



# *EWEC 2008 - Brussels*

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**Why and how to protect wind  
feed-in tariffs systems from potential  
negative effects of inflation ?**

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# Introduction

- ❑ **European economy suffered from high inflation rates resulting mainly from the two oil crisis (1974-1986)**
- ❑ **After a long period of low inflation rates ( $< 2\%$ /year to comply to the Maastricht treaty), increasing European imports of fossil fuels at higher and higher prices participate to higher inflation rates and presents new threats to the European economy**
- ❑ **So, all decision makers must :**
  - ⇒ **Contribute to decrease inflation risk, e.g. by contributing to decrease imports of fossil fuels**
  - ⇒ **And so, they must promote local, zero fuel cost energy sources**
- ❑ **Wind Power is such a zero fuel cost energy technology and can substantially contribute to lower fossil fuel imports and inflation risk:  $> 100$  TWh in 2007,  $> 200$  TWh in 2012**



# FIRST CONSEQUENCES

- **Technologies such as wind power which help European economies to fight against “imported inflation” deserve to:**
  - ⇒ **Be promoted with demonstrated fair and efficient policies, e.g. within policies based on “fair and efficient feed-in tariffs”**
    - ☆ **Fair**: recognising their value for sustainable development, climate protection, energy security, fight against imported inflation, with fair profitability levels. (not ridiculous compared to those resulting from investments in technologies without those advantages, for example fossil fuels based technologies).
    - ☆ **Efficient**: ensuring sufficient profitability, including taking into account inflation effect, in order to attract a sufficient amount of debt and equity.
  - ⇒ **Be protected against negative impacts that future inflation rates can have on their development at both levels:**
    - ☆ **Economic and energy policies**: clear signal to investors that inflation risk is reduced if they choose to invest in wind power projects
    - ☆ **Programmes**, for example resulting from wind feed-in tariffs systems
    - ☆ **Individual projects**, within power purchase contracts



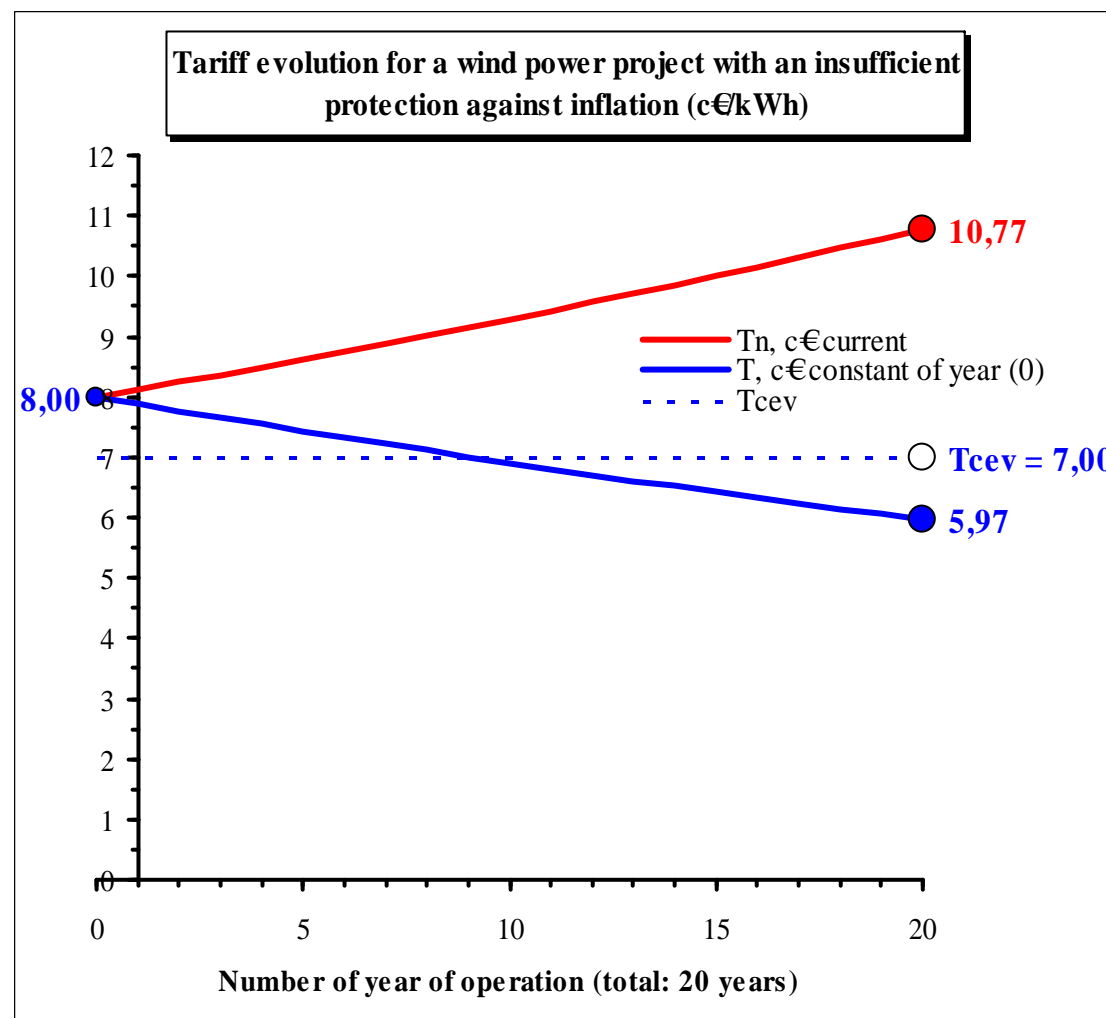
# Back to basics: effect of inflation on a tariff : "T"

