

# Prosumers in Norway - with focus on solar energy

13.09.2017 |

Energy Lab  
Ann-Mari L. Knudsen

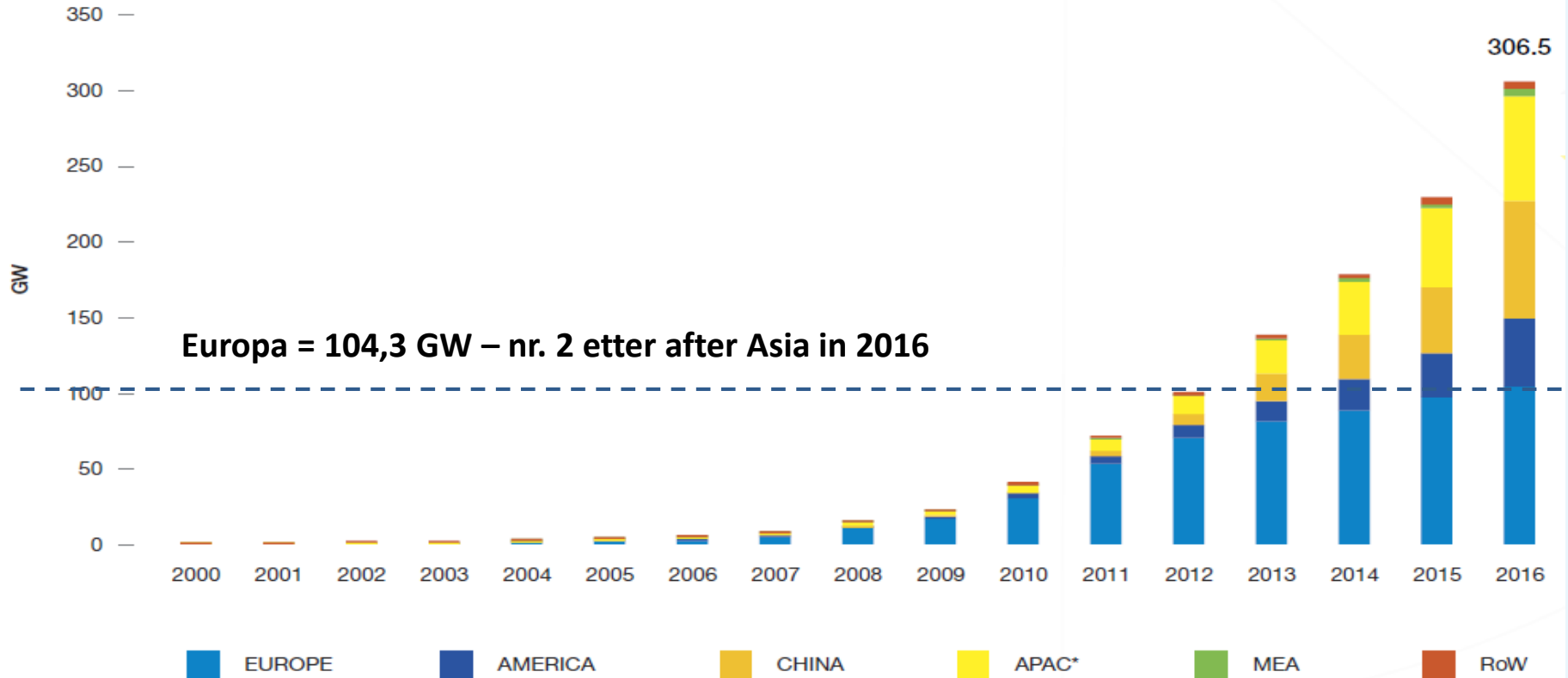


<https://curiositykilledtheconsumer>

