Do cost fall faster than revenues?

Dynamics of renewable entry into electricity markets

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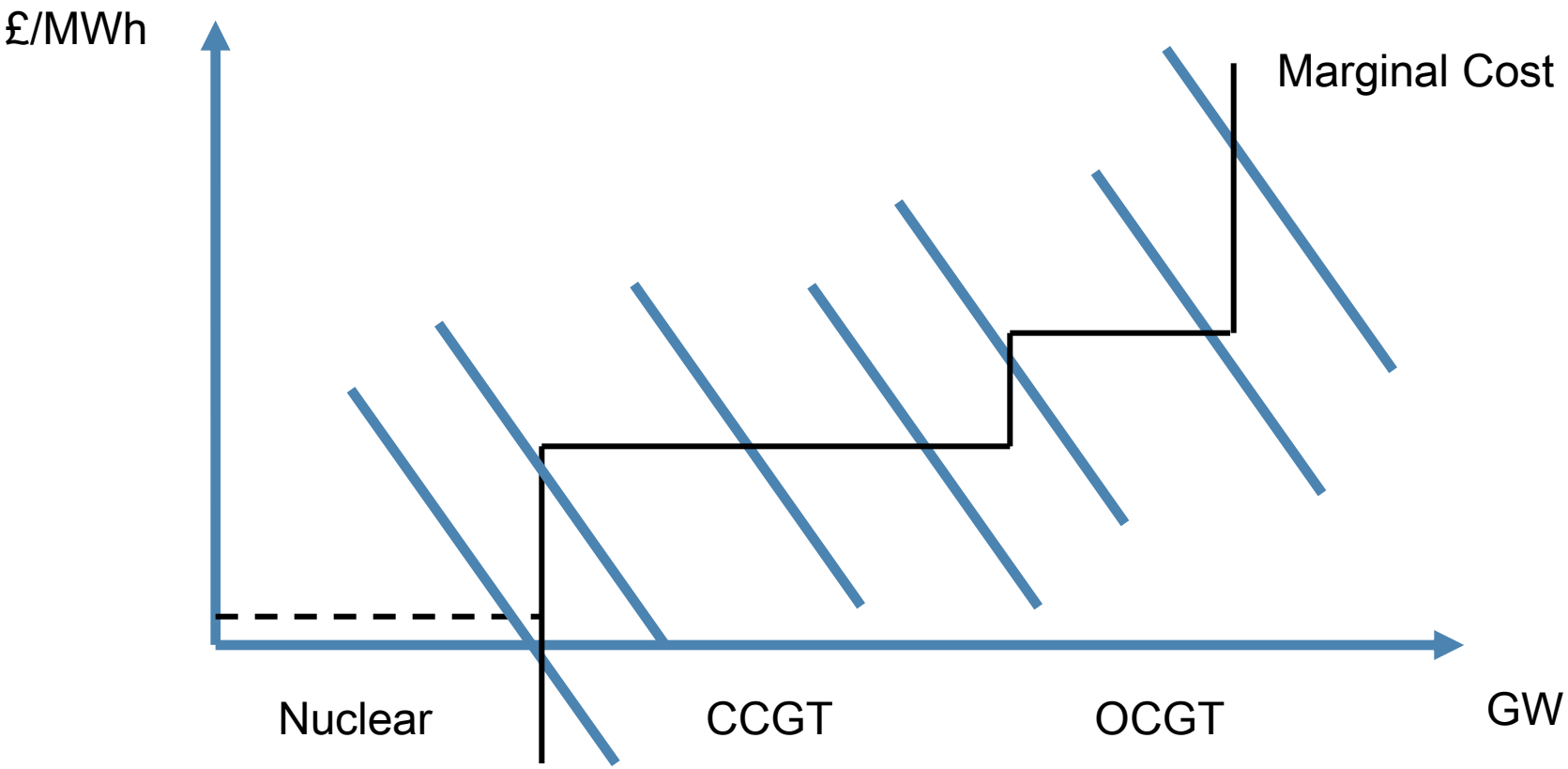
Renewable integration and subsidies

