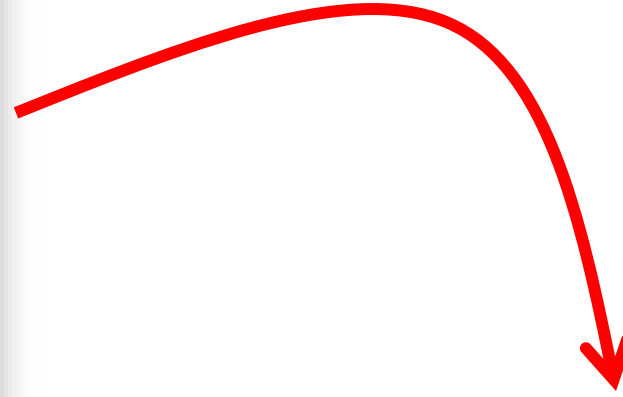


Eduardo Guerra

**Empowering the
End User to be More
Sustainable in Web Applications**



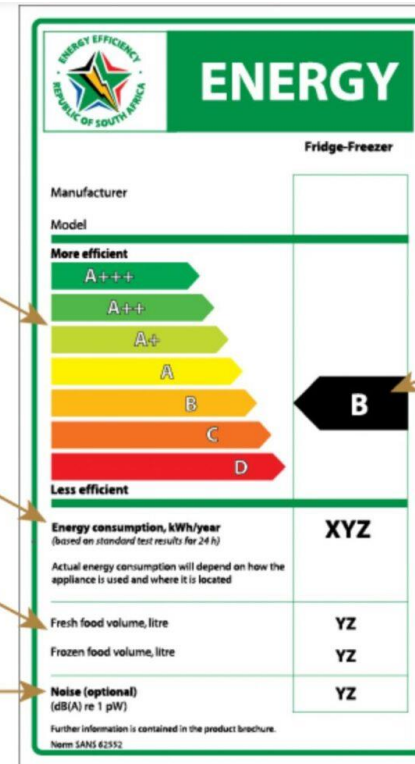
When you buy a fridge, you have access to information about its energy consumption.

Energy efficiency classes
The seven energy efficiency classes for fridges and freezers

Energy consumption
The estimated kWh that the fridge or freezer will use in a year

Food volume
This shows the volume of fresh and frozen food that can be stored by the fridge or freezer

Noise
This is an optional item on the label and it indicates the likely noise level of the fridge or freezer



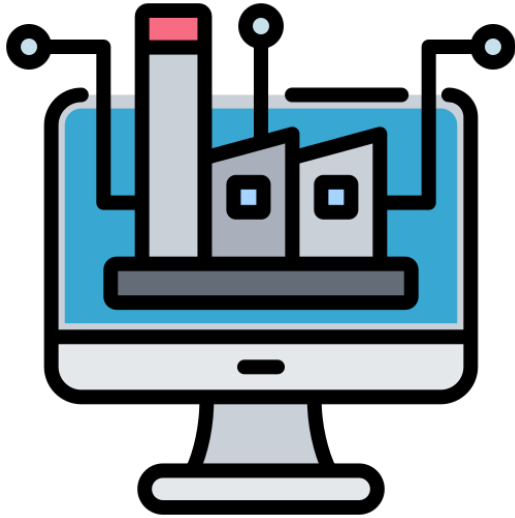
Energy performance class of the particular fridge or freezer
The most efficient fridges are rated as A+++. Only fridges rated as B or better can be sold. Only freezers rated as C or better can be sold

Do you know how much energy the sites you are accessing on the web consume?

Do I really need to care about this?

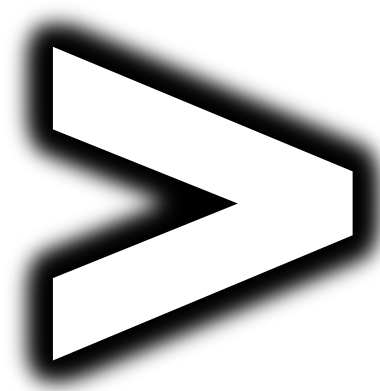


Carbon Footprint



3%

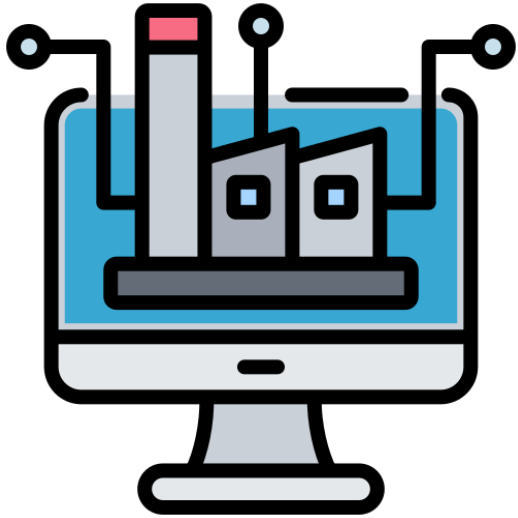
IT sector



2%

aviation sector

Carbon Footprint



3%

IT sector



Do you know how much energy the sites you are accessing on the web consume?

