UNDERSTANDING IMPACTS OF POWER INTERRUPTIONS ON QUALITY OF LIFE:

OPPORTUNITIES FOR SOCIALLY-OPTIMAL POLICY AND DEMAND-SIDE RESILIENCE

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1ST IAEE ONLINE CONFERENCE
8 JUNE 2021

kxan

ERCOT: Texas power grid was ‘seconds, minutes’ away from catastrophic blackout event

TexasMonthly

POLITICS & POLICY

The Texas Blackout Is the Story of a Disaster Foretold

Those in charge of Texas’s deregulated power sector were warned again and again that the electric grid was vulnerable.

By Jeffrey Ball | February 19, 2021 | 97

FOX 4

Rolling power blackouts turn into lengthy outages in Texas as energy demand reaches record high

By Hanna Battah , Steve Noviello , Steven Dial and Mark Norris | **Published** February 15 | Dallas | FOX 4

Vox

Why every state is vulnerable to a Texas-style power crisis

“The infrastructure we have built right now really isn’t ready.”

By Umair Irfan | Mar 11, 2021, 4:30pm EST

EcoWatch

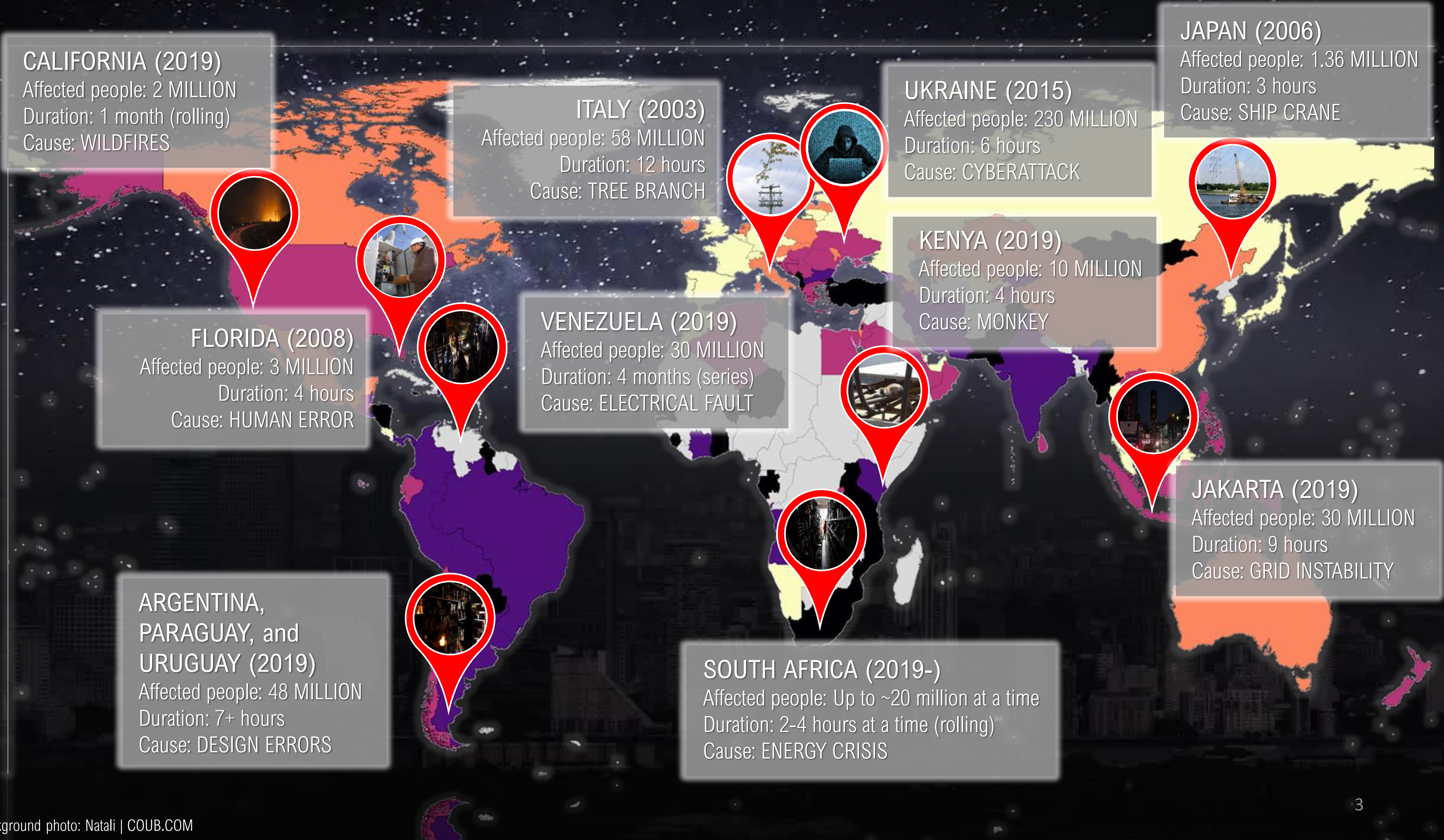
POLAR VORTEX

Texas Blackout: Death Toll Mounts While Food and Water Are Impacted

By Climate Nexus | Feb. 18, 2021 11:36AM EST

CLIMATE

Background photo: Bronte Wittpenn | AP



CALIFORNIA (2019)
Affected people: 2 MILLION
Duration: 1 month (rolling)
Cause: WILDFIRES

ITALY (2003)
Affected people: 58 MILLION
Duration: 12 hours
Cause: TREE BRANCH

UKRAINE (2015)
Affected people: 230 MILLION
Duration: 6 hours
Cause: CYBERATTACK

JAPAN (2006)
Affected people: 1.36 MILLION
Duration: 3 hours
Cause: SHIP CRANE

KENYA (2019)
Affected people: 10 MILLION
Duration: 4 hours
Cause: MONKEY

FLORIDA (2008)
Affected people: 3 MILLION
Duration: 4 hours
Cause: HUMAN ERROR

VENEZUELA (2019)
Affected people: 30 MILLION
Duration: 4 months (series)
Cause: ELECTRICAL FAULT

JAKARTA (2019)
Affected people: 30 MILLION
Duration: 9 hours
Cause: GRID INSTABILITY

ARGENTINA, PARAGUAY, and URUGUAY (2019)
Affected people: 48 MILLION
Duration: 7+ hours
Cause: DESIGN ERRORS

SOUTH AFRICA (2019-)
Affected people: Up to ~20 million at a time
Duration: 2-4 hours at a time (rolling)
Cause: ENERGY CRISIS

Background photo: Natali | COUB.COM

48 BILLION HOURS

"LOST" HUMAN TIME WORLDWIDE DUE TO POWER INTERRUPTIONS

Estimations done by researcher based on The World Bank Doing Business Report 2020

Interrupted Human Time = SAIDI × Electricity Access × Population

Background photo: Natali | COUB.COM

“DRESS REHEARSALS”

for the future in which they will appear with greater frequency and severity.

(Byrd & Matthewman, 2015)

Background photo: CNN.COM

Infrastructure and Public Services

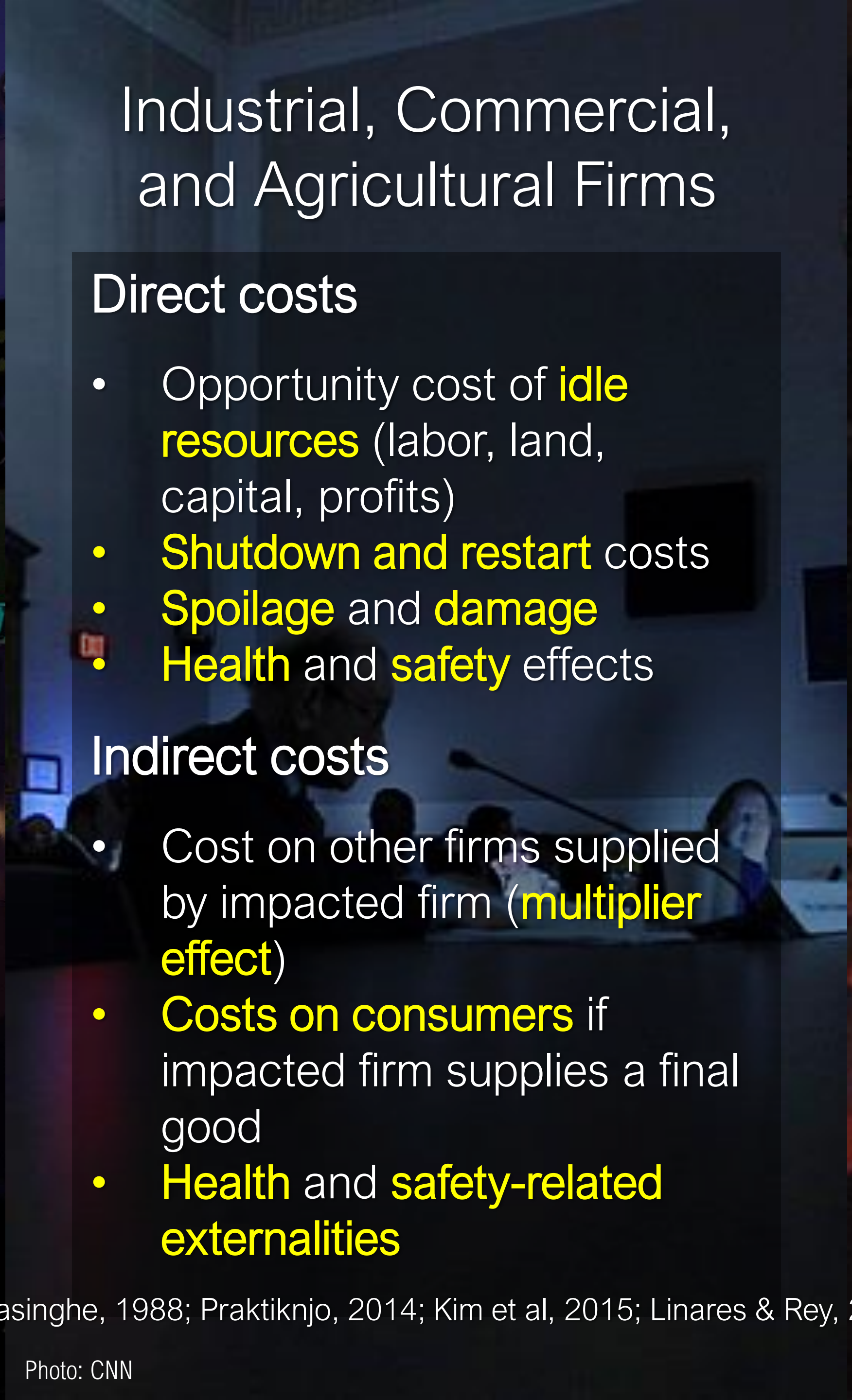
Direct costs

- Opportunity cost of idle resources
- Spoilage and damage

Indirect costs

- Costs to public users of impacted services and institutions
- Health and safety effects
- Potential social costs stemming from looting, vandalism, etc.

Photo: Reuters



Industrial, Commercial, and Agricultural Firms

Direct costs

- Opportunity cost of idle resources (labor, land, capital, profits)
- Shutdown and restart costs
- Spoilage and damage
- Health and safety effects

Indirect costs

- Cost on other firms supplied by impacted firm (multiplier effect)
- Costs on consumers if impacted firm supplies a final good
- Health and safety-related externalities

Photo: CNN

Residential Consumers

Direct costs

- Inconvenience, discomfort, lost leisure, stress, etc.
- Restriction of household activities
- Difficulty on ICT access
- Limited use of financial services
- Lost income
- Water shortage
- Out-of-pocket costs (spoilage, property)
- Health and safety effects

Indirect costs

- Costs on other households and firms associated with household members (spillover effects)

Photo: ABSCBN News

(Munasinghe, 1988; Praktiknjo, 2014; Kim et al, 2015; Linares & Rey, 2013)

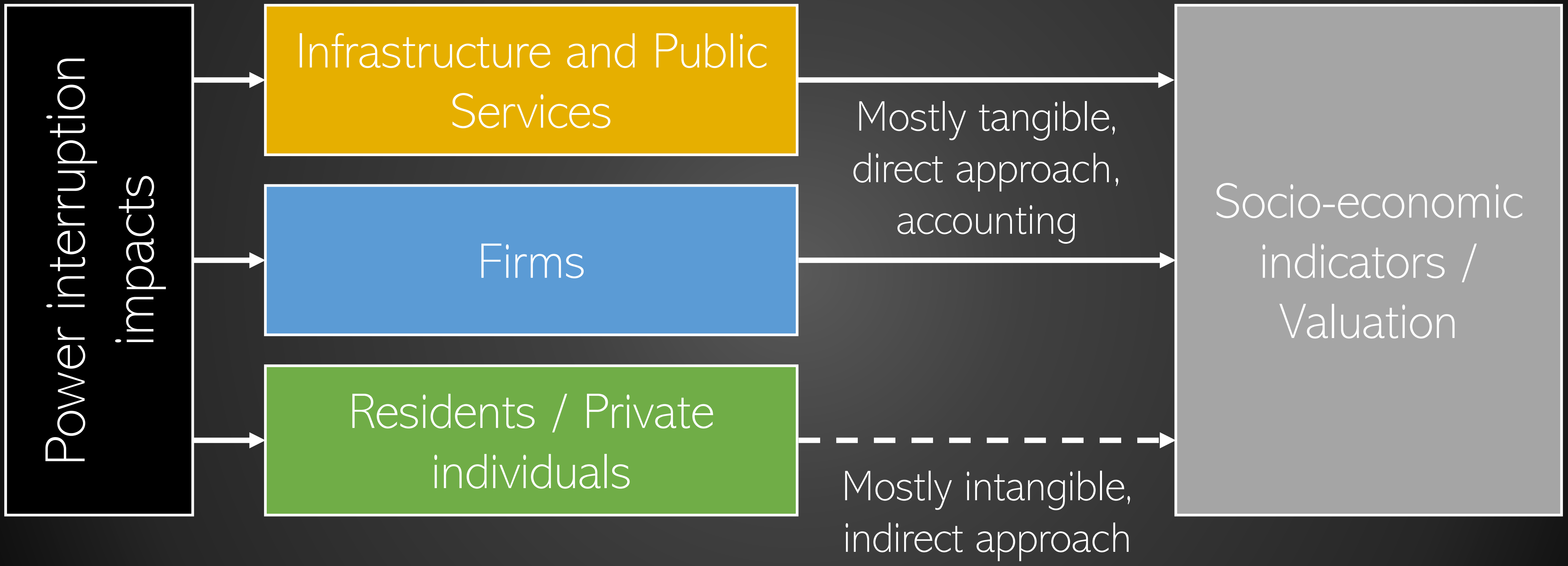
diminished

QUALITY OF LIFE

multidimensional character of living conditions

(Krause, 2016)

IMPACT VALUATION APPROACHES



Power interruption impacts

Infrastructure and Public Services

Firms

Residents / Private individuals

Mostly tangible, direct approach, accounting

Mostly intangible, indirect approach

Socio-economic indicators / Valuation

IMPACT VALUATION APPROACHES

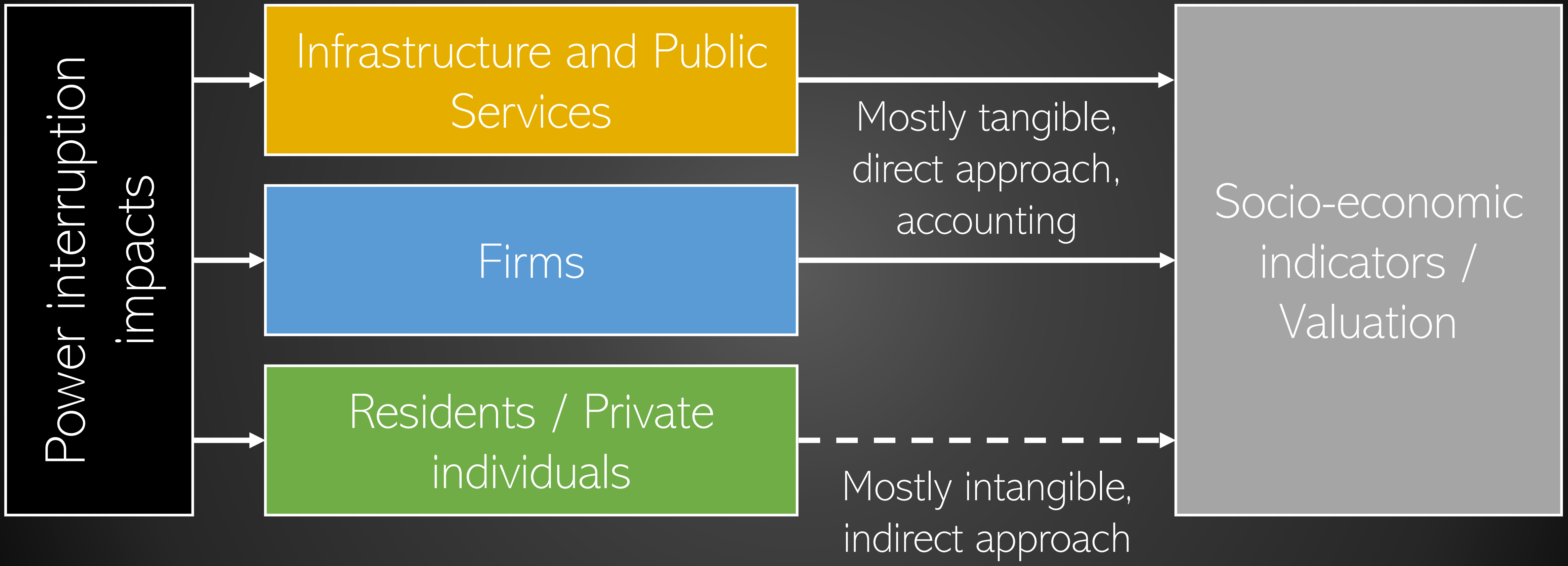
Cost per unit of unserved energy

- Typical unit: $/kWh, $/kW (normalized)
- Terminologies
    - Value of Lost Load
    - Customer Interruption Cost
    - Cost of Energy Not Supplied
- Most commonly used
- Useful for scarcity/ration planning (de Nooij, et al, 2007)