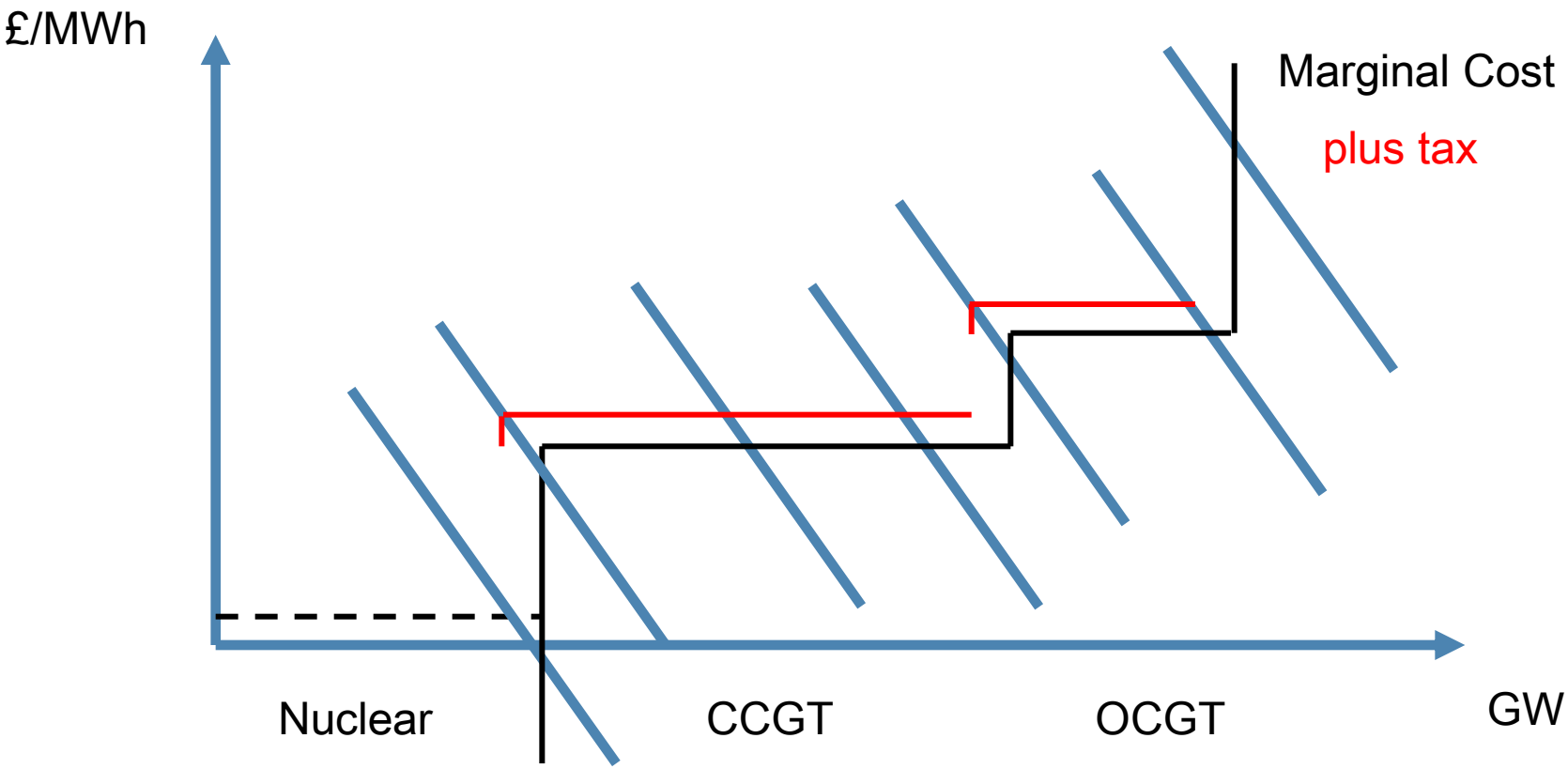
- Renewable entry has already had a profound impact on the generation mix and led to a high tax in Germany, and soon in other European countries
- This research project
  1. determines analytically the “laws of motion” of renewable entry, i.e., the dynamics of the generation mix, subsidy, and tax
  2. illustrates the analysis on the case of Great Britain
- It finds that
  1. massive entry under the current physical dispatch priority rule would push inflexible nuclear out of the market, and lead to a significant increase in the subsidy and tax
  2. replacing physical dispatch priority by financial dispatch priority would mitigate these negative effects without altering renewable economics

