Decarbonizing Virginia's Economy: Pathways to 2050

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VIRGINIA CLEAN ENERGY SUMMIT - ONLINE

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ENERGY TRANSITION INITIATIVE
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Energy Transition Initiative

A center of excellence for rigorous analysis of Virginia energy systems

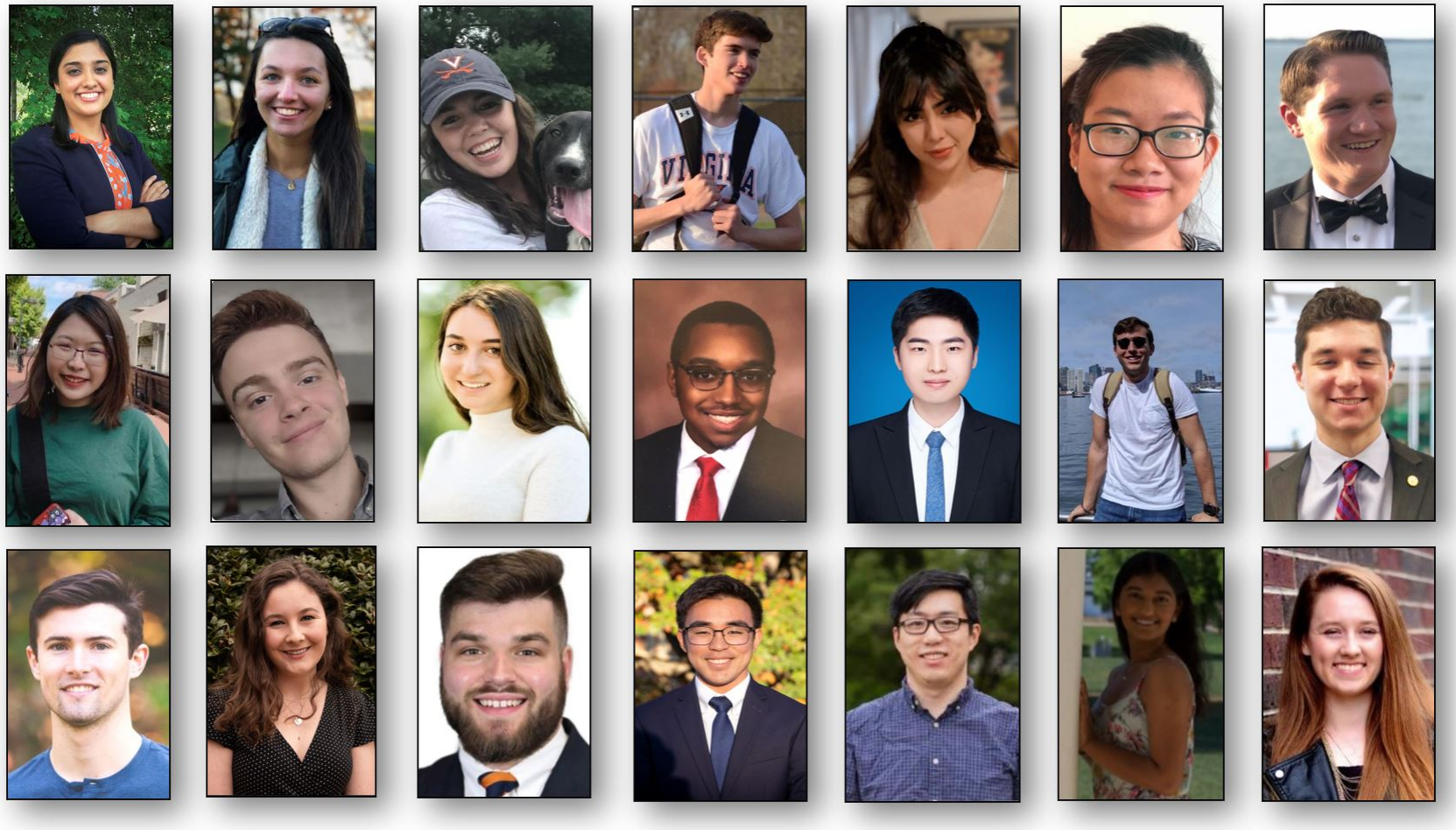
1. Help chart pathways and policies for net zero carbon by 2050
2. Identify opportunities and roadblocks on the road to zero carbon
3. Promote informed, engaged and inclusive decision making on Virginia's energy future

Thanks to our supporters and partners

The Greatest Resource

Why professors are generally so hopeful about the future…

Thanks to our dedicated army of student volunteers.