Cost per unit time

- Typical unit: $/hour; $/year
- Terminologies
    - Customer Interruption Cost
    - Damage Cost
    - Value of Lost Leisure
- Useful for network reliability investment planning (de Nooij, et al, 2007)

IMPACT VALUATION APPROACHES



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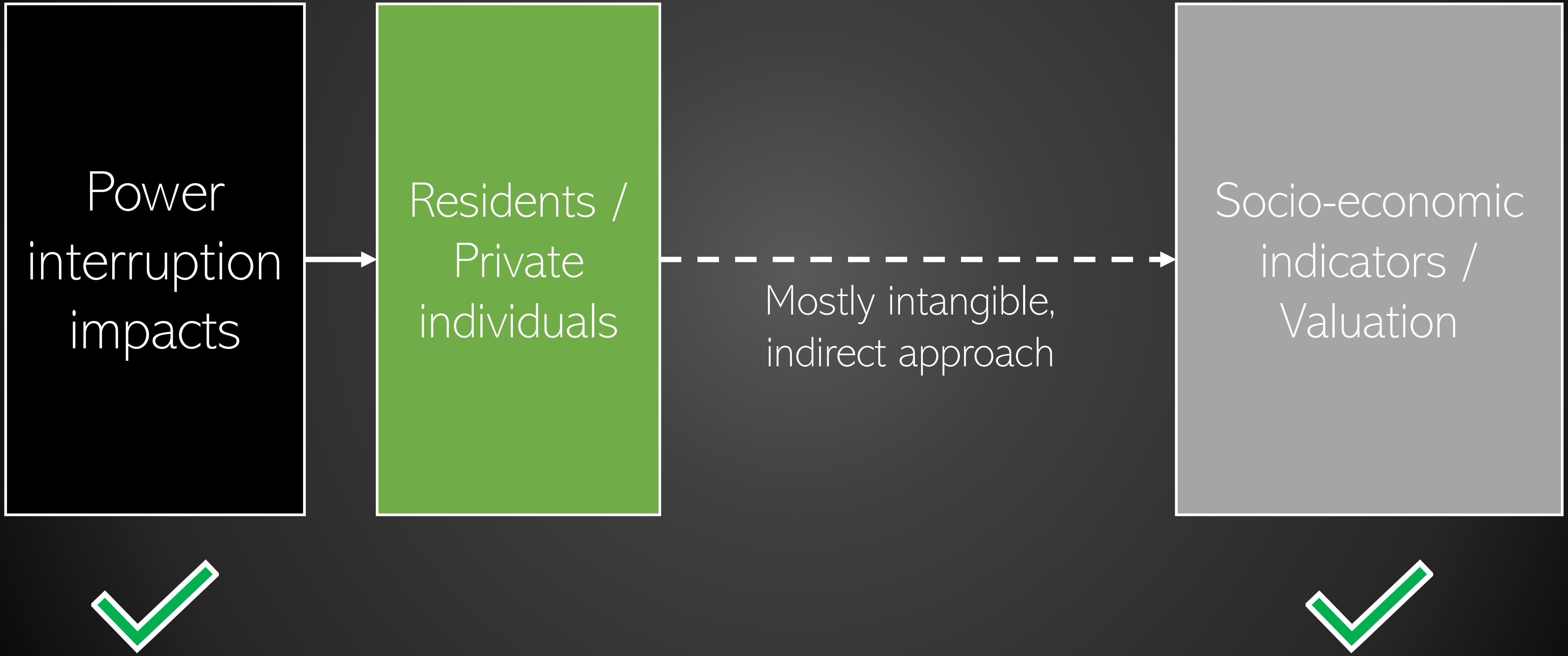
RESEARCH GAP



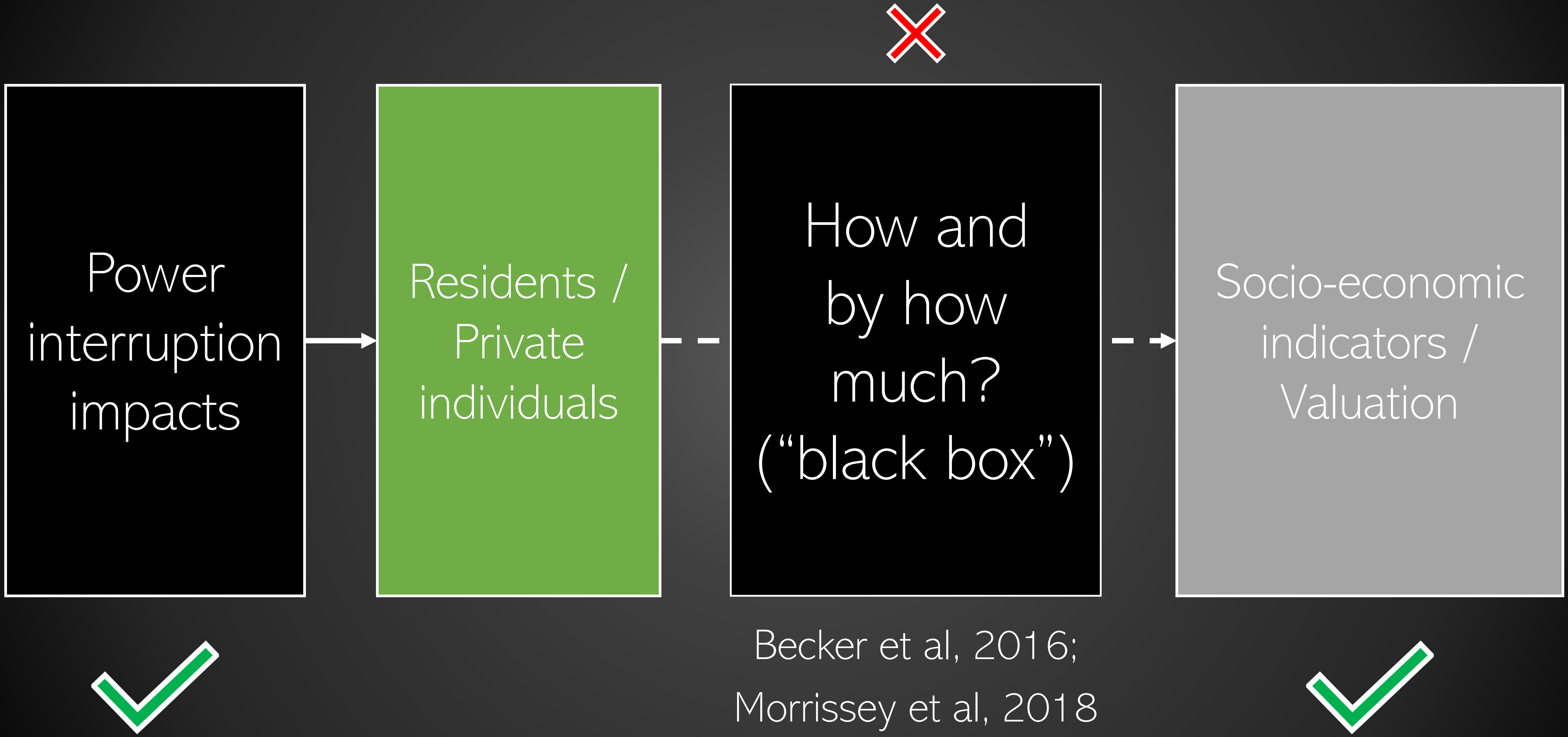
Power interruption impacts ✓

Residents / Private individuals

Mostly intangible, indirect approach

Socio-economic indicators / Valuation ✓

RESEARCH GAP



Power interruption impacts

✓

Residents / Private individuals

✗

How and by how much? ("black box")

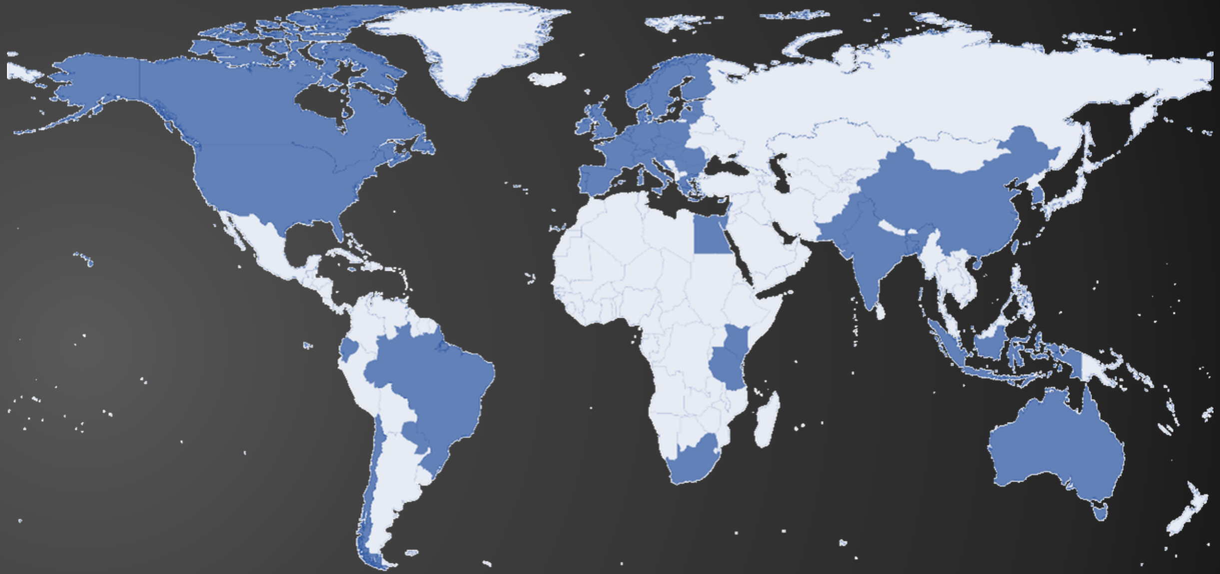
Becker et al, 2016;
Morrissey et al, 2018

Socio-economic indicators / Valuation

✓

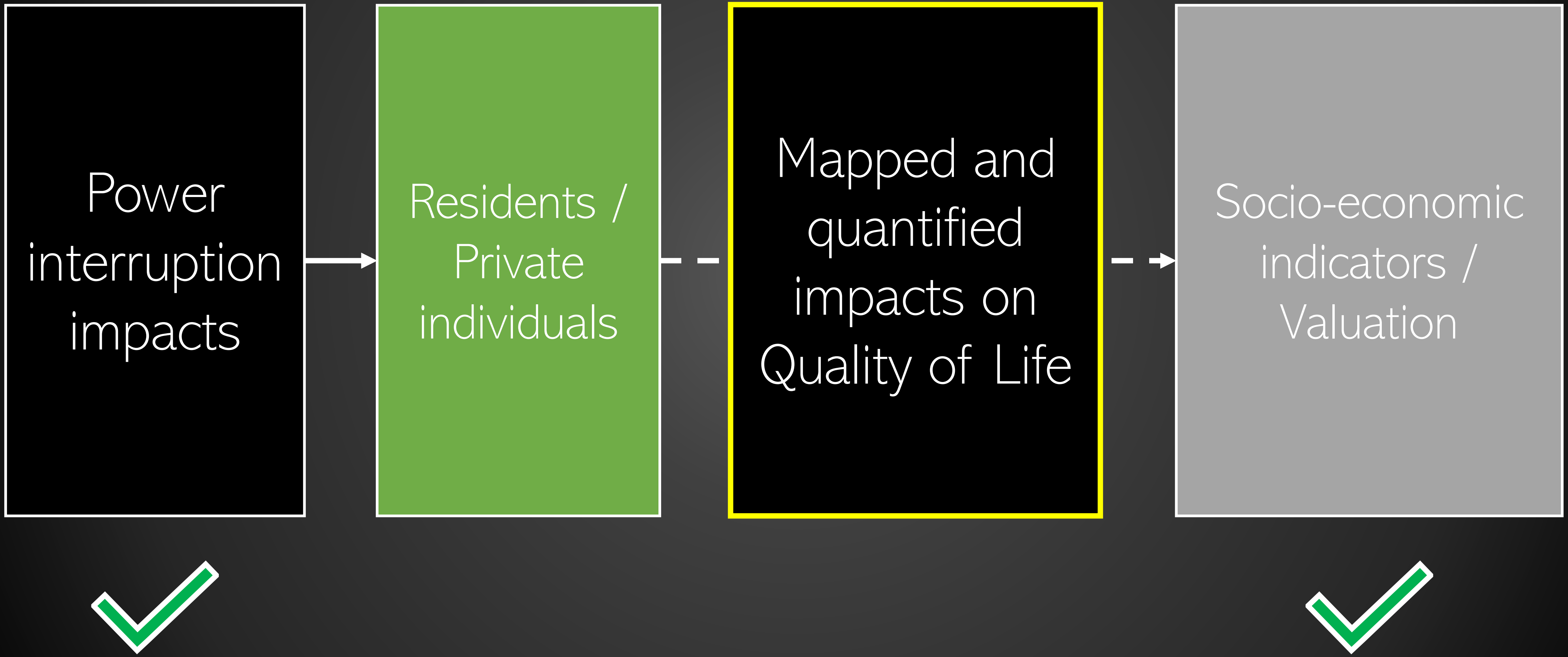
IMPACT VALUATION STUDIES IN THE RESIDENTIAL SEGMENT

- **"Black-box"** models (Becker et al., 2016; Morrisey et al., 2018)
- **Nonstandard methodology**
- Lacking in **international comparability** (Schroder & Kuckshinrichs, 2015)
- Potentially **speculative / hypothetical** (de Nooij, et al, 2007; Shivakumar et al., 2017)



Only 52 countries so far have published work on quantifying impacts of power interruptions on the residential segment (33 are in Europe)

OBJECTIVE



Power interruption impacts

Residents / Private individuals

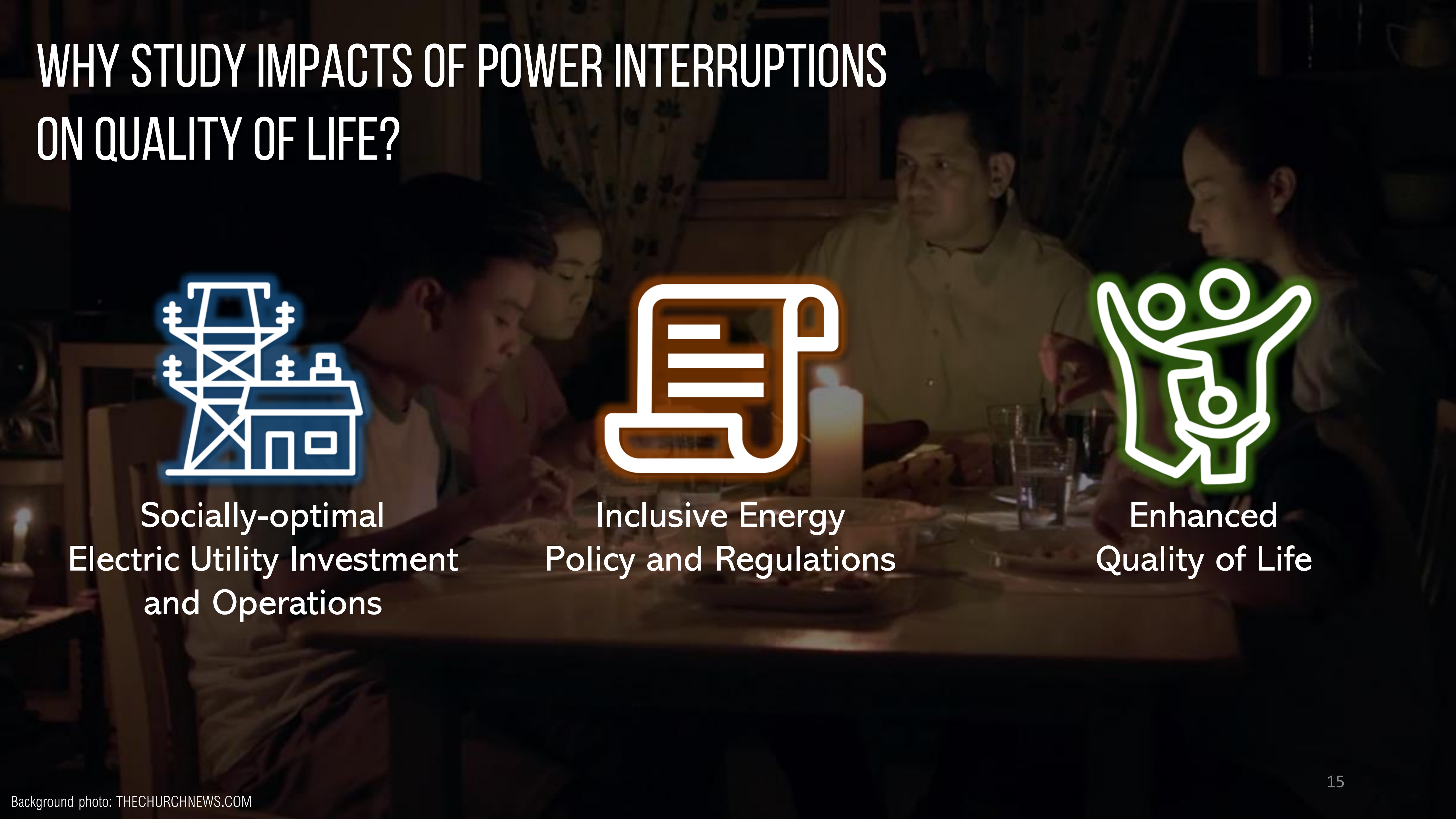
Mapped and quantified impacts on Quality of Life

Socio-economic indicators / Valuation

✓

✓

WHY STUDY IMPACTS OF POWER INTERRUPTIONS ON QUALITY OF LIFE?