Long-term generation mix: Marcel Boiteux forever



Source: Green and Léautier, 2015

Generation mix evolution as renewables enter



Source: Green and Léautier, 2015

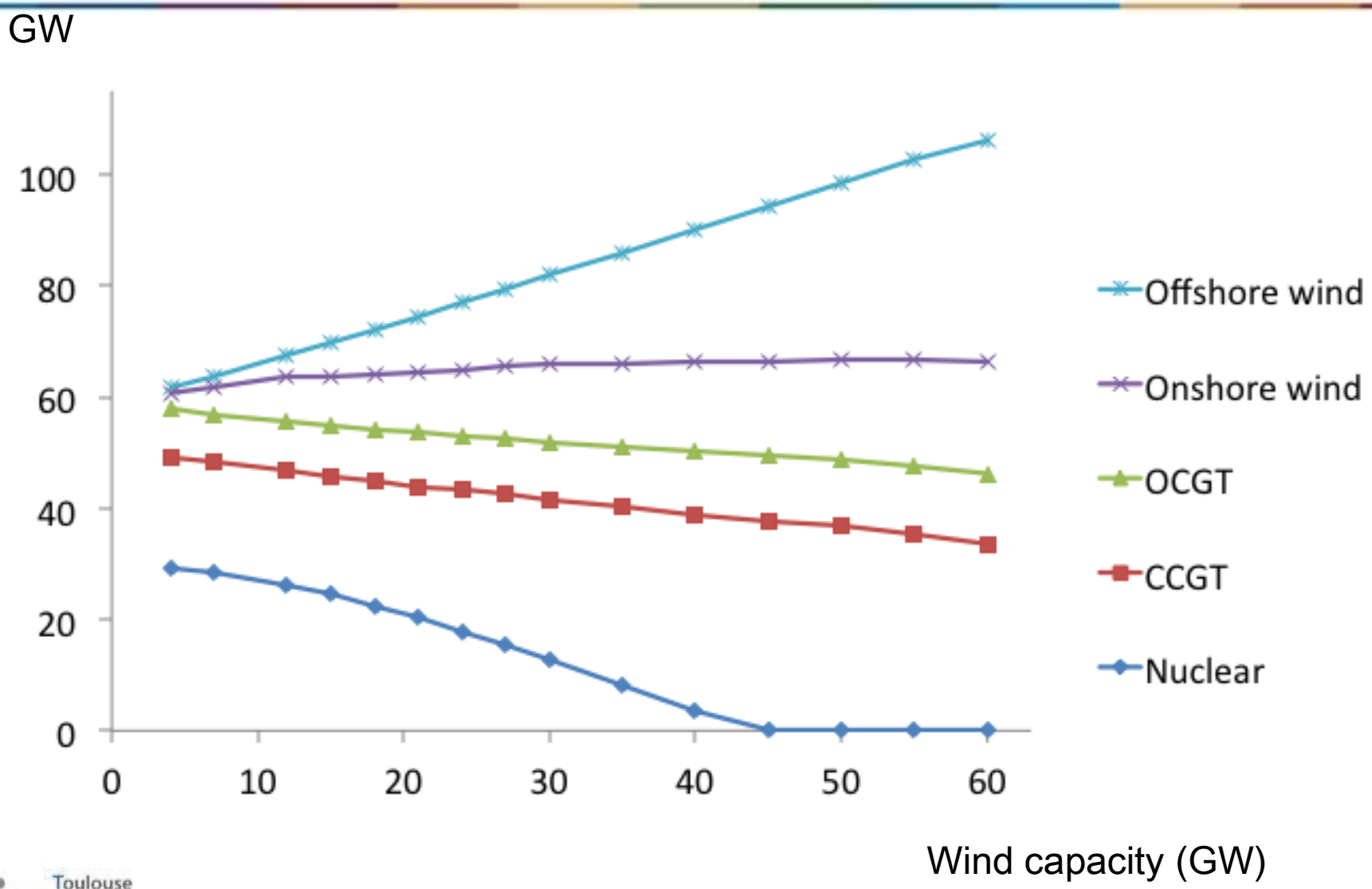
Dynamics of generation mix

- Long term equilibrium: conventional installed capacity is reduced as renewables capacity increases

$$\frac{\partial K_n}{\partial K_0^i} = -\frac{1}{b}\frac{\partial \tau}{\partial K_0^i} - \mathbb{E}\left[\alpha^i(\theta)\,|v_n\right]$$

  - K_n cumulative capacity of first n technologies (ordered by MC), K_0^i installed capacity of renewable technology i
  - b is slope inverse demand $P(Q,\theta) = a(\theta) - bQ$
  - τ is the unit tax required to cover the subsidy
  - $\alpha_i(\theta)$ is the availability of renewable technology i in state θ
  - v_n is the vertical portion of the supply curve where technology n produces at capacity

