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The componential semantic reflection of Russian energy industry terms in scientific articles

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Abstract
This paper examines the reflection of semes of energy terms in different scientific contexts and the semantic relationship between them according to their constant and potential semes. The aim of this study is to determine the semantic characteristics and functions of terms and the relationship between them in different contexts which play an important role for the formation of modern terminological thesaurus dictionaries. Componential and contextual semantic analyses were carried out based on 100 scientific articles of energy industry and other closely-related fields. It is concluded that the key terms for a certain text constitute a kind of scheme (scenario), according to which the presentation of scientific texts unfolds. The content and composition of each of the selected scenarios is determined by the title of an article and the aspect of the presentation by the authors. The typological description of the scenarios in the article is based, on the one hand, on the indication of the composition of the given scenario, and on the other hand, on the analysis of the content of each of the allocated compositional fragments.

Keywords: componential semantic reflection, energy industry, Russian language, scientific texts, term, terminology

Public Interest Statement

Semantic features are used to represent the meaning of a word. Obviously, they are related to the concepts and ideas we want to convey through words. They can refer to different aspects of meaning, such as object, action, quality or attitude etc. This study sheds light on the semantic components of Russian energy industry terms and the relationship between them in scientific contexts, which plays an important role in the process of teaching and learning terminology, in the standardization of the terminological system, in professional communication and in the formation of a thesaurus for the energy sector.

1. Introduction

Modern society is under the influence of scientific and technological progress, as a result, most of the scientific terms are included in everyday communication and on the contrary some lexemes and phrases of the general literary language transformed into professional lexical units. Knowledge of terms, their formation, functions and sematic connection helps to understand scientific texts, implement self-study in various scientific fields, carry out researches in order to solve emerging problems or discover new knowledge in the chosen field of science.

Nowadays, the energy industry is closely related to other branches of science. It brings together dozens of specialties and hundreds of professions. Scientists from different professional fields such as energy, physics, chemistry, economics, ecology, including linguistics etc., pay attention to the role of this industry from different perspectives and conduct interdisciplinary researches. The terminology of this field is dynamically developing and, as a result, needs to be studied in various aspects. Since terminology, in particular the terminology of the energy industry, represents an actively evolving part of the lexicon of modern Russian language, the processes occurring in it are an important source of understanding the mechanisms of development of the lexical system of the language as a whole.

There are a plenty of studies by linguists on the ways of the formation, characteristics and functions of terms and terminology, and standardization of a terminological system, ways of introducing the concept of special vocabulary in different professional spheres, questions about terms and terminology in the modern world: Lotte (1931, 1932, 1961); Leychik (1979, 2009); Shelov (1984); Golovin et al. (1987); Grinev (1993); Prokhorova (1996); Khakimova et al. (2012); Akhmetova (2014); Gagarina et al. (2019); Talanina (2020); Pushmina et al. (2021); Skornyakova, Vinogradova (2021, 2022); Murzo et al. (2021, 2022), Boyko et al. (2023) etc.

Terminology is designed to convey information and expand knowledge in the field of the topic under discussion. The terminology is divided into two groups:

1) theory-oriented terminology, i.e., terminology consisting of the writings of linguists who focus on the meaning of terms, the formation of concepts, term formation, and standardization;
2) translation-oriented terminology, i.e., the one in which it is important to find an appropriate translation of words, word combinations, sentences and texts depending on the context (Thelen 2012).

Vinokur (1939) in his first work on terminology noted: "Any word can act as a term, terms are not special words, but words in a special function. The special function in which a word acts as a term is the naming". Many linguists share his point of view and in accordance with it consider the function of naming, nomination, expression, designation, indication and fixation as a distinctive feature of the lexicon

of language for special purposes (LSP). A term is a semantic homonym of commonly used lexical units that arose as a further meaning of a word in relation to its closest meaning (Stepanov 1975). The authors of this study share the same thought with the above-mentioned scientists as it was found that many energy industry terms in modern terminology are formed by the methods called terminologization and claque in order to fulfill communicative functions.

Terminology itself has multidimensional character like cognitive, linguistic and communicative (Sager 1990). In modern terminology it is needed to considerate not only ways of formation and characteristics of terms in accordance with word-formation, grammatical and other linguistic rules, but also their functional and semantic features for standardization of a terminological system.

Nowadays, topics like thesaurus organization, lexical accretion, predictability of terms use, the opinion of the author's choice of terms became essential to be studied. Especially, the functional relations between terms and their typical relations in the thesaurus are necessary to be analyzed through contexts of scientific articles. There are common energy terms for closely-related scientific fields and specific ones for only this industry. Among these two types, the first ones are determined in this study.

