Green Energy Act Alliance

Design Elements of Feed-in Tariffs:
Spain, Germany, France and Ontario

France's Advanced Renewable Tariffs

Bernard CHABOT
Renewable Energy Consultant and Trainer
bechabot@wanadoo.fr

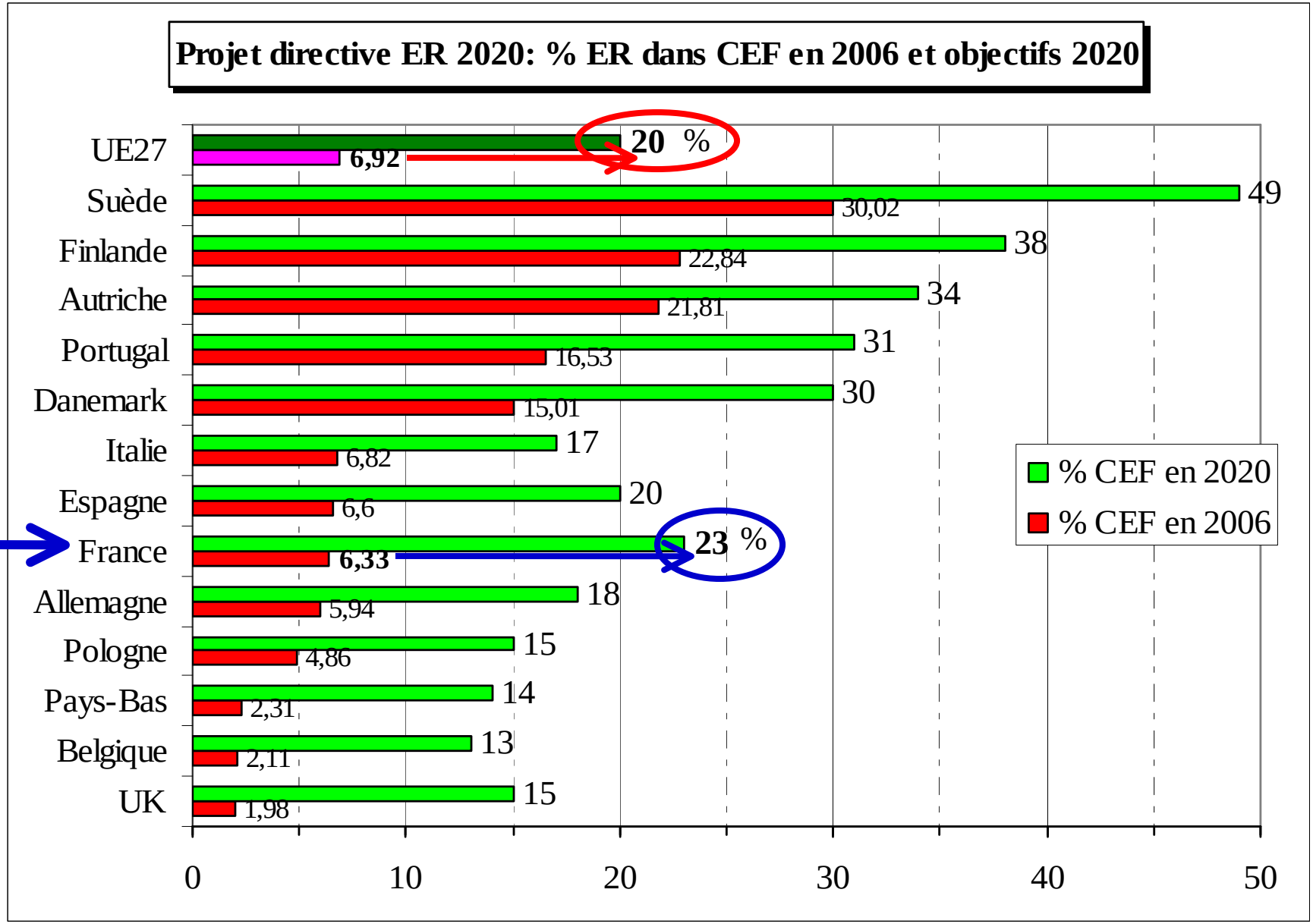
The European Context

Europe energy and climate policy: « 3 * 20 % in 2020 »

