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Representing the research landscape of the circular economy

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Representing the research landscape of CE

Why we started:

Circular economy (CE) is one way to support transition towards a more sustainable future.

Need to identify technologies that support this transition.

(Ena et al. 2016)

➡ How can we contribute to this with data driven / tech mining methods?

➡ What is needed to enable researchers, managers and policy makers to identify such technologies?

Research aim:

Representing the research landscape of CE

- Identify scientific knowledge fields
- Track scientific knowledge fields over time

🎯 Find continuous research streams → may be the “drivers”

🎯 Identify new scientific knowledge elements and fields

The basis of our research

Definitions:

Research landscape consists of different scientific knowledge fields, evolving over time.

Scientific knowledge field is union of **scientific knowledge elements**, which are information embedded in a scientific article.

(Zhang et al. 2020)

CE:

- Minimizing waste generation and material inputs
- Maintaining value of products and resources

- Eco-design,
- Sharing, repairing, refurbishing,
- Recycling and reusing of products.

(Wijkman and Skanberg; 2015; Merli et al. 2018)

https://twitter.com/EU_ENV/status/1000037176233680896/photo/1

Finding research streams and new scientific knowledge elements and fields

Search query in Dimensions database

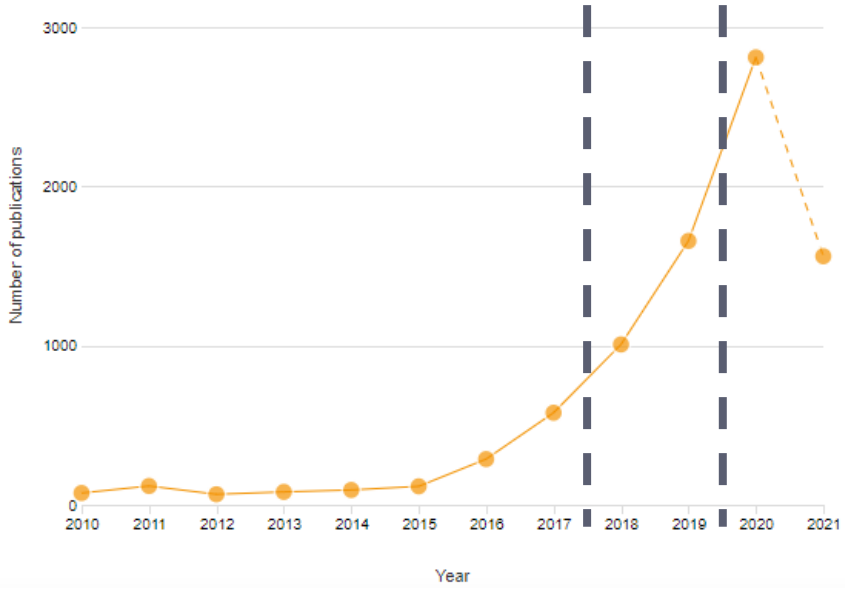
Basic facts:

Query: “circular economy”

(Geissdoerfer et al., 2017)

8,447 publications since 2010

CE has a higher growth rate than the Dimensions database as of 2013



Data

Finding research streams and new scientific knowledge elements and fields

Search query in Dimensions database

Because of its nutritious properties the black soldier fly has emerged as one of the most popular species in advancing circular economy through the re-valorization of anthropogenic organic wastes to insect biomass.

Example

Abstracts

Noun phrase extraction

SciBERT

Data

Text mining

Finding research streams and new scientific knowledge elements and fields

Search query in Dimensions database

Abstracts

Noun phrase extraction

SciBERT

Proxy scientific knowledge element

Sentence specific noun phrase embeddings

Example

Doc.	Sent.	Noun phrase	Embedding
1	1	Black soldier fly	[1.8, 3.0, 4.5 …]
1	4	Black soldier fly	[1.6, 3.1, 5.5 …]
2	2	Black soldier fly	[0.9, 2.8, 4.4 …]

768 dimensions

Data

Text mining

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Proxy scientific knowledge element

Doc.	Sent.	Noun phrase	Embedding
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Abstracts

Noun phrase extraction

SciBERT

Sentence specific noun phrase embeddings

Cleaning

Summarize + filter noun phrases

Data

Text mining

Clustering + Evaluation

Finding research streams and new scientific knowledge elements and fields

Search query in Dimensions database

Proxy scientific knowledge element

Abstracts

Noun phrase extraction

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Sentence specific noun phrase embeddings