The aim of this study is to determine models which reflect the correlation between Russian energy terms in different scientific contexts. In order to achieve this goal, the research articles under the consideration of energy supply and saving were chosen and common energy terms were selected. The componential and contextual analyses were carried out to determine the components of the meaning of these terms and the semantic relationships between them in different contexts. The theoretical significance lies in the fact that the developed models of the use of terms in scientific articles provide insight into one of the fragments of scientific thesaurus. The findings of this study give the opportunities to create modern terminological dictionaries, the thesaurus of the energy field, to be used in training courses and professional communications for different purposes.

2. Literature Review

Nowadays, special attention is paid to minimal non-divided units of the content plan of a lexicon, which is proved by a number of the following significant linguistic studies on this topic: ***«Логика смысла»*** (The logic of meaning) (Kravets 2004); ***«Проблема установления сем при компонентном анализе лексики»*** (The problem of establishing semes at the component analysis of a lexicon) (Samatova 2009); ***«Семы и их типологическое разнообразие в аспекте словарной лексикологии»*** (Semes and their typological diversity in the aspect of dictionary lexicology) (Morkovkin et al. 2011); ***«Терминологический аппарат семного описания значения слова»*** (Terminological apparatus of seminal description of word meaning) (Maklakova 2011); **«К вопросу о лексическом значении слова»** (On a lexical meaning of the word) (Shkhapatseva 2014); ***«Семантическое поле слов и его элементы»»*** (The semantic field of words and its elements) (Khashimov 2015); ***«Алгоритм семного описания значения слова»*** (Algorithm of seminal description of the meaning of the word) (Maklakova 2016); ***«Комбинаторная семасиология: рестриктивный компонент значения слова»*** (Combinatorial Semasiology: Restrictive Component of Word Meaning) (Vlavatskaya 2017); ***«О понятии коммуникативного значения слова»*** (On the concept of communicative meaning of the word) (Rudakova et al. 2017) and so on.

In modern semantics, the meaning of a lexical unit is considered as a symbolic model of non-linguistic content, representing a more or less complex structure with internally organized relations (Vasiliev 2009). Semes are microcomponents of meaning, reflecting a distinctive feature of the word denotation or word usage, capable of distinguishing its meanings, i.e., such components that differentiate or unite individual meanings (Sternin et al. 2011). According to Novikov (1982), a seme is a minimal limiting constituent part (component) of the elementary meaning of a word. A single lexeme can express

several semes. Vasiliev (1975) introduced the concept of the sememe, which implies a set of semes of one lexeme. Gak (1971) said that the semantic structure of word meaning is the totality of elementary senses called semes.

According to the definitions, semes of terms are usually categorized into a specific set: *1) devices and items, 2) conditions and properties, 3) processes and phenomena, 4) magnitude and units of measurement,* and *5) laws and regularities*.

However, different dictionaries sometimes describe different semes even within the same language (Chubur 2010). In dictionaries, constant semes of one lexeme are marked, and potential semes are used by different contexts. One term can perform several functions in different contexts; therefore, contextual connections must be taken into account when a semantic analysis is carried out.

3. Methodology

Common energy terms were obtained by consideration of 100 articles from the field of energy industry and other closely-related fields with this industry like physics, metallurgy, mining, economic etc. in which energy supply and saving are highlighted. Componential and contextual semantic analyses were carried out to determine the constant and potential semantic components of common Russian energy terms from the studied articles.

3.1 Data analysis

After analyzing scientific articles from the journals ***«Энергетическая стратегия»*** (Energy Strategy), ***«Записи Горного института»*** (Journal of Mining Institute), ***«Технологии нефти и газа»*** (The Oil and Gas Technology), ***«Новости электротехники»*** (Electrical Engineering News), ***«Безопасность труда в промышленности»*** (Industrial Safety), ***«Горное оборудование и электромеханика»*** (Mining Equipment and Electromechanics), «**Цветные металлы» (Non-ferrous metal) etc., it was found that the following common terms and phrases of the energy industry are commonly used in these articles:**