- **20 % reduction of greenhouse gases emissions in 2020**
  - ⇨Compared to 1990 emissions
- **20 % more energy efficiency**
  - ⇨Beyond effects of already decided policies and measures
- **20 % renewable energy in final energy consumption**
  - ⇨Compared to 6.9 % in 2006
  - ⇨Binding target at the European Union level
  - ⇨Binding target of 10 % of fuels for transportation from RES
  - ⇨A related European Directive (= European Law) in preparation
    - ¶ Under the French Presidency (June to december 2008)
    - ¶ To be adopted before June 2009
  - ⇨All the 27 member states will have to present a National Action Plan to the European Commission
  - ⇨Interim targets will be defined from 2012 to 2018

The coming European Directive « 20% RE in 2020 »

(Heat, electricity, fuel)



Renewable Electricity Roadmap for the « 3 * 20 % » Plan

Source: European Renewable energy Council, November 2008

Source: EREC, Nov 2008, "RE Technology Roadmap"	TWh from RE in EU27				GW RE in EU27	
	2006	**2010**	**2020**	% in 2020	GW 2020	% in 2020
Wind	**82**	**176**	**477**	**35%**	**180**	**35%**
Hydro	357,2	360	384	28%	120	23%
Bioenergy	89,9	135	250	18%	50	10%
Photovoltaic	**2,5**	**20**	**180**	13%	**150**	29%
Solar Thermal	0	2	43	3%	15	2,9%
Geothermal	5,6	10	31	2%	4	0,8%
Ocean Energy	0	1	5	0,4%	2,5	0,5%
TOTAL	**537**	**704**	**1 370**	100%	**522**	100%
% of EU Electricity	**16%**	**19,7%**	**33 to 40 %**			

The French Context

The « Grenelle de l'Environnement » outcome

- **A 2007-2008 national debate on environment, energy and sustainable development between government and « civil society »**
- **Complements the July 2005 law on energy (« F4 in 2050 »)**
- **The « Grenelle 1 » law adopted in November 2008**
- **The « Grenelle 2 » law (detailed measures) to be passed in spring 2009**
- **Will serve as a basis for French action plan for renewables**
  - ⇨Confirms the **23 % target from renewables** in France's final energy consumption in 2020 compared to 6.3 % in 2006
  - ⇨From -35 Mtoe by supplementary Energy Efficiency measures
  - ⇨And by **+ 20 Mtoe of Renewables**, of which **+ 7 Mtoe power**
    - ¶ Of which **+ 5.3 Mtoe from wind power: 60 TWh from 25 GW in 2020**
    - ¶ And around **+ 0.5 Mtoe from Photovoltaics: 5.8 TWh from 5,6 GW**

French Renewable Tariffs as an example of Advanced Renewable Tariffs (ARTs)

ARTs (1): French renewable tariffs are differentiated

- **By renewable energy technologies**
  - ⇨Wind
  - ⇨Solar photovoltaic
  - ⇨Hydropower
  - ⇨Bioenergy: biogas, solid biomass, biomass part of MSW
  - ⇨Geothermal energy

- **By Applications**
  - ⇨Wind: onshore or offshore
  - ⇨PV: Building integrated, non BI, PV plants on land
  - ⇨According to rated power range: biomass, biogas, Hydropower
  - ⇨High efficiency CHP
  - ⇨Options for time and seasons of delivering: hydropower

