



**How is the next generation motivated by oil industry of 2015 in CEE region**

**Conference**

**Visegrád, 19 November 2015**

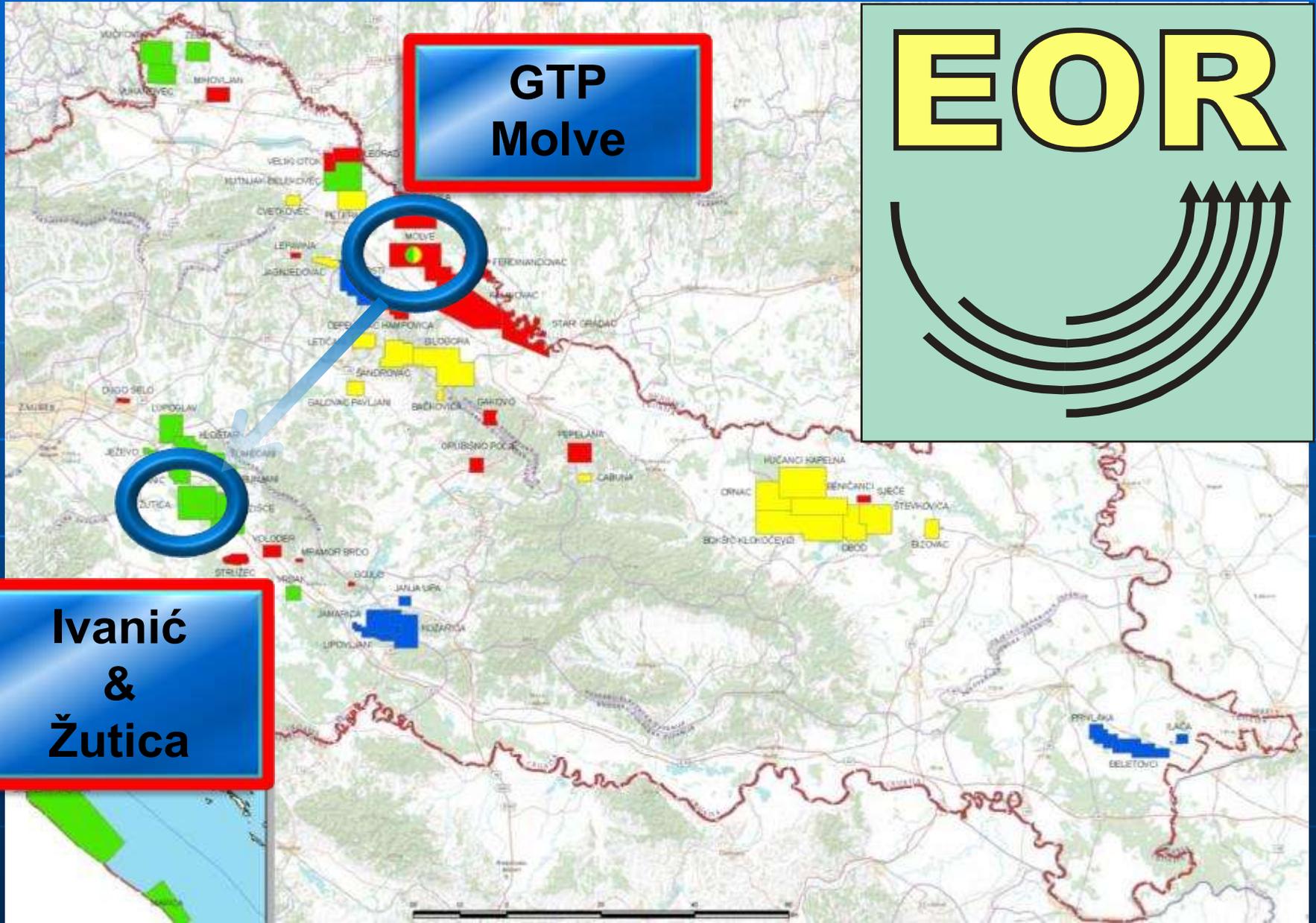
**Society of Petroleum Engineers**

# MONITORING AND THE FIRST RESULTS OF THE CARBON DIOXIDE INJECTION AS PART OF EOR PROJECT ON EXPLOITATION FIELD IVANIĆ

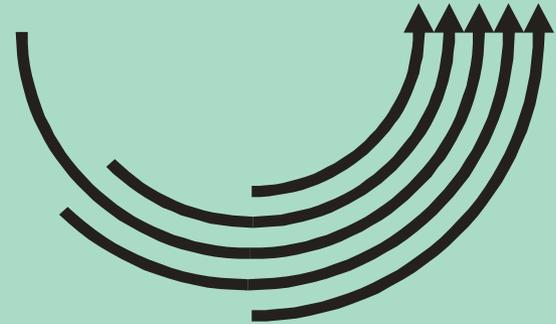
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# EOR – CO<sub>2</sub> source



