



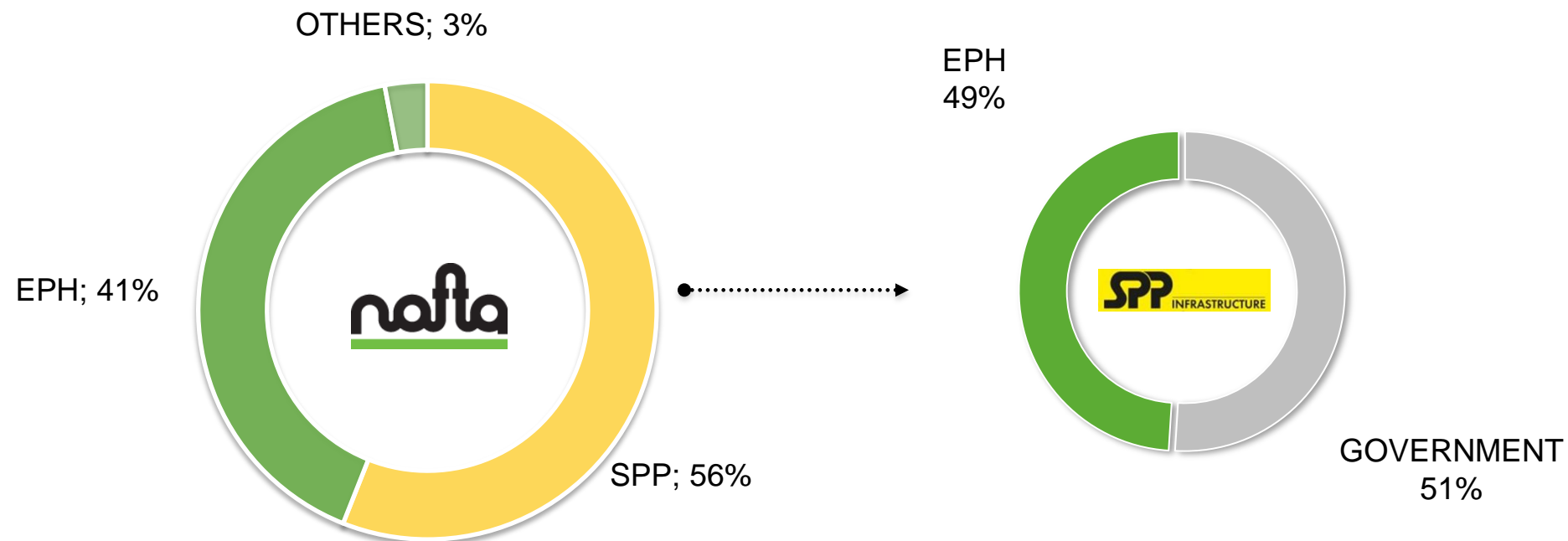
EXPERIENCES WITH ABANDONMENT OF ENVIRONMENTAL BURDEN RELATED TO CRUDE OIL PRODUCTION

BRATISLAVA 2016

NAFTA

- **Leader in exploration and production of hydrocarbons in Slovakia**
 - ~ yearly gas production at approx. 90 mcm
- **Key Slovak Underground Storage Operator**
 - ~ capacity 2.6 bcm
- **Operating unique storage asset**
 - ~ portfolio of 8 geological structures
- **Variety of grid interconnections, strategic location**
- **Important tool of security of gas supplies**
- **Flexible business partner**

