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Natural gas in UK and Scottish energy policy



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REPORT

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Introduction

This paper considers the current and future role of natural gas in the UK and Scottish energy mix. The aim is to identify and highlight fundamental perspectives that must be considered in designing energy policy going forward. The paper considers the current energy mix and the role and presence of gas alongside other energy sources, both renewable and non-renewable. It then sets the discussion in the context of natural gas production in the UK before discussing the role of gas in the energy costs faced by consumers, with particular attention to the important policy concern of fuel poverty.

Attention then moves to climate policy as a second key policy concern, but one where the impact of gas production and use in Scotland and the UK must be set in a global context.

The paper concludes that gas must continue to play an important role in the energy mix of Scotland and the UK, with a potential continued role in the context of 'game changers' such as hydrogen and Carbon Capture and Storage (CCS). The main question is then whether the gas we use should be produced at home or abroad.

I The energy mix today

UK and Scotland's energy serves three main purposes: heating, transport and the production of electricity. In 2015, the UK split was;

Table 1: UK division of energy, by purpose 2015 (1)

	Thousand tonnes of oil equivalent	Percentage
Transport	54,810	41.3%
Heating	58,801	44.3%
Electricity (excl. heat)	17,454	13.2%
Other	1,548	1.2%
Total	132,613	100.0%

Taking each energy use in turn, 70% of UK heating is provided by natural gas (2) and 8 out of 10 UK households use natural gas for heating (3). Those which do not use natural gas burn

coal or use heating oil (kerosene), with a small proportion using firewood as a supplement. Electric heaters are used in homes and businesses also. Peak demand for power in winter reaches around 50 GW. Demand for gas for heating in equivalent units reaches 300 GW meaning we will depend upon gas at least for heating for the foreseeable future (4).

For transportation, the energy source is almost exclusively hydrocarbon liquid such as petrol, diesel or aviation fuel.

Electricity is generated from natural gas (~30%), nuclear power (~20%), renewables (~20%) and coal (~30%). These proportions reflect historical trends but are shifting rapidly, particularly with drop-off of coal being replaced largely by gas (5).

Natural gas was the biggest contributor to electricity generation in 2016. It is less expensive than power generated by renewables or nuclear and more reliable than renewables. Electricity generated from natural gas produces less greenhouse gas emissions than electricity generated from burning coal and is the most responsive to changes in demand. Combustion of natural gas for generation of electricity produces more CO₂ emissions than nuclear or renewables.

Nuclear power provides base-load running at, or close to, capacity of between 7 and 8 GW continuously. UK power demand varies between 30 and 50 GW.

Renewable power generation is dominated by wind from approximately 6,000 onshore and offshore wind turbines. Wind is highly intermittent and contributes between zero and 5 GW to the grid.

While it is hard to estimate the contribution of solar power as it is mostly off-grid, estimates, based on demand drop and volunteer sites providing data, suggest it produces up to 5 GW in the middle of the day but this is only for short periods. For most of the 24 hour day, its contribution is negligible (6).

In 2014, approximately one quarter of renewable energy was from burning imported wood pellets to generate power and the sustainability of this 'biomass' electricity is under question (7).

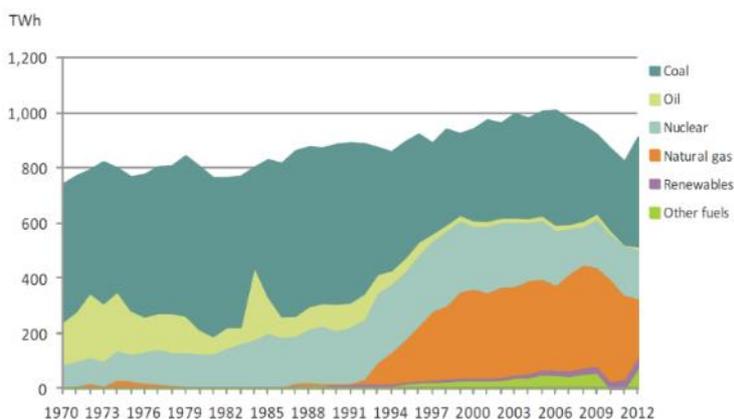


Chart 1: UK energy mix over time (1970 – 2012)

Coal has historically dominated the UK energy mix for heating and power but is being rapidly displaced by natural gas (8). Recently it has been used mostly to generate electricity. Electricity generation from coal is relatively inexpensive and reliable. However it is less responsive to short-term

demand fluctuations and is used to meet more predictable seasonal variations. Coal combustion produces more greenhouse gas emissions than the other sources of power generation and emits sulphur dioxide, nitrogen oxides and particulates (9).

