ENERGY TRANSITION AND THE
EVOLVING TRANSPORTATION LANDSCAPE

Dr. Selda Gunsel
President
Shell Global Solutions US

Presented at API DAP Industry Forum
April 12, 2022
DEN I T IO N S A N D CA U T I O N A RY N O T E

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The world today is dynamic and fast-changing, and for many, energy is a defining feature. Lives and livelihoods, economies and communities depend on convenient, reliable and affordable energy to thrive. As the global population increases and incomes rise, demand for energy will grow. Meanwhile the need to address stresses on the environment – especially climate change – has never been more important.
SHELL IS A GLOBALLY INTEGRATED ENERGY COMPANY WITH THE SCALE, EXPERTISE, AND DEMONSTRATED ABILITY TO DELIVER.

- 70+ countries
- 83,000 employees (2020)
- 70 million tonnes of liquefied natural gas (LNG) sold in 2020
- 255+ TW h global power sales approx. to end customers in 2020
- 5.6+ GW operating renewable capacity access globally

AT A GLANCE

- >80 thousand electric vehicle charging points and growing.
- >1 million B2B customers in >160 countries
- 46 thousand Shell-branded retail stations
- ~30 million customers per day

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Case For Change

Carbon Intensity

CO₂ intensity at constant purchasing power parities (kCO₂/$2015p)

Source: Enerdata
Case For Change

**Total energy consumption (Mtoe) Trend**

- **World**
- **Europe**
- **NA**
- **Canada**
- **US**
- **Asia**
- **China**
- **India**

**Emissions from Fossil Fuel Consumption**

- **World**
- **Europe**
- **North America**
- **Canada**
- **US**
- **Asia**
- **China**
- **India**

Source: Enerdata
## Population and CO₂ Emissions from Fossil Fuel

### Country / Region

<table>
<thead>
<tr>
<th>Region</th>
<th>% of Global Population</th>
<th>% of Global Emissions</th>
<th>Most Recent Rate of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>9.5%</td>
<td>11.2%</td>
<td>-3.9%</td>
</tr>
<tr>
<td>NA</td>
<td>4.7%</td>
<td></td>
<td>-2.2%</td>
</tr>
<tr>
<td>Canada</td>
<td>0.5%</td>
<td>1.7%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>US</td>
<td>4.2%</td>
<td></td>
<td>-2.4%</td>
</tr>
<tr>
<td>Asia</td>
<td>59.0%</td>
<td>48.5%</td>
<td>1.1%</td>
</tr>
<tr>
<td>China</td>
<td>18.4%</td>
<td>29.7%</td>
<td>2.8%</td>
</tr>
<tr>
<td>India</td>
<td>17.7%</td>
<td></td>
<td>-1.1%</td>
</tr>
</tbody>
</table>

Europe: 1.18
NA: 3.57
Canada: 3.40
US: 3.57
Asia: 0.82
China: 1.61
India: 0.38

Source: Enerdata
OUR PURPOSE
To power progress together by providing more and cleaner energy solutions

POWERING PROGRESS
Our strategy to accelerate the transition to net-zero emissions, purposefully and profitably

GENERATING SHAREHOLDER VALUE
Growing value through a dynamic portfolio and disciplined capital allocation

POWERING LIVES
Powering lives through our products and activities, and supporting an inclusive society

RESPECTING NATURE
Protecting the environment, reducing waste and making a positive contribution to biodiversity

ACHIEVING NET-ZERO EMISSIONS
Working with our customers and sectors to accelerate the energy transition to net-zero emissions

UNDERPINNED BY OUR CORE VALUES AND OUR FOCUS ON SAFETY

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Our Climate Target: become a net zero emissions energy business by 2050 in step with society

**Energy efficiency**
- Own Operations
- Customer Operations

**Use of low carbon energy**
- E-mobility
- Hydrogen production, supply
- Biofuels, Renewables, Natural Gas

**Carbon sinks**
- Carbon capture, utilisation and storage
- Nature-based solutions
A NET-ZERO EMISSIONS ENERGY BUSINESS BY 2050 IN STEP WITH SOCIETY

OUR CLIMATE TARGET

NET ZERO BY 2050
Net-zero emissions energy business by 2050 including all emissions (Scope 1, 2, and 3)

FROM 1.7 GTPA TO ZERO
Total carbon emission from energy sold peaked in 2018 at around 1.7 Gtpa and will be brought down to 0 by 2050

NO SINGLE SOLUTION, BUT MANY

The three-part answer: avoid, reduce, and compensate

Avoid emissions

Reduce emissions

Compensate emissions

WORKING TOGETHER, SECTOR BY SECTOR

Helping customers reduce their emissions from their use of our energy products to net-zero by 2050
Mobility Sector: The global passenger electric car stock surpassed the 16M mark, BEV & PHEV sales more than doubled in 2021 compared to previous year.

