

## “Pedagogical Material about European Union Policies and Research on Sustainable Transportation Fuels”

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The unabated rise in atmospheric carbon dioxide (CO<sub>2</sub>) levels, which recently surpassed 419 parts per million, exacerbates climate change and the uncertainty about the future of our planet. As the highest emitter of greenhouse gases (GHG) in the United States (27%) and second highest worldwide (23%), the transportation sector is in urgent need of reform to curtail emissions to combat climate change that raises sea level, negatively effects food production, and intensifies droughts and hurricanes. The EU has taken global leadership in this effort with a two-prong approach that combines policy making with research funding.

(1) **Policy:** During the last 20 years, the EU has been consistently instituting policy measures that aim at reducing GHG emissions, including those from the transportation sector that consists of passenger vehicles, buses & trucks, and aviation. In 2009, the *EU Energy and Climate Change Package* set a target of at least 10% renewable energy use by the transportation sector of all member states (MS) by 2020. Within that legislation, the *Renewable Energy Directive (RED)* instituted specific conditions and goals to be achieved during the period 2010-2020. In 2018, the EU adopted a revised directive, RED II, setting a new goal of 32% renewable energy use in the entire EU economy by 2030 and a 14% renewable energy goal specifically for transportation through the use of low-carbon renewable fuels termed “advanced biofuels”. In an effort to meet RED II, many MS have adopted biofuel use mandates, but there is still significant variation among countries. Advanced biofuels identified by the EU include renewable fuels produced from algae, cellulosic biomass, bio-waste, a wide range of residues from agricultural crops (such as wheat, sugarcane, corn, grapes), used cooking oil, and some types of animal fat. RED II specifies that advanced biofuels used in transportation, like ethanol, biodiesel, and SAF, can qualify for the 14% goal only if they achieve at least 65% lower GHG emissions than their fossil counterparts, like gasoline, diesel, and aviation fuel. Although the COVID-19 pandemic and the Russian invasion of Ukraine resulted in temporary suspension or reduction of the RED II target due to supply chain and pricing issues, MS are once again resuming their efforts to increase use of biofuels.

Recently, the EU focused on promoting the manufacture and use of SAF to reduce aviation emissions, which are considered hard to decarbonize due to the limited range of fuel options. In April 2022, the EU agreed to adopt the *Fit for 55* legislative proposal, which aims to reduce EU’s overall CO<sub>2</sub> emissions by 55% by 2030, compared to 1990 levels, and reach carbon neutrality by 2050. Part of the proposal is the *ReFuelEU* provision that intends to boost production and use of SAF through a biofuel-fossil fuel blending mandate imposed on aviation fuel suppliers throughout the EU. The mandate will start with a minimum volume of 2% SAF by 2025, 6% by 2030, 20% by 2035, and eventually 70% by 2050. All airlines departing from EU airports will be obligated to use SAF blends. The United States, on the other hand, is taking a different approach to promote SAF production. Instead of blending mandates, the US provides SAF producers with tax credits to enhance the economics of SAF manufacturing.

(2) **Research Funding:** In parallel with policy, the EU is pursuing research funding to promote the development of low-carbon intensity fuels, including SAF. Succeeding the Horizon 2020 program, Horizon Europe is now EU’s key funding program for scientific research and innovation, raising science spending by 50% to €95.5 billion for the period 2021-2027, although this is still less than US research spending.

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Importantly, Horizon Europe focuses on addressing climate change, meeting the United Nations Sustainable Development Goals (SDG), increasing EU competitiveness and job growth, and boosting collaboration with other countries. The program entails significant funding for the development of biofuels, including SAF, under the “Climate, Energy & Mobility” cluster, which is funded with €15.1 billion over the program’s 7 years. An example of projects funded by Horizon Europe is the algae research conducted by Professor Christos Chatzidoukas at the Aristotle University of Thessaloniki (AUTH), Greece. A collaborative project was initiated in 2022 between USF and AUTH bringing together the teams of Dr. Philippidis and Dr. Chatzidoukas. The goal of the collaboration is to combine algae know-how developed in Florida with algae strain development and cultivation in Greece to jointly promote the commercialization of renewable algal products, such as SAF and other biofuels, nutraceuticals, cosmetics, and animal feed.

These findings will be incorporated into the existing USF graduate course “Renewable Transportation Fuels” (IDS 6207) in the form of a new module entitled “European Union Policy and Research on Low-Carbon Transportation Fuels”. This way, the course content will be internationalized to complement existing material on US efforts in the transportation sector with new material on EU efforts for a more holistic pedagogy on sustainability. It is anticipated that through the EU module, students will gain in-depth understanding of and appreciation for biofuel initiatives underway in the EU, so as future sustainability leaders they can collaborate with their European and other counterparts to jointly curtail the global threat of climate change.