# Agenda

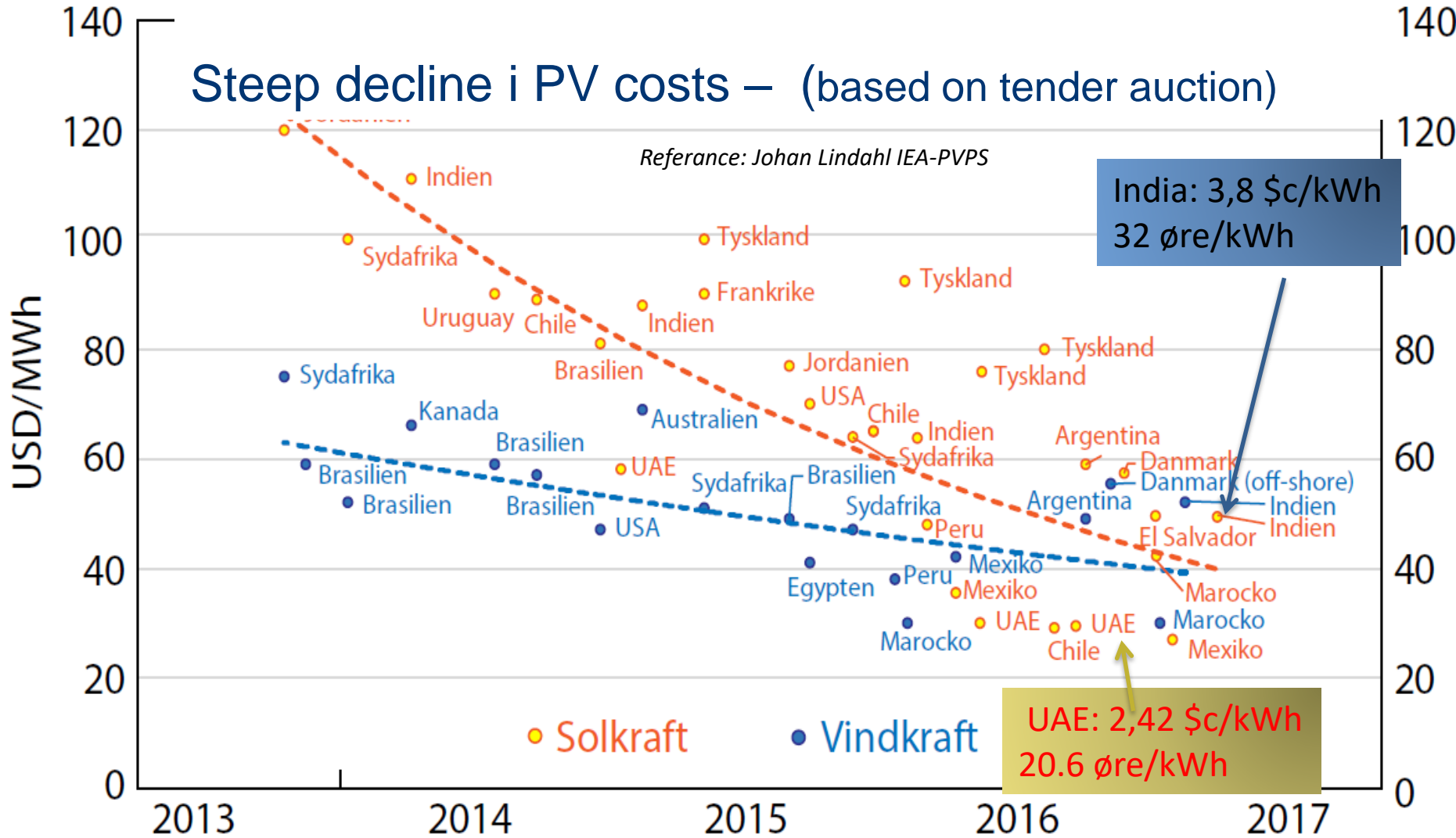
- **Global overview**
- **Development of PV in Norway**
- **Incentives for prosumers**
- **Potential for PV**
- **LCOE**
- **Net present value**

