

15th IAEE European Conference 2017

'HEADING TOWARDS SUSTAINABLE ENERGY SYSTEMS: EVOLUTION OR REVOLUTION?'

3rd to 6th September 2017, Hofburg Congress Center, Vienna, Austria

Electricity Planning X Markets?

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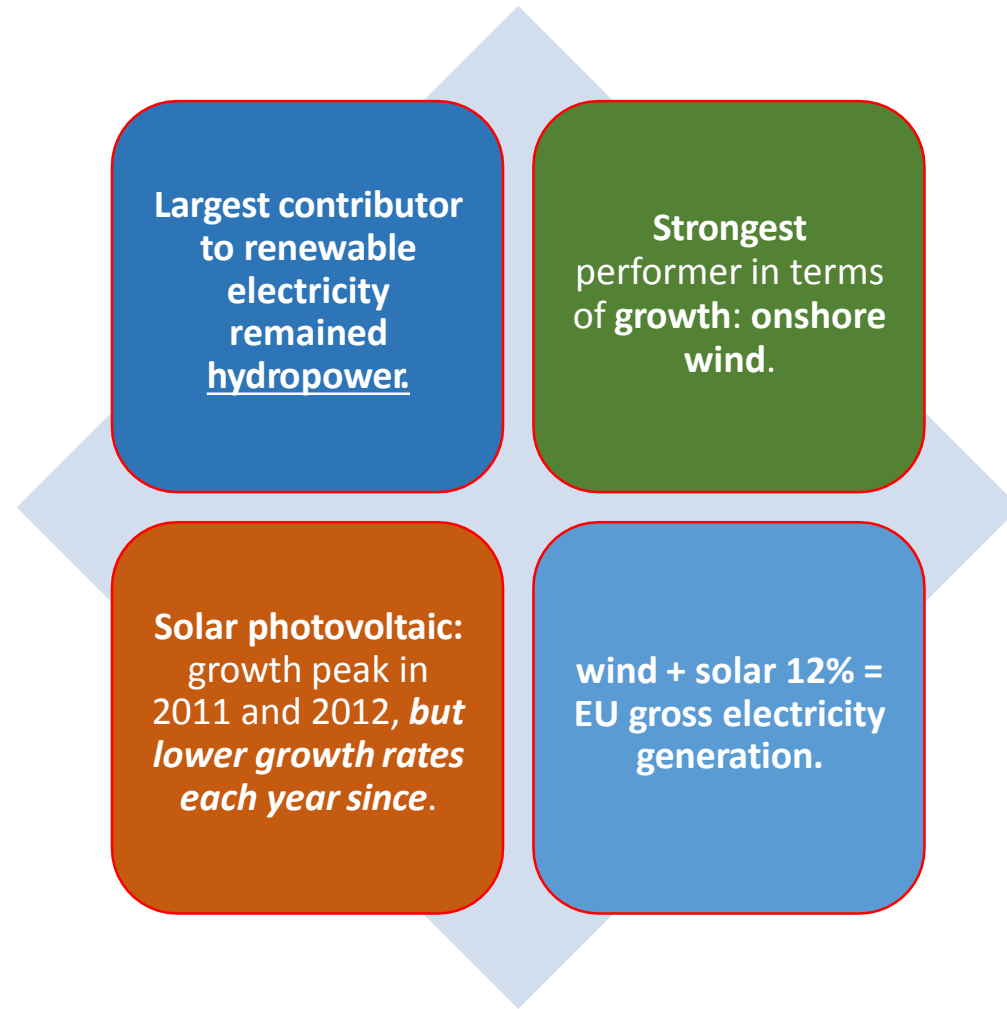
Outline

- ❑ (Sustainable, supply security) Energy Planning and Electricity Markets: *are they compatible?*
- ❑ Energy Policy, Utilities Governance and Investment Optimisation: *market structure matters...*
- ❑ Final comments



The electricity sector has seen the fastest growth in renewable share, which currently reaches 28.81% of total electricity production (2015)*

*14.31 (2004).