Deep-mining of coal in UK ceased in December 2015 (10) so generation of electricity from coal in recent years (2012) has depended upon imported coal from Russia (40%), USA (24%), Colombia (27%) as well as other lesser exporters (11).

Coal has been used to generate power at scale since 1882. On 10th May 2016, for the first time since 1882, coal did not contribute to the UK electricity generation grid (12).

II A brief history of UK natural gas

Natural gas was discovered in the North Sea in the 1960’s and has been in production since 1968 when the Phillips-operated Hewett field was developed (13).

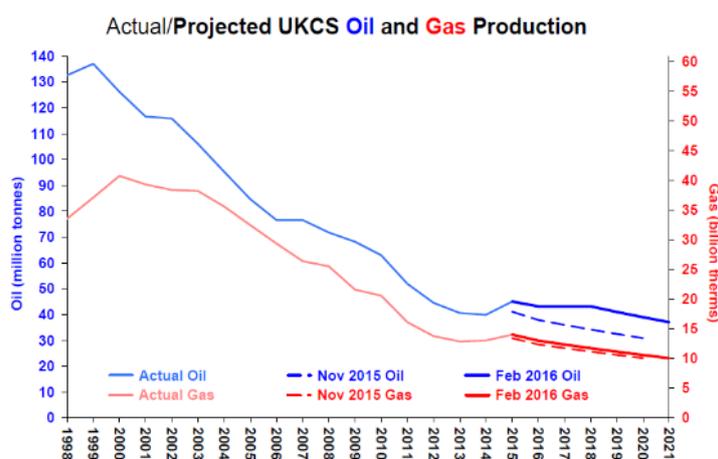


Chart 2: UK offshore oil & gas production (15)

UK then undertook a campaign through nationalised energy companies to convert all industrial and domestic properties to natural gas previously served by ‘town gas’ and coal. The campaign lasted from 1968 to 1976 (14). Production of natural gas in the North Sea reached a peak in 2000 and has since

been in decline. Current production is approximately a third of peak production and is forecast to decline by approximately 8% per annum (15).

UK demand for natural gas has dropped steadily in recent years (15), particularly following the global recession of 2008, but is less than the drop in domestic production.

This has led inevitably to an increase in imported gas to maintain supply. After decades of being self-sufficient or a net exporter, today the UK imports a similar volume of gas as its domestic production but with domestic production declining, imports are likely to dominate in the future. National Grid forecasts that imports of natural gas may be as high as 90% by 2035 (16). The UK was self-sufficient in gas production as recently as 2000. Importing natural gas is predicted to cost UK £9 billion pa and with no revenue, supply chain or jobs generation (17).

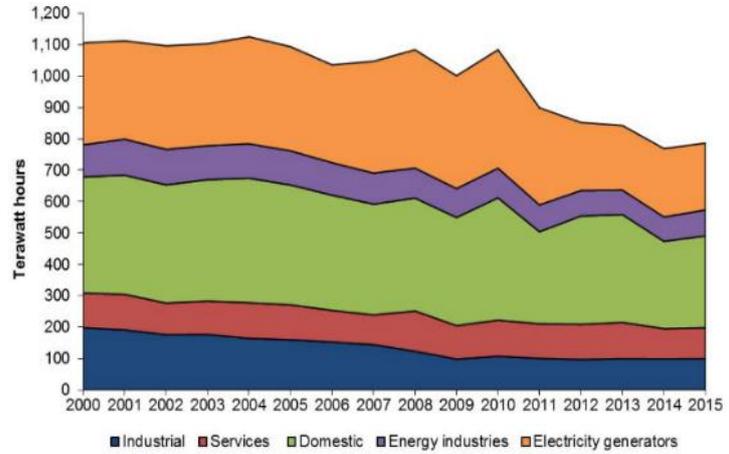


Chart 3: Trends in gas demand (14)

