

Burning Peat in Ireland: An Electricity Market Dispatch Perspective

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- Background & Introduction
 - Why peat generation?
 - Current role in market
- Motivation
 - Examine under 3 pillars of energy policy
(Competitiveness, Security of Supply, Environmental)
- Methodology
- Results & Conclusions

- Peat: Sub-category of brown coal
- Ireland is one of few countries using peat to generate electricity
- Provides labour and price/ physical security (very high import dependency)
- Generating by peat illustrates a number of aspects of energy policy
- Three pillars: Security of supply, competitiveness, environmental impact

- Public support due to security, which impacts societal cost
- Considers the societal perspective using economic dispatch tools
- Current method of operation may not be optimal from societal cost (economic/ environmental)
- Also, might not be most profitable for peat plants

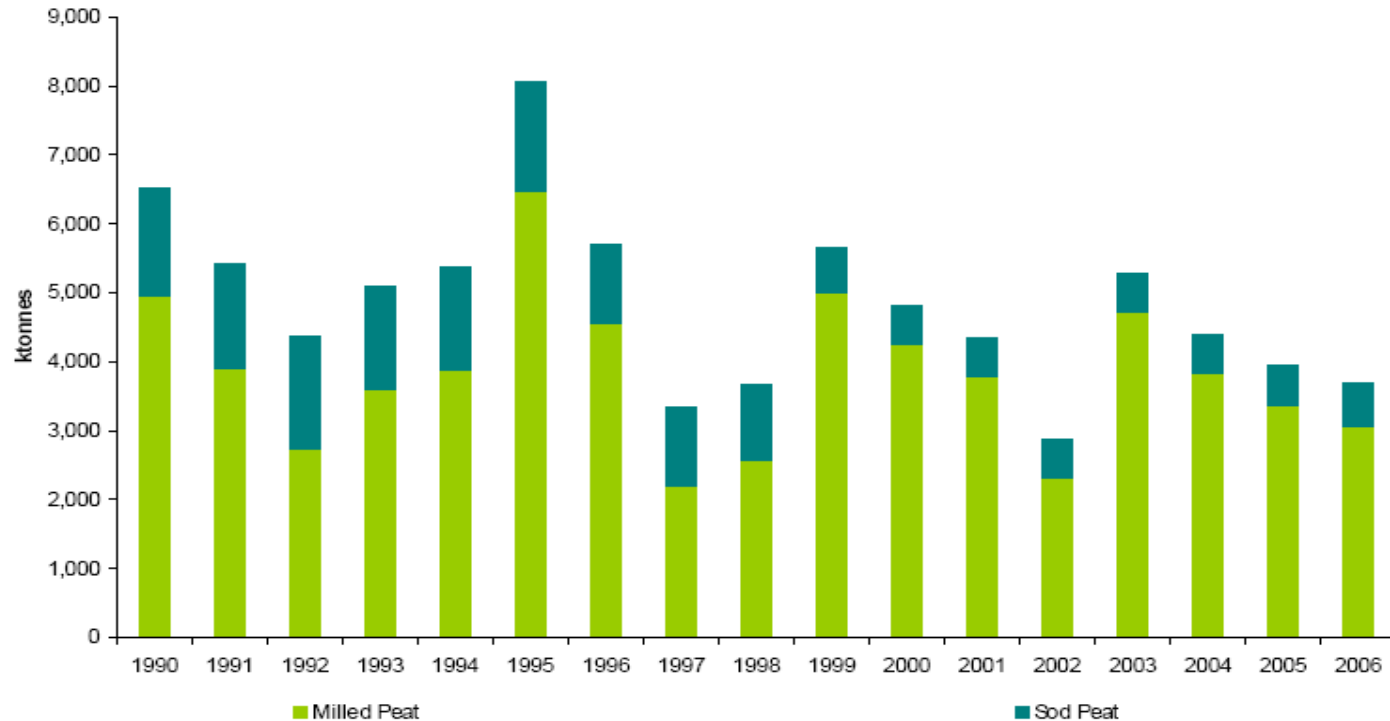
Peat Resources

- Peatland – mainly in temperate zones
- Peatlands cover 16.2% of Ireland
- 4th largest percentage in the world¹
- Peat production ~4Mt per annum² (Second in the world)
- Bord na Móna – produces all peat used for electricity (~3Mt per annum)
- Resource of ~90Mt (70Mt Bord na Móna)