EU ambitious targets on RE can imply that inefficiencies in investments in RE plants (firm level)...

Can have cumulative effects

Consequently: costly for the Electricity system

Most common renewables support schemes in EU to encourage investment in RE generation capacity. : Feed-in Tariffs (FIT) and Feed-in Premia (FIP).

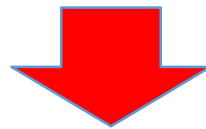
In principle, FIP can implement the socially optimal investment in renewable capacity,

FIT cannot since this system remunerates renewable generation independently of the electricity market prices.

- ✓ Even when RES generation is fully integrated in the wholesale market, usually it still benefits from an advantage position due to the merit-order rule

MEANWHILE:

- ✓ Most electricity markets are still oligopoly or duopoly markets.
- ✓ Concerns of **underinvestment** AND generating companies **behavior on energy markets and capacity markets**
 - ☐ NB: Firms **Asset value VS** Firms **Market value**



RES becoming increasingly competitive (wind, solar PV,...)

Starting to be remunerated according to market mechanisms.

PROS & CONS of dispatching RES in the market?

OPTIMAL GENERATION MIX (RES and non-renewable) ?

HOW FULL RES INTEGRATION AFFECTS EQUILIBRIUM MARKET OUTCOMES (short run)?

FIRMS' INCENTIVES TO INVEST IN BACK-UP CAPACITY?

- ❑ Under S and D uncertainty, RES generators prefer to strategically reduce market price (strategically evicting the last efficient conventional generator in that period.
- ❑ When RES capacity and the asymmetry in firms' marginal production cost is sufficiently high, RES generator may strategically manipulate the market, leaving conventional energy producers inactive.
 - ❑

