ESTONIAN OIL SHALE INDUSTRY

YEARBOOK 2015

100 YEARS MINING OIL SHALE

The yearbook of the Estonian oil shale industry was issued by:

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YEARBOOK 2015

Estonian oil shale industry in 2015

Income into the state treasury EUR	Total investments EUR	Investments into the environment EUR	Positions for	Sales revenue EUR
120 million	199 million	82 million	7411 people	669 million

Estonian oil shale industry in 2014

Income into the state treasury EUR	Total investments EUR	Investments into the environment EUR	Positions for	Sales revenue EUR
312 million	266 million	43 million	7774 people	933 million

The oil shale industry is cleaner than ever before

Hando Sutter
chairman of the management board of Eesti Energia

In 2015, Eesti Energia completed large-scale environmental investments to bring all power plants into conformity with the more stringent environmental requirements due to enter into force in 2016. The oil shale industry will not stand in the way of meeting climate objectives – up to 2050, it will be possible to meet all targets set for Estonia in a manner that preserves the role of the oil shale industry in the Estonian economy.

In 2015, market conditions put energy producers to the test. In spite of record low energy prices, oil shale companies managed to remain competitive and contributed EUR 120 million to the state budget. While we can't influence prices on the world energy markets, we can find solutions to increase efficacy and make smarter choices.

The state did its part to support the efforts of the oil shale sector to adjust to the extraordinary market conditions by reviewing the regulations on environmental charges. The charges for use of oil shale were temporarily lowered and the goal was set to link the system of environmental charges to the market by 2018. These decisions create the precondition for the oil shale industry to be able to earn income for the state in the future as well.

Congratulating the oil shale industry on a great year

Ahti Asmann
chairman of the management board of Viru Keemia Grupp (VKG)

Despite the reversal of fortunes on the oil market, 2015 was a very successful year for VKG in terms of development of production. Plants consistently operated above their rated capacity, allowing the group to produce 560,000 tonnes of shale oil products and maintain second place among producers worldwide. The Petroter III plant made an important contribution to this result, achieving its maximum production regime just a week after its launch. The project is the largest private sector investment in Estonia in recent years. With the Petroter plants, we have proven yet again that the oil shale sector in Estonia remains competitive and is highly efficient and environmentally friendly even under the new climate policy conditions.

2016 is an anniversary year for the oil shale industry across the country. Exactly a hundred years ago, oil shale mining in Estonia and research into the energy potential of oil shale started. Today this mineral is one of the country's most important natural resources, and mining operations mean jobs for thousands of people, fund a substantial part of the state budget and serves as the linchpin of our energy independence. For that reason, I hope very much that the oil shale industry in Estonia has many more banner years ahead of it.

With the state, we can take the oil shale industry to a new level

Marti Hääl
chairman of the supervisory board of Kiviõli Keemiatööstus (KKT)

The entire oil shale sector is undergoing complicated times. In early 2016, world oil prices were the lowest they have been since Estonia joined the European Union.

The downtrend put one of Estonia's biggest exporting industries in a difficult position where it has to ensure the same level of tax revenue for the state even with the income tax rate dropping incrementally over time, keep up with the constant salary increases and also continue its environmental investments to meet the European Union's climate goals.

Thousands of employees are performing small miracles every day to make all of the above happen. I believe that in cooperation with the state, the Estonian oil shale industry can survive these difficult times and find new energy to become more efficient and a more modern industry while providing jobs to tens of thousands of people in Estonia and serving as part of the bedrock of Estonian export. In doing so, we ensure that the Estonian oil shale industry will have reached a new level of development where the old practice of "stoking the stoves with rock" will have transformed a modern chemical industry that supplies sophisticated chemical products for developing the technologies of tomorrow.

Knowledge-based development is sustainable

Kalle Pirk
Director of the Oil Shale Competence Centre at the Tallinn University of Technology Virumaa College

We have become used to taking oil shale's role in Estonian society for granted, to the point where we don't think about the multifaceted ways we relate to it. Or we assume that everything is just fine. But at a time when voices proclaiming the demise of the industry and exhaustion of reserves are becoming ever louder, all facets have to be examined neutrally and fairly. It seems that all of the sins are being visited upon at least a couple generations of current entrepreneurs, who have invested hundreds of millions of euros into making production more environmentally friendly and eliminating residual pollution.

All of the investments, including into developing technologies, ultimately serve one goal – to ensure the sustainability of the oil shale industry. It's important for society as a whole, as thriving oil shale sector companies will ensure maximum value for our common national resource is maximized, providing security for thousands of jobs and preserving Estonian energy independence. These are goals that require constructive cooperation from all parties to create balanced development strategies and to put in place the optimum regulations. It will be critical to engage the full scientific and research potential to ensure that key decisions are based on the necessary studies and analyses, not on emotions.

Kukruse mine in 1919 or 1920

ESTONIAN OIL SHALE

100

A century of oil shale industry

For the last 100 years, oil shale has been one of Estonia's most important natural resources and energy sources. The development of industry, which started with a fuel crisis in Petrograd in 1915, had seminal importance for Estonia's energy security and economic development. "Brown gold" is the underpinning of an entire industry in Estonia: mines, power plants and oil plants. Companies that valorise oil shale employ thousands of people, make a substantial contribution to the state budget, ensure the country's energy independence and champion the well-being of the north-eastern Estonian region and the whole state.

More efficient industry

Of the 20 underground and opencast mines that have operated over the last century, a number are still in operation. Over its long history, the industry has developed in all facets: going from simple combustion of oil shale in furnaces to manufacturing fine chemical products used in the cosmetics and pharmaceutical industry. The oil shale industry is today smarter, more efficient and a better environmental citizen than it has ever been. While in the early years of the industry, only 30% of the energy stored in oil shale was harnessed, today's new technologies allow companies to extract 80% of the energy when co-generating oil, gas and power.

Mining technologies have also made huge leaps over the decades. Twenty years ago, it took around 10,000 miners to extract 16 million tonnes of oil shale, today only one-quarter of the workforce is needed to do the same amount of work.

1916 The first test mining operations are started near Pavandu

1918 On 24 November, the Republic of Government's Provisional Government discusses the status of the oil shale mines – this date is considered the official start of the Estonian oil shale industry. Oil shale starts to be used as a fuel in various industrial branches as well as in everyday life

1920 The Estonian Mining Board gives the Northern Paper and Cardboard Factory (Põhja Paberi- ja Puupapivabrik) permission to perform oil shale exploration in the lands between Sonda and Püssi railway stations

1921 Trial oil production was launched in Kohtla trial oil factory

1922 The paper mill AS Põhja Paberi- ja Puupapivabrik assigns all of its rights and claims to AS Eesti Kiviõli

1924 The first oil plant is launched in Kohtla, with an output of 10,000 tonnes a year

1924 Tallinn Power Plant starts using oil shale as its basic fuel. This marks the beginning of the use of oil shale for generating electricity for the public power grid

1937 A fan-driven forced-air ventilation system is introduced in Ubja. Electrical light is introduced in major underground mining tunnels immediately before World War II

1940 AS Eesti Kiviõli and AS Küttejõud are nationalized, and AS Eesti Kiviõli becomes Kiviõli Põlevkivikeemia Kombinaat

1941-1944 A large-scale industrial complex is built in Kiviõli: two new tunnel kilns, eight gas generators and a power plant

1941 German forces capture Kiviõli and an oil shale company, Baltische Ölgesellschaft in Estland, is founded

1949 The oil-shale-fired Kohtla-Järve thermal power plant is launched

1953 The first 500 tonnes of an oil shale varnish called Kukersool is produced, as are epoxy, tanning substance, formalin and other products

1953 The first experimental solid-heat-carrier-based system, the UTT-200, is introduced, with a processing capacity of 200-250 tonnes of fine-grade oil shale a day

1958 The Scientific Oil Shale Research Institute is founded at Kohtla-Järve

1959 The start of the era of major power plants: Baltic thermal power plant is completed in Ida-Viru County

Caring about the environment

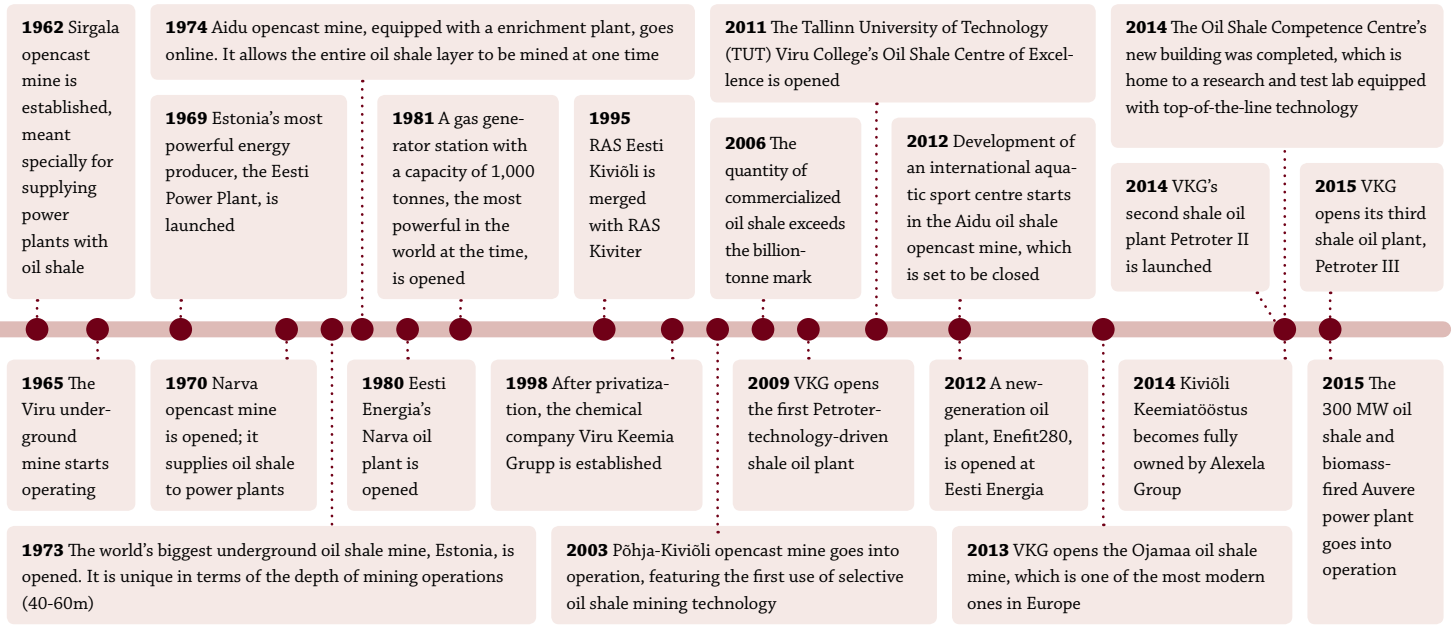
Estonia uses the most modern technologies there are, allowing oil shale to be mined and enhanced in an increasingly environmentally friendly and sustainable manner. The smoking stacks that symbolized the oil shale industry in the last century have been replaced by the clean burning systems required by European Union standards. Oil shale industries have minimized their environmental impact by making significant investments for eliminating past pollution problems and keeping their environmental footprint lower than ever before.