FIGURE 4 EVOLUTION OF GLOBAL TOTAL SOLAR PV INSTALLED CAPACITY 2000-2016



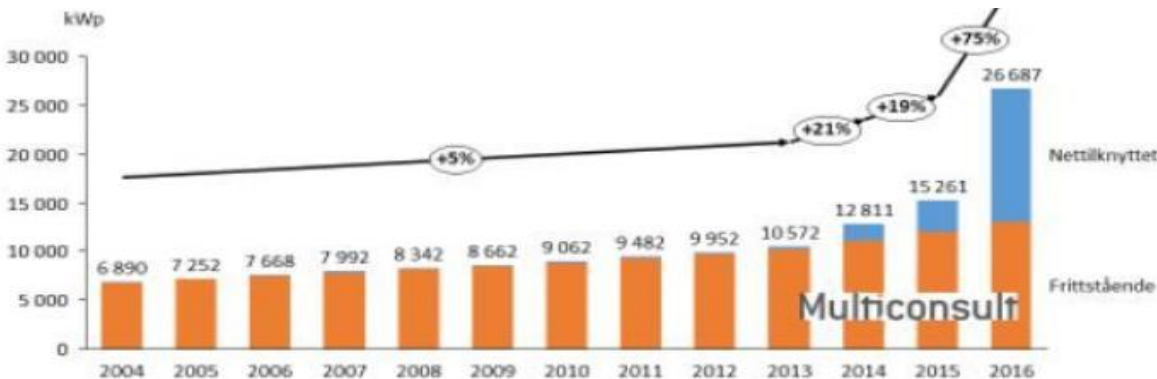
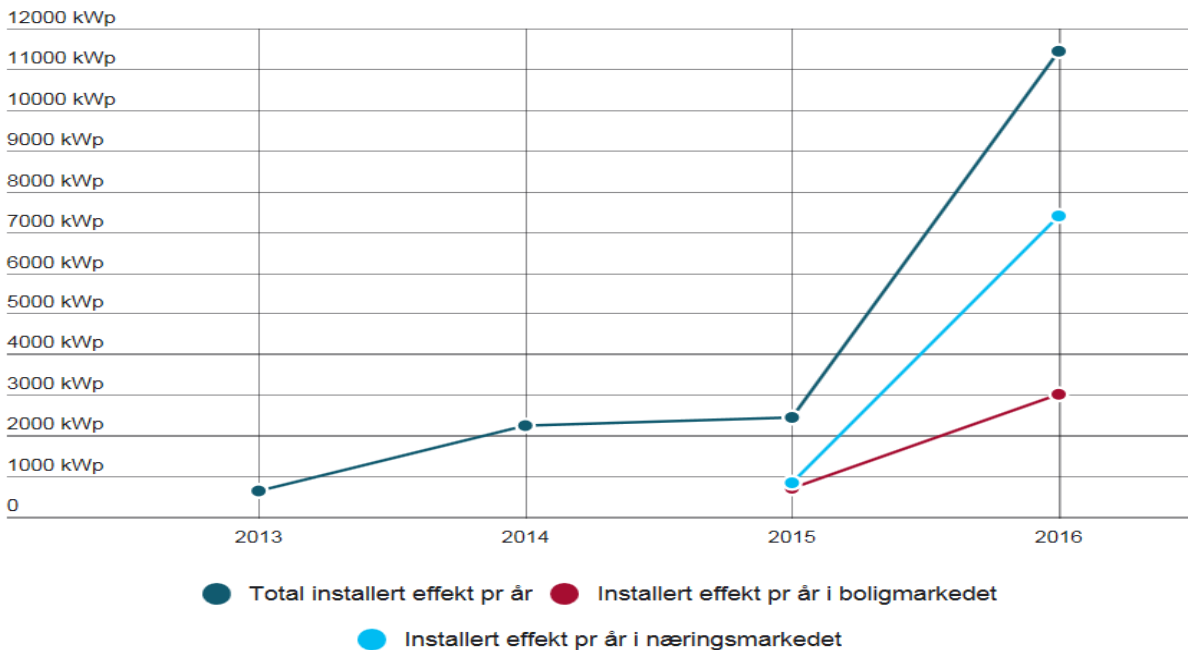
# Steep decline i PV costs – (based on tender auction)

Referance: Johan Lindahl IEA-PVPS



# PV in Norway

- Yearly installed capacity more than tripled from 2015 to 2016
- Largest growth in business sector
- Norway: 24 GWh
- Sweden: 180 GWh
- Denmark: 840 GWh



# Incentives for solar in Norway

## Plusskundeordning

- Max 100 kW surplus of power (650 m2 )
- Reduced tariff
- Hourly settlement
- No energy tax or grid tariff for own consumption
- May apply for elcertificates

## Enova –support

- 10 000 kr support for the installation
- 1.250 kr /kW installed capacity up to 15 kW
- = maximum **28.750 kr**