Do I really need to care about this?



But is there
something that I
can do?



But is there
something that I
can do?

NO!



**Existing web applications don't allow users to
configure a more sustainable behaviour!**



Consider a stock market application...



There is a user
doing day
trade...



There is a user
just following
the trends...

He wants to see the updates in the prices as fast as possible!

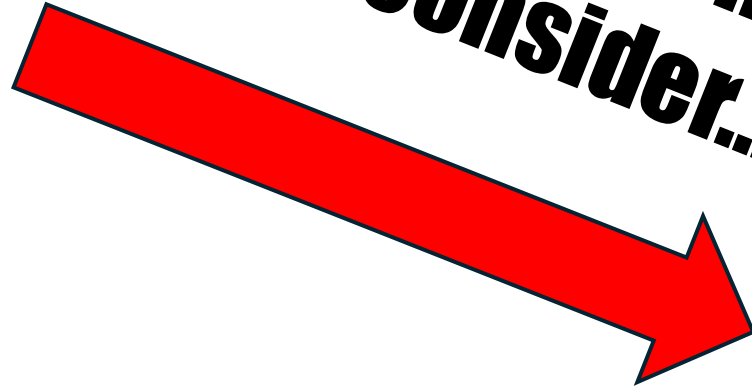


He don't need to have
the same update rate!





**Implementations
always consider...**



A lot of waste!

The screenshot displays the STOCKPULSE dashboard with the following sections:

- Balance:** Shows a current balance of \$32,875.40. It also displays a projected profit of \$12,345.70 and a total invested amount of \$20,529.70, with buttons for Deposit and Withdraw.
- Stock monitor:** Focuses on Meta Platforms Inc. (META), showing a price of \$20,520.70, a 24h change of +12.2%, and a 24h volume of 12.32 million.
- My Wallet Composition:** A donut chart showing the distribution of assets: META (24.7%), SPOT (32%), AMPL (27%), and LNKD (14.3%).
- Order book:** A table for buying and selling META, showing price, amount, and total values.
- Transactions:** A list of recent transactions including SPOT, META, LNKD, and AMPL with their respective prices and trade directions (BUY/SELL).
- Latest news:** A section for news articles such as "Trump's tariffs are changing the way Americans spend" and "Capital One to pay \$425 million to settle litigation over savings accounts".

Do you already have the feeling that you don't need everything that a web page is showing to you?



What if I could
configure the
application to my
needs, making the
choice to be more
sustainable?



LEAF S

BRINGING SUSTAINABILITY INTO THE DIGITAL

to the rescue!