¹World Energy Council, 2001, Survey of Energy Resources

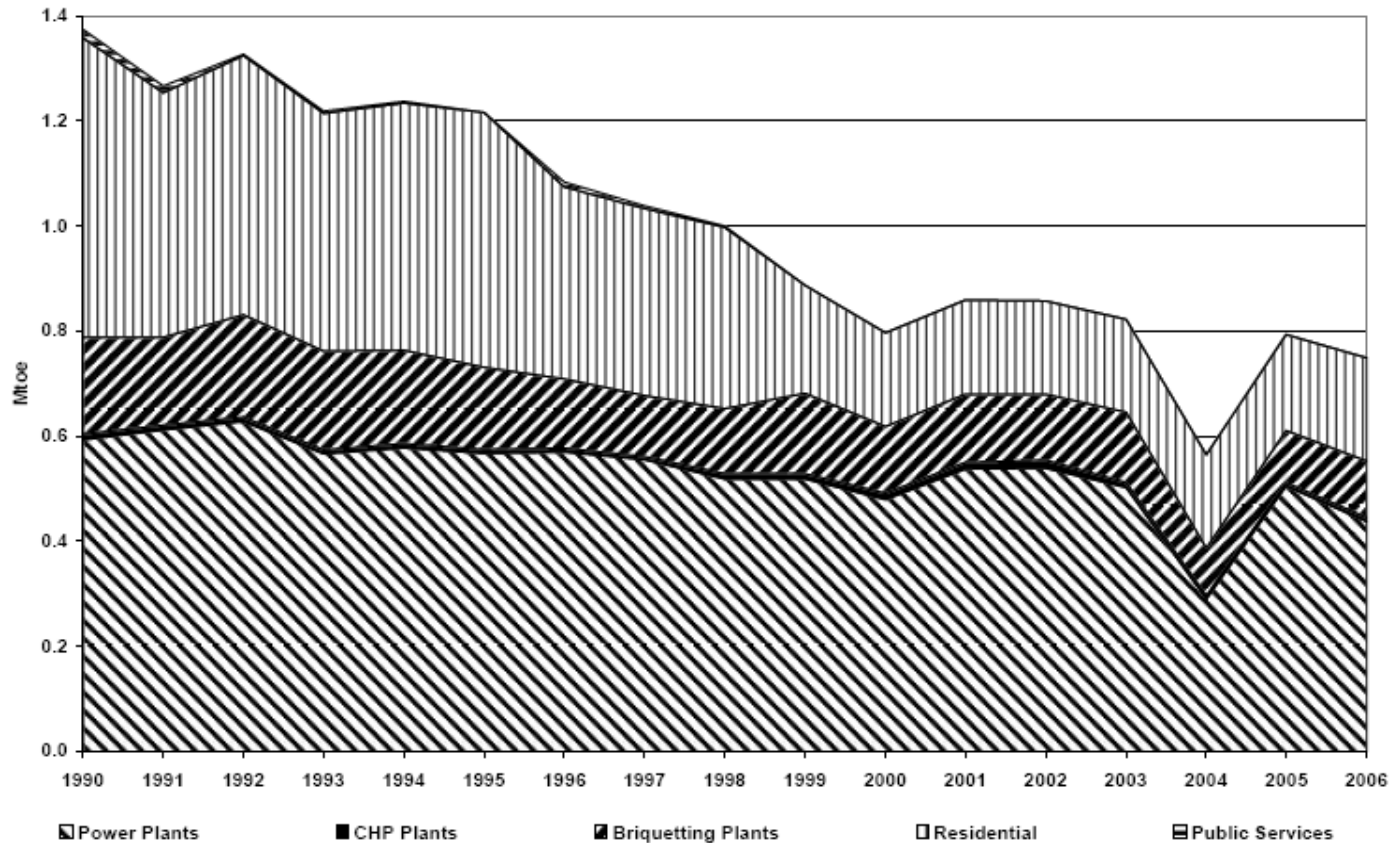
²IEA 2007 *Coal Information*. Published by the International Energy Agency

Peat Production



□ Milled peat used for electric, sod peat for private use (sod has higher calorific value)