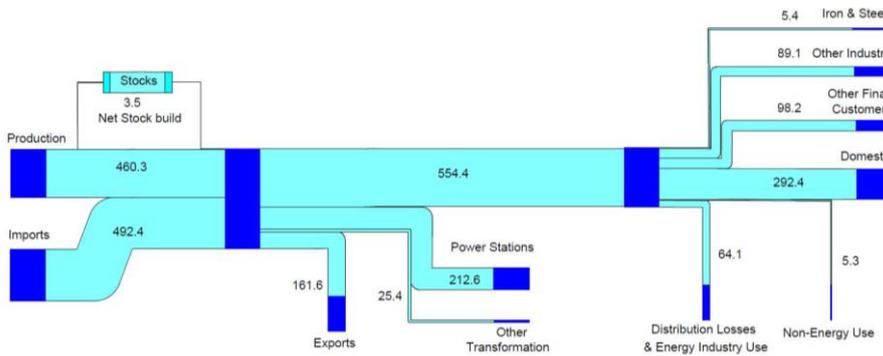


Chart 4: UK natural gas inputs and outputs (16)

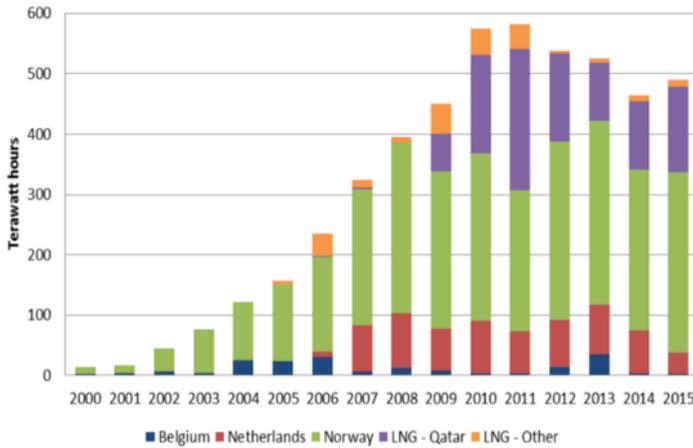


Chart 5: Source of UK gas natural gas imports (15)

Most UK gas imports are by pipeline from Norwegian North Sea gas fields or by Liquefied Natural Gas (LNG) from Qatar. Since 2007, gas imported from the Netherlands has become significant.

UK also imports some gas via the Zeebrugge (Belgium) interconnector. It is not straightforward to trace the

origins of this natural gas due to its complex connections, but this system is connected to Siberian gas fields in Russia. The Russian press agency Tass claims exports of Russian gas to the UK are increasing significantly (18).

III Gas cost and cost of energy

Natural gas has become more of a global or semi-global / regional commodity since LNG became a viable solution for meeting national energy demands. The plentiful supply of natural gas around the world means that this has depressed the global price of natural gas. However, regions can behave independently. US shale gas has caused US gas prices to dip (19) while costs in the UK, though relatively low, are rising (20).