DECARBONIZING VIRGINIA

A WHOLE-ECONOMY PERSPECTIVE

No one who is paying attention can doubt what Virginia has at stake

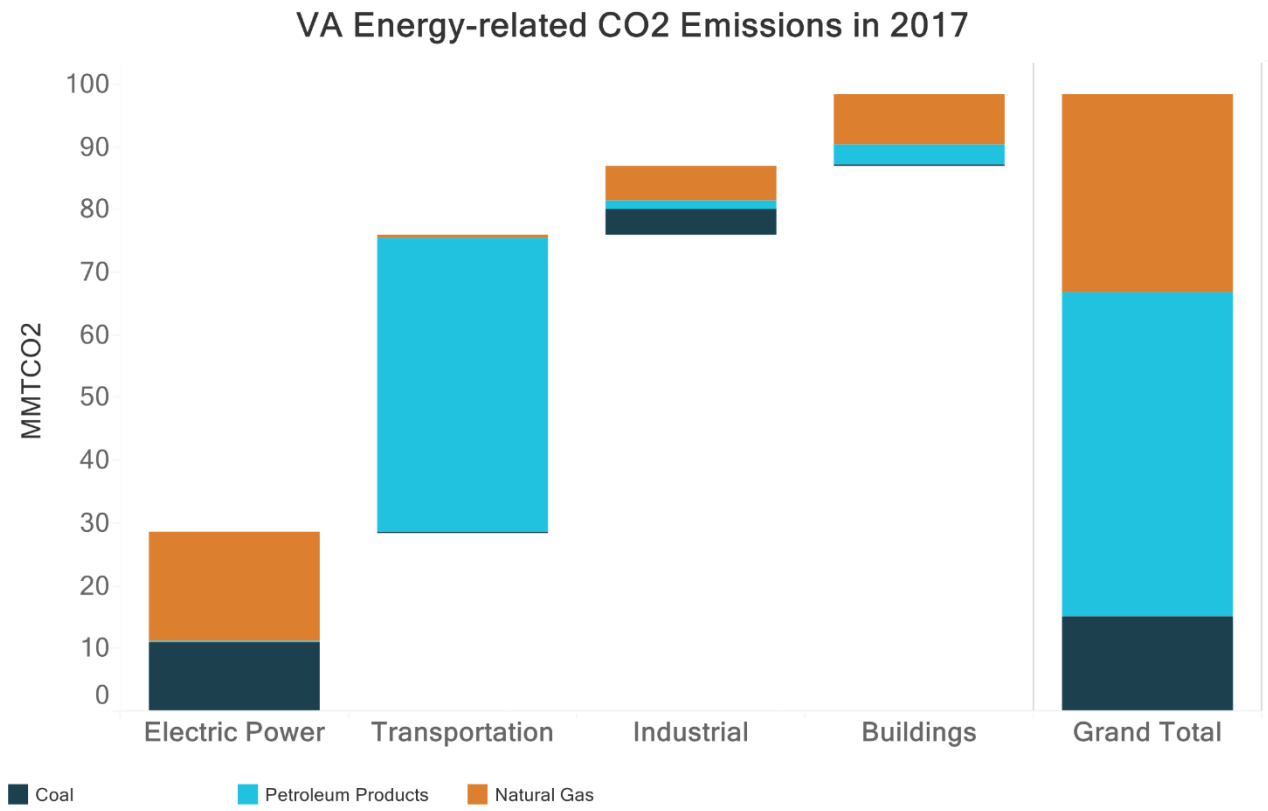
Virginia moves into a leadership role

- With Virginia Clean Economy Act, Virginia joins the “2050 Club” of states pursuing aggressive decarbonization goals
- VCEA focused mainly on electric power
- Next step: address the 70% of emissions from transport, buildings and industry
- Consider energy equity in all stages of decarbonization

To decarbonize the *whole* economy, we need to plan now

- Delay is costly
- Integrated planning pays huge dividends

We need to address emissions from the whole economy



Electricity accounts for only ~ 30% of Virginia's CO2 emissions.