Cleaning

Split da… time fr…

Summarize + filter noun phrases

kmeans++

2010-2017:
- 12 cluster
- 638 noun phrases

2018+2019:
- 15 cluster
- 1,142 noun phrases

2020+2021:
- 18 cluster
- 1,706 noun phrases

Data

Text mining

Clustering + Evaluation

Finding research streams and new scientific knowledge elements and fields

Search query in Dimensions database

Abstracts

Noun phrase extraction

SciBERT

Proxy scientific knowledge element

Sentence specific noun phrase embeddings

Cleaning

Split data into time frames

Summarize + filter noun phrases

kmeans++

Proxy scientific knowledge field

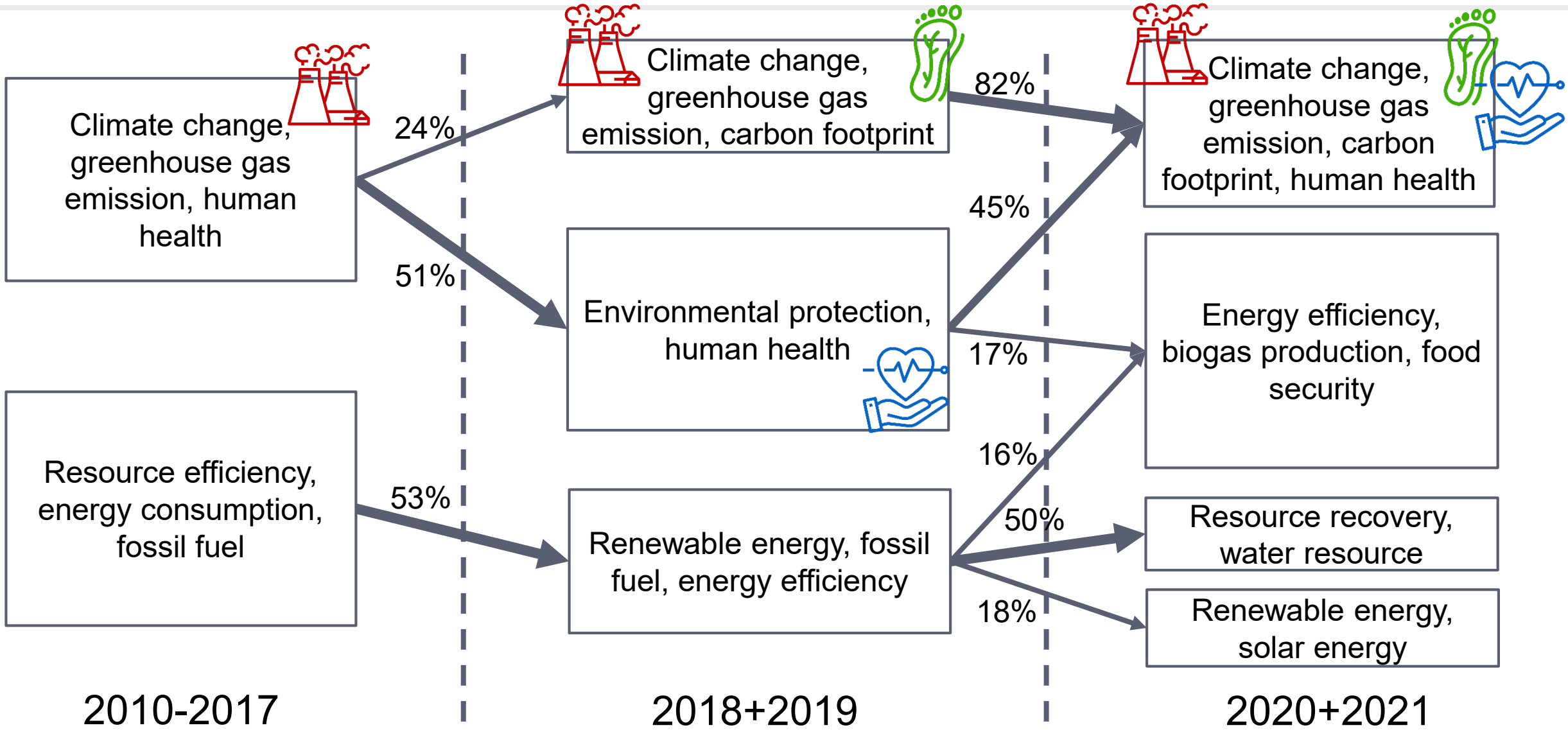
Labelling + development of clusters by intersection of noun phrases