# Nordic PV potential (Roof)

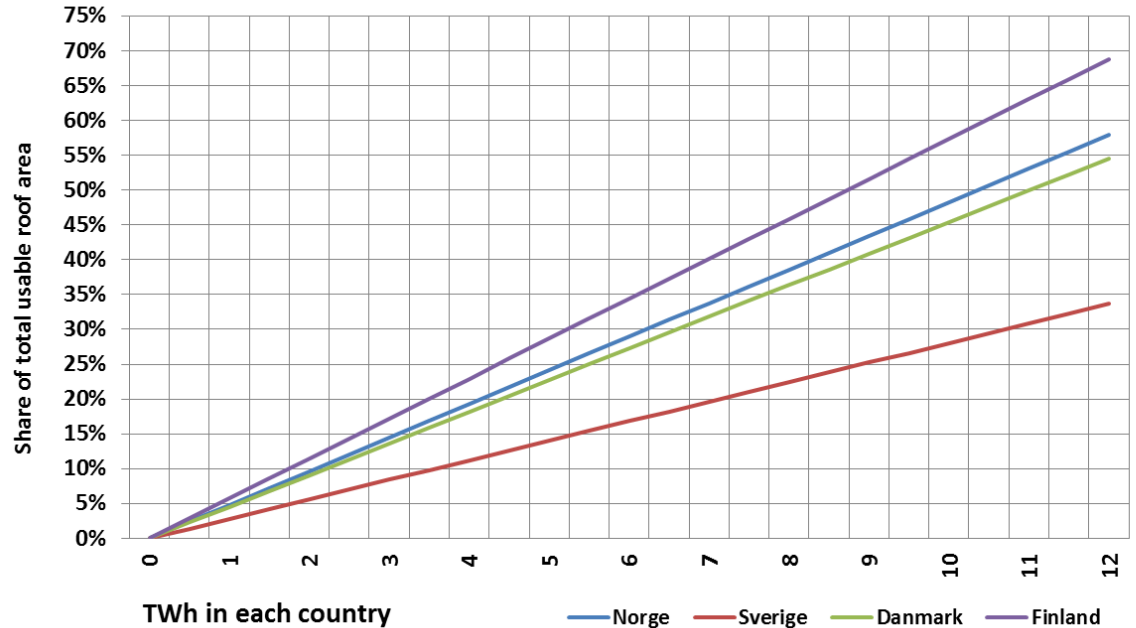
## PV Potential

- Norway: 20 TWh
- Nordic: 95 TWh

## Assumption

33 % of total roof area defined as usable

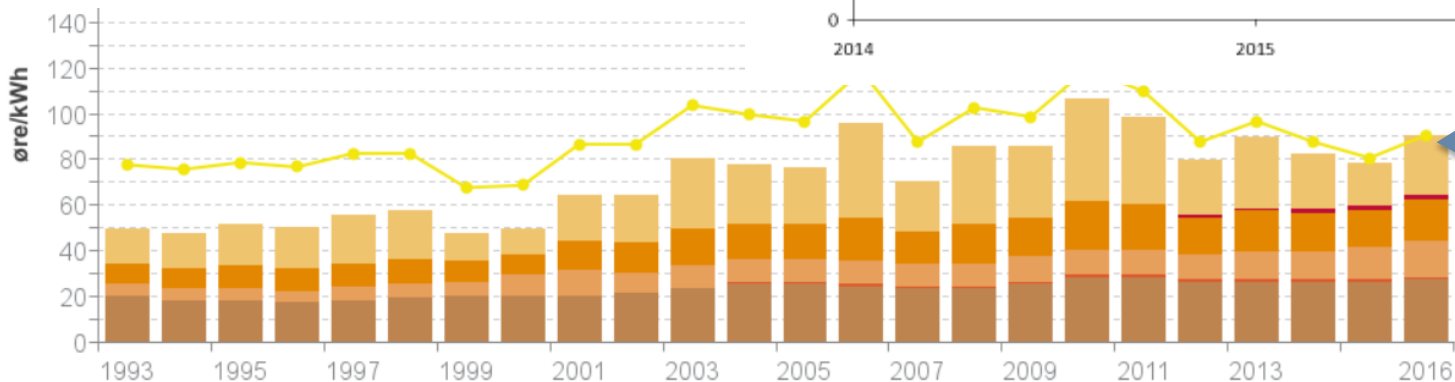
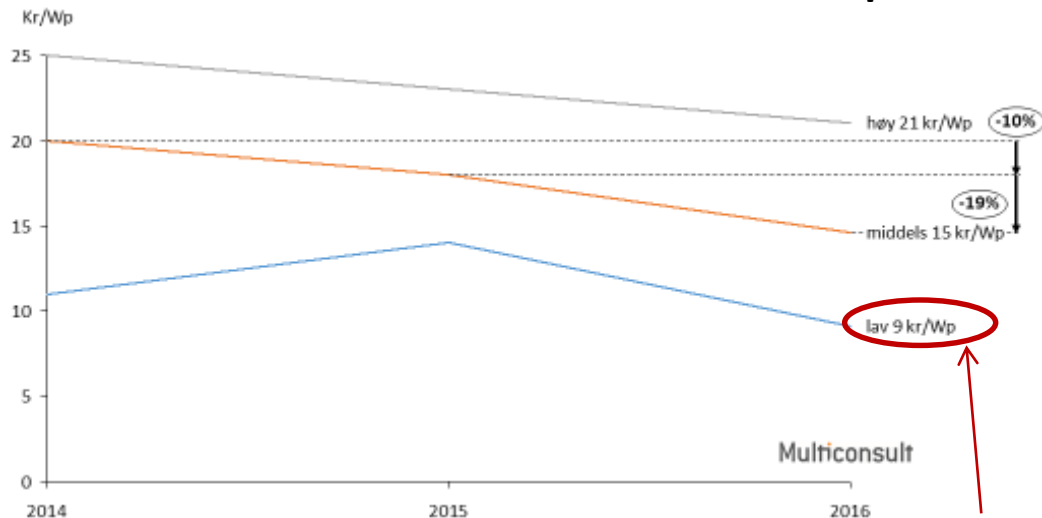
- *Increasing efficiency of PV*
  - *More buildings*
- **30 % increase towards 2040?**



# PV costs in Norway

- Imature market
- Enova support improves the economy
- New network tariffs may weaken profitability

