Edison2’s Winning Solution for the X Prize and the Future

Brad Jaeger
Director of Research and Development

Progressive Insurance Automotive X Prize

• Officially announced in 2008
• $10 million competition
• Safe, clean, production-capable, well-performing, >100 MPGe* vehicle
• 3 classes
  – $5 million mainstream class
  – Two $2.5 million alternative classes
• 111 teams entered

*MPG equivalent = energy contained in one gallon of pump gasoline (measured plug-to-wheels for EV’s)
Edison2

- Oliver Kuttner
  - CEO & Founder of Edison2
  - Charlottesville & Lynchburg real estate re-developer
  - Automotive entrepreneur and racer

The Team

- Top ranks of sports car racing and aerospace industry
  - Ron Mathis, Chief of Design
  - Barnaby Wainfan, Chief of Aerodynamics
  - Emanuele Pirro, Co-driver and board member
Brad Jaeger

- Director of R&D for Edison2
- B.E. from Vanderbilt University with honors in Mechanical Engineering
- Professional Race Car Driver
- Co-driver for Edison2 in X Prize

Edison2 Wins the Progressive Insurance Automotive X Prize!

- Virginia based company
- $5 million mainstream class winners
First Principles

The Design Process for Edison2’s X Prize-Winning Very Light Cars

The Rule Book

• Mainstream Class Requirements
  – 4 passenger vehicle w/ cargo space
  – 4 wheels
  – 200+ mile range
  – Less than 15 seconds 0-60MPH acceleration
  – Lateral acceleration of at least 0.7g
  – 100+ MPGe
Energy Equivalency

- MPGe
- Energy Content in 1 Gallon of Gasoline

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FTP 75 City Cycle
HWFET Cycle

Energy Expenditure & Recovery
Energy Analysis: Weight & Regenerative Braking’s Effect on Energy Consumption

The Two Absolute Virtues

“There are only two absolute virtues for an efficient car: the first is light weight and the second is low aerodynamic drag…everything else is a desperate compromise”

-Ron Mathis, Edison2 Chief of Design
First Sketches and Renderings

Platform Efficiency

- Analysis points to the platform instead of powertrain
- Simply use less energy, no matter what the power source
Light-weight, Elegant Structures

The Engine

- 250cc Single Cylinder
- Turbocharged
- Exhaust Gas Recirculation
- E85
- Max Power ~ 40HP
- Max Torque ~ 29 ft-lbs
- Cold Start Emissions
On Track Testing
X Prize Foundation and Argonne National Labs

• 129.6 MPGe
  Highway Cycle
• 110.8 MPGe
  Combined Cycle
• 82.6 g/mile CO₂
  Emissions

On Track Testing
Consumers Union Dynamic Safety

• Fastest Double
  Lane Change at
  49.06 mph
• Peak 1.18g on
  skid pad
• 128 ft stopping
  distance 60-0
  (mph)
The Very Light Car

- < 830 lbs
- Drag Coefficient of 0.16: Lowest ever seen at GM Aero Lab for 4-passenger vehicle
- 129 MPGe (highway) in X Prize on-track testing
- Lowest greenhouse gas emissions at the X prize
- Lowest coastdown results at Chrysler’s Chelsea Proving Grounds ever
- The VLC requires 3.5 HP to cruise at 50 MPH
- All achieved with an internal combustion engine using a gasoline and ethanol blend

Lessons of the X Prize
Ground-Up Design

- Lesson of the X Prize: leap in efficiency cannot occur with existing platforms
- VLC: Almost all components redesigned for weight and strength
- “Light because it is light”

Electric Vehicles & Platform Efficiency

- Energy Density
  - Energy in 1 gallon of gas (6 lbs) = 450+ lbs of batteries
- Range
  - 16 kWh battery pack in Volt has a 40 mile range
  - 16 kWh battery pack gives a VLC 200+ mile range
Energy Implications

- Low mass = fewer material inputs
- Low mass: secondary benefits
  - Tires, roads, brakes
- Conventional materials
  - Readily available, inexpensive, recyclable
  - Known production methods

Emissions

- Argonne National Labs GREET Model
  - 2014 Grid
- Lowest GHG Emissions out of all X Prize Finalists (including electrics)!
Energy Source Agnostic

- Diversification is the future
- Drivelines determined by individuals location, needs, and drive cycles

What’s Next?
The Next Generation VLC

- Maintain virtues of efficiency
- More consumer-friendly
- Safety Standards
- Interior Packaging
Corporate Partners Team

• Efficiency Development Program
  – Multiple tiers of investment
  – Small investment to be part of an extensive, high budget program
• Non-conflicting interests
  – Multiple fields
• Program diversification
  – A downsized future

The Henry Ford
The car of the future is one that simply takes less energy to move!

Thank You! Brad Jaeger
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