Even more areas of use

Historically, the first use of oil shale was to produce oil, then gas for household use; it then started to be used primarily for generating electricity. Today oil shale is still mainly used for generating power and heat and for producing shale oil, as well as in the chemical industry and the construction sector. Uses are also being explored for the by-products created in the process of mining and processing oil shale.

Broader-based knowledge and experience

The centuries-long history has turned Estonia into a world leader in the oil shale sector. Today the Estonian oil shale industry can be considered the world's most advanced. Half of all of the oil shale mined worldwide is extracted in Estonia. Thanks to the unique know-how, experience and technology amassed over the century, Estonia itself has become a centre of excellence in oil shale.



Workers in Kukruse mine in the 1920s

ROLE OF THE OIL SHALE INDUSTRY IN THE ECONOMY

State revenue from the oil shale industry

In spite of record low prices for power and liquid fuels, the oil shale industry managed to make a noteworthy contribution to the state budget in 2015. A total of EUR 120 million flowed into the state treasury as resource and pollution charges (EUR 74 million), workforce taxes (EUR 41 million) and other taxes (EUR 5.5 million).

Oil shale enterprises also continued implementing large-scale development projects in 2015. The total investments made by four industrial enterprises over the year totalled around EUR 200 million.

A total of EUR 120 million flowed into the state treasury from the oil shale industry

In cooperation with the state, the enterprises worked to create a strategic vision and, led by the Government Office, a package of analyses was initiated to plan the future of the oil shale industry. The state responded to the drop in market prices and put together a plan to implement a new system of environmental charges that would depend on the market price of oil shale end products, where the resource charges for oil shale processing would be linked to world market prices for liquid fuels that impact the price of oil shale end products. To this point, oil shale enterprises had paid resource charges independently of the market price level, but in 2015, studies were launched to link resource charges to the market price. The plan is that if the market price drops, the resource charge for mining oil shale will also go down; if the market price goes up, so would the resource charge.

THE ESTONIAN OIL SHALE INDUSTRY IN FIGURES	Sales revenue (millions of EUR)	Average number of employees	Oil shale mined (thousands of tonnes)	Energy content of mined oil shale (MJ/kg) *	Tax footprint 2015 (millions of EUR)**
Companies related to Eesti Energia's oil shale industry	456.4	4 621	11 083.4	8	84.2
Viru Keemia Grupp (VKG)	151.3	1 930	2 637.1	8.2 and 11.8	21.6
Kiviõli Keemiatööstus (KKT)	23.2	664	1 349.9	9	6.5
Kunda Nordic Tsement (KNT)	37.7	196	116.7	7.3	8.0
TOTAL	**668.6**	**7 411**	**15 187.1**		**120.3**

** Calorific value of commercial oil shale*

*** Workforce taxes, resource and pollution charges, corporate income tax, customs duty, land tax*

Competitiveness of the oil shale industry

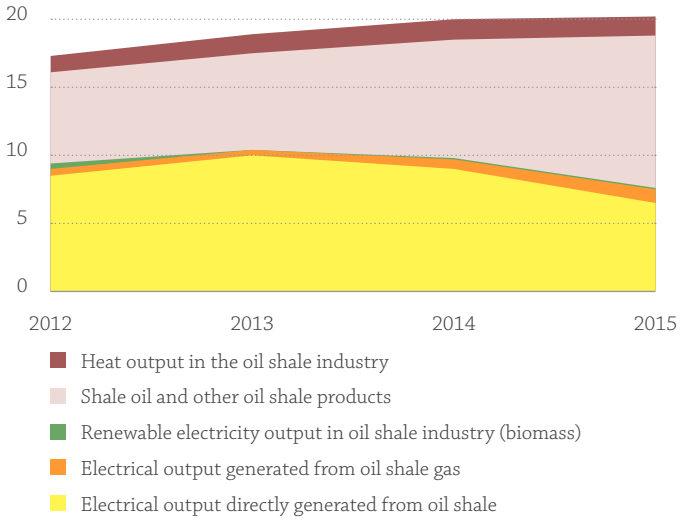
Estonia – the least energy-import-dependent country in Europe

According to the latest survey from Eurostat, Estonia was only 8.9% dependent on energy imports in 2014. This is the lowest level in the whole European Union and much lower than the European Union's average, which is 53.5%. With this result, Estonia topped Europe's longstanding former leader in energy independence for the second year running. Denmark's figure was 12.8% in 2014.

Strengthening the domestic energy industry

Above all, the decrease in Estonia's import dependence level signals to a stronger domestic energy industry. Consumption of imported energy sources dropped. With regard to liquid fuels, which Estonia imports close to 60% of, consumption decreased by 6%. At the same time, the consumption of natural gas, for which Estonia is 100% import-dependent, dropped an entire 43.5%.

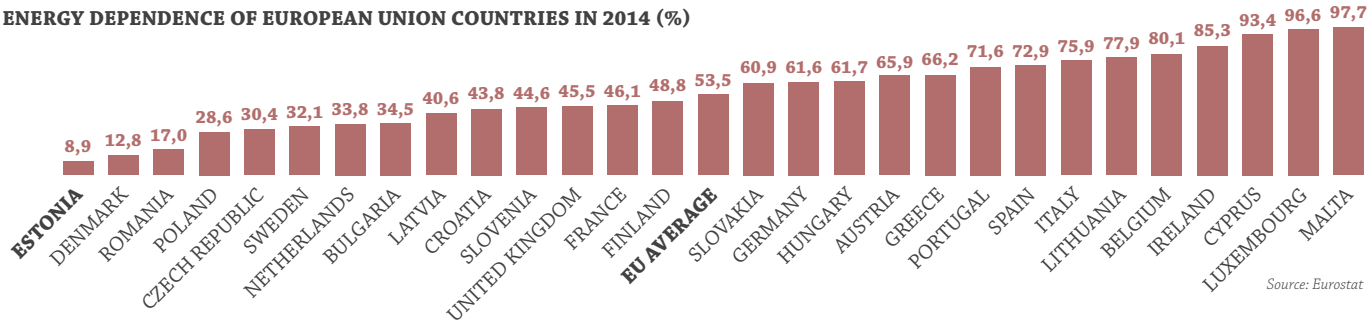
ENERGY OUTPUT OF OIL SHALE ENTERPRISES (TWh)



Source: Eesti Energia, Viru Kremia Grupp, Kiviõli Keemiatööstus

Estonia strengthened its position as the least energy-import-dependent country in the EU

ENERGY DEPENDENCE OF EUROPEAN UNION COUNTRIES IN 2014 (%)



Source: Eurostat

A new and better framework for activity in Estonia

The activity framework related to the oil shale industry is constantly being updated and supports better upgrading of oil shale and reduction of environmental impact.

Mining 'after the fact'

The crisis in the world's oil sector has had an impact on legislation governing the mining of natural resources in Estonia. In June 2015, Parliament approved amendments to the Earth's Crust Act and the Environmental Charges Act, which allows companies in the sector to carry forward the unused part of their allotted mining volumes since 2009. The amendment helps oil shale enterprises better adapt to market demand fluctuations. In the last five years, companies have mined over 31 million tonnes less than the volumes allotted to them.

Tens of millions in environmental charges

In 2015, nearly EUR 74 million flowed into state treasuries from oil shale enterprises in the form of resource and pollution charges. In 2015, government officials considered raising the environmental charges for 2016 but in the course of the discussions it was found that this would not be justified. The charges were thus not raised and the 2015 rates were left untouched. The Ministry of the Environment launched a project for evaluating external costs of the environmental impacts.

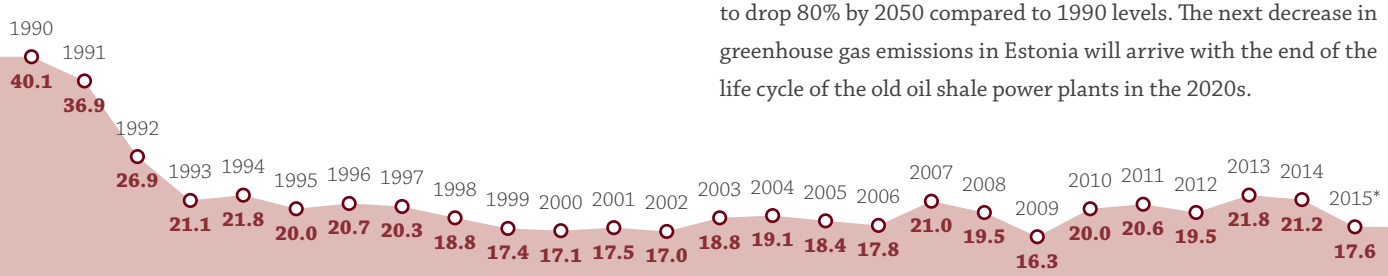
National Development Plan for Use of Oil Shale

In late 2015, the government approved the National Development Plan for Use of Oil Shale for 2016-2030, which sets forth the principles and directions for the development of the field. In the next 15 years, the main focus will lie on better upgrading of oil shale – in other words, producing oil, with the use of oil shale for heat and power set to decrease. To increase the effectiveness of the use of oil shale, the development plan calls for the best available practices to be developed and implemented, emissions cut, resource conservation increased, the amount of waste generated reduced and the recovery of waste increased. All of this is to further extend the value chain for the use of oil shale and to make maximum use of the oil shale resource.