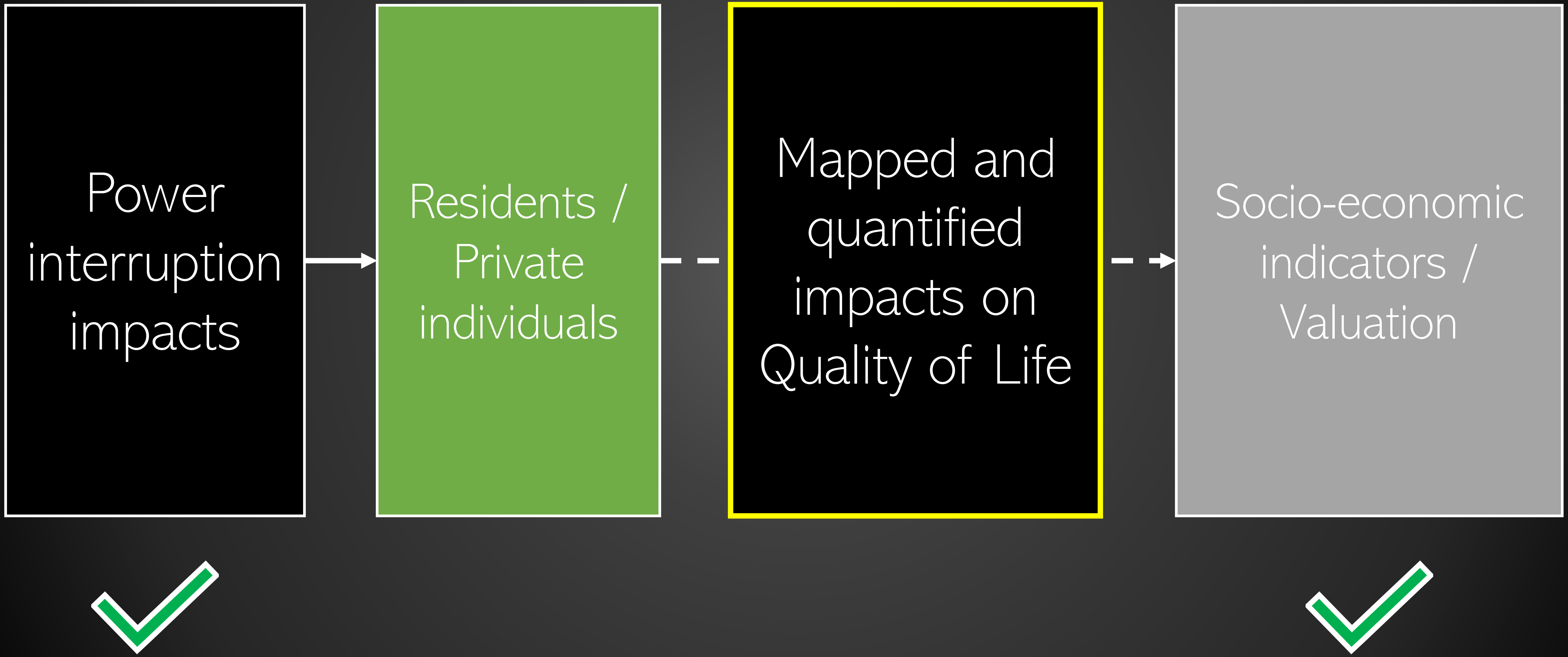
Socially-optimal
Electric Utility Investment
and Operations

Inclusive Energy
Policy and Regulations

Enhanced
Quality of Life

Background photo: THECHURCHNEWS.COM

OBJECTIVE



Power interruption impacts

✓

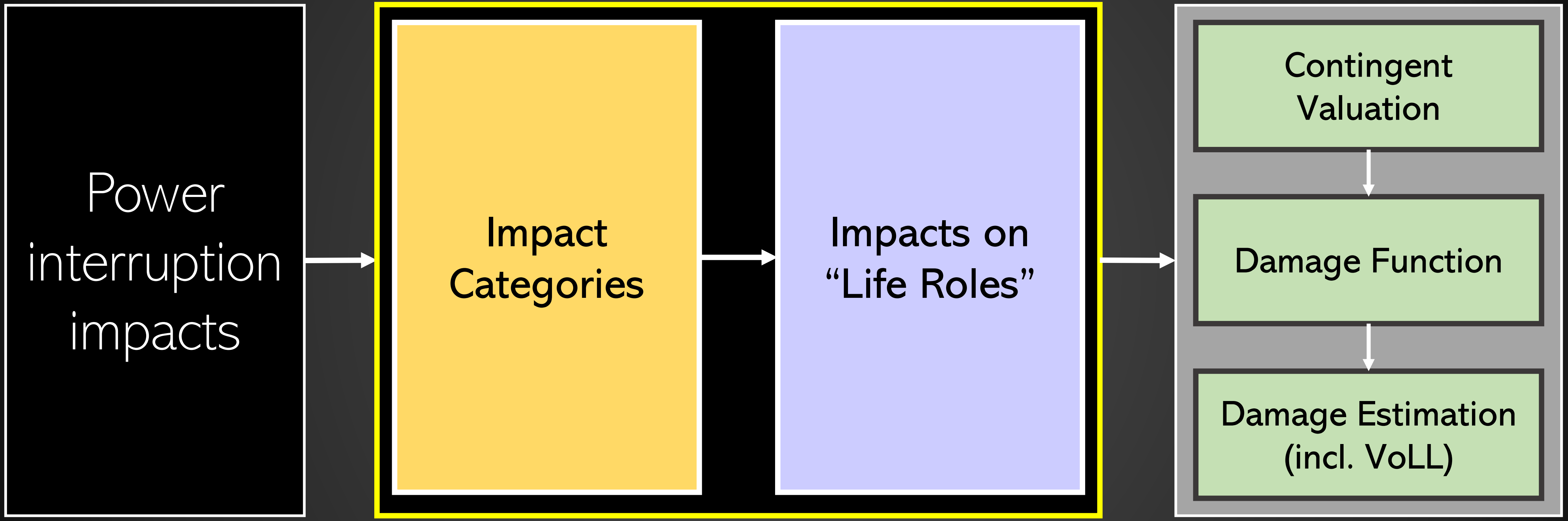
Residents / Private individuals

Mapped and quantified impacts on Quality of Life

Socio-economic indicators / Valuation

✓

METHODOLOGY



Power interruption impacts

Impact Categories

Impacts on "Life Roles"

Contingent Valuation

Damage Function

Damage Estimation (incl. VoLL)

Raw inputs

Proposed Power Interruption Impact Assessment (PIIA) Model

Existing methods

FRAMEWORK BASED ON LIFE CYCLE IMPACT ASSESSMENT (LCIA)

Selection

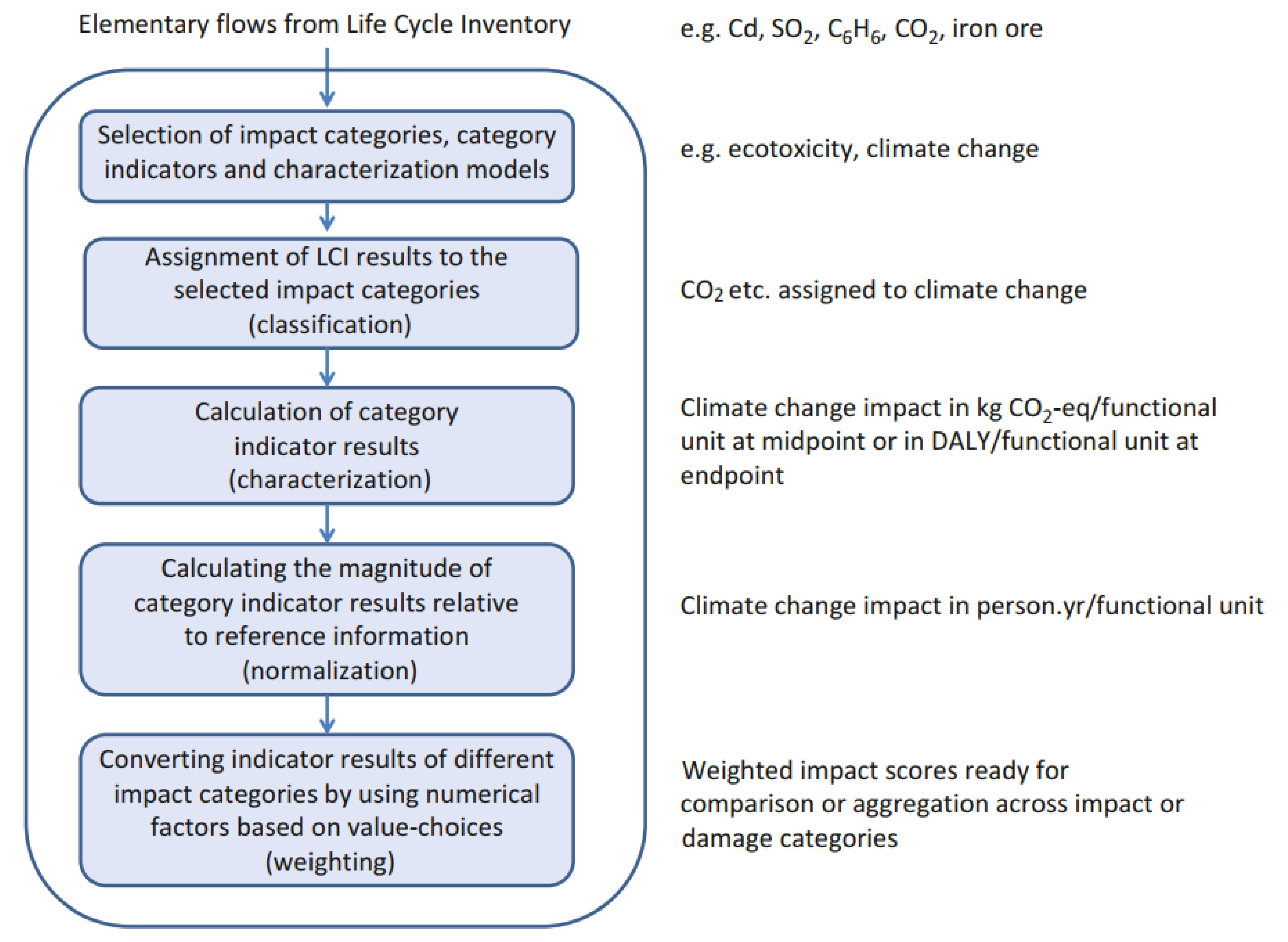
Classification

Characterization

Normalization*

Weighting*

*optional components as per ISO 14044



Elementary flows from Life Cycle Inventory — e.g. Cd, SO_2, C_6H_6, CO_2, iron ore

Selection of impact categories, category indicators and characterization models — e.g. ecotoxicity, climate change

Assignment of LCI results to the selected impact categories (classification) — CO_2 etc. assigned to climate change

Calculation of category indicator results (characterization) — Climate change impact in kg CO_2-eq/functional unit at midpoint or in DALY/functional unit at endpoint

Calculating the magnitude of category indicator results relative to reference information (normalization) — Climate change impact in person.yr/functional unit

Converting indicator results of different impact categories by using numerical factors based on value-choices (weighting) — Weighted impact scores ready for comparison or aggregation across impact or damage categories

Fig. 1.1 The five steps of life cycle impact assessment

Hauschild & Huijbregts, 2015

LCIA: ENDPOINT MODELLING

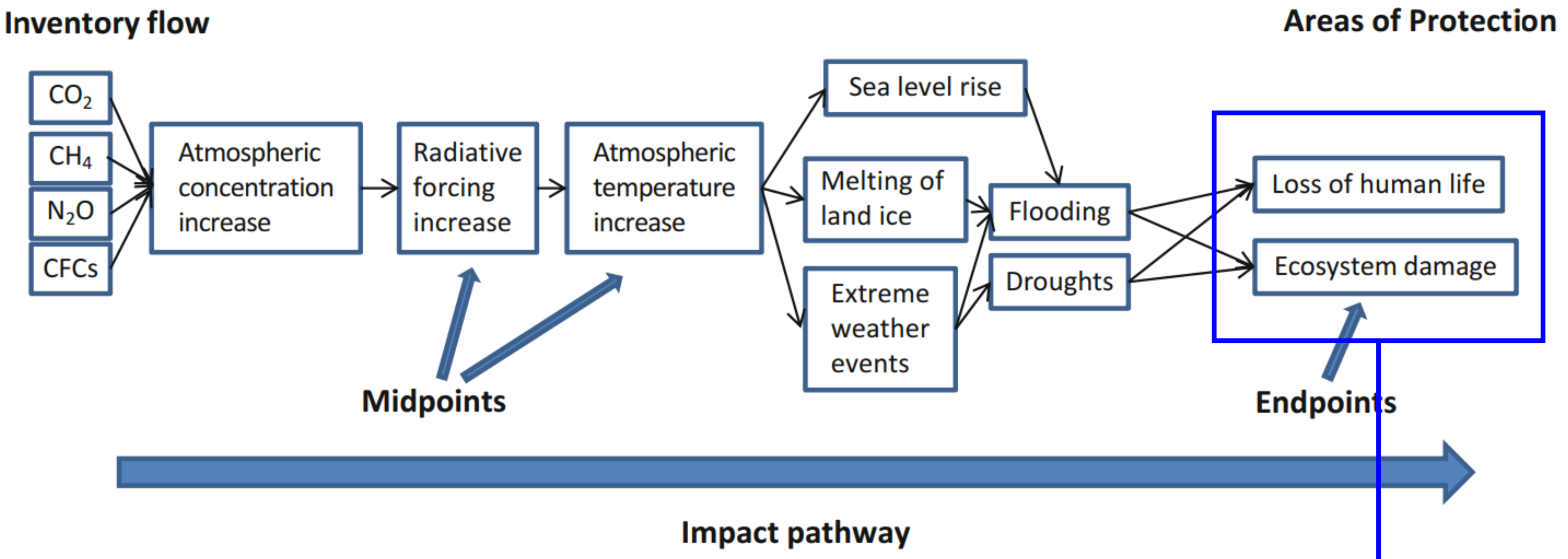


Fig. 1.2 Simplified impact pathway for global warming connecting elementary flows from the inventory to the areas of protection

Hauschild & Huijbregts, 2015

Endpoint indicators – “damage modelling”

CHARACTERIZATION OF “ELEMENTARY FLOWS” IN LCIA

Generic framework

CF Characterization Factor	=	**FF** Fate Factor	•	**XF** Exposure Factor	•	**EF** Effect Factor
		Based on **proportion** and **duration** of flow		Based on **sensitivity** of receiving environment		**Effects of exposure** on targets for the impact category

Hauschild & Huijbregts, 2015

POWER INTERRUPTION IMPACT ASSESSMENT (PIIA)

Conceptually based on Life Cycle Impact Assessment (LCIA)

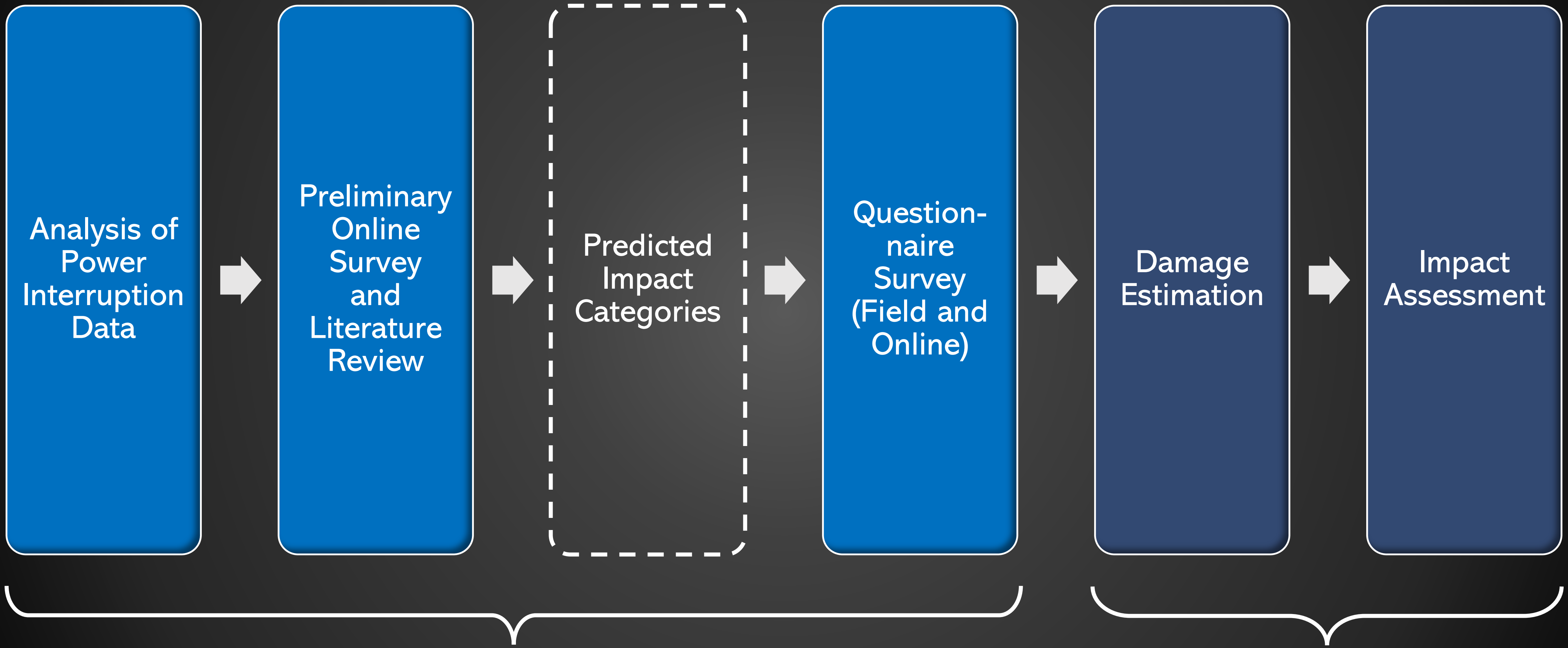
CF Characterization Factor = **FF** Fate Factor • **XF** Exposure Factor • **EF** Effect Factor

IF Interruption Impact Factor = **IX** Interruption Index • **ED** Electricity Dependence • **IS** Impact Salience

IX	ED	IS
Based on **frequency** and **duration** of interruptions* (2018 values)	Based on self-reported **electricity dependence** of respondents	Rated **effects of impacts** on "life roles"

*as affected by advance notice and intermittency

METHODS



Analysis of Power Interruption Data

Preliminary Online Survey and Literature Review

Predicted Impact Categories

Question-naire Survey (Field and Online)

