EXAMPLE CHAPTER – Contributed chapter

Chapter 9: (Chapter Title)

Author(s):
*J. Smith (Univ of Texas, jsmith@website.com)
K. Jones (Univ of Texas, kjones@website.com)
*(Include all authors' names, affiliations, and contact info. Indicate lead corresponding author with *)*

9.1 Introduction: Background and Driving Forces

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9.2 Value of Fuels and Lignocellulose as Raw Material

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$$CH_xO_y + (1 + x/4 - y/2)\ O_2CO_2 + x/2\ H_2O \quad \Delta_R H < 0 \qquad (9.1)$$

$$\Delta_R H^0_{298} = -422.5 - 117.2\ x + 177.5\ y\ (kJ/mol) \qquad (9.2)$$

$$HHV = -\Delta_R H^0_{298} / M_{CHxOy}\ (kJ/kg) \qquad (9.3)$$

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9.3 Thermochemical Routes for Biomass Conversion to Fuels

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elementum. Integer nisl orci, discusses lignocellulose molecules in Figure 9.3 ornare eget dignissim vulputate, tincidunt vitae massa. Vestibulum lectus neque, elementum sit amet laoreet vel, malesuada at diam. Suspendisse tristique felis ut eros convallis, in pulvinar nibh. Suspendisse eget bibendum ligula, vitae pharetra nisl. Praesent a massa sem. Class aptent taciti sociosqu ad litora torquent per conubia.

9.4 Pyrolysis

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Figure Legend (figure art must be provided separately from the text)

Figure 9.1: Molar ratio H/C and O/C of fossil and renewable fuels. (Based on Boie 1953)

Figure 9.2: Structural elements in lignocellulose molecules. (Adapted from Schaub and Reimert 2003).

Figure 9.3:Overview of thermo-chemical conversion routes for lignocellulosic biomass feedstocks. (Source: Arpe 2007).

Figure 9.4: Reactor principles of different gasification processes. (Modified from "Fischer-Tropsch-regime", Schulz 2003, with permission).

Figure 9.5: Effect of oxygen consumption on synthesis gas. (Courtesy of Photographers name)

Sample tables (All tables must be editable)

Table 9.1: Significant criteria for the assessment of chemical fuels. (Data from Elliott, D.C. 2007)

- energy density (per mass or volume), heating value
- C-content (specific CO2 emission), minor constituents (process complexity for cleaning)
- application potential, flexibility, handling and combustion characteristics
- transportation characteristics, storage
- efficiency in production/upgrading process
- availability of raw material/resources
- production cost, price, market potential

Table 9.2: Overview of liquid and gaseous fuels generated from lignocellulose and their properties

	Units	**Pyrolysis oil**	**FTS Diesel**	**SNG**	**Hydro-gen**	**Petro Diesel (reference)**
chemical compounds		aromatic, phenolic, alkyl, carboxyl CH_xO_y	hydrocarbon (alkane) C_nH_{2n+2} n = 10-20	hydrocarbon CH_4	molecular H_2	hydrocarbon (alkane, aromatic) C_nH_{xn} n = 10-20+ x = 0.5-2
composition	CH_xO_y	$CH_{1.6}O_{0.5}$	$CH_{2.1}$	CH_4	H_2	$CH_{1.86}$
boiling-temperature [1)]	°C	>150	160-380 (var)	-161.5	-252.8	180-360 (var)
mass density [2)]	kg/l	1.0	0.77	0.135 [3)]	0.017 [3)]	0.84
energy density [2)]	MJ/l	10.0	34.3	6.4 [2)]	1.9 [3)]	35.0
application		FU	DE	DE/FC	DE/FC	DE
other significant properties: vaporization, ignition, combustion, chemical stability						

[1)] at 1 bar, [2)] at 15 °C, [3)] at 200 bar