Transport accounts for nearly half.

Getting to net zero requires reducing emissions from transport, buildings and industry, along with electricity.

Not to spoil the punchline, but...

- Decarbonization by 2050 is *achievable* and *affordable*
- It generates many economic benefits: money, health, climate
- Different policies and priorities imply a different resource mix
- Careful planning and policy design pay big dividends
- Coordination between state and local governments is essential
- A quicker start means lower long-run costs

MODELING POSSIBLE PATHWAYS

EXPLORING ENERGY FUTURES FOR VIRGINIA

The Four Pillars of Cost-effective Decarbonization

1. Efficiency and responsiveness in end-use
2. Electricity sector decarbonization
3. Electrify everything (almost)
4. Capture carbon (to sequester or use)

Our Initial Model

POSSIBLE POLICY PATHWAYS, NOT FORECASTS

- Modeling partner: *Evolved Energy Research*
  - Scenario analysis
  - Energy system optimization
- Realistic treatment of
  - Technology
  - Virginia-specific resources
  - Existing Virginia law

The Scenarios: Common Assumptions

- All scenarios achieve net zero carbon by 2050
- Existing law, including VCEA, RGGI, etc.
- NREL “Mid” technology costs
- No more than 1% of land area in utility-scale solar
- Keep current nuclear fleet (re-license 4 existing units)
- $0.01/kWh subsidy to distributed solar
- Nationwide decarbonization along with Virginia

The Scenarios: Specific Assumptions

BASELINE OF NO DECARBONIZATION POLICIES

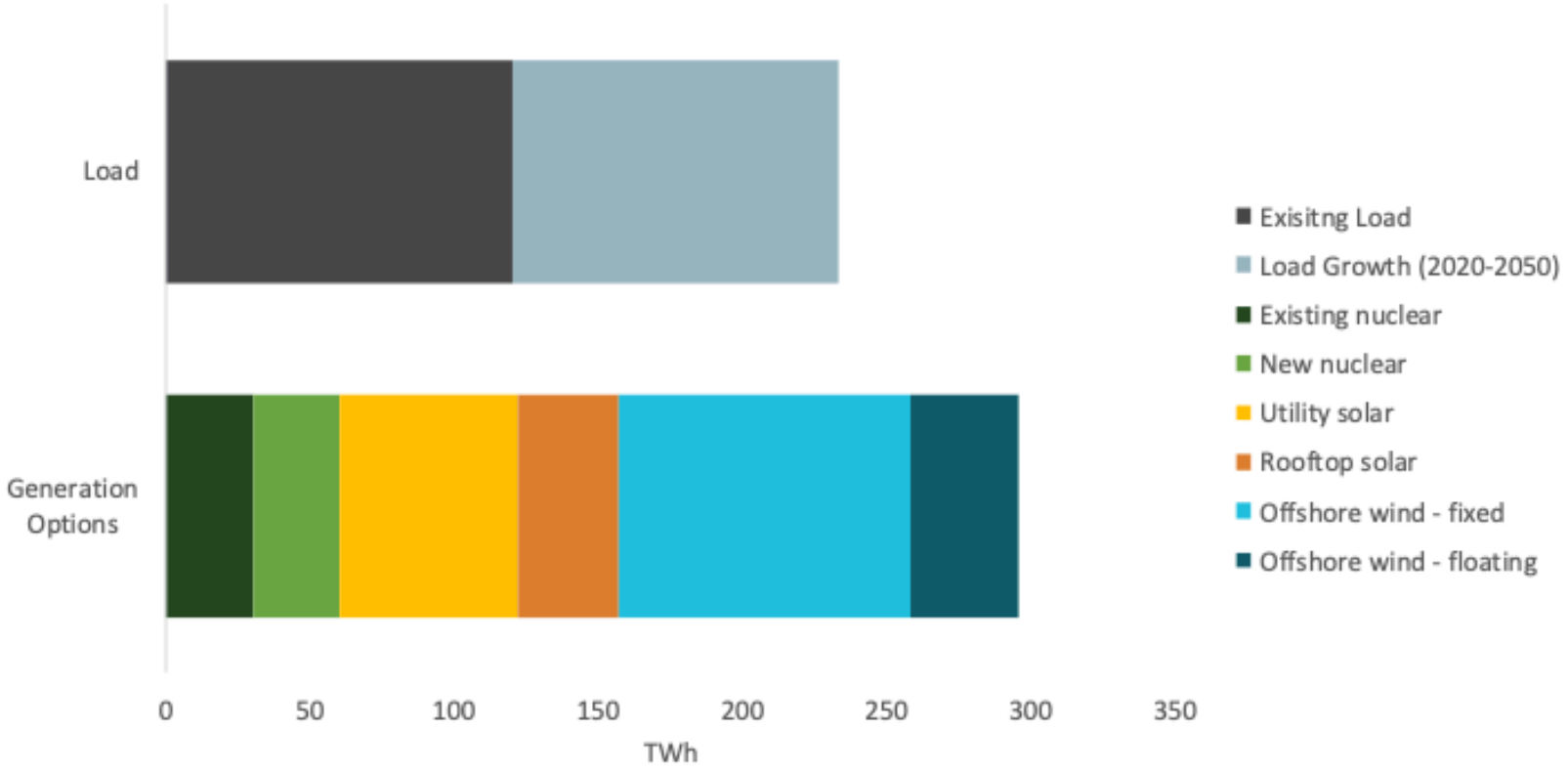
Four decarbonization scenarios:

1. Net zero: least cost given current technology
2. Constrained solar land use and no new nuclear
3. Slow consumer adoption of EVs and building electrification
4. Rapid technological innovation

Modeling: Key Results

- Solar, offshore wind and existing nuclear are the foundation
- Storage complements solar
- Natural gas capacity remains but transitions to carbon-free fuel
- Hydrogen (and syn fuel) plays an increasingly important role
- Bio-based synthetic fuels are imported, electricity is homegrown
- Some negative emissions (BECCS) will be needed

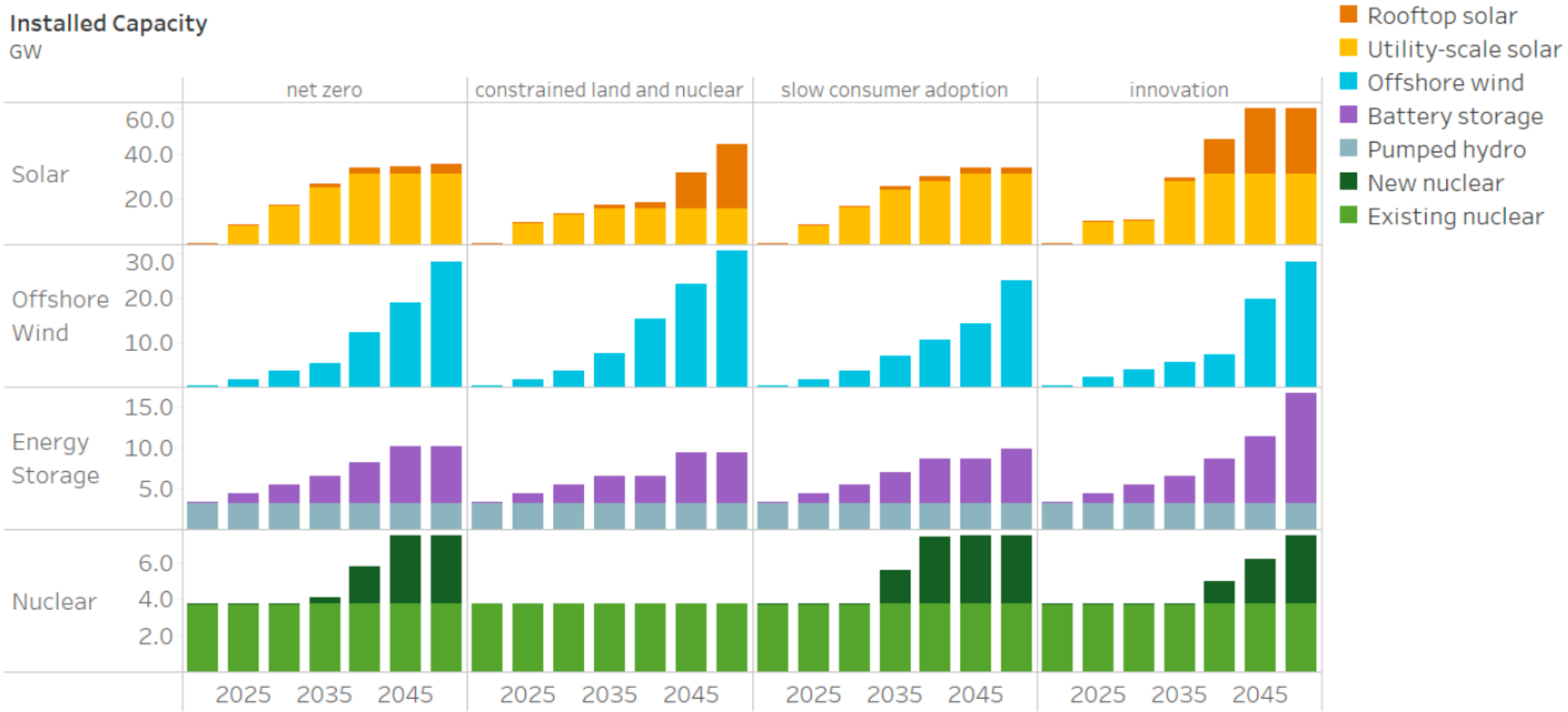
There are Enough Resources to Meet the Load