## Considering a power purchase contract with:

- ⇒ Value  $T_0$  at year "0":  $T_0 = 8 \text{ c€}$
- ⇒ Protection against inflation: +1,5 %/year from year 1 to 20, leading to a  $T_n = 10,77 \text{ current c€/kWh}$  in year 20

## If the future inflation rate is 3%/year constant on 20 years

- ⇒ Real power purchase of the tariff, expressed in constant € of year 0 is decreasing to  $5,97 \text{ c€(0)}$  in year 20
- ⇒ The "Constant equivalent tariff  $T_{Cev}$ " giving the same profitability (the same net present value in constant € of year "0") to the project is  $7 \text{ c€(0)/kWh}$ , well below the initial value  $T_0 = 8 \text{ c€}$



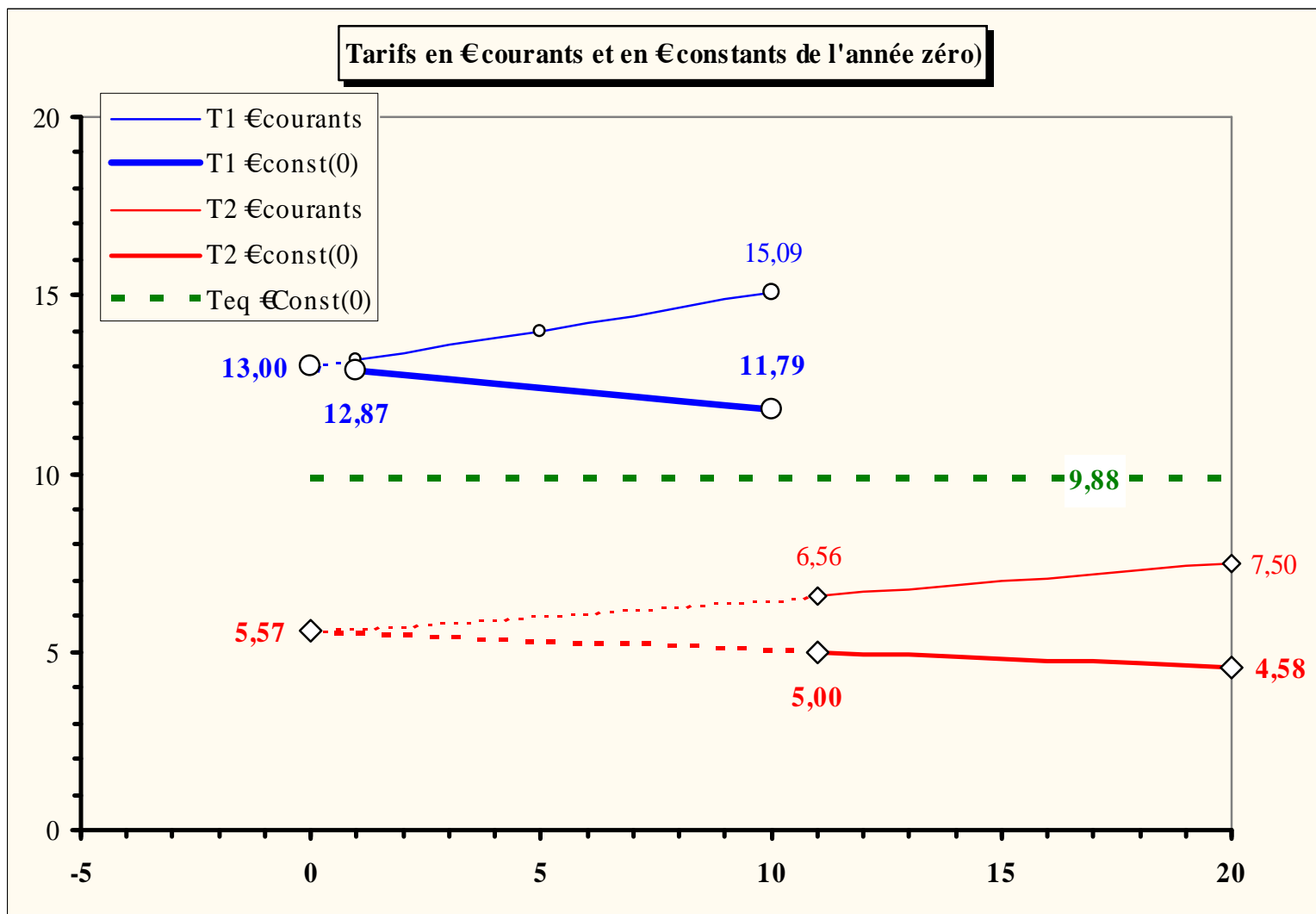


# Example of a 2007 French offshore wind tariff

Potential French project  $N_h = 3\,600$  h/y,  $i = 2,5\%$  /y on 20 years; T1 on 10 years, T2 on 10 years

$T_{eq}$ =equivalent constant tariff in constant €of year 0 which would give same project profitability

**A strong recommendation: assess tariffs from their values in constant €of year “0”**





## Two basic questions

- ❑ How to assess inflation impact on wind power projects profitability ?
- ❑ How to design a protection against inflation within a power purchase contract deriving from a “fair and efficient Feed-In Tariff system” ?
- ❑ In both cases, the “Profitability Index Method” gives a direct and reliable solution
  - ⇒ Profitability Index = Project Net Present Value per Invested €
  - ⇒  $PI = NPV / I$ ; where I is the project initial invested cost in year 0
  - ⇒ Using a real discount rate  $t =$  Averaged Weighted cost of Capital before Tax. At the moment in Europe,  $t$  is around 5 to 6 % real
  - ⇒ “The best kept secret for successful industrial development”:
    - ☆ Ensure projects PI values before tax on profit between “0.1 to 0.3”
    - ☆ After taking into account the potential effect of inflation and the effect of the relevant protection against inflation



## Profitability from targeted equivalent constant tariff $T_{ce}$

### □ Direct calculation from the targeted PI level and ratios :

$$\Rightarrow \text{PI} = \{ N_h / [\text{CRF}(t,n) \cdot I_u] \} * T_{ce} - \{ 1 + K_{om} / \text{CRF}(t,n) \}$$

$$\Rightarrow \text{So: tariff } T_{ce} = \{ (1 + \text{PI}) * \text{CRF}(t,n) + K_{om} \} * I_u / N_h$$

$\Rightarrow$   $T_{ce}$  being constant, expressed in constant € of year (0)

### □ Definition of ratios:

$\Rightarrow$   $T_{ce}$  : constant required tariff (in constant € of year zero) which will deliver the targeted profitability level expressed in  $\text{PI} = \text{NPV} / I$

$\Rightarrow$   $N_h = E_y / P$  (kWh/year / kW = h/year)

$\Rightarrow$   $\text{CRF}(t,n) = \text{capital recovery factor} = t / \{ 1 - [1+t] \exp(-n) \}$ ,

$\Rightarrow$   $t =$  real discount rate (expressed in % real, corrected from inflation)