Resulting capacity mix in Great Britain



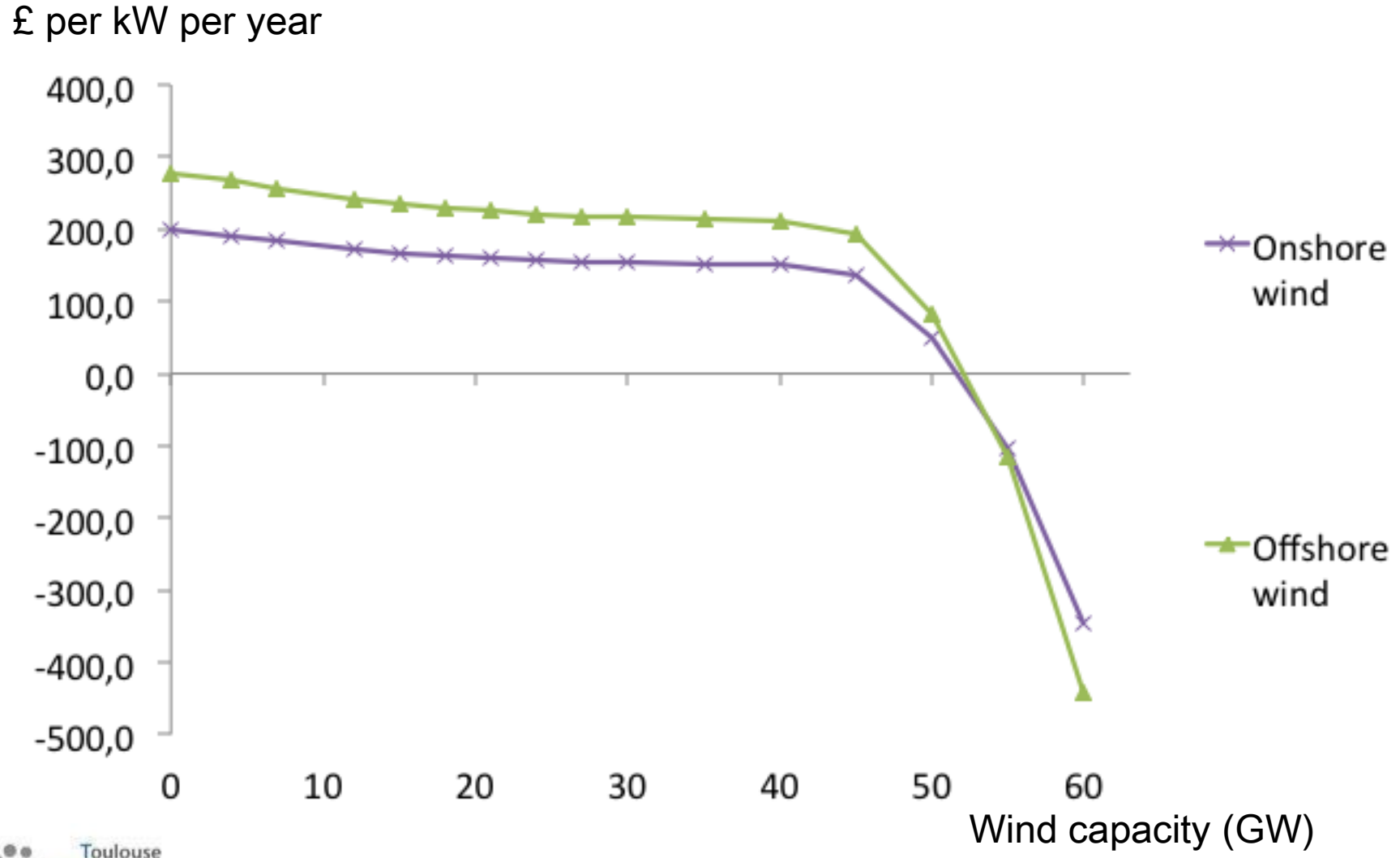
Source: Green and Léautier, 2015

Dynamics of the marginal value of renewable capacity

- The marginal impact of renewable technology *i* on the value of technology *j* is proportional to the covariance of availabilities