- Load growth: includes expected load growth from data centers and end-use electrification net of incremental energy efficiency
- New nuclear: assumes a doubling of VA's current installed capacity
- Utility solar: limited to 1% of state's land area
- Offshore wind: potential identified by NREL

Modeling Results: Capacity

Installed Capacity of Key Generation Technologies: 2020 through 2050



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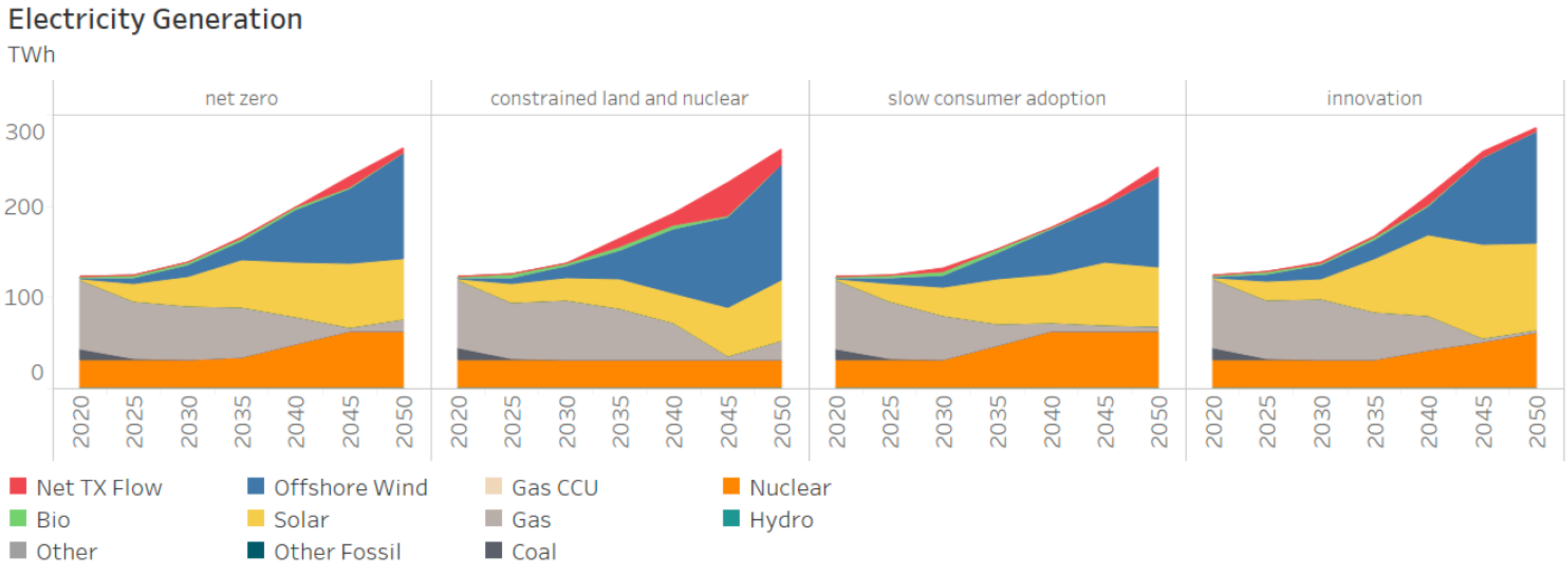
Modeling Results: Generation



