



# **CFA Lectures**

## **Renewable Energy Investments: Opportunities and Risks**

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**Donner & Reuschel**

# Agenda

-  **Sun, wind and more**  
Technological overview
-  **Renewables are not real estate or private equity**  
Modeling, valuation and special properties
-  **True and false friends**  
Key financial ratios and performance measure
-  **“If it is too good to be true it might not be true”**  
Sound financial due diligence
-  **Further reading, Contact and Disclaimer**

# 1. Technologies

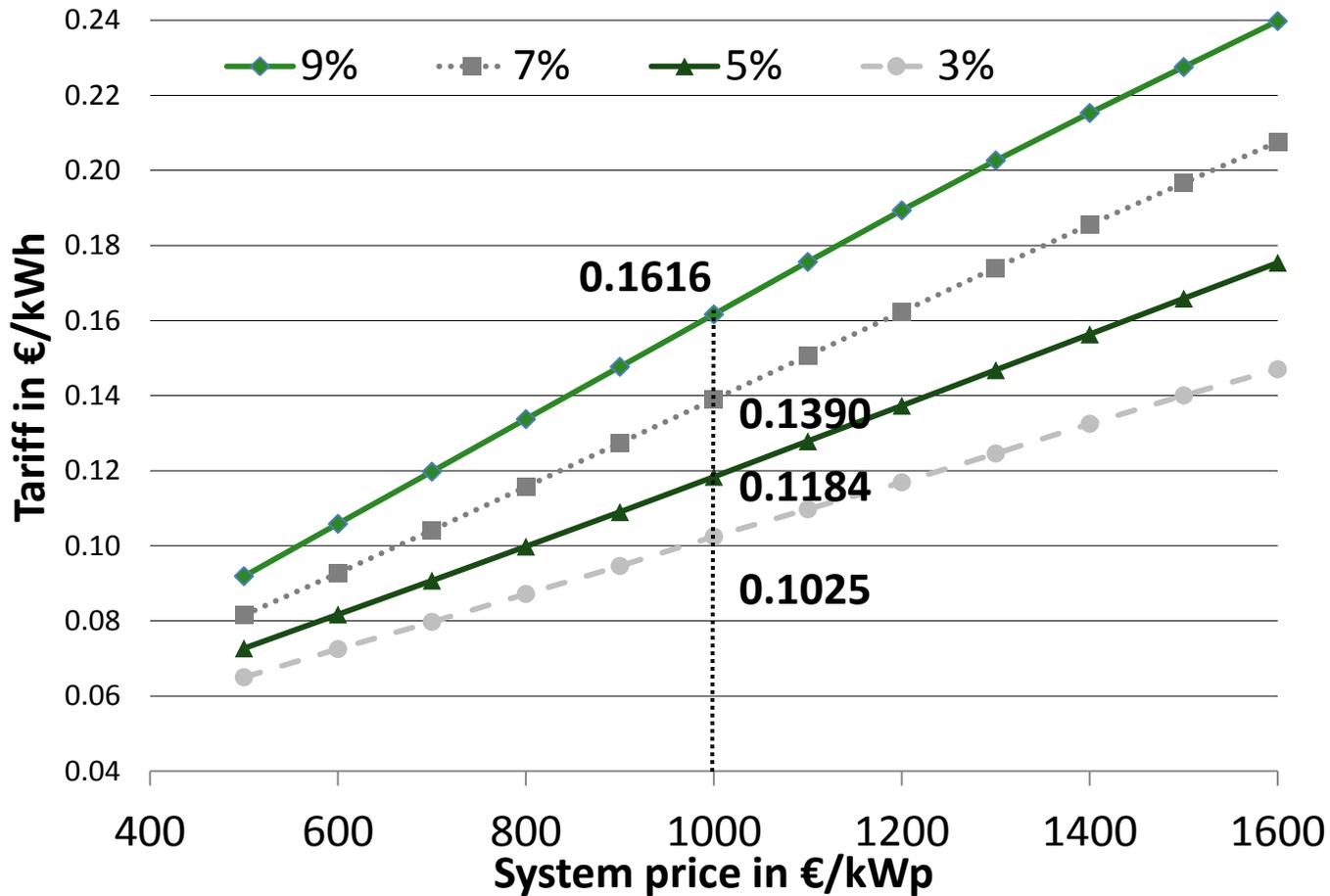
-  Photo Voltaic
-  Onshore and Offshore Wind
-  Hydro Power
-  Geothermal Power
-  Biomass