**Xiaofeng
Wang**



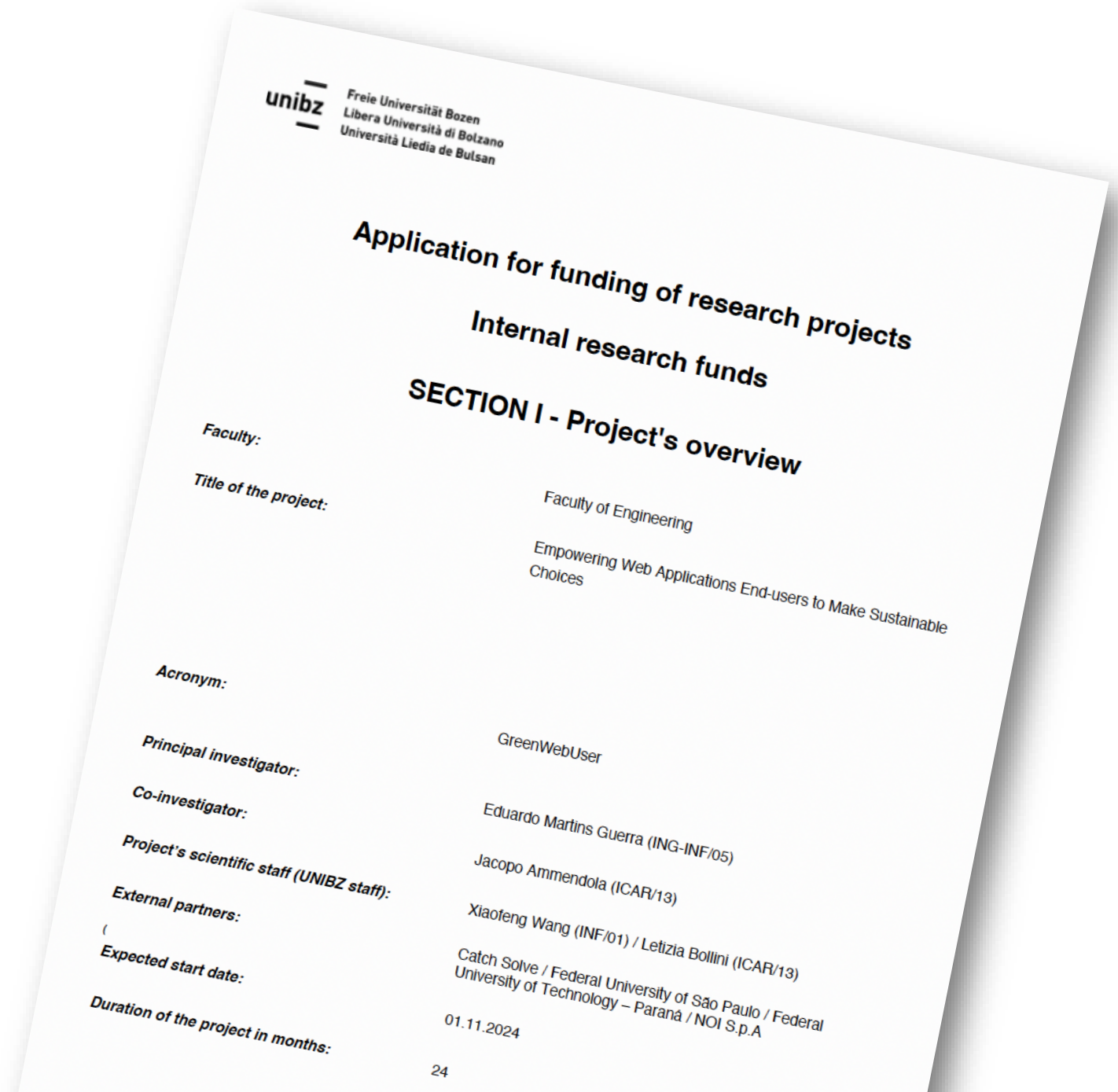
**Jacopo
Ammendola**



**Giuliano
Bonazzi**



**Thiago
Carvalho**





MAIN MENU

- Dashboard
- Market Stocks
- My Assets
- Transactions
- News
- Logout

HELP CENTER

- Preferences
- Support



Balance

\$32,875.40
19:28:35 Refresh

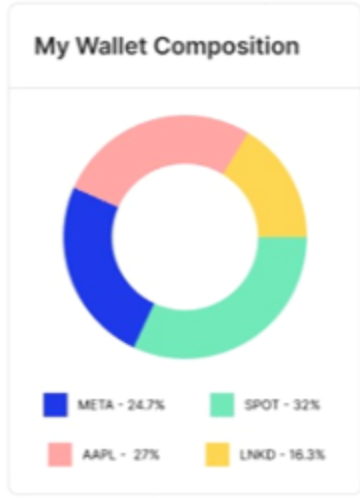
\$12,345.70 Projected Profit
\$20,529.70 Total Invested

Deposit Withdraw

Stock monitor

META

Meta Platforms Inc. \$20,529.70 \$2,342.89 12.32 million
+12.3% Price 24h change 24h volume



Transactions

TODAY

SPOT	\$11,453.67	\$8,200,330.3	\$4,696,234.17	\$12,896,564.47	\$6,125,781.31
		Positive	Negative	Volume	Mediam

YESTERDAY

META	\$8,702.47				
------	------------	--	--	--	--

MAY 10

LNKD	\$4,621.39				
------	------------	--	--	--	--

MAY 15

SPOT	\$11,259.07				
LNKD	\$2,133.90				
META	\$7,913.82				

Order book

META

Price	Amount	Total
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84
\$126.36	144	\$18,195.84

Mediam: \$128.94 Weekly

A pluggable component that can be accessed from different points in the web page.



Activate a hidden menu where the user can configure the application to be more sustainable.

STOCKPULSE

MAIN MENU

- Dashboard
- Market Stocks
- My Assets
- Transactions
- News
- Logout

Balance

\$32,875.40

19:26:35 Refresh

\$12,345.70 Projected Profit

\$20,529.70 Total invested

Deposit Withdraw

Stock monitor

Meta Platforms Inc. \$20,529.70 \$2,345.00

+12.3% Price 24h change

Transactions

Symbol	Price	Action
SPOT	\$13,459.67	SELL
META	\$8,702.00	SELL
LNKD	\$4,621.00	BUY
SPOT	\$11,259.07	BUY
LNKD	\$2,133.90	SELL

LEAFS

LEAFS onboarding

How to reduce my carbon footprint?

What is LEAFS?

LEAFS is an open and free tool that enables you to change how websites behave to reduce your environmental impact.

[Know about the project](#)

Choose a profile:

33% more efficient



Most sustainable profile

- Hide news and stocks monitor sections.
- 50% reduced stocks monitor section refresh rate.
- Hide promotional content.

13% more efficient

Performance

- Hide news section.
- 25% reduced stock refresh rate.
- Hide promotional content.



You can always check how many emissions you have cut by using LEAFS.

START

In the first configuration, the users can configure their starting profile!