# EOR



# EOR – SCOPE OF THE PROJECT

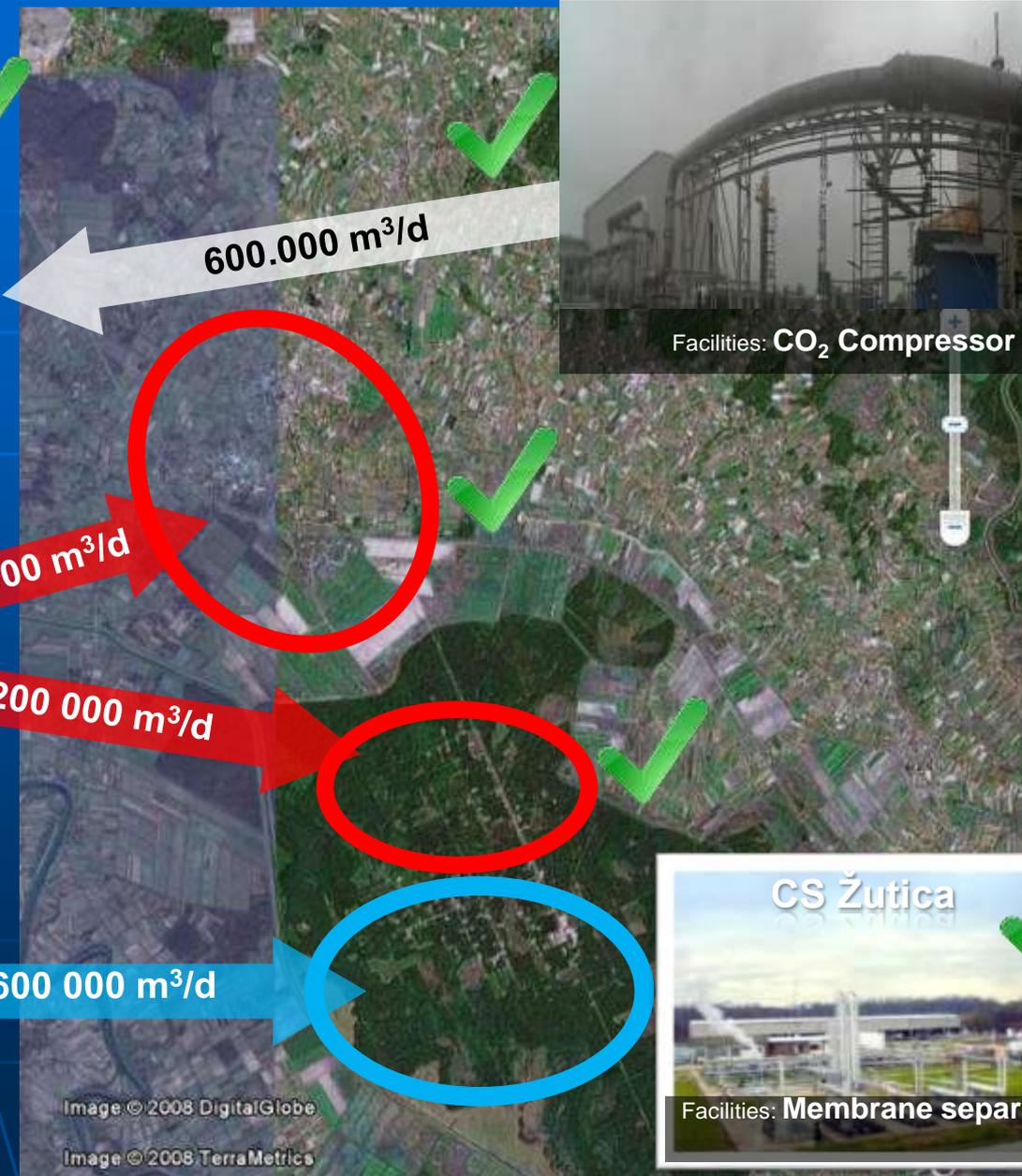
## GTP Ethane



Facilities: **CS CO<sub>2</sub>**, Liquefaction and pumping station



Facilities: **CO<sub>2</sub>** Compressor station



1st PHASE

**Ivanić  
Žutica North**

- **INJECTORS:**  
22 WAG, 8 DISPOSAL
- PRODUCERS:** 76

2nd PHASE

**Žutica South**

- INJECTORS:**  
23 WAG, 5 DISPOSAL
- PRODUCERS:** 85

**CS Žutica**

Facilities: **Membrane separation unit**

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# EOR 1<sup>st</sup> phase – finalization

- Received (3) use permits for CS Molve, CS Ethane and membrane separator unit on CS Žutica;
- June 24<sup>th</sup> submitted request to Ministry for trial work and start up of CO<sub>2</sub> injection in July 2014;
- July 18<sup>th</sup>- September 9<sup>th</sup> functional testing of CO<sub>2</sub> system ( CS Molve, CS Ethane and 11 wells on Ivanić);
- **September 30<sup>th</sup> received approval from Ministry for trial exploitation of the CO<sub>2</sub> system and CO<sub>2</sub> injection into 12 wells in exploitation field Ivanić for one year period;**
- **October 14<sup>th</sup> 2014 CO<sub>2</sub> injection started into 12 wells in Ivanić;**
- *Injection into 2 more wells in Ivanić and Žutica<sub>north</sub> started in Oct 2015*