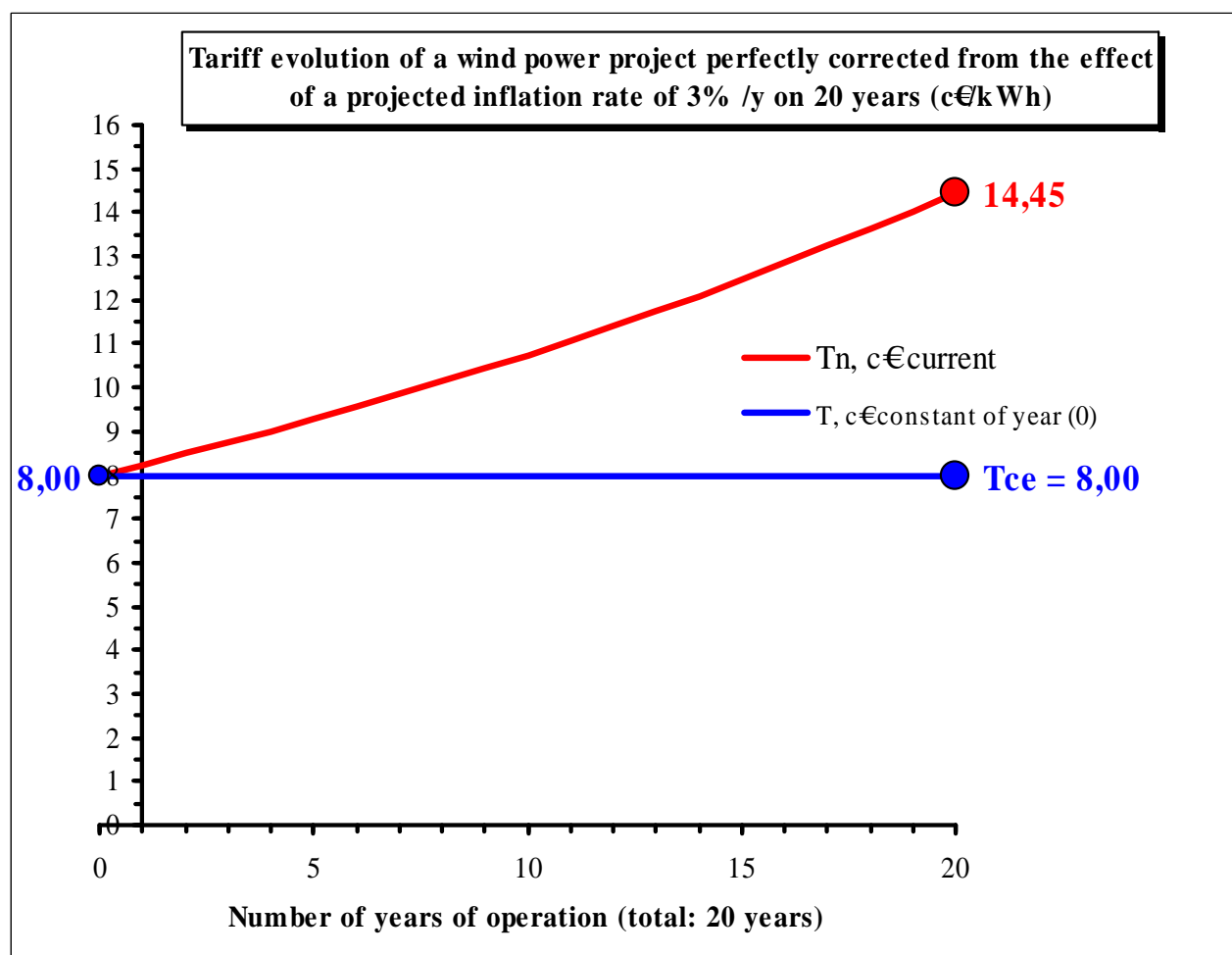
$\Rightarrow$   $I_u = I / P$  (€ per installed kW)

$\Rightarrow$   $K_{om} = D_{om} / I$  with  $D_{om}$  = yearly O&M expenses including provision for big repairs (typically  $K_{om} = 4$  to  $5$  % for wind power)