Damage Estimation

Impact Assessment

Data Collection

Data Analysis

Albay, Philippines

QUICK FACTS (as of Mar 2019)

- 1.3 million population
- 275,601 households (2015)
- 191,275 electricity subscribers
- 88 kWh average residential electricity consumption (19th)

3RD HIGHEST FREQUENCY OF INTERRUPTIONS

HIGHEST NUMBER OF MOMENTARY INTERRUPTIONS

(duration < 5 mins)

Background photo: Natali | COUB.COM

STUDY AREA: ALBAY, PHILIPPINES

15

times

1 TO 25, DEPENDING ON LOCATION

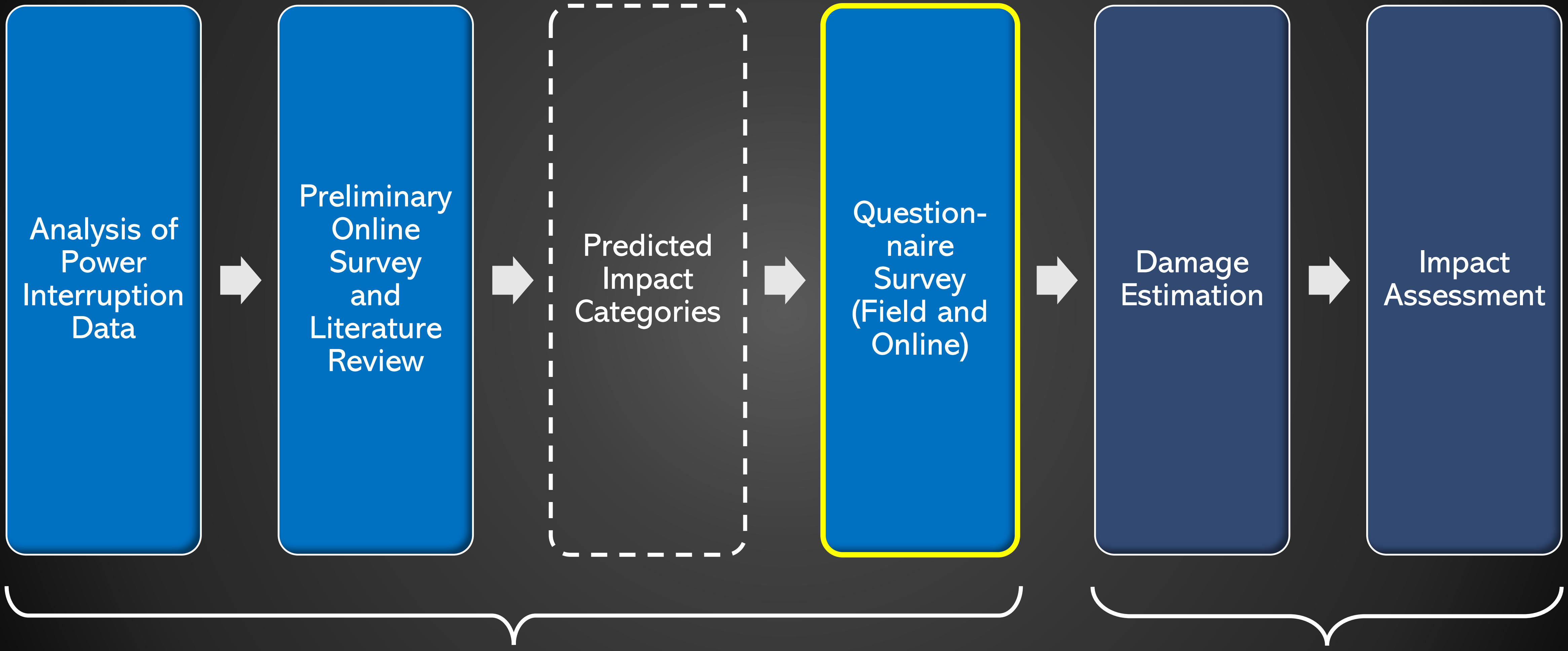
13

hours

3 TO 19, DEPENDING ON LOCATION

monthly power interruptions

METHODS



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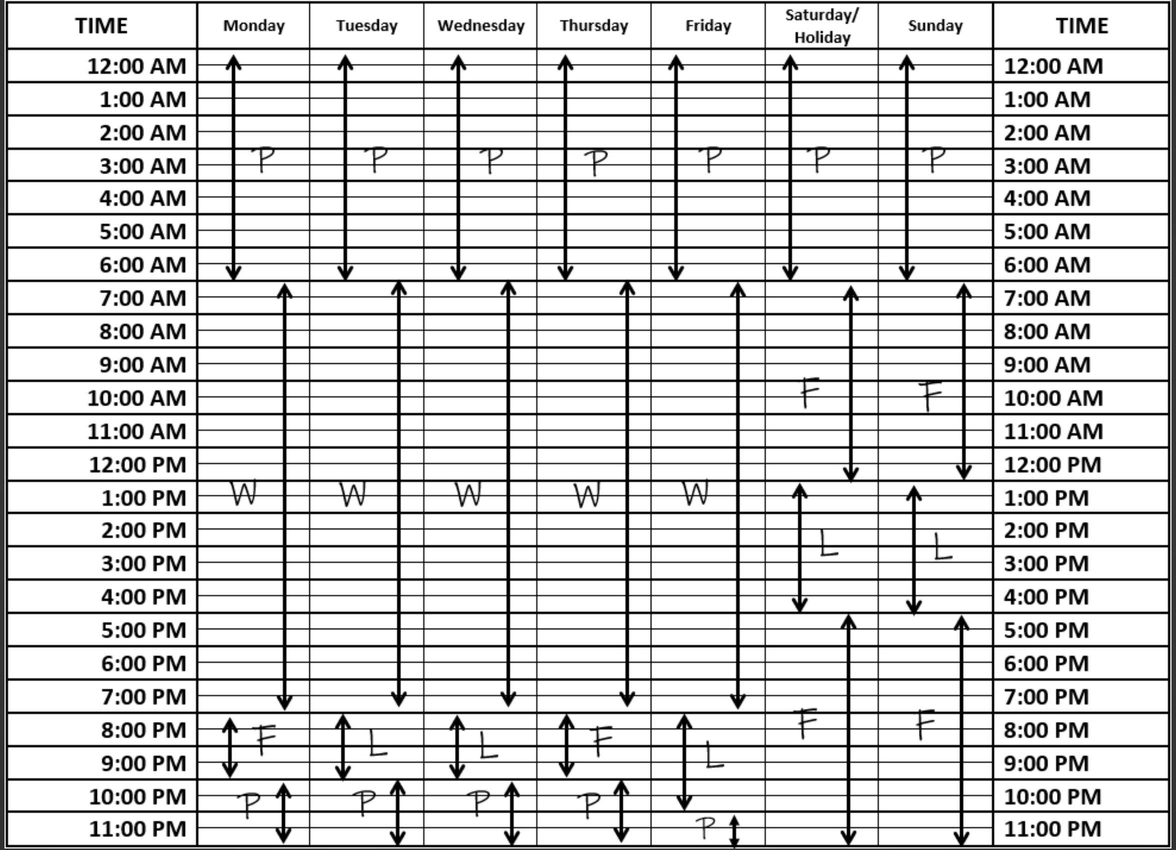
POWER INTERRUPTION IMPACT ASSESSMENT (PIIA)

Conceptually based on Life Cycle Impact Assessment (LCIA)

ED

Electricity Dependence

Based on self-reported **electricity dependence** of respondents



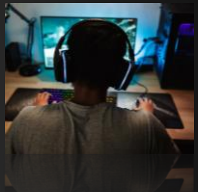
TIME	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday/ Holiday	Sunday	TIME
12:00 AM								12:00 AM
1:00 AM								1:00 AM
2:00 AM								2:00 AM
3:00 AM	P	P	P	P	P	P	P	3:00 AM
4:00 AM								4:00 AM
5:00 AM								5:00 AM
6:00 AM								6:00 AM
7:00 AM								7:00 AM
8:00 AM								8:00 AM
9:00 AM								9:00 AM
10:00 AM						F	F	10:00 AM
11:00 AM								11:00 AM
12:00 PM								12:00 PM
1:00 PM	W	W	W	W	W			1:00 PM
2:00 PM						L	L	2:00 PM
3:00 PM								3:00 PM
4:00 PM								4:00 PM
5:00 PM								5:00 PM
6:00 PM								6:00 PM
7:00 PM								7:00 PM
8:00 PM	F	L	L	F		F	F	8:00 PM
9:00 PM					L			9:00 PM
10:00 PM	P	P	P	P				10:00 PM
11:00 PM					P			11:00 PM

Life Role Time-use Inventory

“Life Roles”

(Nevill & Super, 1986)

Family/ Household



Leisure

Studying

Work

Community

Personal Care*

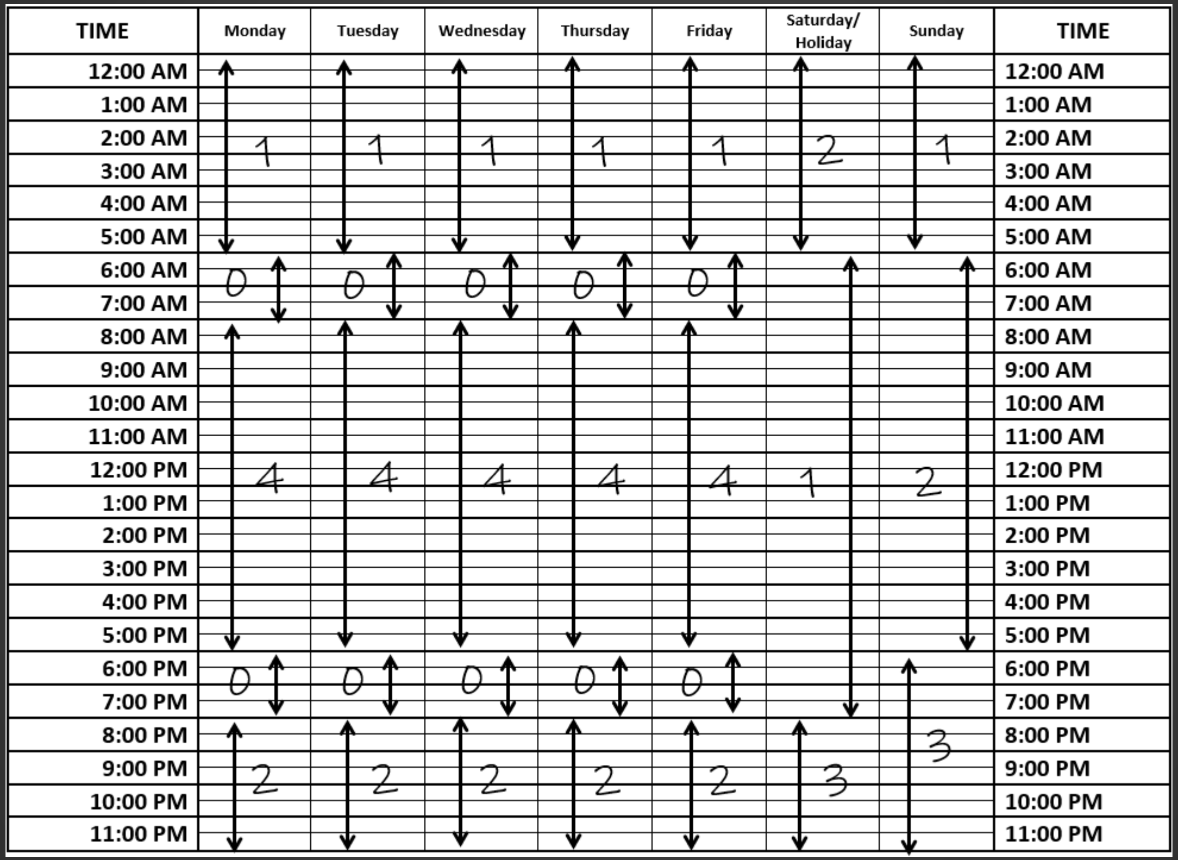
POWER INTERRUPTION IMPACT ASSESSMENT (PIIA)

Conceptually based on Life Cycle Impact Assessment (LCIA)

ED

Electricity Dependence

Based on self-reported **electricity dependence** of respondents



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12:00 AM	1	1	1	1	1	2	1	12:00 AM
1:00 AM								1:00 AM
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4:00 AM								4:00 AM
5:00 AM								5:00 AM
6:00 AM	0	0	0	0	0	1	2	6:00 AM
7:00 AM								7:00 AM
8:00 AM	4	4	4	4	4			8:00 AM
9:00 AM								9:00 AM
10:00 AM								10:00 AM
11:00 AM								11:00 AM
12:00 PM								12:00 PM
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5:00 PM								5:00 PM
6:00 PM	0	0	0	0	0		3	6:00 PM
7:00 PM								7:00 PM
8:00 PM	2	2	2	2	2	3		8:00 PM
9:00 PM								9:00 PM
10:00 PM								10:00 PM
11:00 PM								11:00 PM

Electricity dependence schedule (0-4)

- ● 4 Totally dependent
- ● 3 Very dependent
- ● 2 Dependent
- ● 1 Slightly dependent
- ● 0 Not at all dependent

POWER INTERRUPTION IMPACT ASSESSMENT (PIIA)

Conceptually based on Life Cycle Impact Assessment (LCIA)

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(2018 values)

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POWER INTERRUPTION IMPACT ASSESSMENT (PIIA)

Conceptually based on Life Cycle Impact Assessment (LCIA)

IS

Impact Salience

Rated **effects of impacts** on "life roles"

Impact	Household responsibilities	Leisure activities	Work effectiveness	Learning activities	Community participation	Personal care
Discomfort	3	4	2	2	1	2
Cannot watch TV shows	0	3	0	0	0	0
Cannot charge mobile phone	0	3	4	1	1	0

Self-reported impacts and disruption levels (0-4)

- ● 0 Not disruptive at all
- ● 1 Not too disruptive; many alternatives
- ● 2 Somehow disruptive; enough alternatives
- ● 3 Disruptive; few or inconvenient alternatives
- ● 4 Totally disruptive

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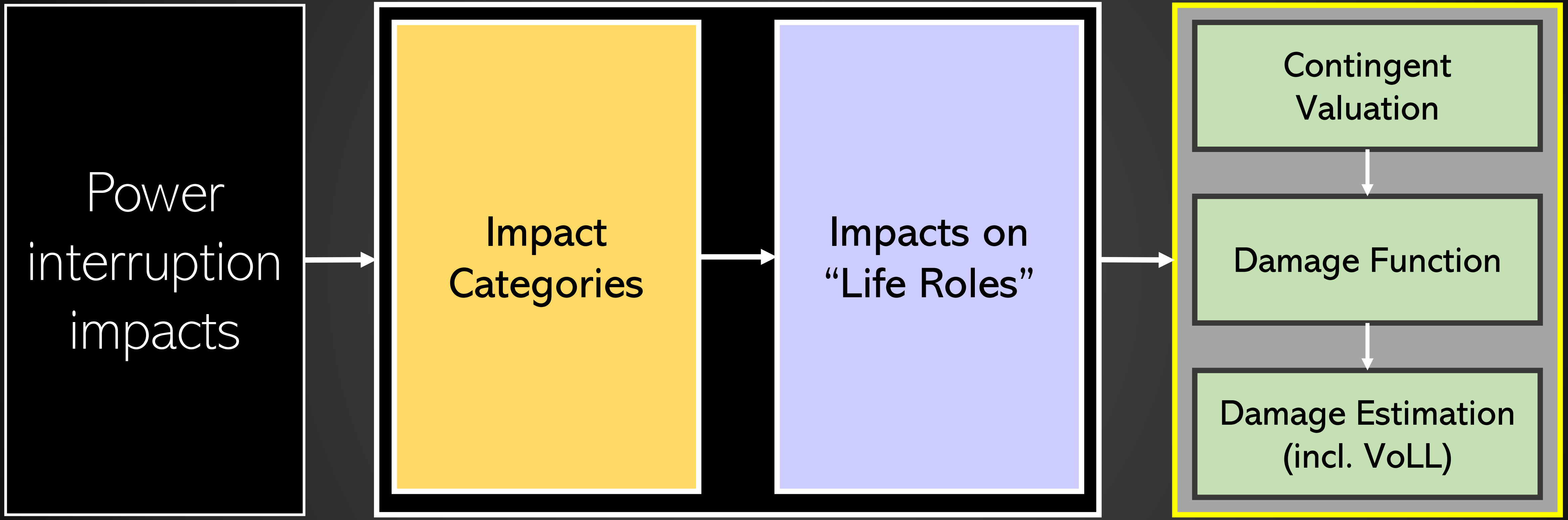
METHODOLOGY



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Impacts on “Life Roles”

Contingent Valuation

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Damage Estimation (incl. VoLL)

Raw inputs

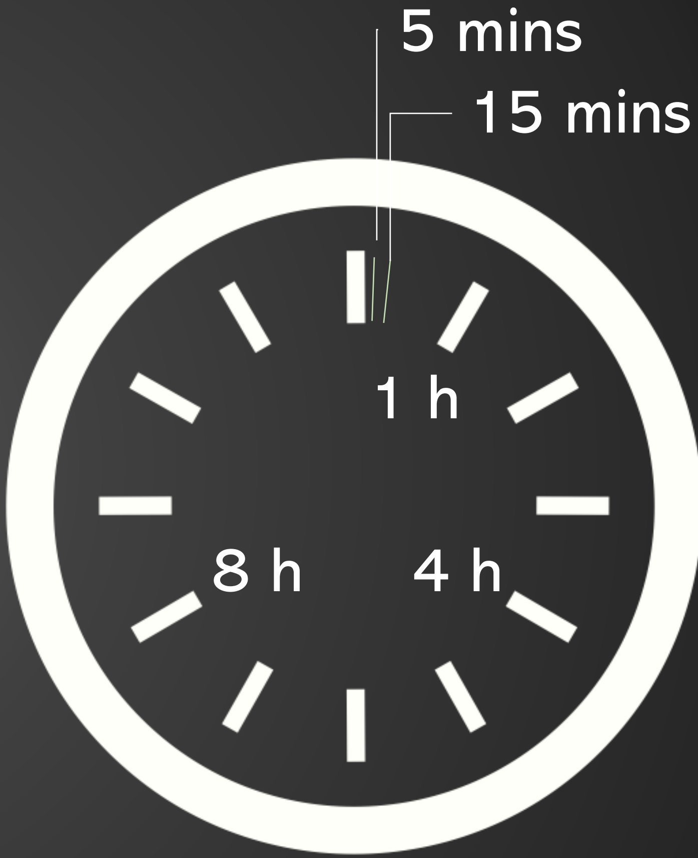
Proposed Power Interruption Impact Assessment (PIIA) Model

Existing methods

CONTINGENT VALUATION

"There is a device you can rent that you can use during power interruptions to power up ALL your appliances and devices at home. You will be shown scenarios based on duration and a corresponding price for usage of such device. If you are willing to pay for it, select YES. Otherwise, select NO."

