Issues in accessing enormous renewable resource in Ireland

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Resource in Ireland

Accessing Resource

Issues with Access

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Hywind (Statoil/Siemens)

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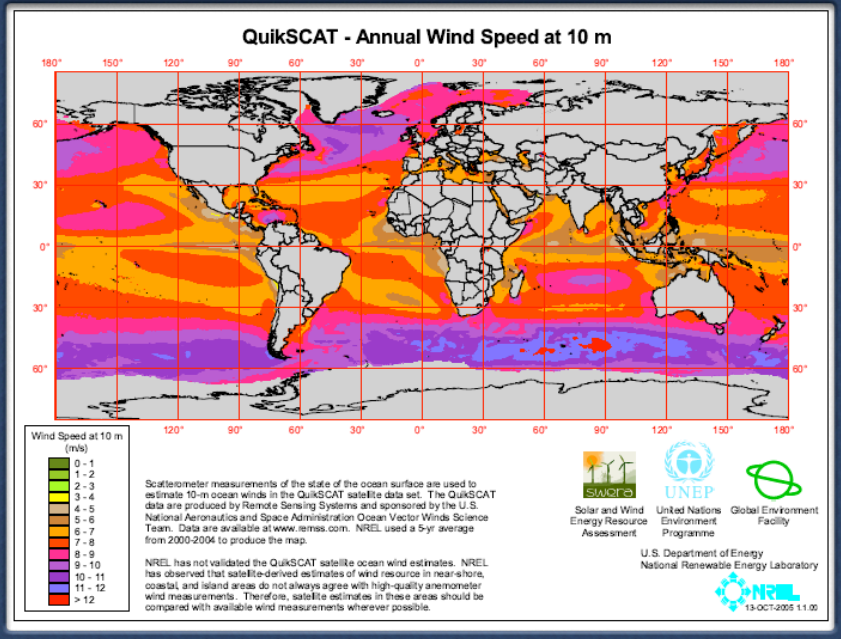
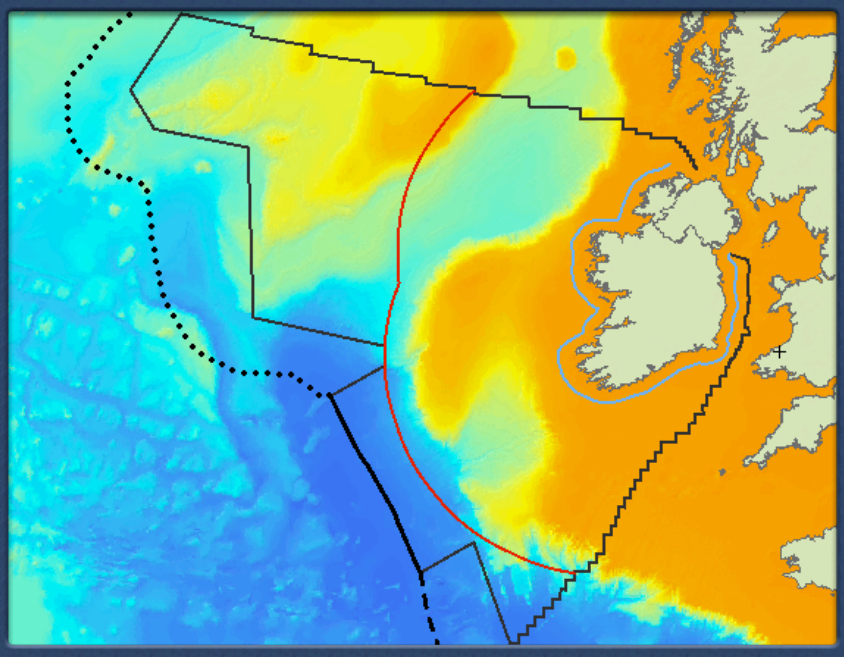
EUROSOLAR Turkey



Ireland's enormous wind resource

QuikSCAT Satellite data, presented by NREL (posted at www.retscreen.net)



Ireland's nautical territorial boundaries

www.dcenr.ie

Renewable resources

Estimate of Ireland's technical resource, electricity:

Onshore wind: 2,000 TWhrs/yr

Offshore wind, fixed/floating: 7,000 TWhrs/yr

Approximate demand:

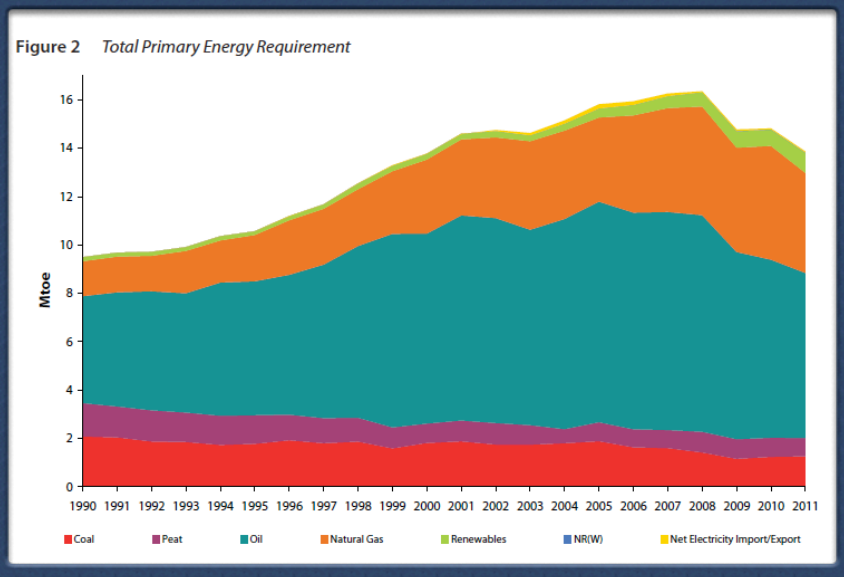
Ireland 25 TWhrs per year

UK 350 TWhrs per year

EU 3,000 TWhrs per year

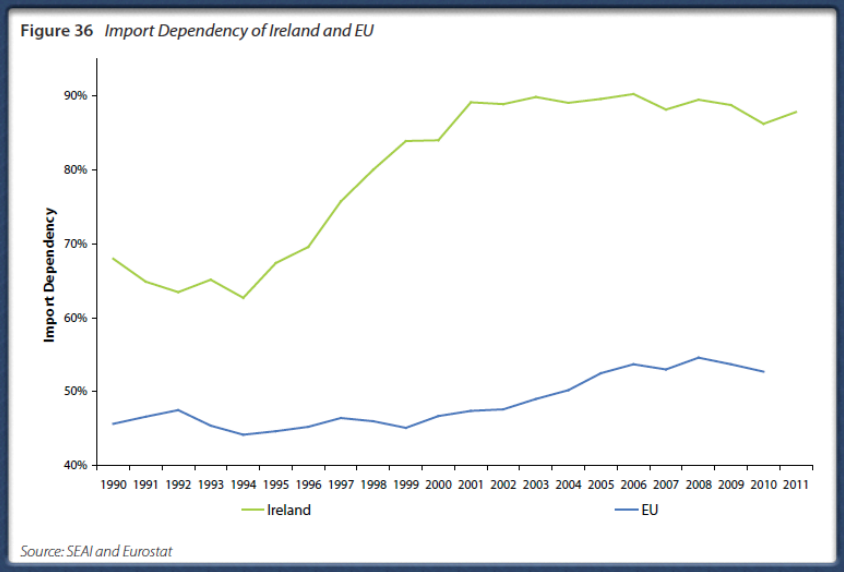
Historical trend in Ireland

- *First thermal power station 1947 (North Wall)*
- *Up to then virtually all electricity from hydro:*
  Ardnacrusha 86MW (1929-34)
  Liffey 38MW (1938)
- *High % energy in Ireland then from renewables (but limited data publicly available at present)*
- *Renewables only 6% of TPER in 2011*