NAFTA / SHAREHOLDERS STRUCTURE



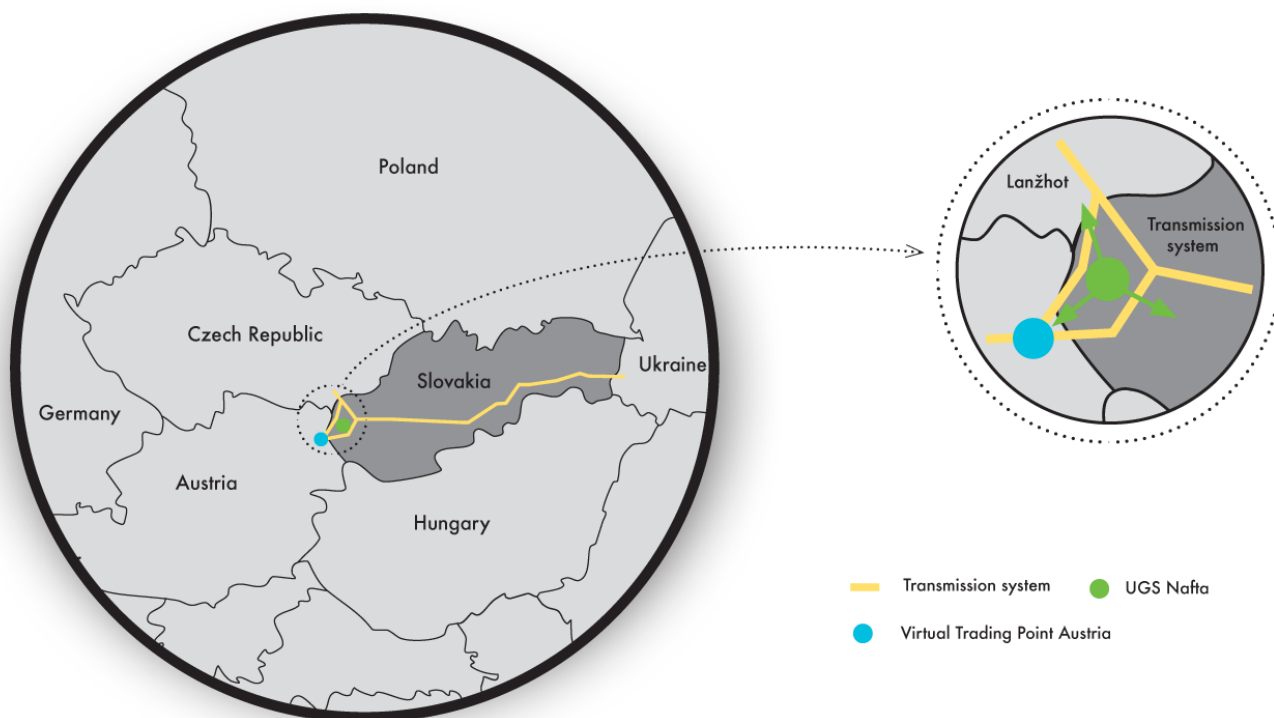
NAFTA / HISTORICAL MILESTONES

- **1913** Gbely 1 was the very first well drilled for hydrocarbons in the Vienna Basin: it was spudded on the 28th October 1913
- **1914** Beginning of industrial oil production
- **1950** Beginning of industrial gas production
- **1973** Beginning of storage of natural gas in underground storage facilities in Láb
- **1977** Successful exploration of deep pre-Neogene formations
- **1988** First 3D seismic campaign performed in the Závod area of the Vienna Basin

NAFTA / HISTORICAL MILESTONES

- **2002 – 2004** Implementation of standard E&P methodology to prospect evaluation (IFP, AAPG)
- **2006** Geological optimization of UGS structures and increase of capacity to 2 bcm
- **2008** Construction of a new UGS facility Gajary-Baden started
- **2013** EPH became a shareholder of NAFTA via SPP
- **2014** End of Gajary-Baden development. Working gas volume 2.6 bcm
- **2015** NAFTA partners RAG to construct a testing storage facility for renewable energy

NAFTA / UNDERGROUND GAS STORAGE (UGS)



NAFTA / EXPLORATION & PRODUCTION (E&P)

- **100-years history** of successful exploration and production of hydrocarbons
- Exploration activities in Slovakia focused on the **Vienna Basin, Danube Basin** and **East Slovakian Basin**



NAFTA / E&P ACTIVITIES AND ACHIEVEMENTS

- Since 2004, we have drilled a total of 44 wells with **50 % success rate**.
- Exploration licenses in the extent of **2 800 km²**
- 3D seismic data covering a total area of up to **1 400 km²**
- Approximately **3 200 wells** have been drilled
- The **deepest well** drilled to a total depth of **6 505 m**

ENVIRONMENTAL BURDEN

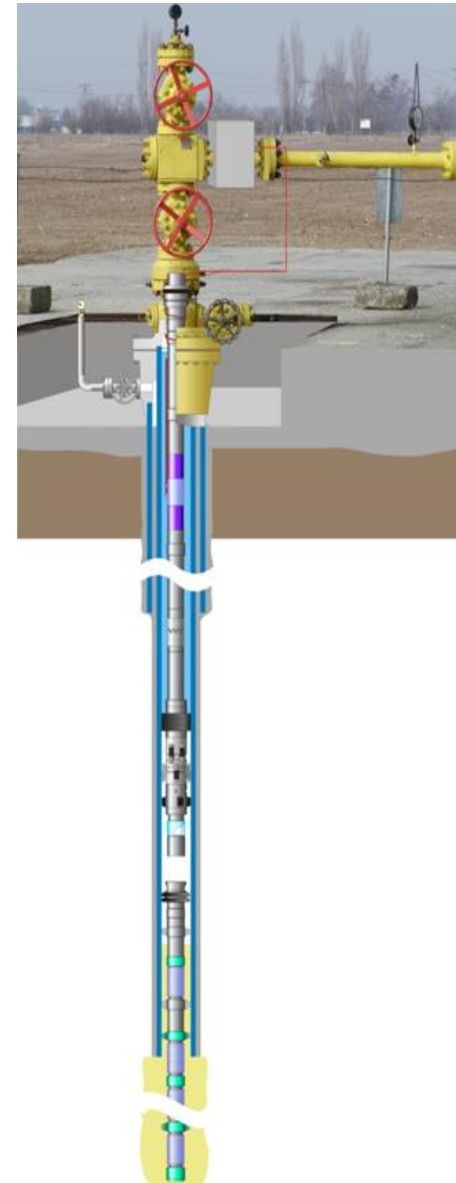
- The crude oil production started in Austro-Hungarian Empire in 1914 in Gbely
 - ~ The knowledge about crude oil was that is better than coal
 - Nobody cares about environmental impact, the main goal was to follow the industrial revolution
 - ~ The crude oil was found in shallow horizons from couple of tenth meters to 300 meters
 - The production well was drilled in triangles approx. each 70 meters
 - Waste was stored just near to well in mud pit – it was simple pit without any isolation
 - Collecting of crude oil was done by trench