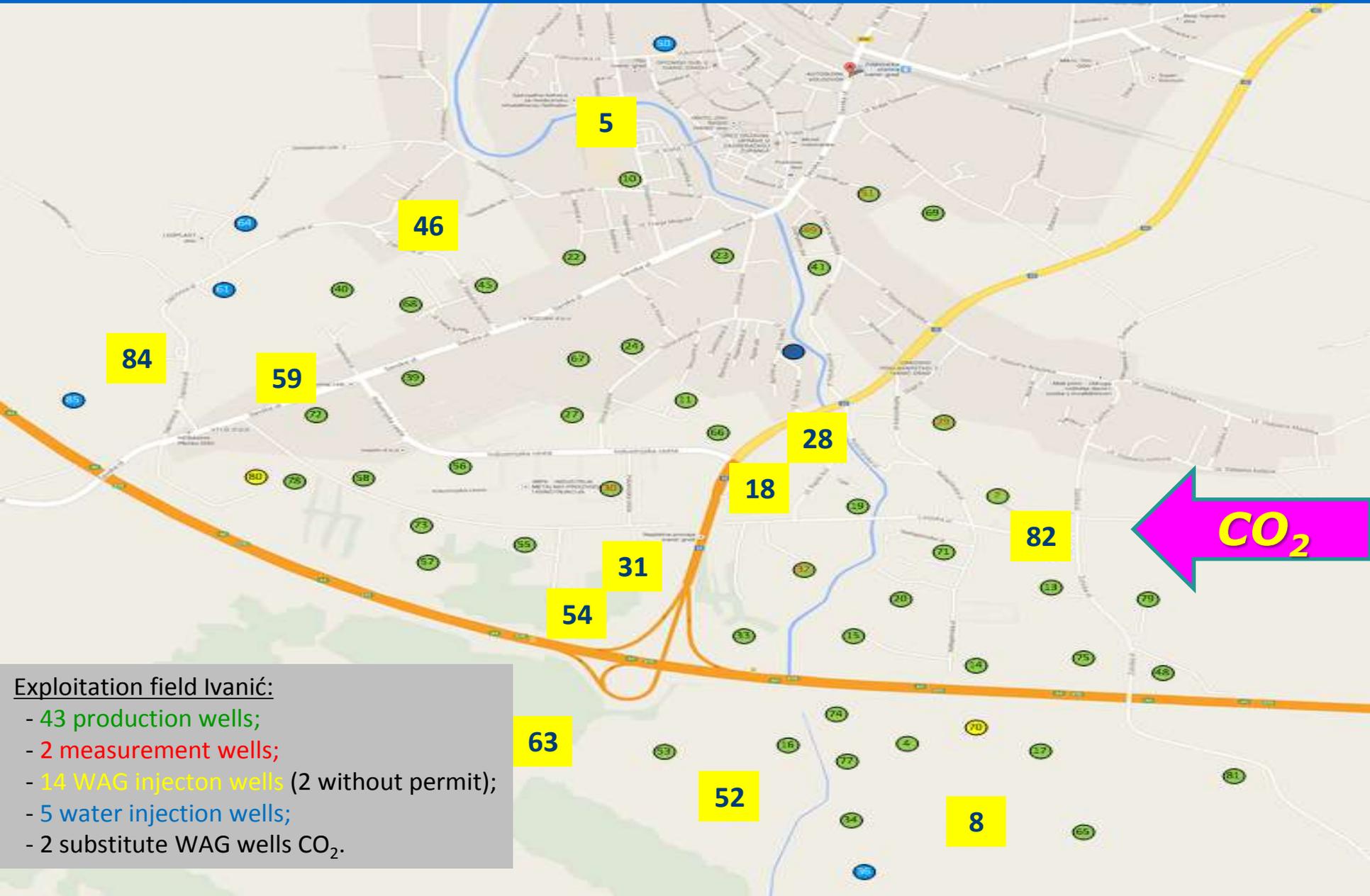
# EOR 1<sup>st</sup> phase – functional testing

- July 18th- September 9<sup>th</sup> functional testing of CO<sub>2</sub> system ( CS Molve, CS Ethane and 11 wells on Ivanić);
- CO<sub>2</sub> injection quantities during functional testing July - September:

**TOTAL: 7.6 MM m<sup>3</sup>**



# Exploitation field Ivanić – functionally tested



Exploitation field Ivanić:

- 43 production wells;
- 2 measurement wells;
- 14 WAG injection wells (2 without permit);
- 5 water injection wells;
- 2 substitute WAG wells CO<sub>2</sub>.