The annual amount of oil shale that can be mined each year remains at 20 million tonnes in the development plan. The position that the annual allowance should be decreased was taken off the agenda. At the 20 million tonnes per year rate, oil shale reserves in existing mines are sufficient to last 17-18 years. There is however enough oil shale left in Estonia to last decades after that.

Fundamental principles of Estonian climate policy up to 2050

The principles of Estonian climate policy up to 2050, prepared by the Ministry of the Environment, take into consideration the objectives of EU climate policy. These call for greenhouse gas emissions levels to drop 80% by 2050 compared to 1990 levels. The next decrease in greenhouse gas emissions in Estonia will arrive with the end of the life cycle of the old oil shale power plants in the 2020s.



* *Forecast*

GREENHOUSE GAS EMISSIONS IN ESTONIA, 1990-2014 (MILLIONS OF TONNES)

Source: Eurostat, Ministry of the Environment

European Union climate policy

The Paris climate agreement

At the end of 2015, 195 countries signed a pact in Paris to limit greenhouse gas emissions. The purpose of the agreement is to keep the rise in global temperature well under 2°C compared to pre-Industrial Revolution levels. Encompassing around 95% of the global greenhouse gas emissions, it is the first truly global agreement to draw attention to climate change and its impacts.

The objective of the Paris Agreement is long-term and requires the entire energy sector to be reshaped. The speed of the process depends largely on the development of the new and existing low-carbon technologies (agriculture, production, transport, energy production), while maintaining people's existing quality of life.

The European Union's climate policy objectives

The European Union's 2014 climate policy objectives are significantly more ambitious than those of any other Paris Agreement signatory. The EU's climate policy development will proceed from the five-year cycle of reviewing compliance with the Paris Agreement's targets and will thereby encourage other countries as well to devote more attention to climate policy. In addition to the global decrease in emissions, it will also allow the carbon leak threat to be reduced and contribute to more equitable international trade.

The strategic development areas for Estonian oil shale companies support achievement of the European Union's objectives. Generating energy from oil shale is becoming increasingly efficient and environmentally friendly, as the emphasis is placed on the production of oil, the CO_2 emissions of which are low.

The European Union Emissions Trading System

Since 2011, the European Union has had an oversupply of CO_2 allowances due to the recession and decrease in production. In 2015, the European Parliament approved the plan to carry out, in 2019, a reform of the emissions trading market with the goal of reducing the oversupply and lack of clarity and to thereby improve the investment environment. It is likely that it will result in a rise in the price of CO_2 emissions allowances.

By focusing on producing oil with low CO_2 emissions, Estonian oil shale enterprises are contributing to achieving the EU's goals

Shale gasoline station in Virumaa in the 1930s

OIL SHALE VALUE CHAIN:

FROM MINING TO FINISHED PRODUCT

Mining permits and volumes

Enough oil shale energy to last more than 50 years

Oil shale formed in Estonia 450 million years ago. The first efforts to mine and study the energy potential of this "brown gold" started a hundred years ago. Over the century, slightly over a billion tonnes of oil shale have been extracted from the earth's crust in Estonia. Of the current 4.8 billion tonnes in oil shale reserves, there is 1.3 billion tonnes of active oil shale left that can be mined without restrictions. At today's rate of consumption and efficient and responsible activity, it will last for another 50 years at least.

According to the positive scenario, this time may be even longer, as the other 3 billion tonnes of oil – not accessible due to unfavourable geological conditions and restrictions – could also be mined and upgraded in future as technology advances.

Estonia's two main oil shale deposits are located in north-eastern Estonia. The thickest oil shale strata lie in an area between Rakvere and Narva, in the so-called "Eesti" site where industries have established both underground and opencast mines. The oil shale layer being mined is between 2.7 and 2.9 metres thick. As the oil shale in the so-called Tapa site between Väike-Maarja and Ambla is of low quality and lies deep, no oil shale is being mined there.

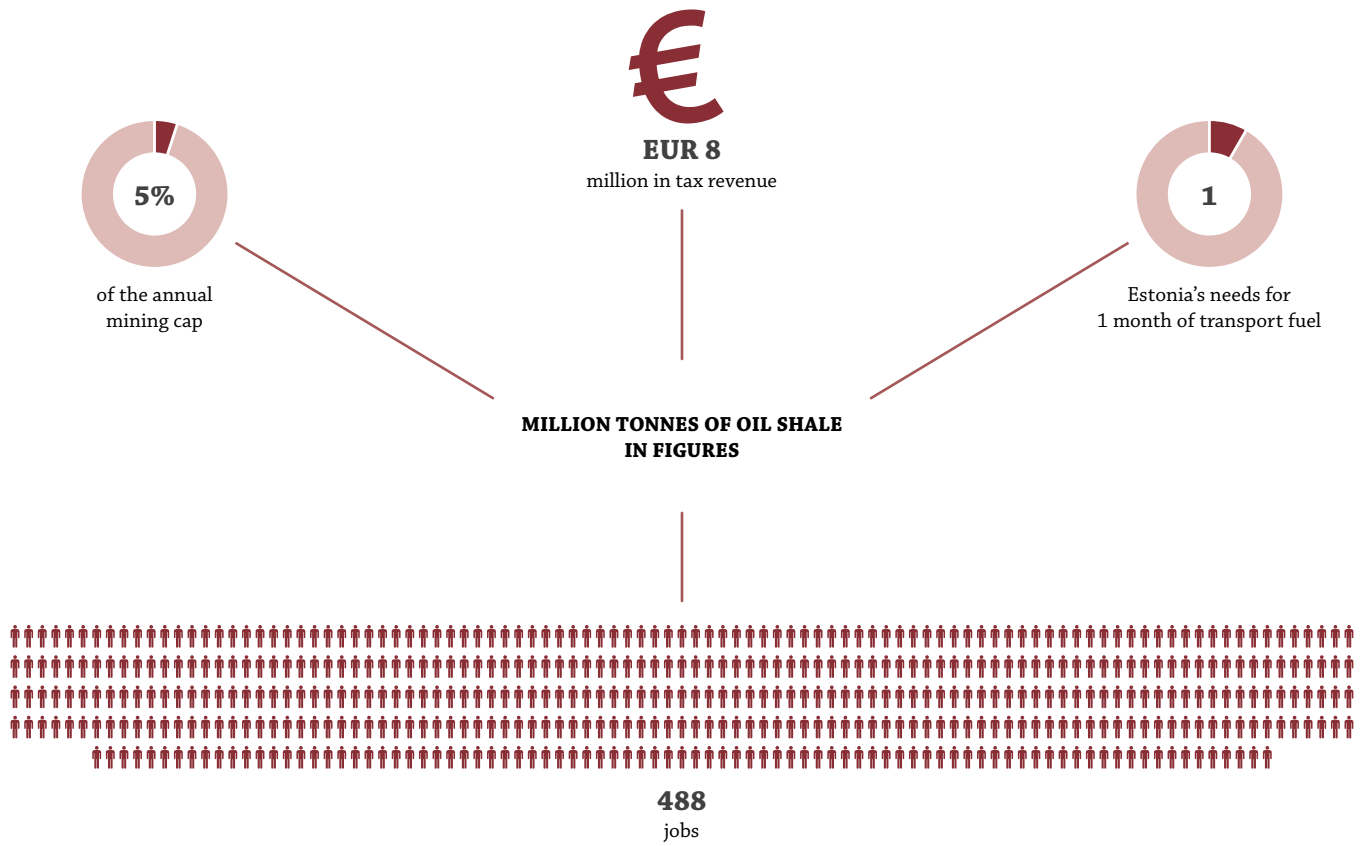
5 million tons less oil shale than allotted

In Estonia, four companies hold permits to mine oil shale – Eesti Energia (EE), Viru Keemia Grupp (VKG), Kiviõli Keemiatööstus (KKT) and Kunda Nordic Tsement (KNT). Pursuant to the state's long-term development programme, 20 million tonnes of oil shale can be mined each year in Estonia. The actual volumes of the four oil shale enterprises have been only around 15 million tonnes due to the low market prices for electricity and liquid fuels as well as because of the limited production capacity. In the last four years, companies' average mining volume has been 75% of the allowed amount, which means that close to 5 million tonnes of oil shale less than the allotted volume is extracted each year. In 2015, none of the oil shale mining enterprises sought an increase in their 2016 limit using allotment carryover from the past seven years.

MINING METHODS

- **Opencast mining** – in places where the oil shale layer lies up to 30 metres deep, the oil shale is mined in opencast mines, after removal of the overburden.
- **Underground mining** – if the oil shale layer lies deeper than 30 metres, an underground mine has to be built – mine shafts have to be established, reinforced and the necessary systems for extracting the rock put in place.