The screenshot shows the STOCKPULSE dashboard with the following sections:

- Balance:** Shows a balance of \$12,345.70 and a total invested amount of \$20,529.70. It includes buttons for 'Deposit' and 'Withdraw'.
- Stock monitor:** Displays a chart for Meta Platforms Inc. with a price of \$20,529.70 and a 24-hour change of +12.3%.
- Transactions:** A list of transactions including:
 - TODAY: SPOT (\$13,453.67) - SELL
 - YESTERDAY: META (\$8,702.47) - SELL
 - MAY 16: LNKD (\$4,621.39) - BUY
 - MAY 15: SPOT (\$11,259.07) - BUY
 - MAY 15: LNKD (\$2,133.90) - SELL
 - MAY 15: META (\$7,913.82) - BUY
- Latest news:** A list of news items from CNN Business, Reuters, and Bloomberg.

LEAFS onboarding

How to reduce my carbon footprint?

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Choose a profile:

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- Hide news and stocks monitor sections.
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Performance

- Hide news section.
- 25% reduced stock refresh rate.
- Hide promotional content.



You can always check how many emissions you have cut by using LEAFS.

START

MAIN MENU

- Market Stocks
- My Assets
- Transactions
- News
- Logout

Balance

\$32,875.40

19:26:35 Refresh

\$12,345.70 Projected Profit

\$20,529.70 Total invested

Deposit Withdraw

Stock monitor

Meta Platforms Inc. \$20,529.70 \$2,345.00

+12.3% Price 24h change

Transactions

DATE	SYMBOL	PRICE	ACTION
TODAY	SPOT	\$13,453.67	SELL
YESTERDAY	META	\$8,702.47	SELL
MAY 16	LNKD	\$4,621.39	BUY
MAY 15	SPOT	\$11,259.07	BUY
	LNKD	\$2,133.9	SELL
	META	\$7,913.82	BUY

Latest news

Source	Headline
CNN Business	Trump's tariffs are changing the way we spend
Reuters	Capital One to pay \$425 million to settle over savings accounts
Bloomberg	Binance, Kraken Are Said to Have Been Hacked

My LEAFS ✕

Get feedback on your latest achievements

Did you know? 🔄

The Olympic-sized pool can hold up to 2.5 million liters of water.

Source: <http://us.org>

My progress last year

My total carbon footprint reduction in grams of CO₂e

Insights (last year)

Total reduction	Days using Leafs	Trees saved	Water litters saved
465g CO ₂ e +10,9%	346 days +93	23 trees +10	126 L +57

How is [SITE NAME] performing?

Total reduction	Olympic pools saved
23.324 kg CO ₂ e +65,9%	27 pools +17
Soccer fields saved	Trees saved
12 fields +7	1.5 million L +1 million

My profile Change

Information

Individual metrics

Application metrics



The user can also access detailed configurations to customize the experience.

MAIN MENU

Dashboard

Market Stocks

My Assets

Transactions

News

Logout

Preferences

LEAFS

GB

Gabriel Boz
Accounts Admin

Balance

\$32,875.40

19:26:35 Refresh

\$12,345.70

Projected Profit

\$20,529.70

Total invested

Deposit

Withdraw

Transactions

SPOT \$13,453.67 SELL

SPOT \$8,702.47 SELL

LNKD \$4,621.39 BUY

SPOT \$11,259.07 BUY

LNKD \$2,133.90 SELL

META \$7,913.82 BUY

Stock monitor



Meta Platforms Inc.

\$20,529.70

\$2,345.67

+12.3%

Price

24h change

Latest news



CNN Business

Trump's tariffs are changing the way spend



Reuters

Capital One to pay \$425 million to set up over savings accounts



Bloomberg

Binance, Kraken Are Said to Have Been Hacked

Back

X

Profile details

View details and customize your profile

My profile

Change

Most sustainable profile:

+ 33% reduction of carbon footprint

- Hide news and stocks monitor sections.
- 50% reduced stocks monitor section refresh rate.
- Hide promotional content.

Options available

- Hide section "Latest News"
- Hide section "Transactions"
- Hide promotional content

Weekly Calculations Change median calculation frequency

Calculating the average number of actions per period is a heavy process performed by the server. You can change the period and frequency considered for the calculation to reduce processing.

Tips: The longer the interval, the more sustainable it will be.