Energy Planning

Long-term perspective, required for definition of Energy Policy

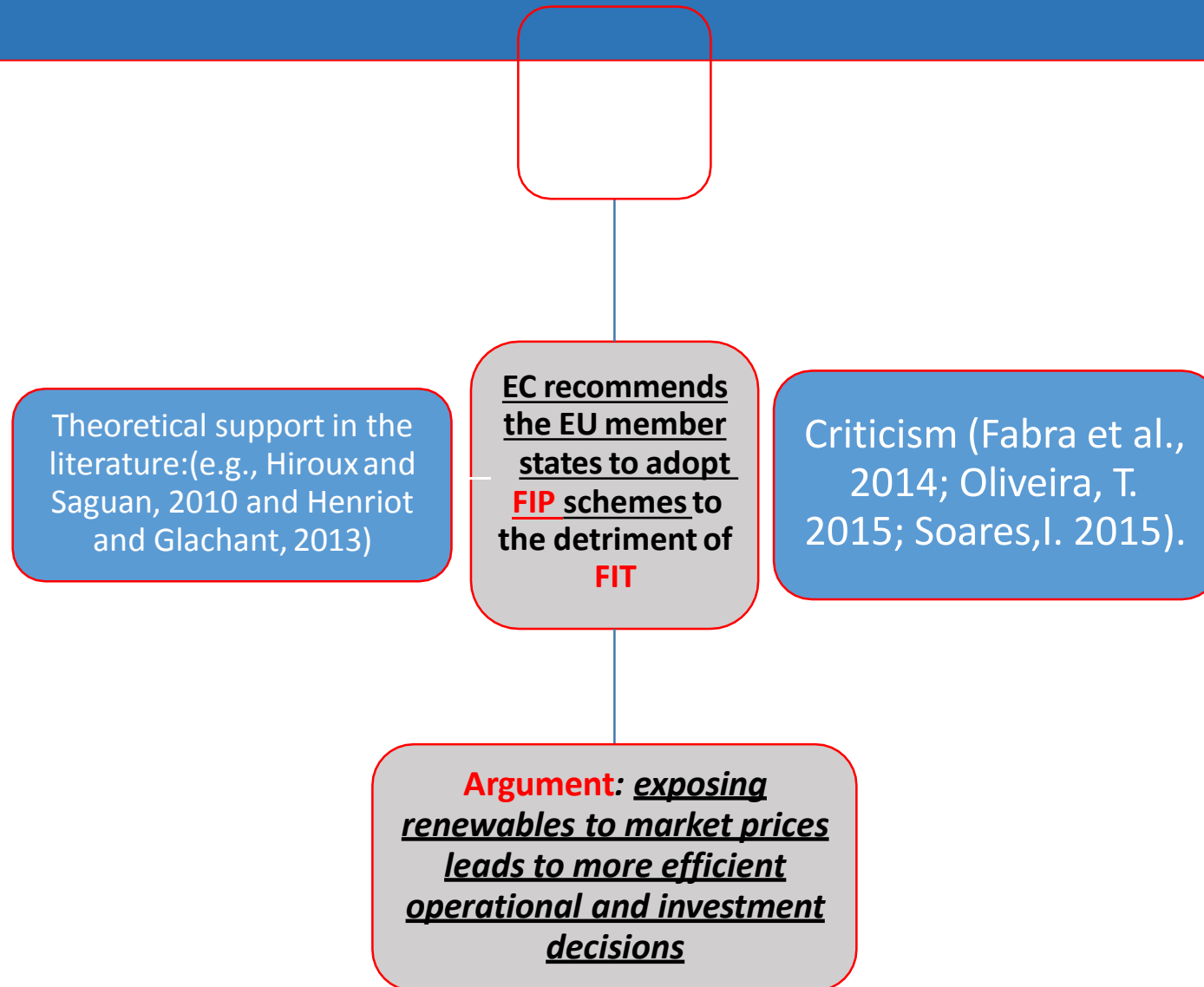
- ✓ Must be compatible with existing markets
- ✓ For each type of infrastructure: compatibility between regulation, investment, goals (*climate change mitigation, supply security,...*)
- ✓ Which are the right economic signals (*for investment, technologies, consumption behavior*) ?



Do we need a different approach (which include all stakeholders of society) and new planning processes?




Energy Policy, Utilities Governance and Investment Optimisation




This divergence between both remuneration schemes implies that **each system may induce different incentives on firms, leading them to adopt different operational and investment strategies.**

Each support scheme may result in a distinct overall outcome of the energy market.


Dynamic effects that differ across technologies (e.g., learning by doing and learning by using) **justifies differentiated levels of support** (del Río, 2012) → existence of **market signals** remains important for investment choices within technologies (for ex. to influence the choice of capacity, location, ...).



Assuming that prices are linear and that the thermal generation cost function is quadratic
(usual in the literature on electricity markets)



for example to influence the choice of the capacity and location for wind plants.



Despite the advantages of integrating renewables in the market, there is a trade-off when choosing how to support renewables via FIP or FIT systems.

Final Comments

- ✓ **To attain the socially optimal level of investment in renewable capacity: *necessary that firms internalize the market value of their renewable generation***
- ✓ **HOW?** By remunerating renewable electricity with a constant subsidy which is independent of market prices
- ✓ **FIT** are unable to implement the optimal outcome.
- ✓ **FIP** systems lead firms to internalize the market value of their renewable generation by exposing them to market prices, thus ***encourage investment in plants whose generation profile correlates with periods of high electricity spot prices.***

FIP firms have incentives to make their decisions based on forecasts of the evolution of market prices.

