Welcome

to the

First International Workshop to Explore Synergies between Nuclear and Renewable Energy Sources

Pete Lyons, Workshop Chairman

Golden Colorado

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Motivations for Hybrid Energy Systems

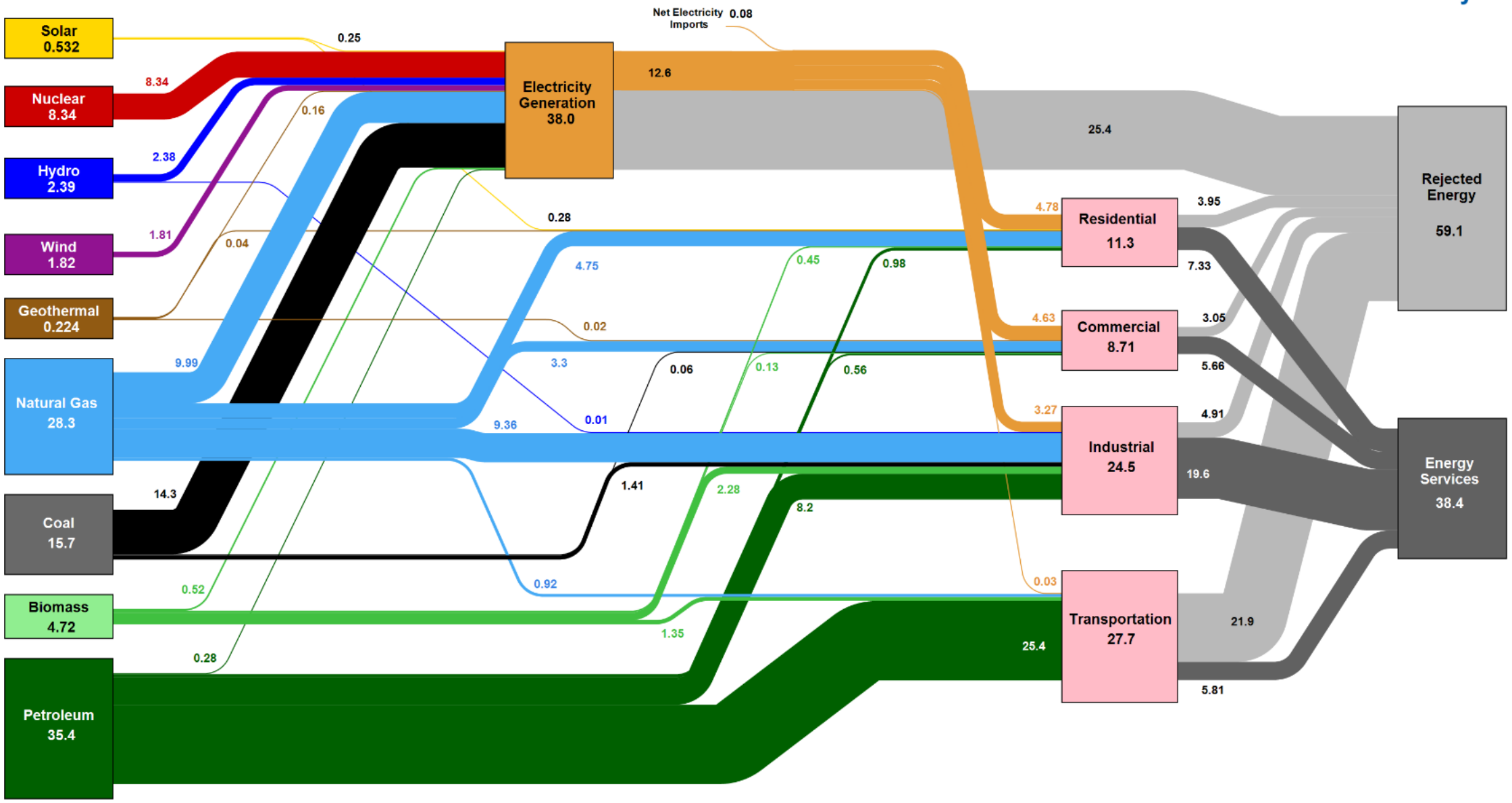
- Renewables and nuclear energy: the only clean sources available today.
  - Hydro can not expand significantly in the U.S.
- Electricity sector decarbonization cannot solve the global climate issues.
- Integration of assets on a grid level will be essential.
- A national grid must exhibit supply diversity and excellent reliability.

Key Attributes of Hybrid Energy Systems

- Designed to optimize contribution of nuclear **and** renewable assets.
- Cleanly produce all needed electricity PLUS another asset in the industrial or transportation sector.