# Perfect protection of tariffs against inflation

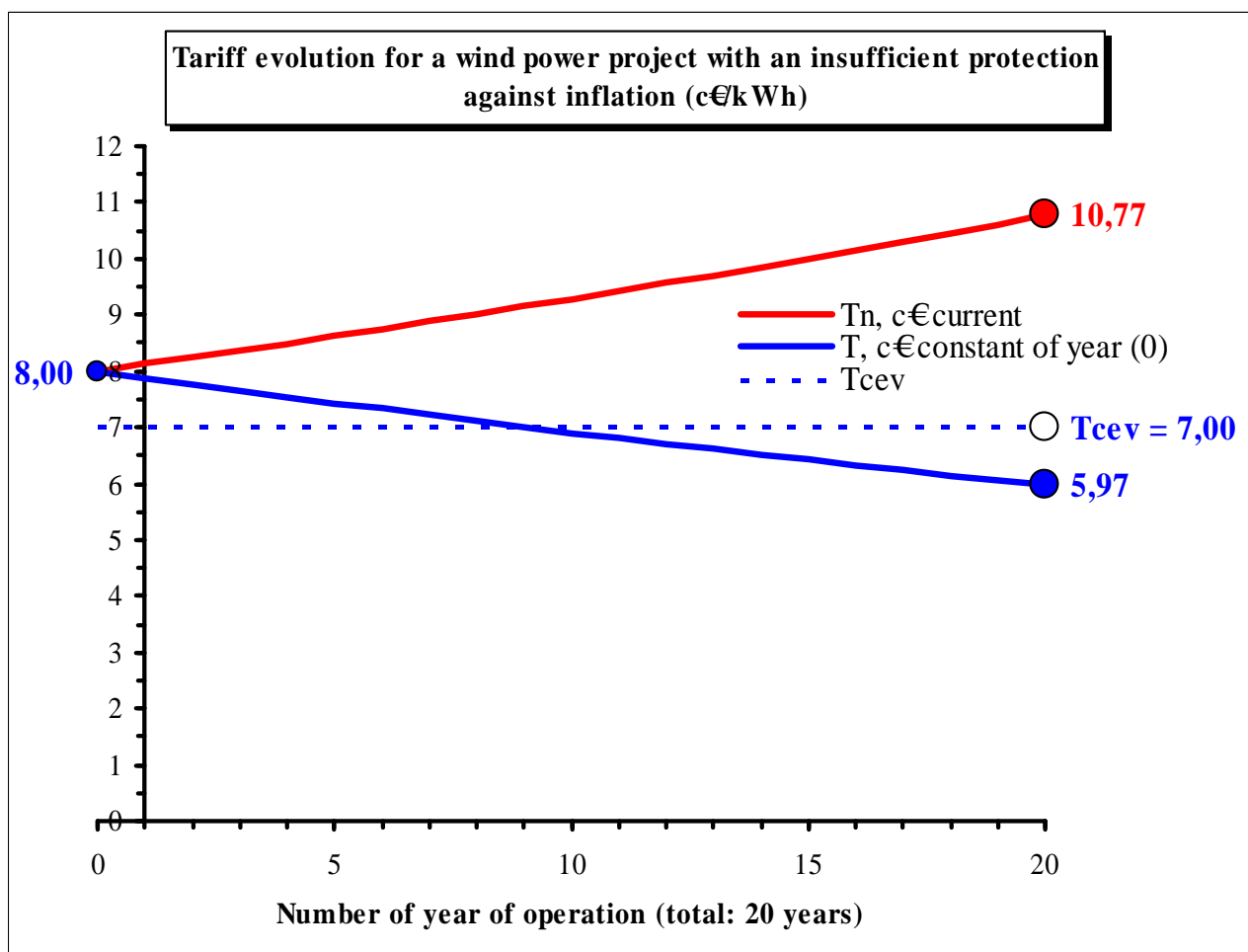
- ❑ In this case, wind power projects are considered as fighting against imported inflation and are fully protected from inflation effects
- ❑ **Tariff within a contract  $T(n)$  in current  $\text{€} = (1+i) * T(n-1)$  with  $i =$  inflation rate**
- ❑ **Investors and banks are reassured  $\rightarrow$  more advantageous debt and equity (lower interest)**
- ❑ **The targeted profitability level  $PI_0$  will be reached: projects are built and targeted sum of installed wind parks MWs will be reached within targeted time-frame**





# Insufficient protection of tariffs against inflation

- Tariff  $T(n) = (1+v)*T(n-1)$ , with  $v$  = tariff drift in constant €(0), example:  $v = -1,5\%$  /year
  - Targeted PI which is  $PI_0$  will not be reached:  $PI_v < PI_0$ 
    - ⇒ Either those projects will not be selected by banks and investors
    - ⇒ Or some those of these projects will be selected, but with increased failure risks
- ⇒ **Targeted number of installed wind MWs not achieved !**





# Correcting $T_o$ into $T_{ov}$ to achieve targeted $PI = P_{Io}$

- **Increasing tariff defined at year (0):  $T_{ov} = T_o * CRF(t,n,v) / CRF(t,n)$** 
  - ⇒ With  $CRF(t,n,v) = (t - v) / \{1 - [(1 + v) / (1 + t)]^{exp(n)}\}$
- **Example:  $T_o = 8$  c€/ kWh, inflation 3 %,  $t = 6\%$  real,  $n = 20$  y,  $v = -1,5$  %**
  - ⇒  $T_{ov} = 9,1$  c€/ kWh = + 14 % compared to  $T_o$ : a sensible increase !
- **$T_{ov}$  and inflation impact on badly protected 9,1 c€/ kWh tariff will result in a constant equivalent tariff identical to the 1st case:  $T_{cev} = 8$  c€/ kWh**
- **The targeted profitability level  $P_{Io}$  will be achieved, as in the case of a complete protection against inflation**
  - ⇒ Projects will be built
  - ⇒ But :
    - ☆ Anticipated protection against future inflation is not visible and investors and bankers are less reassured
    - ☆ If future inflation rate is higher than anticipated, the correction from  $T_o$  to  $T_{ov}$  will be insufficient
- **This approach is neither the more rational neither the most efficient !**
- **Better to choose the approach by a complete protection against inflation !**