Peat in the Irish energy market



Decline in sod use – big decline in energy (central heating increase)

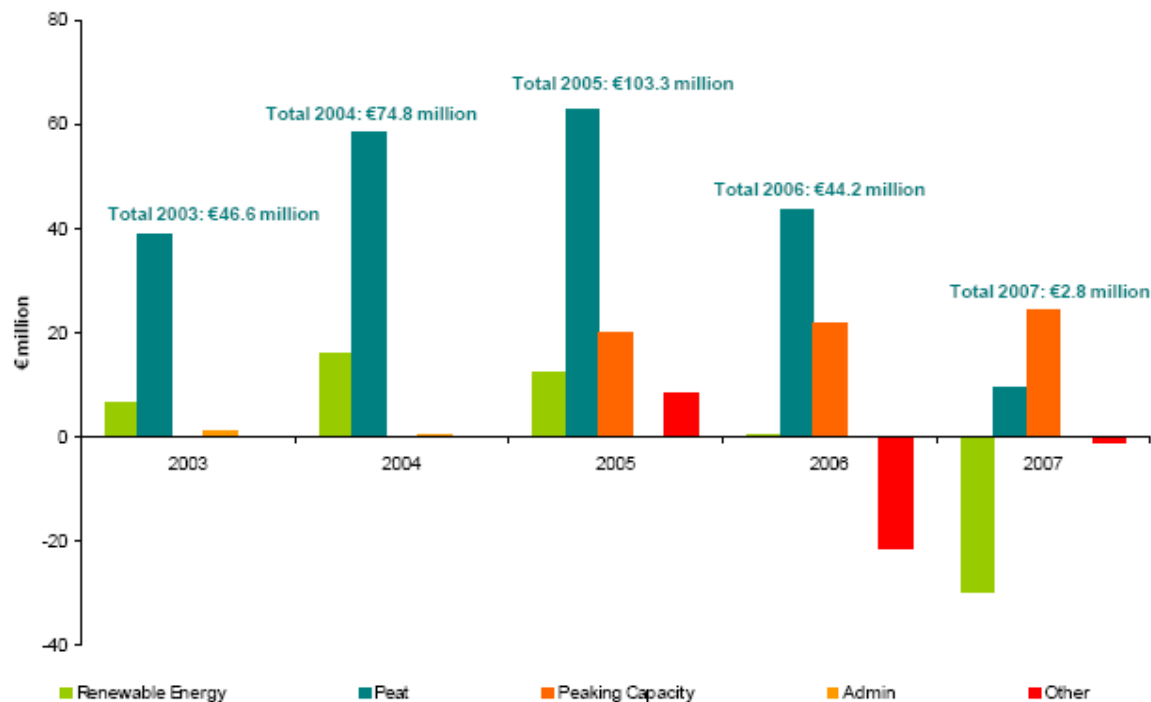
Peat-fired electricity generation

- First established by ESB (then national utility) in 1958
- Gave employment – not as important with near full employment
- 3 'new' peat plants in past decade
- Operate as base loaded (must run) due to Public Service Obligation (PSO)
- Peat purchase agreements in place for 15 years (3Mt /annum - emitting 2.6Mt CO₂)

Public Service Obligation

- Requires Public Electricity Supplier (ESB PES) to purchase from renewables, peat
- Order issued by government to regulator
 - Aims to ensure Ireland has reasonable self-sufficiency in capacity (peat)
 - Protect the environment (renewables)
- Regulator determines amount by comparing cost to Best New Entrant (costs over this are covered by PSO)

Public Service Obligation



2008 – PSO is ~€0, but €47m increase due to 2 of the peat stations (third station is more efficient and had EU grant)

Emissions from Peat Generation

- No consensus on life-cycle emissions
- Bogs can be re-used (i.e. tree planting)
- Co-Firing with biomass – licenses granted, more possible (up to 30%)
- Could be Meat & Bone Meal, Wood Residue
- Carbon Sequestration – not realistic currently, but with carbon prices high, may become more attractive
- $1090\text{gCO}_2/\text{kWh}$ to $227\text{gCO}_2/\text{kWh}$ (cost 5-6c/kWh)