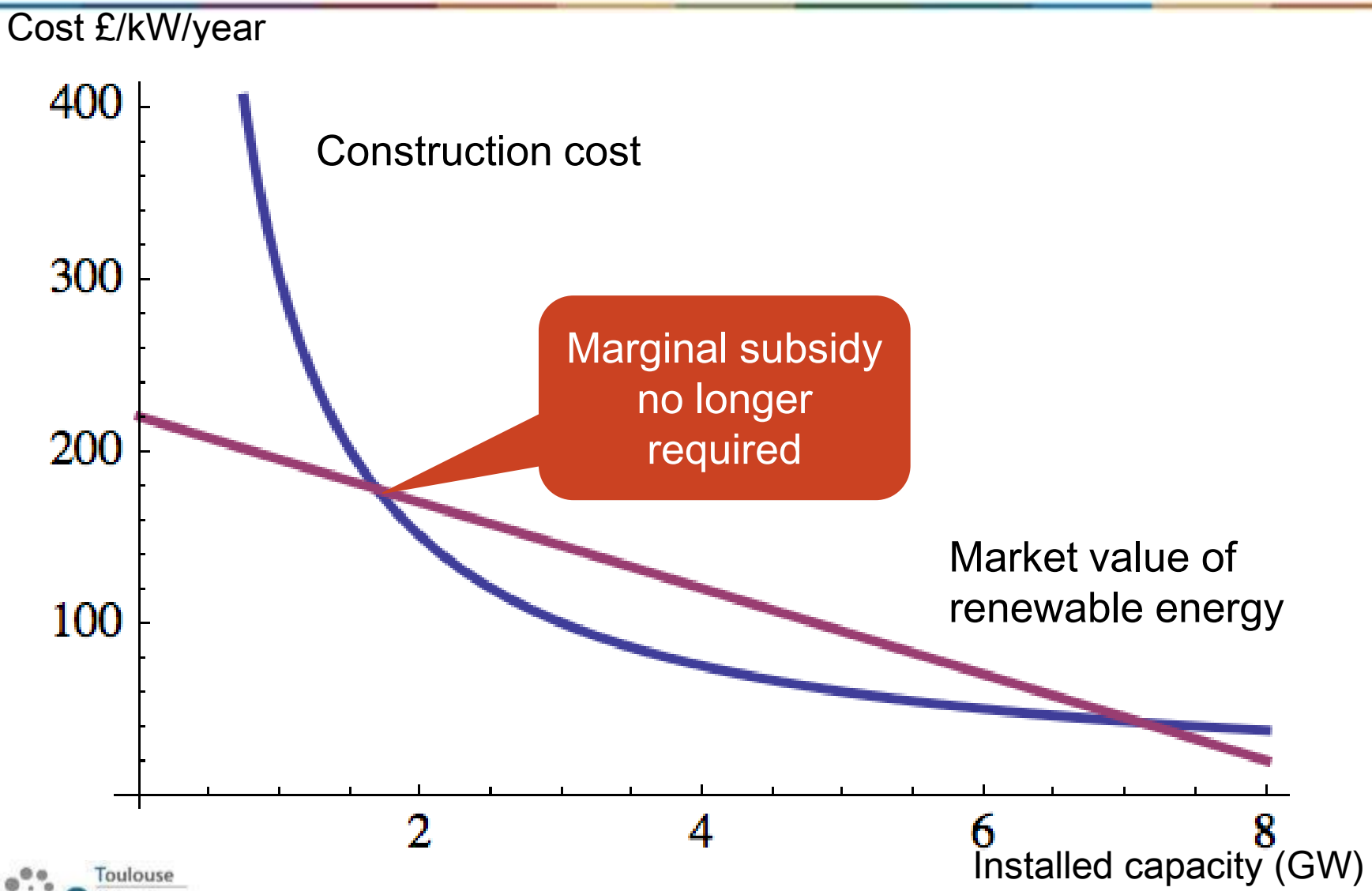
$$\mathbb{E}\left[\alpha^j(\theta)\frac{\partial p}{\partial K_0^i}\right] = -b\widehat{cov}_{\mathbf{K_0}}\left[\alpha^i(\theta), \alpha^j(\theta)\right]$$

Marginal value of wind turbines (status quo)