PROJECT SCOPE

- In 2004 the owners of NAFTA a.s. decide to settle environmental burdens
 - ~ Identification of wells, centers mud pits owned by NAFTA
 - ~ The goal was to define financial provision for each center and well in case that it will be not use anymore
 - ~ For each well was define
 - Project of subsurface liquidation
 - Potential contamination model and estimation of costs
 - Technical recultivation
 - Biological recultivation
 - ~ For each center was define
 - Project of wrecking of the buildigns and technology equipment
 - Potential contamination model and estimation of costs
 - Technical recultivation
 - Biological recultivation

WELL ABANDONMENT

- For each well was prepared project for workover / well abandonment
- The well was isolated with several cement plugs
- The tightness of cement plug was tested
- The overground production tree was removed
- The well casing was cut approx. 2 meter bellow the ground level
- Casing was closed by metal cover and tighten by welding



DECONTAMINATION – INSUFFICIENT EXPERIENCES

- We had small experiences from previous abandonments
 - ~ There were several experiments with in-situ decontamination
 - It takes a long time
 - It needs permanent care
 - ~ We were not satisfied with results and progress from the past decontaminations
 - There were big pressure from shareholders to set up process which will have clear time and expense frame
 - Simply they don't want open bill
 - ~ We decide to use ex-situ decontamination
 - Weak point is only estimation of contaminated soil
 - All the risks related to decontamination is transferred to supplier

DECONTAMINATION – WHICH METHOD

- We studied technical articles and did market search to decide for method
 - ~ We decide for biodegradation
 - We had some experiences from in-situ project
 - There were existing suppliers
 - Transportation costs were reasonable
 - The prices were high
 - ~ We started active communication with potential suppliers to make bigger market competition
 - We expect to deliver early more than 50 thousand tons of contaminated soil

DECONTAMINATION – COSTS ESTIMATION

- We identified approx. 150 crude oil wells and 10 centers where we expect contamination of soil
 - ~ We had no time and money to make monitoring of all the places
 - ~ We decide to make several sample pollution monitoring – 10 wells and all centers
 - Monitoring was not detailed but only for rough estimation with expected accuracy about 30%
 - ~ We collect data about the wells production history
 - We was looking for correlation between production data and polluted area around the well
 - We decide to use three parameters for calculating of costs estimation
 - Drilling year, amount of produced crude oil
 - Area index which represent the ground water level

ON THE SITE WORKS / COSTS CONTROL

- We run decontamination usually on 5-6 wells parallel
- The goal was to excavate only necessary amount of the soil
- We need quick identification of pollution
 - ~ The limit was to have less than 1000 mg/kg of soil of Non-polar extractable substances (NEL) which is good indicator for crude oil pollution
 - ~ Smell – the first indicator for pollution more than 3000 mg/kg NEL
 - ~ Quick laboratory works – delivery of results within 24 hours
- **Important – skilled personal**
 - ~ Excavator operator was able to take layers less than 10 cm.

FINISH OF DECONTAMINATION

- There was supervisor for decontamination works
 - ~ Supervision of works
 - ~ Final inspection of decontaminated area / sampling and evaluation of result from laboratory
 - ~ Final report form each site
- Before technical recultivation we invite the regional environmental officer
- When everything was OK we finished decontamination and technical recultivation follow

RECUltIVATION

- Technical recultivation means
 - ~ heap up of new soil
 - ~ alignment
- Biological recultivation means
 - ~ plantig of naturally occuring vegetation