Motivation behind work

- Is the PSO on peat costing society? How much? What are alternatives?
- PSO seems a contradiction
 - On one hand, encouraging reduction of CO₂
 - On the other, using dirty fuel
- How would peat be operated otherwise?
- Would peat plants be better themselves?
- Not examining shutting down stations as they are already there – i.e. only short term costs considered

- Using Plexos modelling tool
 - Full unit commitment- meet expected demand at lowest cost maintaining security over next 24 hours
 - Min and max load, heat rate, minimum up and down times, start up costs & times, ramping rates, reserve etc, scheduled outages considered
- Wind and load estimates for 2008 (wind assumed higher than actual installed)
- 3 Peat Units – 343MW (max load ~7GW)
- Peak provides 6.6% of approx 40Twh demand if must run

Note: Work done in 2007/2008 using then-current data (will be different in current economy)

Irish system examined

- Approx 10GW total installed
 - 7782MW conventional
 - 1980MW wind assumed (clearly high for 2008)
 - 508MW hydro + pumped storage
 - Price on 500MW interconnector to Great Britain by crude 'blocked' model of GB
 - Wind significantly higher – 500MW more than current installed wind – but no increase in demand in last 18 months – will affect results but not significantly

Scenarios examined

- 2 main scenarios
 - 'Must-run' – peat always at full load when available (approx 85% cap factor)
 - 'Dispatched' – Normal economic dispatch considered – cheapest units first, then next cheapest, considering temporal/reserve constraints
- Sensitivities around carbon cost (base case - €21/t, also €0/t and €50/t)
- Co-firing considered – 30% with MBM (0 c/kWh) for all 3 plants

Fuel price assumptions

- Other fuel prices taken from all-island modelling project – gas prices given monthly

Fuel	Price (€/GJ)	CO ₂ content (t/GJ)
Coal	2.2	0.0946
Distillate	11.08	0.0741
Heavy fuel oil	5.35	0.0774
Gas	5.82	0.0561
Peat	3.4	0.106

- Centrally committed market – similar SEM (without uplift- also doesn't consider capital costs / capacity payments)