Source: Green and Léautier, 2015

Cost falls faster than the price: marginal subsidy ends



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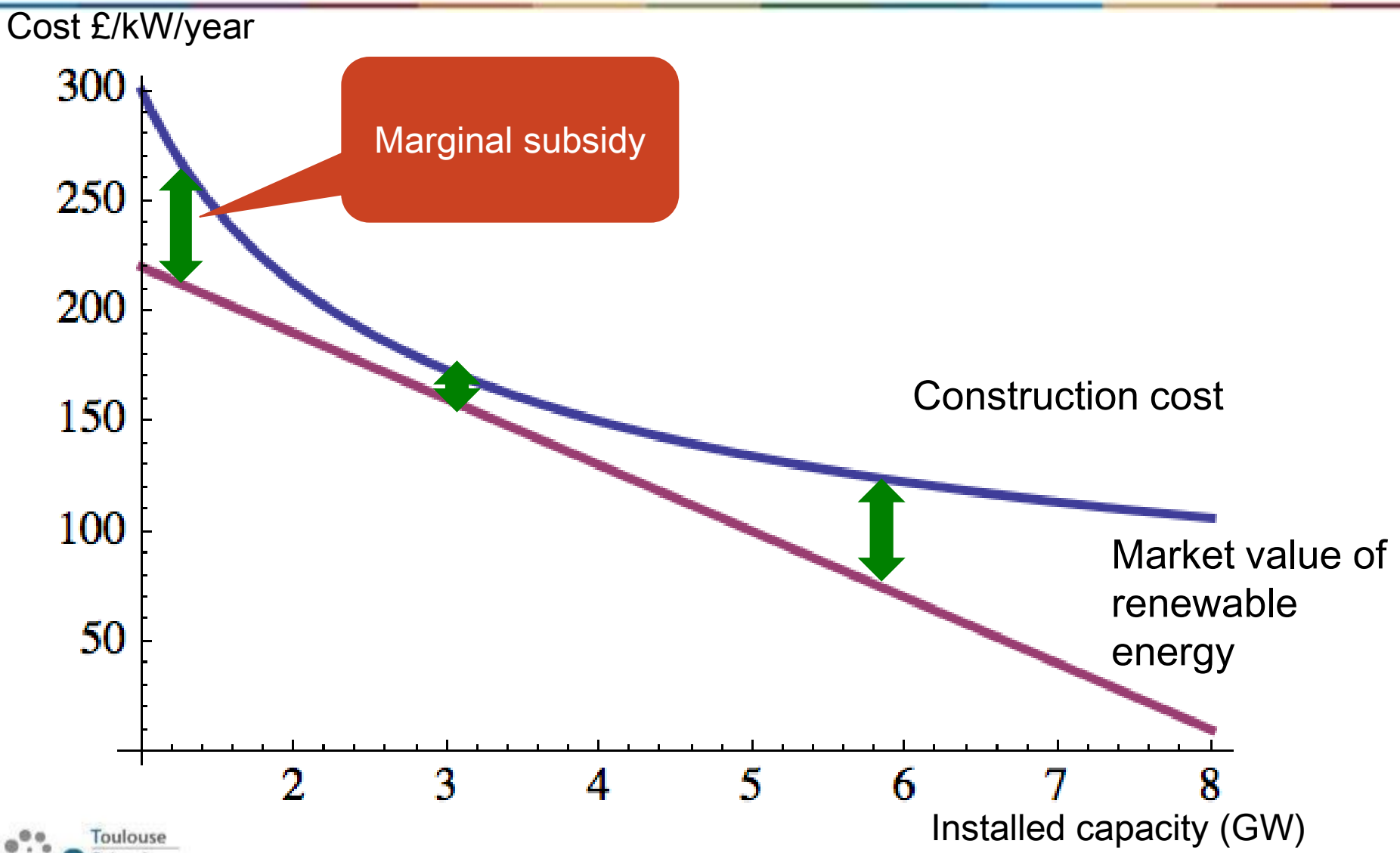
Price falls faster than the cost: marginal subsidy required