Ireland TPER peak 2008: 16.4 Mtoe/190TWhr

data SEAI



Ireland/EU energy import dependency

SEAI/Eurostat

Inter Governmental Agreement

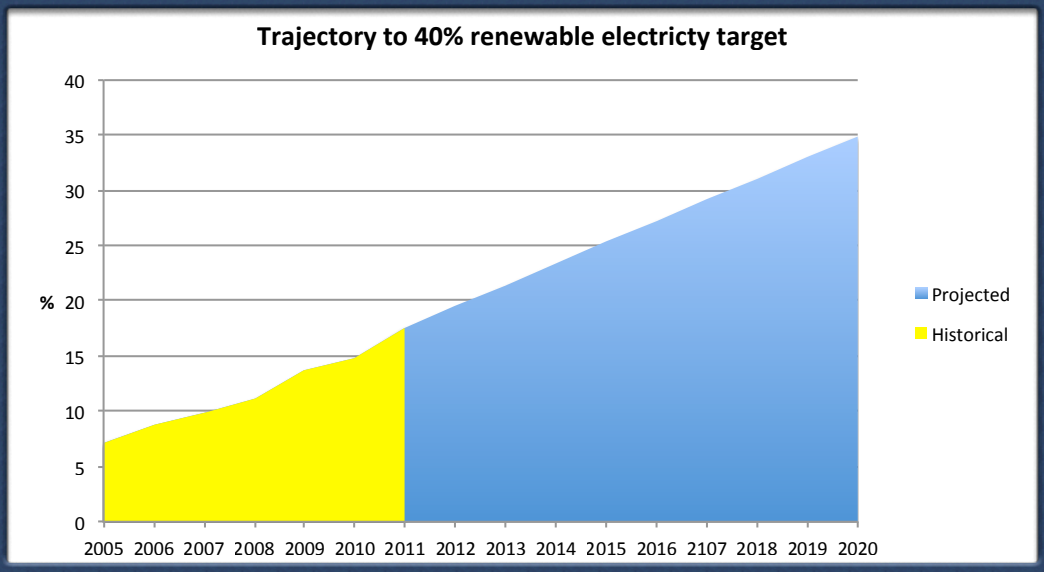
- *UK-Ireland MOU signed 24th January 2013*
- *IGA being negotiated for year end/early 2014*
- *Would enable trade between the countries under RE Directive*
- *Supports paid & credits claimed by the UK*
- *UK wants up to 10,000 MW by 2020*
- *Main issues are price and delivery by 2020*

Current development scale

- *Onshore connected: ~ 1,800 MW*
- *Onshore contracted: ~1,600 MW*
- *Offshore connected: 25 MW*
- *Onshore in development: ~ 10,000 MW*
- *Offshore consented: ~ 2,000 MW*
- *Offshore in development: ~ 5,000MW*
- *Potential output per year: ~ 60 TWhrs*

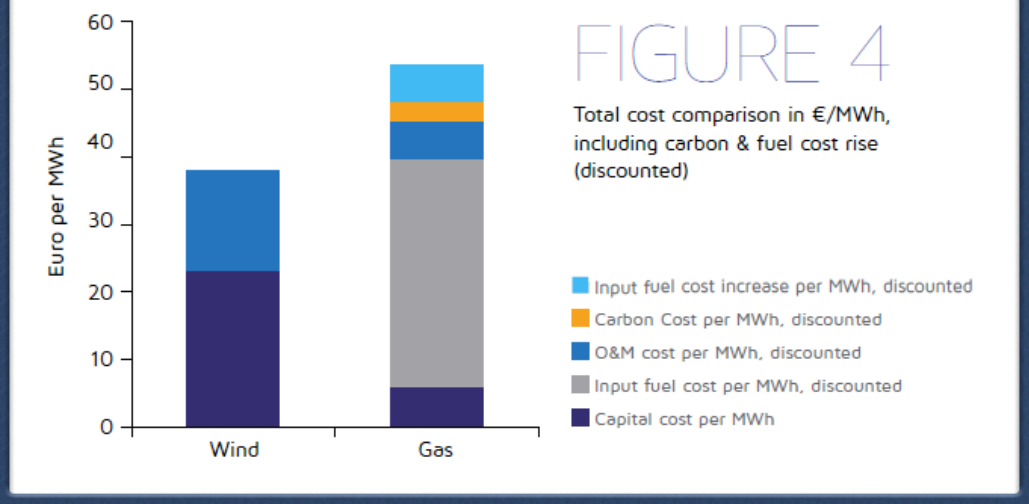
Ireland's own needs

- *Legally binding EU 2020 renewable targets:*
  16% primary energy, which means (NREAP):
  - 40% electricity
  - 12% heat
  - 10% transport
- *Estimated need 4-5,000 MW wind by 2020*
- *Must meet own target to allow exports*



Currently off trajectory for 2020 elec. target

(historical data SEAI)



