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School of International and Public Affairs

Columbia University Capstone Project

Project WTP:

What Drives Public Willingness-to-Pay for Low Carbon Fuel?

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Columbia University Capstone Team

Ryan Hakim
Tina Yujie Si
Mitsuyo Murata
Riya Yingran Guo
Lina Li
Akari Nagai
Corentin Donatien
Ebtihal Alsekaity
Mengqi Chen

I. Context and Research Questions

Mixed public voices have been heard along the transition towards low-carbon fuel (LCF), leading to policy uncertainties. On one hand, the European Union (EU) issued the ReFuelEU Aviation regulation in October 2023, setting the target of 70% Sustainable Aviation Fuel (SAF) by 2050. On the other hand, the Swedish government announced to slash its biofuel mandate in Jan 2024 as a response to high energy costs. Public opinion plays an important role shaping public policies. For companies considering investment in LCF, it is important to evaluate the public sentiment towards LCF and assess potential impacts on policies.

Project WTP studies the **public sentiment and willingness-to-pay for low-carbon fuels in developed economies**. Based on big-data analytics of over 120,000 pieces of media and social media contents in **US, UK, Germany, France, Japan**, the study provides insights to the following critical questions

- What are the main contexts in which people discuss LCF?
- How do the public view LCF? Interest level? Positive vs. negative views?
- How do willingness-to-pay (WTP) evolve over time? What drives the changes?
- Any regional differences by market?
- What are the key indicators for LCF players to watch?

II. Methodology

2.1 Data sources

Public sentiment is assessed based on **media articles and social media posts**. Three data sources are adopted to capture different facets of public opinions

(a) ***Dow Jones Factiva:*** Media articles from all major newspapers and magazines globally. Factiva allows country specific data search. Sample size: 15,227 articles that mentioned LCF in 2021-2024.

(b) ***ProQuest TDM Studio:*** Large-scale data sets containing newspapers, journals and primary sources. Sample size: 50,000+ articles.

(c) ***YouTube:*** Viewer comments on videos of LCF / climate topics. The social media content reflects the voices of the general public. Sample size: 63,701 comments.

2.2 Key measures

To enable quantitative comparison, three variables are tracked by country by year.

(a) ***Interest Index:*** A measure of public interests in LCF topics. Number of articles mentioning LCF as % of total number of media articles.

(b) ***Sentiment Score:*** A measure of positive views vs. negative views on public discussions, which is generated by natural language processing (NLP) algorithm. The higher the sentiment score, the more positively the public views LCF.

(c) ***WTP Index:*** A indicator of willingness-to-pay for LCF, calculated by adjusting sentiment score with (i) cost premium of LCF over normal fuel, and (ii) cost of living by country.

2.3 Driver analysis

Besides identifying the trends and cross-regional differences, the project also looks into the drivers behind the changes. Regression is conducted between the WTP Index and 12 driver indicators in 4 categories – (a) Awareness and perception on climate change; (b) Regulation and policy incentives; (c) Political environment; (d) Economic conditions and energy prices.

The drive analysis gives light to the key factors affecting public willingness-to-pay, which investors and corporations should watch out for.

III. Key Findings

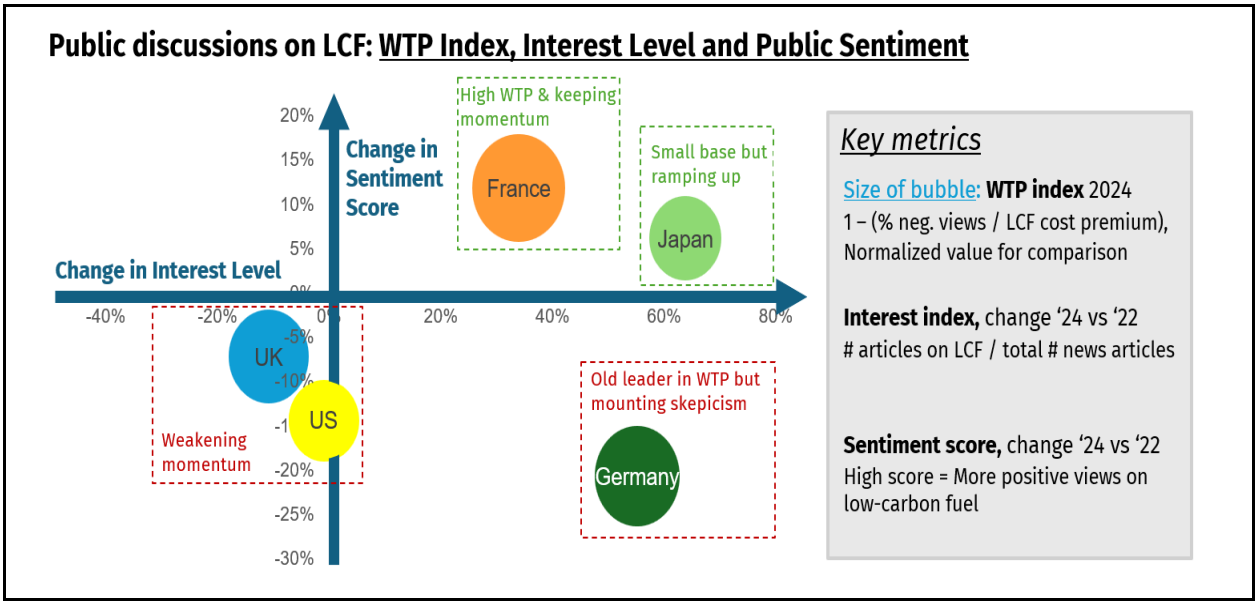
3.1 Context of public discussions on LCF