# Monitoring on oil field Ivanić

Before the start of CO<sub>2</sub> injection **ZERO STATE** of the exploitation field Ivanić was recorded on all 43 production wells:

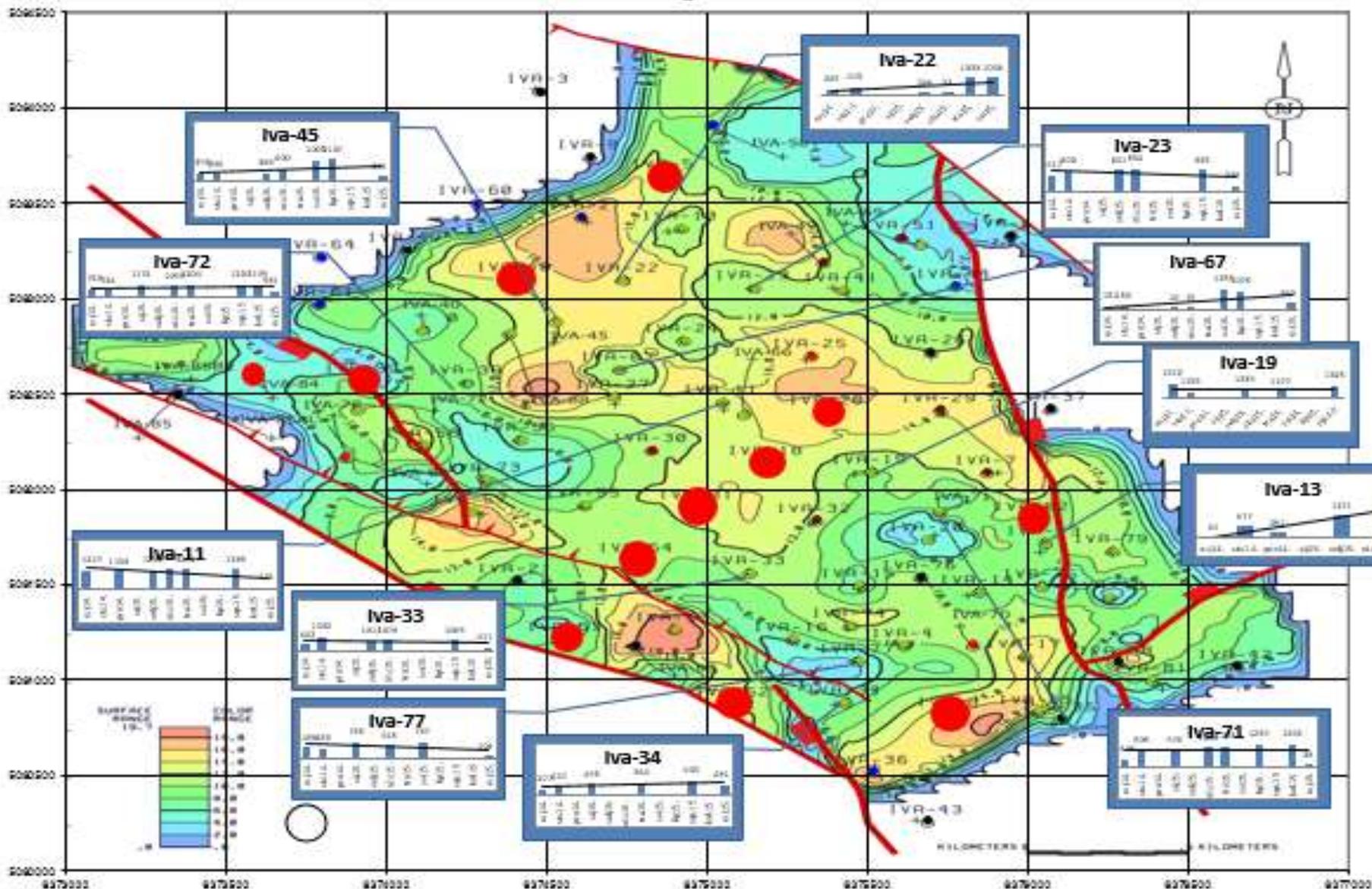
- measurement of fluid level in wells;
- pressure measurements in boreholes;
- measuring of produced quantities of oil, gas and water with mobile separator unit;
- laboratory analysis of oil and gas.

