Title: Bicycle Transportation Accessibility: How Electronic-Assist Bicycles can Supplement Human Physiology

PRESENTER:

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BACKGROUND

One barrier to cycling as a consistent form of transportation are the limits of human physiology, which may be overcome in part to the use of electronic assist bicycles (e-bikes).

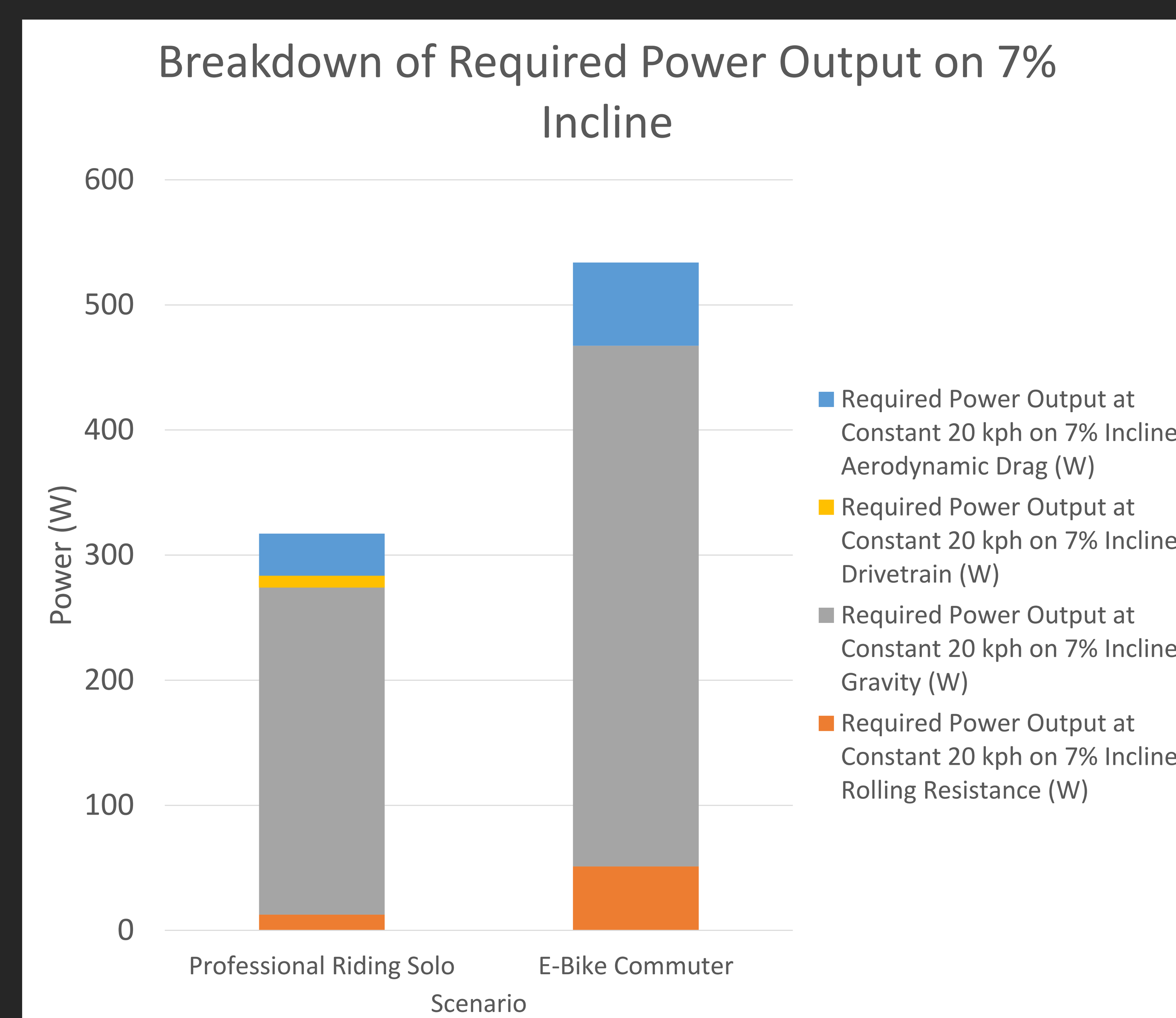
METHODS

A literature review was conducted to explore the frictional and gravitational losses in power when cycling. Numerical calculations were performed to determine the necessary input power required to ride a bicycle at a constant speed under multiple environmental conditions, rider physical characteristics, and structural design elements of different bicycles. Optimal bicycle technology and resistance factors were chosen for the professional cyclists, while commuters utilized economical and convenient technology and resistance factors.