- **By regional application: Mainland, Overseas department**

ARTs (2): French renewable tariffs are Cost + Profit based

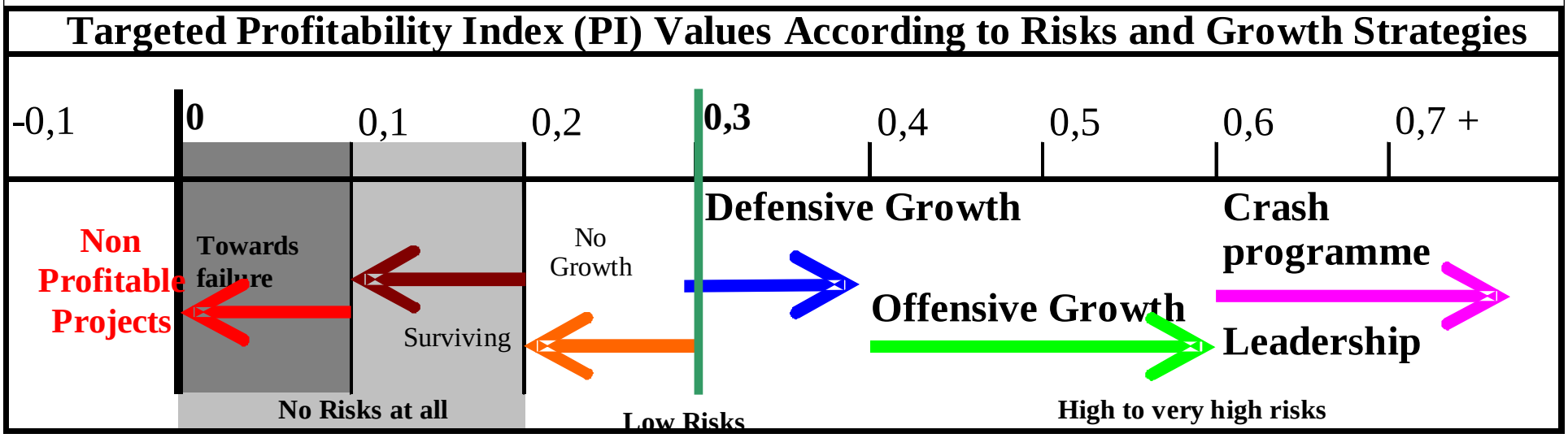
- **Officially based on a real project IRR before tax on profit**
  - ⇨8% real project IRR from the 2006 review imposed by the July 2005 law on energy (« Loi POPE »)

- **Fined-tuned by profitability levels adapted to targets**
  - ⇨Wind: profitability increase with wind speed at hub height
  - ⇨BIPV: increased profitability to help innovation and market deployment of new BIPV modules and systems
  - ⇨CHP from biogas: at least same profitability level than the one from CHP based on fossil fuels