# 1.1 PV in Germany

- 🌐 Important key figures:
  - 🌐 Total amount installed (2012): 32.6 GWp\*
  - 🌐 System price per kW installed: 1,000-1,200 €/kWp
  - 🌐 Feed-in tariff (20 years, January 2013; -2.5% per month)
    - 🌐 17.02 cent/kWh (Roof up to 10kWp)
    - 🌐 11.78 cent/kWh (Roof up to 10 MWp, or conversion area)
  - 🌐 Full load hours per year: about 1000 hours (of 8760 hours in a year)
  - 🌐 Module efficiency: about 20%
  - 🌐 Area per kWp installed: 5.9 square meter

\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

# 1.1 PV in Germany



\* See also: [http://www.matobis.com/Content/PV\\_JenseitsdesEEG2012De.pdf](http://www.matobis.com/Content/PV_JenseitsdesEEG2012De.pdf)

# 1.2 Wind in Germany

- 🌐 Important key figures:
  - 🌐 Total amount installed (2012): 31.3 GWp\* (0.28 GWp of it Offshore)
  - 🌐 System price per kW installed: 1,500-2,500 €/kWp
  - 🌐 Feed-in tariff (2012) degression 1.5% p.a.
    - 🌐 Onshore: 8.93 cent/kWh (5 years + 2 months/0.75% below 150% reference yield)
    - 🌐 Offshore: 19.0 cent/kWh (8 years + bonus for distance and depth)
  - 🌐 Full load hours per year (of 8760 hours):
    - 🌐 2,000-3,000 hours, Onshore
    - 🌐 over 4,000 hours, Offshore
  - 🌐 Turbine efficiency: 40-50% (theoretical limit 59% Betz Law)
  - 🌐 Rotor Area per kWp installed: 2-3 square meter

\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

# 1.3 Hydro power in Germany

- 🌐 Important key figures:
  - 🌐 Total amount installed 4.7 GWp\*
  - 🌐 System price per kWp installed: 4,000-5,000 €/kWp
  - 🌐 Feed-in tariff (2013) for 20 years, degression 1.0% p.a.
    - 🌐 12.57 (500kWp), 8.22 (2MWp), 6.24 (5MWp) ,...3,37 cent/kWh (50MWp)
  - 🌐 Full load hours per year: 90-95% of 8760 hours in a year (base load)

\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

# 1.4 Geothermal in Germany

- 🌐 Important key figures:
  - 🌐 Total amount installed (>400 m depth, 2012):
    - 🌐 12.1 MWp\* electricity
    - 🌐 193 MWp\* thermal
  - 🌐 System price per kWp installed: 10,000-15,000 €/kWp
  - 🌐 Feed-in tariff (2013)
    - 🌐 25 cent/kWh for 20 years (electricity, SOO before 2017)
    - 🌐 -5% p.a. from SOO 2018
  - 🌐 Full load hours per year: 85-95% of 8760 hours in a year (base load)
  - 🌐 Required water temperature > 100 °C, >150 °C (direct turbine operation)
  - 🌐 Depth 2,500-5,500 meter (in Germany)
  - 🌐 Own electricity consumption 20-30%