Source: EV Volumes
Passenger car sales recovering after Covid-19 shock in all key geographies

Source: EV Volumes
Growth in electrification & ICE bans...not globally uniform

Increasingly, OEMs and energy companies will need to meet the needs of very different markets transitioning at different rates.

Source: EV Volumes, ICCT
SHELL’S ROLE in E-MOBILITY

Charging on the go
High-powered fast or super-fast chargers [50kW to 350kW] on forecourts can charge an electric vehicle in between 10 and 30 minutes, depending on the size of the battery.

E-Fluids and E-Greases
Our next generation e-mobility lubricant technology ‘Shell E-Fluids and E-Greases’ are designed to meet the needs of electric vehicles. The technical requirements placed on fluids in hybrids and EVs are much greater than they are in ICE vehicles. By designing several dedicated screening methods and through close collaboration with OEMs, these Shell products are engineered for both the latest wet e-motors, as well as dry e-motors that have dominated e-mobility to date.

Immersion Cooling Fluid

Clean Power generation
Turning low-carbon energy sources into electricity to meet the needs of commercial, industrial and residential customers.

Destination, Depot and Hub Charging Solutions
Supporting businesses to provide charging facilities and services for employees, customers and fleets using electric vehicles, providing a reliable base to charge their vehicles.

Home Charging
Convenient and cost-effective charging solutions and solar energy storage at home.

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**SOLAR**

Our portfolio of solar activities include:

- Developing greenfield solar and storage projects
- Acquisition of Savion LLC
- 46.5% interest in Silicon Ranch, US
- Deploying solar at our own assets
- Acquisition of EOIFI, French solar & wind developer
- 49% interest in Cleantech Solar, Singapore
- 49% interest in ESCO Pacific, Australia

**WIND**

Our wind projects in operation and in development have the potential to generate > 6 GW of power

- **18 GW +**
  - Savion capacity

- **1.1+ GW**
  - Silicon Ranch's operational capacity

- **2 GW**
  - Shell Share US offshore wind in development

- **236 MW**
  - Shell Share US onshore wind installed capacity

- **US onshore wind** — Investing since 2001 - four operating wind farms in the US that produce enough electricity to power ~ 97,000 homes

- **US offshore wind in development:**
  - Mayflower – 1.6 GW estimated, Shell Share 50%
  - Atlantic Shores – 2.5 GW estimated, Shell Share 50%
SHELL IS SEEKING COLLABORATIVE SOLUTIONS FOR A CHANGING WORLD, OFFERING LOW CARBON ALTERNATIVES TO REFLECT MARKET, SECTOR AND CUSTOMERS’ CHOICE

- **Hydrogen**
  - Building Retail Sites for Hydrogen

- **Electricity**
  - Slow & fast charging offer for EVs
  - E-Fluids

- **GTL**
  - Pioneering Gas to Liquid (GTL) Technology

- **Biofuels**
  - Conventional & Advanced

- **CNG & LNG**
  - CNG for Light Duty Vehicles, LNG for Trucks and Marine

+ **Nature-Based Solutions**
  - to offset CO₂ Emissions

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Cars and light trucks create ~ 20% of U.S. emissions.

Shell is expanding electric charging infrastructure and services to fleets and consumers.

- Clean Power for electrified fleets
- Turnkey EV charging systems
- Intelligent energy management

PLANS FOR 500,000 EV-CHARGING POINTS BY 2025
The super charger has 3 main features to enable a safe and fast charging experience in an extreme environment:

1. **350kW Maximum Power**
   - Technology developed by Shell & Tsinghua University in China
   - Technology demonstrated at the 2022 Beijing Winter Olympics

2. **Bi-Directional Pulse Heating**
3. **External Thermal Management**

**Performance Outcomes:**
- Battery temperature only increased from 0°C to 25°C in 4 mins
- Vehicle was recharged to a range of 130km in 5 mins while maximum power is restricted to 250kW, and battery temperature was controlled below 35°C throughout the charging process
Hydrogen is emerging as a valuable path to a more sustainable transportation sector.

Shell is building infrastructure and supply to increase the production and availability of hydrogen.

**Green & blue hydrogen supply**

- Building electrolysers in Germany, China, N L

**Building networks**

- Consortium with Toyota and Kenworth to develop the first hydrogen truck refuelling network in California

- Part of the H2Accelerate collaboration in Europe for building hydrogen trucking infrastructure

More than 50 SHELL HYDROGEN FUELING STATION S open around the world and growing
RENEWABLE NATURAL GAS

Renewable Natural Gas is most often used as a transportation fuel, but it can be used for other applications, such as a lower-carbon alternative to fossil natural gas or as a feedstock for generating low carbon grid power or green hydrogen.