## Small installations <10 kWp



- Nettleie
- Enovaavgift
- Forbruksavgift
- Merverdiavgift
- Elsertifikat
- Kraftpris
- KPIjustert sluttbrukerpris (2016 kr)

End-user price  
(5-year average)  
**89 øre/kWh**

≈ 82 øre/kWh



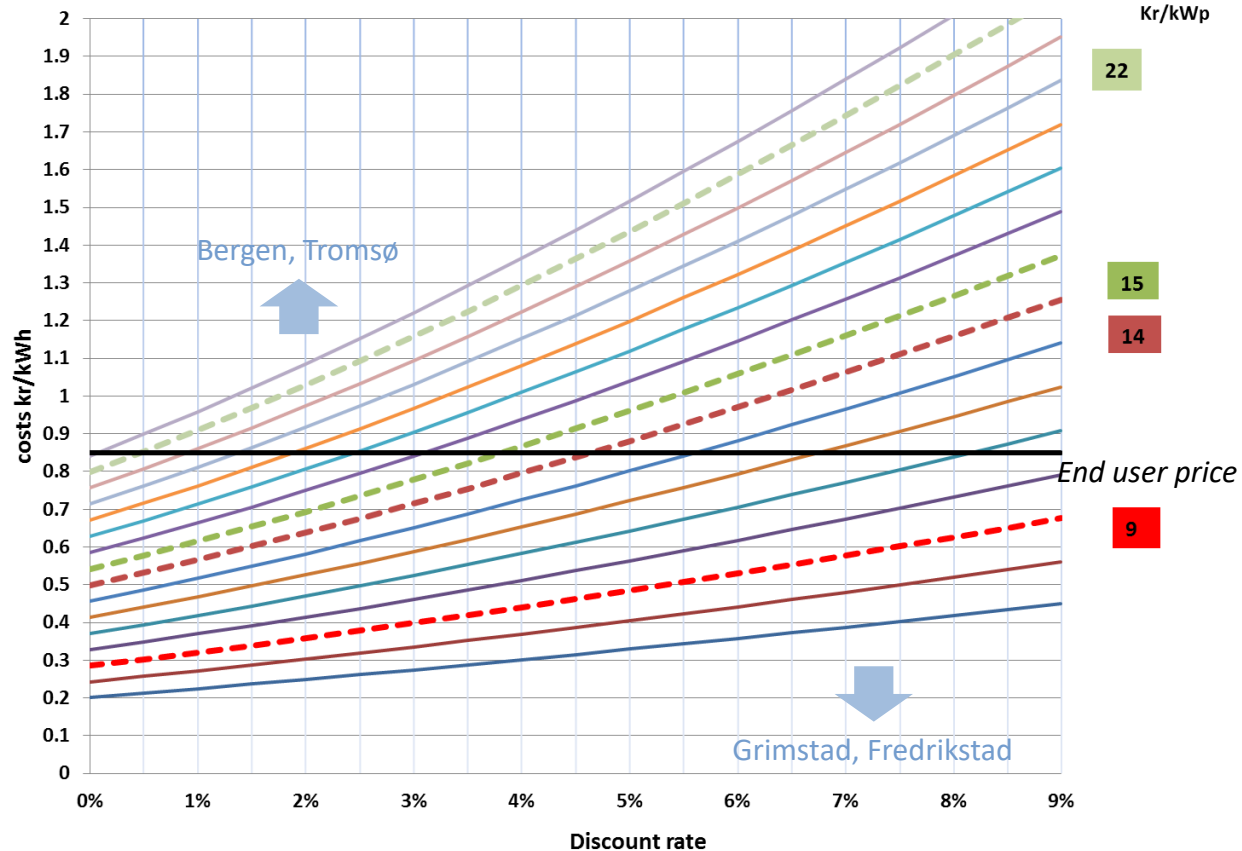
# LCOE for PV in Norway

*Variations in investment costs  
and discount rate*

*Based on 2016-observations  
(Multiconsult)*

## Main assumptions

- 4 kWp
- 900 kWh/1 kWp
- 30 years of operation
- 1 inverter shift
- Maintenance cost 0,25 %/y