\* Source: Bundesverband Geothermie

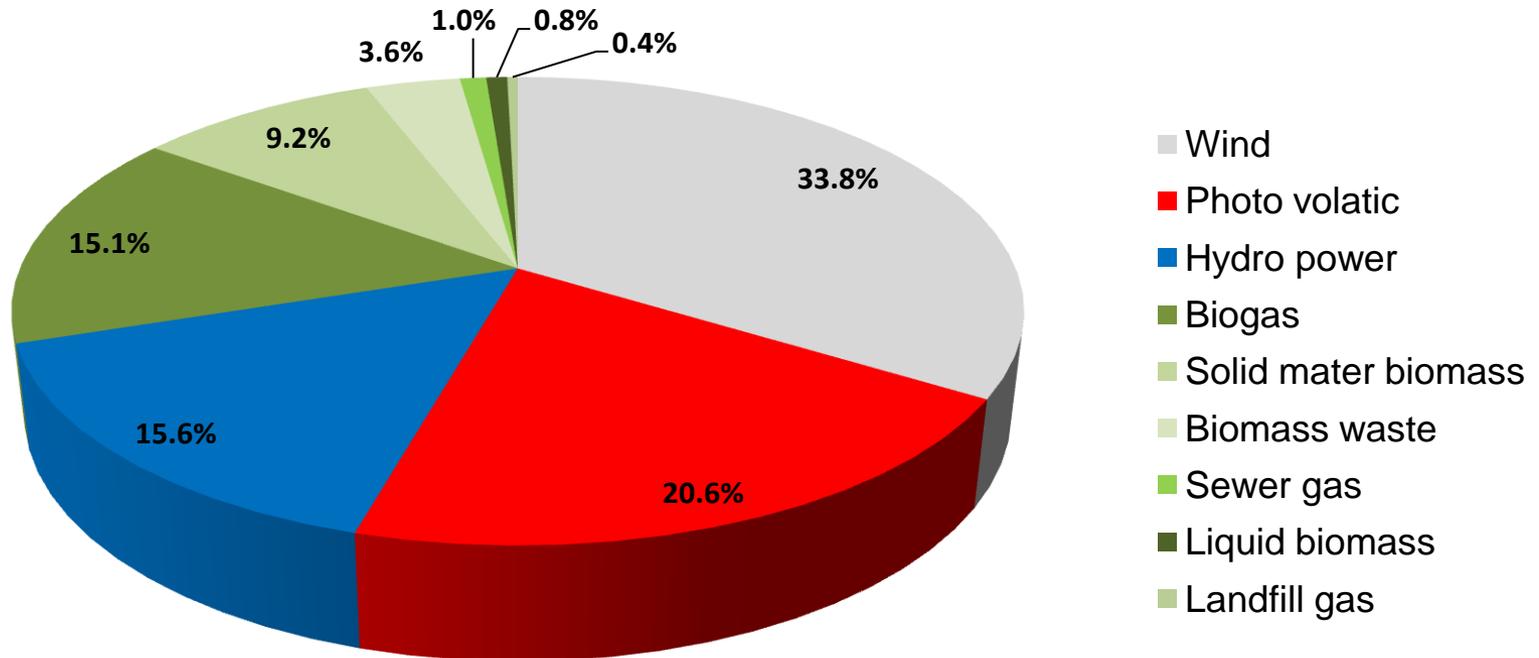
# 1.5 Biomass in Germany

- 🌐 Important key figures:
  - 🌐 Total amount installed 4,2 GWp\* (electricity)
  - 🌐 System price per kWp installed: 2,500-5,500 €/kWp
  - 🌐 Feed-in tariff (2013, electricity)
    - 🌐 14.01 cent/kWh (<150 kW), 12.05 cent/kWh (150-500 kW), 10.78 cent/kWh (500 kW-5MW), 5.88 cent/kWh (5MW-20MW)  
+ bonus for 20 years, start of operation in 2013
    - 🌐 -2% p.a. afterwards
  - 🌐 Full load hours per year: 80-95% of 8760 hours in a year
  - 🌐 Qualifies for base load

\* Source: Fachverband Biogas

# 1.6 Renewable electricity production 2012

Renewable electricity production: 136.1 TWh (22.9%)