# Monitoring on oil field Ivanić during trial exploitation

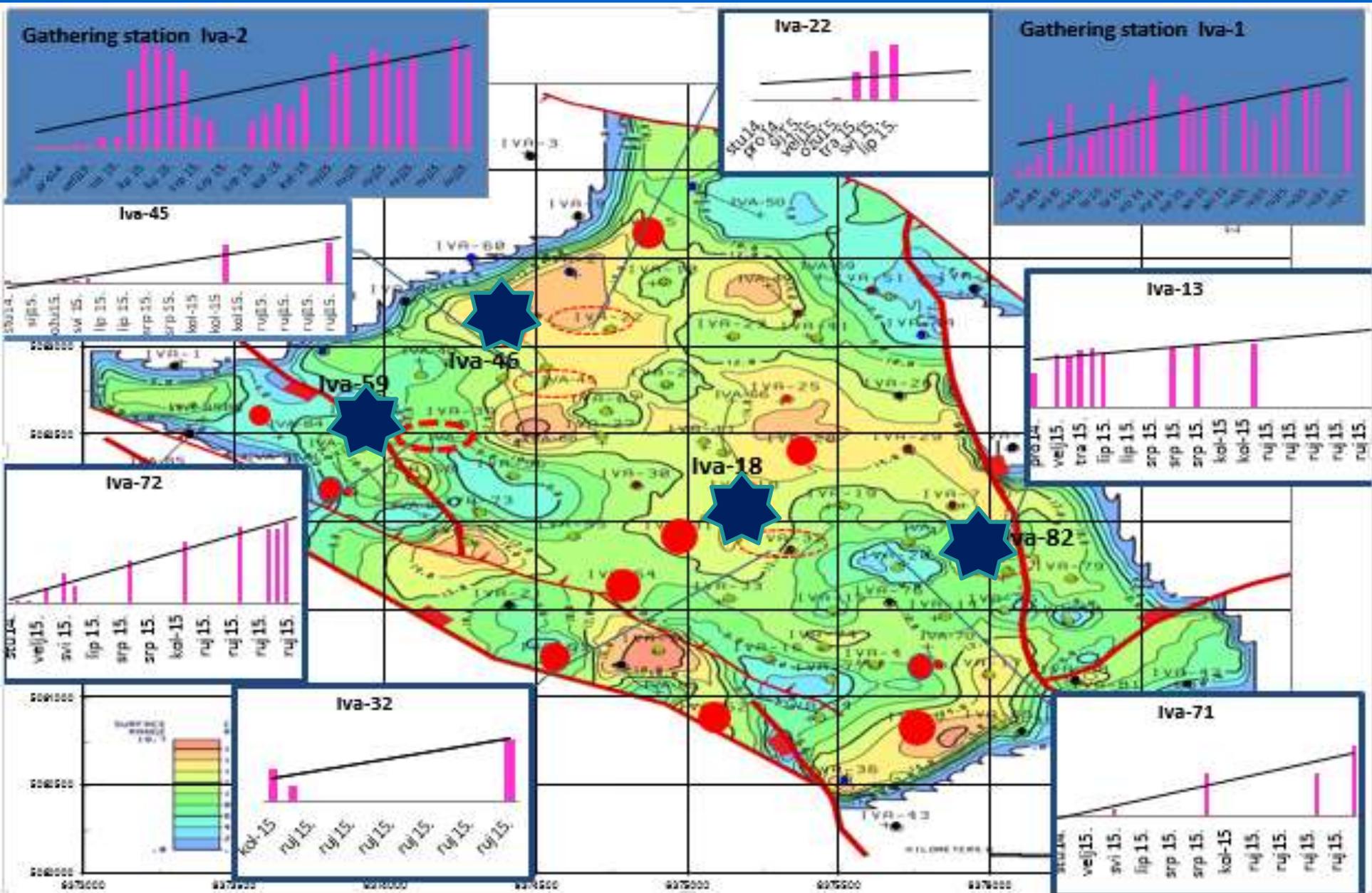
- Continuous measurements of fluid quantities on all exploitation wells with movable separator unit to detect any increase in production (hundred of measurements);
- during all measurements samples of fluid were taken for laboratory analysis;
- On all exploitation wells continuously sampling of gas for chromatographic analysis (hundreds of laboratory analysys)
  - important to detect every possible increased CO<sub>2</sub> concentration;
  - resulted making timely decisions for mining interventions in exploitation wells;
- Continuous fluid level measurement on all exploitation wells (hundreds of measurements)
  - important for timely response in order to possibly increase the capacity rod of pumps, the change of the operating cycle of swings, etc .;
  - changing from atificial lift method to natural flowing.

