Stakeholder Interview Report

Prepared for

U.S. Department of Energy
Office of
Electricity Delivery and Energy Reliability
Under Award No. DE-FC-06NT42847
Task 1. Deliverable #1 – Results of Stakeholder Interviews

By
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August 2007

Acknowledgement: This material is based upon work supported by the United States Department of Energy under Award Number DE-FC-06NT42847.

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Background

One of the initial tasks in the second phase of the Hawaii Energy Roadmapping Study is to solicit the perspective of various stakeholders in order to identify potential world scenarios, Hawaii's energy goals, technology responses, and key metrics. This information will be used in the development of various energy scenarios that will be evaluated using the Phase 1 models.

A list of stakeholders (interviewees) was developed by HNEI in late March, with support from the U. S. Department of Energy (USDOE) and the State of Hawaii Department of Business Economic Development and Tourism (DBEDT). Following the development of this list, interviews were scheduled. The interviewers for most of the meetings were Terry Surles (HNEI), Devon Manz (GE Global Research), and Larry Markel (Sentech). Where this varied, it is noted on the listing below.

To assist the interviewers in describing the project, a brief presentation was provided to each of the interviewees (See Appendix A). Given the diversity of the interviewees, each interview was flexibly tailored to the needs and interests of the interviewee, while still maintaining the ability to obtain requisite information for the project. The following stakeholders were interviewed as part of this process:

County of Hawaii Energy Office

Bob Arrigoni (Hawaii County Energy Coordinator)

Economic Development Alliance of Hawaii

Paula Helfrich (CEO) – *Surles*

Enterprise Honolulu

Mike Fitzgerald (President and CEO) and John Strom (Vice President)

Fairmont Orchid

Ed Andrews (Director of Engineering) – *Manz, Markel*

Hamakua Energy Partners (HEP)

Joe Clarkson (Plant Manager) – *Manz*

Hawai‘i County Council

Pete Hoffmann (Council Member for District 9) – *Surles*

Hawai‘i Island Economic Development Board

Mark McGuffie (Executive Director) – *Surles*

Hawaiian Electric Company, Ltd. (HECO)

Karl Stahlkopf (Chief Technology Officer & Senior VP for Energy Solutions) – *Manz, Markel*

Hawai‘i Electric Light Company, Inc. (HELCO)

Hal Kamigaki (Supervising Engineer, Planning & Engineering Division), Chengwu Chen (Electrical Engineer), Art Russell (Electrical Engineer), Lisa Dangelmaier

Hawi Renewable Development

Jim Nestman (Vestas), Raymond Kanehaikua (HRD) – *Manz, Markel*

Hilton Waikoloa Village

Rudy Habelt (Director of Property Operations)

Kohala Center

Betsy Cleary-Cole (Deputy Director)

Life of the Land

Henry Curtis (Executive Director) – *Surles*

Office of Hawaiian Affairs

Mark Glick (Director of Economic Development), Yuko Chiba

Powerlight

Riley Saito (Senior Manager, Hawaii Projects) and former Controller at the Mauna Lani – *Manz, Markel*

State of Hawaii, Department of Business, Economic Development & Tourism (DBEDT)

John Tantlinger (Manager, Energy Planning and Policy Branch), Steven Alber (Energy Planner, Energy Planning and Policy Branch), Priscilla Thompson (Energy Analyst, Energy Planning and Policy Branch)

State of Hawaii, Public Service Commission, Division of Consumer Advocacy

Catherine Awakuni (Executive Director)

Tesoro Hawaii Corporation

Carlos De Almeida (Manager, Oils Planning)

University of Hawaii at Manoa

Makena Coffman

Project Objectives

The Roadmapping Project's objectives were presented to the stakeholders as:

- To develop and apply an evaluation process that Hawaii can use to accurately model advanced energy technologies and policies, and
- To identify programs and technologies that best address the State's need for an affordable, reliable, environmentally-acceptable, petroleum-minimizing energy sector.

Interview Objectives

The stakeholder interviews were designed to obtain input from key individuals/organizations to ensure that the models being developed accurately reflect the situation in Hawaii, to identify important metrics and technologies for Hawaii's energy future, and to discuss stakeholders' views on how they balance costs, environment (local and global), economic development, reliability and energy security, and cultural sensitivities as they characterize and evaluate possible energy policies. The interviews provided the GE/HNEI team with the desired inputs. The information obtained by the team will be utilized in developing scenarios for presentation at the Stakeholder Summit to be held later this year.

General Observations Related to the Project Objectives

The stakeholders widely accept the objectives of the Hawaii Energy Roadmapping study and support the need for Transportation, Electricity, and Economic models of the Big Island. The stakeholders welcome this in-state capability to evaluate policies and to better understand the systems-level impact of various technology paths. This study intends to create the framework for this capability.

The information clearly contributes to the enhancement of the transportation and electricity models and provides insight into reasonable forward-looking scenarios for the island. Although some stakeholders had diverging perspectives on Hawaii's energy goals, the themes, risks and concerns of many stakeholders were quite common.

Theme 1: State Policy Goals

The State of Hawaii's energy policy goals are focused on increasing energy efficiency, maximizing the use of indigenous resources, enhancing energy security, minimizing greenhouse gas emissions, and reducing the cost of energy. These overarching goals are manifested in the State's Renewable Portfolio Standard and Alternative Fuels Standard (20% by 2020). The majority of stakeholders agree with these overarching goals. However, some of the stakeholders question the methodology used to establish these specific targets. They are concerned that insufficiently robust analysis will underestimate the costs or resources needed and, consequently, result in unanticipated, adverse effects. Further, this limited analysis may preclude the examination of potentially more attractive options.

Theme 2: Ancillary Power Generation

Some stakeholders believe the Big Island could significantly benefit from reduced consumers' costs of electricity by increasing the penetration of wind power. Some stakeholders were surprised to learn that the intermittency of wind power requires that ancillary services (typically fossil-fuel-based electricity generation) be available to cope with this intermittency. Often times this requires fossil units to operate at a less than optimal (i.e., less efficient) operating level, which increases the cost to the utility and therefore the cost to the consumer. Technologies and policies must consider the true cost of as-available generation.

Theme 3: Utility Partnerships and the Need for Public Policies

A common theme in many discussions was the idea of utility partnerships. In particular, a number of comments were received that stressed that a strong state economy was dependent on relatively competitive prices for energy that also required an economically-healthy electricity utility. Many stakeholders would like to work closely with the utility and leverage the utility's experience. Combined Heat and Power (CHP) and Distributed Generation (DG) projects were two commonly mentioned projects for collaboration with the utility. Collaborative projects, such as DG, will build up equity in power distribution for the citizens of the island. Some stakeholders suggest that new technologies and alternative energy solutions can more easily find their way into the market when the utility is a partner. It should be noted that the requirement for effective partnerships must necessarily include the state government assisting in development of policies and regulations that are fair to the end user and also fair to the utility in the creation of these partnerships.

Theme 4: Biofuels, Energy and Economic Security, and Climate Change

Energy security is a driving policy in the State of Hawaii. However, Hawaii also relies heavily on imported food. This raises questions about the interactions between the food supply and energy supply. Some stakeholders are looking to biofuels as one solution to reducing petroleum dependency. Other stakeholders see biofuels as a commodity that, if produced on the Island, could displace food crops, strain the already scarce water supply, and create a number of byproducts with no direct local use.

There are economic concerns as well. If fuel crops on the Big Island are more expensive to produce than importing the commodity, Hawaii will import biofuels or the commodity for the fuels. If these fuels or crops are imported, Hawaii should be concerned about the environmental impact of the agricultural practices in the source nation. Additionally, imported biofuel will not curb the flow of funds out of the island's economy.

Finally, a number of stakeholders were concerned about the overall impacts that increased cropping for biofuels would have on the local environment. As mentioned above, this will include competition for limited arable land resources, water supplies, and available labor. This is coupled with an understanding that climate change (and the attendant economic, weather, and regulatory changes) may change the mix of and competition for viable biomass resources for energy feedstocks.

Theme 5: Key Energy Metrics

The results of the models and analyses of the Hawaii Energy Roadmapping Study must be measured against key metrics. Stakeholder input was solicited in order to identify key metrics. The most common metrics cited by the stakeholders were cost of energy ($/gal, $/kWh), amount of renewable energy (% of total), reliability (SAIFI [system average interruption duration index] & CAIDI [customer average interruption duration index]), as well as power quality, land use (% available land), and water use. The cost of electricity was the most commonly cited metric. The business community has suggested that they will cope, reluctantly, with high energy prices, but they cannot cope with short-term price fluctuations.

Theme 6: Energy Technologies

Some stakeholders provided the GE/HNEI team with technology recommendations that could help the Big Island achieve its energy objectives. In the transportation sector, biofuels (palm oil, micro-algae, and eucalyptus), lightweight vehicles, plug-in hybrid electric vehicles, compressed natural gas, and enhanced mass transit were some technologies mentioned. In the electricity sector, gasification (coal, waste, biomass, and refinery residue), wind, solar, and wave power were mentioned. Energy storage (batteries, pumped hydro, and ultra-capacitors) and grid communications, and control and monitoring technologies were seen by some to be technologies that will enable the island to achieve higher penetration of intermittent renewables and lower the Island's costs of electricity. Many stakeholders would like to see higher levels of wind penetration, while some suggest wind turbines are visually obtrusive, occupy native land, and light up the night sky. The relationship between wind developers and the utilities was discussed. Some of the questions raised include: How should the power purchase agreements with wind farms be structured (and their price levels indexed) to provide an economic incentive for the utility to maximize use of renewable energy? How can the short-term objectives of the wind farm (i.e., maximize kWh production and sales) be reconciled with those of the utility (i.e., minimize short-term fluctuations in wind farm output that disrupt power system stability and require additional regulating reserves)?