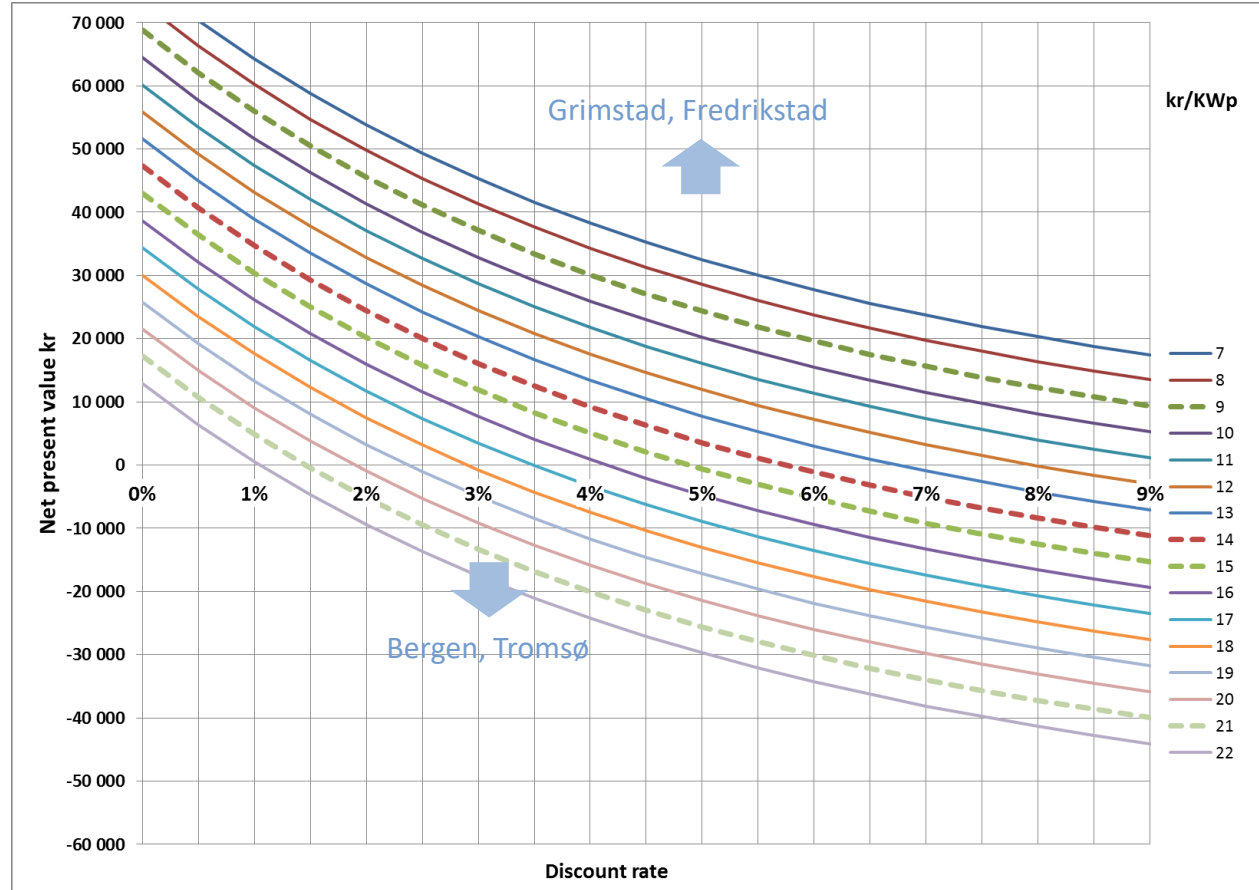


# Net present value

*Variations in investment costs and discount rate*

## Main assumptions

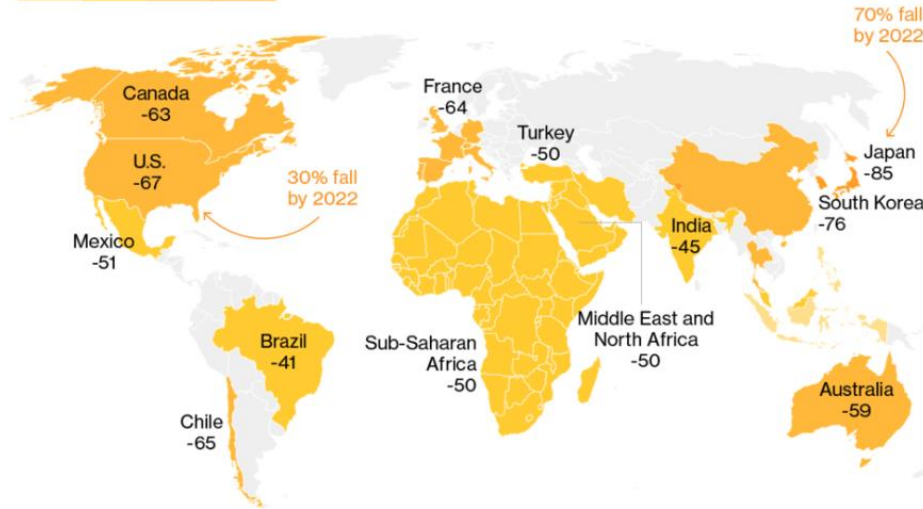
- 4 kWp
- 900 kWh/1 kWp
- 30 years of operation
- 1 inverter shift
- Maintenance cost 0,25 %/y
  
- **End user price: +2 %/y**
- **Share of own use: 75 %**
- **Suplus of power sold at: 50 % of end user price**