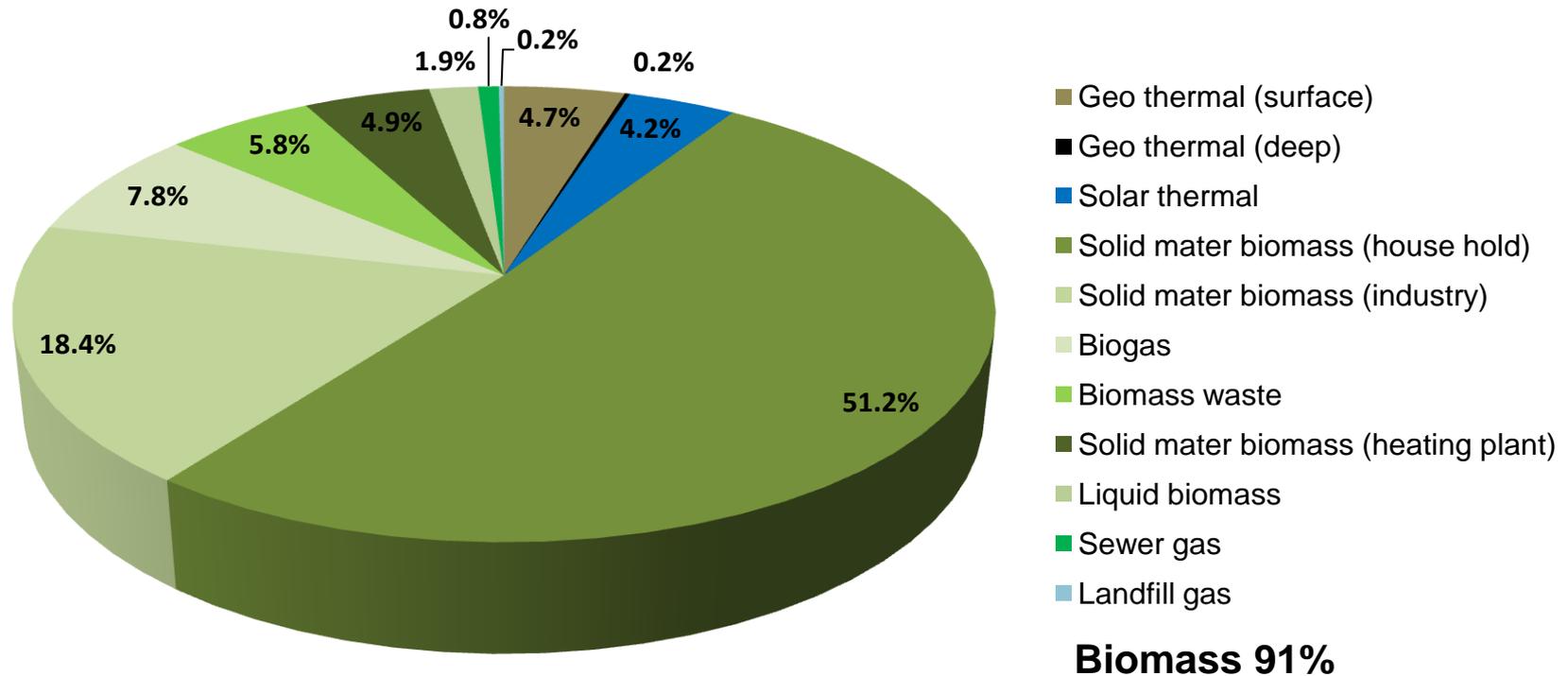


**Biomass 30%**

\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit „Erneuerbare Energien 2012“, page 5

# 1.6 Renewable heat production 2012

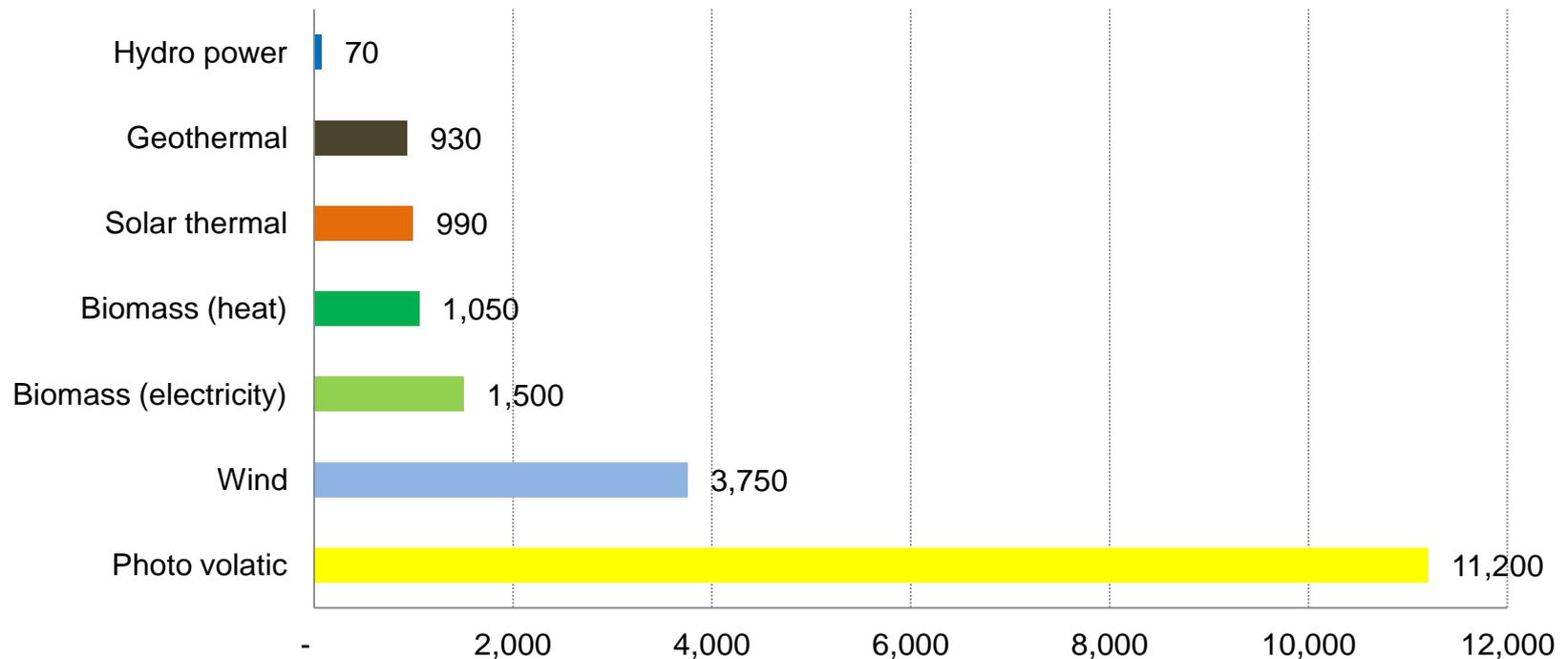
Renewable heat production: 144.3 TWh (10.4%)