Irish wind more economical than gas

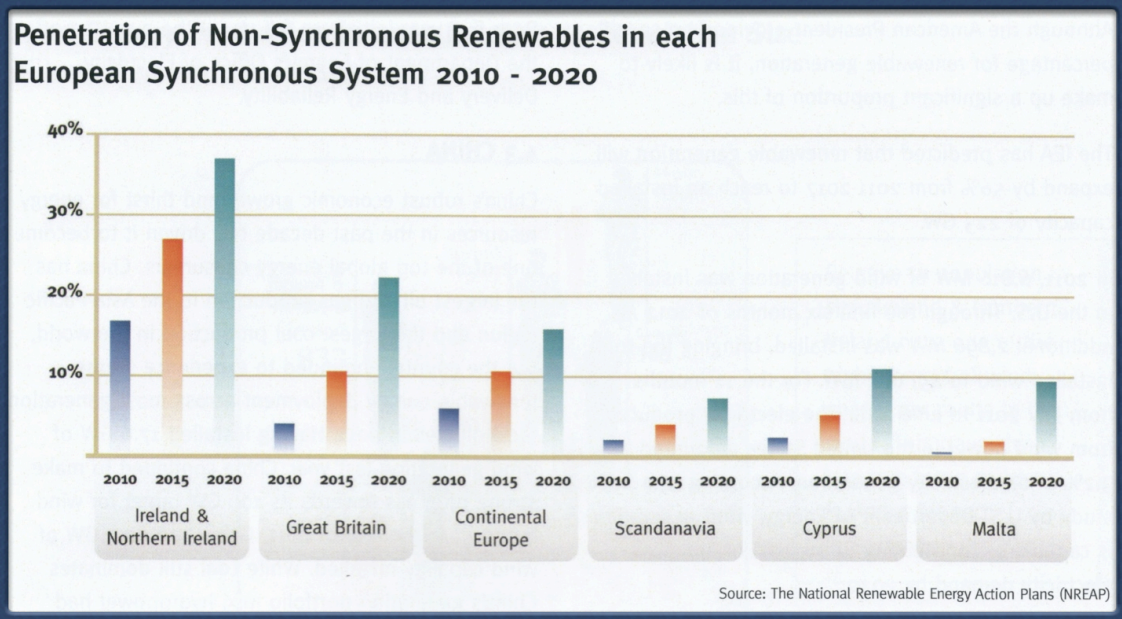
"Embedding Sustainability...", Meitheal na Gaoithe, 2013

Accessing Resource - Issues with Access

Island of Ireland relatively isolated electrically;
only two 500MW HVDC interconnectors

Operation of electrical system

- *RE electricity target 40% both North & South*
- *Implies instantaneous ~75% on all-island system*
- *Highest non-synchronous penetration in EU*
- *TSO considers this at limits of dynamic stability*
- *Requires a set of measures to enable 75% (DS3)*
- *Limit of 50% currently operating*
- *'MinGen' also imposing limit of around 40%*
- *Resulting in significant curtailment of free energy*



Eirgrid Annual Report 2012

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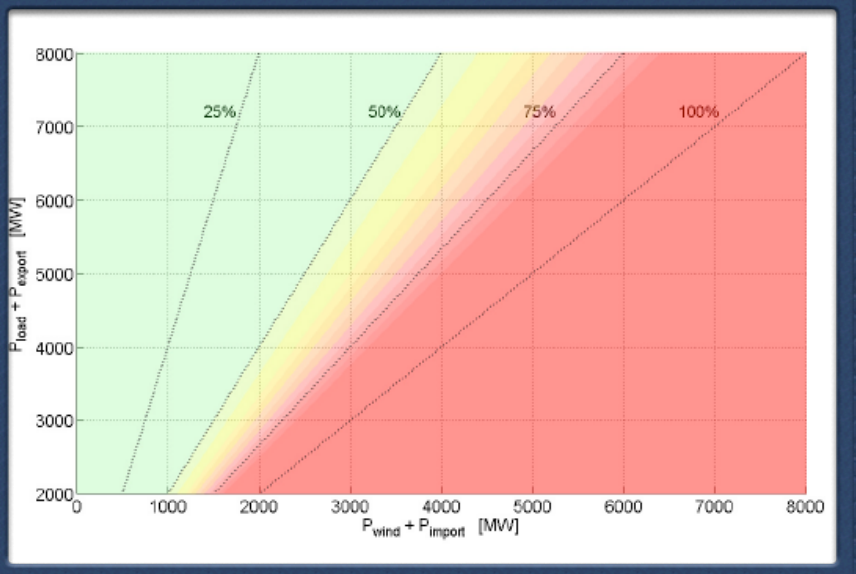


Limits to 'inertialess penetration' (or 'SNSP')

