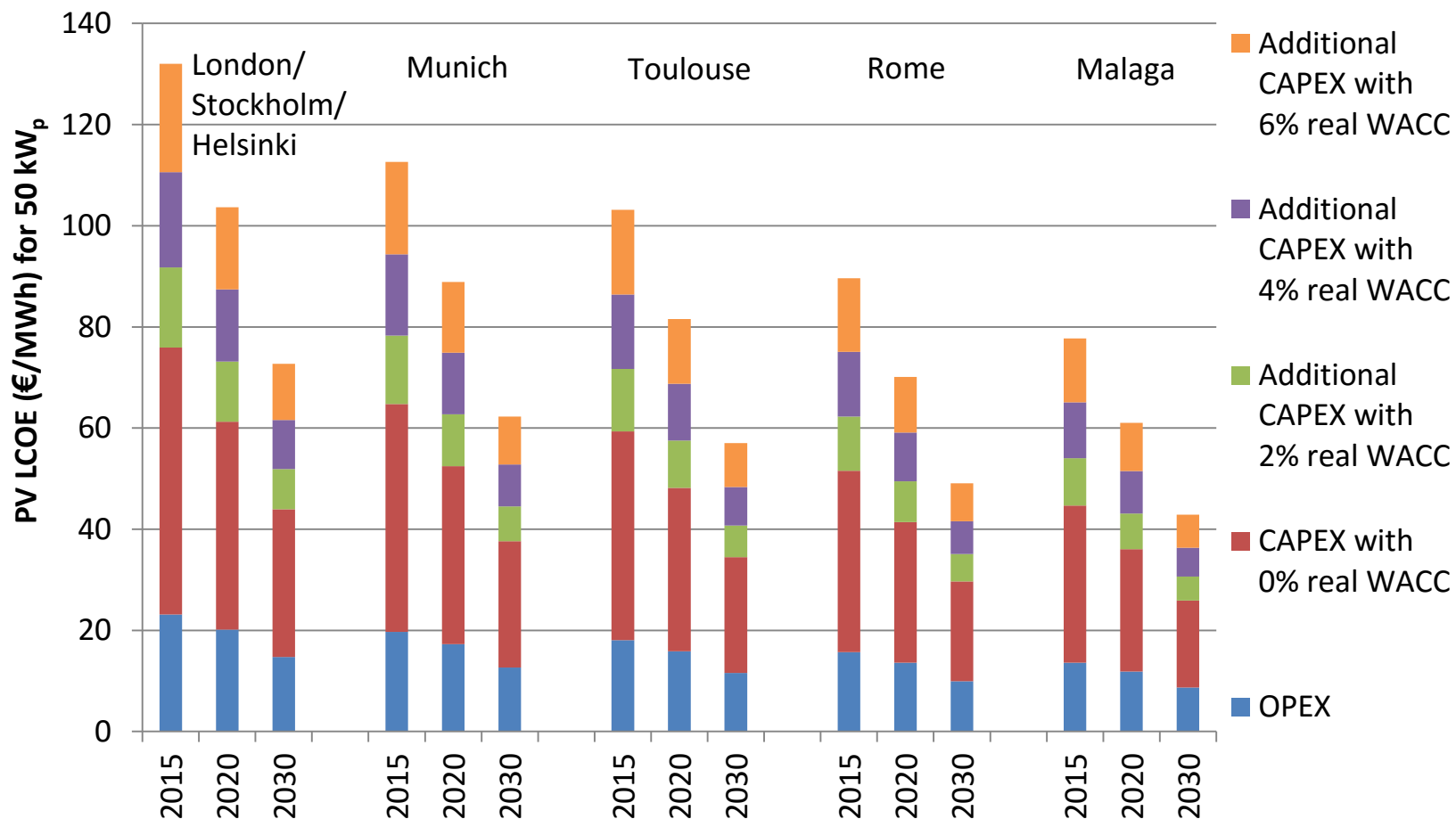
Source: EU PV Technology Platform report on PV LCOE (9/2015)

