



МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ
федеральное государственное бюджетное образовательное учреждение
высшего образования
«РОССИЙСКИЙ ГОСУДАРСТВЕННЫЙ
ГИДРОМЕТЕОРОЛОГИЧЕСКИЙ УНИВЕРСИТЕТ»

Кафедра экологии и биоресурсов

ВЫПУСКНАЯ КВАЛИФИКАЦИОННАЯ РАБОТА
(магистерская работа)

На тему «Альтернативные методы утилизации твердых коммунальных отходов»

Исполнитель **Иванов Сергей Александрович**

Руководитель **д.т.н., профессор**

Музалевский Анатолий Александрович

«К защите допускаю»

Заведующий кафедрой

(подпись)

к.г.н., доцент

Дроздов Владимир Владимирович

«14» июня 2019г.



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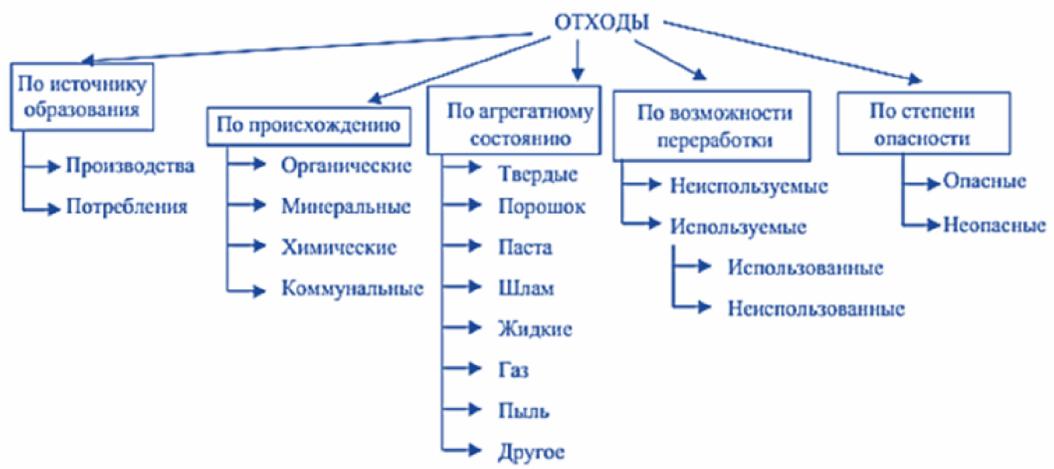
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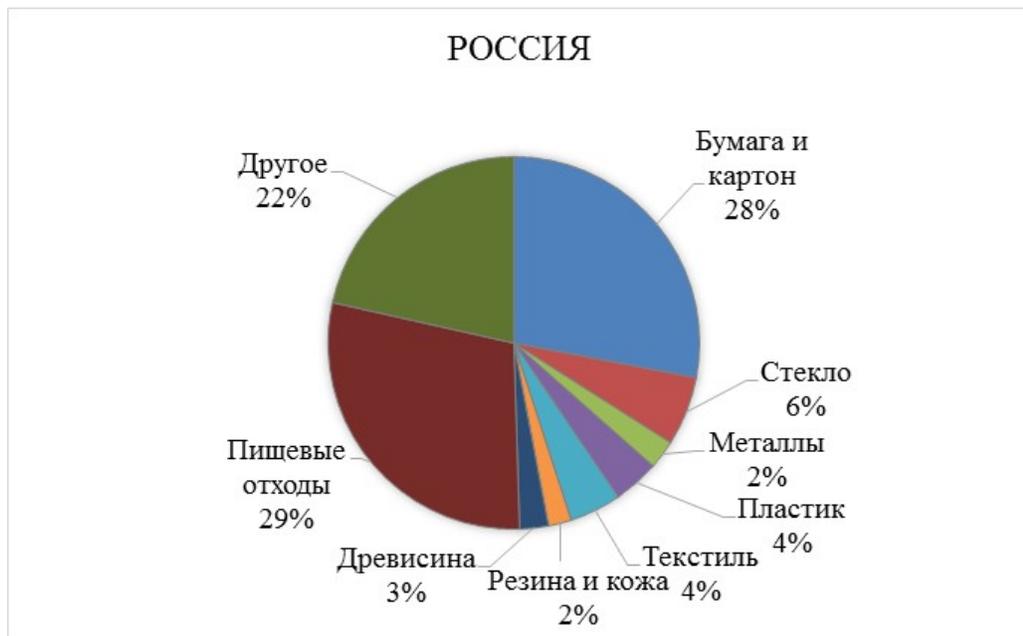
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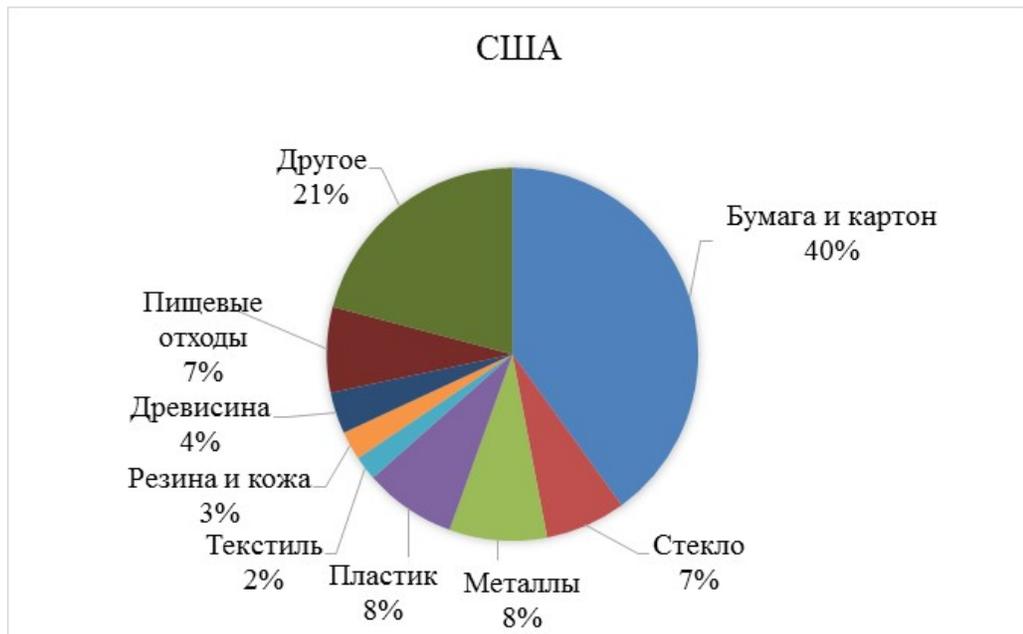