Under conditions of responsible use, there will be enough oil shale in Estonia for at least 50 years



15 MILLION TONNES OF OIL SHALE IS MINED EACH YEAR – LESS THAN THE 20 MILLION TONNES ALLOWED

Company	Annual volume allotted, thousands of tonnes	Actual amount mined (thousands of tonnes)*, share of the allowance used (%)										Average % 2011–2015
		2011		2012		2013		2014		2015		
Eesti Energia	15 010	14 478	96%	13 124	87%	11 830	79%	11 614	77%	11 083	74%	83%
Viru Keemia Grupp	2 772	647	23%	1 097	40%	2 344	85%	2 483	90%	2 637	95%	66%
Kiviõli Keemiatööstus	1 980	637	32%	615	31%	755	38%	1 058	53%	1 350	68%	45%
Kunda Nordic Tsement	238	146	61%	107	45%	98	41%	113	47%	116	49%	49%
TOTAL	**20 000**	**15 908**	**53%**	**14 943**	**51%**	**15 027**	**61%**	**15 268**	**67%**	**15 186**	**71%**	**61%**

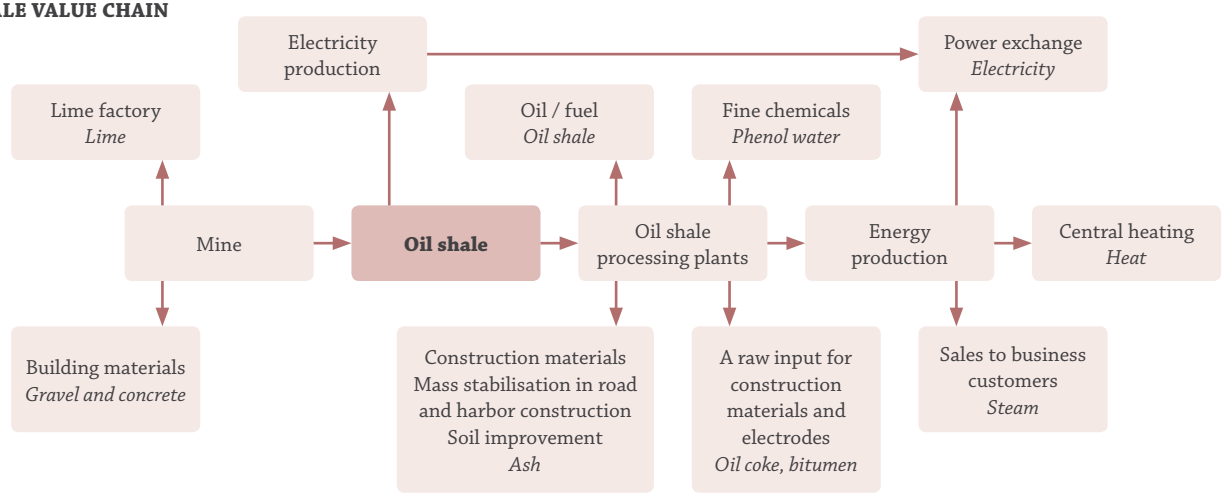
** Geological reserves without considering losses*

Use of oil shale

Estonia's unique energy sector is based on the multifaceted use of oil shale. The majority of it – 73% – is used to generate electricity. The rest is used to generate heat and produce shale oil. Oil shale has uses in the chemical industry and a few percent of the mined volumes are used for producing cement and road construction.

Although the value chain of oil shale is longer than ever before, the depressed fuel prices are forcing companies to invest even more into research and testing to find novel opportunities for the use of oil shale and its by-products.

OIL SHALE VALUE CHAIN



Use of oil shale decreased by 7%

IN 2015

- the average market price of electricity fell 17%
- oil shale remained the cheapest residential heating source
- the average oil price fell 44% compared to 2014

Electricity

In 2015, a total of 10.3 TWh of electricity was produced in Estonia, which is 17% less than the year before. The continuing drop in electrical output was impacted by the lower power exchange prices and the possibility of importing electricity from the Nordics more cheaply. In spite of the decrease in output, power generation still outstripped domestic consumption.

In 2015, for the first time in Estonia, less electricity was produced from oil shale than was consumed in the country. While domestic consumption was a little over 7.4 TWh, 6.8 TWh of electricity was generated. During the year, 1.5 TWh was generated from renewable energy sources, which made up around 17% of the total consumption.

Price of electricity in decline

In 2015, the average prices of electricity fell in every bidding area in the Nordic electricity market. The system price, which expresses the ideal price level for the market, dropped 29% and the average price for the year was 20.98 €/MWh. The main reasons for the price drop were good opportunities to produce hydroelectric energy in the Nordics and the modest growth in consumption.

The average price in the Nord Pool Spot (NPS) in the Estonian bidding area in 2015 was 31.08 €/MWh, which is 17% lower than in 2014. The average monthly prices in 2015 were between 26 and 35 euros per MWh. The electricity market price was less than 30.70 €/MWh (the regulated price valid until the end of 2012) in the case of 53% of last year's hourly prices.

Electricity is a noteworthy export article for Estonia. In 2015, Estonia sold 6.4 GWh of electricity to foreign countries, of which 95% went to Latvia.

ELECTRICITY OUTPUT AND ELECTRICITY CONSUMPTION IN ESTONIA, 2012–2015 (GWh, %)

	2012	2013	2014	2015
Eesti Energia	9 201	10 278	9 343	7 312
Viru Keemia Grupp	210	190	217	311
Kiviõli Keemiatööstus	42	38	39	41
TOTAL POWER OUTPUT	**9 453**	**10 506**	**9 599**	**7 664**
of which oil shale electricity	*8 776*	*10 193*	*9 259*	*6 754*
Consumption of electricity in Estonia	7 407	7 332	7 417	7 440
Share of oil shale electricity of total consumption of electricity in Estonia	*119%*	*139%*	*125%*	*91%*

Source: EE, VKG, KKT, Statistics Estonia

ELECTRICITY PRICES ON THE NORD POOL SPOT POWER EXCHANGE 2014-2015 (€/MWh)

Average price	2014	2015	Change
System price	29.6	21.0	▼ -29.1%
Finland	36.0	29.7	▼ -17.6%
Estonia	37.6	31.1	▼ -17.3%
Latvia	50.1	41.8	▼ -16.5%
Lithuania	50.1	41.9	▼ -16.3%

AVERAGE MONTHLY PRICES OF ELECTRICITY ON THE NORD POOL SPOT ESTONIA POWER MARKET (STARTING 1 APRIL 2010), €/MWh

Source: Thomson Reuters

Liquid fuels

Estonia is one of the world's largest producers of shale oil. Shale oil's advantages over petroleum-sourced heavy fuel oil are its low viscosity, low pour point and low sulphur content. Shale oil is used as an additive in marine fuels and for fuelling boiler units and industrial furnaces.

Thanks to stable demand on foreign markets, the volume of shale oil output has increased with each passing year. In 2015, a total of 915,000 tonnes of electricity was produced in Estonia, which is one-fifth more than the year before. More than 90% of the output was exported: over half (61%) went to the Netherlands, and one-tenth went to Belgium and Sweden.

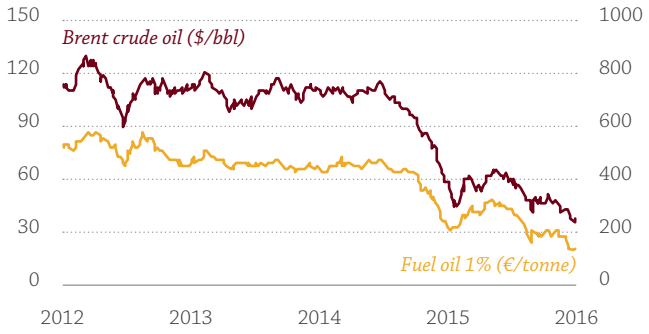
Nowadays, highly energy efficient, environmentally clean production technologies are used to produce oil. The centuries-long experience of Estonian engineers and their contribution into technological progress provide ample evidence for the claim that local oil shale enterprises are using the world's best technology for producing shale oil. The new technologies allow oil shale to be more efficaciously upgraded, leading inevitably to a reduction of the workforce in the oil shale sector.

Oil producers are actively developing possibilities to distil shale oil into fuels with higher value. For example, Eesti Energia is getting ready to distil petrol from oil shale gas; it can be used to produce motor fuels and as a raw material used in the chemical industry.

THE ESTONIAN OIL SHALE INDUSTRY'S LIQUID FUEL OUTPUT, 2012-2015 (THOUSANDS OF TONNES)

	2012	2013	2014	2015
Eesti Energia	209	214	265	337
Viru Keemia Grupp	325	358	433	506
Kiviõli Keemiatööstus	62	56	62	72
TOTAL	**596**	**628**	**760**	**915**

PRICES OF LIQUID FUELS ($/BBL)



Source: Thomson Reuters

FUEL OIL AND BRENT CRUDE OIL CRACK SPREAD

Source: Thomson Reuters

Oil price halves

The continuing downtrend in oil prices that started in the second half of 2014 left a strong mark on 2015. Although after hitting a low point of 45 USD per barrel in January 2015, the price of Brent crude rose back to 69 USD per barrel, the drop in prices continued in the second half of the year and the price of crude oil at the end of the year – 37 USD per barrel – was the lowest it had been all decade. The average price of Brent crude underwent a 44% drop from 2014 levels, falling to 54 USD per barrel.

According to the forecasts for the oil shale industry, energy production and demand will grow in absolute figures in the next 10-15 years and in spite of the slight growth seen in the market share of renewable energy, the market share of fossil energy carriers will not fall much below 80%. Production of oil from oil shale depends largely on domestic policy and the world price of oil. To maintain the competitiveness of the local industry, both companies and the government are making increased efforts, such as developing a stable taxation environment that takes into account the fluctuation of prices on the world market.

In 2015, for the first time in Estonia, less electricity was produced from oil shale than was consumed in the country. At the same time shale oil production went up by 17%

Heat

The use of oil shale for generating heat has decreased consistently in the recent years. The reason for the lower demand is milder weather and increased investments into energy conservation. In 2015, a total of 6.7 TWh of heat was generated, which is 0.4 TWh less than a year before. As it is not possible to store or transport heat efficiently, it is consumed immediately and in close proximity to the production site. Estonian heat output is therefore more or less equal to demand.

Heat from oil shale by-products

Most of the thermal energy generated in Estonia comes from co-generation (heat and power plants) as this is environmentally more sustainable. There are several types of co-generation plants and they run on different fuels. One of the largest ones, Balti Power Plant – has an output of up to 400 MW of heat. Eesti Energia routes the heat produced there to the Narva Soojusvõrk's district heating systems and hot water consumers. Steam is also supplied to industrial consumers.

The Kohtla-Järve, Ahtme and Jõhvi areas are supplied with heat by VKG's subsidiary VKG Soojus. The company uses the residual heat generated in the course of processing oil shale. The residual heat arrives at consumers in the Kohtla-Järve and Jõhvi areas through an 18.5-kilometre long trunk line. VKG Soojus distributes the heat generated in the oil shale industry both to industrial enterprises in Ida-Viru County and consumers in the region; electricity from co-generation is also used across Estonia. Co-generation of heat and power at KKT covers the company's own needs as well as those of the city of Kiviõli.