1) **one-component terms:** ***энергетика*** (energetics), ***электроэнергия*** (electric power), ***напряжение*** (voltage), ***электроснабжение*** (power supply), ***трансформатор*** (transformer), ***энергоснабжение*** (energy supply), ***газоснабжение*** (gas supply), ***газопровод*** (gas pipeline), ***электроприёмник*** (electric receiver), ***диэлектрик*** (dielectric), ***энергосистема*** (energy system), ***электрооборудования*** (electronic devices), ***электропередачи*** (power transmission), ***электродвигатель*** (electric engine), ***энергоресурсы*** (energy resources), ***электростанция*** (power station), ***генератор*** (generator), ***энергобезопасность*** (power safety), ***электропотребления*** (power consumption), ***ресурсосбережение*** (resource conservation), ***преобразователь*** (converter), ***трубопровод*** (pipeline), ***скважин*** (borehole), ***шлам*** (sludge), ***гидродинамика*** (hydrodynamics), ***фильтрация*** (filtration);

2) **two-component terms:** ***тепловая энергия*** (thermal energy), ***возобновляемая энергетика*** (renewable energy), ***потерь электроэнергия*** (loss of electric energy), ***однофазное замыкание*** (single phase closure), ***надёжность электроснабжения*** (reliability of power supply), ***электрическая дуга*** (electric arc), ***энергосберегающие технологии*** (energy-saving technologies), ***эксплуатация электроустановок*** (electrical installations), ***электрическая нагрузка*** (electrical load), ***альтернативная энергетика*** (alternative energy), ***ветро-солнечная электростанция*** (wind-solar power station), ***атомная энергетика*** (nuclear energy), ***ядерная энергетика*** (nuclear power), ***дизельное топливо*** (diesel fuel), ***природный газ*** (natural gas), ***обсадный труб*** (casing pipe), ***буровой шлам*** (drilling mud), ***двухфазный поток*** (two-phase flow), ***напряженно-деформированное***

состояние (stress-strain state), ***водная фаза*** (aqueous phase), ***нефтяная фаза*** (oil phase);

3) **three-component terms:** ***вторичные энергетические ресурсы*** (secondary energy resources), ***брызгозащищенное электротехническое изделие*** (sparge proof electrical device), ***вертикальный стальной резервуар*** (vertical steel tank), ***вероятность безотказной работы*** (reliability function), ***взрывобезопасное электротехническое изделие*** (explosion safety device), ***вращающаяся электрическая машина*** (electrical rotating machinery), ***изоляция нетоковедущих частей*** (protective isolant), ***кабельная линия электропередачи*** (underground cable).

4. Results and discussions

According to the definition of the terms in terminological dictionaries, the constant components of the meaning of the above-mentioned energy terms can be categorized into three main groups: 1) *conditions and properties, 2) materials and devices, and 3) resources*. As a result of the analysis, it is concluded that terms from group 1 are mostly used in the articles. The percentage of the use of terms from each group can be seen as in the following diagram (Fig. 1) [by authors]:

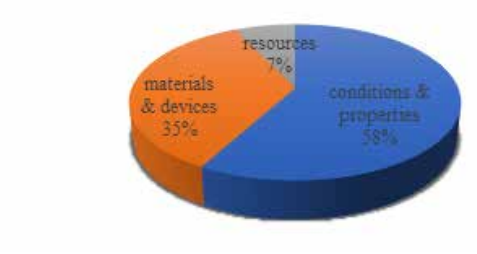

Figure 1. Percentage of the use of each group of terms in articles

A term always has one constant semantic component i.e., a constant or an actual seme. If a term is polysemous, it can have either the same constant seme or different ones. However, no polysemous terms are found in articles reviewed.

Apart from a constant seme, a term can have one or more potential semes in contexts. Potential semes play an important role to understand the concept of the terms in different scientific discourses. Therefore, a componential analysis was carried out to reveal the meaning and concept of terms in scientific contexts, the relation between terms and with other parts of speech on a paradigmatic and syntagmatic levels.

As a result of the analysis of the contexts of scientific articles, it was found that terms are mostly related with each other by the following semantic features: **condition, resource, result, cause**. Although a condition itself consists of parameters, devices, process and resources and closely related to the causes and results, in some cases all these components are considered by an author separately. For example, the article ***«Опыт внедрения энерго- и ресурсосберегающих технологий в системах электроснабжения металлургического предприятия»*** (Experience in implementing energy and resource saving technologies in an electric power supply systems of metallurgical production) (Kornilov et al. 2022) proves that, depending on the context, terms perform the different functions and have the following potential components of meaning:

- **parameter/condition:** ***система энергоснабжения*** (power supply system), ***энергосберегающая технология*** (energy-saving technology), ***энергетическое оборудование*** (power generating equipment), ***энергосистемы*** (power systems), ***электростанции*** (power stations), ***надёжность***

(reliability), ***электропотребления*** (power consumption), ***ресурсосберегающая технология*** (resource-saving technology);

- **device:** ***генератор*** (generator), ***трансформатор*** (transformer), ***выпрямитель*** (rectifier), ***угольная печь*** (coal kiln), ***электродуговая печь*** (electric arc furnace), ***двигатель*** (engine), ***электропривод*** (electric drive), ***нагрузка*** (load);
- **resource:** ***природный газ*** (natural gas), ***топливный газ*** (fuel gas);
- **result/ cause:** ***энергозатраты*** (energy expenditure), ***мощность*** (capacity), ***энергосбережение*** (energy conservation).