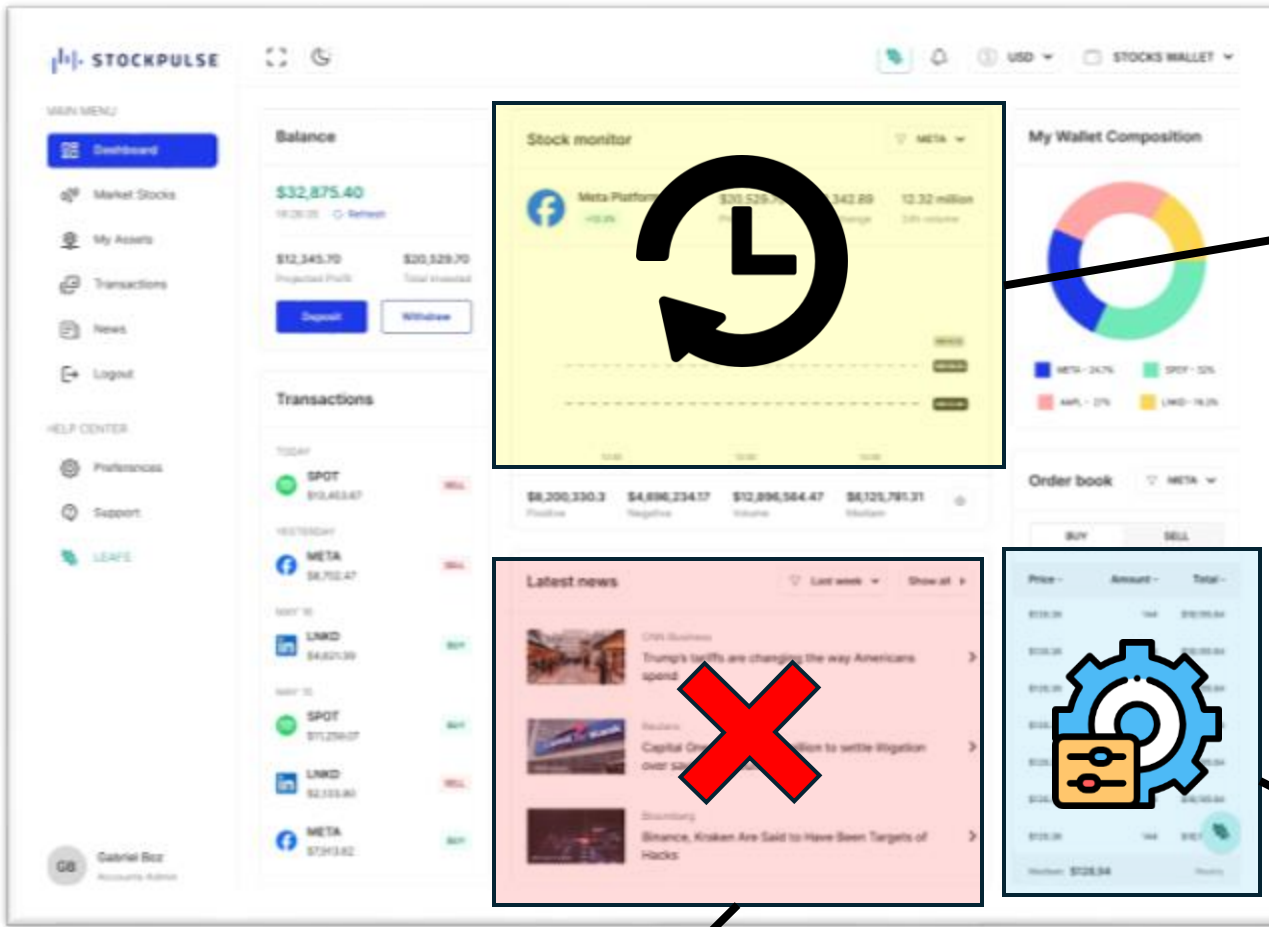
Reduce refresh rate of the "Stocks Monitor" section

1 s 2 s 5 s 10 s

The chart's refresh rate refers to the time interval at which the chart updates information. This requires additional processing and communication of this data at each time interval defined here.

Tips: The longer the interval, the more sustainable it will be.