Oil shale regions enjoy preferential status

In 2015, the limit price of heat for end consumers approved by the Competition Authority averaged 66 euros per MWh across Estonia. Residential heating was still more affordable than the average in cities where it is generated as a by-product of the oil shale industry. For example in 2015, heat only cost 34 euros per MWh in Narva, while the price was 51 euros in Kiviõli and Sillamäe and 55 euros in Ahtme, Jõhvi and Kohtla-Järve.

Residential heating was still more affordable than the average in cities where it is generated as a by-product of the oil shale industry

OIL SHALE COMPANIES' HEAT OUTPUT AND HEAT CONSUMPTION IN ESTONIA, 2012–2015 (GWh)

	2012	2013	2014	2015
Eesti Energia Narva Power Plants	599	584	603	604
Viru Keemia Grupp	365	650	581	532
Kiviõli Keemiatööstus	93	90	107	108
TOTAL	**1057**	**1324**	**1291**	**1244**
Consumption of thermal energy in the form of district heating in Estonia	8598	8098	8015	7789

Source: EE, VKG, KKT, Statistics Estonia

Fine chemical industry

The scale of uses for chemicals derived from oil shale is very broad. Chemicals produced from Estonian oil shale can be found in dyed textiles and tanned furs, the hair dyes marketed by L'Oréal, Wella and Schwarzkopf, and facial creams and suntan lotions. They are also used in producing Samsung TV screens and Lexus and Toyota automotive parts.

Honeyol and Rezol, two oil shale phenol fractions, are used as epoxies in the tyre, plywood and oil industry and as base chemicals for making paints and lacquers. Starting in 2012, the so-called "red resin" is also produced from Estonian oil shale, which is used to make automotive tyres – it is used by the world's leading tyre manufacturers such as Goodyear, Pirelli and Bridgestone.

Valued chemicals

VKG is today the only company in Estonia that distils valuable fine chemicals from the oil products of plants that use the Kiviter technology. VKG is capable of producing extremely pure (in excess of 99%) chemicals that can fetch up to several hundred euros per kilogram. In 2015, VKG sold about 500 tonnes of fine chemicals and phenol products.

The largest consumers of Estonian oil shale chemicals are well-known companies in the European Union, Japan and India. The fine chemicals made in Kohtla-Järve have also reached Iran and Latin America.

KKT also launched a research project in 2015 to investigate ways of upgrading oil shale into chemical products. This constitutes rediscovery of an old science that KKT hopes will reduce dependence on world oil prices. It will also ensure greater value for oil shale and refining shale as opposed to producing oil would result in 10 times less CO_2 emissions. The quantities of solid waste generate would also decrease.

The most valuable part of Estonian oil shale is the extremely reactive fine chemicals

Uses for by-products of the energy generation process

The potential of by-products of the energy generation process was recognized already decades ago. But they are still only on the cusp of their real heyday: Products made from oil shale by-products can be used as analogues for many construction materials and commodities. Making maximum use of the by-products will reduce the environmental impact while creating economic benefits at the same time. Transforming industrial waste to valuable, environmentally friendly products is currently a field of great interest in the European Union and elsewhere in the world.

Each year, oil shale mining and enrichment generate as by-products close to 20 million tonnes of mine waste and ash that can be used in power generation. Preventing these from ending up in landfills reduces the environmental impact of oil shale and increases the competitiveness of the industry.

Crushed stone from opencast oil shale mines

In 2015, mining and enrichment of oil shale generated around 12 million tonnes of mine waste consisting of limestone, dolomite, marl and a low level of oil shale as well. One-third of this was used as crushed limestone for road construction, landscaping and filler.

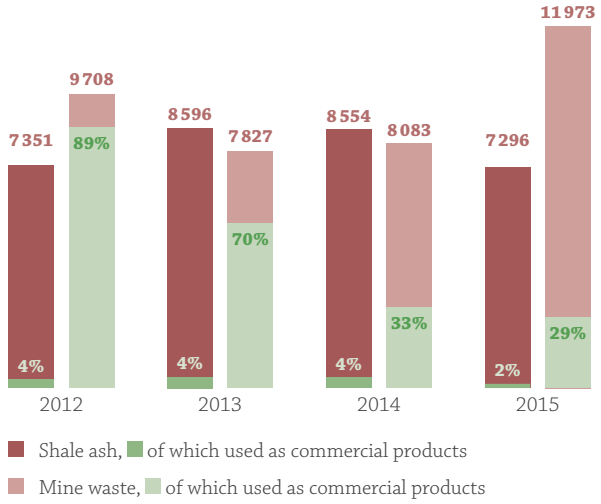
Mine waste is essentially limestone. Actively using mine waste means fewer limestone opencast mines to be opened. Due to the high cost of transport, crushed stone from oil shale mines has been used only in Ida-Viru County construction sites so far. For its part, the state can do more to contribute to waste recovery through establishing various systems of charges and tax incentives.

Standardized products from oil shale ash

Estonia is one of the few countries that categorises the fine ash generated in the course of power generation and then disposed of in landfills as a hazardous waste. In spite of this fact, many products made of burnt oil shale, i.e. oil shale ash, are standardized, allowing the ash to be used better than if it were just dumped in a heap.

In 2015, the Estonian Centre for Standardization published a new standard that allows the ash from pulverized shale combustion furnaces and bag filters as well as cyclone ash to be used for producing cement, concrete and cellular concrete in Estonia and

BY-PRODUCTS GENERATED BY THE OIL SHALE INDUSTRY (THOUSANDS OF TONNES) AND THEIR USE AS COMMERCIAL PRODUCTS (%)



elsewhere. Instead of waste status, oil shale ash was reclassified as a product, ensuring that it enjoys a position on the construction products market.

In 2015, the Estonian oil shale industry generated 7.3 million tonnes of ash, of which 2% was recovered for new products. Shale ash has very high potential for use as a product. In addition to cement and concrete, it can be used to produce masonry units, other construction materials, and plastics.

A vehicular road made of ash

2015 saw the OSAMAT pilot project – launched in 2010 as part of the European Union programme LIFE+ – continue. Its goal is to significantly increase the use of the oil shale ash that is a by-product of power generation. Increased use of oil shale ash means less CO2, a greenhouse gas, is formed and natural resources such as crushed stone, sand and clay can be conserved. In the course of the testing, oil shale ash was added to concrete mixes used for mass stabilization of marshy and clayey areas in highway construction. Test areas for existing secondary roads built on soft substrate in Lääne-Viru and Ida-Viru County were also constructed. The results of the pilot project confirmed that the test segments constructed of oil shale ash have high strength and load bearing capacity indicators and that there was no negative impact on the environment. User manuals and standard documents are being developed for Estonian road construction technology.

Fly ash for more fertile soil

For decades now, oil shale ash has been used to raise the pH of farmland. Eesti Energia separates the fine particles and calcium-rich fly ash from smoke gases generated during the high-temperature combustion of oil shale, and uses it as a fast-acting neutralizer of acidic soil. Fly ash also contains many minerals such as phosphorus, potassium, magnesium, zinc, copper, sulphur, manganese and silicon, which can raise the fertility of soil. In 2015, four years of testing was completed in the Estonian University of Life Sciences forest section. The results showed the nutrients contained in soil amendments based on fly ash were suitable not only for improving cropland characteristics but also for growing forest stands and for stimulating the rate of growth of forest stands on peat soils.

PIPING ASH UP THE HILL

In 2015, VKG adopted the Baltics' and Scandinavia's most powerful conveyer system for removing ash. It will decrease noise and dust levels, reduce the amount of emissions and keep the surroundings cleaner. The new system, which allows 380 tonnes of ash per hour to be transported, delivers ash from all three Petroter shale oil plants into an ash heap through a 1.5 kilometre long pipe conveyor. At the end of the conveyer, ash is mixed with water, spread and rolled into the landfill. This process creates a geotechnically stable water-resistant and concrete-like monilith.

Now fewer trucks are required for transporting the ash. The trucks' journey also was shortened by four kilometres. Compared to the hydro ash removal system, this new technology conserves clean water.

Kiviõli ash mountain in the 1930s

OIL SHALE INDUSTRY AND THE ENVIRONMENT

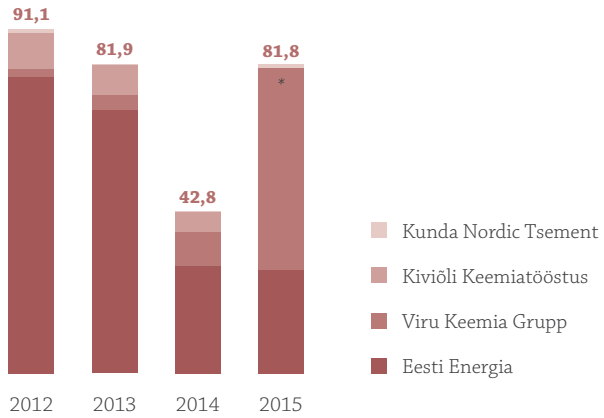
Investments into the environment

33 million euros into the environment

The ecological footprint of the Estonian oil shale industry is smaller than ever before. For the sector, caring about the environment is now a priority. As a result of consistent efforts, companies have minimized the environmental impacts of mining and upgrading oil shale, simultaneously increasing the effectiveness of use of oil shale as a resource.

In 2015, oil shale companies' direct investments into environmental conservation totalled nearly EUR 33 million. Factoring in indirect investments, environment-related investment stood at EUR 83 million. In comparison, the foundation Environmental Investment Centre invested EUR 45 million into environmental projects in 2015.

ESTONIAN OIL SHALE COMPANIES' DIRECT AND INDIRECT ENVIRONMENTAL INVESTMENTS IN 2012-2015 (MILLIONS OF EURO)



** Includes indirect environmental investments in connection with expanded production volumes and the establishment of the Petroter III shale oil plant*

New-generation plants have less of an environmental impact

Despite the complicated times in the oil shale sector, many investment-intensive production units were completed in 2015 allowing more effective upgrading of oil shale and making full use of its potential.

In 2015, Eesti Energia's new Auvere power plant began generating power and feeding it to the power grid. Auvere plant uses an environmentally clean fluidized-bed technology. Up to 50% of the oil shale used in the power plant can be replaced by biomass. Other fuels such as peat or coal can also be used to generate electricity. The capacity for use of biomass reduces the environmental impact of the power plant and increases its competitiveness amidst increasingly stringent European Union climate policy conditions.