- **Fine-tuning easier from the Profitability Index than from IRR**

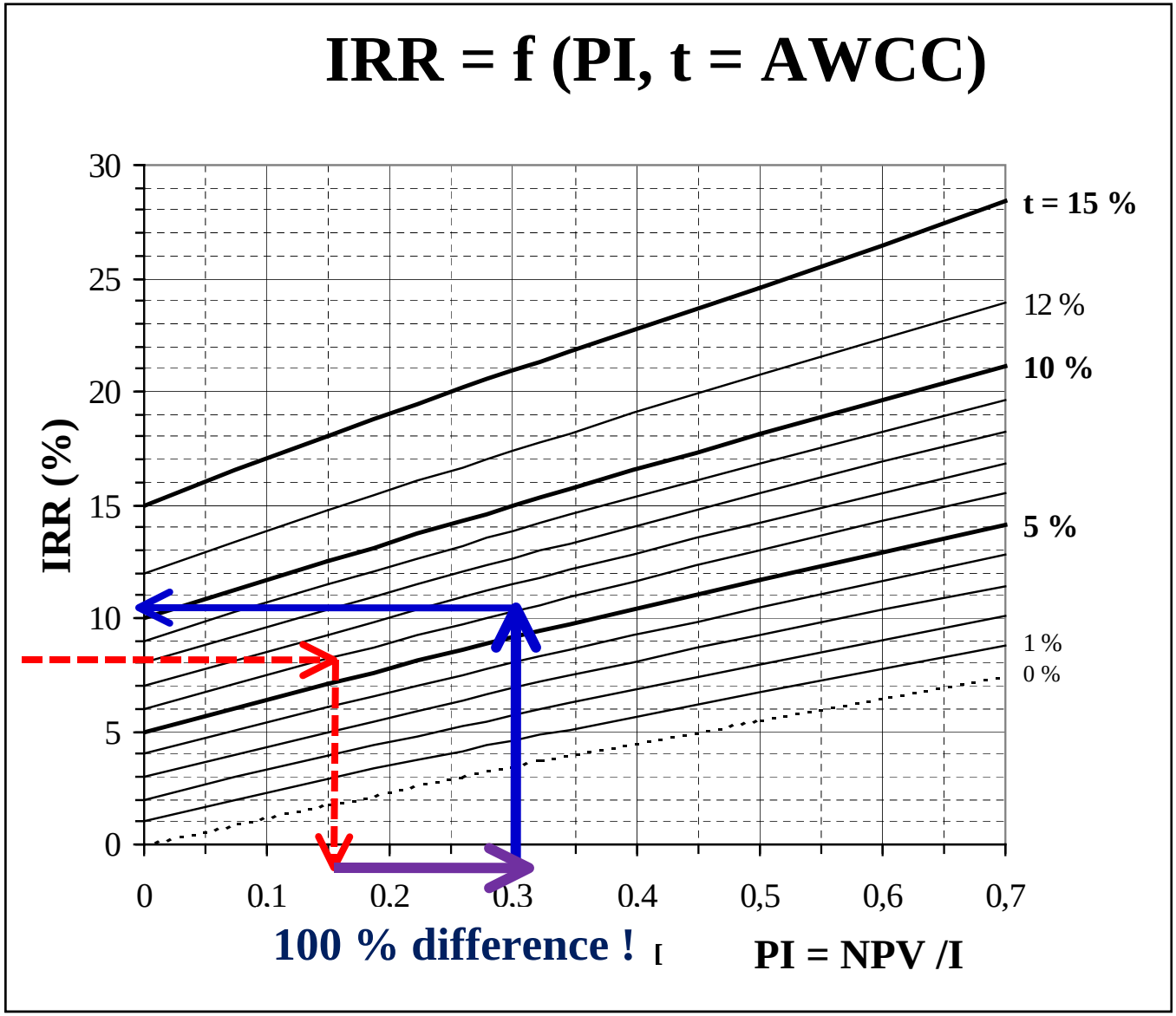
Example of profitability target choice

- **Using the Universal Profitability Scale based on the Profitability Index PI=NPV/I**