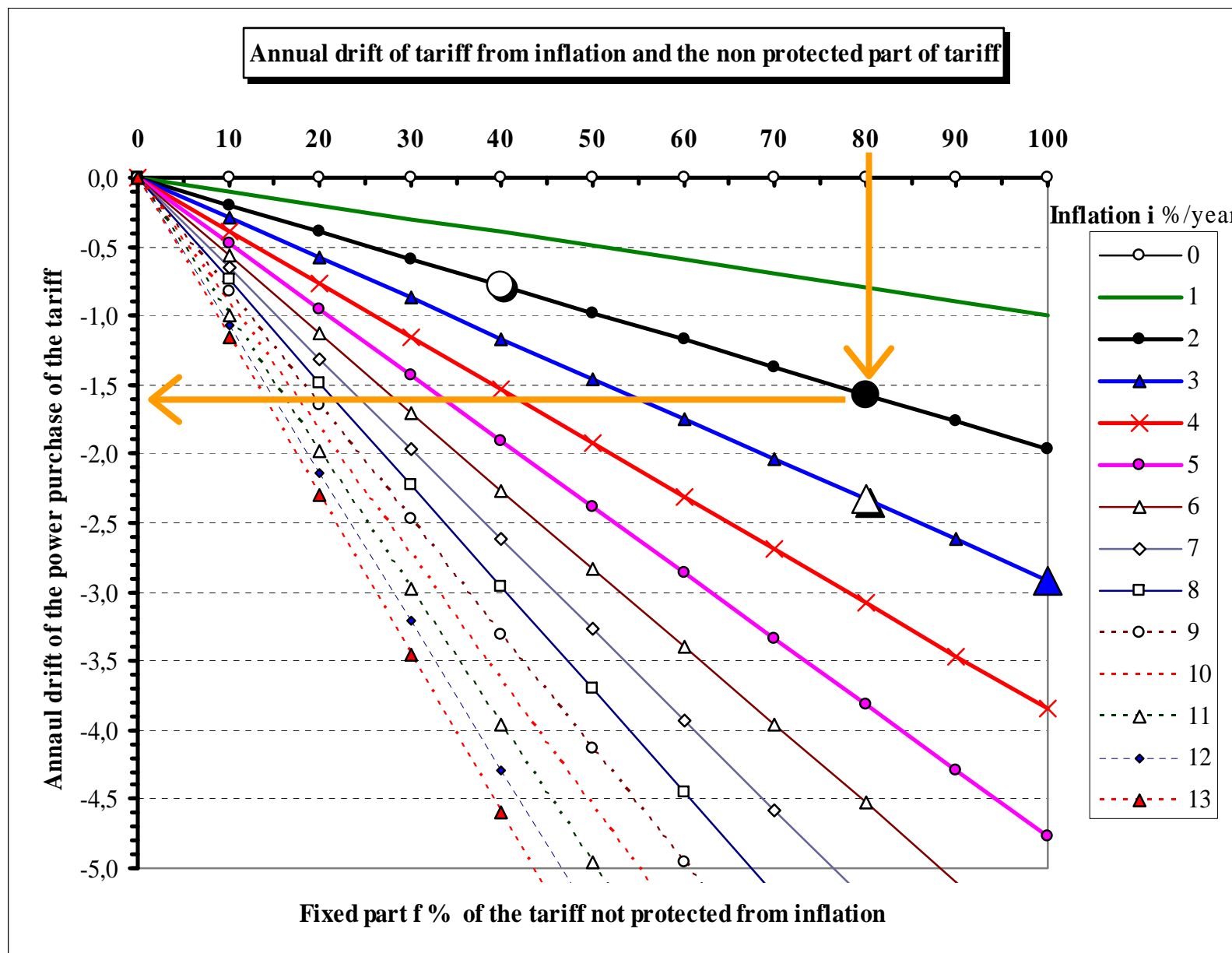
# Quantifying protection levels of tariffs against inflation