At the end of the year, VKG opened its third oil plant, which uses the Petroter technology, noted for its superb performance. During 2015, VKG oil shale plants processed more than 3.5 million tonnes of oil shale, producing 506,000 tonnes of shale oil, which is 56% of the total volume of oil produced in Estonia. At over 80% energy efficiency, the plants' footprint is many times smaller than in the case of past technologies. The construction of the Petroter plants is the largest investment in Estonian industry made by a privately owned company in recent years. VKG invested over EUR 220 million into three plants, of which EUR 84 million was used to build Petroter III.

In 2015, Eesti Energia's Enefit280 oil plant produced a record of over 137 thousand tonnes of shale oil. Due to the innovative technology used in the Enefit280 plant, its energy efficiency is higher than

that of other plants and the emissions into ambient air are many times lower. The unique technology used at the new oil plant enables electricity to be produced from residual heat besides shale oil and oil shale gas. As a result of this co-generation, oil shale yields more energy and CO_2 emissions from generating electricity based on the use of residual heat and oil shale gas have been cut by up to 40%.

In 2015, Eesti Energia announced a procurement for increasing the use of oil shale gas in unit no. 8 of the Eesti power plant. The upgrade will allow using the gas produced in oil plants more efficiently and reduce emissions into ambient air significantly. It is planned to complete the works by the end of 2018.

Also in 2015, KKT completed long-running preparations at the second reactor in its solid heat carrier system. As the tests conducted showed that the required stability had been reached in the reactor's operation, KKT was able to receive an authorization for use for its most recent oil production equipment. The company also started upgrading its technology for purifying heavy oil so that it could produce higher-quality shale oil with lower environmental impact.

A contemporary approach to environmental protection

The oil shale sector uses the ISO 14001 standard environmental management in its everyday work, aiming to map all environmental impacts and constantly improve ways of dealing with the impacts. That means that the companies analyse systematically environmental impact, clean consumption and recovery of resources and engage in close cooperation with research institutes for developing more conservation-minded and innovative solutions.

Environmental impacts associated with mining

The impacts of mining on the environment are related to land and resource use, changes in the water regime, waste generation and the emergence of new surface features. The extent and nature of environmental impacts depends largely on whether underground or opencast mining is used to extract the oil shale.

Oil shale, a shaper of the landscape

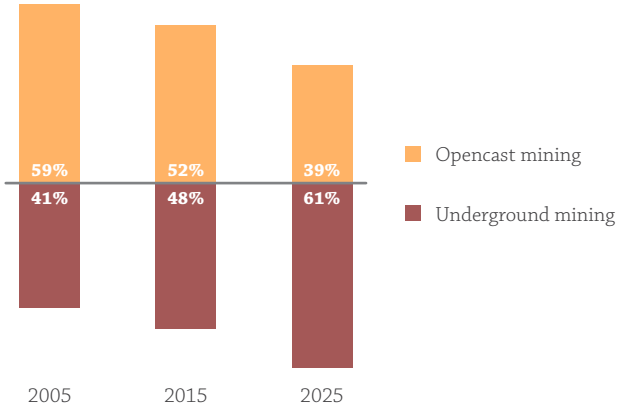
Any sort of mining entails environmental impacts to some degree. Underground oil shale mining creates areas prone to subsidence and sinkholes. Opencast mining, on the other hand, creates entirely new landscape forms. Heaps of mine waste accumulated over the years contain hundreds of millions of tonnes of production waste.

Underground mining – easier on nature

Compared to opencast mining, underground operations have less of an impact on local population and the environment. The existing landscape and ecosystems are preserved, although they may be affected to some extent by changes in the soil water regime. The transportation of oil shale from mines by conveyor is dust- and noise-free and preserves local roads.

At the same time, underground mining leads to an increasing amount of mine waste that goes into landfills, which in the case of opencast mining would stay in the mines. Mine waste is already successfully used in road construction and to fill in underground mine passages. The oil shale industry is constantly looking for additional ways to recover mine waste in order to use its full potential.

SHARE OR OIL SHALE EXTRACTED VIA OPENCAST AND UNDERGROUND MINING (%)



Today oil shale is mined using the underground method in VKG Ojamaa mine and Eesti Energia's Estonia mine and using the opencast method in KKT's Põhja-Kiviõli opencast mine and Eesti Energia's Narva opencast mine.

Oil shale mining in Estonia is clearly moving in the direction of underground mining. According to the best of our knowledge today, in 2030, nearly all oil shale will be mined in underground mines, as the mining is moving deeper into the earth's crust each year in search of the valuable brown gold.

Increasingly more efficient mining

In 2015, Eesti Energia started adopting advanced room-and-pillar mining technology in 2015, which due to the lower volumes of penetration, has lower mining costs than the current method. The new method is similar to room-and-pillar mining in that the ground surface remains intact; at the same time, the mining takes place along a 700-metre slice instead of the usual 200 metre wall. Eesti Energia, which invested over 21 million euros into developing the new methods, obtained the first output in January 2016. Full capacity will be achieved in early 2017, when the supplemental annual volume will be close to 0.8 million tonnes of oil shale.

KKT upgraded the opencast mine's technical equipment in 2015 to increase efficiency. The most important addition was the acquisition of the largest excavator in the Baltics, capable of harvesting much more oil shale for the same expense outlay.

Restoring the landscape

Over the century, the oil shale industry has left a discernible mark on the landscape of Ida-Viru County. Ash hills rise in the area between Kiviõli and Narva, along with the highest artificial hill of semi-coke in the Baltics, and artificial lakes; pine forests cloak undulating afforested knolls.

Fascinating sights

An integral part of oil shale mining is the process of reconditioning former opencast mine areas to return them as close to the pre-mining condition as possible or at least shape an equivalent landscape. Over time, it has become better thought-through and there is an increasing ability to make use of the industrial landscape in a positive way for the region. Ida-Viru county's obligatory sights include the Estonian mining museum, unique in Europe, located in a onetime oil shale enrichment plant; the former Aidu opencast mine, being turned into an aquatic sport centre; and the Kiviõli adventure park set on a semi-coke hill.

A new generation of forests instead of oil shale

A large share of the landscape reconditioning involves afforestation of the opencast mines, in the course of which the mining area is restored to as close to the natural state as possible. The afforested opencast mine areas do not look much different to natural forests. The mined areas are levelled while the opencast mine is still operational, young trees are planted. When the mining ends, the area will be clad in forest already several decades old, or by cropland.

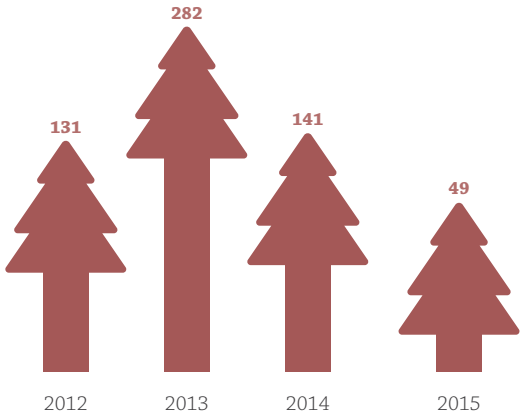
In 2015, the State Forest Management Centre was commissioned by Eesti Energia to plant young pine trees on 49 hectares of opencast mine area.

Beloved lakes

Vesiloo Lake, created in the 1970s in Viivikonna opencast mine, is the first example of the diversity of mined and reconditioned areas. Later on, Presidendi Lake, Kenajärv Lake and other smaller artificial bodies of water were also established in Viivikonna and Sirgala opencast mines.

The heart of the sport and recreational centre established in Aidu opencast mine, closed in 2012, is a rowing lane that meets international requirements. The Aidu aquatic sport centre is a great place to hold world-championship level tournaments and offers possibilities for rowing and canoeing, motorized water sport, scuba, fishing, sailing and hiking. In 2015, Aidu aquatic sport centre received 8th place in the 100 Estonian Treasures voting dedicated to the country's centennial. Aidu was visited in 2015 by over 850 aquatic sport aficionados and over 1000 people came on guided tours of the future competition venue.

AFFORESTATION OF FORMER OPENCAST AREAS (HECTARES)



Emissions into ambient air

Industrial emissions into ambient air have consistently declined over the years. In 2015, a "cleanliness record" was set yet again – emissions of SO_2, NO_2, CO_2 and solid particulates reached an historical low. Compared to 2014, quantities have dropped by a respective 23%, 32%, 59% and 21%. Compared to five years ago, the solid particle count in air has dropped eightfold and SO_2 and NO_2 emissions are less than half of previous levels.

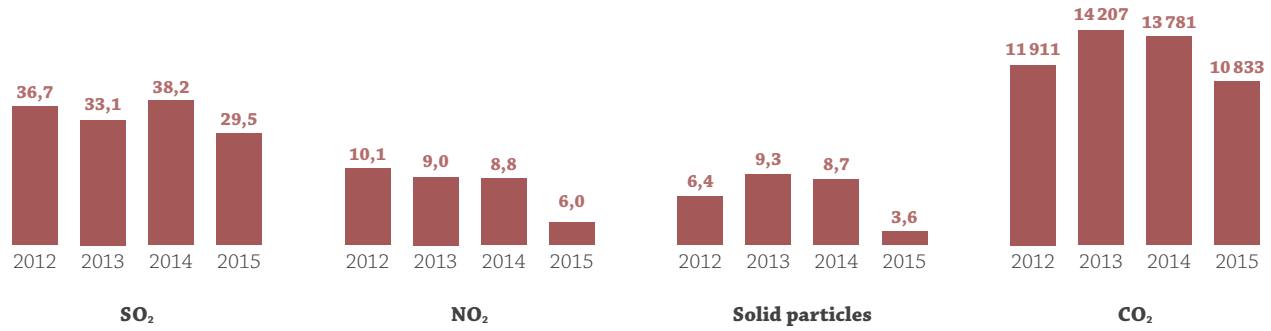
Power generation from oil shale meets the more stringent air emissions limits set forth in the 1 January 2016 Industrial Emissions Directive. The European Union climate and energy package obliges member states to reduce greenhouse gas emissions by 40% by 2030 (compared to 1990 levels). In addition, more stringent European Union requirements are coming into effect for many airborne emissions, the aim being to improve ambient air quality.

