

ELECTRIFICATION EUROPE

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Solutions for a Decarbonized Society



Financing low carbon energy infrastructure

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Summary

- Action to mitigate climate change argues for higher investment and a **low discount rate**
 - Discount rates have been falling for three decades
 - Are now at an **all time low**
 - **Nuclear** is low-carbon but faces investment challenges
 - Lengthy **uncertain** construction time and cost
 - 40-60 yr life
 - **Political risk** of premature life curtailment
 - No nuclear plant built without Govt/Regulatory underwriting
 - The **RAB model** is well suited to support **large, long-lived low-carbon investment like nuclear**
- => Economic at low WACC with carbon credit/tax**

Low discount rates: the *Stern Review*

- UK all-party commitment to **net zero CO₂ by 2050**
- *Stern Review* “The costs of stabilising the climate are significant but manageable; **delay** would be dangerous and much **more costly**.”
Social discount rate is
$$\rho = \delta + \eta g,$$
- δ = pure time preference = 0.1%, g is per capita growth = 1.3%
- η rate at which marginal utility falls with consumption. Ethically $\eta = 1$
weights lives equally at different income levels
- => Consensus that **$\rho = 1.4\%$** for future climate **damage**
- HMG’s *Green Book* Appraisal Manual proposes low discounting for
long-lived investment projects, especially to **mitigate climate damage**