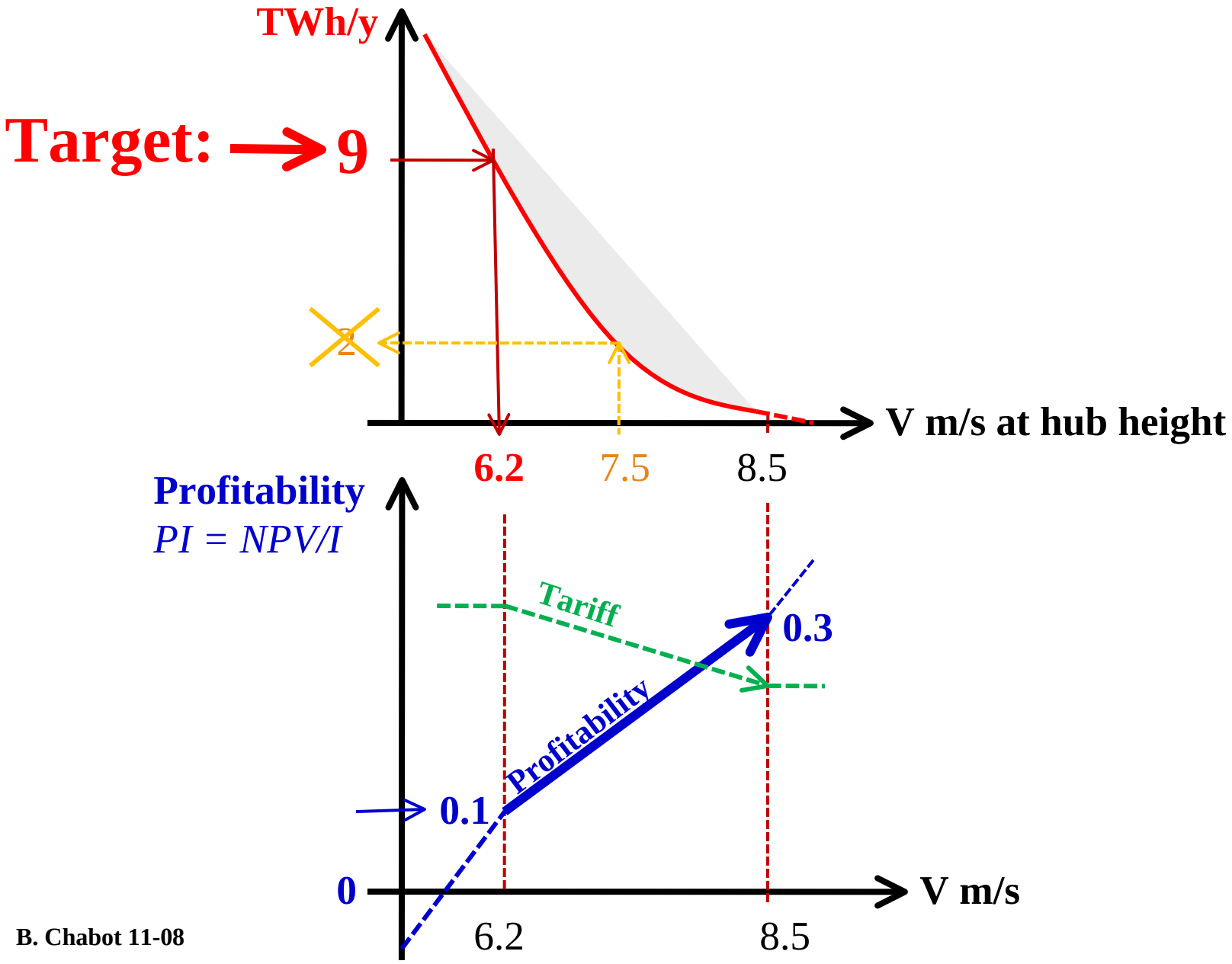


Links PI / IRR for n = 15 years

Ex: t = AWCC = 6 %: 100 % PI variation from 0.15 to 0.3 : IRR vary only from 8 to 10.3%