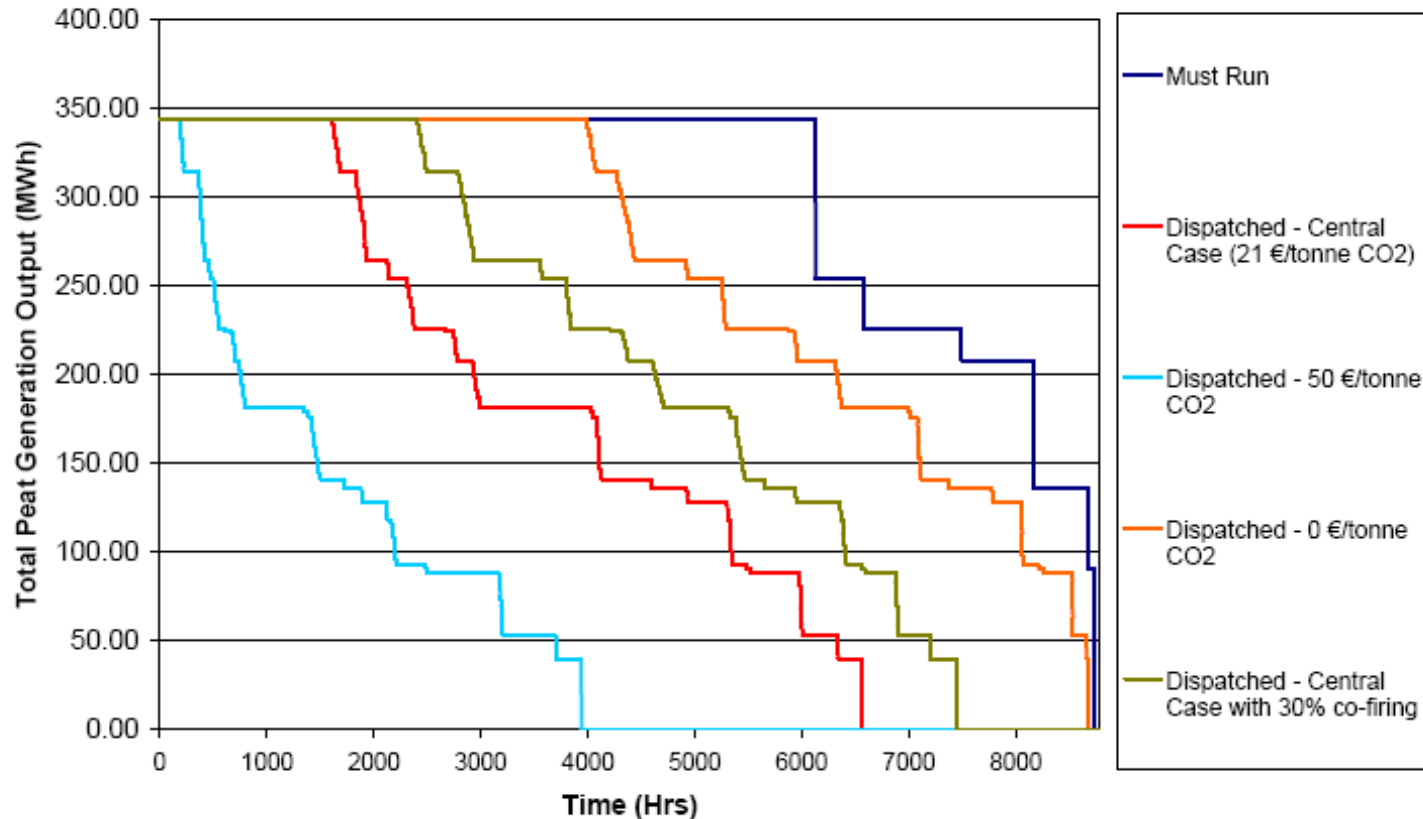
Social Economics

Scenario	Mode of operation	Energy produced by peat (GWh)	Change in overall system cost if peat is economically dispatched (€M)	
Central case (21€/tonne CO ₂)	Must run	2638	-20.6	Total ~€1.6B
	Dispatched	1352		
50€/tonne CO ₂	Must run	2638	-57.8	
	Dispatched	564		
0€/tonne CO ₂	Must run	2638	-4.4	
	Dispatched	2273		
Central case (21€/tonne CO ₂) with 30% Co-firing using meat and bone meal	Must run	2638	-25.9	
	Dispatched	1741		

Only short run costs – peat nearly always makes profit here

As price of CO₂ increases, benefit in overall cost increases

Social Economics ctd



Carbon cost has greatest impact

Co-firing increases use

Peat generation economics

Scenario		Total Peat Generation Costs (€M)	Reduction in Costs if Dispatched (€M)	Change in Energy Market Short Run Profit if Dispatched (€M)
Central Case (21 €/tonne CO ₂)	Must -Run	144.7		
	Dispatched	77.4	67.2	2.0
50 €/tonne CO ₂	Must -Run	223.4		
	Dispatched	54.1	169.3	8.8
0 €/tonne CO ₂	Must -Run	87.8		
	Dispatched	76.8	49.1	0.5
Central Case with 30% Co-firing	Must -Run	138.3		
	Dispatched	89.1	11.1	5.4

