The composition of fatty acids and phytosterols of oils recovered from the seeds of nine industrial fruit by-products: watermelon (Citrullus lanatus), honeydew melon (Cucumis melo), sea buckthorn (Hippophae rhamnoides), red currant (Ribes rubrum), pomegranate (Punica granatum), Japanese quince (Chaenomeles japonica), grape (Vitis vinifera), gooseberry (Ribes uva-crispa) and apple (Malus domestica) were studied. The oil yield in the investigated fruit seeds ranged from 11.8% (sea buckthorn) to 28.5% (watermelon). The main phytosterol identified in all fruit seed oils was β-sitosterol with the concentration ranging between 0.5 and 3.1 mg/g of oil, in watermelon and Japanese quince, respectively. The fatty acid composition was unique for each fruit seed oil. The majority of samples had high linoleic acid content (38.0-70.7%), whereas the pomegranate seed oil was extremely rich in punicic acid (86.2%). Japanese quince seed oil had the highest potential value for biodiesel production; while the unique profile of bioactive compounds recorded in pomegranate seed oil indicated great potential for utilization in cosmetic and/or pharmaceutical industries. The ωPUFA/(ωSFA + ωMUFA) ratio of nine fruit seed oils highly correlated (r > 0.9, p < 0.0001) with all biodiesel properties, with the exception of the cold filter plugging point [P. Gómaš*, M. Rudzińska (Institute of Horticulture, Latvia University of Agriculture, Graudu 1, Latvia) Industrial Crops and Products, 2016, 83, 329-338].

Bio-oil from fast pyrolysis of biomass requires multi-stage catalytic hydroprocessing to produce hydrocarbon drop-in fuels. One process design currently in development involves fixed beds of ruthenium-based catalyst and conventional petroleum hydrotreating catalyst. As the catalyst is spent over time as a result of coking and other deactivation mechanisms, it must be changed out and replaced with fresh catalyst. A main focus of bio-oil upgrading research is increasing catalyst lifetimes to 1 year. Biofuel life cycle greenhouse gas (GHG) assessments typically ignore the impact of catalyst consumed during fuel conversion as a result of limited lifetime, representing a data gap in the analyses. To help fill this data gap, life cycle GHGs were estimated for two representative examples of fast pyrolysis bio-oil hydrotreating catalyst, NiMo/Al₂O₃ and Ru/C, and integrated into the conversion-stage GHG analysis. Life cycle GHGs are estimated at 5.5 kg CO₂-e/kg catalyst for NiMo/Al₂O₃. Results vary significantly for Ru/C, depending on whether economic or mass allocation methods are used. Life cycle GHGs for Ru/C are estimated at 80.4 kg CO₂-e/kg catalyst using economic allocation and 13.7 kg CO₂-e/kg catalyst using mass allocation. Contribution of catalyst consumption to total conversion-stage GHGs at 1-year catalyst lifetimes is 0.5% for NiMo/Al₂O₃ and 5% for Ru/C when economic allocation is used (1% for mass allocation). This analysis does not consider the use of recovered metals from catalysts and other wastes for catalyst manufacture and therefore these are likely to be conservative estimates compared to applications where a spent catalyst recycler can be used [L. J. Snowden-Swan*, K. A. Spies, G. J. Lee, Y. Zhu (Pacific Northwest National Laboratory, United States) Biomass and Bioenergy, 2016, 86, 136-145].

**Hydrodeoxygenation of oxidized distilled bio-oil for the production of gasoline fuel type**

Distilled and oxidized distilled bio-oils were subjected to 1st-stage mild hydrodeoxygenation and 2nd-stage full hydrodeoxygenation using nickel/silica-alumina catalyst as a means to enhance
hydrocarbon yield. Raw bio-oil was treated for hydrodeoxygenation as a control to which to compare study treatments. Following two-stage hydrodeoxygenation, four types of hydrocarbons were mainly comprised of gasoline and had water contents, oxygen contents and total acid numbers of nearly zero and higher heating values of 44-45 MJ/kg. Total hydrocarbon yields for raw bio-oil, oxidized raw bio-oil, distilled bio-oil and oxidized distilled bio-oil were 11.6, 16.2, 12.9 and 20.5 wt.%, respectively. The results indicated that oxidation had the most influence on increasing the yield of gasoline fuel type followed by distillation. Gas chromatography/mass spectrometry characterization showed that 66.0-76.6% of aliphatic hydrocarbons and 19.5-31.6% of aromatic hydrocarbons were the main products for oxidized bio-oils while 35.5-38.7% of aliphatic hydrocarbons and 58.2-63.1% of aromatic hydrocarbons were the main products for non-oxidized bio-oils. Both aliphatic and aromatic hydrocarbons are important components for liquid transportation fuels and chemical products [Y. Luo, V. K. Guda*, E. Hassan, P. H. Steele, B. Mitchell, F. Yu (Mississippi State Univ, Dept Chem Engn, Mississippi State, MS 39762 USA) *Energy Conversion and Management, 2016, 112, 319-327].