Willingness-to-pay is influenced by the perceived sum of "direct" AND "indirect" benefits of LCF policies. Public does not simply view LCF as paying extra price for the pure purpose of decarbonization (direct benefits); Countries also consider the economic values brought by LCF policies (indirect benefits). On media and social media, current discussions on LCF are largely in the context of investment opportunities, target feasibility and policy incentives. In markets where LCF policy is incorporated within a broader industrial strategy and believed to bring business and employment, LCF is more likely to enjoy favorable momentum.

In addition, Inflation and energy security are currently not at the center of LCF discussions. **High inflation does not appear to necessarily lead to public resistance towards LCF**. In times of high energy costs, the price gap between LCF and normal fuel is smaller and it may be easier for businesses to pass on incremental costs to end-consumers.

3.2 Divergent trends globally

Developed economies demonstrate divergent trends on public attitudes towards LCF, as illustrated by the chart below. Three major observations are highlighted.



(a) ***Softened policy drive:*** **In major Western markets (US, UK, Germany), public support and WTP for LCF peaked in 2022, and started to turn weak afterwards along with the overall climate movement.**

When the Ukraine War disrupted global oil and gas supply in 2022, public concerns on energy security and government incentives on green energy investment pushed sentiment on LCF to the highest level. However, when mandates like ReFuelEU Aviation policy came into execution, the industry experienced **feasibility challenges** – feedstock competition, scale-up challenge and high costs. As a result, industry

skepticism on the LCF target built up in 2023-2024. While the business sectors had an increasing desire for policy support, the follow-up stimulus was lacking.

Growing public awareness may not necessarily lead to a higher WTP. LCF, compared to other climate levers, is still a niche topic in public discussions today, resulting in low consumer awareness of its costs and decarbonation efficiency. Media coverage on LCF is increasing but it raises suspicions on its high costs.

(b) ***Asia rise:*** **While the West witnessed rising critics in 2023-24, major Asia markets such as Japan are increasing their interests and support in LCF, despite a low base.** Two reasons contribute to the "Asia rise":

Incremental transition: Japan's LCF strategy is centered on ammonia and hydrogen and built upon its existing tech strengths. Japan's approach and LCF target is seen as pragmatic compared to Europe's drastic transition plan.

Industrial policies: Japan and China adopt green policies to guide its industry upgrade, creating new business opportunities for their companies and expanding overseas. For example, Japan launched the AZEC initiative and supports Japanese ammonia companies to expand to Southeast Asia.

(c) ***Uneven burden:*** **Within the EU, France and Germany show divergent WTP trends – France is increasing support for SAF while Germany is increasingly skeptical.** The divergent WTP trends also echo the 2024/2025 Parliament election result in Europe – French "green party" EELV increased seats; whilst German "green party" Alliance 90/The Greens lost seats. The difference is shaped partly by their differing industrial structures, which are impacted unequally in energy transition.

Viable business model: France, home to Airbus, has a sizable aviation sector (~4% of France GDP) and a complete industry ecosystem to create business opportunities from SAF transition. For example, Airbus launched the SAF "Book and Claim" system in March 2025, driving public sentiment on LCF to a high level.

Supply capability: France has an agriculture sector that is twice the size of Germany's and cheap electricity from nuclear, making local LCF production feasible. Currently France has a larger SAF productive capacity than Germany.

IV. Strategic Implications for the energy industry

Feasible targets, sustained policy incentives, and public communications on derived economic opportunities are the key ingredients of high willingness-to-pay. Beside technology innovations and cost changes, low-carbon fuel players shall monitor key indicators for business opportunities

(a) ***Regional difference:*** Recent WTP trends differ by market, driven by each country's policy approach, industrial structure and supply-demand position. The recent rising momentum in Asia markets is worth attention.

(b) ***Political agenda:*** Continued policy support is needed to sustain motivation of the business community. A political turnover could be a leading indicator of policy shift.

(c) ***Target accomplishment:*** Over-aggressive policy targets could trigger backlashes. Tracking current accomplishment level given hints for future public sentiment.

(d) ***Public awareness of LCF:*** Today LCF has low awareness among end-consumers. As its awareness grows, costs could play a bigger role in impacting future WTP.

Disclaimer:

Open Source Attribution

This research utilizes the Natural Language Toolkit (NLTK) version 3.8+ (Bird et al., 2009) under the Apache License 2.0. For sentiment analysis, the team employs VADER (Valence Aware Dictionary and sEntiment Reasoner) (Hutto & Gilbert, 2014), which is originally developed under the MIT License, though accessed here through NLTK's implementation.

Additional libraries used include striprtf, pandas, and matplotlib, each with their respective open-source licenses.

All license terms have been complied with, and limitations of these tools were addressed through calibration with manually labeled data and expert human review.