Pyrolysis of biomass produces a high yield of condensable oil at moderate temperature and low pressure. This bio-oil has adverse properties such as high oxygen and water contents, high acidity and immiscibility with fossil hydrocarbons. Catalytic hydrodeoxygenation (HDO) is a promising technology that can be used to upgrade the crude bio-oil to fuel-grade oil. The development of the HDO process is challenged by rapid catalyst deactivation, instability of the pyrolysis oil, poorly investigated reaction conditions and a high complexity and variability of the input oil composition. However, continuous catalytic hydropyrolysis coupled with downstream HDO of the pyrolysis vapors before condensation shows promise (Figure 1). A bench scale experimental setup will be constructed for the continuous conversion of solid biomass (100g/h) to low oxygen, fuel-grade bio-oil. The aim is to provide a proof-of-concept for the proposed process (Figure 1), to understand the reaction mechanisms of HDO, to develop highly active and durable catalysts for hydropyrolysis and HDO and to optimize the operating conditions; all in order to develop a sustainable production of green transportation fuels from biomass. To support the process development, the conversion of different bio-oil model compounds over a widerange of catalyst classes (reduced types, oxides, phosphides and sulfides) will be investigated. Special attention will be paid to operating conditions (e.g. temperature, H₂ partial pressure, residence time) and to tolerance against water, sulfur, chlorine and potassium which are abundant in bio-oil.