- $T_n = f * T(n-1) + (1 - f) * T(n-1) * (1 + i)$
- $f$  = part of tariff not protected from inflation (“f” for “fixed”)
- $(1-f)$  = part of tariff protected from inflation
- $i$  = constant inflation rate anticipated for the  $n$  years to come
- Annual drift  $v$  %/year of the power purchase of the tariff expressed in constant € of year (0):  $v$  (%/year) =  $- f * i / (f * i)$
- Examples of protection levels:
  - ⇒ France, wind:  $f = 0,4 = 40\%$  → 60 % of the tariff is protected
  - ⇒ Ontario, wind:  $f = 0,8 = 80\%$  → 20 % of the tariff is protected
  - ⇒ Germany, wind:  $f = 1 = 100\%$  → 0 % of the tariff is protected
  - ⇒ Ireland, wind:  $f = 0$  → 100 % of the tariff is protected
- As wind power participates to the fight against imported inflation, the rational protection level should be 100 % ( $f = 0$  %)
- And the sensitivity to incomplete protection levels is very strong!



# Calculation of the tariff drift $v$ %/year = $f$ (i, part $f$ )

□ Example (black dot): future estimated  $i = 2\%$  per year, fixed part  $f = 80\%$  (20% of tariff protected):  $v = -1,6\%$  /year





# Sensitivity of profitability to the protection of tariff

Example on a wind project :

Perfect protection (green):

⇒  $v = 0 \%$ ,  $PI = 0.3$

⇒ Profitable project, built

Imperfect protection (blue):