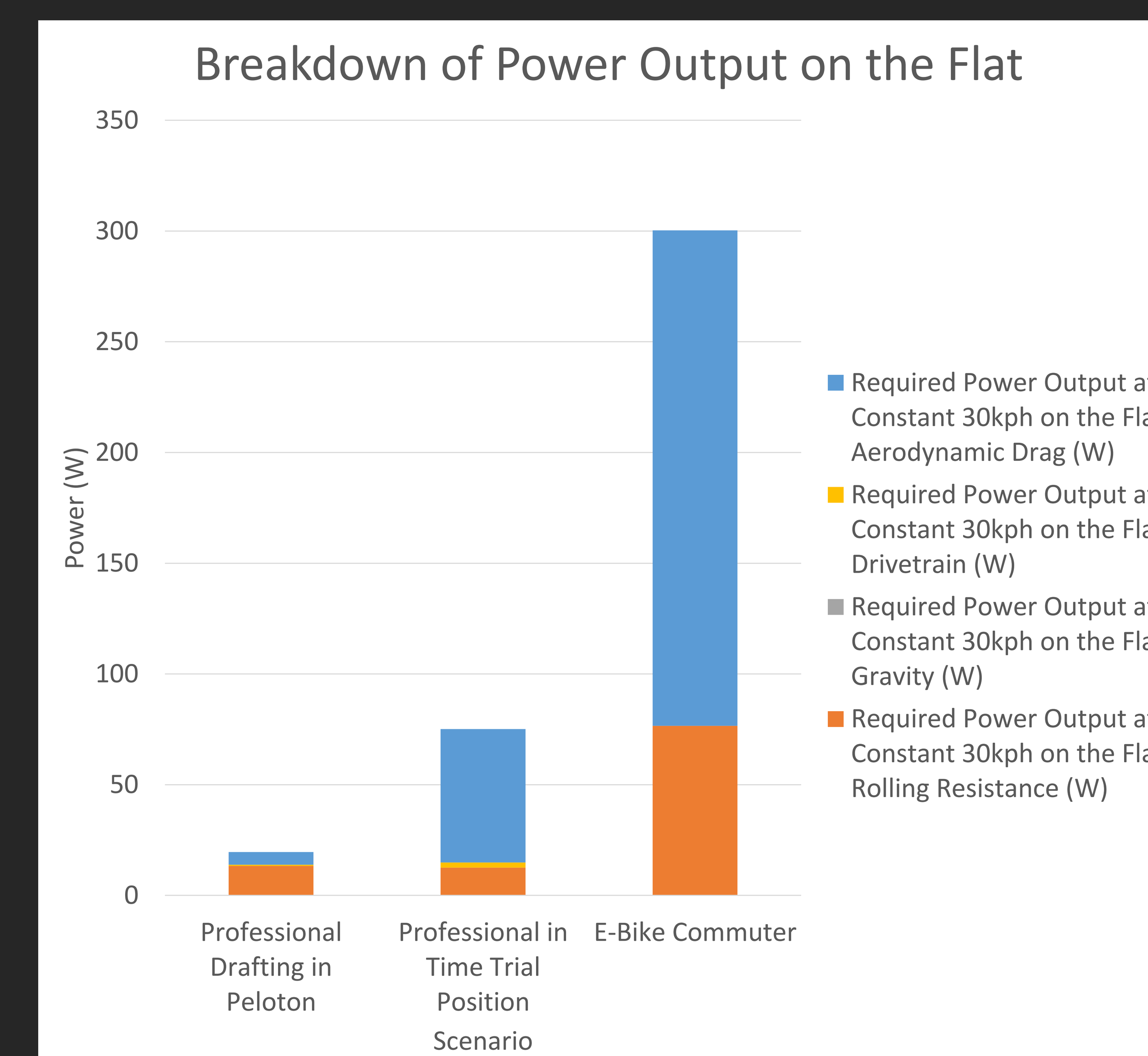
RESULTS

Commuters required approximately 70% more power than professional cyclists to ride at a constant speed uphill on a 7% uphill gradient, and either 300% (solo optimized time-trial position) or 1500% (experiencing the full drafting effect of riding in a peloton) more power to ride on flat terrain at a constant speed.

Electronic bicycles can assist in overcoming **human physiological barriers** to promote **cycling** as a means of **effective transportation.**



Required Power Output at Constant 20 kph on 7% Incline graphically displays the power necessary to overcome all resistive forces for both the professional and the e-bike commuter.



Breakdown of Power on the Flat graphically represents the power required to overcome each of the loss factors on the flat.

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DISCUSSION

The power required to ride at constant speeds is drastically different between trained professional cyclists and common commuters. These differences result from a variety of factors, including the weight of the rider/bicycle combination, position on the bike which contributes to aerodynamic drag, and ability to draft off other cyclists to reduce aerodynamic drag. Despite the massive differences in required power, e-bicycles almost, if not completely, could facilitate the power required to travel at effective commuting speeds for untrained riders.

Breakdown of Required Power Output at Constant 20 kph on 7% Incline

Scenario	Required Power (W)	Rolling Resistance (W)	Gravity (W)	Drivetrain (W)	Aerodynamic Drag (W)
Professional Riding Solo	313.5	12.6	261.5	9.4	33.7
E-Bike Commuter	533.8	51.1	416.2	0	66.5

Breakdown of Required Power Output at Constant 20 kph on 7% Incline displays the power needed to overcome each loss factor for both the professional and the e-bike commuter.

Breakdown of Required Power Output at Constant 30kph on the Flat

Scenario	Required Power (W)	Rolling Resistance (W)	Gravity (W)	Drivetrain (W)	Aerodynamic Drag (W)
Professional Drafting in Peloton	19.6	13.3	0	0.6	5.7
Professional in Time Trial Position	75.0	12.6	0	2.3	60.2
E-Bike Commuter	300.3	76.6	0	0	223.7

Breakdown of Required Power Output at Constant 30 kph on the Flat: the table above displays the power required to overcome each of the loss factors separately.