# First results of CO<sub>2</sub> injection on fluid level

Fluid level changes

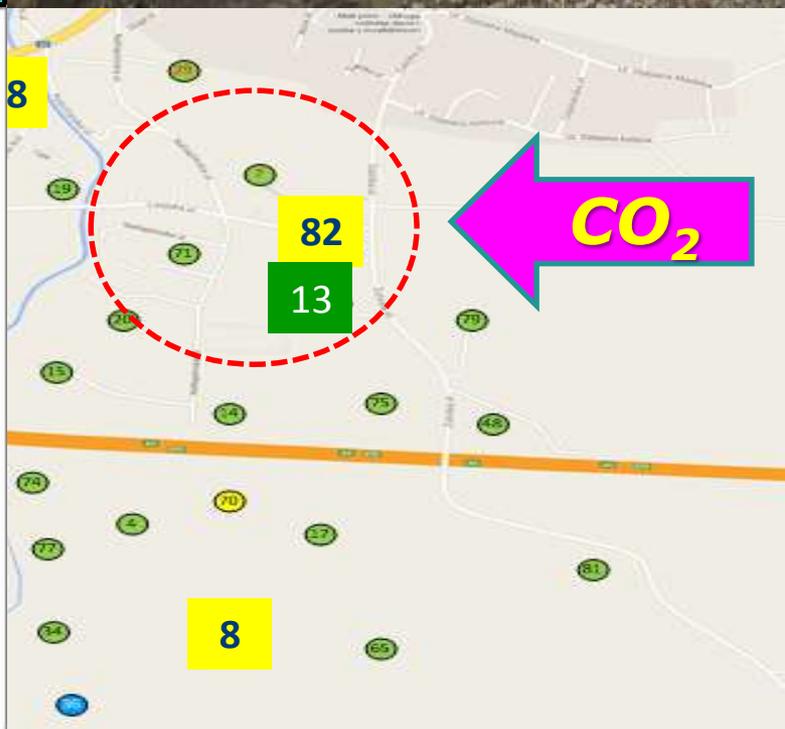
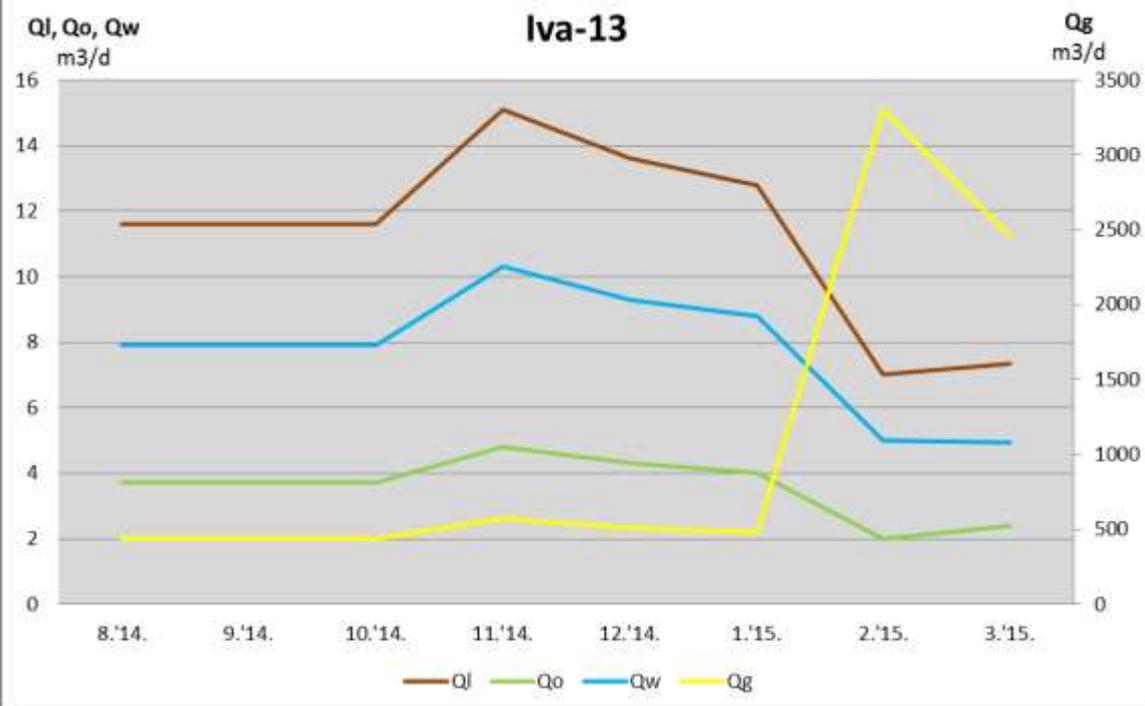


# First results on CO2 % in gas production



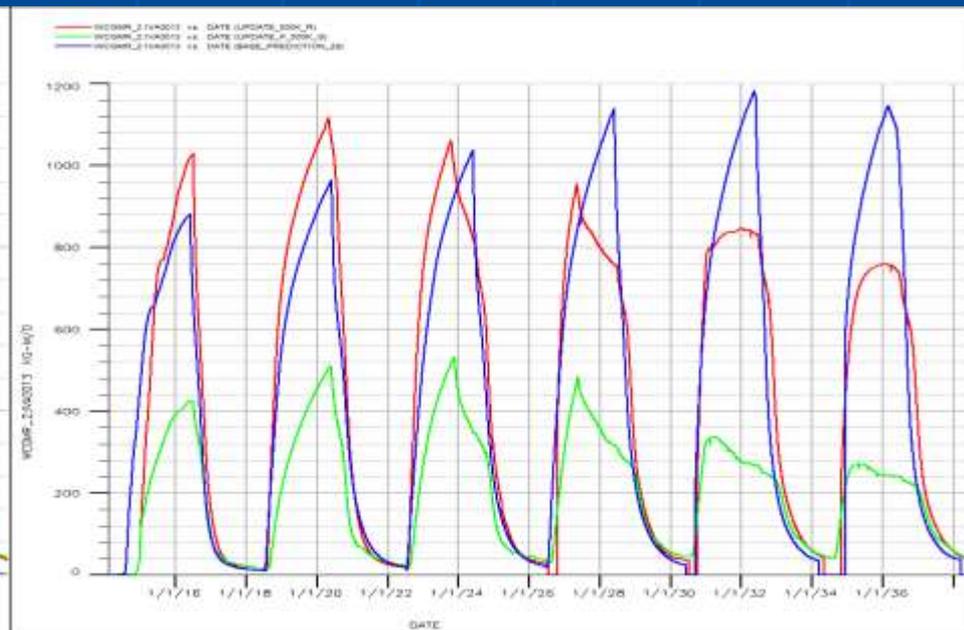
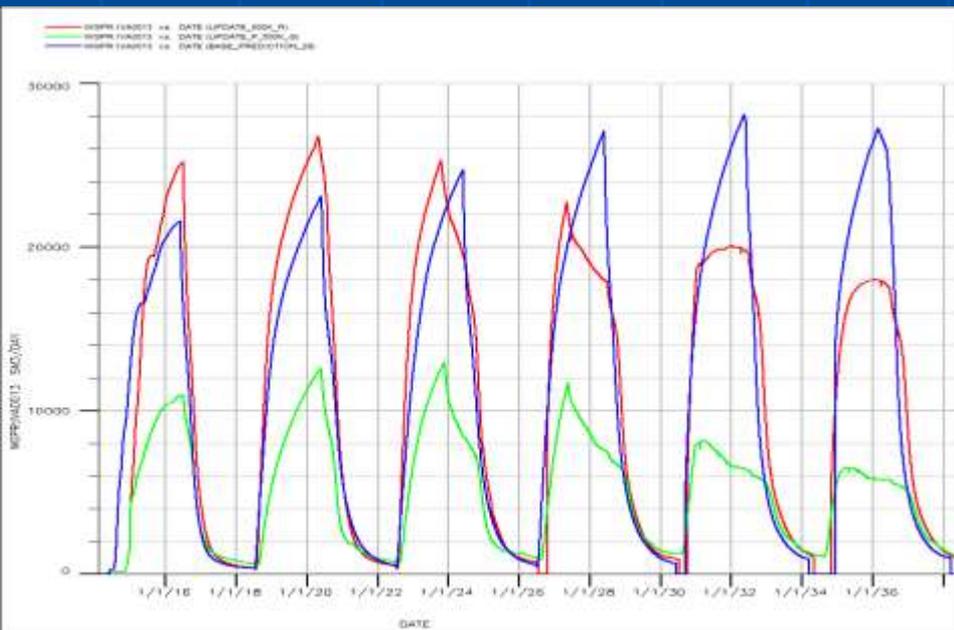
# EF Ivanić first results of CO<sub>2</sub> injection