Estimated U.S. Energy Consumption in 2015: 97.5 Quads

Lawrence Livermore National Laboratory



Source: LLNL March, 2016. Data is based on DOE/EIA MER (2015). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent Rounding. LLNL-MI-410527

Estimated U.S. Carbon Emissions in 2014: ~5,410 Million Metric Tons

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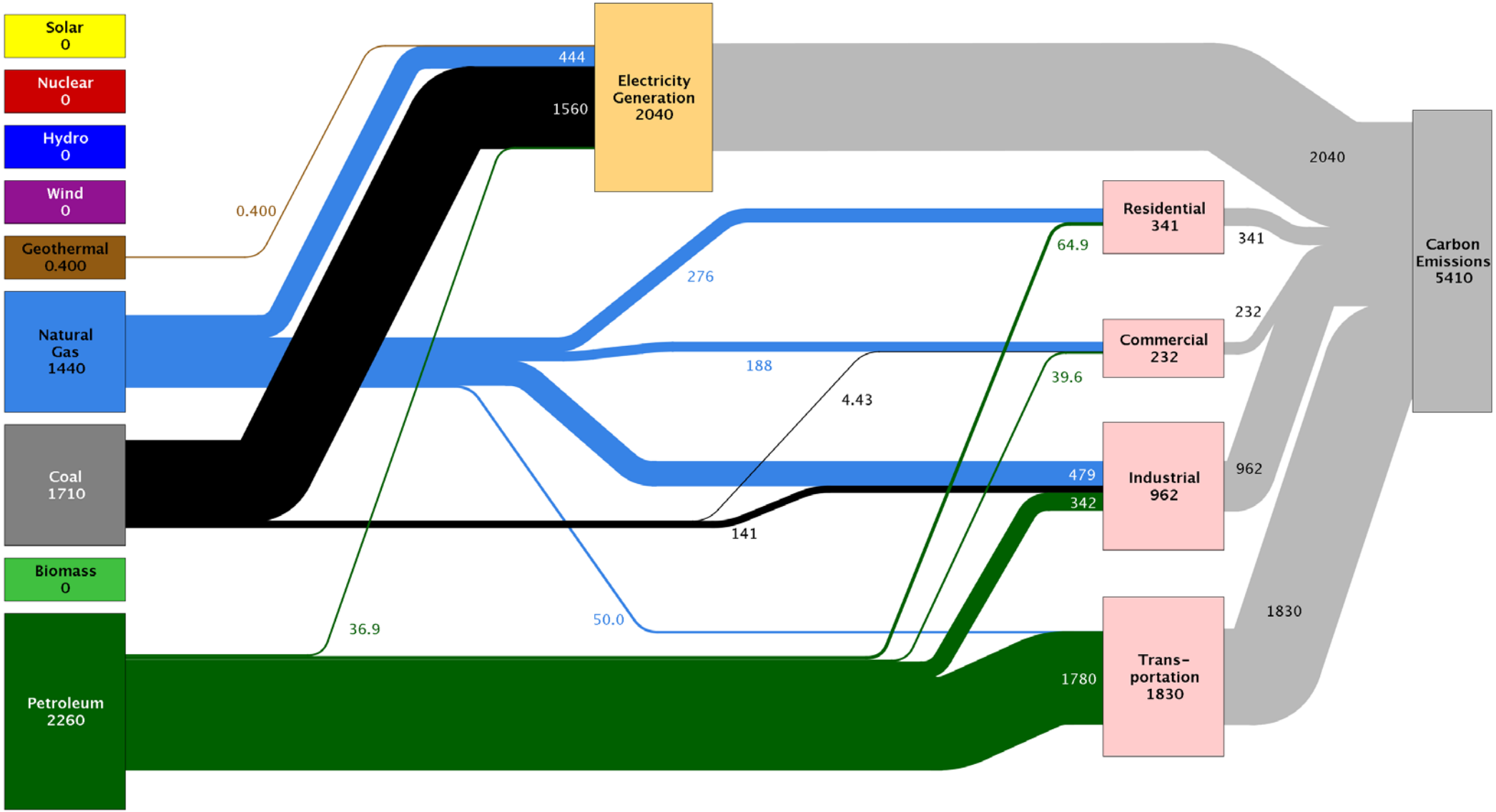

Source: LLNL 2015. Data is based on DOE/EIA-0035(2015-03), March, 2015. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Carbon emissions are attributed to their physical source, and are not allocated to end use for electricity consumption in the residential, commercial, industrial and transportation sectors. Petroleum consumption in the electric power sector includes the non-renewable portion of municipal solid waste. Combusition of biologically derived fuels is assumed to have zero net carbon emissions - the lifecycle emissions associated with producing biofuels are included in commercial and industrial emissions. Totals may not equal sum of components due to independent rounding errors. LLNL-MI-410527

Objectives

- Share the status of ongoing studies
- Explore benefits of, and options for, greater international cooperation.

Flow of Workshop

Day one

Technical Presentations on:

- International and U.S. perspectives on decarbonization
- Hybrid energy system studies
- Enabling technologies

Day two

- Breakout sessions
- Group discussion to frame next steps