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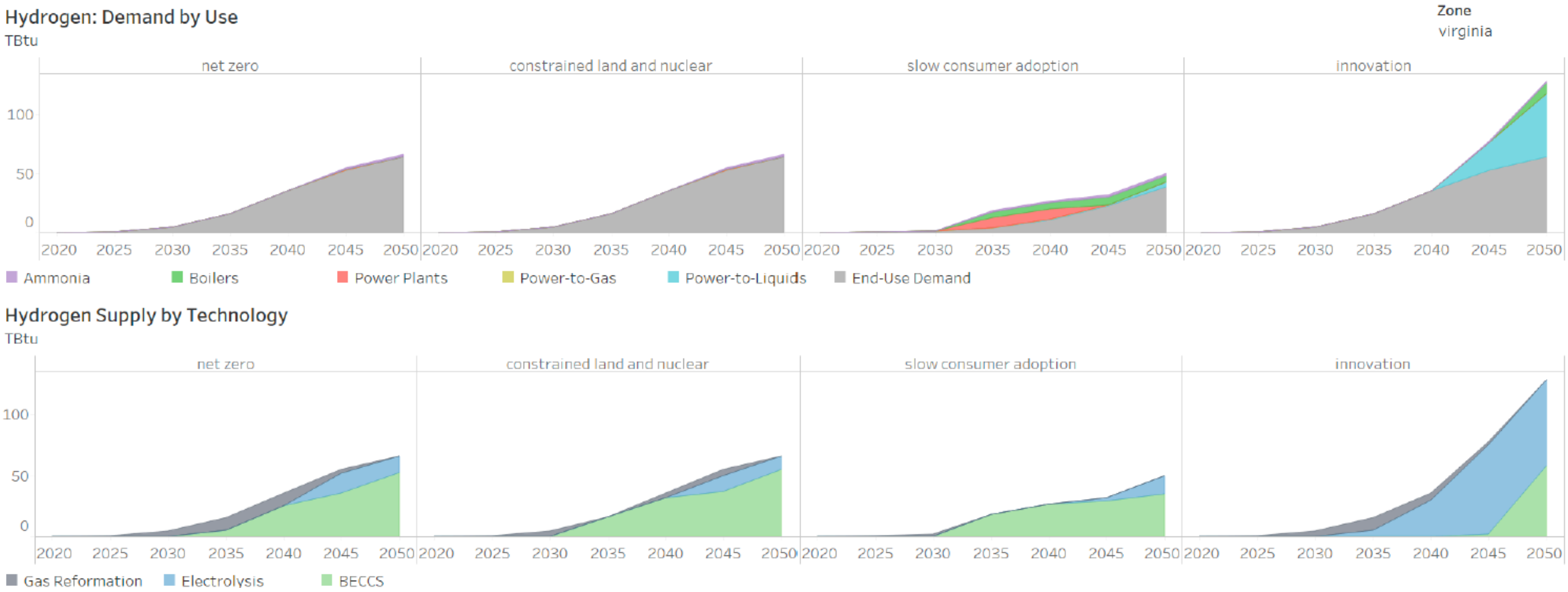
Modeling Results: Hydrogen