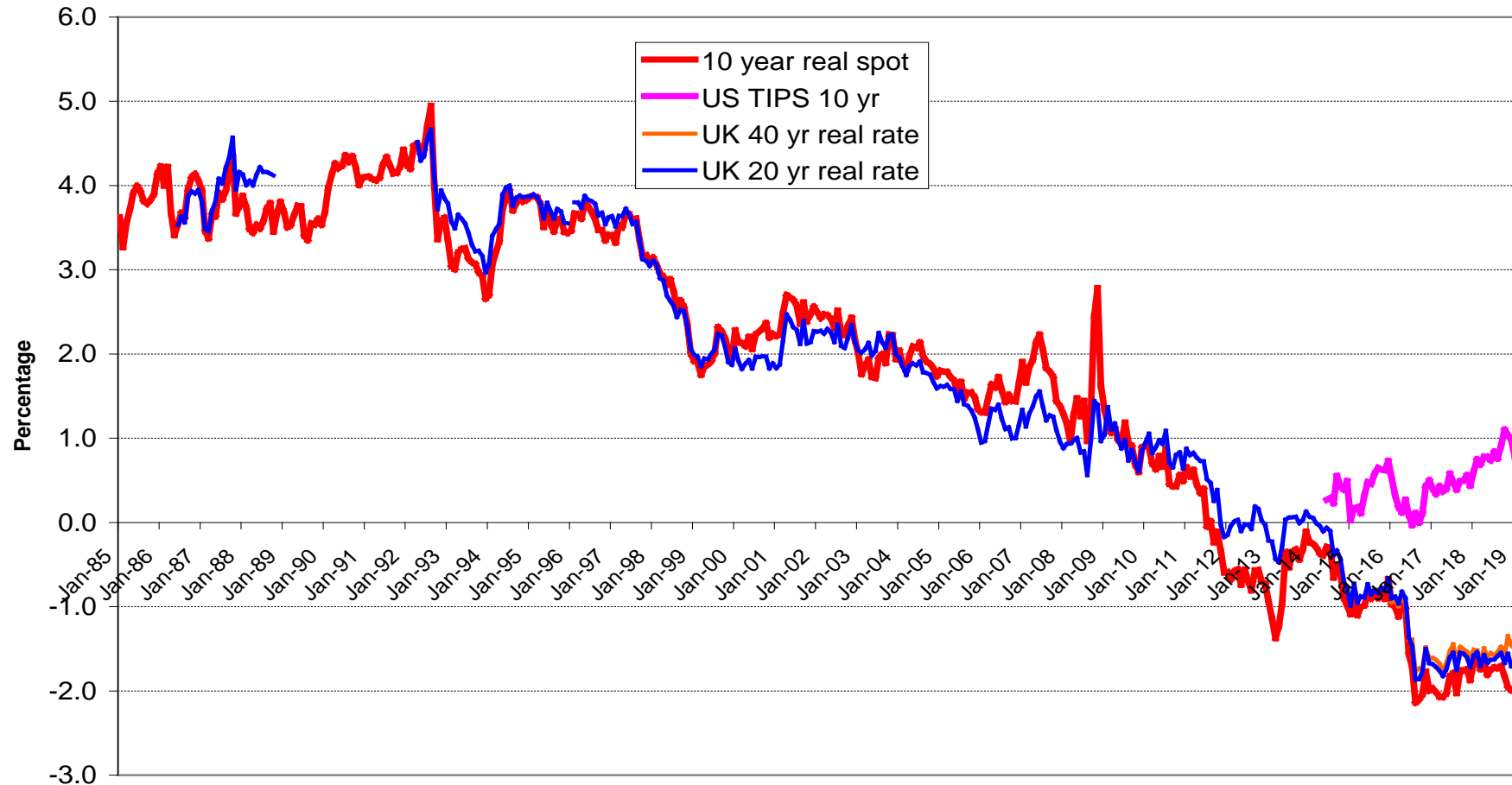
Macro case for increased investment

- **Zero carbon projects are capital-intensive** => high rates of investment needed to decarbonise
- Demography => savings glut => **real interest rates falling**
- **Cost** of public sector support for investment **very low**
- Monetary policy is weak, **fiscal stimulus** for public and private investment now **needed**

Need for zero carbon investment and potential supply of funds are aligned

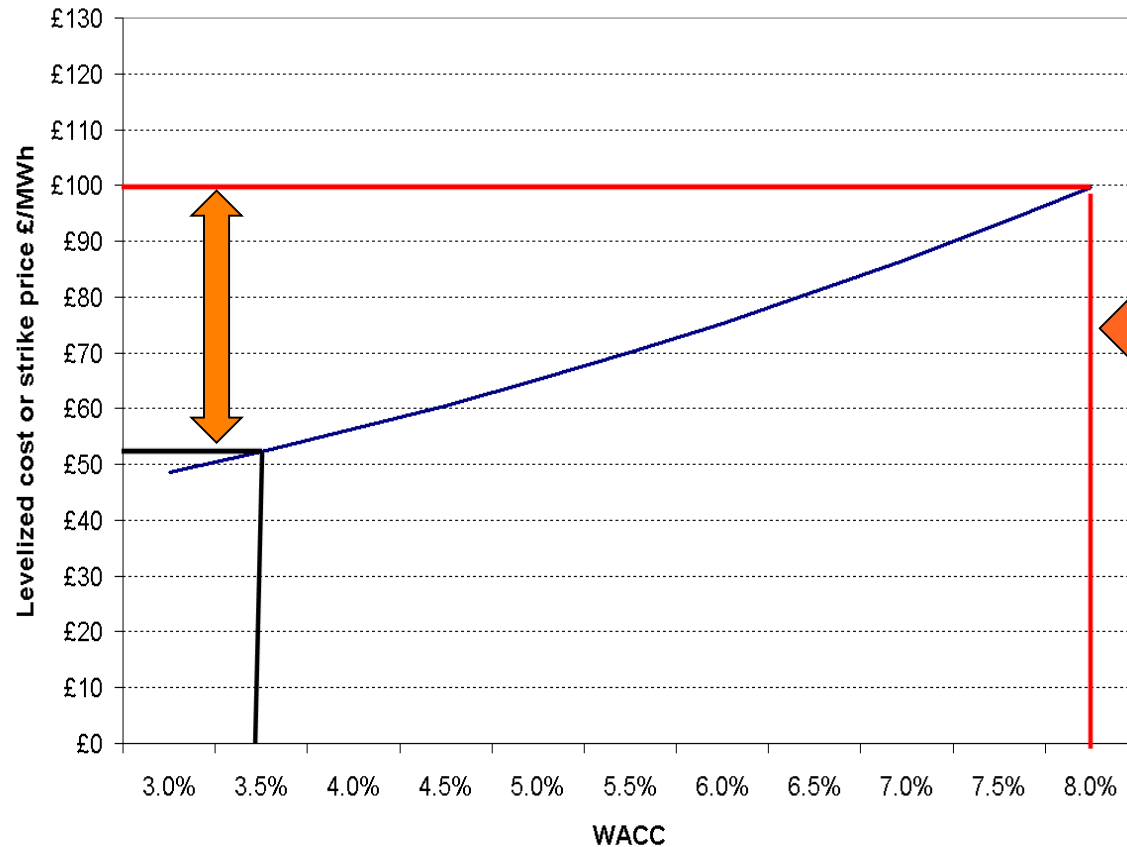
Real interest rates were falling before the financial crash