Iva-13	Ql	Qo	Qw	Qg	Cycle	Method
	m3/d	m3/d	m3/d	m3/d	h	
8.'14.	11.6	3.7	7.9	441	4 x 4h	artificial lift
9.'14.	11.6	3.7	7.9	441	4 x 4h	
10.'14.	11.6	3.7	7.9	441	4 x 4h	
11.'14.	15.1	4.8	10.3	574	3 x 6h	
12.'14.	13.6	4.3	9.3	513	24 h	
1.'15.	12.8	4	8.8	482	3 x 7h	
2.'15.	7	2	5	3300	24 h	natural flow
3.'15.	7.35	2.4	4.95	2456	24 h	



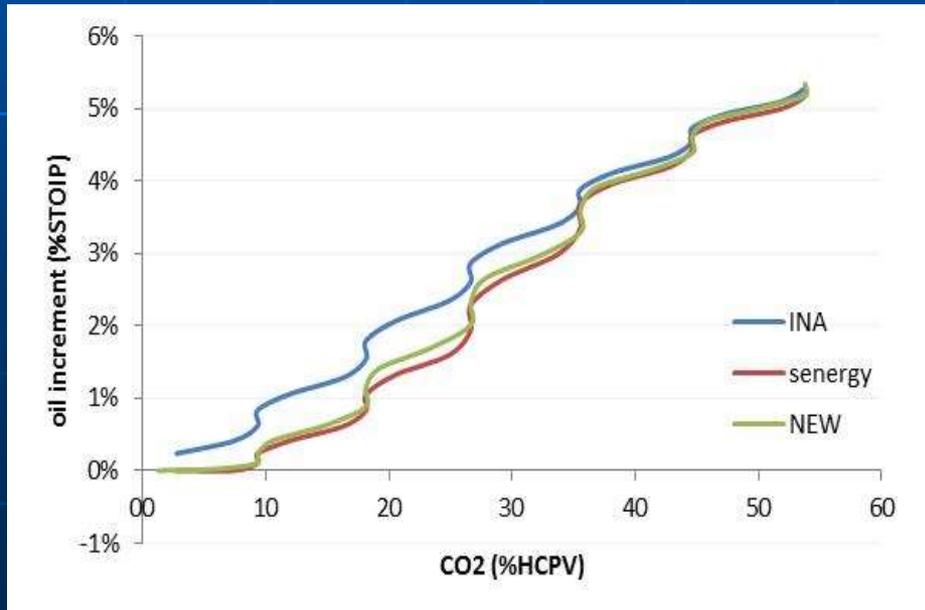
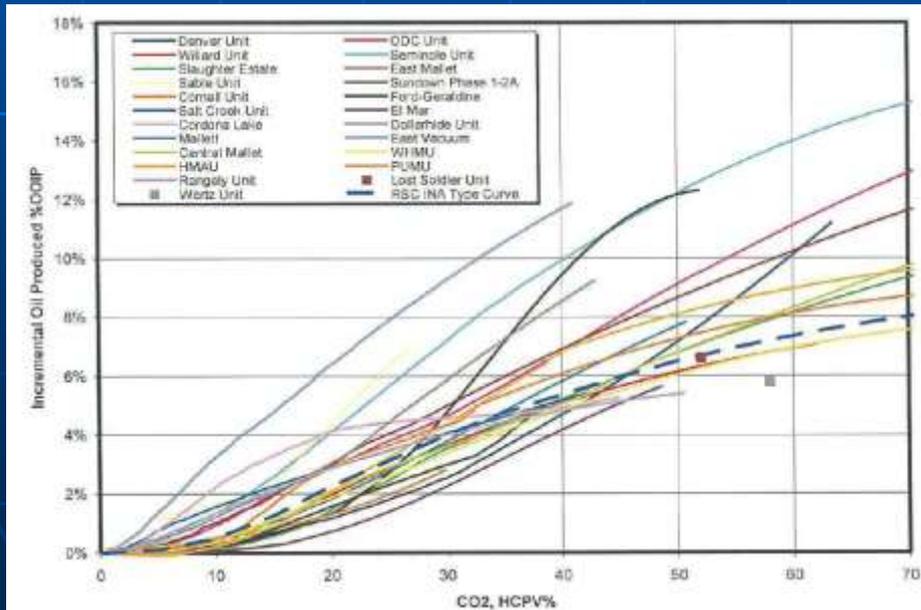
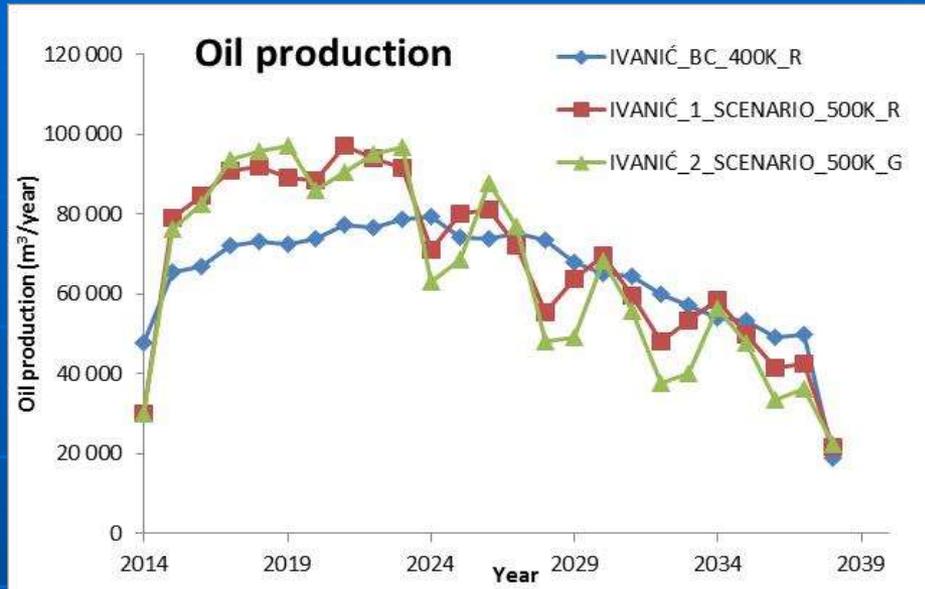
# Monitoring data important for Reservoir Simulation