Effective filtration equipment

The ever-smarter production process in the Estonian oil shale industry has made a definite contribution to the constant decrease of airborne emissions. VKG Energia is the first company in Estonia to introduce the use of desulphurization equipment for smoke gases. The company's first NID (Novel Integrated Desulphurization) technology based system was installed in 2008 and the second one was launched in 2015. The third, powered by flue-gas desulfurization (FGD) technology, was launched in summer 2016. The new equipment has allowed VKG to reduce the sulphur dioxide emissions threefold, improving the air quality in the area.

In the last five years, Eesti Energia has installed desulphurization and denitrification equipment on the older pulverized-combustion-technology-powered energy-generating units at Narva

DECREASE IN AIRBORNE EMISSIONS (THOUSANDS OF TONNES) WITH OIL SHALE MINING VOLUMES REMAINING STABLE



power plants, as a result of which sulphur emissions have dropped to one-third and nitrogen emissions have halved. The older pulverized combustion units were transitioned to a limited operating mode, and when this is over, the units will be shut down. In addition to reducing sulphur and nitrogen emissions, the company also modernized the electrical filters at its power plants in 2015, which will significantly cut the quantities of fly ash released into the atmosphere.

In addition, Eesti Energia built five new smokestacks in connection with installation of the filtration equipment. These will allow the energy units to be used more flexibly and efficiently and, by superior measurement of environmental emissions, make it possible to manage production better in the new market situation.

In 2015, KKT introduced the use of modern SCADA air and steam measurement system that will allow the efficiency of environmental resources and the impact on the environment to be assessed.

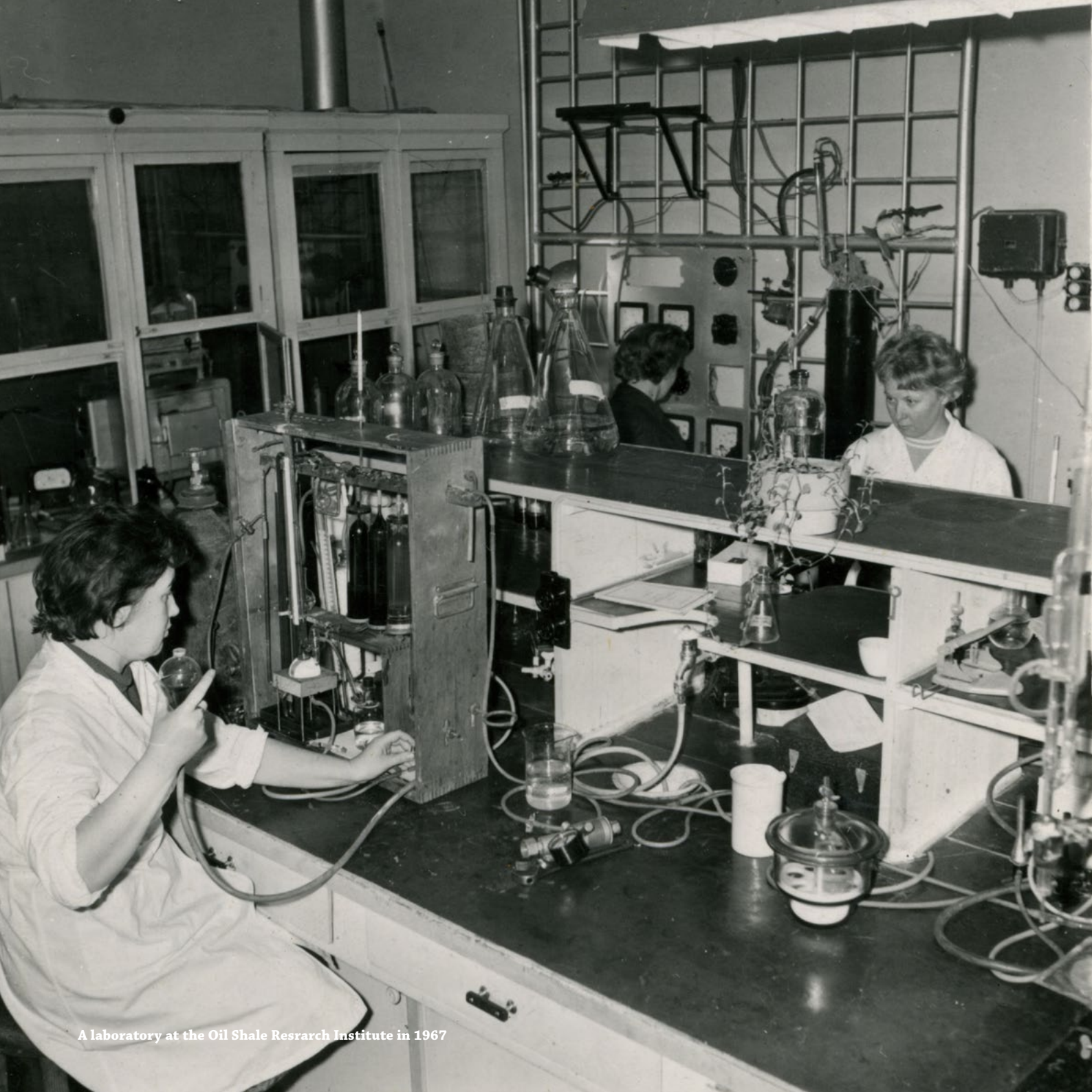
The oil shale industry is cleaner than ever before

Water and the oil shale industry

According to the Estonian Geology Centre, the main source of mining water is rainwater. Rainwater accounts for about 80% of the mining water in opencast mines and 50% in underground mines. To a lesser extent, mining water originates from groundwater and water from closed mines in the area. To keep mines dry, water is pumped out of the area and diverted to settling tanks to remove the suspended solids. After treatment, the water is returned to nature; it primarily flows into the Gulf of Finland and some of it into Lake Peipus as well.

The water in mines' settling basins is often cleaner than that in rivers and lakes and is well-suited for trout farming, for example. Drainage of waterlogged mine areas has had a positive effect on forest growth and agriculture in the surrounding areas.

In 2015, some 120 million cubic metres of water was pumped out of mines and opencast mines, which is about on par with the year before.



A laboratory at the Oil Shale Resrarch Institute in 1967

OIL SHALE AND ESTONIAN SOCIETY

How the oil shale industry contributes to Estonian society

In 2015, the oil shale industry contributed EUR 120 million to the Estonian state budget in the form of taxes and dividends. In addition, oil shale enterprises actively continued their CSR traditions in spite of the complicated times. Support was provided for education, science and culture and a number of traditional events.

Jobs in the oil shale industry

The falling price of oil put the oil shale industry into a complicated situation in 2015 and 2% of the workforce in the sector lost their jobs. The Unemployment Insurance Fund and trade unions tried to find new employment for the people in the region who were laid off. The situation was eased by the fact that many of the unemployed chose to retire. The average employee's time worked for the company decreased by a year compared to 2014.

In spite of the wave of layoffs, the oil shale industry in Ida-Viru County remains one of the region's biggest employers. The oil shale sector employed 7,411 people in 2015, but many times more people are indirectly related to the industry in customer service, lodging, construction or transport services. The average gross wage in oil shale enterprises in 2015 was 1,400 euros, which is nearly twice as much as the average gross wage in Ida-Viru County.

EMPLOYMENT IN THE ESTONIAN OIL SHALE SECTOR (2015)

Total employees	7 411
Average number of years worked	*12*
Annual decrease in number of employees (%)	-2%
Average gross monthly wage (EUR)	1 400

Supporting education

Bringing up a new generation

In 2015, Eesti Energia launched the Insenergia programme to support the development of top engineers. In the framework of the programme, 15 students were given the opportunity to gain unique practical experience. The students were mentored by Eesti Energia experts. The students received 10,600-euro scholarships and given the opportunity to take field trips to industrial enterprises and in-house training at Eesti Energia.

The cooperation with the Noored Kooli (Young People to School) programme is one way in which Eesti Energia and KKT provide for the education of engineers in Ida-Viru County. In 2015, maths, chemistry and physics teacher Liisi Sarap continued teaching at Sinimäe School in Vaivara Municipality. Eesti Energia provided a 6,080-euro stipend over two years to compensate Sarap's costs of living, language study and transport. It's hoped this enthusiastic young teacher will kindle students' interest in engineering.

VKG continued cooperation with the St. Petersburg State Institute of Technology, allowing top students to work in internship spots in leading chemical enterprises, giving them the opportunity to apply their knowledge in practice.

For many years now, VKG has helped to organize Estonia's oldest intermural science tournament – the Competition of Five Schools – and supports the best secondary school students in Ida-Viru in participating in the competition. Each year, the company opens its doors to close to 800 schoolchildren and university students, who discover the behind-the-scenes goings-on at VKG. VKG also actively contributes to the "Back to School" initiative, introducing the modern oil shale and chemical industry to schoolchildren.

In 2015, oil shale companies also entered into an understanding with Jõhvi State Gymnasium, the goal of which is to ensure strong science education at the school. Companies are contributing to the development of engineering education at this state-operated upper secondary school, involving employees who introduce students to modern industry and the interesting opportunities it opens up. Youth also receive career counselling and advice about interesting work in the speciality with a respectable compensation package.

Artistic jewellery from oil shale

To kindle youth interest in the oil shale sector, in 2015 KKT hosted a group of students from Narva Vocational Education Centre and Cambridge University.

In the framework of the project started at the Oil Shale Competence Centre, students at the jewellery art speciality at the Estonian Academy of Arts completed work on beautiful pieces of jewellery made from oil shale, which can now be admired in exhibition halls all over Estonia.

ENTRUM comes to a successful closes

2015 marked the close of the Eesti Energia-initiated ENTRUM programme to help lay the ground work for youth achievement and enterprise. Over five years of activity, it has reached around 2,700 teenage Estonians. Ida-Viru County, Southern Estonia, Western Estonia and Northern Estonia have carried out more than 500 ideas in the field of social enterprise, technology, engineering, oil shale and energy, ecological and creative industries. In the last year of activity, the youth programme was carried out in Ida-Viru County once again.