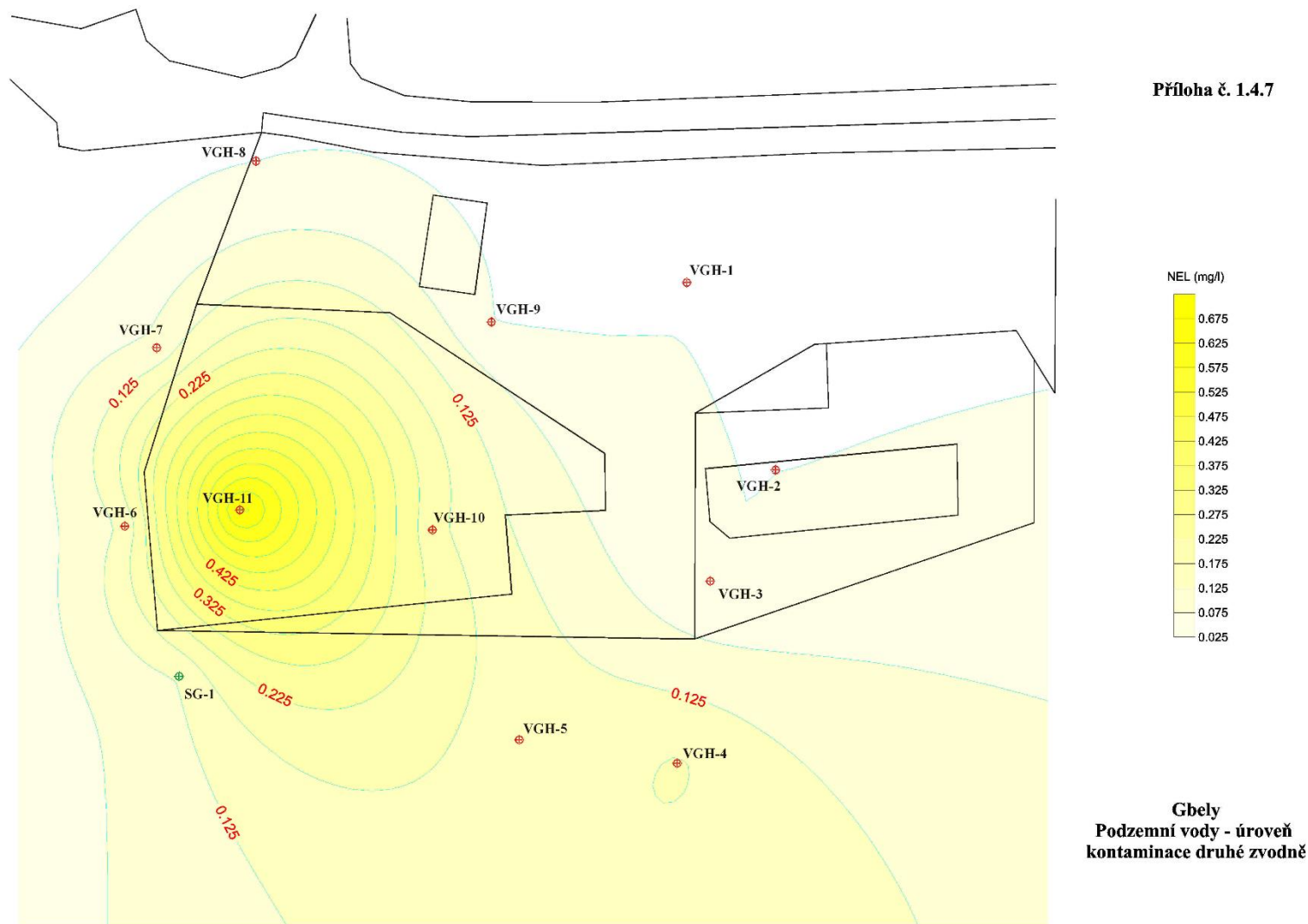
OS GBELY - PAST

Gathering station



During decontamination and recultivation

OS GBELY – POLLUTION



OS GBELY – 10 YEARS LATER



STUDIENKA 9

Gathering station



During decontamination

STUDIENKA 9 – 11 YEARS LATER



ZÁVOD 5

Gathering station



During decontamination

ZÁVOD 5 – 10 YEARS LATER



THE WELL GBELY G 114



During decontamination

THE WELL GBELY G 114 – TODAY



BUDGET EVALUATION

- ~ Our costs estimation was not correct
 - We had more than 30% differences nearly on each well
- ~ Finally the abandonment of environmental burden was cheaper than our cost estimation
- ~ Main reasons:
 - Good procurement – by tendering we decrease prices for more than 60% of soil biodegradation
 - Good process – there was a clear process define
 - Each supplier had own goal
 - Good supervision of works
 - Open and straight communication with all related parties

EVALUATION

- Disposing more than 100 oil wells between 2004 – 2006
- Up to date was disposed more than 450 wells
- Biological recultivation returned all locations to their original state



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