Summary

Given the diversity of the stakeholders that were interviewed, a reasonable consensus was developed on the key issues, which we have described as Themes. In particular, the interview objective of obtaining appropriate and sufficient information with which to develop scenarios for additional analysis was met. GE will use these data to develop up to four future-looking scenarios. These scenarios will be presented at the Stakeholder Summit for consideration, modification, and approval.

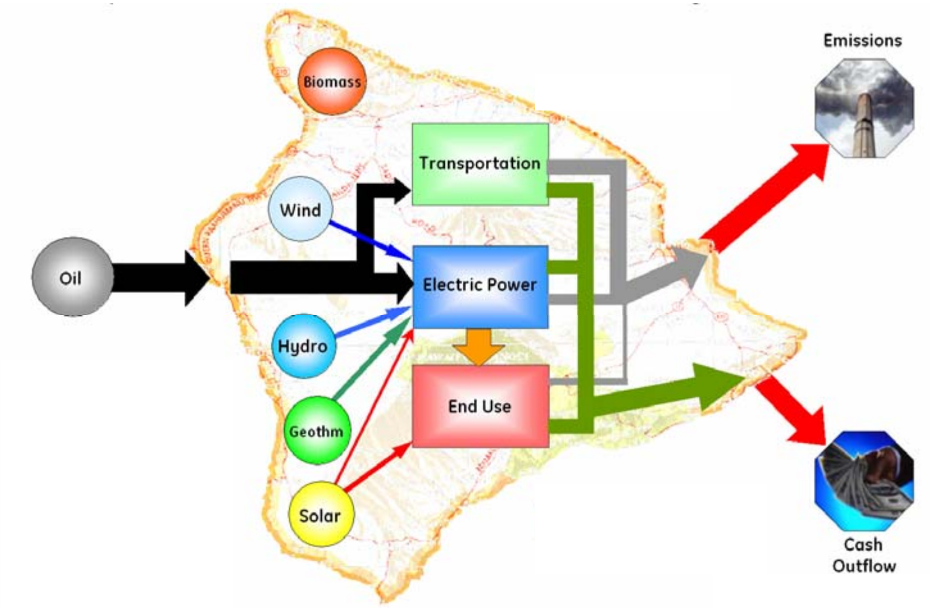
APPENDIX A

Presentation provided to interviewees

Hawaii Energy Roadmapping

Stakeholder Input

Hawaii's Goals, Technology Responses, & Metrics



Devon Manz- GE Global Research

Larry Markel - Sentech

Terry Surles- Hawaii Natural Energy Institute

Agenda

1. Study Purpose/Objectives

2. Program Plan

3. Stakeholder Input

   - **Questions:** Technologies/Policies/Goals/Metrics

   - What's important, what have we missed?

4. Questions/Discussion

Big Island – Strategic Energy Roadmap

What is it?

An **evaluation** of the Big Island's future electricity & transportation **energy options with respect to local goals** and future world conditions, from a **technology-neutral** perspective.

Objectives:

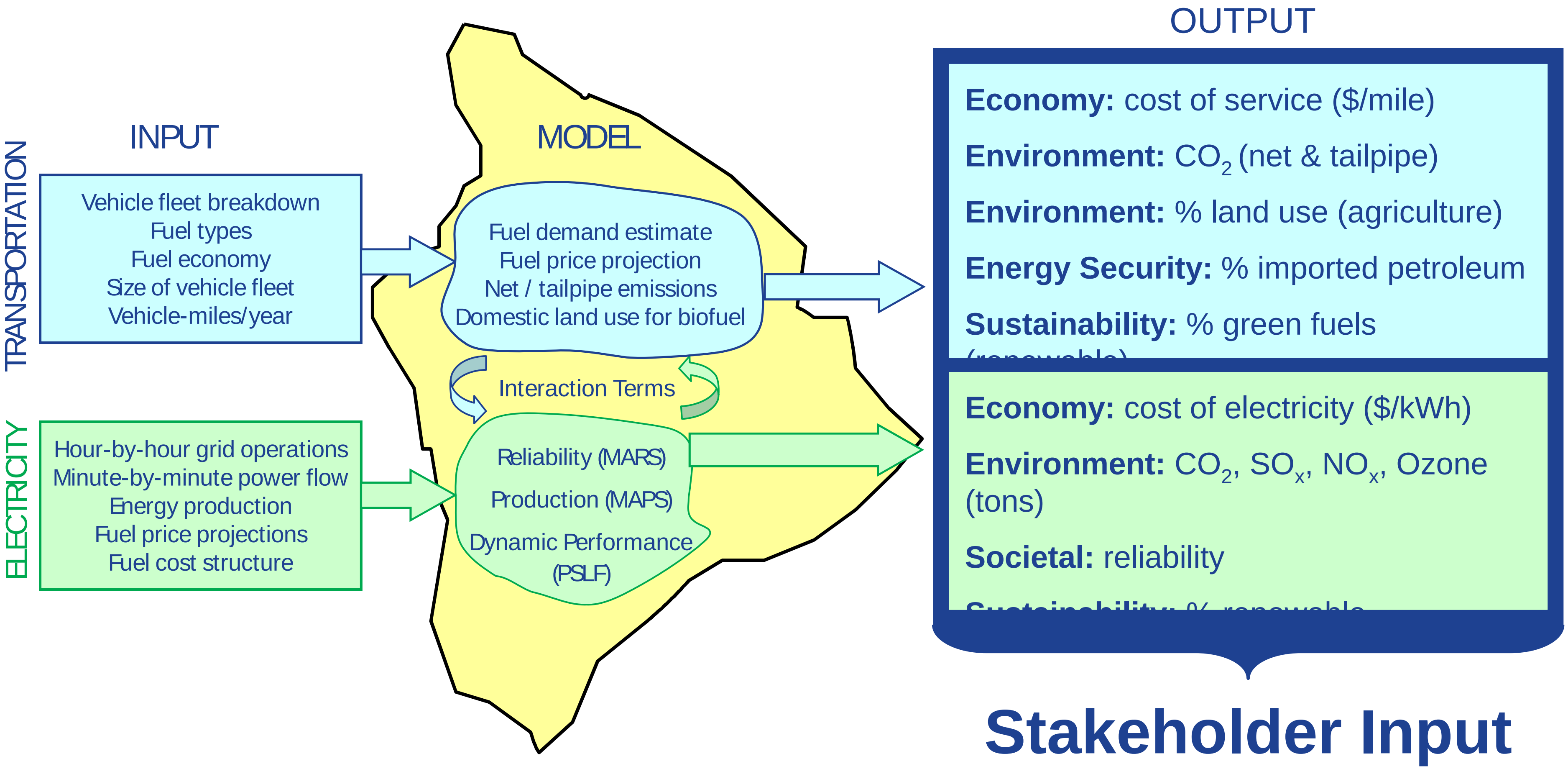
(1) To develop an **evaluation process** that can effectively **assess** energy technologies and policies (Phase 1).

(2) To use this process to **identify programs** that best address **Hawaii's need** for an affordable, reliable, environmentally acceptable, petroleum-minimizing energy sector (Phase 2).

In your opinion…

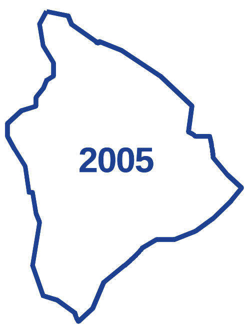
1. What are the key energy-related **metrics** that you value?
2. What are your **energy goals** for 2020?
3. Is 2020 an appropriate **target date** for the study?
4. What do you see as the **key global influences** on the island?
5. What do you see as key **energy technologies** for the island?
6. What **policies** should Hawaii implement?
7. What other **energy issues** concern you?

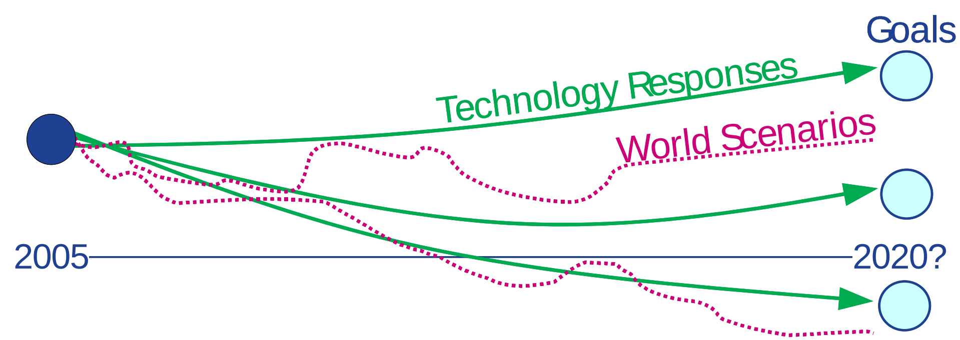
Phase 1 – Electricity/Transportation Models



Program Plan

Phase 1 Calibration		Phase 2 - Big Island Roadmap Infrastructure Evolution			
Transportation & Electricity Model Development	Model Calibration & Validation	World Scenario development	Identification of Hawaiian energy goals	Energy technology responses	Evaluation of performance against metrics
		Stakeholder Interview Task			**Analysis Task**





Purpose of Today's Discussion

Obtain **Stakeholder Input** on World Scenarios, Hawaii's Goals, Technology Responses, Metrics

Consolidate information and report out at Stakeholder Summit

Develop ~4 detailed evolution scenarios & evaluate their performance, using the Phase 1 models, against key metrics

imagination at work

What do you think Hawai‘i should do?