Ida-Viru County Talented Youth Energy Fund

In 2015, Eesti Energia supported a total of 29 school-age children (7-18-year-olds) through the Ida-Viru County Talented Youth Energy Fund. The Energy Fund was founded by Eesti Energia in cooperation with the Ida-Viru County Association of Municipalities and its goal is to promote the development of youth recreational activity. In 2015, the volume of Energy Fund totalled 9,000 euros. The most scholarships went to teens who are engaged in science or sports. Youth achievement in music, culture and art was also supported. The Energy Fund has been in operation since 2013 and has provided scholarships to 93 teens so far.

Supporting innovation and knowledge export

Knowledge-based development

The oil shale industry has kept pace with scientific progress. Estonia has become one of the world leaders in oil shale excellence thanks largely to its long-term research and strong cooperation with research institutes and the energy industry.

Estonia's first oil shale related knowhow export project started 10 years ago when Estonian geologists were invited to Jordan to study the oil shale resource. Today Eesti Energia is developing a 554 MW oil shale power plant in Jordan. In 2015, the project's focus was on financing activities.

The oil shale industry invested EUR 8.6 million into research in the field

Cooperation with scientists

Oil shale energy is a strategic field for the Estonian state. Development and environmental activities are based on scientific research. In 2015, Estonian oil shale companies invested EUR 8.6 million into research in the field.

REFORM AFFECTING STANDARDS IN THE OIL SHALE SECTOR

The Oil Shale Competence Centre at the Tallinn University of Technology's Virumaa College started organizing standardization of the oil shale sector in 2015 in cooperation with the Estonian Centre for Standardization. An Oil Shale and Oil Shale Products Processing Committee (EVS/TK 57) was founded, aimed at determining the need for standardization in the field and update the valid standards, share best practices with recognized experts and develop international cooperation. Participating in the work of the technical committee provides an opportunity to familiarize oneself with the working documents of the international technical committees, make suggestions, participate in the process of developing the international standards and thus contribute to the development of the field.

THE MOST IMPORTANT GENERAL ANALYSES

Research and development activity	Implemented by	Financed by
Analysis of the criteria for assessing oil shale reserves	Tallinn University of Technology	SA Keskkonnainvesteeringute Keskus (Environmental Investment Centre)
Analysis of possibilities to use mining technologies involving filling; economic and environmental requirements in implementing the technology	Tallinn University of Technology	SA Keskkonnainvesteeringute Keskus

THE MOST IMPORTANT SPECIFIC RESEARCH STUDIES

Research and development activity	Commissioned by	Implemented by	Financed by
Mapping the properties of mine waste in Estonia and scientific research into enhancing the value of weak stone material	Road Administration	AS Teede Tehnokeskus, Tallinn University of Technology (TUT) Virumaa College	
Developing digital modelling methods for plateau deposits, hydro geological modelling, stability of earth's crust, geotechnology		TUT	Ministry of the Environment and Estonian Research Fund
Solution of thermal technology and environmental problems related to operation of oil shale power plants		TUT	Eesti Energia Narva Elektrijaamad AS
North-Estonian mining cave-ins – establishing and identifying them and causes		TUT	SA Eesti Teadusfond (Estonian Research Fund)
Assessing the stability of areas where oil shale has been mined underground		TUT	SA Keskkonnainvesteeringute Keskus
Determining heavy metals, permanent pollutants and fine particles in thermal processing of oil shale	Ministry of the Environment		SA Keskkonnainvesteeringute Keskus
Recovery of secondary polymer waste and oil shale ash as a raw input for construction materials. Composite peat-based material with pretensioned polymer rebar		University of Tartu	SA Keskkonnainvesteeringute Keskus
Study examining recovery of ash generated in the process of solid heat carrier process in the oil shale industry		TUT	SA Keskkonnainvesteeringute Keskus
Use of granulated oil shale fluidised bed boiler ash as a soil improvement product - leachate study		Institute of Chemical and Biological Physics	SA Keskkonnainvesteeringute Keskus
Granulating the fluidized bed boiler ash from Narva power plants, synthesis of sorbent and use for treating waste water.		Institute of Chemical and Biological Physics	SA Keskkonnainvesteeringute Keskus
Research study entitled "Description of best available technology for combustion of oil shale gases originating from the Estonian shale oil industry"	Ministry of the Environment		SA Keskkonnainvesteeringute Keskus

Giving back to the community

An oil shale visitor centre unique in Europe

In spring 2015, the Estonian Mining Museum was opened in an old oil shale sorting plant, getting new life as a thematic centre for oil shale that is unique in Europe. The plant provided work for 100 people in the 1930s and now it is the home of exciting exhibit items, many of which were donated by industrial enterprises. Visitors to the exhibition, which is supported by Eesti Energia, can learn through activities and play about mining, generation of electricity and production of liquid fuels as well as renewable and oil shale energy.

In addition to covering the history of industry and modern technologies, the Estonian Mining Museum has an important role as a community centre. The museum is a popular place for holding events. For example, a major regional event held there in 2015 was Miners Day. The Mining Museum is an important tourist attraction in Ida-Viru County and a major destination for visitors on the national level as well. This is attested to by the fact that the museum was chosen as the most attractive tourism site in northern Estonia in 2015.

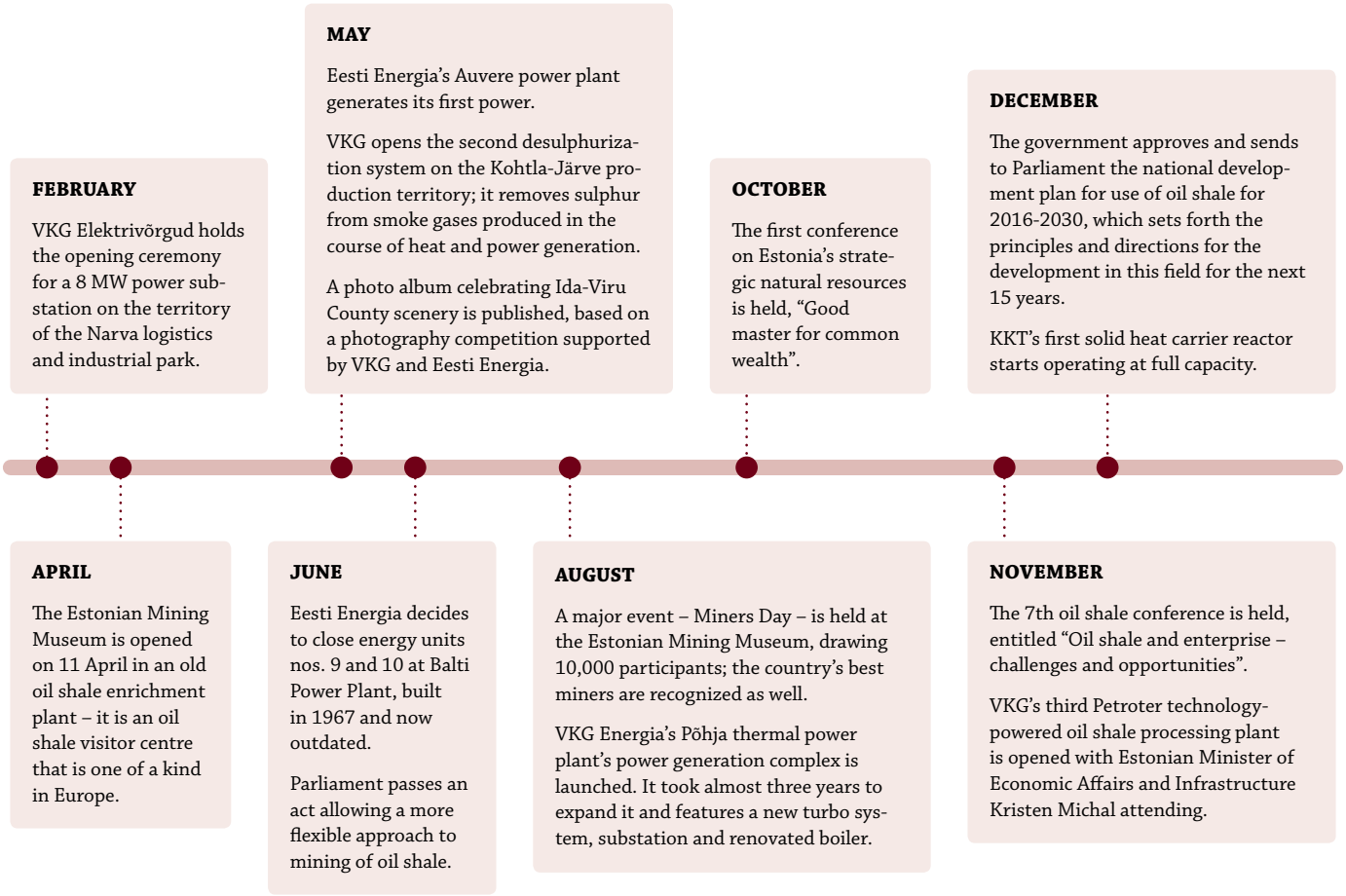
Closer to the community

In 2015, KKT laid major emphasis on stimulating and improving local life. The company held a spring community clean-up action day in Kiviõli and an autumn community activity day as well, where the city's parks and greenspace around factories were tidied up. KKT also provided support for the Kiviõli city festival and an end-of-summer celebration.

For the first time, the Black Nights Film Festival came to Kiviõli thanks to an invitation from KKT. Quality feature films were screened on two November evenings at Kiviõli Secondary School No. 1.

Estonian Mining Museum, which opened in 2015, was chosen as the most attractive tourism site in northern Estonia in 2015

A SELECTION OF EVENTS IN THE OIL SHALE SECTOR IN 2015



Estonian oil shale industry in 2015

Income into the state treasury EUR

120

million

Total investments EUR

199

million

Investments into the environment EUR

82

million

Positions for

7411

people

Sales revenue EUR

669

million

In comparison with 2014

Use of oil shale

-7%

The market price of electricity

-17%

The average oil price

-44%