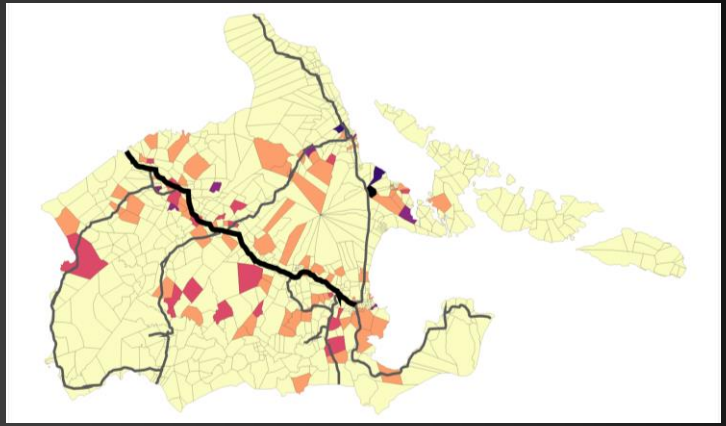
Bidding Game elicitation method
(Online survey: Payment Cards)



Interruption Duration Scenarios

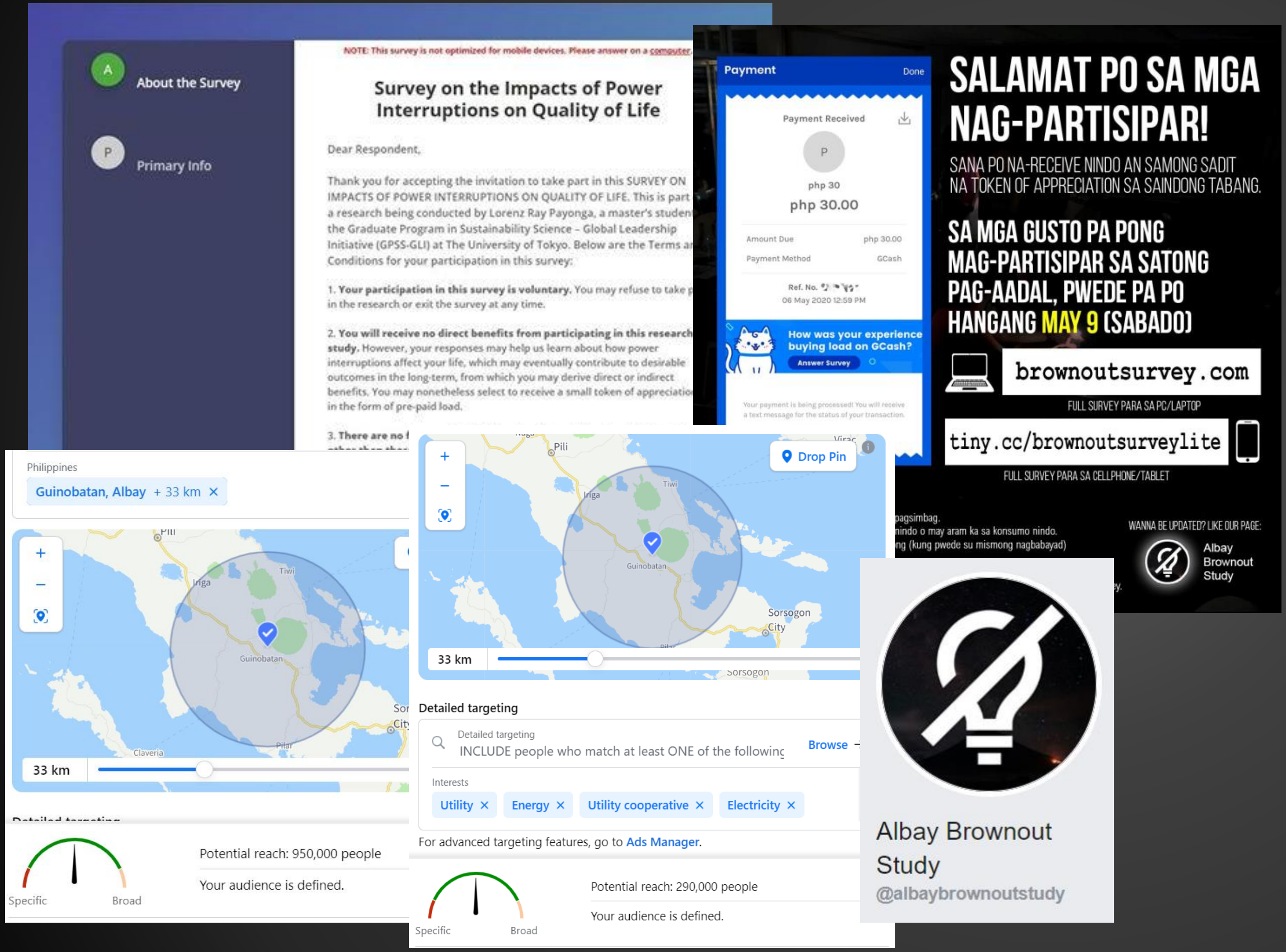
FIELD SURVEY

Pre-test survey (n=13) held on March 23, 2019



- Group-administered surveys held in the top 10 most populous cities and towns of Albay (78% of population) in October 2019
- Stratified random sample invited from local government household databases
- n = 151 (34.3% response rate)

ONLINE SURVEY



NOTE: This survey is not optimized for mobile devices. Please answer on a computer.

Survey on the Impacts of Power Interruptions on Quality of Life

Dear Respondent,

Thank you for accepting the invitation to take part in this SURVEY ON IMPACTS OF POWER INTERRUPTIONS ON QUALITY OF LIFE. This is part
a research being conducted by Lorenz Ray Payonga, a master's student
the Graduate Program in Sustainability Science – Global Leadership Initiative (GPSS-GLI) at The University of Tokyo. Below are the Terms a
Conditions for your participation in this survey:

1. **Your participation in this survey is voluntary.** You may refuse to take
in the research or exit the survey at any time.

2. **You will receive no direct benefits from participating in this research study.** However, your responses may help us learn about how power interruptions affect your life, which may eventually contribute to desirable outcomes in the long-term, from which you may derive direct or indirect benefits. You may nonetheless select to receive a small token of appreciatio
in the form of pre-paid load.

3. **There are no**

Payment Received

php 30

php 30.00

Amount Due	php 30.00
Payment Method	GCash

Ref. No. [redacted]
06 May 2020 12:59 PM

Your payment is being processed! You will receive a text message for the status of your transaction.

SALAMAT PO SA MGA NAG-PARTISIPAR!

SANA PO NA-RECEIVE NINDO AN SAMONG SADIT NA TOKEN OF APPRECIATION SA SAINDONG TABANG.

SA MGA GUSTO PA PONG MAG-PARTISIPAR SA SATONG PAG-AADAL, PWEDE PA PO HANGANG MAY 9 (SABADO)

brownoutsurvey.com

FULL SURVEY PARA SA PC/LAPTOP

tiny.cc/brownoutsurveylite

FULL SURVEY PARA SA CELLPHONE/TABLET

pagsimbag.
nindo o may aram ka sa konsumo nindo.
ng (kung pwede su mismong nagbabayad)

WANNA BE UPDATED? LIKE OUR PAGE:
Albay Brownout Study

Detailed targeting

Detailed targeting
INCLUDE people who match at least ONE of the following
Browse

Interests
Utility × Energy × Utility cooperative × Electricity ×

For advanced targeting features, go to Ads Manager.

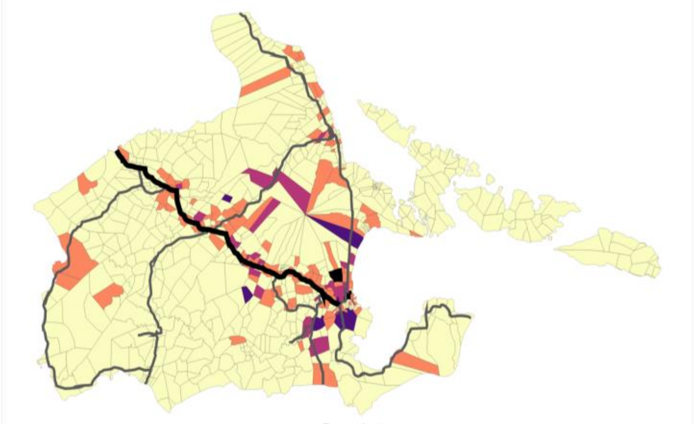
Potential reach: 950,000 people

Your audience is defined.

Potential reach: 290,000 people

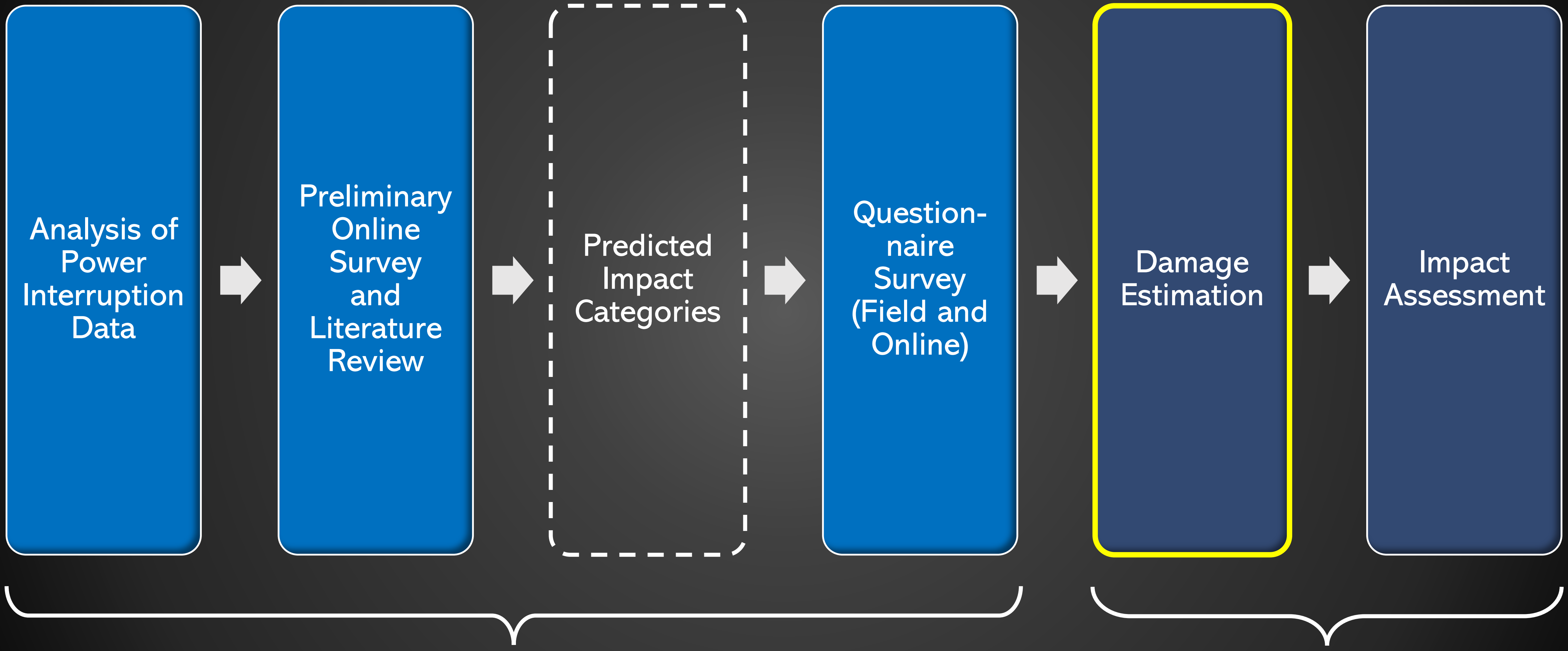
Your audience is defined.

Albay Brownout Study
@albaybrownoutstudy



- Online validation survey
    - Online snowball approach (March 24 to April 28, 2020)
    - Combined w/ Facebook ads (April 28 to May 9, 2020)
- n = 207

METHODS



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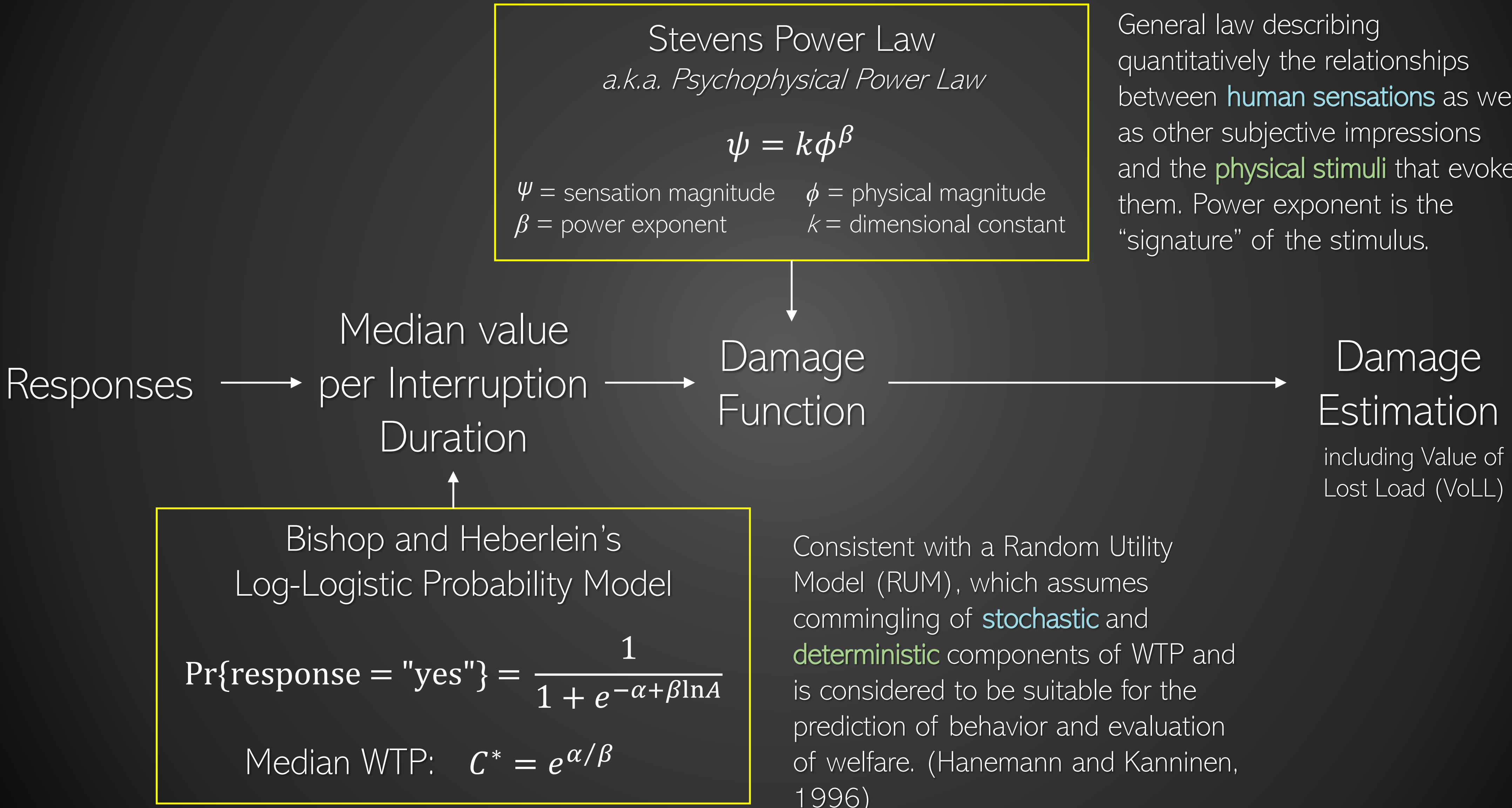
DAMAGE ESTIMATION



Stevens Power Law

a.k.a. Psychophysical Power Law

$$\psi = k\phi^{\beta}$$

Ψ = sensation magnitude
ϕ = physical magnitude
β = power exponent
k = dimensional constant

General law describing quantitatively the relationships between human sensations as well as other subjective impressions and the physical stimuli that evoke them. Power exponent is the “signature” of the stimulus.