SAVE CUSTOMIZATIONS



Change the update rate

Remove panels

Configure processing and functionality



**Easy to
Implement**

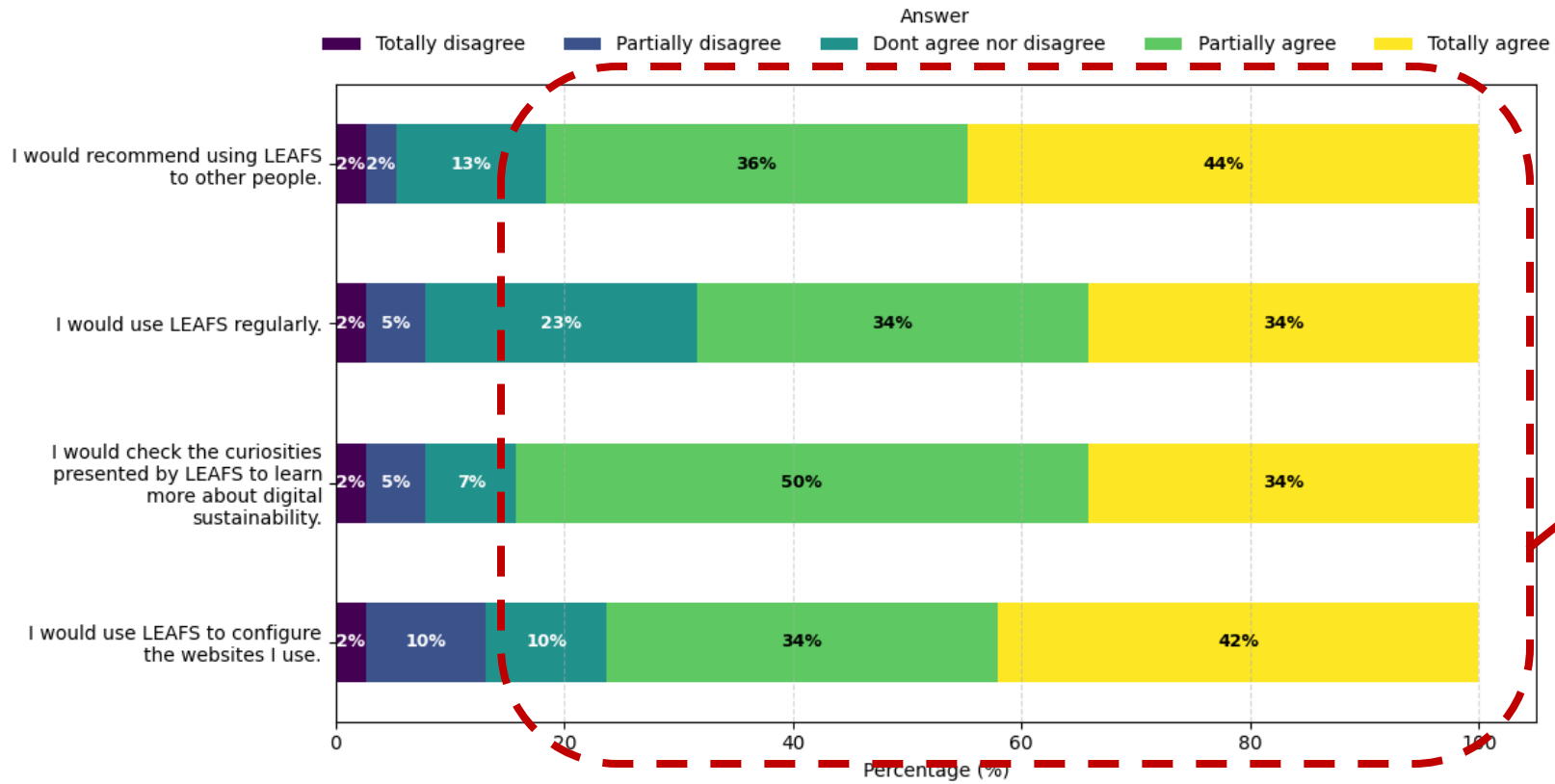
**User
Acceptance**