Data

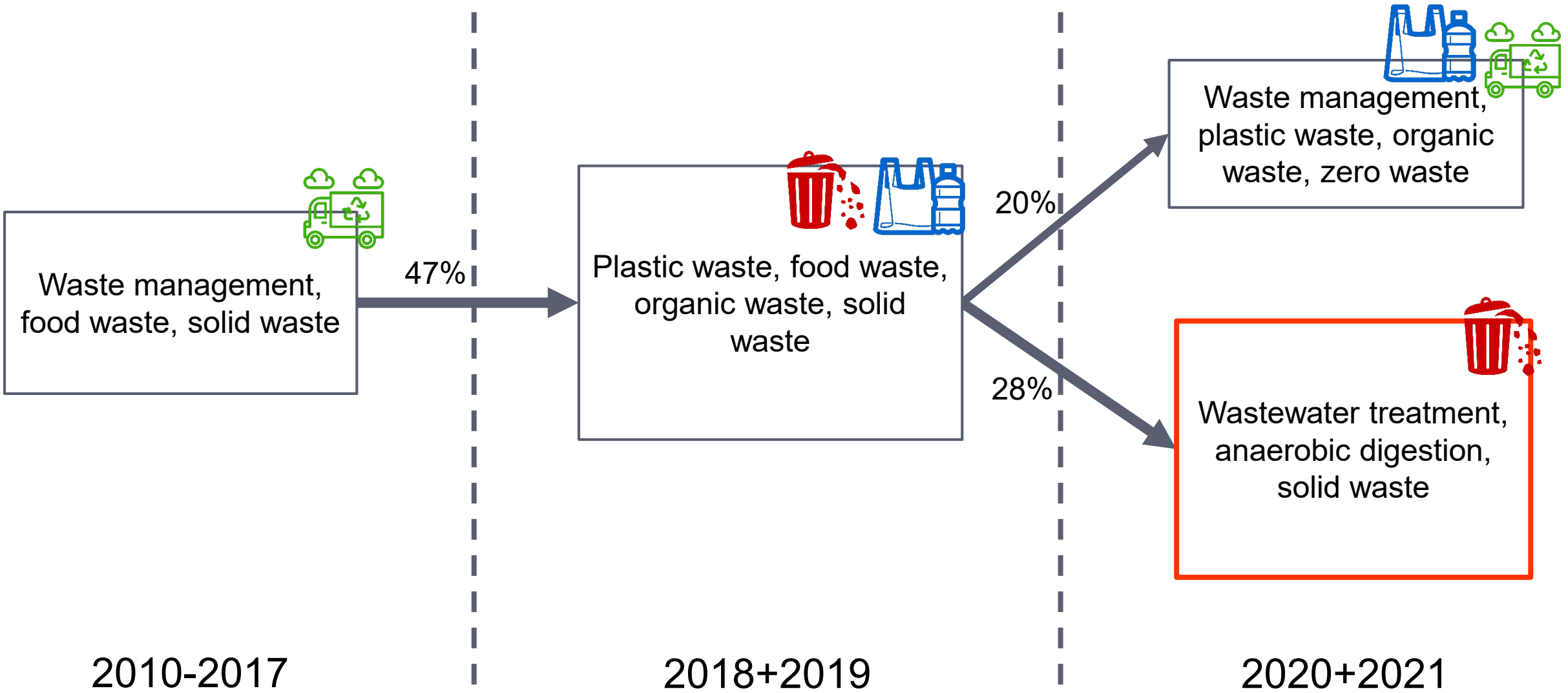
Text mining

Clustering + Evaluation

Continuous research streams in CE research



Continuous research streams in CE research



New scientific knowledge elements and fields in CE research

Wastewater treatment, anaerobic digestion, solid waste

+

Knowledge elements:

commercial fertilizer, hydrothermal carbonization, enzymatic hydrolysis, biorefinery, microalgae biomass

Suitability of Black Soldier Fly Frass as Soil Amendment and Implication for Organic Waste Hygienization

Show Details

/2020

Because of its nutritious properties, the black soldier fly has emerged as one of the most popular species in advancing circular economy through the re-valorization of anthropogenic organic wastes to insect biomass. Black soldier fly frass accumulates as a major by-product in artificial rearing set-ups and harbors great potential to complement or replace commercial fertilizers.

New scientific knowledge elements and fields in CE research

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Cluster from 2020+2021:

Construction industry, food industry, textile industry, secondary raw material

+

Knowledge elements:

green solvent, bituminous mixture, asphalt mixture, polymeric material, black soldier fly, functional food

Remediation of petroleum contaminated saline water using value-added adsorbents derived from waste coconut fibres

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/2021

[...] Therefore, this study aims at developing an technique that uses waste coconut fibres (Cocos nucifera L.) pre-treated with a "green" solvent, viz. protic ionic liquid (PIL) [2-HEA][Ac], for the remediation of oil in saline water. [...] Therefore, the use of these petroleum biosorbents is a technology with environmental benefits, such as the availability of the biosorbent in the form of biodegradable waste and treated with a "green" solvent, both of which can be reused. Thus, it adds value for its use in industries with a circular economy product; that are environment-friendly and economical.

Conclusions, limitations and future work

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Conclusions:

- Approach allows to identify research streams
- Approach allows to identify new scientific knowledge elements and fields
- Noun phrase / information extraction still needs further improvements!

What‘s your experience on information extraction from scientific articles?

Limitations:

- Design decisions e.g. cluster labelling, different thresholds,…
- Need for extended stopword list

Future work:

- Expert evaluation
- Improving information extraction
- Measure degree of interdisciplinarity

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