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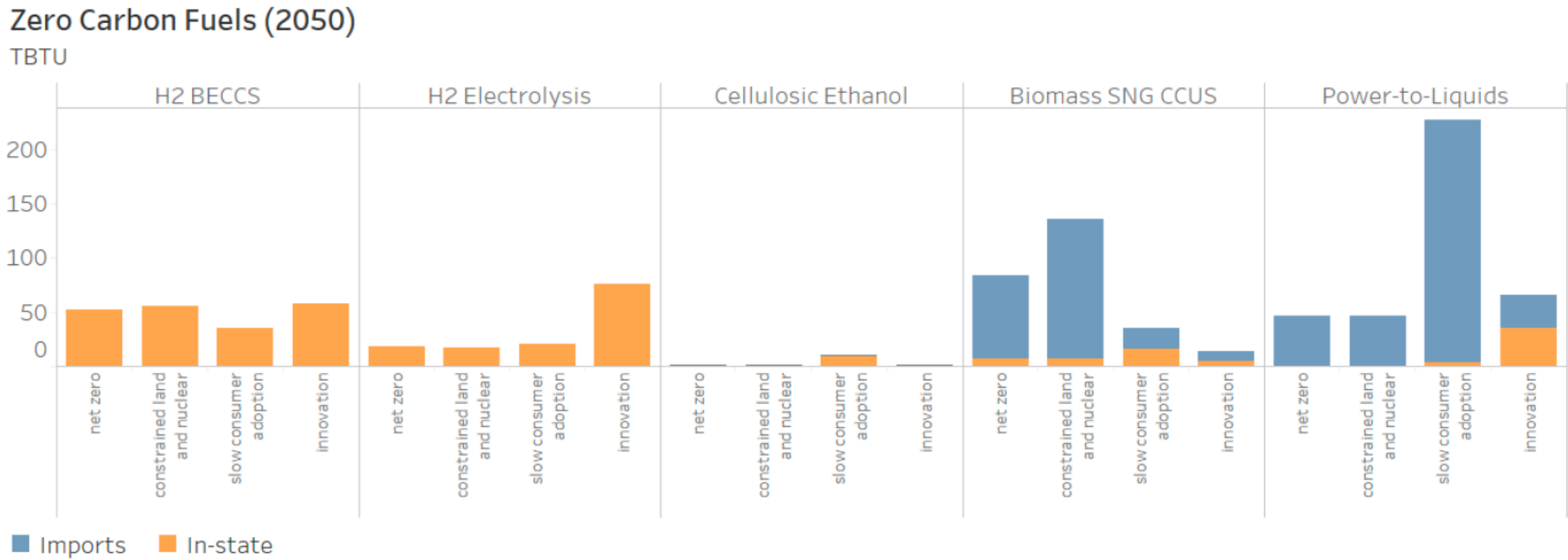
Modeling Results: Zero Carbon Fuels



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KEY INSIGHTS FROM OUR ANALYSIS