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 $\frac{1}{94} - \frac{1}{95} = \frac{95}{8930} - \frac{94}{8930} = \frac{1}{8930}$
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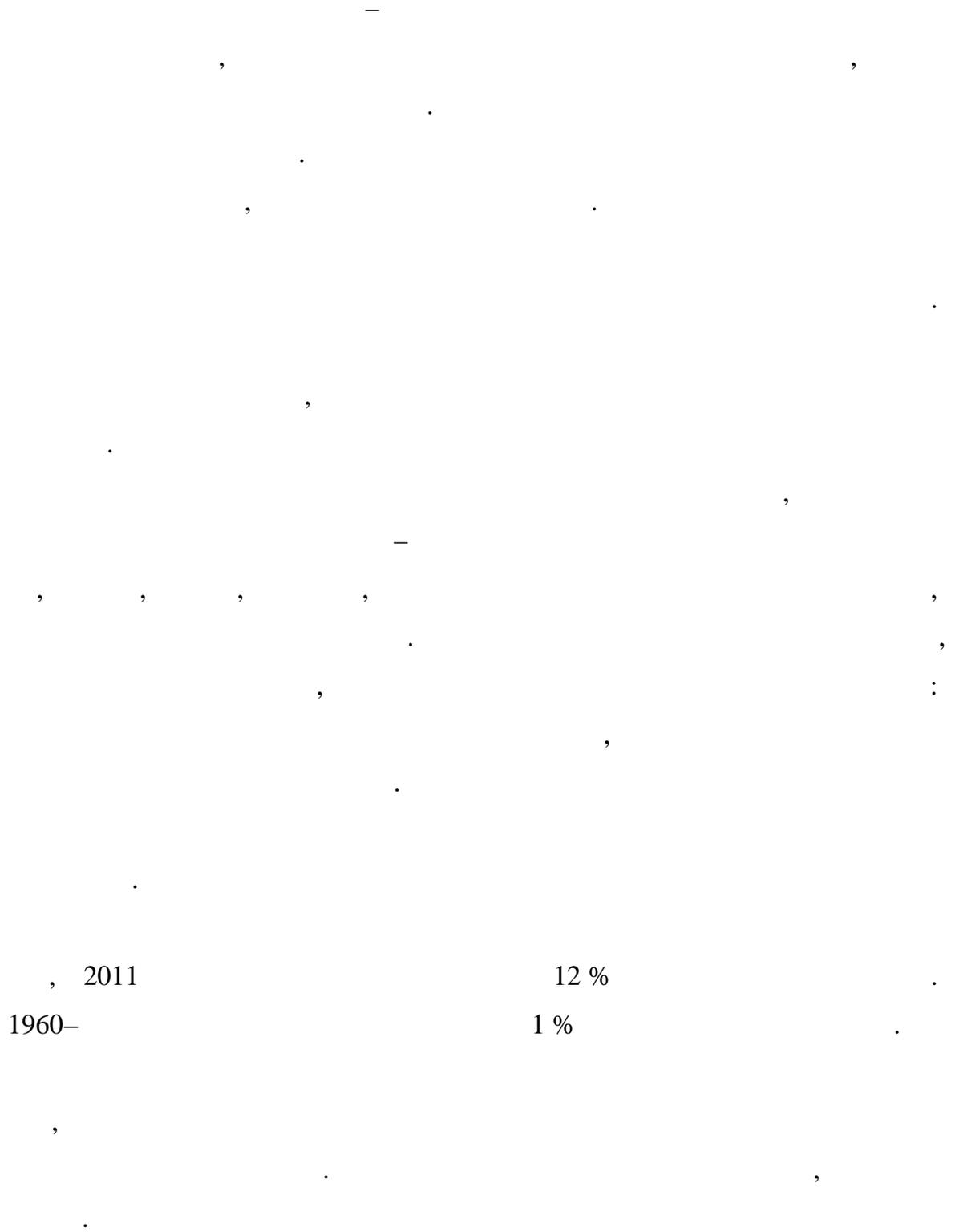
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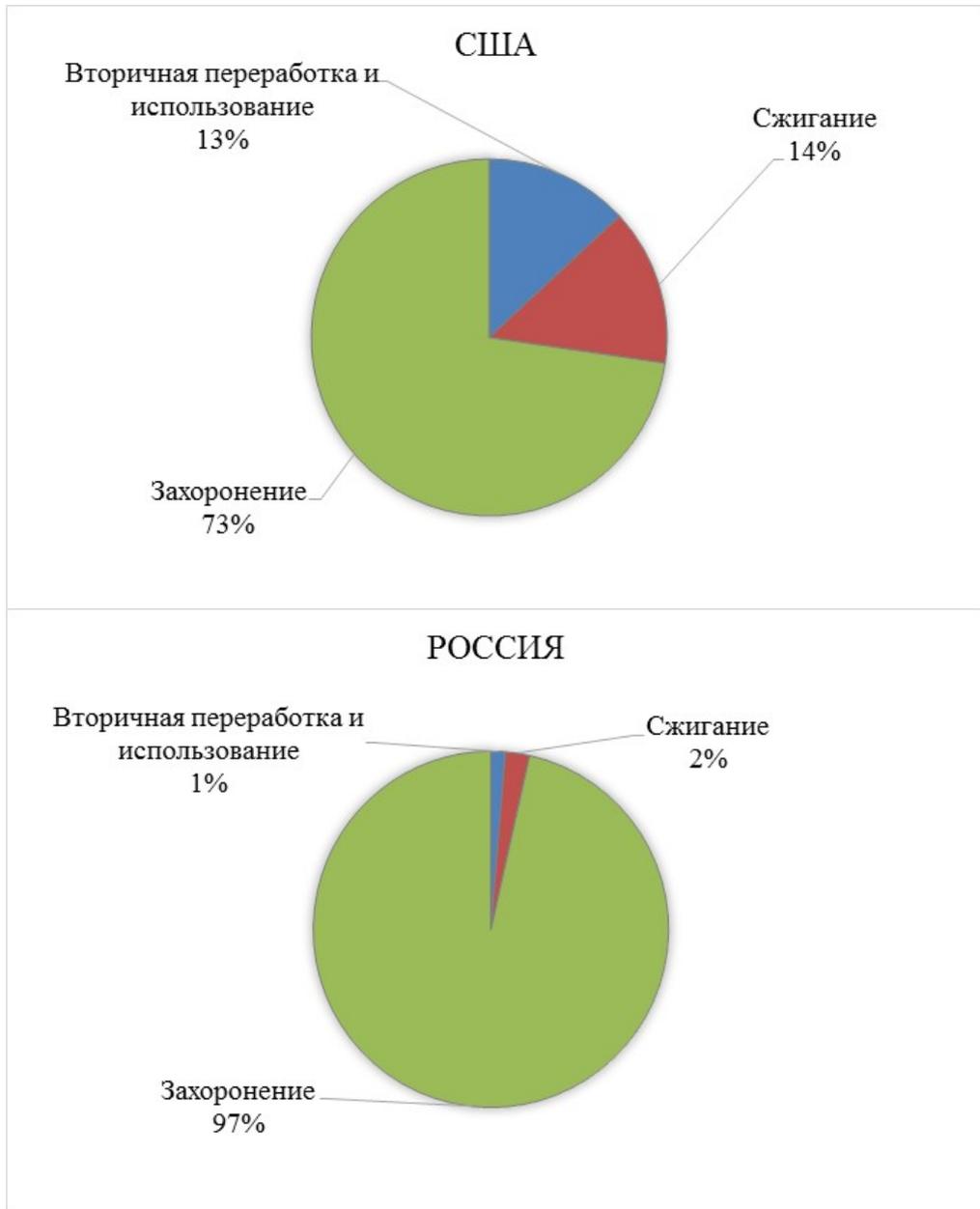
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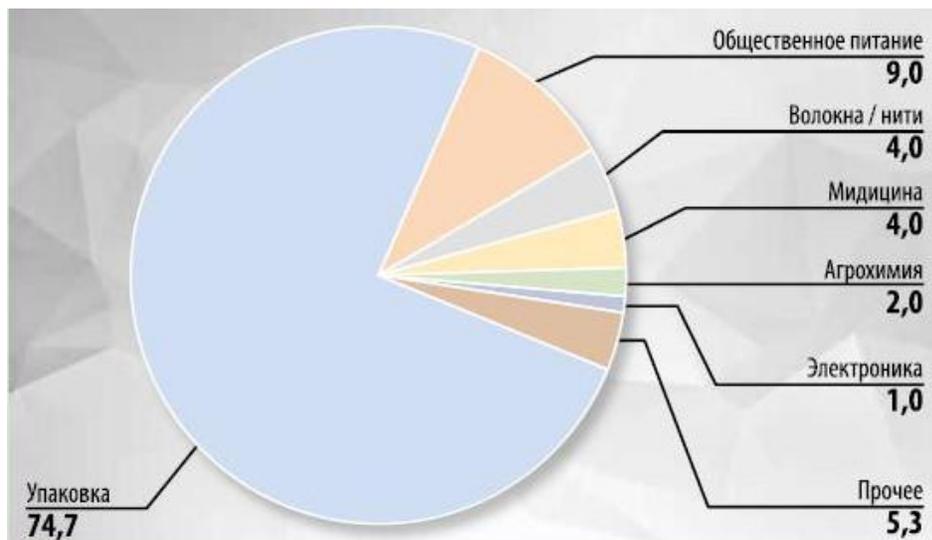
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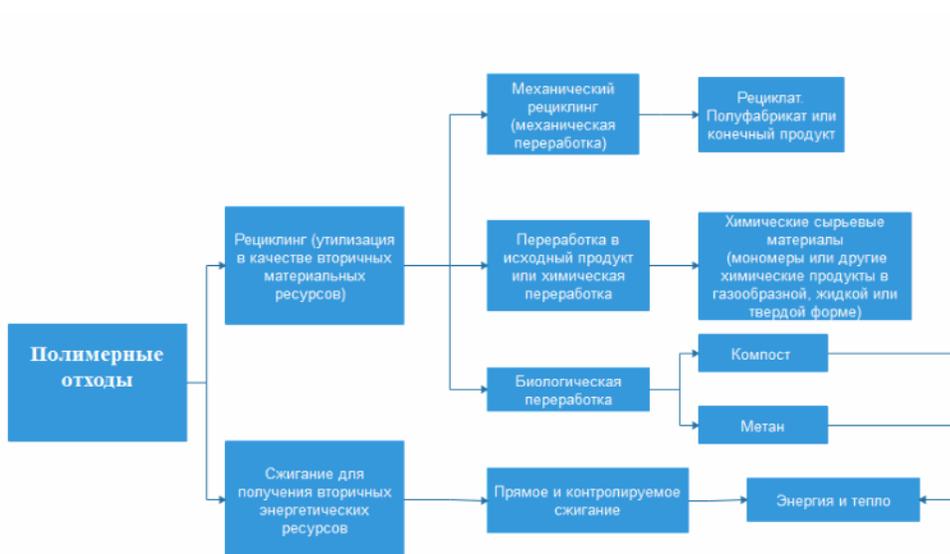
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, 2013.

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(, ,): / . .

, . . ; ,

. – : , 2016.

23 . .

/ . . // . , 2012 .

24 . „ . H.. : ,

2011.

25 . „ . „ . .

, 2001.

26

URL:http://metallicheckiportal.ru/articles/pererabotka/sovremennie_metodi_utilizacii_otxodov.

27

URL:<http://vestkhimprom.ru/posts/biorazlagaemye-plastiki-tekushchee-sostoyanie-rynkov-i-perspektivy>.

28

URL:<https://kulturologia.ru/blogs/030715/25139>.