However:

As, in general, value of electricity for society \neq to its spot price

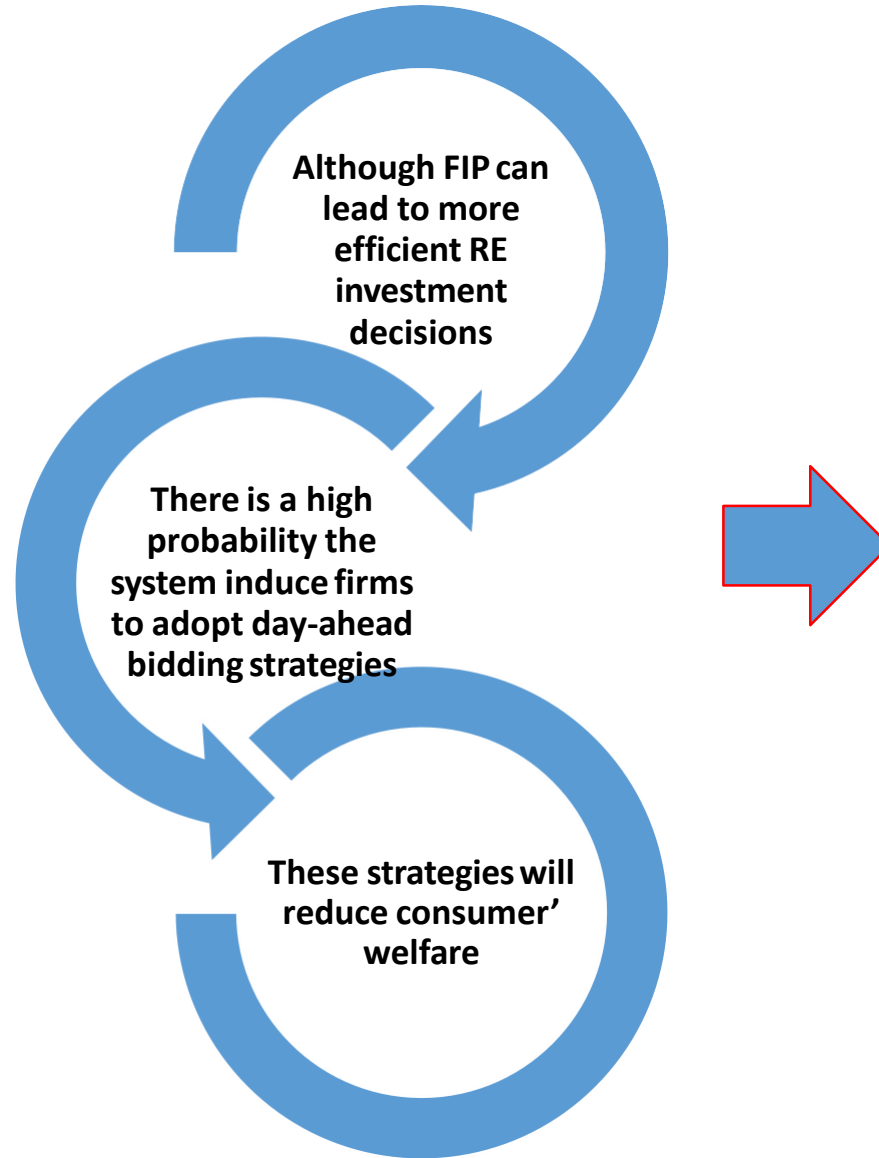


Exposing renewable generators to market prices, although necessary, **is not sufficient for the implementation of the optimal outcome.**

The **socially optimal investment in renewables** *can only be attained if:*

the subsidies under FIP are set at the level that induces firms to internalize the externalities associated with renewable generation.

- This result holds even in the presence of carbon pricing **because:**
- **several externalities may not be priced through this instrument,** (costs of integrating renewables in the electricity system, the reductions in emissions of other types of greenhouse gases or local pollutants) **due to the crowding-out of fossil-fuel based generation**



Final Comments

For each market, there is still a huge amount of work/evaluation of costs & benefits...

Given that *sudden changes in regulation are one of the worst signs for investors.*



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