\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit „Erneuerbare Energien 2012“, page 7

# 1.6 Renewable investments in 2012

**Investments in Renewables in 2012 in Mio €**  
**Total amount invested 19.5 Billion €**

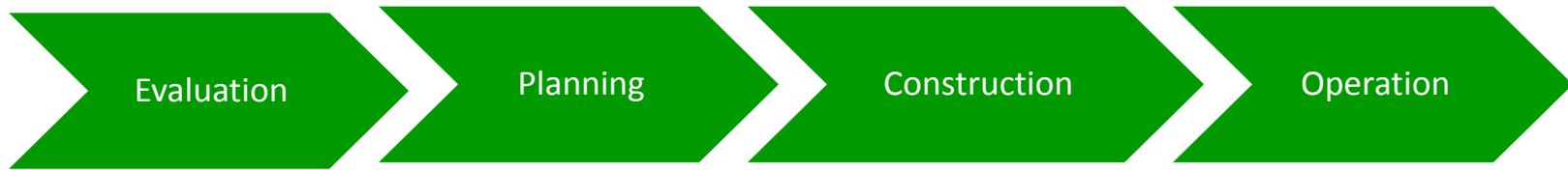


\* Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit „Erneuerbare Energien 2012“, page 11

## 2. Modeling, valuation and special properties

-  Project phases
-  Key factors and cash flow modeling
-  Valuation
-  Special properties
-  Debt financing and Net Asset Value

# 2.1 Project phases



- Feasibility analysis general economic, legal, technical and financial evaluation
- Red flag analysis
- Acquisition of permits and claims
- Pre-Surveys and certifications
- Negotiate Pre-contracts, LOIs
- Creation of project rights
- Founding of project company

- Acquisition of project rights and/ or project company
- Secure all surveys, audits, certifications and commitments
- Project planning
- Due diligence
  - Legal
  - Financial
  - Technical
- Closing of binding contracts for services and construction (EPC)
- Arrange equity and debt investors
- Financial close
- Insurance concept

- Building of energy production site and logistics
- Wiring, transformer station and grid connection
- Implement financing (drawing of funds)
- Set up of operations and maintenance
- Perform acceptance testing
- Obtain operation permits

- Run or monitor operations and maintenance
- Monitor technical and financial performance, taking actions if required
- Provide for decommissioning or retrofitting

Cumulative Expenses

## 2.2 Key factors and modeling

### **Construction:**

-  Detailed payment schedule, drawing of equity, bridge financing

### **Operation:**

-  **Income:** Tariffs (EEG), production

-  **Expenses:** Operation management, maintenance, insurance, consulting and administrative costs, own energy consumption, lease rates, compensation payments, provisions for decommission and repair