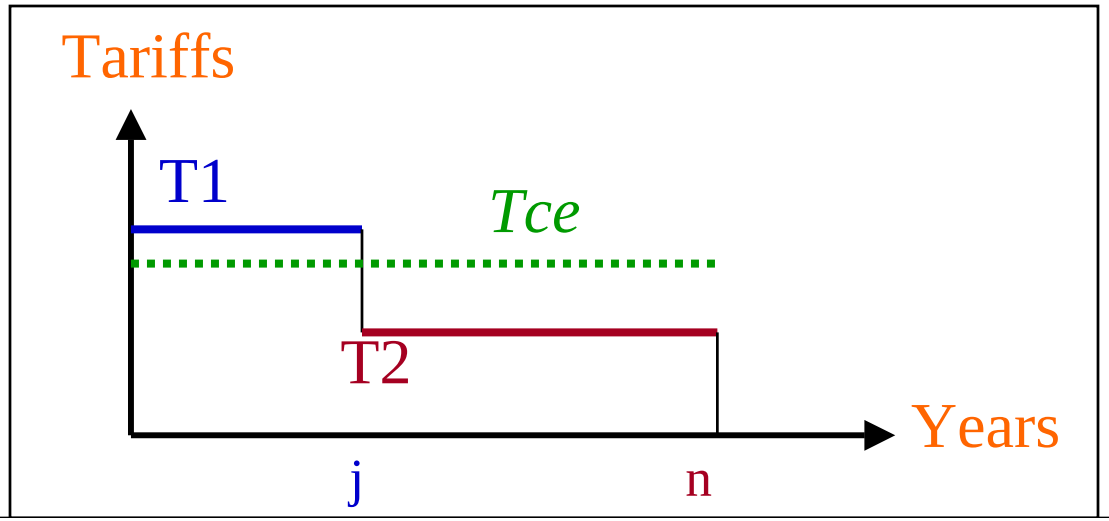


ARTs (3): Tiered Wind Tariffs Principle

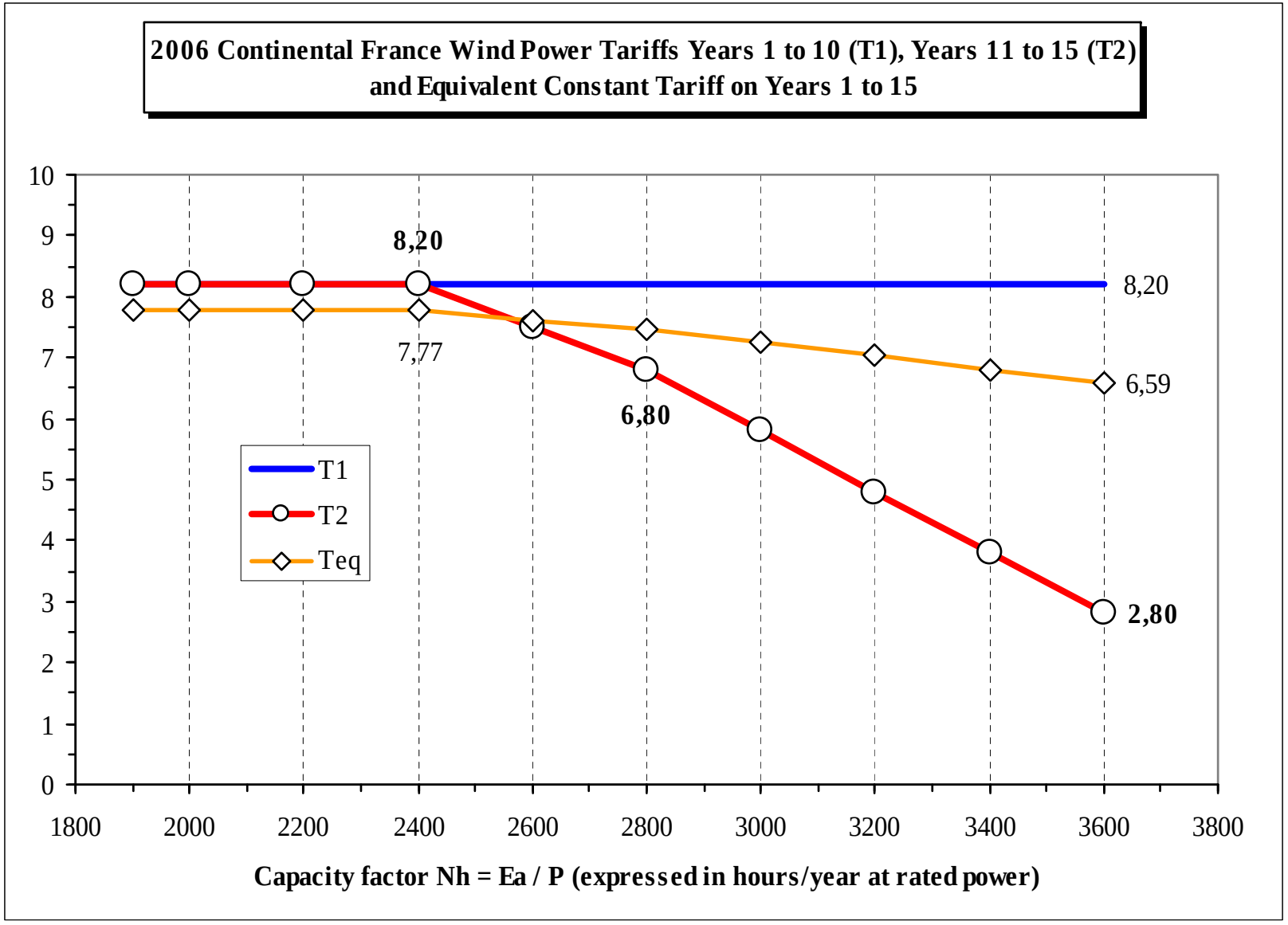


ARTs (3): French Tiered on shore wind tariffs

- **Two successive tariffs levels :**
  - ⇨T1 fixed for all projects from years 1 to 10
  - ⇨T2 variable for projects from years 11 to 15
  - ⇨T1 and T2 define a virtual constant “equivalent tariff”, *Tce*
- **For a specific project :**
  - ⇨Nh = averaged Ey / P from values years 1 to 10
  - ⇨T2: linear calculation from reference values of Nh = Ey / P
  - ⇨{*Tce* from (T1, T2, t = real discount rate = AWCC before tax)}



ARTs (3): French onshore wind tiered tariffs



Equivalent constant tariff TVeq are calculated here with a 6 % real discount rate and a 2 % future inflation rate

