

Gas emissions from produced Icelandic
geothermal fields

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GAS EMISSIONS FROM PRODUCED ICELANDIC GEOTHERMAL FIELDS

INTRODUCTION

Jón Örn Bjarnason has provided gas data for Reykjanes and Svartsengi, Gestur Gíslason for Nesjavellir and Halldór Ármannsson for Krafla and Námafjall. With the present production the largest amount of hydrogen is emitted from Nesjavellir 325 tonnes/year, then Krafla 148 tonnes/year, and Námafjall, 113 tonnes/year. If they are considered on the basis of fluid mass removed, the production from Námafjall is 64 kg/ktonne, Nesjavellir 34 kg/ktonne, Krafla 16 kg/ktonne, Svartsengi 1.5 kg/ktonne, and Reykjanes 0.06 kg/ktonne. Thus if further drilling will take place Námafjall is most promising.

REYKJANES

For the last 15 years, only one well, RN-09, has produced geothermal fluids in the Reykjanes field. For most of this period, production has remained relatively constant. Accordingly, the amount of gas discharged from the field was computed as an average for the years 1996 - 2000. The gas concentrations were first averaged within each year, and the resulting value multiplied by that year's production. The annual discharge was then averaged over the five years. The gas emissions thus calculated, rounded to two significant figures, are as follows:

CO ₂	1300
H ₂ S	44
H ₂	0.070
CH ₄	0.050

The units are metric tons per year.

The average concentrations of the non-condensable gases, collected after condensing to 25°C steam separated from the liquid phase at 250°C, is as follows:

CO ₂	96.66
H ₂ S	2.71
H ₂	0.14
CH ₄	0.02
N ₂	0.47

The units here are mole per cent.

SVARTSENGI

There are currently ten geothermal wells producing fluids in Svartsengi. Of these, six are steam-water wells, namely SV-07, SV-08, SV-09, SV-11, SV-18, and SV-19, and four are dry-steam wells, viz. SV-10, SV-14, SV-16, and SV-20. Only about 5% of the total amount of gas discharged from the field comes from the six steam-water wells. The four dry-steam wells thus account for the bulk of the gas released. In fact, only two of these, SV-10 and SV-16, produced approximately 85% of the gas discharged from the field in 2000 and 2001.

In 1999, mass production from the Svartsengi field was increased by around 70%, when a new power plant went on line. For this reason, the estimate of the amount of hydrogen and other gases discharged from the field was based on the years 2000 and 2001 only, since data from earlier years would not properly describe the current situation.

The gas discharge figures shown below were calculated as follows. Gas concentrations from each well were first averaged within each year, and the resulting value then multiplied by the mass production from that well in the same year. The annual releases were averaged for the two years and summed for the ten producing wells.

The gas emissions thus calculated, rounded to two significant figures, are as follows.

CO ₂	65000
H ₂ S	990
H ₂	18
CH ₄	4.1

The units are metric tons per year.

The average concentrations of the non-condensable gases, after condensing to 25°C steam separated from the liquid phase at 200°C (for steam-water wells), or by directly condensing steam to 25°C (for dry-steam wells), are as follows:

CO ₂	96.74
H ₂ S	1.30
H ₂	0.58
CH ₄	0.04
N ₂	1.34

The units here are mole per cent.

KRAFLA AND NÁMAFJALL

In 1996 additional drilling was effected in Krafla to provide steam for production of additional 30 MW thus bringing the production to 60 MW. The drilling programme finished in 1999 and the last wells started discharging towards the end of that year. Several types of fluid are produced from the Krafla field and gas concentrations (not least H₂ concentrations) vary widely. Production had become reasonably stable in 1999 and production was from wells that gave a similar amount of H₂ emission per year. Therefore

an average for the years 1999 – 2001 is presented for Krafla. During these years 20-21 wells were producing.

The production from Bjarnarflag, Námafjall is somewhat variable but an average for the 5 years 1997-2001 is regarded as giving a representative picture of gas emissions. The total mass production and total production of CO₂, H₂S and H₂ is presented in the following table.

Field/period	Total mass removed ktonnes/year	CO ₂ , tonnes/year	H ₂ S, tonnes/year	H ₂ , tonnes/year
Krafla 1999-2001	9220	72.300	5.460	148
Námafjall 1997-2001	1770	2200	1090	113

NESJAVELLIR

In 1999 production from the field was increased significantly and gas emissions for earlier years are not relevant to the present purpose. The average mass removed is an average for 1999 and 2000, but for the gases 1999 - 2001

Field/period	Total mass removed ktonnes/year (1999- 2000)	CO ₂ , tonnes/year	H ₂ S, tonnes/year	H ₂ , tonnes/year
Nesjavellir 1999-2001	9.450	14.000	6.130	325