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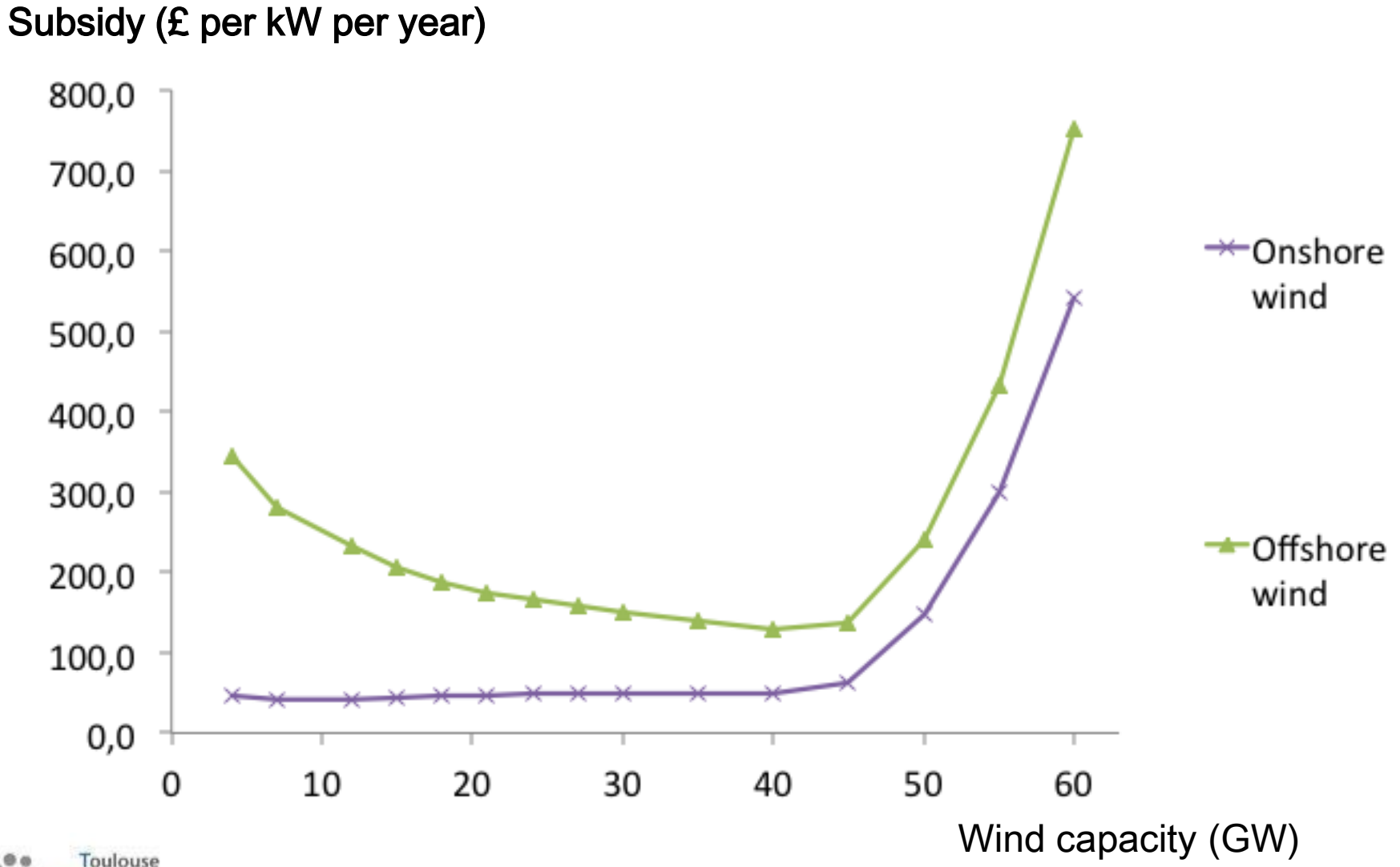
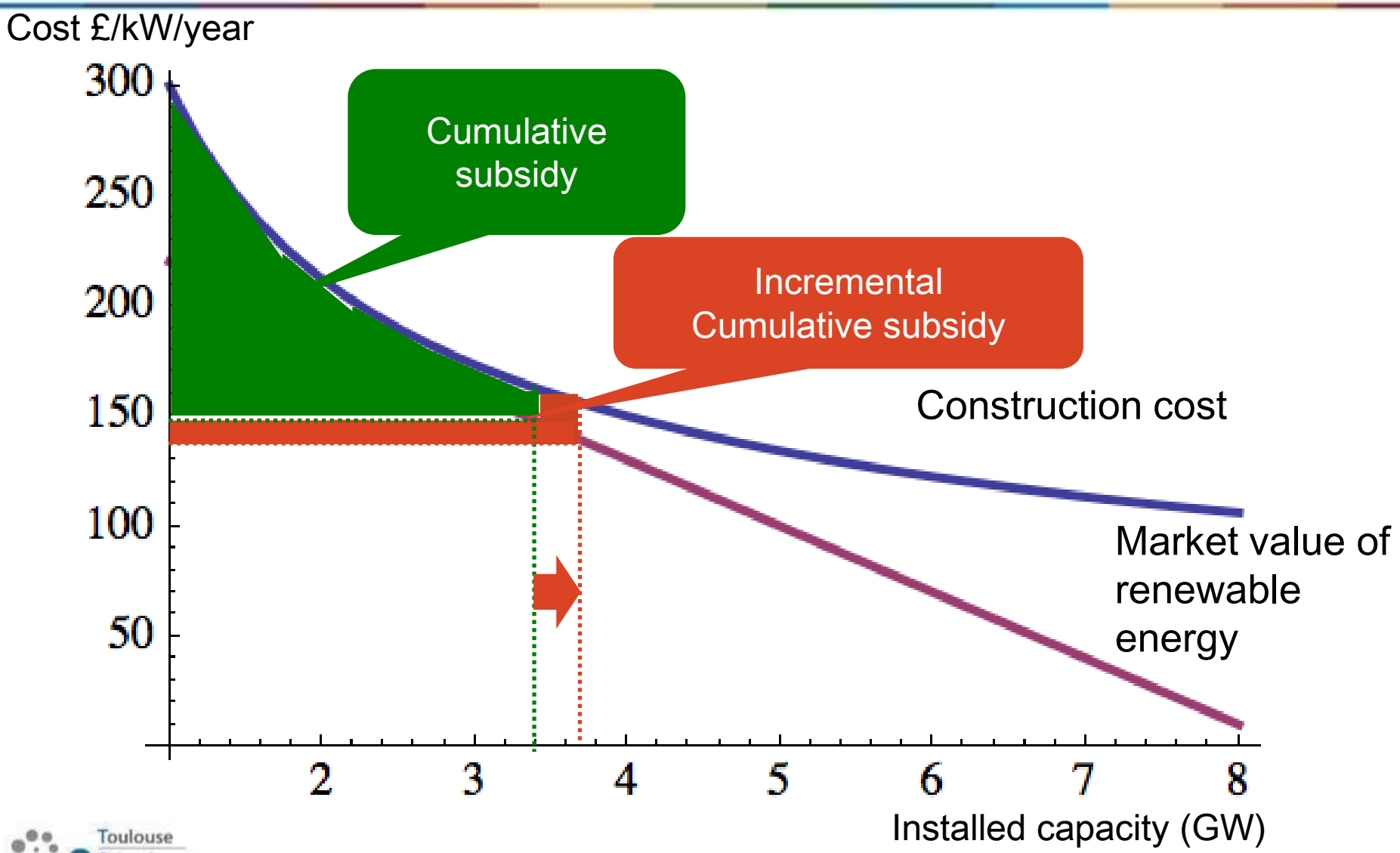
Marginal subsidy to wind turbines