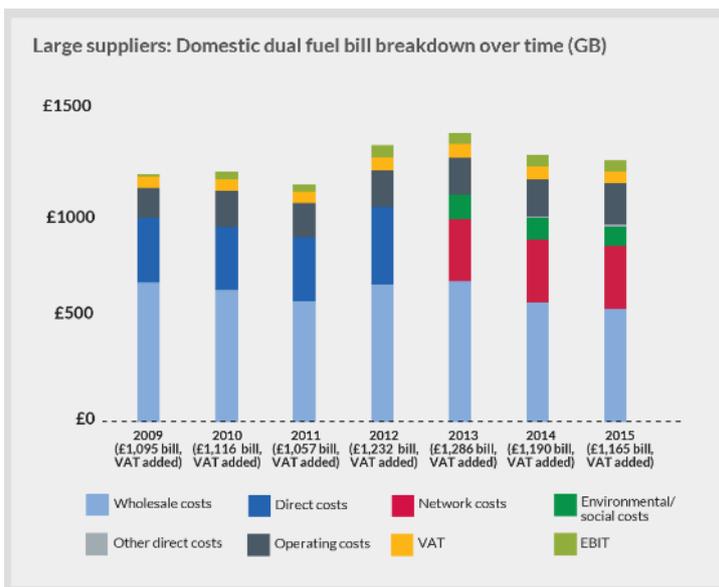


Chart 6: Domestic dual fuel bill and cost breakdown, 2009-2015 (21)

The cost of household energy (gas and electricity) is complex due to such things as change in demand, change in network costs, introduction of “environmental/social costs” but overall, average gas and electricity bills have remained quite stable around £1,100 per year (refer Chart 6). UK ranks about average for

electricity bills in Europe and above average for cost of gas (21).

The UK is highly dependent upon one storage facility to respond to high demand for natural gas such as a UK cold snap. Rough Storage Facility is a depleted north sea gas field situated off the Lincolnshire coast and provides 70% of UK gas storage. Gas is injected in the summer months when demand and prices are lower and made available in winter. However, the facilities, designed and built to last for the production lifetime, are showing signs of aging and the operator has announced it will not be available for injection this summer. This is likely to put pressure on prices and supply security in winter 2017/18 (22).

While average household energy bills have remained relatively stable there are significant variations and fuel poverty is an important social consideration in energy policy.

How and when fuel poverty is calculated is not consistent across the UK but methods are broadly comparable. In England, where fuel poverty is calculated as where households “have required fuel costs that are above average and were they to spend that amount, they would be left with a residual income below the official poverty line”, the *incidence* of fuel poverty covers approximately 10% of households in 2015 and this figure was stable and predicted to remain so (23, page 6).

UK government reports indicate that single-parents, unemployed, younger families households

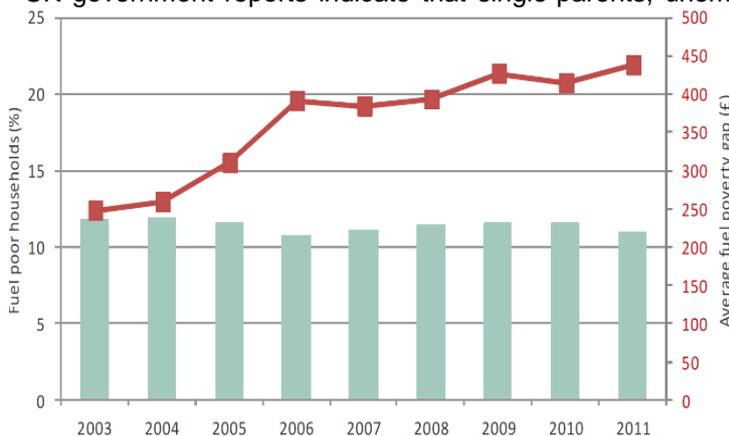


Chart 7: Fuel poverty (% and depth) in England (23)

and those in rented accommodation are worst affected. However the *depth* of fuel poverty increases markedly for those living in poorest-rated energy efficiency properties and the depth of fuel poverty in England has increased, even though the incidence of fuel poverty (proportion of people in fuel poverty) has been stable at around 10% of all households (8).

In Scotland, the then Scottish Executive, in 2002, in its Scottish Fuel Poverty Policy statement set a target of eradicating fuel poverty “as far as is reasonably practicable”, by November 2016 (24, page 1). Over the period 2003 to 2012, fuel poverty rose from 16% to 27% of all Scottish households, reaching a high of 34% in 2009. Rural areas tend to be worse affected, with areas such as Eilan Siar and Orkney having fuel poverty rates of 62% and 58% respectively in 2012. A chief reason given for this in government reports, is their lack of access to inexpensive mains natural gas and a dependency on higher cost heating fuels.

Fuel poverty in Scotland is defined as households spending more than 10% of disposable income on fuel.