⇒  $v' = -1,5 \%/y$ ,  $PI' = 0.08$

⇒ Project insufficiently profitable

⇒ Project not selected, not built

⇒ Or if built, risk of stranded cost or bankruptcy

**Very strong sensitivity of project profitability to the protection level of the tariff !**

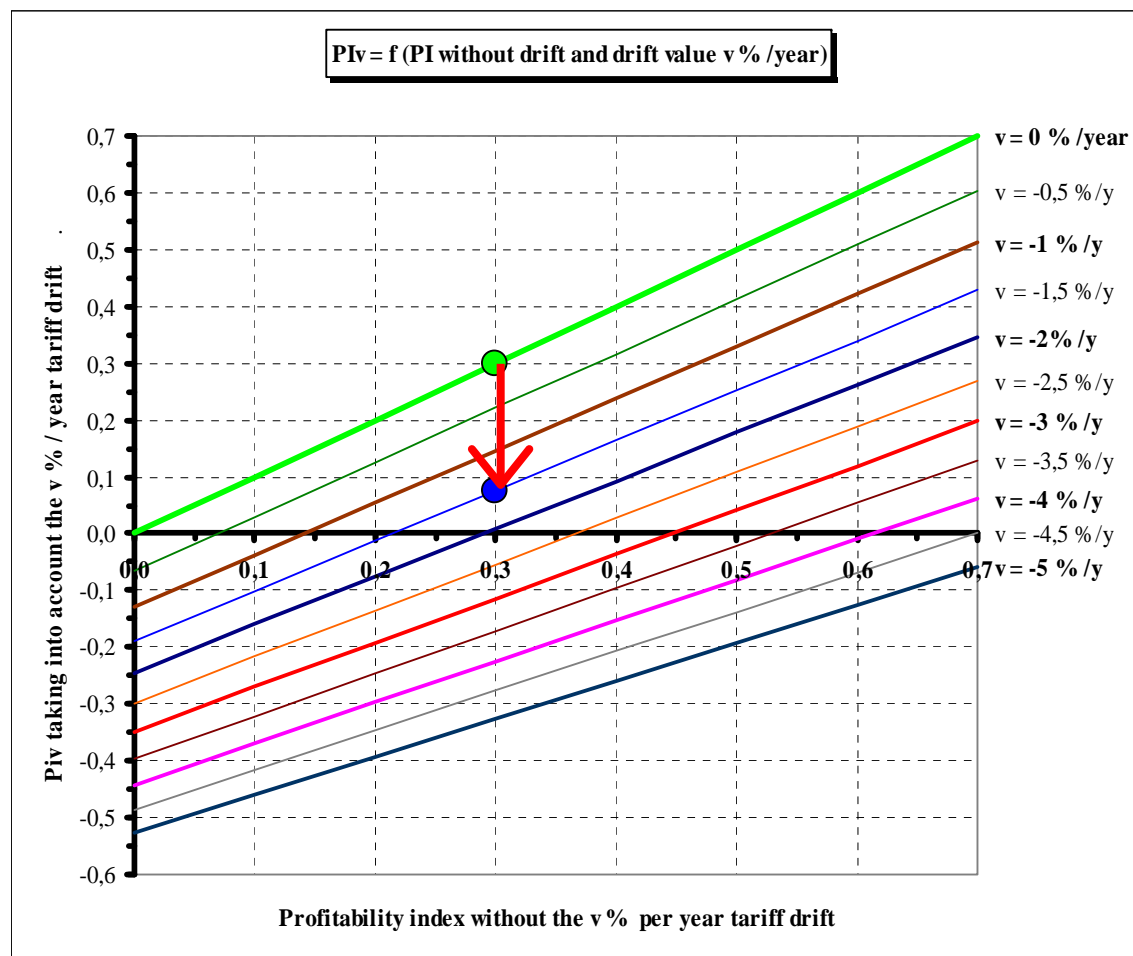
Advantage of using PI

⇒ Explicit formula

⇒ Reliable profitability scale

Onshore Wind Power

n	20,00	years	Ka(t,n)	0,08718	
t	6,00	% real	Com	2,17	c€/kWh
Iu	1 300	€/kW	Ci	4,72	c€/kWh
Nh	2 400	h/year	ODC	2,80	c€/kWh
Kom	4,00	%	Ci/ODC	0,630	





## Conclusion at this step

- ❑ **A tariff system must be designed without forgetting to take into account tariff protection against inflation**
  - ⇒ **Either by protecting completely tariffs against inflation (formula with  $f = 0\%$ ), which is legitimate as wind power projects are participating to the fight against imported inflation**
  - ⇒ Either by defining a tariff system with no protection against inflation or an imperfect protection against inflation but by “correcting” by an increase the initial value of tariffs to compensate the effects of anticipated level of future inflation
  - ⇒ **The first option is legitimate, simpler, more reliable, more visible by investors and bankers, it gives lower initial tariffs values and within a project contract a constant tariff expressed in constant € of year (0)**
- ❑ **If economic decision makers are reluctant to give a signal of “100 % protection against inflation”, a minimum protection level should be 80 to 90 % (fixed part  $f <$  to 10 to 20 %)**



# Indexation of a tariff within a project contract

- ❑ It will result from the choice made for the definition of the tariff system (see above)
- ❑ So, according to this choice, it will be either:
  - ⇒ **Complete indexation of the tariff on** inflation rate (fixed part  $f = 0$  %) to protect it completely from inflation: a **legitimated, simple, reliable, visible solution**
  - ⇒ **Partial indexation**, the same that has been chosen for the design and calculation of the tariff systems, with integration of the correction of the initial tariffs values from  $T_0$  to  $T_{0v}$  (cf. above example)