1. **Differing Objectives**
2. **Competing Metrics**

- Cost of Energy
- Economic development
  - Jobs
  - Tourist trade
- Reduced petroleum usage
- Reliability, stability
- Fuel diversity
  - Oil price/availability
- Recreation
- Environment
  - Land use
  - Water
  - Air emissions
  - Aesthetics
  - Hawaii's culture
  - Climate change

It is proper for citizens on the Big Island to debate what is most important to them

"Electricity reliability vs. cost vs. environment"

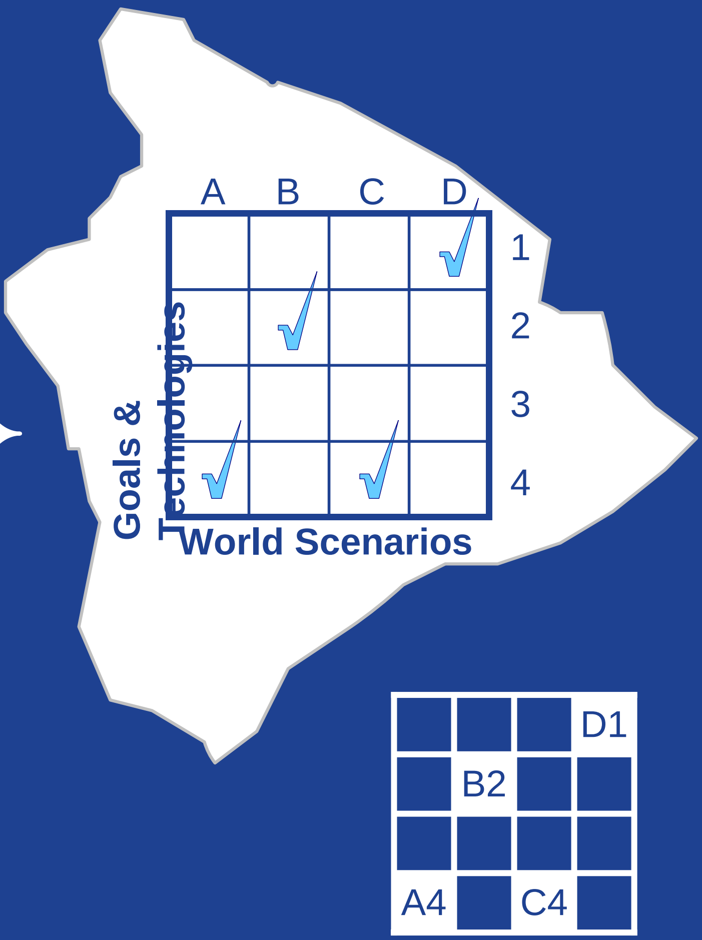
Technology-neutral analyses must be accurate and objective

"What is the true cost and infrastructure requirement to add more wind?"

"How much land and water do we need to use native-grown biofuels?"

Stakeholder Input can take many forms…

Opinion	“we pay too much for electricity” “gasoline prices are too high” “global warming is my priority“ “the Island is addicted to oil”
Goals	reduce cost of electricity reduce dependence on oil increase use of renewables increase use alternative fuels
Tech.	wind power, geothermal biofuels flex-fuel vehicle, EV, PHEV
Policy	xx% electricity from renewables yy% renewable fuels standard alternative fuel vehicle tax credit



Evaluate performance using Metrics

Stakeholder Summit

Who: A broad audience of individuals and organizations concerned about the Big Island's energy future.

Objectives:

(1) Summarize the metrics, technologies, policies, and state goals identified by the stakeholders in today's discussion.

(2) Describe potential transportation and electricity scenarios that will be evaluated against the stakeholder-suggested key metrics

Questions

1. What are the key energy-related **metrics** that you value?
2. What are your **energy goals** for 2020?
3. Is 2020 an appropriate **target date** for the study?
4. What do you see as the **key global influences** on the island?
5. What do you see as key **energy technologies** for the island?
6. What **policies** should Hawaii implement?
7. What other **energy issues** concern you?

Discussion

Additional Chapters

Program Plan

Scenario Planning

World Scenarios

Metrics

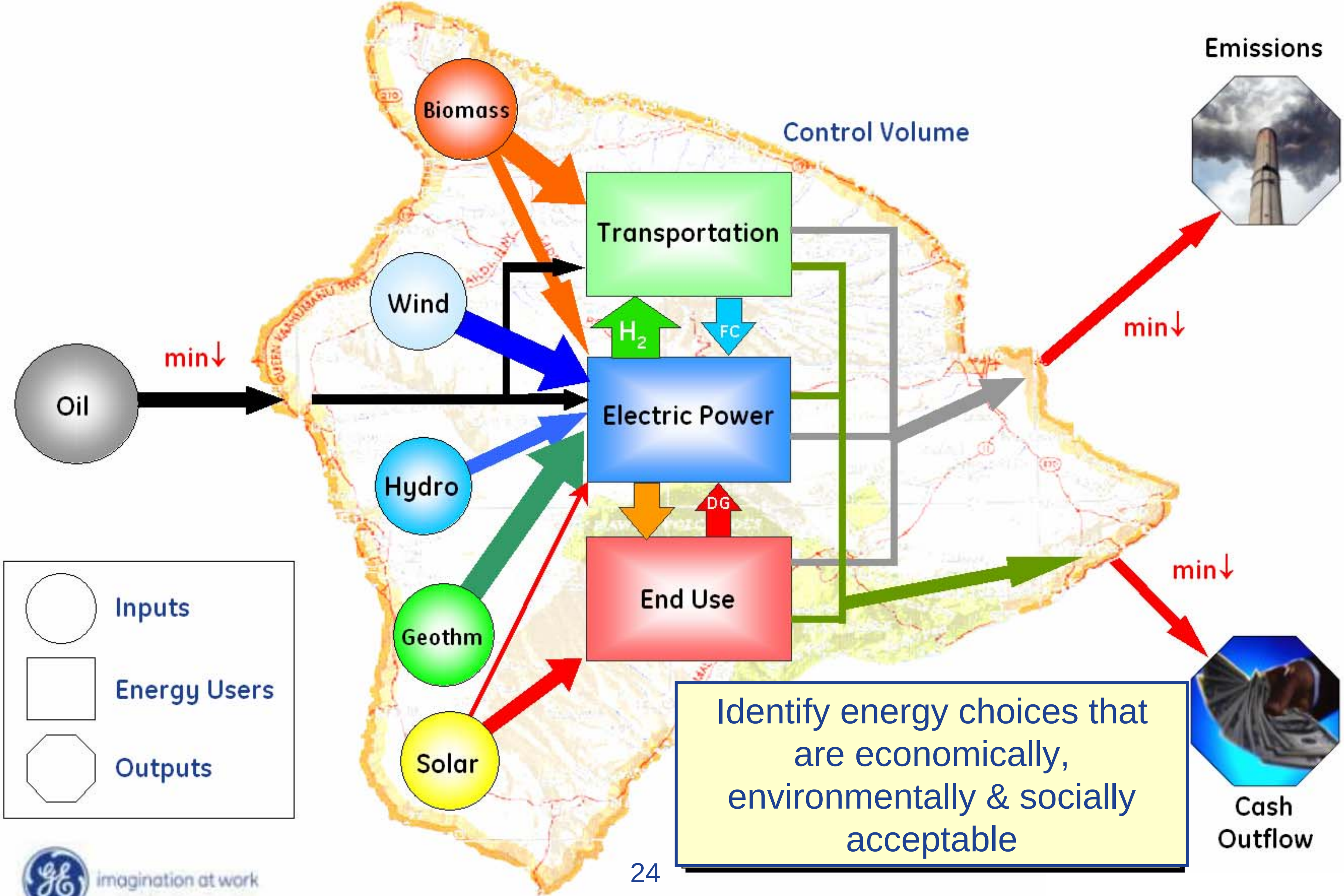
Technology Responses

GE Transportation Model

GE Electricity Model

Program Plan

Sustainability – DOE/State Objective



Identify energy choices that are economically, environmentally & socially acceptable