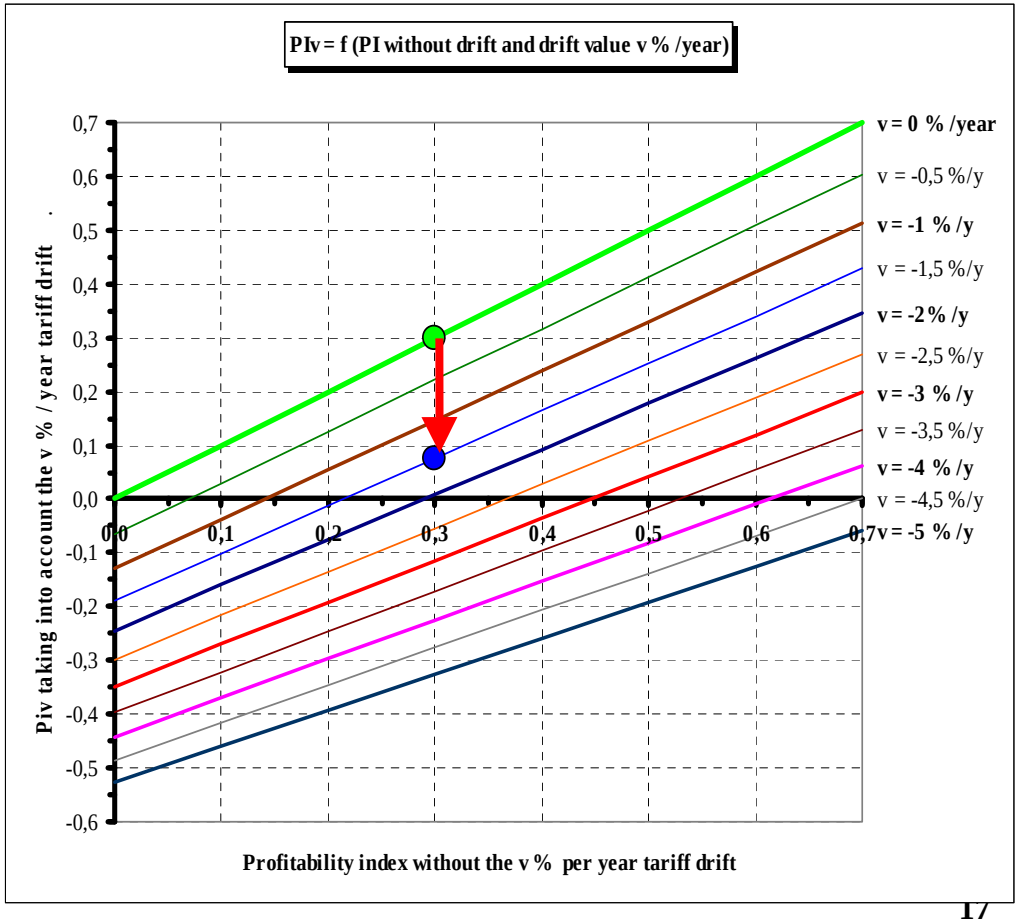
ARTs (4): protection against inflation

- **A tariff system must be designed without forgetting to take into account tariff protection against inflation**
  - ⇨**Either by protecting completely tariffs against inflation, which is legitimate** as wind power projects are participating to the fight against imported inflation
  - ⇨Either by defining a tariff system with 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 a "100 % protection against inflation", is not possible, a minimum protection level should be 60 to 90 %**
- **French tariffs are 60 % protected against inflation within a PPA**

Sensitivity of project 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	



ARTs (5) 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 % / 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 (wages) + 50 % variation « PPEI » (products and services for industry)
  - ⇨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**