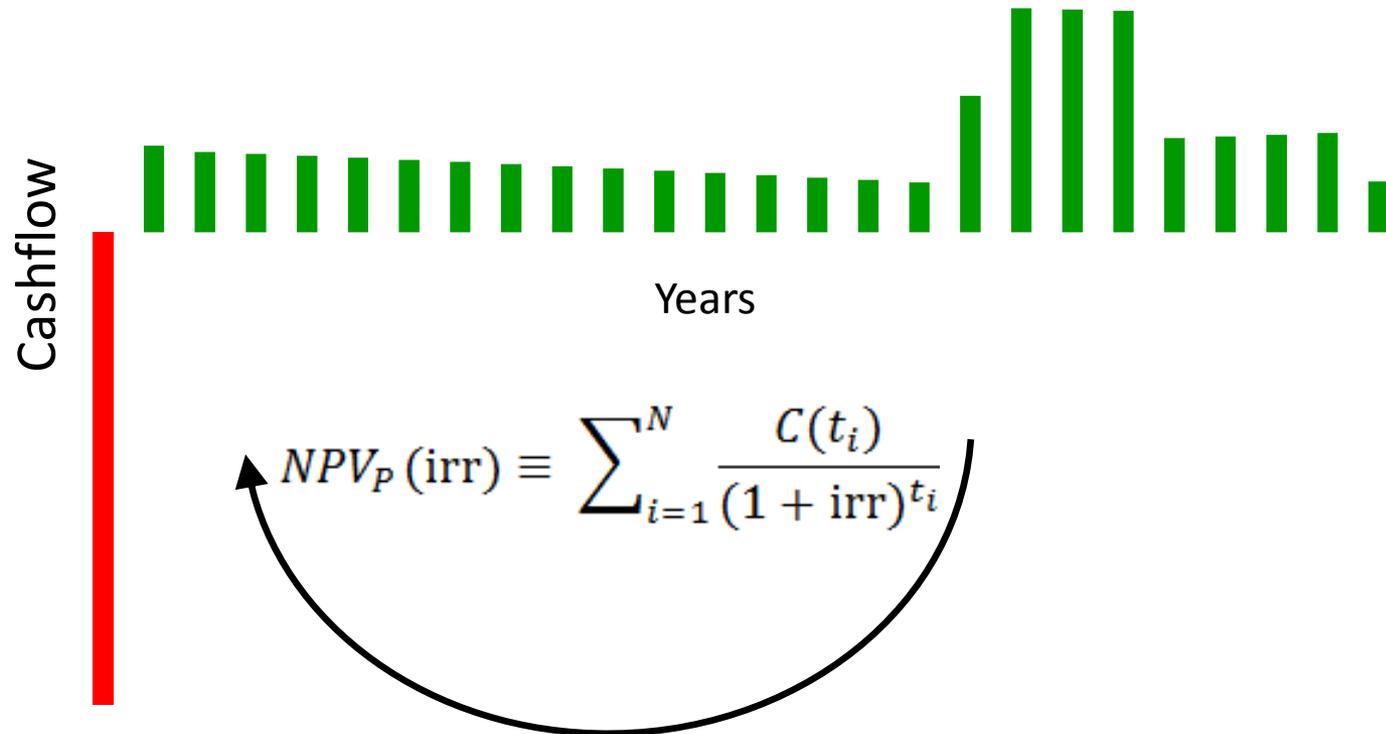
-  **Financing:** Debt level, maturity, interest rate, redemption scheme, senior/junior, debt service account, lock-ups, guarantees

-  **Miscellaneous:** Tax rates, depreciation, inflation, FX rates, etc.

**=> Detailed cash flow model For sample report see:**

<http://www.matobis.com/Content/Demo%20Overview%20Onshore%20Wind%20en.pdf>

## 2.3 Valuation



- 🌐 Concept of IRR
  - 🌐 For valuation of turnkey project -> IRR is output
  - 🌐 For fair value calculation of project -> IRR is input

