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Prof. Tagliabue's research in nanophotonics for energy develops controlled experimental platforms and bridges micro- and macro-scale characterisation methods towards clarifying emerging light energy conversion pathways and demonstrating proof-of-concept devices for sustainable technologies. LNET's research focuses on three complementary processes.

**Light-to-X:** Redefining Energy Transport and Conversion with Nanophotonics  
Nanophotonics has transformed light-matter interactions at the nanoscale, with optical nanoantennas bridging the size gap between light wavelength and charge, heat, and ion transport scales. This enables unprecedented control over energy conversion processes and non-equilibrium phenomena, though understanding remains challenging due to complex multi-physics interactions.

**Plasmonic Catalysis:** Metallic nanoantennas generate non-equilibrium charge carriers that enhance chemical reactions. Prof. Tagliabue's work revealed critical details of charge dynamics and transfer at interfaces, advancing plasmonic catalysts for solar fuels production and photochemical energy storage.

**Hydrovoltaic Energy Generation:** Fluid flow over charged surfaces results in electrical energy generation (hydrovoltaic effect). Prof. Tagliabue's research highlighted the critical role of chemical equilibrium at the interface. Her group demonstrated efficient evaporation-driven hydrovoltaic devices that work at high salt concentrations (seawater), opening new possibilities for renewable energy production.

**Thermonanophotonics:** Absorbing optical nanoantennas can act as fast nano heaters. Prof. Tagliabue's research clarified photo-thermo-optical effects in silicon nanoresonators and led to reconfigurable metalens designs, enabling adaptable devices in optics and energy.