# PV LCOE in Europe for a residential 5 kW<sub>p</sub> system (with VAT)

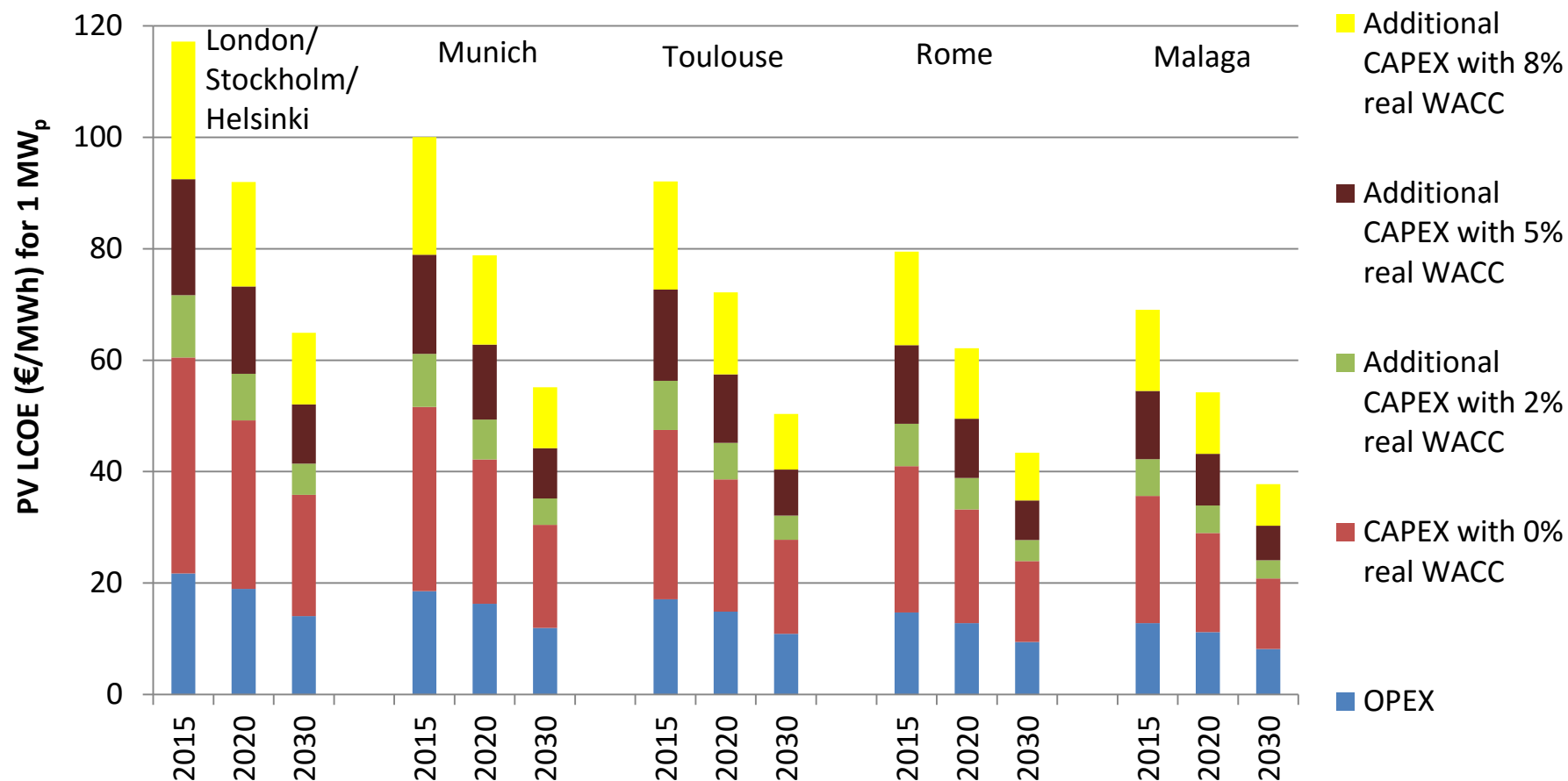