Responses → Median value per Interruption Duration → Damage Function → Damage Estimation

including Value of Lost Load (VoLL)

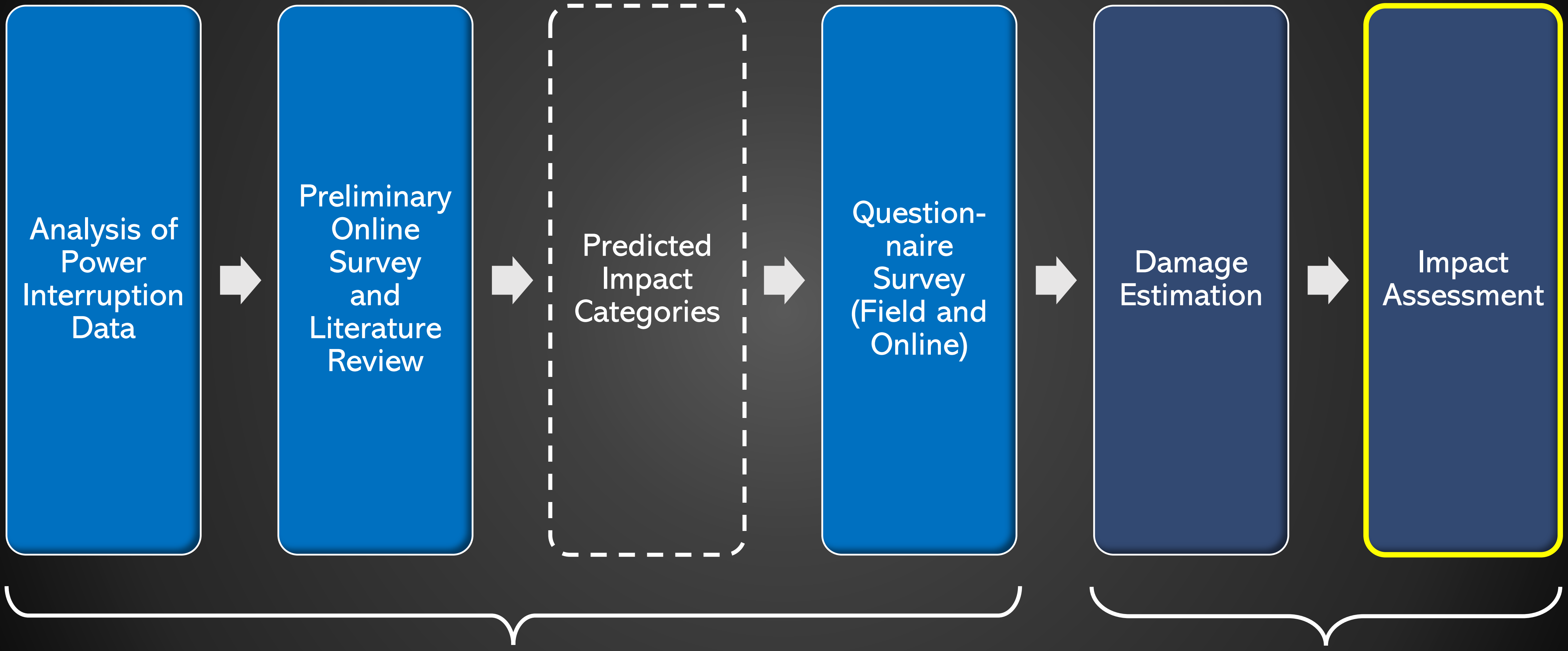
Bishop and Heberlein’s Log-Logistic Probability Model

$$\Pr\{\text{response} = \text{"yes"}\} = \frac{1}{1 + e^{-\alpha+\beta \ln A}}$$

Median WTP: $C^{*} = e^{\alpha/\beta}$

Consistent with a Random Utility Model (RUM), which assumes commingling of stochastic and deterministic components of WTP and is considered to be suitable for the prediction of behavior and evaluation of welfare. (Hanemann and Kanninen, 1996)

METHODS



Analysis of Power Interruption Data

Preliminary Online Survey and Literature Review

Predicted Impact Categories

Question-naire Survey (Field and Online)

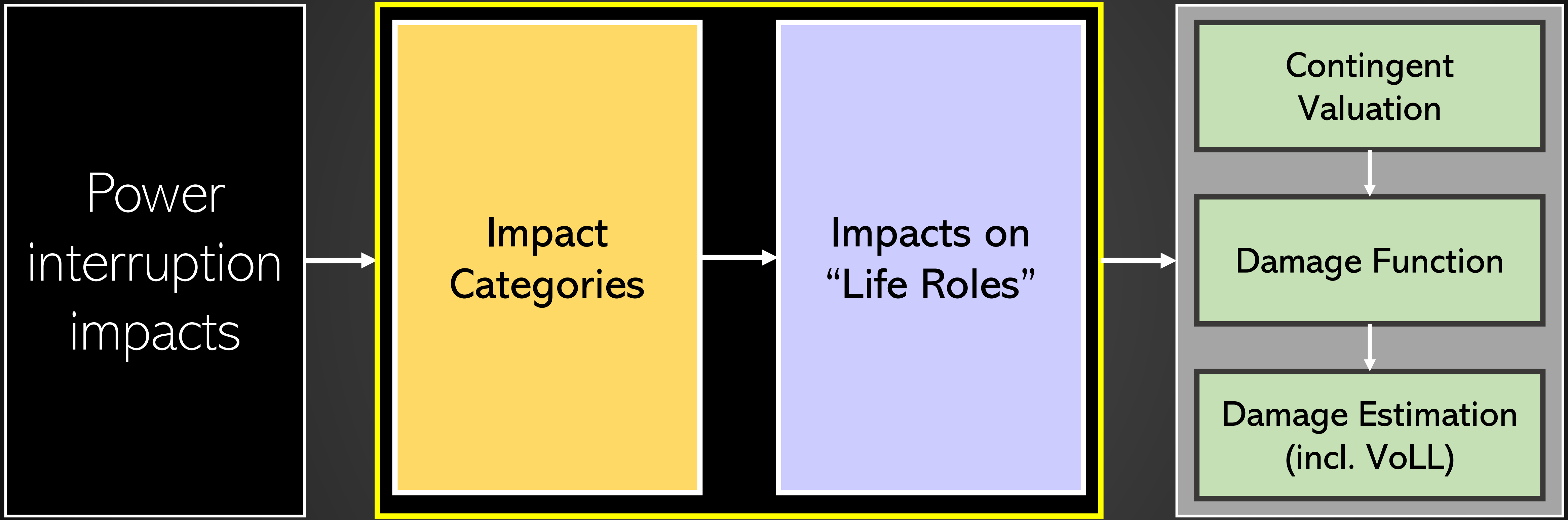
Damage Estimation

Impact Assessment

Data Collection

Data Analysis

METHODOLOGY



Power interruption impacts

Impact Categories

Impacts on "Life Roles"

Contingent Valuation

Damage Function

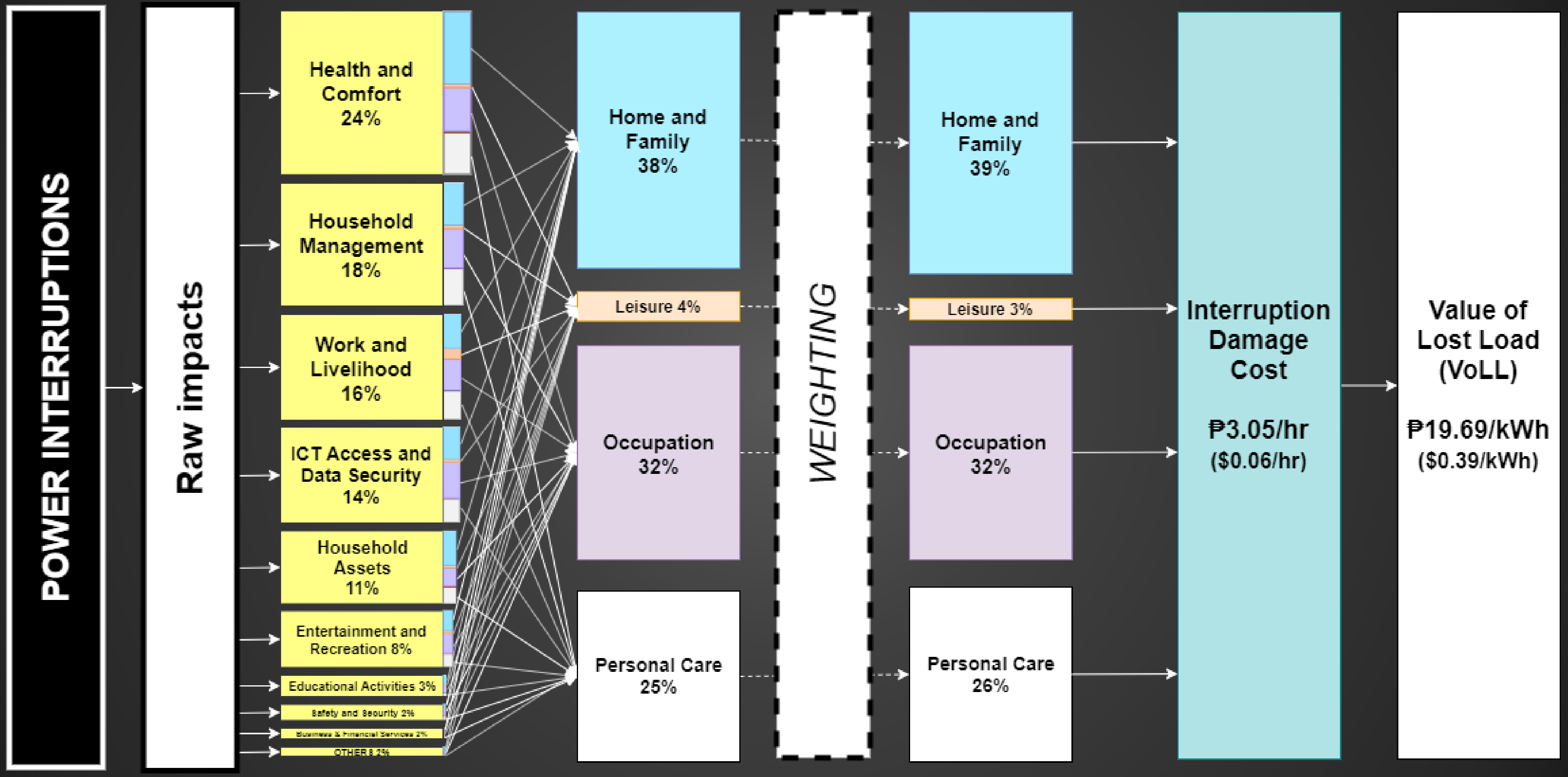
Damage Estimation (incl. VoLL)

Raw inputs

Proposed Power Interruption Impact Assessment (PIIA) Model ←

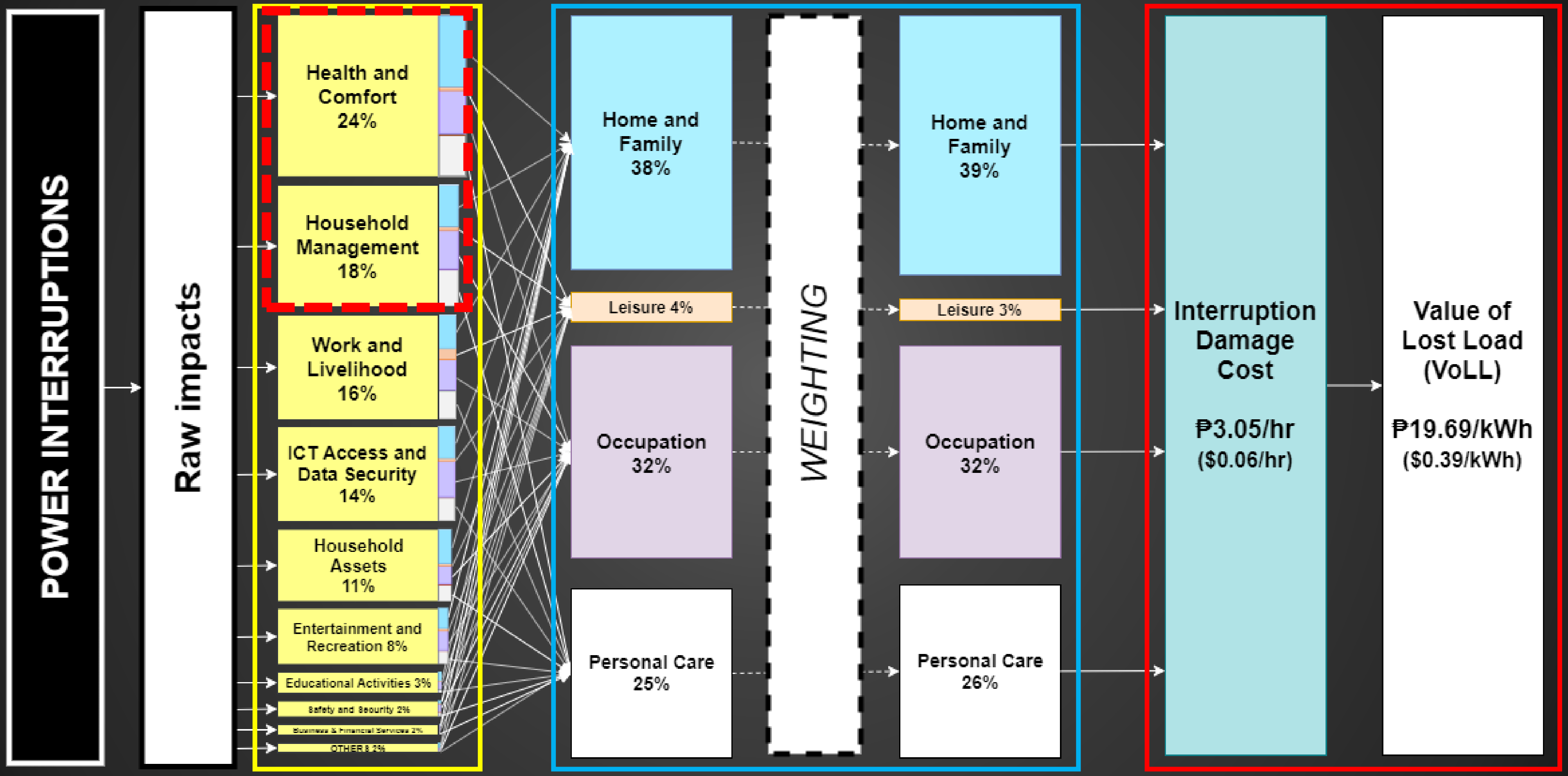
Existing methods

MODEL OUTPUT



Power Interruption Impact Assessment (PIIA) Model

MODEL OUTPUT



POWER INTERRUPTIONS

Raw impacts

Health and Comfort 24%

Household Management 18%

Work and Livelihood 16%

ICT Access and Data Security 14%

Household Assets 11%

Entertainment and Recreation 8%

Educational Activities 3%

Safety and Security 2%

Business & Financial Services 2%

OTHERS 2%

Home and Family 38%

Leisure 4%

Occupation 32%

Personal Care 25%

WEIGHTING

Home and Family 39%

Leisure 3%

Occupation 32%

Personal Care 26%

Interruption Damage Cost

₱3.05/hr

($0.06/hr)

Value of Lost Load (VoLL)

₱19.69/kWh

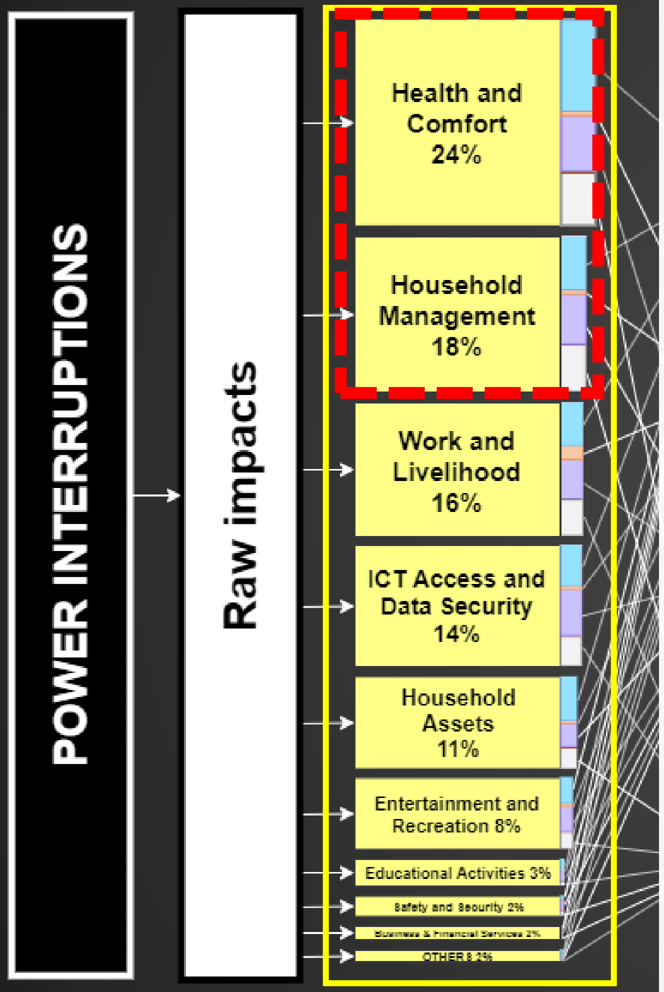
($0.39/kWh)