Program Plan

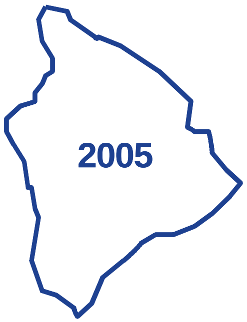
Phase 1
Calibration

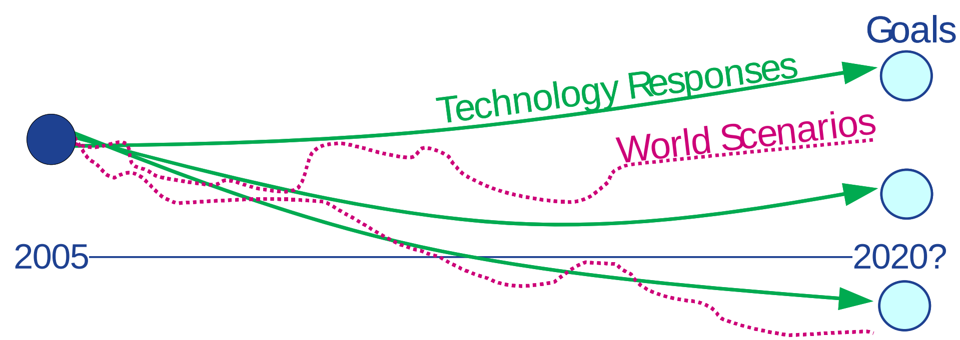
Phase 2 - Big Island Roadmap
Infrastructure Evolution

Transportation & Electricity Model Development → Model Calibration & Validation

World Scenario development → Identification of Hawaiian energy goals → Energy technology responses → Evaluation of performance against metrics

Stakeholder Interview Task | Analysis Task





Purpose of Today's Discussion

Obtain **Stakeholder Input** on World Scenarios, Hawaiian Goals, Technology Responses, Metrics

↓

Consolidate information and report out at Stakeholder Summit

↓

Develop ~4 detailed evolution scenarios & evaluate their performance, using the Phase 1 models, against key metrics

imagination at work

Big Island – Strategic Energy Roadmap

What do we hope to accomplish?

An accurate evaluation of reasonable energy alternatives for and sustainable environment and economy on the Big Island.

An evaluation process that quantifies the advantages and consequences, and highlights the tradeoffs, of future energy policies, choices, and plans.

Metrics

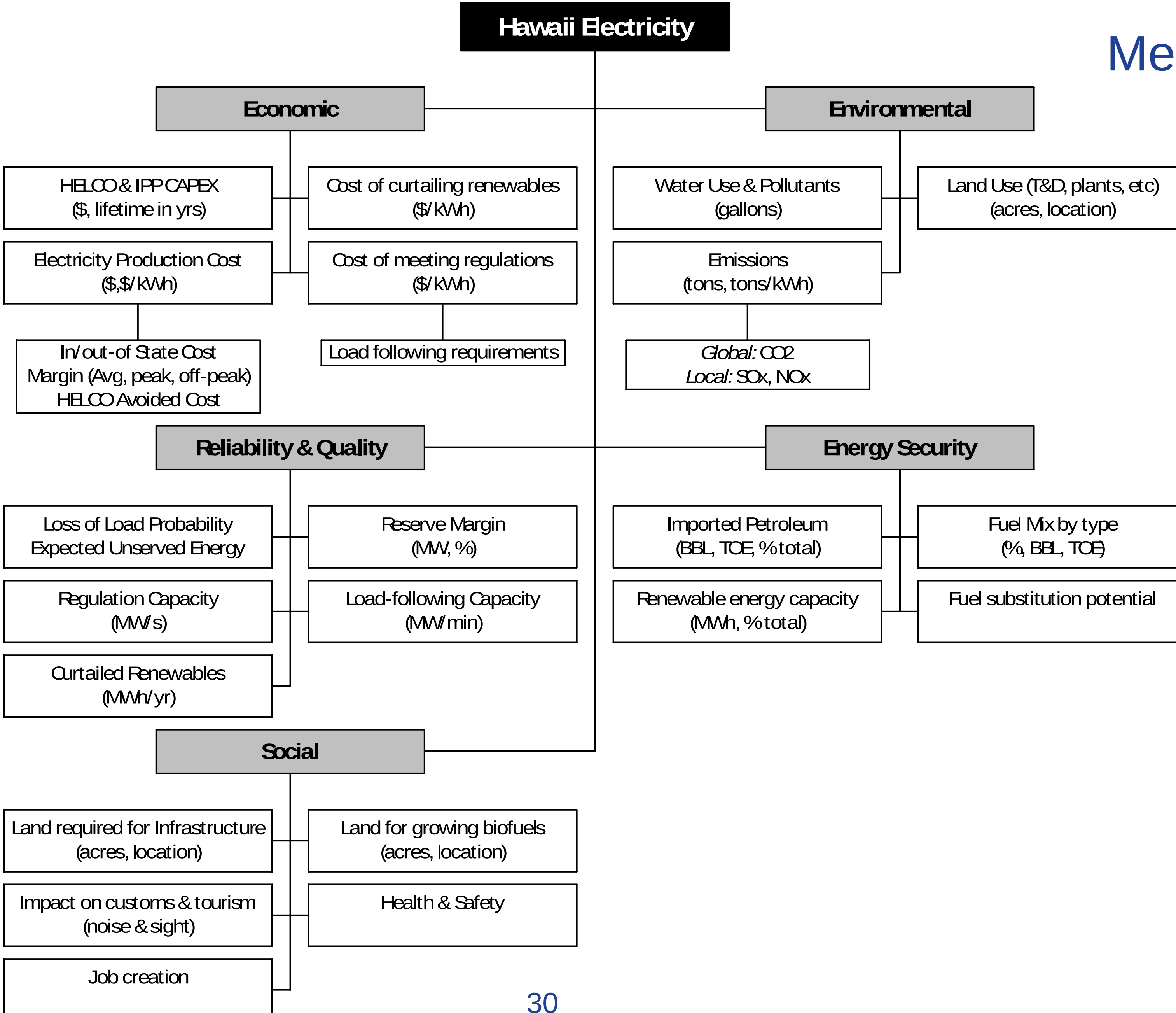
Sample Metrics

METRIC		TRANSPORTATION	ELECTRICITY
Economic	***Cost***	$/mile (consumer)	$/kWh (producer)
Quality/ Reliability	***Public health & safety; business productivity***	fuel availability	Loss-of-load probability, power quality, SAIFI, load disconnection due to frequency load shedding
Environmental	***Emissions***	tons/year (CO_2, NOx, SOx)	
Social	***Land Use***	acres	
Energy Security	***Petroleum Use***	% petroleum	
Sustainability	***Penetration of Renewables***	% renewable	

Metrics

- **Hawaii Transportation**
  - **Economic**
    - Cost-of-Service (COS) ($/mile/class, fleet average)
    - Consumer Capital Cost ($/vehicle, lifetime in yr)
    - Infrastructure Cost ($, lifetime in yr)
  - **Environmental**
    - Waste (vehicle disposal)
    - Land Use for biofuels (acres, location)
    - Total Emissions (well-to-wheel, tons/yr, fleet avg)
    - Tailpipe Emissions (lb/mile/class)
      - *Global:* CO2
      - *Local:* SOx, NOx, CO, VOC, PM
  - **Reliability & Quality**
    - Capability to meet demand (fuel type, fleet, location)
    - Availability of fuel (location, time)
    - Reliance on electricity (% total fleet miles)
    - Distribution
  - **Energy Security**
    - Imported Petroleum (BBL, TOE, % total)
    - On-island biofuel production (% total consumption)
    - Fuel Source Availability
      - Agricultural variability
      - Geopolitical risks
  - **Social**
    - Land required for Infrastructure (acres, location)
    - Land for growing biofuels (acres, location)
    - Impact on customs & tourism (noise, sight)
    - Health & Safety
    - Job creation

Metrics


Hawaii Electricity
Economic
HELCO & IPP CAPEX
($, lifetime in yrs)
Cost of curtailing renewables
($/kWh)
Electricity Production Cost
($,$/kWh)
Cost of meeting regulations
($/kWh)
In/out-of State Cost
Margin (Avg, peak, off-peak)
HELCO Avoided Cost
Load following requirements
Environmental
Water Use & Pollutants
(gallons)
Land Use (T&D, plants, etc)
(acres, location)
Emissions
(tons, tons/kWh)
Global: CO_2
Local: SO_x, NO_x
Reliability & Quality
Loss of Load Probability
Expected Unserved Energy
Reserve Margin
(MW, %)
Regulation Capacity
(MW/s)
Load-following Capacity
(MW/min)
Curtailed Renewables
(MWh/yr)
Energy Security
Imported Petroleum
(BBL, TOE, % total)
Fuel Mix by type
(%, BBL, TOE)
Renewable energy capacity
(MWh, % total)
Fuel substitution potential
Social
Land required for Infrastructure
(acres, location)
Land for growing biofuels
(acres, location)
Impact on customs & tourism
(noise & sight)
Health & Safety
Job creation