- ❑ This simple and logical approach is advocating for the choice of the **general rate of inflation in the country** as the index to use for annual correction, and not one or a mix of sectorial indexes (Ontario has made this choice in 2006)



## Indexation of new contracts tariffs at year (n+1)

- Define if one must apply a decreasing rate of the tariff for new projects, e. g. in France (2006 tariffs):
  - ⇒ Wind power tariffs : « - 2 % per year from 1/1/2008 »
  - ⇒ Photovoltaic tariffs: « no decrease » → “- 0 % per year”
- And above all define if this possible decreasing rate :
  - ⇒ Must be applied on the initial value of the initial tariff, example of Ontario tariffs : no decrease in tariff expressed in current \$ → the real power purchase of the tariff is in fact decreasing in constant \$ :  $v = - i \% / \text{year}$  → around minus 2 % to minus 3 % / year
  - ⇒ Or on this value corrected from inflation
  - ⇒ Or on this value corrected by a specific index, e.g. wind power in France: 50 % variation of index ICHTTS + 50 % variation « PPEI »
  - ⇒ Or by an index **specific to the technology** : case to consider for wind power due to large specific variation of wind turbine costs ?
- Apply the corresponding definition



# General conclusions

- ❑ **Designing a fair and efficient wind power tariff system is particularly simple and reliable :**
  - ⇒ If analysis is based on a global economic profitability before tax, to be checked later by a financial profitability analysis on equity after tax on reference cases
  - ⇒ If the Profitability Index Method is used: universal targeted profitability values, explicit formulas for tariffs calculation and for their protection against inflation and for sensitivity studies...
- ❑ **Taking into account the effects of inflation and taking into account the protection to include against negative effects of inflation is mandatory due to the strong sensitivity of wind projects to those factors (long term projects)**
- ❑ **As wind power projects are fighting against imported inflation, the wind tariffs systems and the related power purchase contracts deserve a total protection (or a quasi total protection) against the effects of inflation**