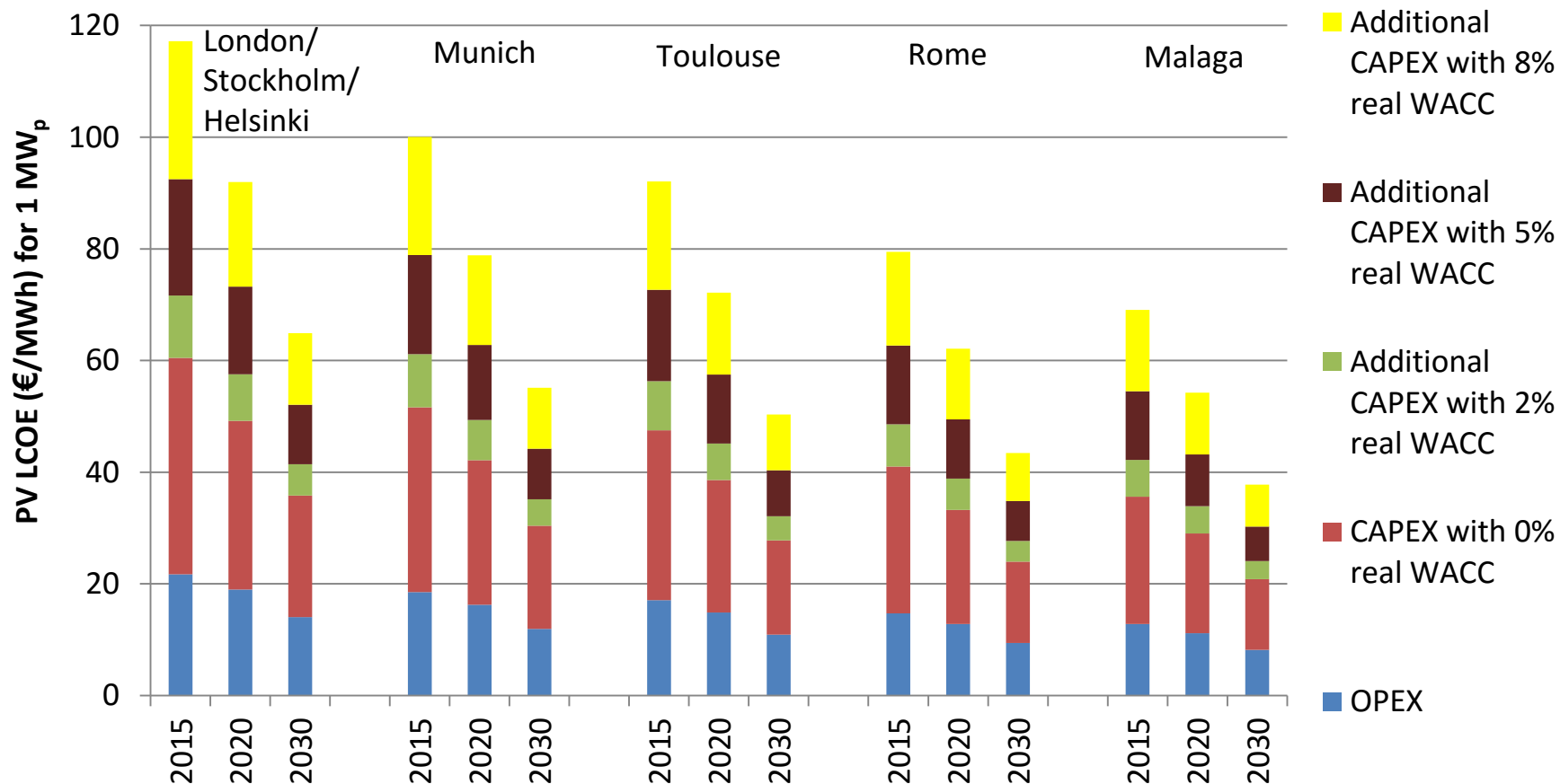
# PV LCOE in Europe for a commercial 50 kW<sub>p</sub> system (w/o VAT)