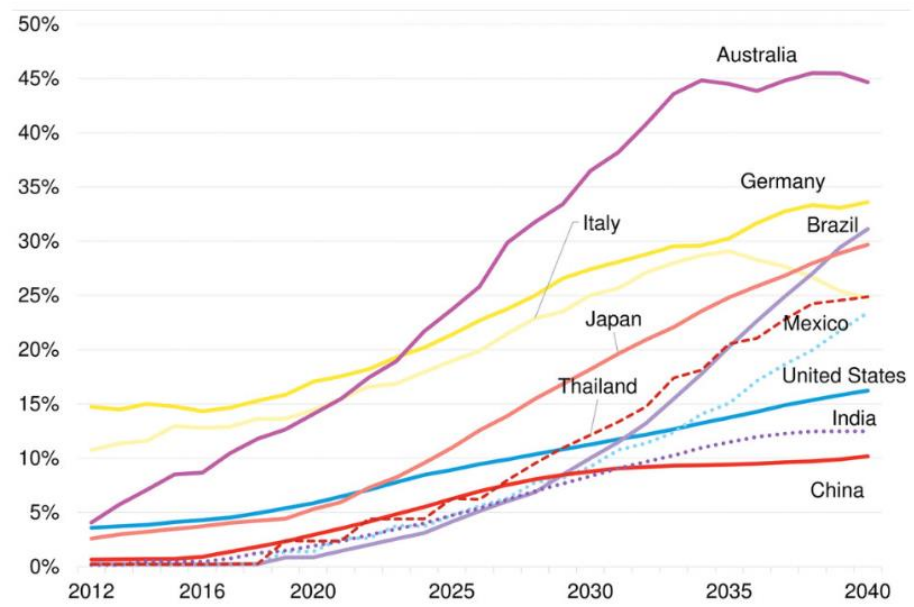
# A brighter future for prosumers?

## A Brighter Future

Solar costs will sink 67% in U.S. and 85% in Japan by 2040



## Ratio of small-scale solar and battery capacity to total installed capacity



Source: Bloomberg New Energy Finance

Change in large solar farm costs. Source: Bloomberg New Energy Finance

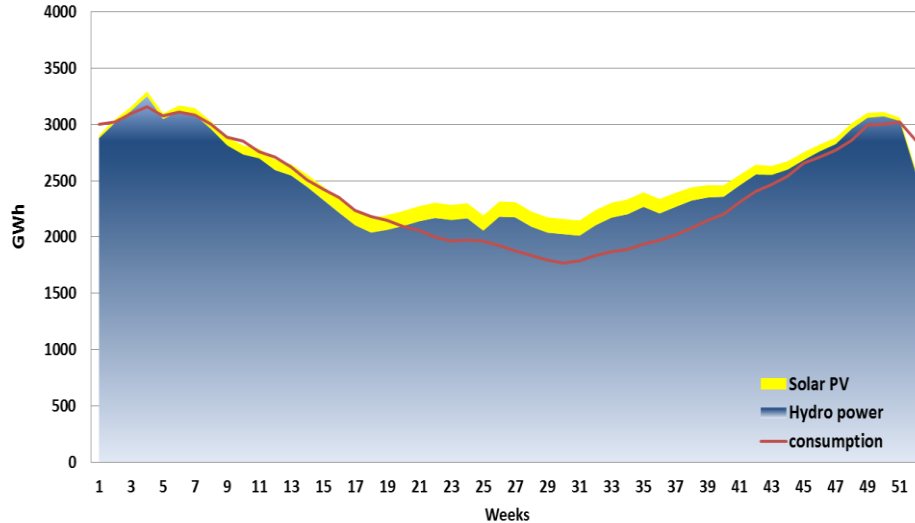


- The levelized cost of new electricity from solar PV drops by 66% by 2040  
 → A dollar will buy 2.3 times as much solar energy than it does today