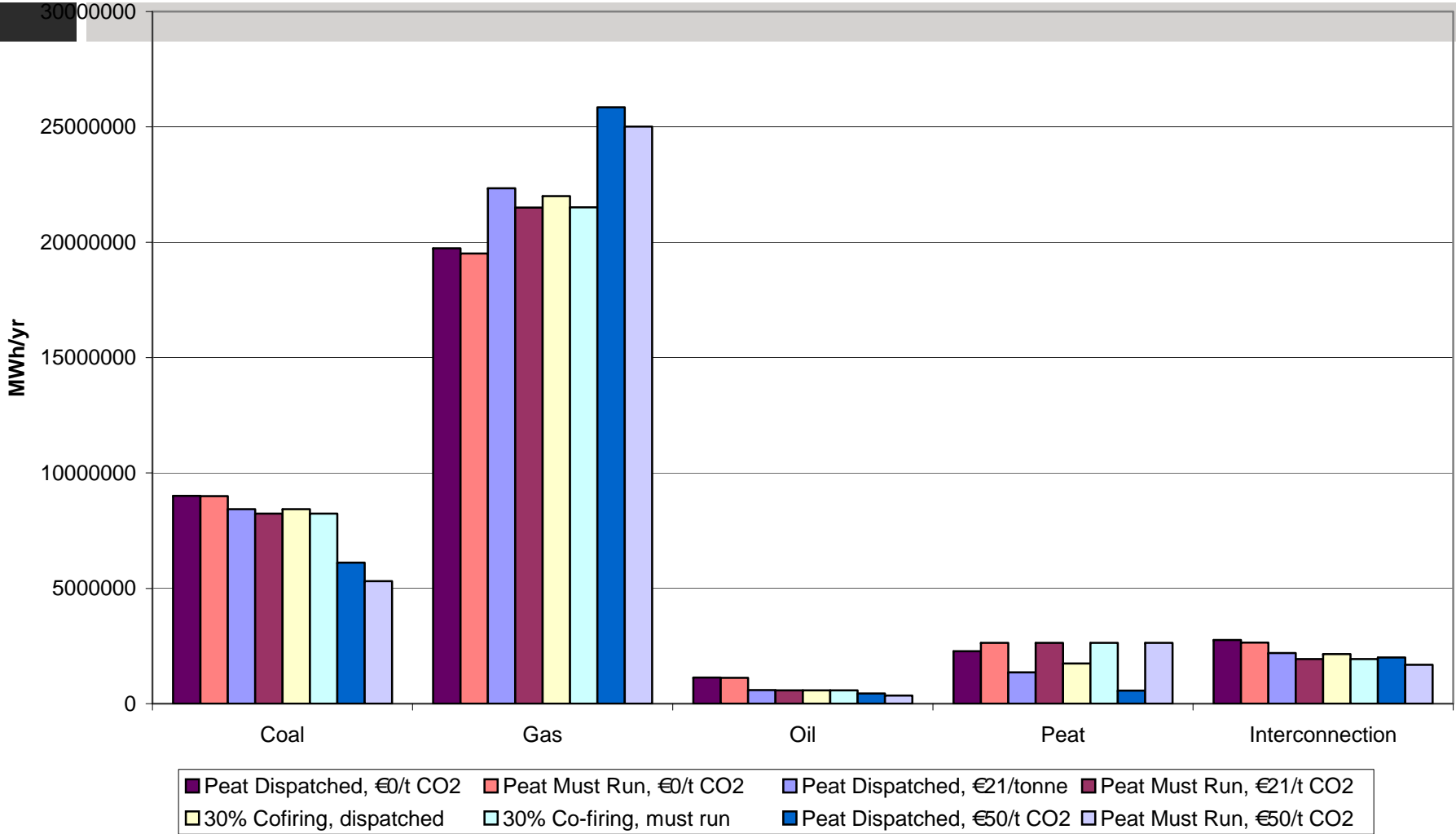
- Dispatched mode increases profit – as now, peat is price maker and is turned on at optimal times