Table 2: Fuel poverty by UK nation, 2012

	Scotland	England	Wales (estimated)	Northern Ireland (estimated)
Number of households	650,000	3,050,000	390,000	290,000*
% of population	27%	14%	29%	42%*

*2011 figures

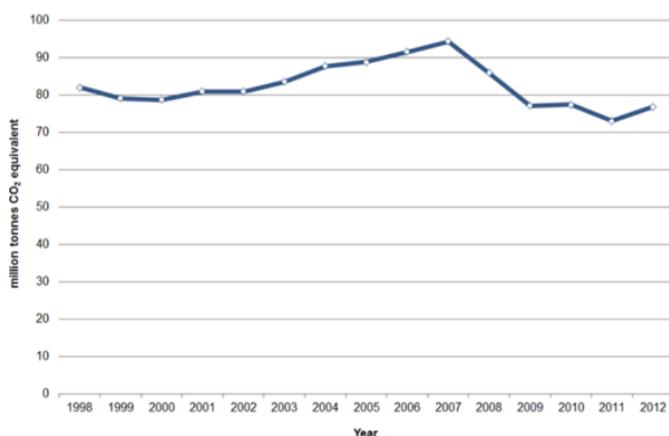
Note: Wales has not undertaken an official survey of fuel poverty prevalence since 2008 and Northern Ireland since 2009 (Scottish Government, 2015)

(Source: DECC, 2014a)

IV Natural gas, energy and the environment

One part of energy costs which has altered is the introduction by government of environmental costs which have been added to energy bills rather than being delivered through central taxation. If we assume that the less well-off are more commonly in poor housing and on pre-payment tariffs - which are among the most expensive sources of per unit of energy - then the most vulnerable to fuel poverty are picking up a larger share of payments for the environmental costs of energy.

Renewable energy, dominated by wind, remains heavily subsidised. The National Audit Office



anticipates the subsidies will be about £8 billion by 2020, placing a cost on the average bill of £110 or 10% of recent average household bills (25).

In 2012, Scotland's carbon footprint had reduced from just above 80 million tonnes CO₂ in 1998 to just below 80 million tonnes in 2012 with a high above 90 million tonnes before the global recession in 2008 (26).

Chart 8: Scotland CO2 emissions (25)

There is widespread if not complete consensus that we must remove or at least significantly reduce carbon from our energy supply. However, very few argue that we can take natural gas out of the system in the near-term, given the very significant role it plays in heating, cooking and electrical generation.

Moreover, gas (or more specifically, non-gas liquids produced with gas, such as ethane) is a key petrochemical feedstock in a range of industrial processes that are used to produce many of the goods and services that Scottish and UK households consume every day. This is particularly relevant in Scotland, where ethane derived from gas is used as a feedstock in the petrochemical industry at Grangemouth, an activity that is widely accepted as making a significant direct and

indirect contribution to Scotland's GDP and employment (INEOS's own figures estimate a GDP contribution of 3-4% (27)).

To set climate change concerns in context, the total UK contribution to global greenhouse gas emissions from energy use is about 1.5% (28). A similar volume is generated from UK agricultural activity, specifically sheep and cattle farming. Cattle and sheep population in UK generate equivalent carbon dioxide of approximately 2 trillion cubic feet each year (29, 30). UK demand for natural gas is 2.5 trillion cubic feet per annum (31).

Thus, given that power generation is about 13% of our energy use, if electricity were entirely provided by renewables it could only reduce global GHG emissions by 13% of 1.5% or 0.2% (approximately 0.02% for Scotland).

There is an important distinction to be made between the role of gas, and our current gas production and supply capability, relative to other activities that contribute to climate change. In considering some of the potential 'game changers' such as CCS and hydrogen, our capabilities and infrastructure may play an important role. It is commonly understood that CCS could provide a means by which to continue the use of fossil fuels (gas and coal) with reduced carbon emissions. Hydrogen, on the other hand is identified as a 'clean' replacement fuel for both transport and heat. However, gas may still have a role to play in either or both in the production of hydrogen (with CCS to remove carbon), while the existing gas network infrastructure and the related skills/expertise may play an important role in the distribution of hydrogen and/or the transport of (potentially both domestically produced and imported) carbon to off-shore storage sites.