Impact Categories

Impact on Life Roles

Socio-economic valuation

MODEL OUTPUT



Impact Categories

Health and Comfort

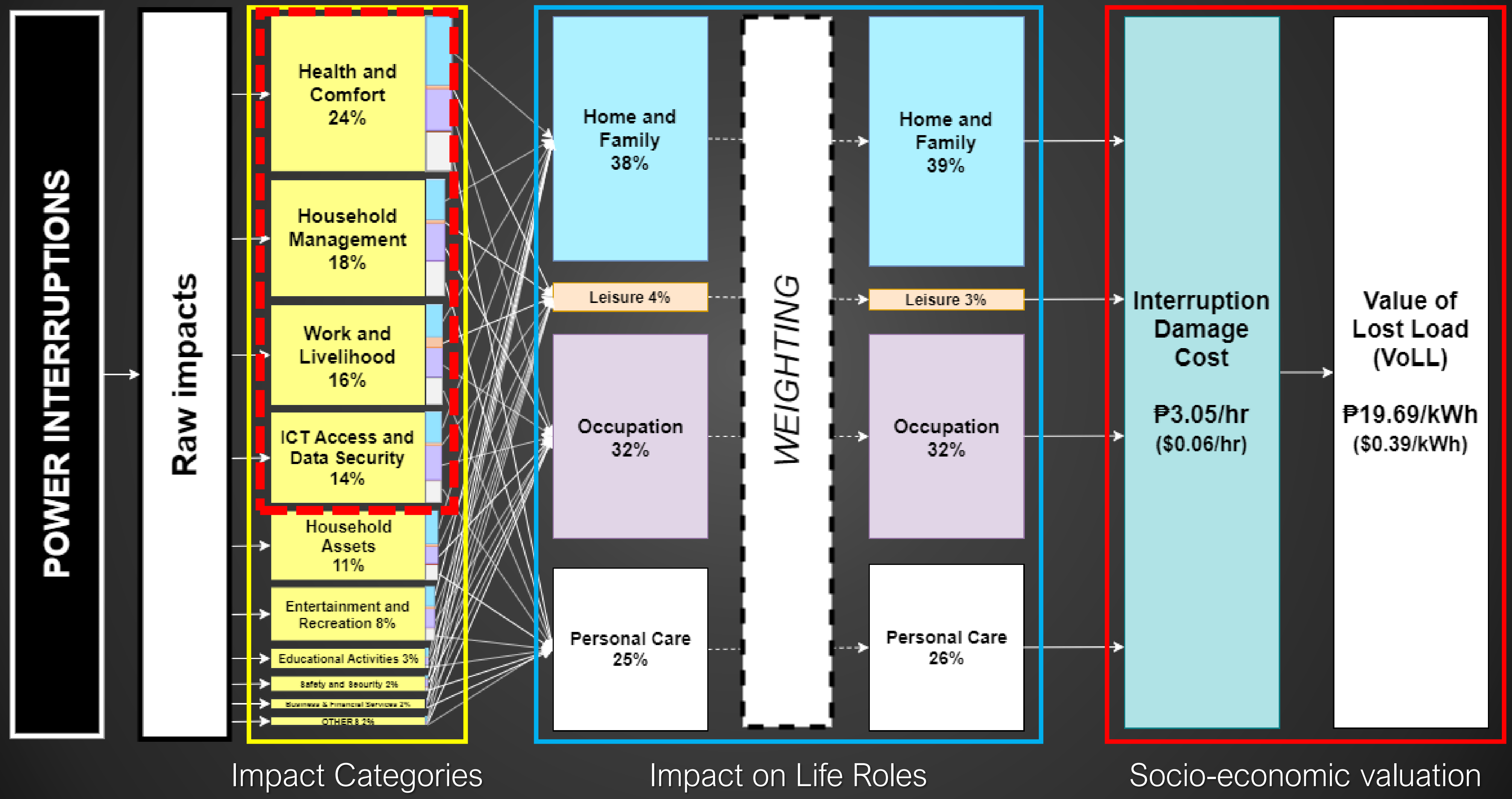
- Discomfort due to hot temperature
- Cannot sleep well
- Getting sick

Household Management

- Cannot do household chores needing electrical equipment/appliances
- Food spoilage
- Difficulty of caring for household members, especially those vulnerable

❖ **Mostly linked to duration**

MODEL OUTPUT



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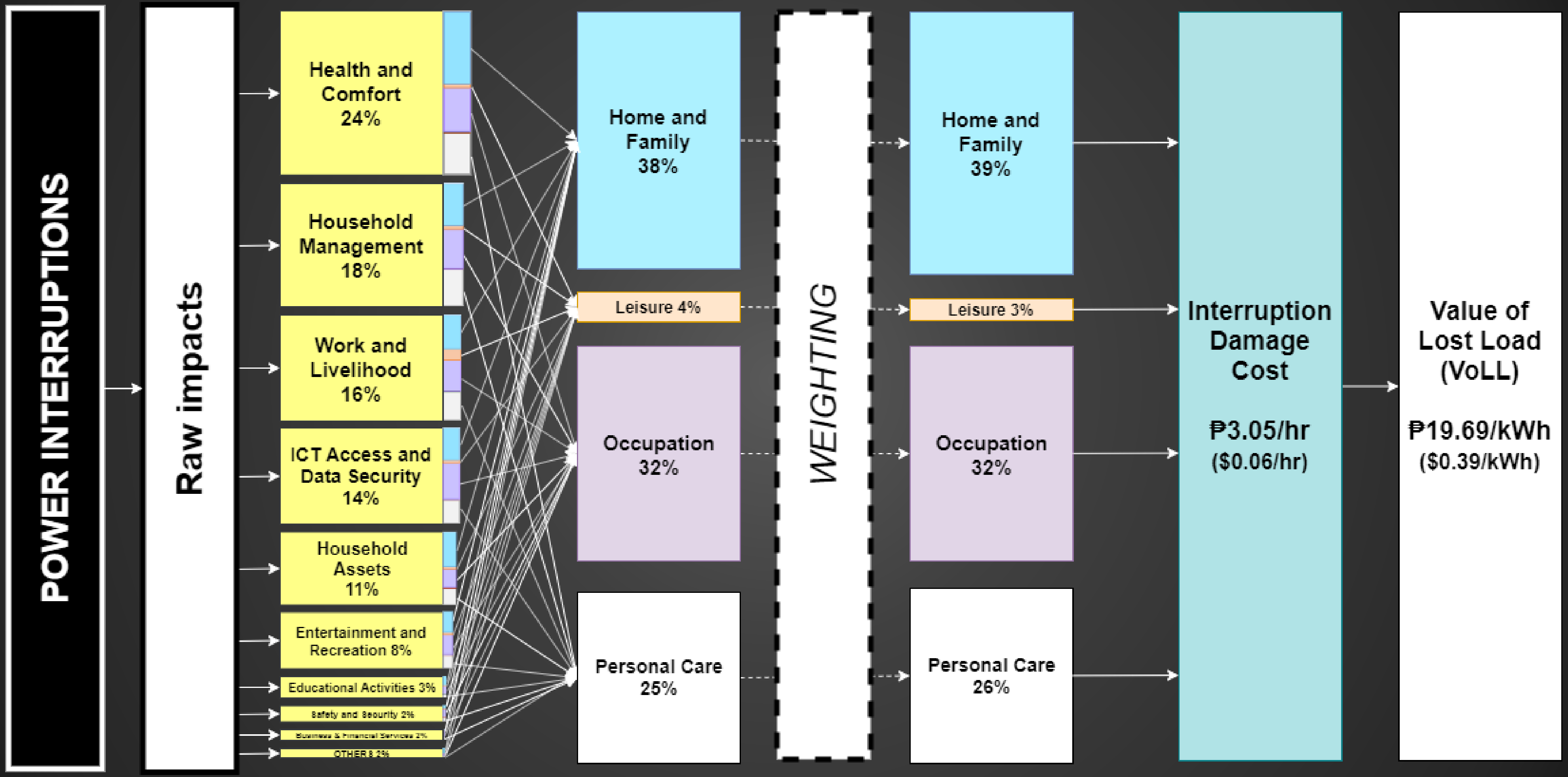

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($0.06/hr)

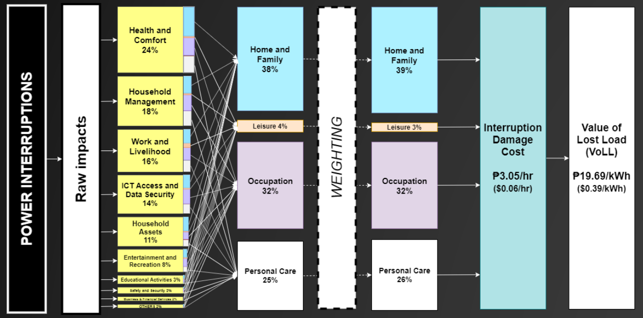
Value of Lost Load (VoLL)

₱19.69/kWh

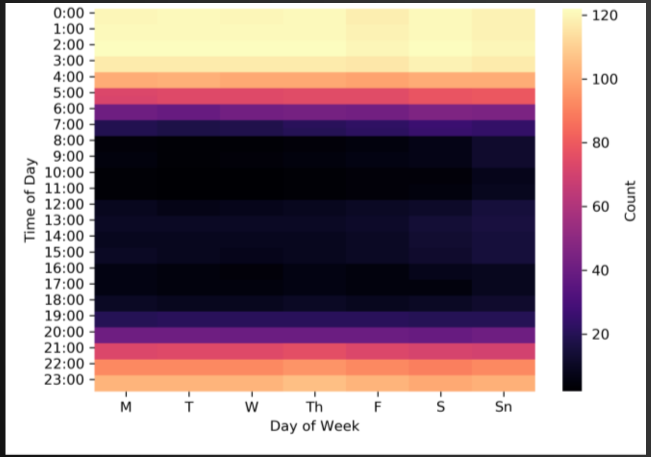
($0.39/kWh)

Power Interruption Impact Assessment (PIIA) Model

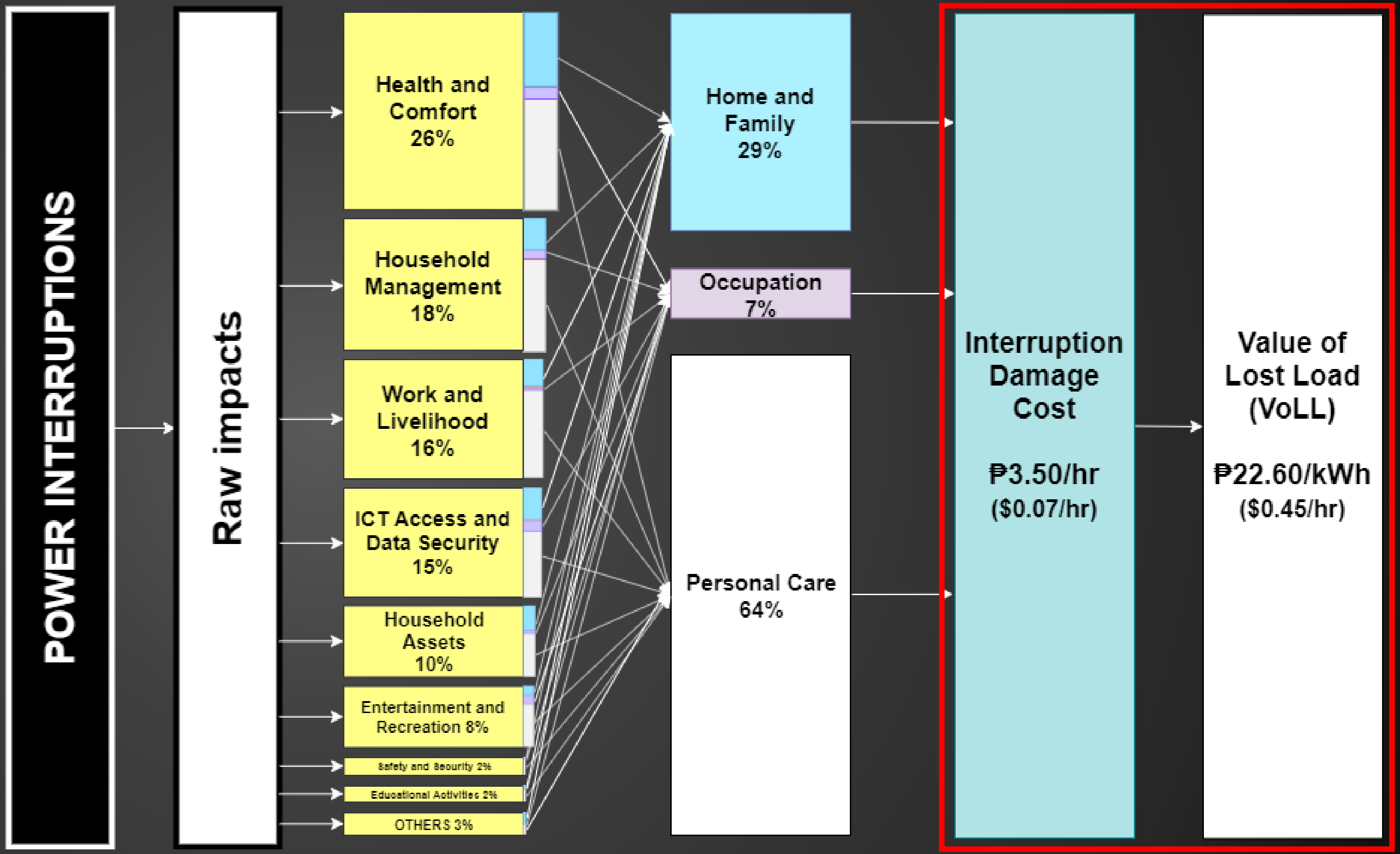
MODEL OUTPUT: BY PART OF DAY



- High component of effects on personal care; mostly asleep



Personal care time



POWER INTERRUPTIONS

Raw impacts

Health and Comfort 26%

Household Management 18%

Work and Livelihood 16%

ICT Access and Data Security 15%

Household Assets 10%

Entertainment and Recreation 8%

Safety and Security 2%

Educational Activities 2%

OTHERS 3%

Home and Family 29%

Occupation 7%

Personal Care 64%

Interruption Damage Cost

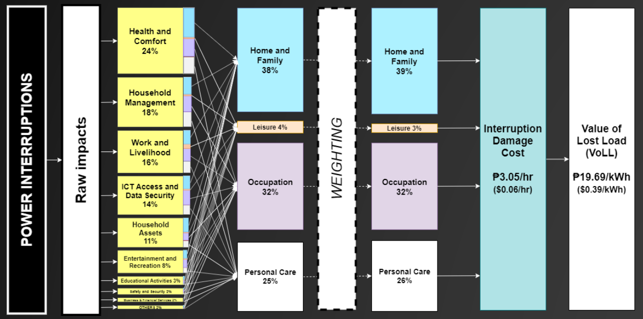
₱3.50/hr
($0.07/hr)

Value of Lost Load (VoLL)

₱22.60/kWh
($0.45/hr)

12-6AM

MODEL OUTPUT: BY PART OF DAY



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OTHERS 2%

Home and Family 38%

Leisure 4%

Occupation 32%

Personal Care 25%

WEIGHTING

Home and Family 39%

Leisure 3%

Occupation 32%

Personal Care 26%

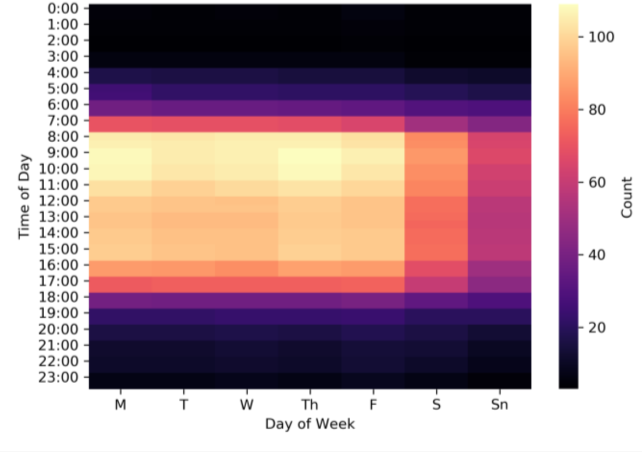
Interruption Damage Cost

₱3.05/hr
($0.06/hr)

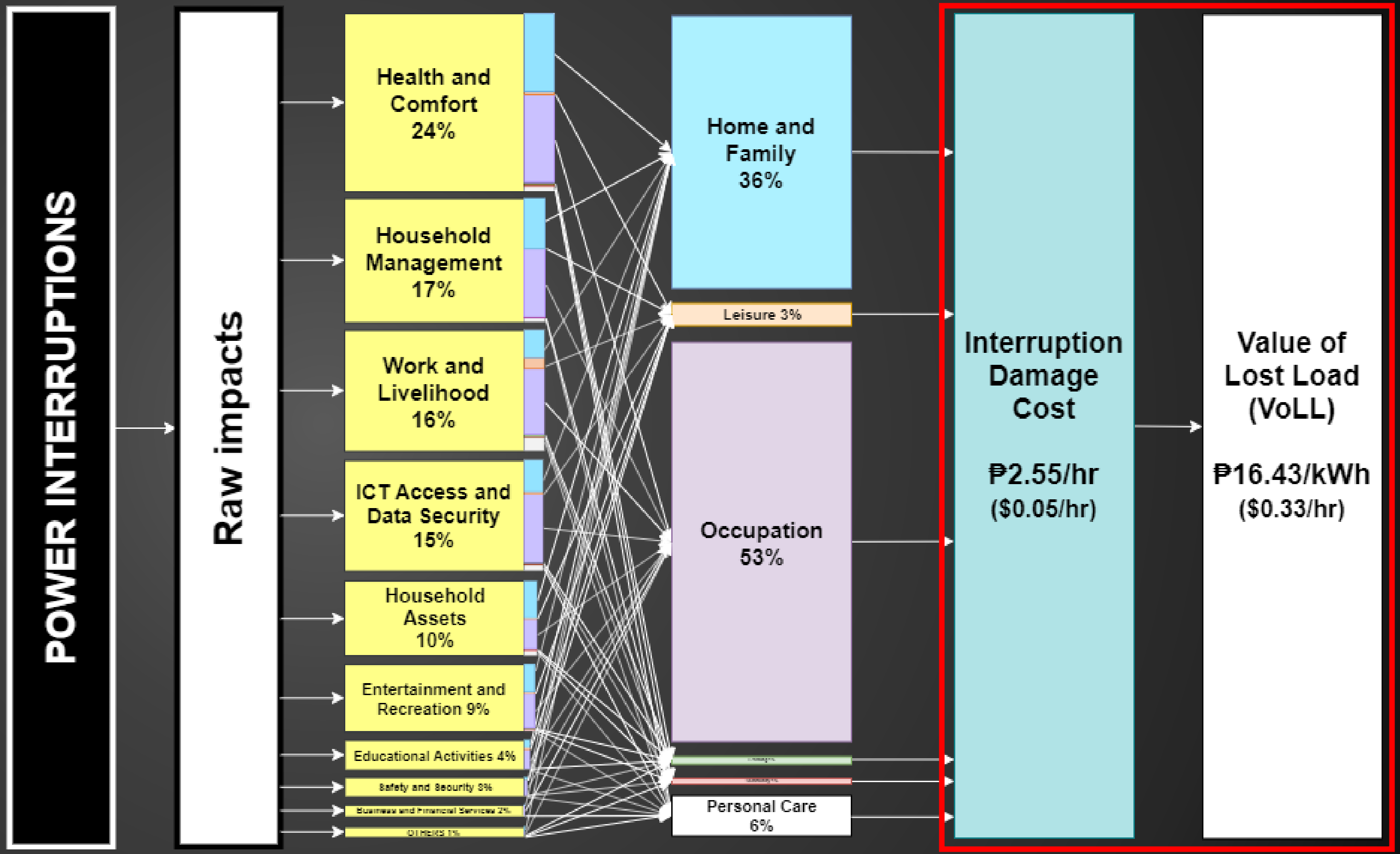
Value of Lost Load (VoLL)

₱19.69/kWh
($0.39/kWh)