In the article ***«Повышение энергоэффективности автономной системы электроснабжения буровой установки при провалах напряжения»*** (Increasing the energy efficiency of an autonomous power supply system of a drilling rig in case of voltage dips) (Chervonchenko et al. 2023) the selection, order of presentation and concentration of terminology is largely determined by the orientation not at a specific enterprise, as in the previous case, but at the whole complex. Especially, common energy terms with the following semantic components are used in this article:

- **parameter/ condition: энергосистема** (energy system), **электроустановка** (electrical installation), ***энергоэффективность*** (energy efficiency), **мощность** (generation sources), **надёжность** (reliability), **нагрузка** (load), **напряжение** (tension), **дизель генератор** (diesel engine generator), **аккумуляторные батареи** (rechargeable batteries);
- **device: энергокомплексы** (power complexes), **электроприводы** (electric drives), **дизель генератор** (diesel engine generator), **аккумуляторные батареи** (rechargeable batteries);
- **process:** ***провал напряжения*** (voltage dip), **электроснабжение** (electricity supply);
- **cause: короткие электрические связи** (short circuits), **электродвигатели** (electric motors), **провал напряжения** (voltage dip).

Energy terms in contexts usually have potential semes called **a condition**, **a parameter**, **a resource**, **a device**, **a cause** and **a result**. According to the above-mentioned articles, it is obvious that some energy terms can have more than one potential semes in a context. But these semantic components in most cases are related as 1) **a cause** and **a result**, 2) **a condition**, **a parameter** and **a device**.

The titles of the articles that were determined in this study contain at least one term. In most cases terms used in the articles and their potential semes are closely related to the ones in title of that articles. A term that is used in a title of an article usually have potential semes called **a goal** or **a condition**. The nature of the relationship between the title and the terminology used is established through a lexical analysis of the key words of the title. The selection of terminology for the description is carried out in two stages. In the first stage, logical groups are selected, which are specified in the second stage depending on the object of description.

Obviously, the title of a scientific article is a hint of which terms can be used in it. As an example, in the above-mentioned article ***«Опыт внедрения энерго-*** *и* ***ресурсосберегающих технологий*** *в* ***системах электроснабжения металлургического предприятия»*** (Experience in implementing energy and resource saving technologies in an electric power supply systems of metallurgical production) (Kornilov et al. 2022), in accordance with the main energy terms «***энерго-*** *и* ***ресурсосберегающие технологии»*** (energy- and resource-saving technologies) **и *«системы электроснабжение»*** (power supply systems), the following terms were found: ***энергетическое оборудование*** (power-generating equipment), ***электростанции*** (power stations), ***природный газ*** (natural gas), ***топливный газ*** (fuel gas), ***надёжность*** (reliability), ***электропотребления*** (power consumption), ***генератор*** (generator),

трансформатор (transformer), ***энергозатраты*** (energy expenditure) and so on. This connection between terms can provide a scheme as follows (Fig. 2.) [by authors]:

Conditions:

1) ***энерго****- и ресурсосберегающие технологии;*

2) системы ***электроснабжение***

Conditions:

электростанции

Condition:	**Resources:**	**Result:**
энергетическое оборудование	*1) природный газ*	*1) электропотребления*
	2) топливный газ	*2)* ***энергозатраты***

Devices:

1) ***генератор***

2) ***трансформатор***

Figure 2. The scheme of the connection between energy terms in the title and content

A scheme can vary in accordance with the perspective of a person. However, all the possible schemes will be more or less alike.