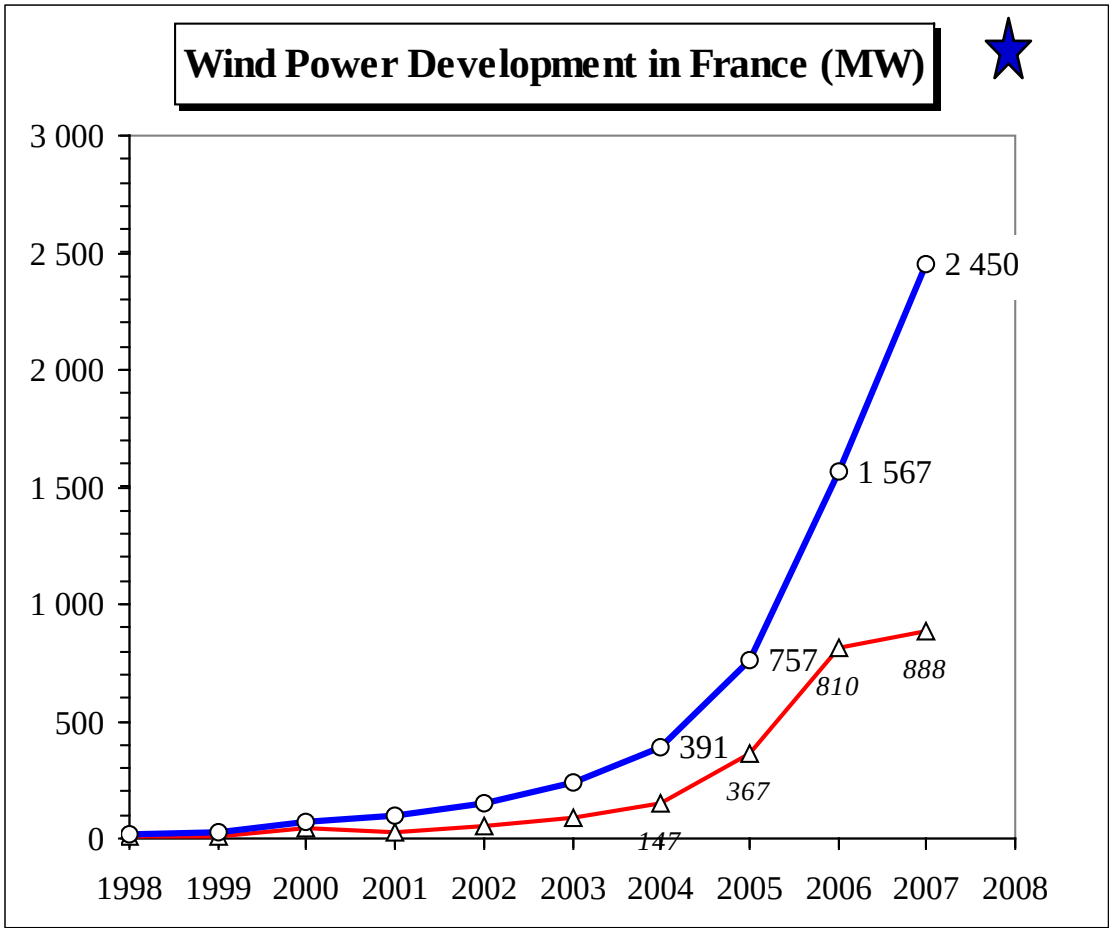
ARTs (6) : What next for French FITs = 100 % ARTs ??

- **General**
  - ⇨Shift inflation protection within a PPA from 60 % to 80 // 90 %
- **Wind**
  - ⇨Shift from capacity factor Nh (h/year) to Energy Yield Eas (kWh/m2.year): cf **OSEA 2005 adoption and proposal**.
  - ⇨For onshore shift from n = 15 years to n = 20 years
  - ⇨Adapt levels of tariffs versus the 25 GW target in 2020 and versus increasing wind turbines costs.
  - ⇨…
- **Photovoltaic:**
  - ⇨Create tiered PV tariffs: North: 1000 kWh/m2.y, vs 1800 south
- **Solid biomass: increase tariff level**
- **…**
- **Nobody is perfect, but everyone can learn from others to make progress !**

Results of French ARTs

French Wind Tariffs are Efficient (2)

- **France was in 2007:**
  - ⇨N° 8 wind capacity
  - ⇨N° 5 wind market (**third in EU**)
- **Jobs created:**
  - ⇨ < 100 in 1993
  - ⇨Around 1000 in 2000
  - ⇨Around 5000 in 2007
  - ⇨**Towards 18 100 in 2012**
- **FITs overcost passed on electricity consumers**
  - ⇨Based on the difference between FIT and electricity market price
  - ⇨ < 5 % of public service charges
  - ⇨**Less than 0.6 €/familly in 2007**



Conclusions

- Market regulation in favour of RE electricity is logical and is simple and effective if based on fair and efficient tariffs (ARTs) as demonstrated in Europe and in France
- Benefits from this regulation are rapidly outweighing its cost
- 2001 and 2006 French Feed-In Tariffs confirmed as the main wind development driver in France to get 25 GW in 2020
- Same dynamic growth created now for PV and Biogas with 2006 relevant tariffs
- Future French wind and other renewable policy from the new 20 % European target for renewables in 2020 will be based on continuity in success from fair and efficient tariffs
- An extension of FITs for renewable heat is on the way in France to get the 23 % French target for renewables in 2020
- Sharing experience, methods and tools can avoid delays and unnecessary or risky tests or trials for FITs systems designs