Real interest rates for UK indexed gilts and US TIPS



Problems of nuclear investment

A commercial rather than regulated WACC almost doubles the cost



Nuclear: lengthy uncertain construction period, high capital cost, low running cost, 60 years delivery of zero-carbon electricity, capital cost almost proportional to WACC

Private sector unwilling to finance lengthy uncertain projects at low WACC without credible guarantees and risk mitigation

RAB model for next nuclear station

- RAB = Regulated Asset Base
 - EdF agrees profile of investment I_t to commissioning with regulator
 - RAB_t at end of year $t = RAB_{t-1} + \text{agreed investment } I_t \text{ in } t$
- EdF engages in competitive book building to finance project at **WACC = r**
- Ofgem agrees WACC and pays EdF $r \times RAB_t$ **during construction**
- If costs exceed agreed amount, EDF pays 40% of excess, added to RAB, customers pay balance; if costs less, EdF benefits 40% via RAB
- **Cost over-run capped at 30%, excess refinanced and paid by consumers**
- On commissioning, Ofgem sets strike price for Contract-for-Difference for next 5 years, based on **$r \times RAB_t + \text{depreciation} = \text{RAB at commissioning/life}$**
- Periodic reviews reset strike price, revisits WACC

RAB model

- Low WACC requires **low risk and assurance of return**
- Benefits of placing risk on developer small, extra WACC cost high
=> lowest WACC consistent with incentive
- **Hybrid RAB model** (e.g. Thames Tideway Tunnel; **WACC = 2.5%**)
 - with excess cost sharing + cost cap can reduce risk and WACC
 - Access **infrastructure funds not requiring specialised knowledge**
- Payment on RAB during construction increases confidence,
reduces risk and WACC
- Limit risk of cost over-runs, provide fairly predictable long term return => **investment attractive to institutional investors** seeking “infrastructure-like” returns

Case for RAB financed nuclear power

- **RAB model proven** for National Grid, water, gas pipes
- **Spread risk** over all consumers reduces total risk cost, each would bear negligible risk
- Debt:equity 70:30 gives **WACC = 3.5% real**
- RAB interest on households about £4/yr during construction
 - Levelized price over the 60 year life could be as low as **£47/MWh** discounting at the **WACC of 3.5%** if built on time and budget.
- Worst case scenario - 8 yr delay, 30% cost over-run
 - levelized cost **£59/MWh** at the WACC of 3.5%
- The resulting electricity cost is less than all fossil and most renewable generation on a total system cost basis including carbon cost

Conclusion

- **Rapid decarbonisation consistent with macro needs**
 - Real interest falling, set to remain low
 - investment stimulus urgently needed
- **Capital intensive durable low-C investment can be financed by a **hybrid RAB model at low WACC****
- **not just nuclear, also CCS, BioEnergy with CCS**
- **Contract to **limit risk** of cost over-runs **lowers WACC****
- **Ensure **attractive to infrastructure/pension funds****