NPARR, 7(3), 2016-259 Quest for sustainable bio-production and recovery of butanol as a promising solution to fossil fuel

Biobutanol has conventionally been generated by fermentation of carbohydrates derived from biomass (starch or sugar-based feedstock, such as corn) using Clostridia strains (mainly C. beijerinckii and C. acetobutylicum) under anaerobic conditions in batch mode. Under these premises, it has been tough for the acetone-butanol-ethanol fermentation to compete with petro-butanol production from an energy efficiency and material consumption standpoint. Challenges for butanol production from biomass comprised high cost of feedstock, scarcity of hyper-butanol producing bacteria and low butanol yield, volumetric productivity and titre, leading to high water usage and separation-purification costs. This article is an up-to-date review on several under explored sections, such as optimization of fermenter feed, microbial culture responsible for solvent production (co-culture techniques and electro-biochemical process), latest recovery techniques and the studies integrating in situ continuous fermentation processes. Biobutanol refinery way forward should build upon the use of low-cost lignocellulosic matter and zero cost organic wastes and by-products from food, agriculture, forestry, fermentation and paper industries as feedstock; optimized fermentation of such diversified feed with appropriate hyper-butanol producing strains in biofilm reactors and integration of fermentation step with hybrid high butanol-selective recovery techniques [S. Maiti, G. Gallastegui, S. K. Brar*, Y. LeBihan, G. Buelna, P. Drogui, M. Verma (Ctr Eau Terre Environn, Inst Natl Rech Sci, 490 Rue Couronne, Quebec City, PQ G1K 9A9, Canada) *International Journal of Energy Research, 2016, 40(4), 411-438].

NPARR, 7(3), 2016-259 Advances in biofuel production from oil palm and palm oil processing wastes: A review

Over the last decades, the palm oil industry has been growing rapidly due to increasing demands for food, cosmetic, and hygienic products. Aside from producing palm oil, the industry generates a huge quantity of residues (dry and wet) which can be processed to produce biofuel. Driven by the necessity to find an alternative and renewable energy/fuel resources, numerous technologies have been developed and more are being developed to process oil-palm and palm-oil wastes into biofuel. To further develop these technologies, it is essential to understand the current stage of the industry and technology developments. The objective of this paper is to provide an overview of the palm oil industry, review technologies available to process oil palm and palm oil residues into biofuel, and to summarise the challenges that should be overcome for further development. The paper also discusses
the research and development needs, technoeconomics, and life cycle analysis of biofuel production from oil-palm and palm-oil wastes [J. C. Kurnia*, S. V. Jangam, S. Akhtar, A. P. Sasmito, A. S. Mujumdar (Mechanical Engineering Department, Universiti Teknologi PETRONAS, 32610 Bandar Seri Iskandar, Perak Darul Ridzuan, Malaysia) Biofuel Research Journal, 2016, 3(1), 332-34].

NPARR, 7(3), 2016-260 **Interpreting long-term energy scenarios and the role of bioenergy in Germany**

Defining the long-term development of Germany’s energy sector, has been the subject of a series of studies carried out by governmental, industrial and independent interest groups. These studies play a significant role in energy political debate for understanding the long-term role of bioenergy in the national energy system. However, a deep insight and critical assessment of these studies is necessary to increase their transparency and traceability for policy and research. This article aims to provide with information for better understanding energy scenarios and to interpret the expectations of the role that bioenergy can play in 2050.

Firstly, 18 long-term energy scenarios were selected based on defined criteria, and analyzed in details in terms of their goals, methods, data used and obtained results. Furthermore, four specific bioenergy-related indicators were selected to carry out a quantitative analysis and interpretation across the selected studies. The results for the four indicators show a high uncertainty and a wide range of potential bioenergy development futures in Germany by 2050 – e.g. the sustainable domestic biomass potential ranges from 350 to 1700 PJ, the share of biomass in final energy consumption lies between 5 and 28% – principally due to the different key questions and methods and heterogeneous driving forces.

The study provides with recommendations for energy scenario users for quality measures (e.g. traceability and transparency of methods and data) and contextualization of the results [N. Szarkaa*, M. Eichhornb, R. Kitzlera, A. Bezamab, D. Thräna (Deutsches Biomasse forschungszentrum, Leipzig, Germany) Renewable and Sustainable Energy Reviews, doi:10.1016/j.rser.2016.02.016].