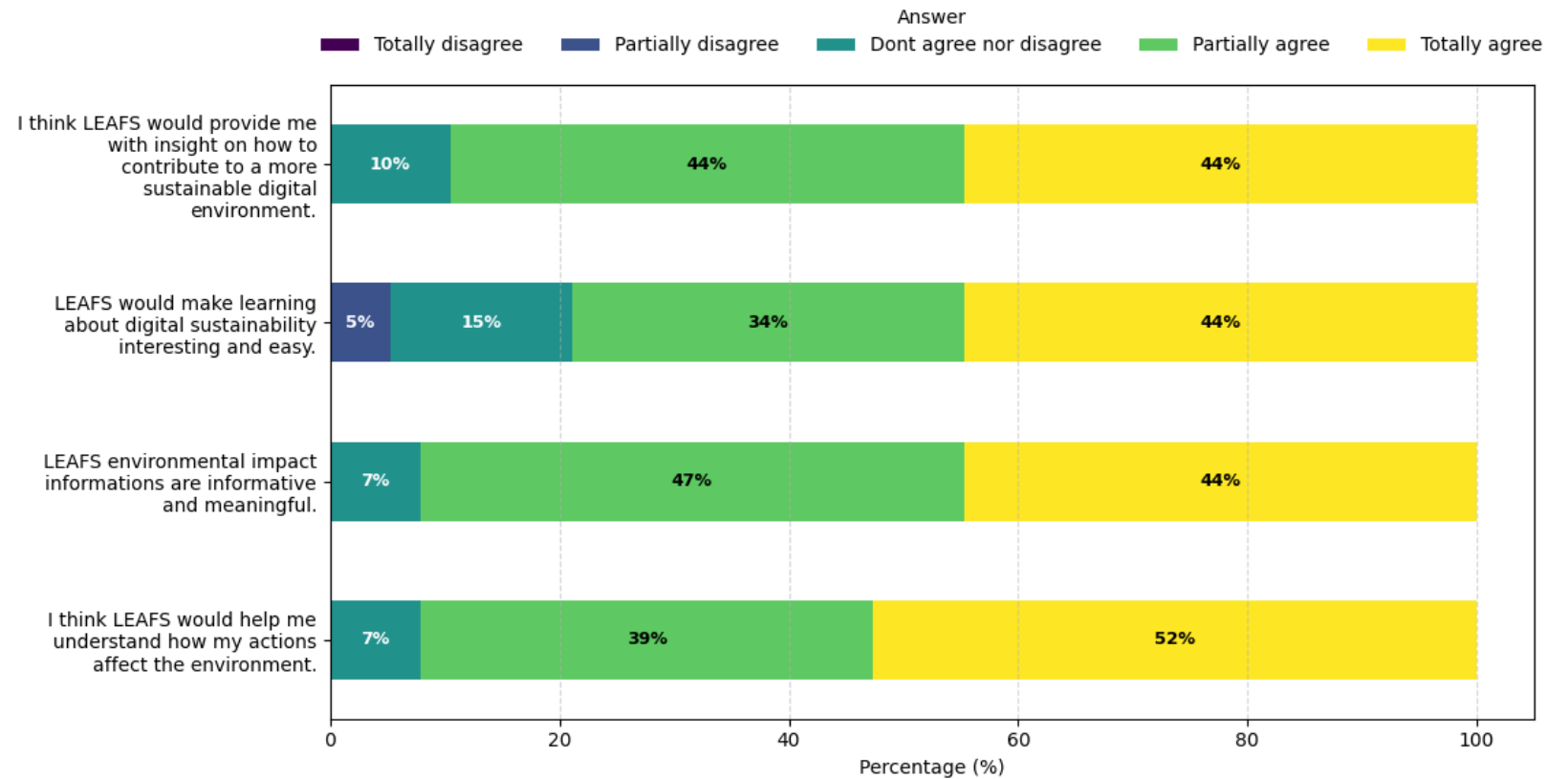
User Acceptance

Technology Acceptance Study

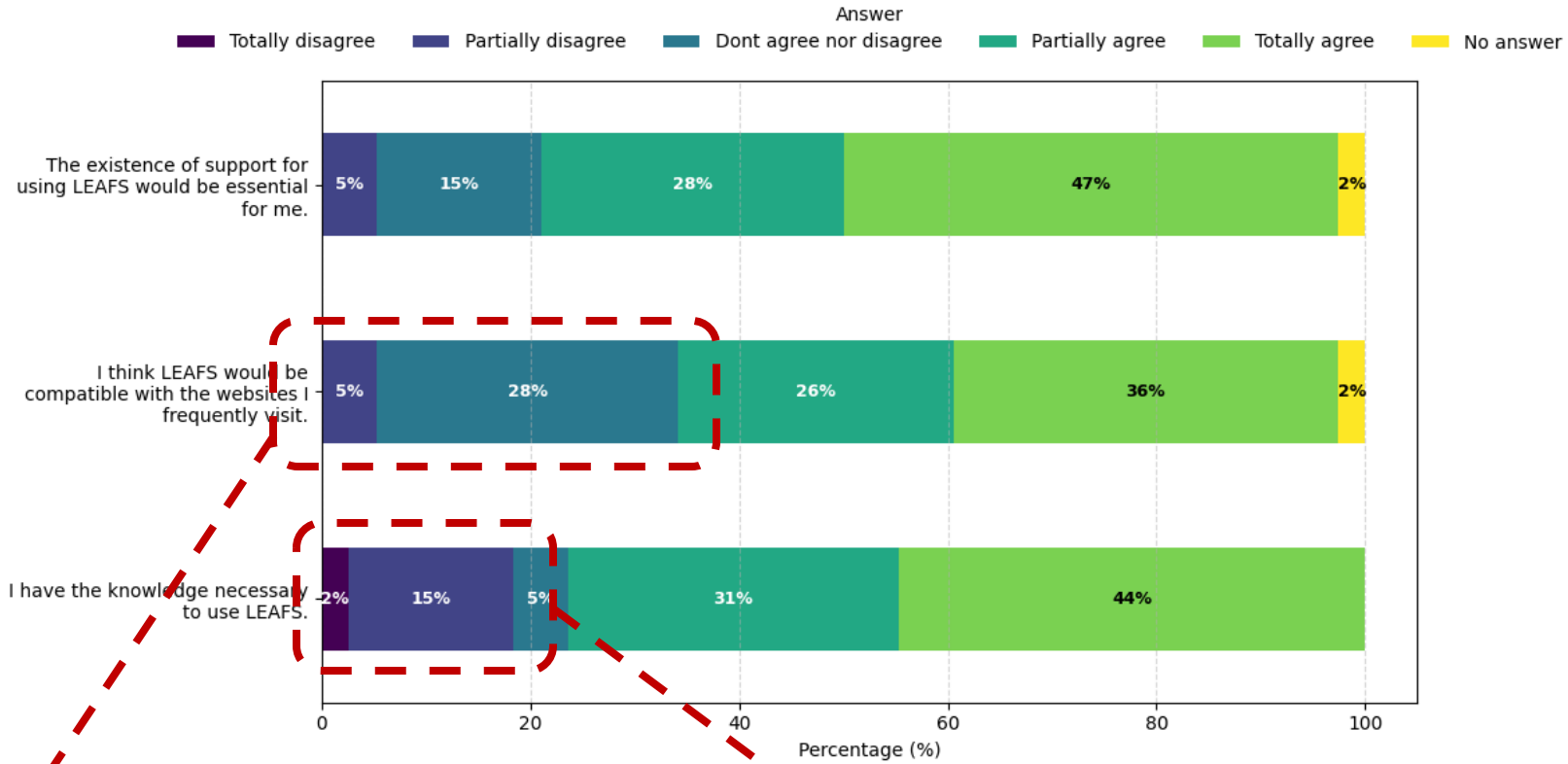




The idea had a high acceptance from participants!