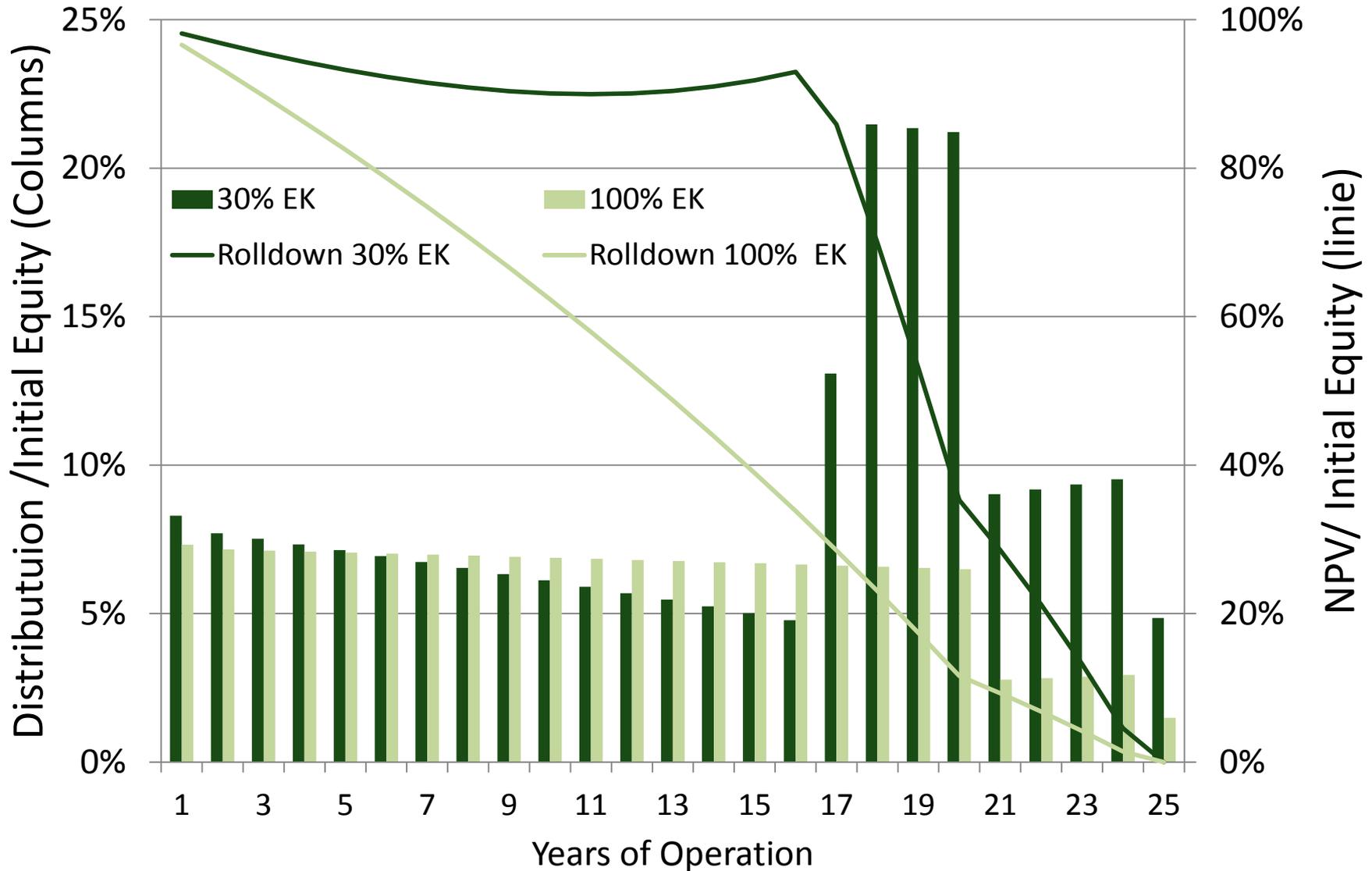
## 2.4 Special properties of Renewables

-  “Use by” date
-  Single source of income
-  Low residual value
-  Guaranteed or long term fixed tariffs
-  Guaranteed sales
-  Low market price exposure

## 2.5 Debt financing

- 🌐 Increases IRR
  - 🌐 Leverage and tax effects
- 🌐 Increases volatility
  - 🌐 Leverage
- 🌐 Supports diversification
  - 🌐 Frees equity for other investments in a portfolio
- 🌐 Preserves NAV
  - 🌐 Roll-down effect of future cash flows
  - 🌐 Redemption of debt compensates NAV loss

# 2.5 Net asset value



# 3.1 Key financial ratios and risk measures

1. Should reflect economic performance not account profits
2. Source of calculation should be: free-cash flow after tax
3. Should consider 'time-value-of-money'
4. Should consider dividend and repayment

## **Equity measures:**

-  Cash flow for distribution (ROE)
-  IRR and sensitivities
-  NPV
-  Repayment time
-  Not useful for performance evaluation: EBIDTA ROE

## **Debt measures:**

-  DSCR
-  Loan/value
-  Duration of Loan

## 3.2 Key figures for equity and debt

Equity key figures	Equity	Operating phase	First year	1-5 years
IRR	30%	6.44%	-	-
IRR	100%	3.92%	-	-
Cum. distrib/Equity	30%	221.84%	8.30%	38.00%
Cum. distrib/Equity	100%	150.14%	7.32%	35.75%
ROE	30%	8.87%	8.30%	7.60%
ROE	100%	6.01%	7.32%	7.15%
EBIDTA ROE	30%	22.03%	26.15%	25.85%
EBIDTA ROE	100%	6.79%	8.05%	7.96%
Debt key figures	Equity	Average	Min	Max
DSCR	30%	1.37	1.26	1.48
Loan/Value	30%	53.30%	15.40%	70.00%
Duration [years]	30%	5.90		

\*See also: <http://www.matobis.com/Content/MicrostepNewsletterJuni2013de.pdf>

# 4.1 Sound investment analysis

- 🌐 “If it is too good to be true...”: **total markup on IRR -> + 480 BP\***
- 🌐 Key issues in financial due diligence
  - 🌐 “Anti-aging” and residual value
    - 🌐 +5 years of operation -> + 120 BP
    - 🌐 +10% residual value -> + 50 BP
  - 🌐 Over optimistic tariffs after EGG
    - 🌐 +1.5% additional inflation on tariff -> + 50 BP
  - 🌐 Creative production adjustments
    - 🌐 +10% electricity production -> + 130 BP
  - 🌐 Too conservative Opex
    - 🌐 -10% Opex -> + 50 BP
    - 🌐 No indexation -> + 60 BP
  - 🌐 Missing covenants
    - 🌐 No debt service account -> + 20 BP
  - 🌐 Fancy figures: average ROE instead of IRR -> (+ 240 BP)

\* Simulation results for a typical Renewable project. Sensitivities are subject to specific project conditions and may vary largely!