The topic of the article ***«Особенности выбора оптимального состава ветро-солнечной электростанции*** *с* ***дизельными генераторами»*** (Features of the optimal composition of a wind-solar power plant with diesel generators) (Lavrik et al. 2020) including the terms ***ветро-солнечная электростанция*** (wind-solar power plant) and ***дизельный генератор*** (diesel generator) with semes **an installation** and **a device** gives an opportunity to predict the fact that the content will contain terms with semantic functions like **conditions**, **results** and **causes.**

After reviewing this article, it was found that terms in this study ***электроэнергия*** (electric power), ***гибридная электростанция*** (hybrid power plant), ***ветряная станция*** (wind farm), ***солнечная станция*** (solar station), ***ветро-солнечная станция*** (wind-solar station), ***возобновляемые источники энергии*** (renewable energy sources), ***система электроснабжения*** (energy supply system), ***надёжность*** (reliability), ***нагрузка*** (load) and ***мощность*** (capacity) indeed have the predicted semantic characteristics.

The article ***«Повышение качества электроэнергии в системах электроснабжения минерально-сырьевого комплекса гибридными фильтрокомпенсирующими устройствами»*** (Improving the quality of electricity in the power supply systems of the mineral resource complex with hybrid filter-compensating devices) (Sychev et al. 2021) with three key terms of energy industry in the title: ***электроэнергия*** (electric energy) (with the seme **"result/goal"**), ***система электроснабжения*** (energy supply system) (with the seme **"parameter"**), ***гибричные фульторкомпенсирующие устройства*** (hybrid filter compensating devices) (with the seme **"device"**) gives a prediction that the text contains a number of terms related to the features of the selected devices. A title of an article with the description of a settled goal, in other words, a result of the study, usually provides information that terms in the with semes called **conditions**, **parameter** and **properties** will be considered by the author(s).

In the article ***«Влияние термической обработки на микроструктуру стальных змеевиков нагревательной трубчатой печи»*** (Influence of heat treatment on the microstructure of steel coils of a heating tube furnace) (Bazhin, Issa 2021) the authors focus on the outcomes of the process which are used to process energy resources. Especially, the terms with the following contextual semes are found in the discussion:

- **source: *углеводородное сырьё*** (hydrocarbon feedstock), ***источник энергии*** (energy source), ***минерально-сырьевой комплекс*** (mineral complex);
- **process: обработка нефти** (oil treatment), **фазовые превращения** (phase transformations), **предварительная термомеханическая обработка** (thermomechanical pretreatment);
- **result: массы** (mass loss)
- **properties: критические температуры** (critical temperatures), **давление** (pressure), **низкая теплопроводность отложений** (low thermal conductivity of deposits);
- **aggregate: трубчатая термическая печь** (tubular thermal furnace).

The composition of the article, which determines the order of use of terms, can be presented as follows:

- the most relevant energy resource, the process and its fragment that creates problems for the unit during operation;
- the essence of the problem occurred;
- ways to prevent it;
- critical operating conditions.

However, among the scientific texts there were some works on intersectoral topics, such as ***«Ресурсосберегающая электромеханическая трансмиссия карьерного самосвала»*** (Resource-saving electromechanical transmission of a quarry dump truck) (Vasiliev et al. 2019) and ***«Барьеры реализации водородных инициатив в контексте устойчивого развития глобальной энергетики»*** (Barriers to implementation of hydrogen initiatives in the context of global energy sustainable development) (Litvinenko et al. 2020) which do not correspond to the proposed text model and do not imply the above-described links between the terms.

4. Conclusion

A term has not only one or more constant semes, but also potential ones based on the context. As a result of the componential and contextual analysis of Russian energy industry terms in 100 scientific articles, it was found that 60 common energy terms are often used in these articles. According to the definition, 58% of these belong to the group called **conditions and properties**, 35% are under **materials and devices**, and 7% - **resources**. The potential semes of terms vary according to the context. Terms commonly have potential semes like **a condition, a cause** and (or) **a result**. In a context terms are obviously related in syntagmatic and in paradigmatic levels in accordance with the semes they have. The title of an article gives a hint of what terms are going to be used by the author(s) in most cases.

A scheme of the logical connection between the terms depends on the author's intention (i.e., a scheme may be designed differently). The form and complexity of this hierarchical system are especially determined, first of all, by what related problems are considered by the author(s), as well as by the order of the content of the article.

Based on the findings of this study, the role of a title of an article is going to be investigated in detail in future research through an experiment in which the titles of the reviewed articles of this study are going to be provided to the 3rd and 4th year students from SaintPetersburg Mining University specializing in energy industry and in closely-related fields and the terms used in these articles must be predicted. The results obtained from the experiment are going to be used in the creation of highly probable schemes of semantic relationships between terms in different contexts.

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Authorship and Level of Contribution

Both authors were involved at all stages of the work. However, the development of the methodology, study design, synthesis of the results and finalization of the manuscript were the responsibility of the first author, while the collection and analysis of data and writing of the draft version of this study were the responsibility of the second author.

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