Learning about sustainability
was also highlighted!



Doubts about compatibility.

Doubts about the capacity to do the configuration.



**Easy to
Implement**



GreenSfinge

<https://github.com/EsfingeFramework/greensfinge>

```
public class UserService {
```

```
@GreenConfigKey("OPTIONAL")
```

```
@GreenSwitchOff
```

```
public void optionalFunctionalityWithHighEnergyConsumption(StringBuilder strParameter) {
```

```
    strParameter.append("something very high");
```

```
}
```

```
}
```

Annotations are used to
mark methods with
functionality that can be
turned off.

```
public class ProfileService {
```

```
@GreenMetric(metricSavedValue = 5.78)
```

```
public String doSomething6(String otherTest) {
```

```
    String value = "ProfileService - doSomething6 - " + otherTest;
```

```
    System.out.println(value);
```

```
    return value;
```

```
}
```

```
}
```

Estimation of energy consumption can be pre-calculated and added to methods for calculating savings.

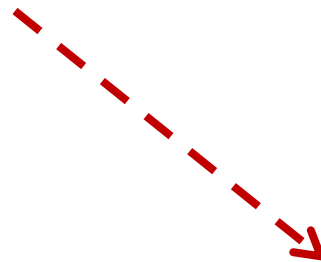
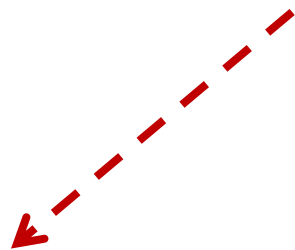
```
GreenConfigurationFacade facade = new GreenConfigurationFacade();
```

```
facade.setGeneralConfiguration(  
    GreenSwitchConfiguration.builder()  
        .ignore(config)  
        .configurationKey("OPTIONAL")  
        .build());
```

Configurations are centralized and affect all the code.

```
UserService userService =  
    GreenFactory.greenify(UserService.class);
```

The application classes just need to be wrapped into a proxy.



Metric	Conventional		GreenFramework	
	\bar{x}	σ	\bar{x}	σ
LOC	26.28	0.24	22.5	0.0
CC	2.04	1.32	1.5	0.0
NOD	0.0	0.0	1.0	0.0
NOA	0.0	0.0	2.0	0.0
ACov	0.0	0.0	5.13	0.0
ADiv	0.0	0.0	2.0	0.0
ADen	0.0	0.0	0.03	0.0
AIF	0.0	0.0	100	0.0

Lower complexity because part of the logic is defined outside the method body in annotations.

The implementations were more uniform because they had a well-defined structure to follow.

Straightforward
Code maintenance
Several configs



Learning curve

Simplicity

WHAT'S NEXT

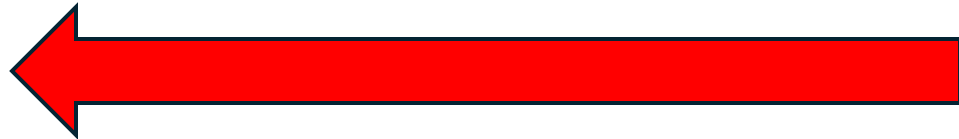
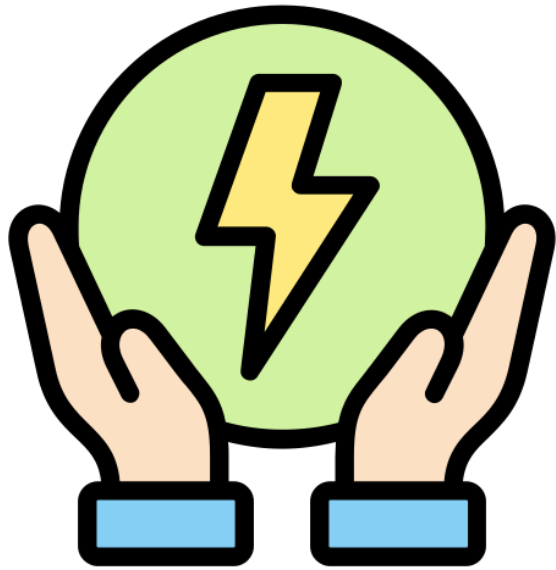




LEAFS



Estimote
FRAMEWORK



Studies to
Measure Impact





Thank You