Source: Green and Léautier, 2015

Evolution of cumulative subsidy



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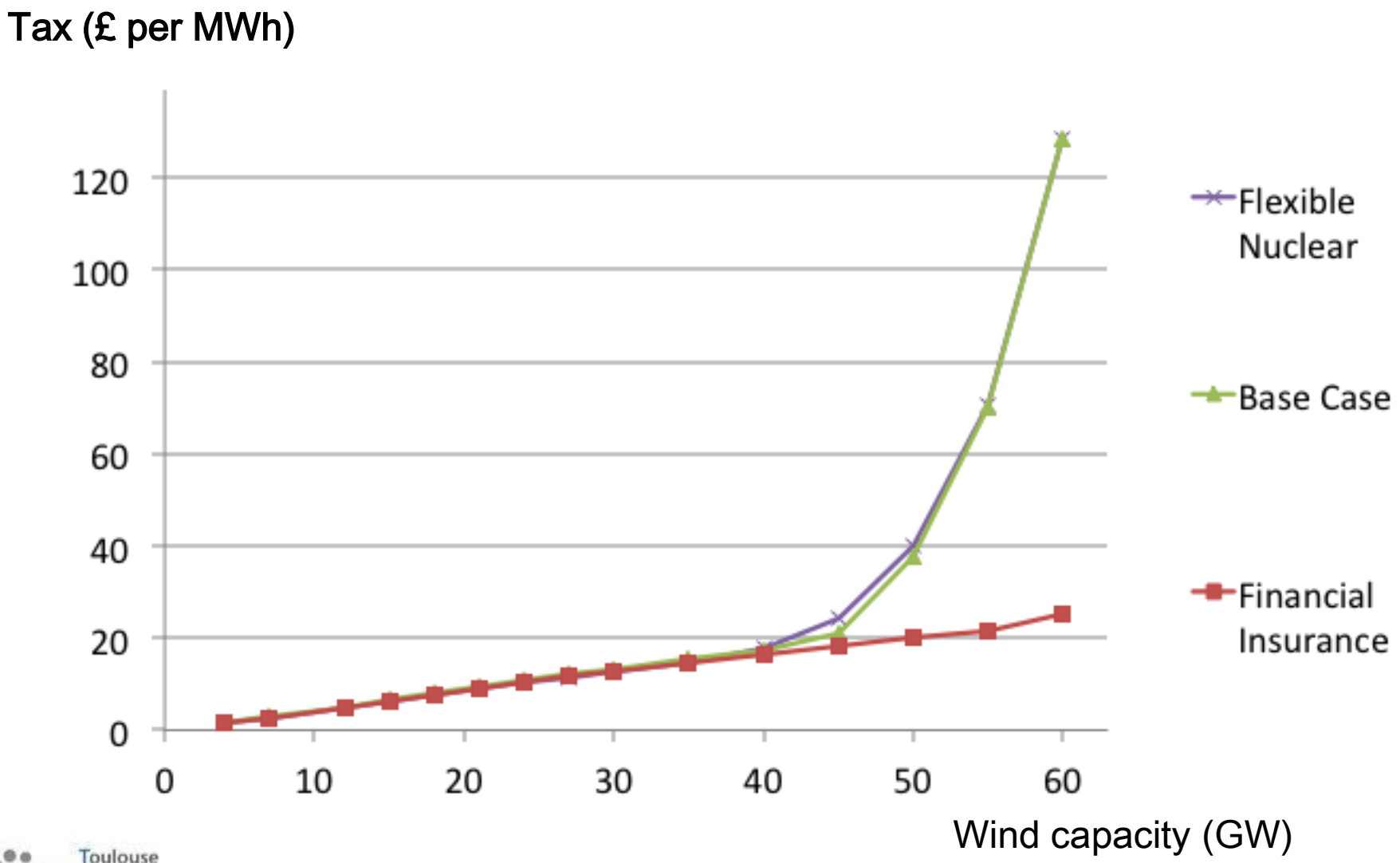
Evolution of the unit tax



Source: Green and Léautier, 2015