- Work day usually begins at 8AM
- Mostly long interruptions



Occupation/Work time



POWER INTERRUPTIONS

Raw impacts

Health and Comfort 24%

Household Management 17%

Work and Livelihood 16%

ICT Access and Data Security 15%

Household Assets 10%

Entertainment and Recreation 9%

Educational Activities 4%

Safety and Security 3%

Business and Financial Services 2%

OTHERS 1%

Home and Family 36%

Leisure 3%

Occupation 53%

Personal Care 6%

Interruption Damage Cost

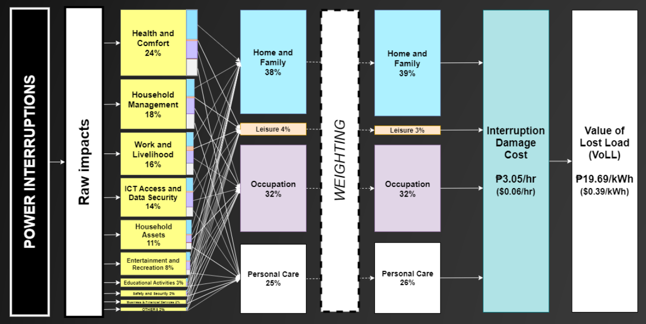
₱2.55/hr
($0.05/hr)

Value of Lost Load (VoLL)

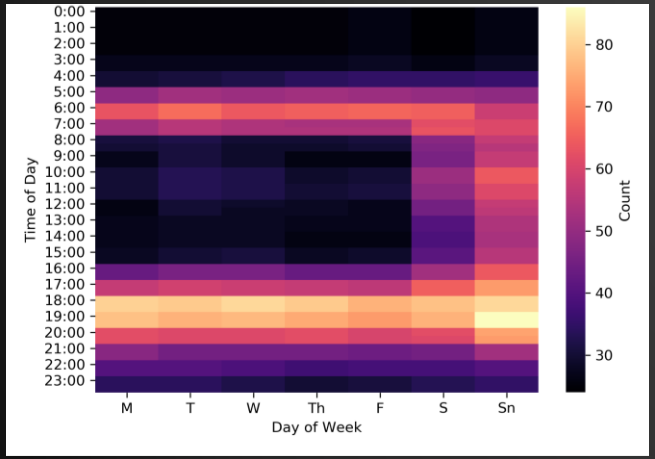
₱16.43/kWh
($0.33/hr)

6AM-12PM

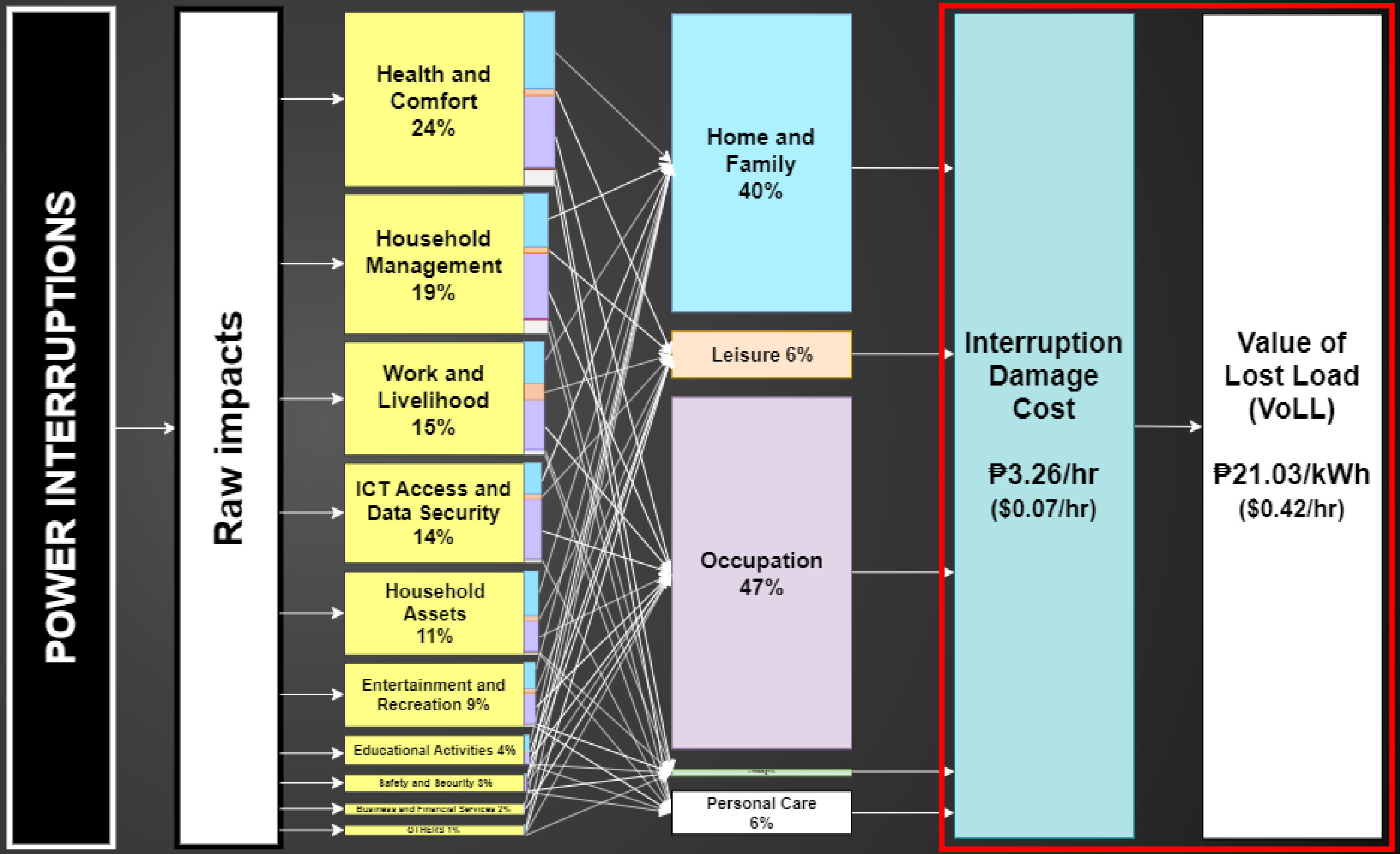
MODEL OUTPUT: BY PART OF DAY



- Work day usually ends at 5PM
- Shift to household activities observed

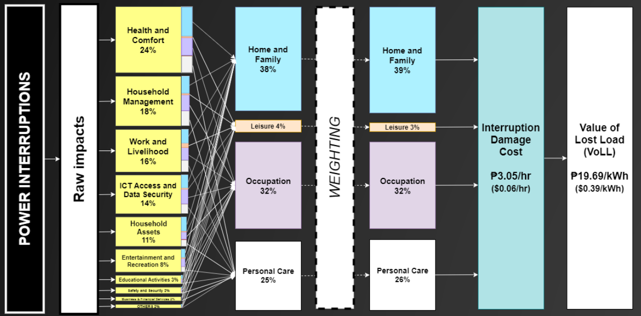


Home/Family time

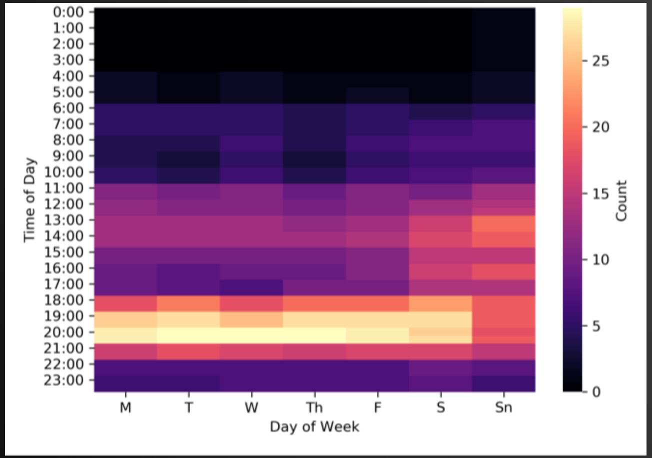


12NN-6PM

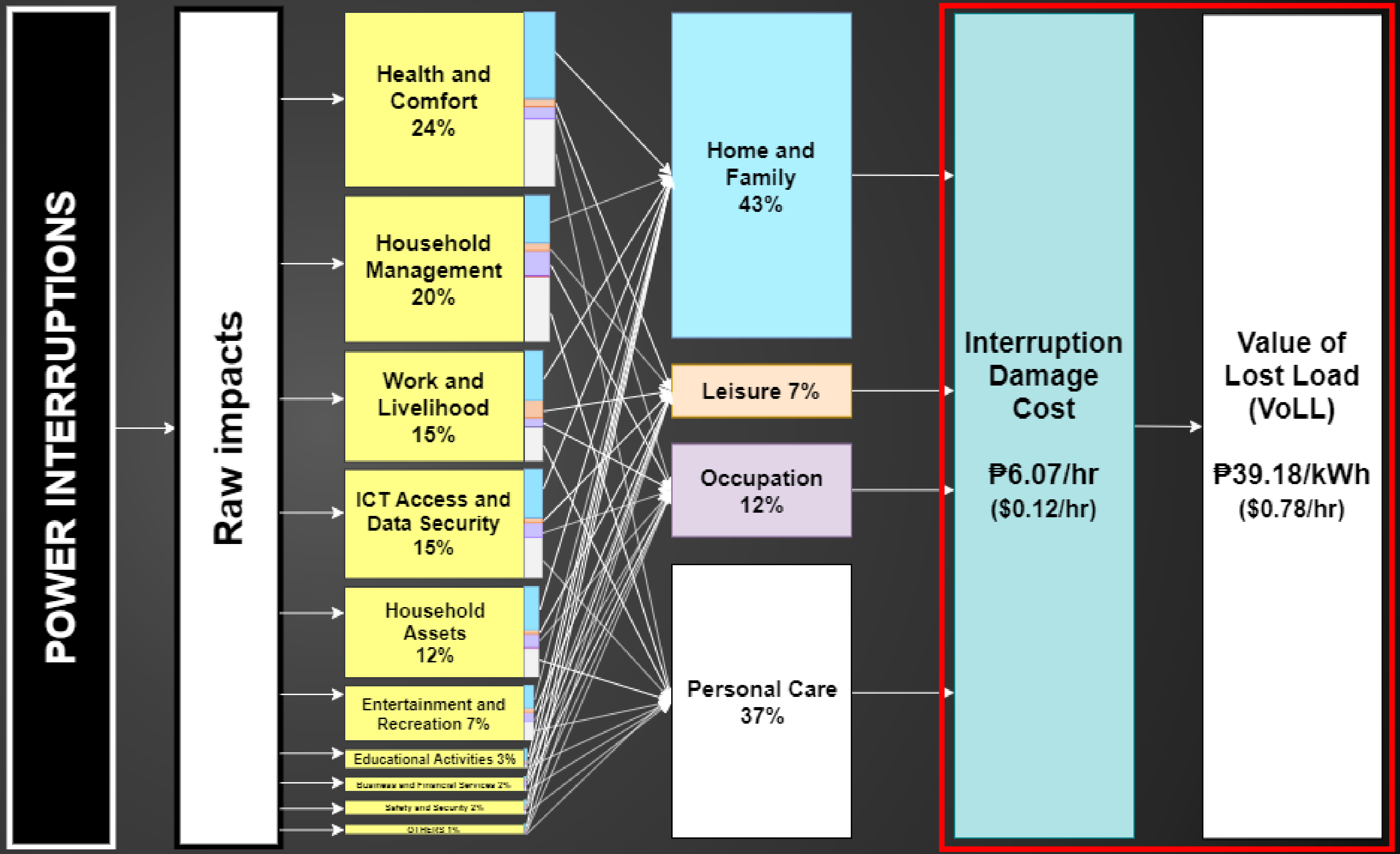
MODEL OUTPUT: BY PART OF DAY



- Peak of household activity and leisure
- Mostly short interruptions



Leisure time



POWER INTERRUPTIONS

Raw impacts

Health and Comfort 24%

Household Management 20%

Work and Livelihood 15%

ICT Access and Data Security 15%

Household Assets 12%

Entertainment and Recreation 7%

Educational Activities 3%

Business and Financial Services 2%

Safety and Security 2%

OTHERS 1%

Home and Family 43%

Leisure 7%

Occupation 12%

Personal Care 37%

Interruption Damage Cost

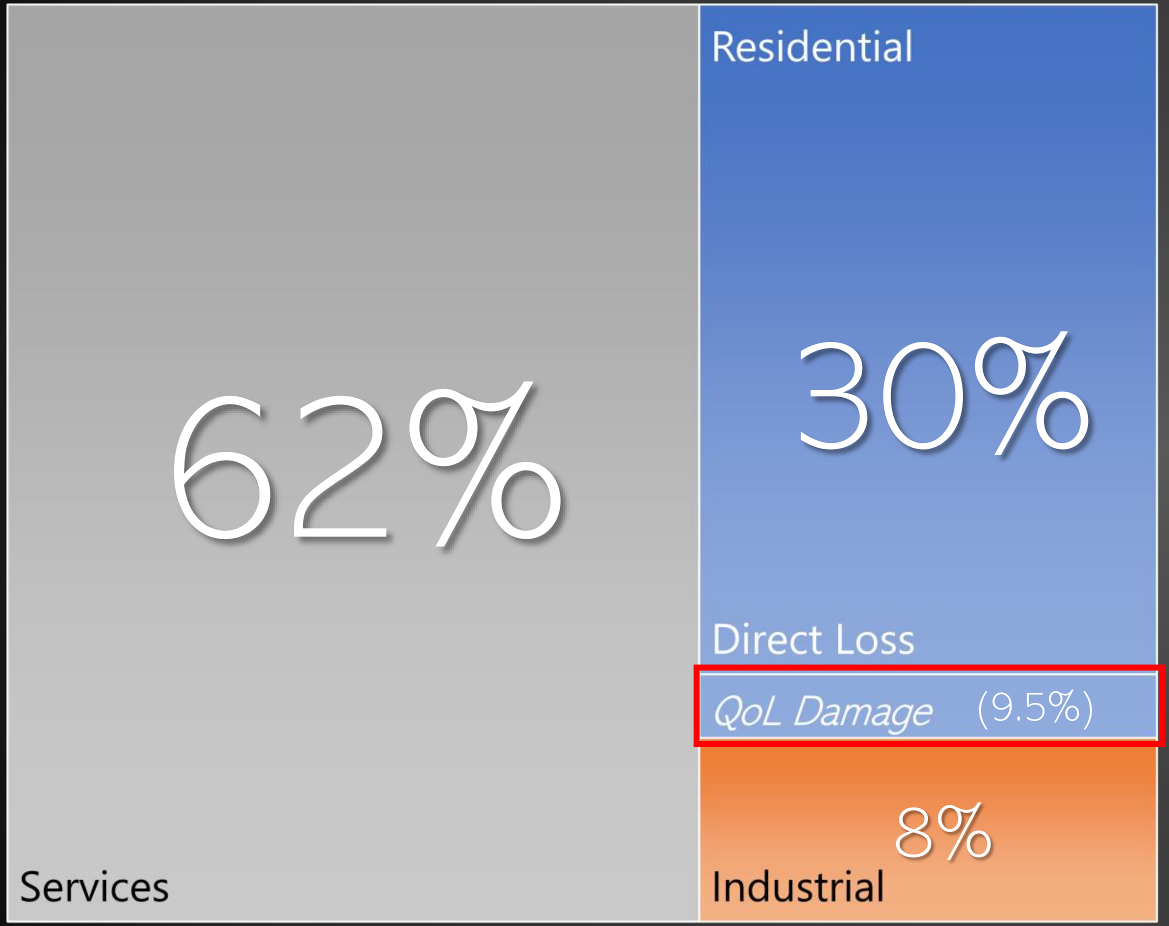
₱6.07/hr
($0.12/hr)

Value of Lost Load (VoLL)

₱39.18/kWh
($0.78/hr)

6PM-12AM

DAMAGE TO QUALITY OF LIFE IN ADDITION TO ECONOMIC LOSSES



Estimated Power Interruption Costs in 2018

$97 MILLION Total Cost

$26 MILLION Residential Segment Cost

$3 MILLION Residential Segment Cost (QoL Damage)

FINDINGS SUMMARY

- QoL impacts are mostly linked to duration and heat-related effects
- Interruptions at different parts of day affect people differently
- Effects on QoL are more salient at night (6PM-6AM) than during the day (6AM-6PM)
  - Might have changed during the pandemic
  - High value placed on the Home/Family life role than Work/Occupation
- As an effect of the pandemic, almost all impact categories are already situated within homes

POLICY IMPLICATIONS

Impact Categories

Relative Importance and Vulnerability

Temporal Variations

POLICY IMPLICATIONS

Impact Categories

- Prioritization of healthcare facilities
- Provisions for ventilation and hydration
- Decoupling of water and electricity supply

POLICY IMPLICATIONS

Impact Categories

Relative Importance and Vulnerability

Temporal Variations

POLICY IMPLICATIONS

Relative Importance and Vulnerability

- Budgeting/Allocation of resources based on revealed relative importance of impact categories and electricity-dependent life roles
- Use of VoLL and damage cost estimates for cost-benefit analyses and resource allocation among consumer groups

POLICY IMPLICATIONS

Impact Categories

Relative Importance and Vulnerability

Temporal Variations

POLICY IMPLICATIONS

Temporal Variations

- Operational decisions by electric utilities must consider time-dependent consumer behavior

FURTHER STUDY

Performance Evaluation

Deep-dive on particular Impact Categories and/or Life Roles

Explore applicability to other utilities

SPECIAL THANKS

Senate Committee
on Energy
Office of Senator
Sherwin Gatchalian

Mayors of 3 cities and 7 municipalities of Albay

Stakeholders

Survey Facilitators

Additional support from the **Environment Research and Technology Development Fund (S-14) of the Environmental Restoration and Conservation Agency of Japan**

Scholarship from the **Ministry of Education, Culture, Sports, Science and Technology (MEXT)**

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UNDERSTANDING IMPACTS OF POWER INTERRUPTIONS ON QUALITY OF LIFE:

OPPORTUNITIES FOR SOCIALLY-OPTIMAL POLICY AND DEMAND-SIDE RESILIENCE

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