# 4.2 Sensitivity analysis

## Sensitivity analysis

Project EX05

Last update 13-Nov-2012

Scenario Base scenario (P90/P50)

Risk Measure		DSCR		Equity IRR		Project IRR		Equity present value	
		Target	1.6	absolute	relative	absolute	relative	absolute	relative
		Min.	Average						
<b>Base Scenario</b>									
Sc_1	Base Scenario	1.602	1.604	12.009%		6.974%		36,956,415	
<b>Construction period</b>									
<b>Construction period</b>									
Sc_2	Construction begin + 3 month	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
Sc_3	Start of operation + 3 month	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
Sc_4	Construction period 6 month stretched	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
<b>Construction costs</b>									
Sc_5	1% Increase of major components	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
Sc_6	3% Increase of major components	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
Sc_7	5% Increase of major components	1.602	1.604	12.009%	0.000%	6.974%	0.000%	36,956,414	0.000%
<b>Operating period</b>									
<b>Operating costs</b>									
Sc_8	1% increase	1.580	1.600	11.997%	-0.097%	6.959%	-0.205%	36,875,054	-0.220%
Sc_9	5% increase	1.403	1.585	11.856%	-1.275%	6.881%	-1.323%	36,384,619	-1.547%
Sc_10	10% increase	1.208	1.571	11.607%	-3.344%	6.772%	-2.899%	35,660,371	-3.507%
<b>Revenues</b>									
Sc_11	5% shrinkage of revenues	0.806	1.529	10.507%	-12.508%	6.332%	-9.198%	32,199,235	-12.872%
Sc_12	10% shrinkage of revenues	0.474	1.491	8.901%	-25.881%	5.742%	-17.658%	27,011,883	-26.909%
Sc_13	Revenue shrinkage in 3. year by 30%	0.831	1.577	11.044%	-8.037%	6.659%	-4.507%	34,717,063	-6.059%
<b>Interest rates</b>									
Sc_14	0.5% Increase in interest costs	0.872	1.559	11.208%	-6.666%	6.924%	-0.708%	34,931,616	-5.479%
Sc_15	1% Increase in interest costs	0.725	1.522	10.696%	-10.932%	6.925%	-0.699%	33,231,022	-10.081%
Sc_16	2% Increase in interest costs	0.457	1.466	9.211%	-23.298%	6.923%	-0.733%	28,487,154	-22.917%
<b>Inflation</b>									
Sc_17	1% reduction of inflation	0.960	1.625	10.904%	-9.196%	6.573%	-5.746%	33,414,386	-9.584%
Sc_18	1% increase in inflation	1.221	1.587	12.185%	1.469%	7.254%	4.014%	39,719,034	7.475%
Sc_19	2% increase in inflation	1.166	1.573	12.881%	7.263%	7.640%	9.550%	43,952,511	18.931%
<b>Tax</b>									
Sc_20	5% increase	1.520	1.601	11.902%	-0.885%	6.943%	-0.438%	36,601,711	-0.960%

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# 5. Literature

-  Ertragskennzahlen Erneuerbare Energien  
<http://www.matobis.com/Content/MicrostepNewsletterJuni2013de.pdf>
-  Werterhalt von Erneuerbaren Energien Projekten durch den Einsatz von Fremdkapital  
<http://www.matobis.com/Content/MicrostepNewsletterMai2013de.pdf>
-  Eigenverbrauch als Schlüssel zu rentablen PV-Investments  
<http://www.matobis.com/Content/MicrostepNewsletterFebruar2013de.pdf>
-  Investments in Erneuerbare Energien  
[http://www.matobis.com/Content/EE\\_Investments2013de.pdf](http://www.matobis.com/Content/EE_Investments2013de.pdf)
-  Die Wirtschaftlichkeit von Photovoltaik in der Spät- und Post-Ära des EEGs:  
Eigenverbrauch als Schlüssel zu rentablen PV-Investments  
[http://www.matobis.com/Content/PV\\_JenseitsdesEEG2012De.pdf](http://www.matobis.com/Content/PV_JenseitsdesEEG2012De.pdf)
-  „Offshore Windparks: Wie eine Seebrise ihr Portfolio elektrisiert“, Ertrag und Risiko aus  
Sicht von Eigen- und Fremdkapitalinvestoren  
<http://www.matobis.com/Content/OffshoreWindparksDe.pdf>
-  ‘Offshore wind parks: Let the sea breeze energize your portfolio’  
Return and Risk from equity and debt investors’ perspective  
<http://www.matobis.com/Content/OffshoreWindparksEn.pdf>

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