How it works

1. Biogas produced
   Biogas produced by anaerobic digestion of feedstock

2. Biogas upgraded to renewable natural gas
   Biogas is upgraded and purified to produce RNG, ensuring it meets pipeline standards

3. Injection into the gas grid
   Pipeline quality RNG is injected into the gas grid

First RNG production facility in Junction City, Oregon

Two dairy digester projects in Kansas and Idaho.

1st RCNG fuelling site in Carson, CA

Shell is committed to RNG and has begun start-up at

A NEW BIOMETHANE FACILITY in the Pacific Northwest
BioFuels

Biodiesel, bioethanol and SAF offer practical, cost-effective solutions for reducing CO₂ emissions associated with long journeys.

Production & Developments Around the World

Rheinland Refinery
Transforming manufacturing operations to produce low carbon products. Producing low carbon diesel fuel in Rheinland since 2020

Raízen JV
Raízen hosts one of the world’s first waste to ethanol plants, and the 4th largest RNG facility in the world. In 2021, Raízen produced 2.5 bln litres of ethanol.

New Technology Developments

IH2 Technology-demo plant in Bangalore, India
Synthetic Fuels via PIL-demo plant in Amsterdam, NL
LUBRICANT INNOVATION OPPORTUNITIES IN ELECTRIC VEHICLES

1. E-motor cooling*
2. Battery thermal management
3. Potential direct cooling of e-motor windings
4. Inverter cooling
5. E-motor bearing lubrication
6. Wheel and steering bearing lubrication
7. Reduction gear lubrication
8. Differential lubrication

Thermal Fluids
Grease
Transmission Lubes

- Rug-in hybrid transmission
- Rug-in hybrid engine oil
- Specific solutions for PHEV

* also applies for transmission lubes
Shell E-Fluids and E-Greases are based on our extensive lubricants expertise. They have been developed according to requirements of OEMs and tested in Formula E.

We have partnered with leading OEMs who are developing their next generation of EVs.
Innovation – Systems Thinking Approach
Improving Efficiency of Existing Technologies:

- Hyper-fuel efficient Class 8 tractor-trailer
- Designed to push boundaries of existing technologies to improve fleet efficiency

Shell Starship Initiative

Join the Conversation #ShellStarship
For more details, visit www.retailer.com/starship
Shell Starship 2.0 maximizes on FTE, Fuel Savings and Emission reductions by integrating best in class industry technologies...

https://www.linkedin.com/posts/shell-lubricant-solutions_starship-20-ugc-Post-6773411989063651329-C_PA
## EFFICIENCIES GAINED*

<table>
<thead>
<tr>
<th>PAYLOAD</th>
<th>TRUCK EQUIVALENT</th>
<th>FUEL ECONOMY (MPG)</th>
<th>FREIGHT TON EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US AVERAGE</strong></td>
<td>2,000,000 Trucks</td>
<td>6.4 MPG</td>
<td>74 Ton-Miles Per Gallon</td>
</tr>
<tr>
<td><strong>STARSHIP 1.0</strong></td>
<td>1,127,820 Trucks</td>
<td>8.94 MPG</td>
<td>178 Ton-Miles Per Gallon</td>
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<tr>
<td>Coast to Coast Run</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>STARSHIP 2.0</strong></td>
<td>955,292 Trucks</td>
<td>10.8 MPG</td>
<td>254 Ton-Miles Per Gallon</td>
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<tr>
<td>Modified Regional Run</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STARSHIP 2.0</strong></td>
<td>1,290,138 Trucks</td>
<td>12.0 MPG</td>
<td>210 Ton-Miles Per Gallon</td>
</tr>
</tbody>
</table>

* Source: NACFE Run on Less Report

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## Emissions Reduction vs North American Average

<table>
<thead>
<tr>
<th>Test Format</th>
<th>Annual CO₂ Reduction U.S. Tons</th>
<th>CO₂ Reduction Tons %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STARSHIP 1.0</strong></td>
<td>229,000,000</td>
<td>60%</td>
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<tr>
<td>Coast to Coast</td>
<td>Reduction of CO₂</td>
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<tr>
<td>19.95 Tons</td>
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<td></td>
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<tr>
<td><strong>STARSHIP 2.0</strong></td>
<td>275,000,000</td>
<td>71.6%</td>
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<tr>
<td>Coast to Coast</td>
<td>Reduction of CO₂</td>
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<tr>
<td>23.55 Tons</td>
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<tr>
<td><strong>STARSHIP 2.0</strong></td>
<td>252,000,000</td>
<td>65.7%</td>
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<tr>
<td>Modified Regional Run</td>
<td>Reduction of CO₂</td>
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<tr>
<td>17.44 Tons</td>
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