# Challenges for the Norwegian power market?

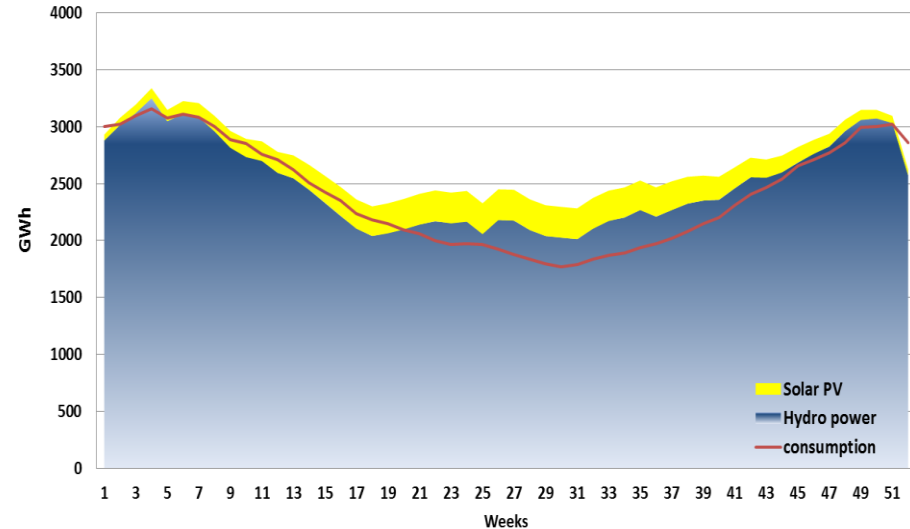
→ 5 TWh Norwegian PV

Norwegian power system (GWh)  
average seasonal profiles 2006-2015



→ 10 TWh Norwegian PV

Norwegian power system (GWh)  
average seasonal profiles 2006-2015



## PV also in Norway?

- Large potential for PV
- Immature market with large price variations
- Already profitable in parts of Norway
- New network tariffs may weaken profitability
- Predictions of further cost reductions

Thank you !

Element / År	Sum/snitt_30år	Sum/Snitt_25år	2017
Årlig kostnad vedlikehold nominell , kr			135
Inverterskift midtlivs = 12 år , kr			
Årlige kostnader diskontert , kr	5102	4921	135
Investeringskost inkludert støtte , kr	39000	39000	
<b>Totalkostnad inkludert støtte, kr</b>	<b>44102</b>	<b>43921</b>	
<b>Totalkostnad uten støtte , kr</b>	<b>59102</b>	<b>58921</b>	
Andel gjennomsnittsproduksjon av startårproduksjon	93.08 %	94.22 %	100.00 %
Produksjon med degradering, kWh	3350.779394	3392.057003	3600
Diskontert produksjon, kWh	52424.28005	48402.19093	3428.571429
<b>LCOE_Inkl_Enovastøtte_Kostnad kr/kWh</b>	<b>0.841</b>	<b>0.9074</b>	
<b>LCOE_Uten_Enovastøtte_Kostnad kr/kWh</b>	<b>1.127</b>	<b>1.217</b>	
Antatt strømpris nettlevert 1. år kr /kWh			0.75
Antatt strømprisstigning nettlevert strøm , kr /kWh			2.00 %
Strømpris levert på nett aktuelt år nominelt , kr /kWh			0.85
Dekningsgrad egetforbruk av produksjon			70 %
Besparelse/inntekt på solkraftanlegget - til egetforbruk, kr			2142
<b>Diskontert Besparelse/inntekt på solkraftanlegget - til egetforbruk , kr</b>	<b>40971</b>	<b>36690</b>	2142
Kraftpris andel av nettlevert pris (for overskuddsproduksjon strøm)			50.00 %
Kraftpris for overskuddsproduksjon strøm , kr /kWh			0.425
Inntekt salg av overskuddsproduksjon , kr			459
<b>Diskontert inntekt salg av overskuddsproduksjon , kr</b>	<b>8780</b>	<b>7862</b>	459
<b>Nåverdi inkludert Enova-støtte, kr</b>	<b>5648</b>	<b>630</b>	
<b>Nåverdi uten Enova-støtte, kr</b>	<b>-9352</b>	<b>-14370</b>	

LCOE

Net present value

**Hjelmtveit Rolf:**  
Får 1 kr/kWh for øyeblikket!! -  
Ikke benyttet i beregning

### Levelized cost of electricity [\[ edit \]](#)

The levelized cost of electricity (LCOE), also known as Levelized Energy Cost (LEC), is the net present value of the unit-cost of electricity over the lifetime of a generating asset. It is often taken as a proxy for the average price that the generating asset must receive in a market to break even over its lifetime. It is a first-order economic assessment of the cost competitiveness of an electricity-generating system that incorporates all costs over its lifetime: initial investment, operations and maintenance, cost of fuel, [cost of capital](#).

The levelized cost is that value for which an equal-valued fixed revenue delivered over the life of the asset's generating profile would cause the project to break even. This can be roughly calculated as the net present value of all costs over the lifetime of the asset divided by the total electrical energy output of the asset.<sup>[4]</sup>

The levelized cost of electricity (LCOE) is given by:

$$\text{LCOE} = \frac{\text{sum of costs over lifetime}}{\text{sum of electrical energy produced over lifetime}} = \frac{\sum_{t=1}^n \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^n \frac{E_t}{(1+r)^t}}$$

$I_t$  : investment expenditures in the year  $t$

$M_t$  : [operations and maintenance](#) expenditures in the year  $t$

$F_t$  : fuel expenditures in the year  $t$

$E_t$  : electrical energy generated in the year  $t$

$r$  : [discount rate](#)

$n$  : [expected lifetime](#) of system or power station