Scenario Planning

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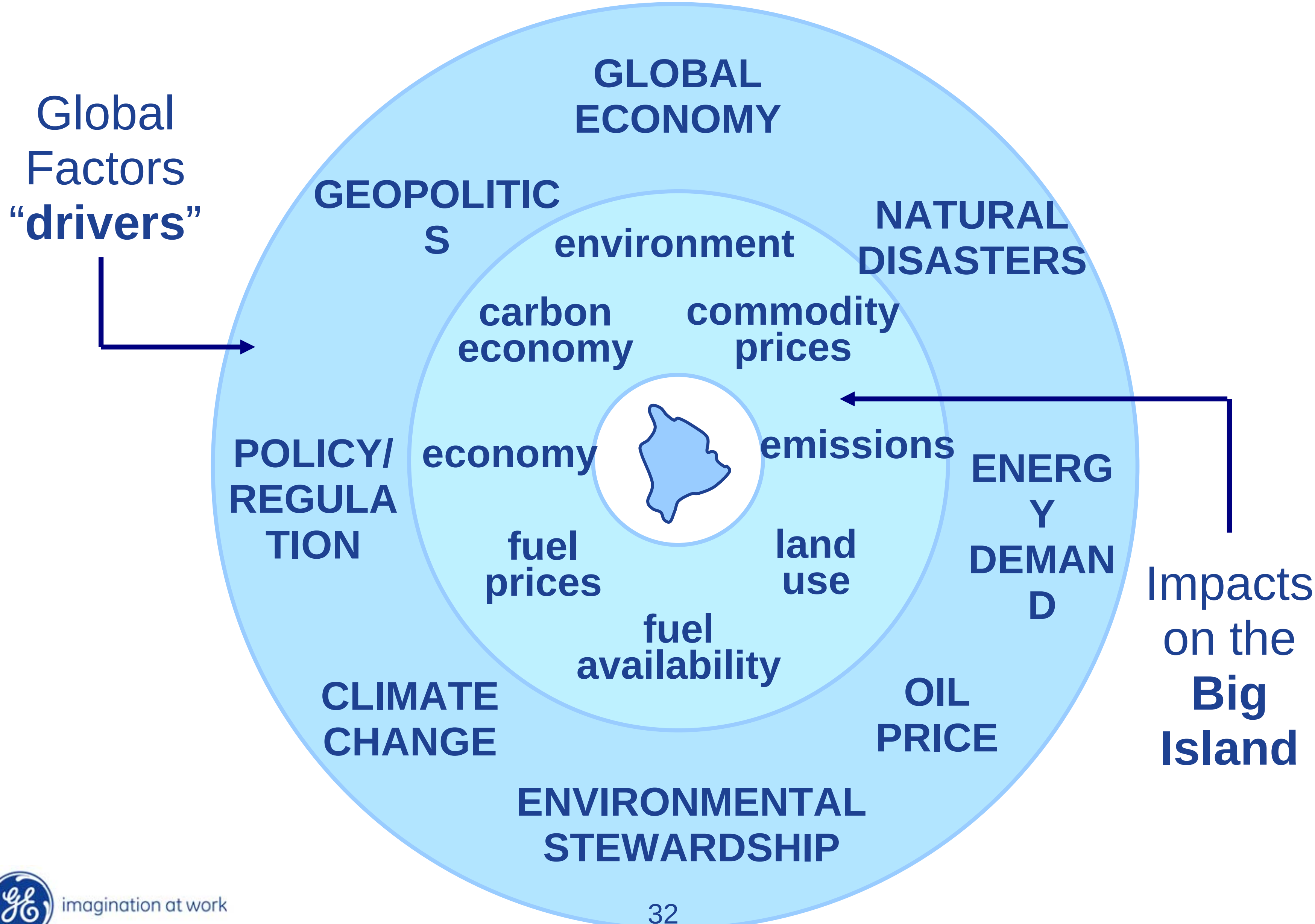
Global factors → Impacts on the Big Island



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World Scenarios

Definition of Terms

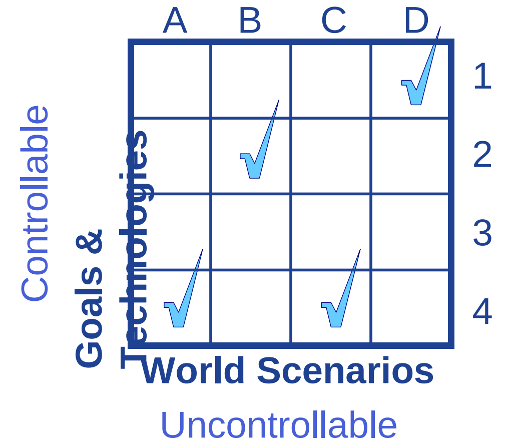
World Scenarios – detailed stories of alternative futures that reference global factors that impact the Island.

Hawaiian Goals – a desirable state of affairs for the Big Island in 2020.

Technology Response – a suite of technologies, infrastructure, fuels, & sources that respond to both the *World Scenarios* & *Hawaiian Goals*.

Metric Set – a set of quantitative & qualitative measurements of the *Technology Response* performance in a given *World Scenario*.

Stakeholder Input



Reduced to a set of 4 or less for full analysis

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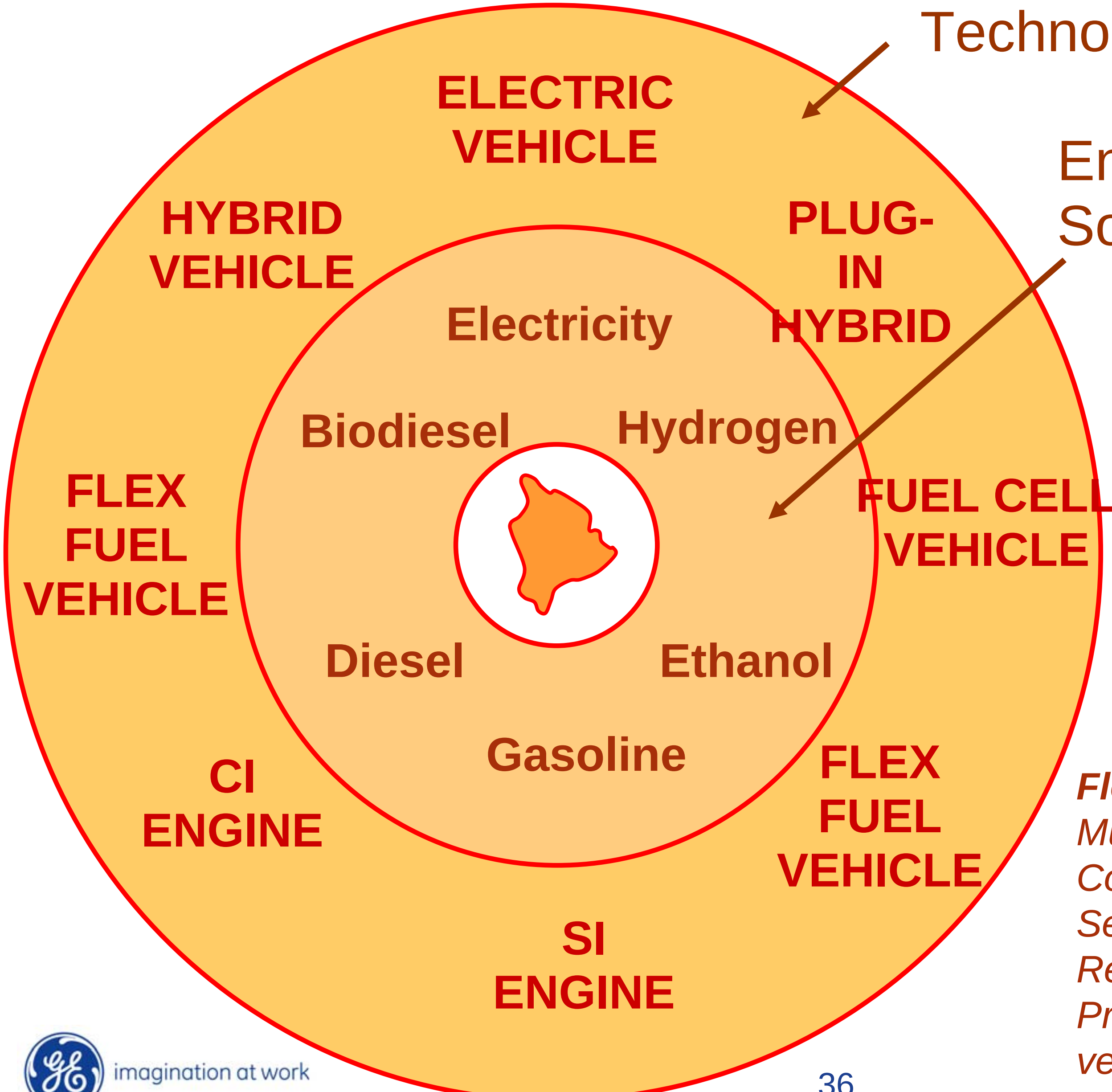
Technology Responses