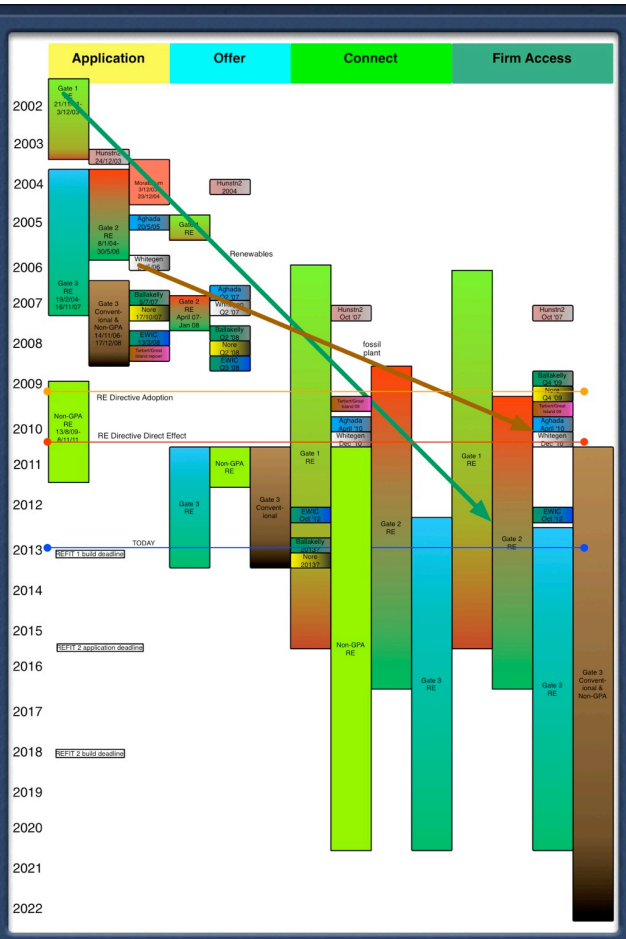
All-island Facilitation of Renewables Study, Eirgrid

Proposed network adaptations

- *Extended static and dynamic sources for reactive power;*
- *Uncompromised grid code compliance of the complete wind portfolio and all other generators throughout the whole lifetime;*
- *Replacement of ROCOF relays in distribution networks by alternative protection schemes or increased ROCOF relays threshold;*
- *Monitoring of short circuit levels and adjustment of network capacity, in particular in 110 kV networks;*
- *Evolution of power plant portfolio in line with the scenario, etc.*

Access to Electricity Network

- *Wind moratorium 2003/4*
- *Fossil plant in meantime - 4 year turnaround*
- *10-15, even 20 years for wind firm access*
- *Delay persists even after RE Directive*
- *Also large connection costs*



Grid access issues

- *'Interaction' led to Group processing & 'Gates'*
- *Exponential increase in processing complexity*
- *Delay (15-20yrs) exceeding planning horizon*
- *Grid first - reversal of usual development model*
- *Enormous grid queue, for uncertain projects*
- *New rules to cope with grid re-location, etc*
- *Increased risk and cost*
- *Need to limit time and adopt a 'German' model*

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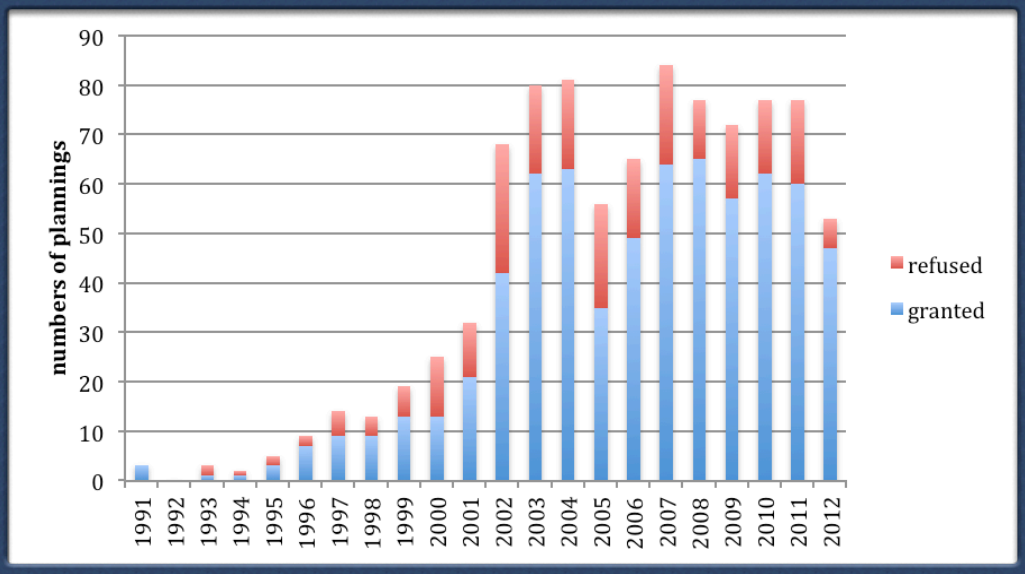
Table 1. Estimated risk & cost in 'forward' & 'backward' renewable development models