V Conclusion

In conclusion, gas plays a key role in the UK and Scottish energy mix. Indeed its role is increasing in electricity generation, where it is rapidly replacing coal due to its demand responsiveness and lower CO₂ emissions. So, the choice would seem to be not one of whether to include gas in our energy mix for the foreseeable future, but where the gas come from? UK gas production is in decline and we increasingly rely on imported gas. In terms of climate change impacts, the production/extraction of gas in Scotland/UK adds to our own territorial emissions, whether it is used at home or abroad. However, gas use has the same impact on our climate emissions whether it is extracted at home or abroad. A shift from domestic production/extraction to importing gas will have significant negative impact on jobs and revenue, as well as potentially depleting / threatening the existing skills and infrastructure base that may prove crucial in making the major shift necessary to produce and use energy in a future low carbon economy.

Notes:

1. Figures come from as recent a reliable document as was available. They are presented where a more recent figure might be different but where the difference would not cause a different conclusion to be drawn. An exception to this is 2016 and 2017 are seeing a significant drop in coal use in the generation of electricity but figures are not yet available.
2. Typically, figures are for UK as they are more readily available over time and form part of ongoing UK research rather than new research which would take more time
3. An assumption of 10% of all figures can be applied between UK and Scotland. This may not be accurate but will be sufficiently close that the inaccuracy would not create an alternative conclusion.
4. Many references are government sources. None are peer-reviewed scientific papers. References are provided in order that reader can understand source rather than to indicate a level of assurance.

LIST OF REFERENCES

1. <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk>
2. <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>
3. <https://www.cambridgeenergy.org.uk/wp-content/uploads/2013/11/UK-Housing-Fact-File-2013-small.pdf>
4. <https://www.gov.uk/government/publications/the-future-of-heating-a-strategic-framework-for-low-carbon-heat>
5. <http://www.gridwatch.templar.co.uk/>
6. <https://www.solar.sheffield.ac.uk/pvlive/>
7. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/594046/Summary_-_Assessment_of_high_carbon_biomass_fuel_sourcing_scenarios.pdf)
8. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345141/uk_housing_fact_file_2013.pdf
9. <http://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/coal-air-pollution#.WLE8cMGmI2U>
10. http://uk.dbcargo.com/rail-uk-en/News_Media/news/10838350/headboard_from_last_train.html
11. <http://www.ukcoal.com/world-coal-statistics.html>
12. Tiratsoo, E.N. (1972). *Natural Gas*. Beaconsfield: Scientific Press Ltd. p. 209
13. <http://www.nationalgasmuseum.org.uk/gas-industry-chronology/>
14. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/503852/OGA_production_projections_-_February_2016.pdf

15. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540923/Chapter_4_web.pdf
16. <http://researchbriefings.files.parliament.uk/documents/POST-PN-0513/POST-PN-0513.pdf>
17. <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>.
18. <http://tass.com/economy/912285>
19. <http://www.eia.gov/naturalgas/weekly/>
20. <https://www.quandl.com/collections/markets/natural-gas>
21. <https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits>
22. <https://www.utilitywise.com/2017/02/06/rough-gas-storage-unclear/>
23. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/468011/Fuel_Poverty_Report_2015.pdf
24. http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_15-13_Fuel_Poverty_in_Scotland.pdf
25. <https://www.nao.org.uk/press-release/controlling-the-consumer-funded-costs-of-energy-policies-the-levy-control-framework/>
26. <http://www.gov.scot/About/Performance/scotPerforms/indicator/carbon>
27. <http://www.ineos.com/sites/grangemouth/news/ineos-completes-construction-of-its-new-grangemouth-headquarters/>
28. <https://www.ncbi.nlm.nih.gov/pubmed/8567486>
29. <https://www.gov.uk/government/uploads/.../structure-dec2014-uk-19mar15.pdf>
30. <https://www.gov.uk/government/uploads/.../structure-dec2015-uk-17mar16.pdf>
31. <https://www.gov.uk/...gas.../shale-gas-and-oil-policy-statement-by-decc-and-dclg>

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