Transportation Platforms



Fleets
Municipal
Commercial
Service
Rental car
Private vehicles
Freight,…

Reva Gwiz EV

Smartcar Fortwo ICE

Toyota Prius HEV

Nissan X-Trail H_2 FCV

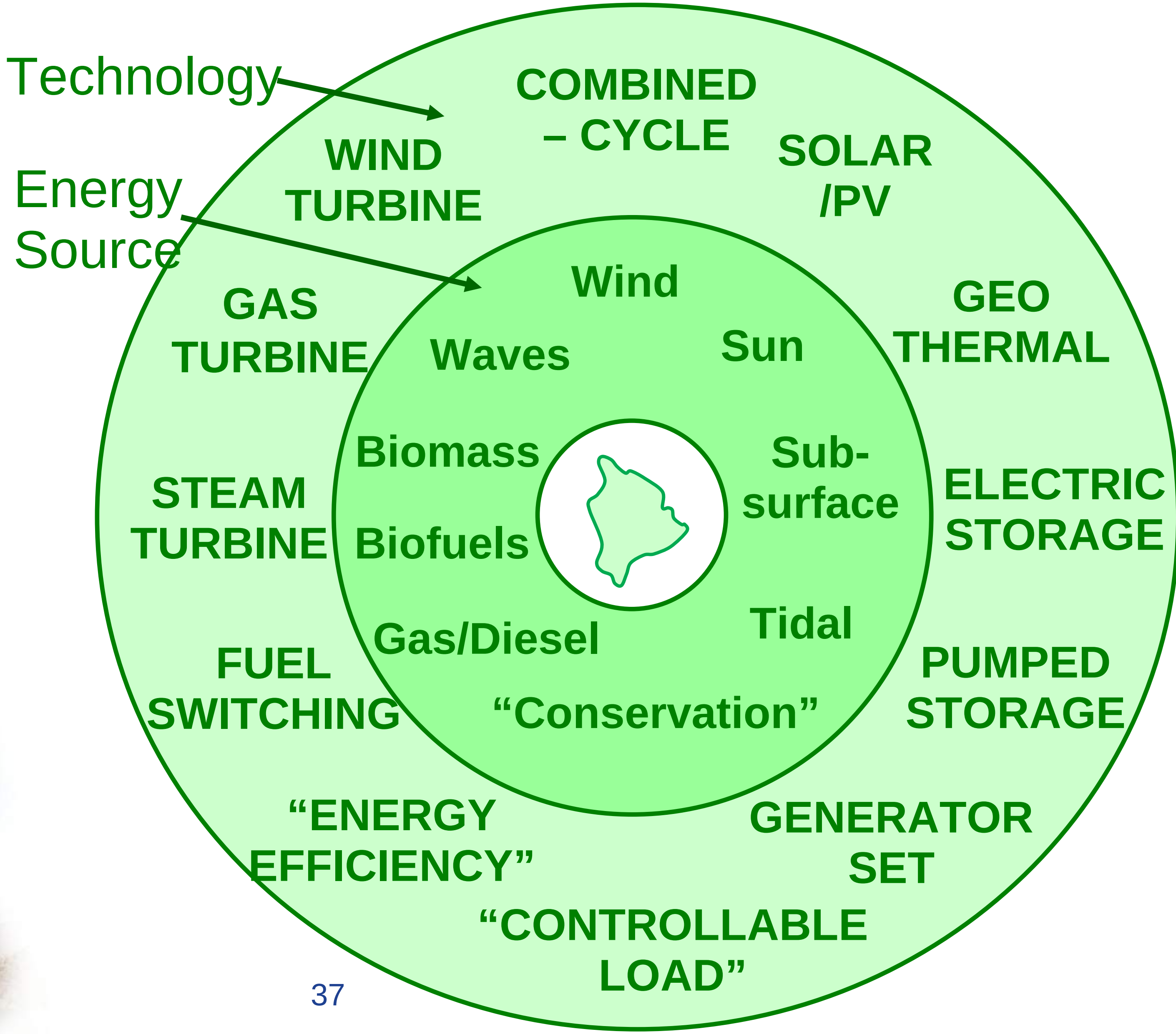
Orion Hybrid bus

Electricity Platforms

Consumers
- *- Residential*
- *- Commercial*
- *- Institutional*
- *- Governments*
- *- Military*

Utilities

IPPs

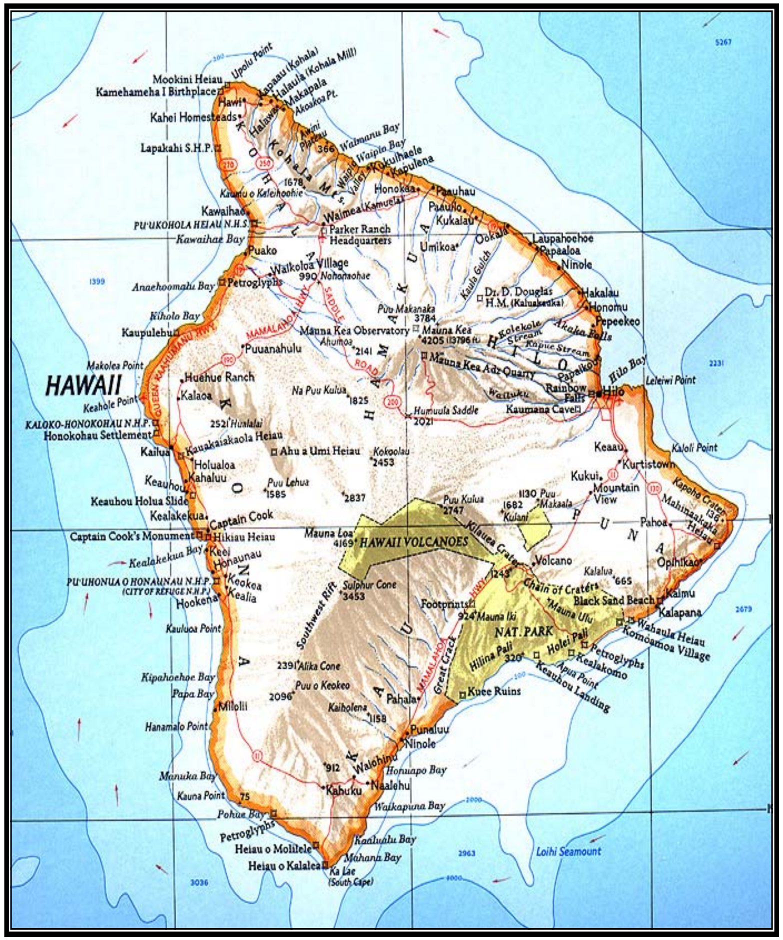


GE Transportation Model

Hawaii Roadmap Phase 1

Transportation System Model

- *Model Approach*
- *Model Capabilities*
- *Validation to Today*
- *Evaluating the Future*



Stephen Sanborn (GE)
Ralph McGill (Sentech)
Lembit Salasoo (GE)
Ching-Jen Tang (GE)
Devon Manz (GE)
Larry Markel (Sentech)

GE Transportation Model

Impact of vehicle fleet penetration levels…

Impact of vehicle fleet technology development…

Impact of fuel type penetration levels…

Impact of Big Island driving habits…

Impact of the size of the vehicle fleet…

ON

Economy: cost of service ($/mile)

Environment: CO_2 (net & tailpipe)

Environment: % land use (on-island biofuels)

Energy Security: % imported petroleum

Sustainability: % green fuels (renewable)

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Transportation Model

INPUT

Parametric Data:
- Vehicle Fleets with class, fuel type & miles/year
- Alternative Fuel production parameters
- Fuel Spot Price benchmark parameters
- Source & Distribution Capacities & cost structure
- Dispensing Infrastructure capacities & cost structure

Pro-Forma User Input:
- *WHAT-IF scenario changes*
  - *% change in # of vehicles by type*
  - *% change in miles per year by type*
  - *Scenario Year for price projection*
  - *% change in MPG by type*
- *Alternative Fuel Fleet(s)*
  - *Define Fleet size and fuel*
  - *Define miles/year/vehicle & MPG*
  - *Select alternative fuel feedstock(s) for CAPEX & biomass agr.*

Processing

- Estimate fuel demand:
  - whole island & each region
  - each conventional fleet
  - each alternative fleet
- Estimate infrastructure capacity & utilization:
  - Dispensing
  - Distribution & Storage
  - Importation
  - Expansion for alternative fuels demand

Estimate Fuel Prices:
- Petroleum & Alternative Mkt. Prices
- Alternative Fuel production CAPEX
- Petroleum Product Distribution
- Alternative Fuel Distribution

- Estimate tailpipe emissions
- Estimate biomass & fuel production, import & distribution emissions
- Estimate feedstock specific biomass acreage needed

Output

Reliability & Quality
- Estimated Consumption
- Utilization of Sourcing, Distribution & Dispensing infrastructure
- Availability & Reliability for:
  - *Imported fuel or feedstock*
  - *In-State agriculture & fuel production*

Energy Security
- % of fuel is petroleum
- % of fuel is biofuels
- % of fuel is green fuels
- % of fuel is electricity or elec-based

***COS**ervice*
- \$\$/gallon for fuel types
- \$\$/mile for vehicle type
- \$/year for vehicle type
- CAPEX estimates:
  - Alternative Fuel production
  - Distribution & dispensing upgrades

Environmental Impact
- Net Emissions
- Tailpipe Emissions
  (CO2, CO, NOx, SOx, VOC, PM10)
- % Agricultural Land area required for local biomass production

Legend

Implemented in Phase 1

Implementation in Phase 2 as required

User Input – "Alternative Fuels" Example

Concentional Fuel Vehicle Fleets	Vehicle_Type	Fuel Type	Current Fleet (# of vehicles)	% Change in # of vehicles	Miles per year per vehicle	% Change in Miles per year per vehicle
Personal Vehicles	Motorcycles & Mopeds	gasoline	3,426	0%	10,000	0%
	Cars	gasoline	124,641	0%	10,000	0%
		diesel				
	Light Trucks	gasoline	21,619	0%	10,000	0%
		diesel	1,380	0%	10,000	0%
Commercial Vehicles	Medium Trucks	diesel	8,081	0%	15,000	0%
	Heavy Trucks	diesel	9,083	0%	15,000	0%
	Off-Road Vehicles	diesel	unknown		60,118,500	0%

10%	ethanol_blending_percentage
sugarcane_syrup	standard_ethanol_source_type
bagasse	cellulosic_ethanol_source_type

20%	biodiesel_blending_percentage
palm_oil	biodiesel_source_type

NOTE: regions highlighted with the Dark Bllue color are the numbers that a user can change to reflect a given transportation scenario.