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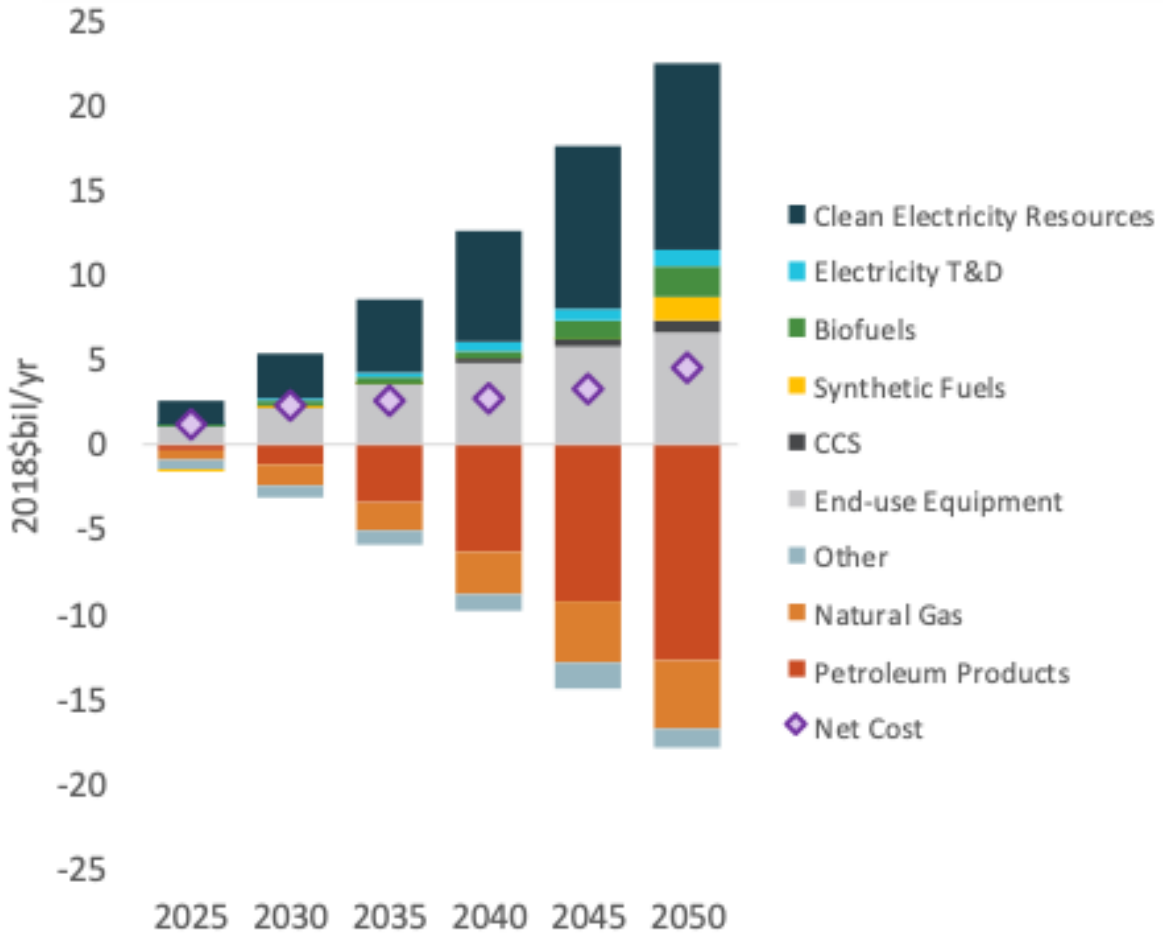
Modeling Results: Increasingly Homegrown Energy



- Decarbonization substitutes made-in-Virginia energy for fossil fuel imports
- Investment in local clean electricity and end-use equipment is offset by reduced spending on natural gas and refined petroleum

Key Lessons

- Timely adoption of electric technologies is critical
  - Transport and buildings, in particular
  - Slow adoption requires more imported biofuels
- Constraints on solar and new nuclear are expensive
  - Pushes mix to rooftop solar, syn. gas, imported electricity
- Innovation increases the benefits for Virginia
- State and local governments need to coordinate
- No new fossil sources (or pipelines) needed for reliability
- Natural gas capacity becomes intermittent, carbon-free generation

How Shall We Proceed?

2020s

- No more fossil infrastructure
- Start adding renewables capacity (VCEA, check)
- Move on electrification and efficiency in transport and buildings
- Keep existing nuclear (relicense)
- Build expertise in shift to modern grid architecture
- Invest in innovation
- Pilot new technologies and techniques

2030s

- Electrify everything (almost)
- Accelerate solar and wind deployment as costs fall
- Expand storage and begin relegating gas to backup role
- Carbon capture for recalcitrant sources (industry)
- Begin developing BECCS and hydrogen infrastructure
- Evaluate potential new nuclear technologies

2040s

- Complete electrification of transport and buildings
- Develop carbon-free gas to replace natural gas backup
- Deploy BECCS at scale for hydrogen and negative carbon
- Convert remaining natural gas plants to carbon-free sources

The Economics of CleanTech

- Use RGGI and TCI markets, cap emissions on a path to zero
    - The price induced on emissions makes everything easier
- Costs of own energy resources have fallen
    - So we make it ourselves, it's cheaper
- Electrification saves money and reduces pollution
- The skills needed are the skills available
    - Workforce development will expand opportunities
- Innovation makes it likely that Virginia will produce more of its own energy needs


We Can Do It!
POST FEB. 15 TO FEB. 28
WAR PRODUCTION CO-ORDINATING COMMITTEE

The problems which the spaceship earth is going to present, therefore, are not all in the future by any means, and a strong case can be made for paying much more attention to them in the present than we now do.

Kenneth Boulding, economist
The Economics of the Coming Spaceship Earth
1966

Thank you

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