- Current Ivanić E300 model is being continuously updated in order to increase its predictiveness;
- Major obstacle in the quality is field production using SRP's;
- When wells start to erupt, predictiveness is expected to improve;
- However, the model has been able to predict rather quick CO<sub>2</sub> breakthrough to Iva-13;
- Currently ongoing campaign is in progress in order to improve definition of vertical and horizontal sweep efficiency (production/injection profiles, wellcheckers)



# Monitoring data important for Reservoir Simulation

- Besides, updating the model with production data. Sensitivities are being run in order to estimate expected EOR increment;
- Expected impact is being manually shifted by using cum CO<sub>2</sub> injected (as %HCPV) vs. expected increment;
- By doing so, better fit to actual pilot is being achieved while expected recovery is being kept.



# Distribution of CO<sub>2</sub> through the reservoir

- A need for measurements in injection and exploitation wells in order to monitor the distribution of CO<sub>2</sub> in the reservoir through a process of injection into oil reservoirs Ivanić;
- Gathered data is necessary for making numerical geological model which will be used for better understanding of CO<sub>2</sub> injection process in exploitation field of hydrocarbons Ivanić;
- Electrical well logging has been done in some injection wells;
- Have not laid down all the necessary parameters for understanding the distribution of CO<sub>2</sub> and making the model → the main reason for extension of trial exploitation in EF Ivanić for another year.

# EOR 1<sup>st</sup> phase – trial exploitation

- Trial exploitation of the CO<sub>2</sub> system and CO<sub>2</sub> injection into 12 wells in exploitation field Ivanić for one year period (30.09.2014.-30.09.2015);
- October 14<sup>th</sup> CO<sub>2</sub> injection started into 12 wells in Ivanić:  
Iva-5, Iva-8, Iva-18, Iva-28, Iva-31, Iva-46, Iva-52, Iva-54, Iva-59, Iva-63, Iva-82, Iva-84;
- **Total CO<sub>2</sub> injection quantities from 14<sup>th</sup> October: 113 MM m<sup>3</sup>**
- All activities are conducted in accordance with the program for trial exploitation in Ivanić;
- Have not laid down all the necessary parameters for understanding the distribution of CO<sub>2</sub> → the main reason for extension of trial exploitation in EF Ivanić for another year.

**THANK YOU FOR YOUR ATTENTION !!!**

**EOR**



***SRETNO !!!***