Alternative Fuel Vehicle Fleets	Vehicle_Type	Conventional Fleet (for reference)	Fuel Type		Number of Vehicles	Miles per year per vehicle
Personal Vehicles	Cars	124,641	ethanol	E10	105,000	10,000
			biodiesel	B20	0	10,000
			hydrogen	-----	20,000	10,000
			electric	-----	15,000	10,000
Personal Vehicles	Light Trucks	22,999	ethanol	E10	0	10,000
			biodiesel	B20	0	10,000
Commercial Vehicles	Medium Trucks	8,081	biodiesel	B20	0	15,000
	Heavy Trucks	9,083	biodiesel	B20	10,000	15,000
	Off-Road Vehicles	unknown	biodiesel	B20	0	15,000

Validation of the current situation

	Hawaii Databook 2004	Infractructure Model (A)	Infractructure Model (B)	Hawaii Databook 2005	Infractructure Model (C)	Infractructure Model (D)
Gas Demand (Mgal)	*not reported*	62.17	63.9	74.148	68.1	69.93
Diesel On-Road Demand (Mgal) *	*not reported*	10.34	15.76	11.535	13.76	16.52
Diesel Off-Road Demand (Mgal)	*not reported*	9.25	9.25	9.54	9.54	9.25
Total Fuel (Mgal) *	85.40	81.76	88.91	89.00	91.40	95.7
		-4.3%	4.1%		2.7%	7.5%
Miles/year/vehicle	9,729	9,730	10k - 15k	10,043	10,032	10k - 15k
Total Vehicle Miles (Mmiles) *	1,516.6	1,613.3	1,701.4	1,651.2	1,784.8	1835.9
Total Vehicles *	168,229	168,231	168,231	178,524	180,338	180,338

within ± 10%,

Model (A): Vehicle Data set for 2004 Databook

Model (B): Vehicle Data set for 2004 with adjusted miles/vehicle/year

Model (C): Vehicle Data set for 2005 Databook

Model (D): Vehicle Data set for 2005 with adjusted miles/vehicle/year

* excludes tractor trailers

Current Fleet (# of vehicles)	% Change in # of vehicles	Miles per year per vehicle	% Change in Miles per year per vehicle
3,426	4%	10,032	3%
124,641	7%	10,032	3%
21,619	5%	9,730	3%
1,380	5%	9,730	3%
8,081	5%	9,730	3%
9,083	0%	9,730	3%
		61,982,174	0%

2005 as a % adjustment of 2004

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Evaluating the future

Scenario "Tuning Knobs"

- o # of vehicles in each sub-fleet
- o Miles/year/vehicle for each sub-fleet
- o MPG improvement for vehicles in each sub-fleet
- o Addition/substitution of alternative fuel sub-fleets
  - o Vehicles include FFV, HEV, PHEV, and EVs
  - o Ethanol blending ratio & feedstock(s)
  - o Biodiesel blending ratio & feedstock
- o Calendar Year for fuel pricing

Vehicle Fleet Growth & Changes

- o Pop. and GCP growth as surrogate indicators
  - o 37% pop. growth by 2020 → personal vehicle fleet
  - o 44% increase in Hawaii GCP by 2020 → commercial fleet
- o Penetration of E-FFVs and B-FFVs
  - o **Target:** 20% renewable fuels by 2020
  - o **Estimate:** 14% FFVs by 2020 (Biofuels Summit)

Hawai'i County

	2005	2020	%
Population	163K	203K	25%
Population (+tourists)	**166K**	**227K**	**37%**
Gross County Product (B$, 2000)	**4.3**	**6.2**	**44%**
Personal Income ($/yr/per)	23K	30K	30%

Source: Population and Economic Projections for the State of Hawaii to 2030, DBEDT0

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GE Electricity Model

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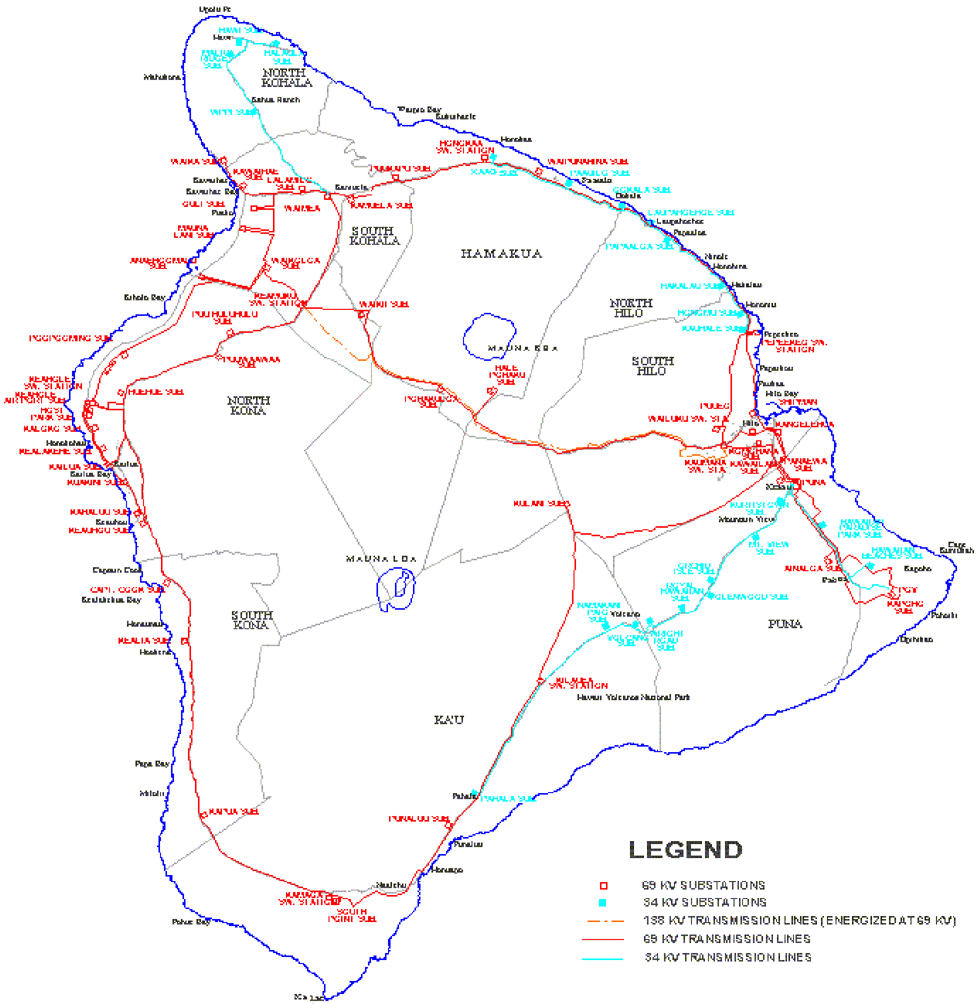
Hawaii Roadmap Phase 1

Electricity System Model

- *Input/Output*
- *Capabilities*
- *Validation*



Nicholas Miller (GE)

Gene Hinkle (GE)

Andrew Kos (GE)

Sebastian Achilles (GE)

GE Electricity Model

Impact of adding 1MW of wind/solar/geothermal…

Impact of adding 1MW of spinning reserve…

Impact of adding 1MW of storage (8hr)…

Impact of adding 1MW of load…

ON

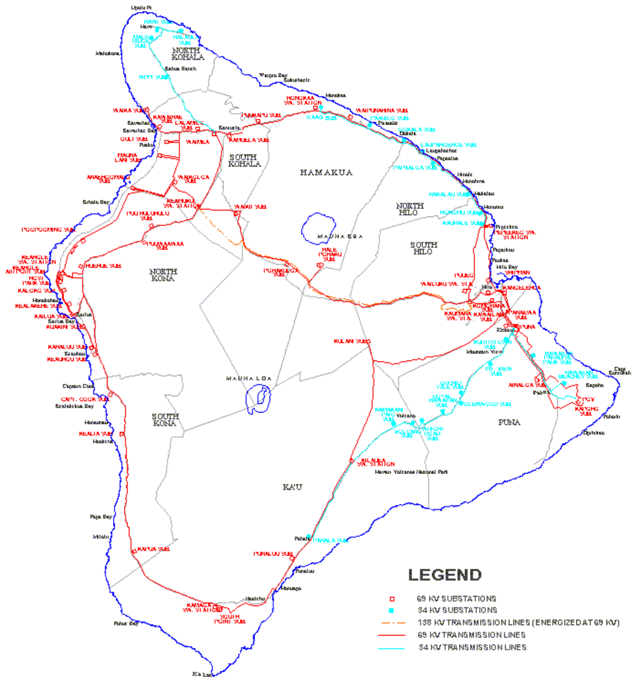
Economy: cost of electricity ($/kWh)