	Approx. probability	Approximate timing	Rough cost estimate
Backward development model			
Get into a Gate	50%	3 yrs	€7k + €20-80k
Get grid offer	100%	3-6 yrs	€300k/MW
Get planning	30%	1-5 yrs	€250k+
Get REFIT	50%	1-2 yrs	€0
Get Finance	70%	1-2 yrs	€100-200k
Overall	5%	15-20 yrs	€1 million +
Forward development model			
Get planning	30%	1-5 yrs	€250k+
Get grid offer	100%	0.5 yrs	€7k + €20-80k
Get grid	100%	3 yrs	€50k/MW
Get REFIT	100%	0 yrs	€0
Get finance	90%	1 yr	€100k
Overall	27%	5-8 yrs	€ half million

Forward & Backward model risks/costs

Legal issues for grid

- *Article 16 of 2009 RE Directive requires:*
  - *Priority dispatch*
  - *Guaranteed transmission*
  - *& either priority or guaranteed access*
- *Ireland elected for priority access (NREAP)*
- *SEMC delivered priority dispatch, ignoring cost*
- *But faster access for fossil due to 'security of supply'*
- *Uncompensated unquantified curtailment instead of adequate measures to avoid it*
- *Excuse is 'Safety & reliability' - wrong interpretation*



Other Obstacles

Number of successful consents declining - data SEAI

Support scheme (REFIT)

- *Offers 'secure income' by providing a floor price (not yet for solar, offshore wind or marine energies)*
- *But not paid on constrained or curtailed output*
- *Undermines whole purpose of support scheme*
- *Grid connections paid by project, but owned by grid*
- *Can be over 30% of CAPEX, undermine REFIT*
- *Both approaches economically inefficient*
- *Periods when no REFIT available at all*

Table 2. Estimated effect of paying for constraint & grid, using author's proprietary financial model

10MW project; constant 20 year Equity IRR	Units	Existing model	Constraint & Curtailment paid at REFIT	Underground Cable Connection paid	Both
REFIT start price (unadjusted)	€c/kWhr	6.808	6.808	6.808	6.808
REFIT start price (adjusted)	€c/kWhr	6.808	6.121	5.794	5.224
CAPEX	€m	14.35	14.35	11.74	11.74
Annualised interest rate (4 loan payments/yr)	%	6.00%	5.50%	6.00%	5.50%
Gearing	%	80.00%	85.00%	80.00%	85.00%
Unpaid constraint & curtailment	%	6-9%	0	6-9%	0
Average annual paid production	MWhr/yr	26,961	29,290	26,961	29,290
20 yr Equity IRR (unadjusted)	%	10.61	16.88	19.53	29.63
20 year Equity IRR (adjusted)	%	10.61	10.61	10.61	10.61
PSO cost (incl. 0.5c balancing; SMP at 5.8c)	€/yr	406,580	240,472	133,190	0
Connection cost to consumer, financed ESB at 4% over 50 yrs	€/yr	0	0	121435	121435
Consumer cost, PSO + connect.	€/yr	406580	240472	254625	121435

Current approach to support is economically inefficient

Conclusions

- *Ireland has a truly enormous renewable energy resource*
- *But difficulty with 2020 targets, and can't go beyond*
- *Without solution to achieve targets, not able to export*
- *Isolated grid a problem for large volumes variable RE*
- *Ireland identifying significant issues before many others*
- *High risk and cost with backward development model*
- *No possibility of '100% Renewables' with this approach*
- *Significant AC interconnection NI-Scotland a solution*

Conclusions

- *Huge connection delays and costs a significant problem*
- *Uncompensated curtailment a major problem*
- *Approach highly economically inefficient*
- *More economically efficient for:*
  grid owner to fund grid connections
  supports to be paid on available output
  connections to have time limits, employ forward model
- *Legally required to take measures to enable renewables*
- *Need all these changes to approach '100% Renewables'*

Thank you - Teşekkur ederim

full colour paper and presentation at: www.ierne.ie