Peat generation economics

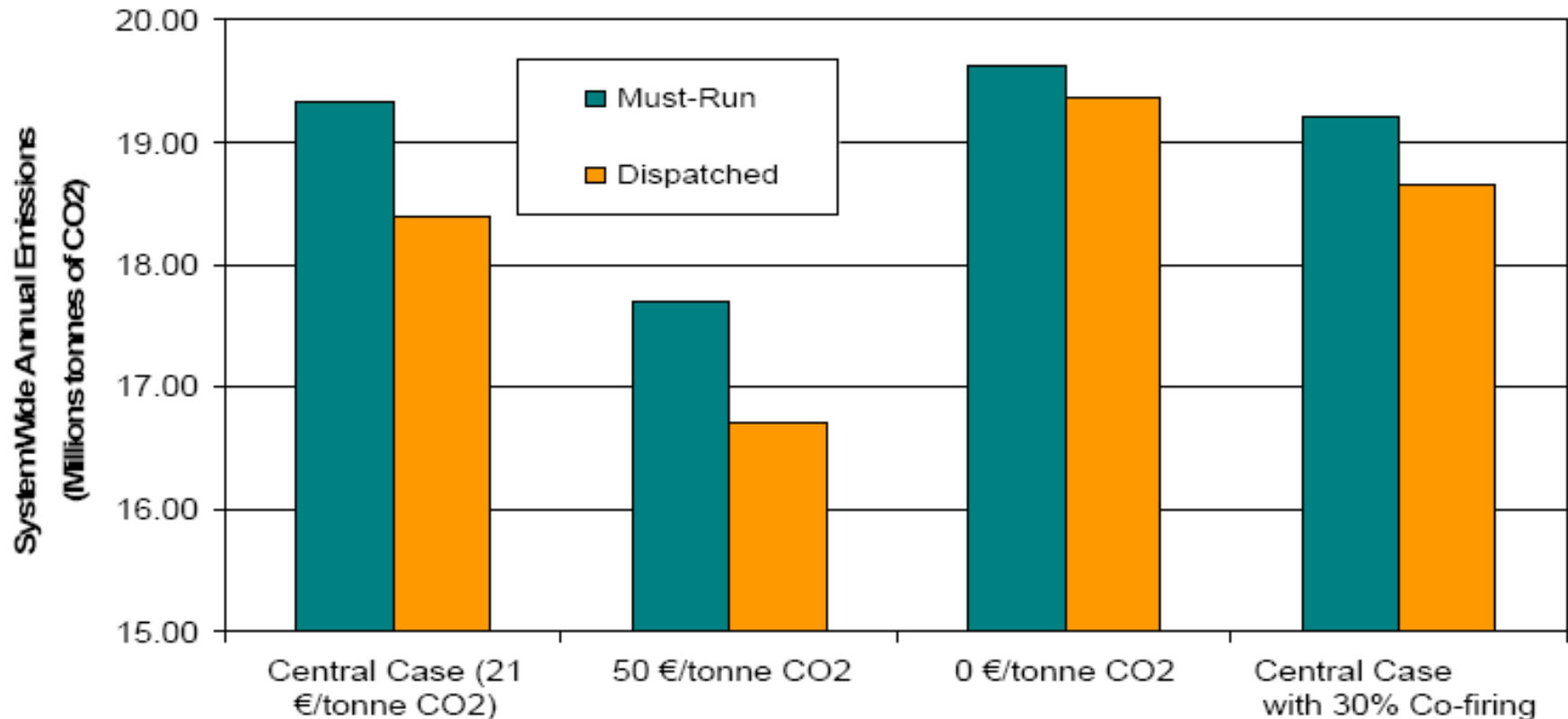
- Reduces costs by €67m, increases market profit by €2m – in context of €60m support scheme (based on these prices)
- €9m additional profit compared to profit under PSO – does not take into account grandfathering of CO₂ permits
- Shadow price of electricity reduce by €1.51/MWh
 - Reduced to €65.37
 - Approximately €60m reduction in fuel bill

Effect on system

Fuel Use for Change in Carbon Cost and Peat Operation



Environmental Impact



5% reduction in €21/t case

Effect on CO₂

- CO₂ reduction has to take into account substitute generation – often coal in low CO₂ cases – affects dispatch of other plant also
- Operational change equivalent to 600MW of wind capacity (0.32 cap factor, average emission 0.55tCO₂/MWh)

Cost of CO ₂ (€/tonne)	Additional tonnes of CO ₂ due to PSO	Cost of additional CO ₂ due to PSO (€)
21	926,434	19,455,119
0	259,671	0
50	989,309	49,465,464
21 (w/co-firing)	553,597	11,625,539

Security of supply

- Ireland remote from centres of supply and at end of long gas pipeline
- 343MW won't prevent blackout but can be used in times of emergency
- Diversifies fuel portfolio, less correlation
- Can be seen as providing cap on price of 343MW of base load, while giving physical security even when dispatched economically – still used when economically dispatched so not shut down

	Gas	Coal	Oil	Peat
Gas	1	0.3	0.75	0.39
Coal	0.3	1	0.28	0.14
Oil	0.75	0.28	1	0.07
Peat	0.39	0.14	0.07	1

Conclusions

- 5% reduction in emissions – further possible but might not be optimal
- May have employment implications
- May need changes to contractual and support mechanisms (fuel contracts, carbon credit allocation and PSO)
- Clear societal benefit of €21m per annum (based on 2007/8 prevailing data)
 - No reason why dispatched mode of operation can't be used while still recovering fixed and capital costs – taking into account carbon allocation

Thanks for your attention

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- The views expressed in this work are strictly the authors personal views and do not represent the views of their employers.

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