Environment: CO_2, SO_x, NO_x, Ozone (tons)

Society: reliability

Energy Security: % imported petroleum

Sustainability: % renewable

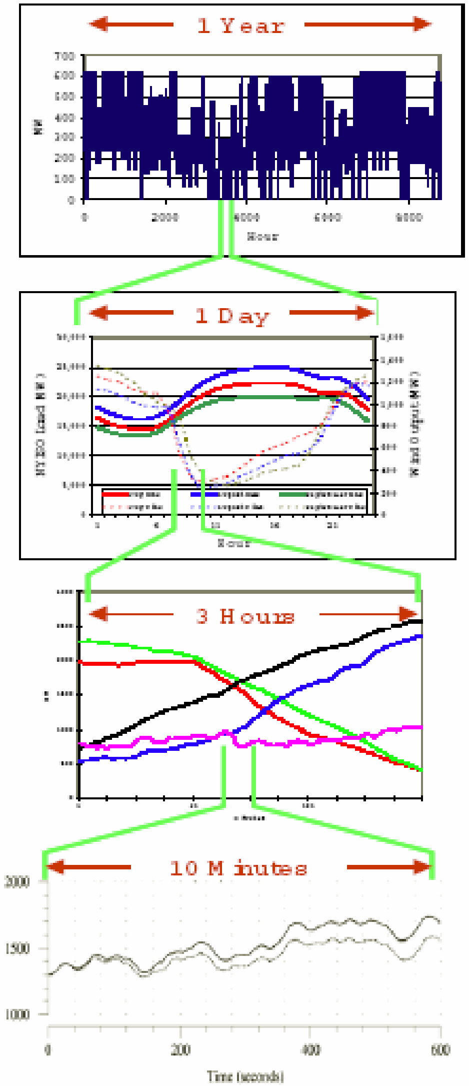


Electrical System Modeling Approach

Time Scales for System Planning and Operation Processes

Slower (Years) — Time Frame — Faster (seconds)

Long-Term Resource and Capacity Planning Capacity Value
Unit-Commitment Day-Ahead Scheduling Multi-Day Forecasting
Load-Following (5-minute dispatch) Hour-Ahead Forecasting
Frequency and Tie-Line Regulation (AGC)



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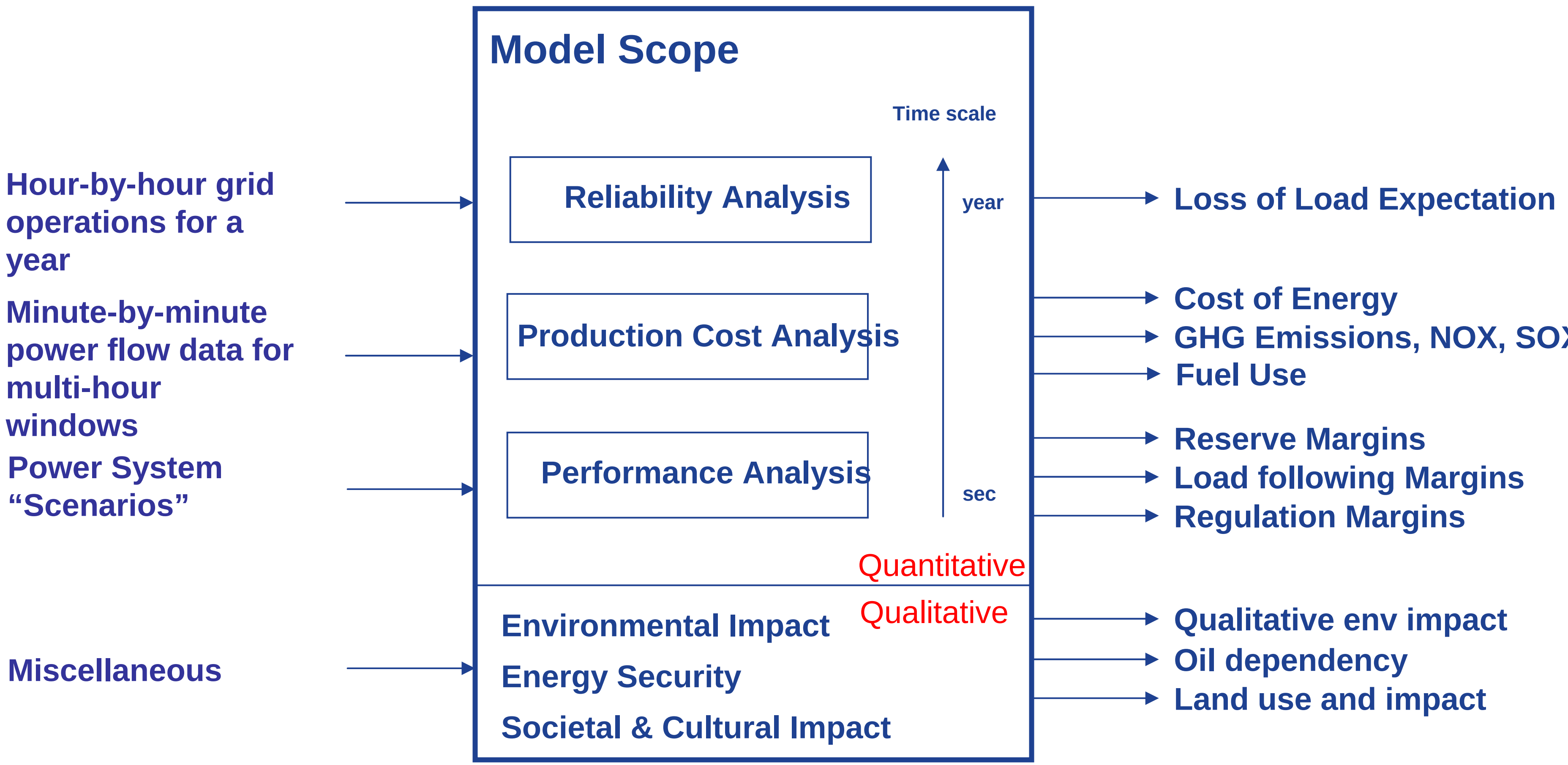
Electrical System Modeling



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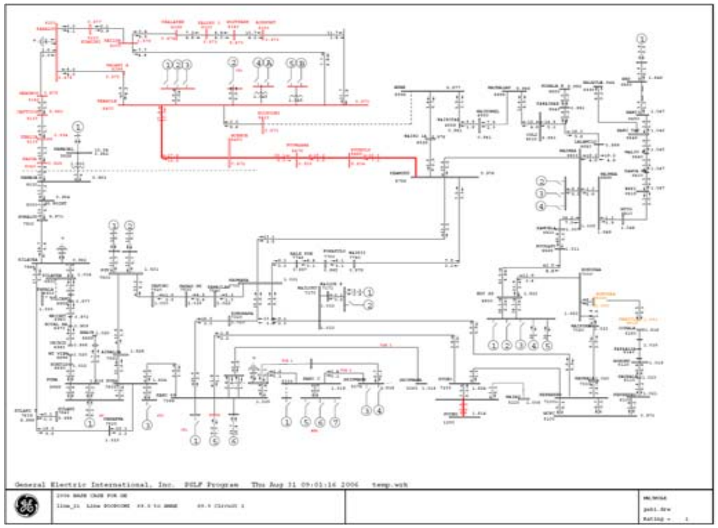
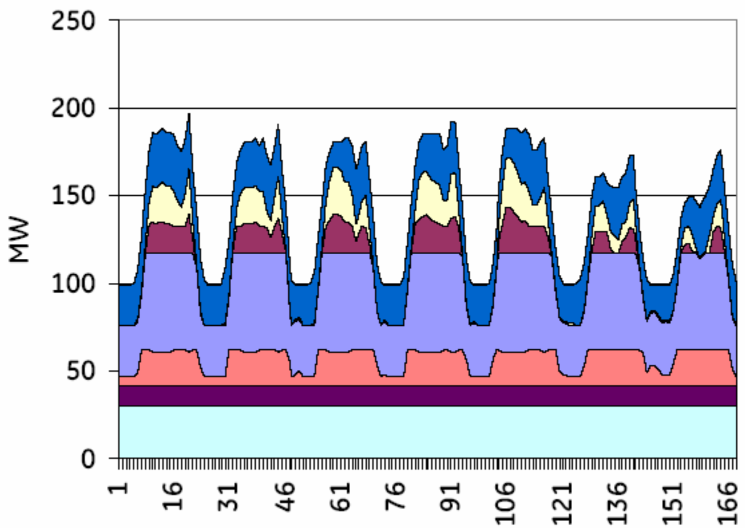
Electrical System Modeling



Transmission and Load Modeling in PSLF



Example of production modeling in MAPS

Performance Analysis

PSLF - Positive Sequence Load Flow

- Long-Term Dynamic Simulation
  - Second-by-second load, wind and solar variability driving full dynamic simulation of entire HELCO grid for several thousand seconds (~1 hour)
- Transient Stability Simulation
- Statistical Analysis

Economic Analysis

MAPS™ - Production Cost Simulation

Production Cost Simulation

- Hour-by-hour simulation of grid operations for an entire year