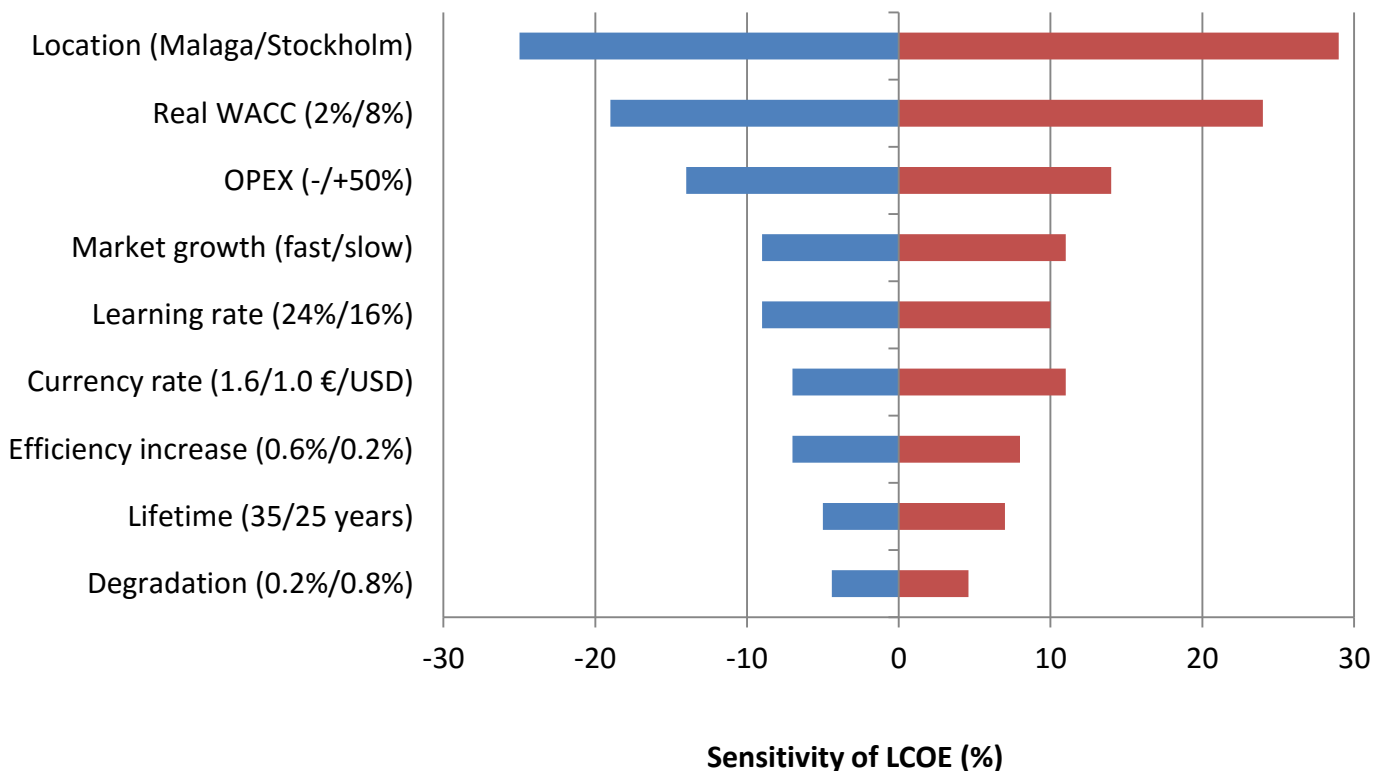
# PV LCOE in Europe for a 1 MW<sub>p</sub> system (w/o company taxes)



# PV LCOE in Europe for a 50 MW<sub>p</sub> system (w/o company taxes)



# Location and real WACC have the biggest influence on PV LCOE



Comparison with a 1 MWp system in Toulouse with a 5% real WACC, base CAPEX and OPEX, 20% learning rate, 1.33 USD/€ currency rate, 0.4% point annual efficiency increase, 30 years lifetime and 0.5% annual degradation

# Conclusions: PV will be competitive by 2030 in most markets

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- PV already competitive with retail electricity all over Europe
- By 2030, PV will be competitive with wholesale electricity in many markets
- With location, cost of capital has the biggest influence on PV LCOE
- Volume growth or learning rate has a relatively small impact
- Uncertainty in OPEX is more significant than in CAPEX

**It is most urgent for the policy makers to create a stable environment for investments, in order to decrease the cost of capital and thus the LCOE of PV**

# What's next - PV LCOE will continue to decrease after 2030

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PVSEC oral presentation 7DO.15.1 'PV LCOE in Europe 2015-2050'  
on Thursday 17<sup>th</sup> at 15.15-15.30

Thank you!

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